Final Environmental Impact Statement

Muscle Shoals Reservation Redevelopment

Prepared by: Tennessee Valley Authority, November 2011

VOLUME I

Front Cover:

Fertilizer Works with Wilson Dam in background, 1935.

Inset:

Poster on TVA Fertilizer and Munitions Center, 1950s.

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FINAL ENVIRONMENTAL IMPACT STATEMENT

MUSCLE SHOALS RESERVATION REDEVELOPMENT
Colbert County, Alabama

VOLUME I

PREPARED BY:
TENNESSEE VALLEY AUTHORITY

NOVEMBER 2011

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Proposed project: Muscle Shoals Reservation Redevelopment
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Lead agency: Tennessee Valley Authority

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Abstract: Tennessee Valley Authority (TVA) proposes to sell approximately 1,400 acres of its Muscle Shoals Reservation in Colbert County, Alabama, for potential redevelopment. In part, this responds to requests over the years from local officials and developers for use of portions of the reservation, while also helping to fulfill TVA's economic development mission by fostering economic development in the area and region. In addition, because this nonreservoir property and associated buildings and facilities are presently no longer needed to support TVA operations, sale of this property would reduce TVA's operations and maintenance costs and environmental footprint in the area. In concert with this environmental review, a comprehensive master plan is being developed in coordination with local governments, TVA, and the public. This environmental impact statement (EIS) examines potential resource effects of adopting a No Action Alternative and five Action Alternatives for the probable future use of this property. Under No Action (Alternative A), this property would not be sold and would remain in public ownership to be managed in accordance with TVA's 1996 *Muscle Shoals/Wilson Dam Reservation Land Management Plan*. Under the five Action Alternatives (Alternatives B, C, D, E, and F), the land would be sold (likely at public auction) and be used for conservation and low-impact development (B); commercial, retail, and residential use (C); industrial use (D); a mix of these uses (E); or unrestricted land use (F). This EIS uses these alternative land uses to evaluate the potential impacts of each alternative on resources on and near the property and compares those anticipated effects. The Environmentally Preferred Alternative is Alternative B and TVA prefers Alternative F.

SUMMARY

PURPOSE OF AND NEED FOR ACTION

Tennessee Valley Authority (TVA) assumed custody and control of the 3,036-acre Muscle Shoals/Wilson Dam Reservation in Colbert County, Alabama, in 1933 when Congress directed its transfer to TVA from the U.S. War Department. TVA has since managed 2,600 acres of this nonreservoir property as the Muscle Shoals Reservation (MSR or Reservation). The Reservation is located in northwest Alabama in an area generally referred to as the “Shoals” or the “Quad Cities” (Figure S-1). Since acquisition of the land, TVA’s need for this amount of property at this location has changed. TVA’s programs have changed over time and the Valleywide and Muscle Shoals employee populations have declined. TVA has determined that an approximately 1,400-acre portion (study area) of its MSR is no longer essential to its needs. Local public and private sector developers have been requesting use of this land for many years. In accordance with its economic development mission, TVA believes sale and redevelopment of this property would help stimulate the local and regional economy. Transferring this portion of the Reservation would also help TVA reduce its operations and maintenance (O&M) costs and help TVA reduce its environmental footprint.

ALTERNATIVES INCLUDING THE PROPOSED ACTION

TVA proposes to declare surplus and sell (i.e., dispose of) approximately 1,400 acres of its MSR, which would allow redevelopment of the property by other business interests. TVA has developed a reasonable range of alternatives for potential future use of this property. These alternatives, evaluated in this environmental impact statement (EIS), include a No Action Alternative and five Action Alternatives. Under Alternative A, the No Action Alternative, TVA would not sell the property but would continue to use it for program purposes and potential development opportunities consistent with the 1996 *Muscle Shoals/Wilson Dam Reservation Land Use Plan Final Environmental Assessment* (1996 Plan). Under the five Action Alternatives (Alternatives B, C, D, E, and F), TVA would declare the 1,400 acres of property unnecessary to carry out future business plans and projects and would dispose of it for future development.

Four of the Action Alternatives vary by the type of post-sale land uses required. These land uses include conservation and low-impact development (LID) uses under Alternative B; commercial, retail, and residential uses under Alternative C; and industrial uses under Alternative D. Alternative E is a mixture of the land uses included under Alternatives B, C, and D. Under Alternative F, TVA would sell the 1,400-acre MSR study area with no particular required future land use. Although TVA would not designate a particular type of future land use or uses under Alternative F, it is reasonably foreseeable that the property would be developed for one or more of those uses reflected in Alternatives B, C, D, and E. TVA believes it is most likely that the property would be developed for mixed or multiple types of uses. Under all alternatives, the property would, however, be subject to restrictions that are necessary to protect historic properties, mitigate other potential environmental impacts, protect TVA’s statutory, programmatic, and other interests, and ensure continued ongoing operational requirements.

Figure S-1. The Approximately 1,400-Acre Muscle Shoals Reservation Redevelopment Study Area

Under the Action Alternatives, TVA would retain the monitored solid waste management unit (SWMU) areas. It would make the phosphate slag area north of Reservation Road available under specific use agreements as a utility infrastructure corridor but would not transfer the fee interest. Because of environmental and reservoir operations constraints, water use facilities, such as commercial docks, would not be approved along the left-descending (south bank) shoreline of the Tennessee River below Wilson Dam in the vicinity of the slag pile. See elements common to all the Action Alternatives in Section 2.1 and description of Alternative D in Section 2.1.4.

AFFECTED ENVIRONMENT

The MSR is located in Colbert County in northwestern Alabama, surrounded by the four cities of Sheffield, Muscle Shoals, Tuscumbia, and Florence. The cities contain a mix of southern small town urban and suburban character with somewhat notable commercial sprawl. Lauderdale County and the city of Florence lie on the north side of the Tennessee River (upper Pickwick Reservoir), a major landmark and source of recreation and water-based transportation. Both Colbert and Lauderdale counties are rural in nature and dominant land uses include agriculture and forestry.

The 1,400-acre MSR study area is located mostly south of Reservation Road (Figure S-1). One perennial stream, Pond Creek, drains most of the area and flows into the Tennessee River just downstream of Wilson Dam. The relatively flat MSR also contains woodlands, fields, floodplain and wetland areas, and a variety of plant and wildlife habitats. Fifty-one historic buildings and structures eligible for listing in the National Register of Historic Places (NRHP) are located on the property. In accordance with Section 106 of the National Historic Preservation Act (NHPA), TVA has consulted the Alabama Historical Commission on the potential fate of these historic properties.

The Tennessee River, adjacent to the northern edge of the MSR, contains a diversity of fish and other aquatic life including rare species afforded protection under the Endangered Species Act. The redevelopment proposal does not include the recreation area north of Reservation Road. This recreation area contains popular recreation facilities, designated natural areas, and other environmental amenities.

Large areas of the MSR study area have been highly affected by past U.S. War Department and TVA land use and facilities operations. These include a legacy of chemical development, research, munitions and fertilizer production and resultant handling, storage, disposal, and cleanup and remediation. Relatively small areas remain contaminated. The MSR study area is contained entirely within and managed in accordance with a 2,260-acre Resource Conservation and Recovery Act (RCRA) permit issued by the Alabama Department of Environmental Management (ADEM). Within the RCRA permit area, approximately 64 acres of land are included in postclosure monitored SWMU areas that will be retained by TVA to meet its current and future obligations. An additional 17 acres in scattered small areas near these SWMUs were part of a RCRA Facilities Investigation in the late 1990s and were subsequently cleaned up or verified at industrial screening levels.

ENVIRONMENTAL CONSEQUENCES

Adoption of the redevelopment land use alternatives is unlikely to directly adversely affect geology, endangered or threatened species, and designated natural areas. Resources that would likely be affected in a minor to moderate degree across the range of alternatives include air quality, global climate change, soils and prime farmland, surface water quality, and fish and aquatic life. Those resources that could be adversely affected by the Action

Alternatives include groundwater, historic and architectural resources, land use, socioeconomic and environmental justice resources, wetlands, floodplains, terrestrial plants and animals (wildlife), recreation, scenic resources, navigation, and noise. Under certain alternatives, there is the potential for significant adverse effects on transportation (i.e., traffic) and human health from possible exposure to remnant hazardous waste via groundwater and if more than specific time thresholds are exceeded on some areas (see Sections 3.1 and 4.1). TVA has identified measures to avoid or mitigate these effects. Potential on-site negative groundwater effects would continue even under Alternative A, No Action.

Due to the legacy contamination currently impacting groundwater, no groundwater development for potable use purposes would be allowed on the MSR study area under any proposed alternative. Potential adverse impacts on historic properties eligible for listing in the NRHP would be mitigated through the implementation of stipulations developed in consultation with the Alabama Historical Commission, State Historic Preservation Officer (SHPO), under any of the Action Alternatives. Under Alternatives D, E, and F, income and employment in the area and region would increase, so benefits to socioeconomic and environmental justice resources could be significantly beneficial. Employment opportunities for minority and low-income individuals would be more likely to occur, and disproportionate impacts would likely be smallest under Alternatives E and F. Areas proposed to be impacted by development in wetlands or fill within the limits of the 100-year floodplain would require additional future evaluation. In compliance with Executive Orders (EOs) 11990 (Protection of Wetlands) and 11988 (Floodplain Management), TVA would need to make a determination that there is no practicable alternative to such development and would assure that impacts are minimized or mitigated.

Because the entire study area is currently regulated by an ADEM RCRA permit, each of the Action Alternatives would require a modification to the existing RCRA permit transferring ownership from TVA to another responsible party. Additionally, any land that is not being released for unrestricted use must be evaluated under ADEM's Covenants Program.

Development of a portion of the southwestern corner of the Reservation or a 4-acre area in the southeast portion of the property could cause significant effects to birdlife and the American Chestnut Foundation Research Orchard, respectively. Such landscape alterations caused by development under any of the Action Alternatives could result in a loss of recreation opportunity (bird watching) and wildlife habitat values as well as potentially valuable research information and could significantly affect restoration of the American chestnut in the southern portion of its range. Portions of the industrial center of the property have been cleaned up to an industrial screening level. Development of these sites for residential use would likely pose a health risk. Without additional cleanup of these sites, they would not be suitable for long-term occupancy such as that presented by a residential scenario. Infrastructure development on the slag storage area could expose workers to similar health risks. Highway traffic in the area surrounding the MSR is already congested at times and, without improvements, would likely get significantly worse under both the Action and No Action Alternatives.

Under the No Action Alternative (i.e., 1996 Plan), some potentially adverse effects to health and safety could occur, even with ordinary maintenance of facilities and grounds and compliance with appropriate standards. Because of the passage of time, change caused by weathering and decay of buildings is inevitable. Structures could fall on employees or members of the public, historic buildings could further deteriorate, and local groundwater could be contaminated. Resources that would likely cause effects or be affected under this alternative would include solid and hazardous waste, groundwater, historic and architectural resources, and transportation. Natural biodecay of remnant hazardous waste as designed has beneficial effects.

TVA is working with the communities and the Northwest Alabama Cooperative District (NACD) and other appropriate local, state, or federal authorities to develop a comprehensive master plan (Master Plan) for the appropriate redevelopment of the approximately 1,400-acre area of MSR property. The approved Master Plan would take into account ways to avoid, minimize, rectify, reduce, compensate, or mitigate environmental impacts in its development.

COMPARISON OF ALTERNATIVES

Regardless of the alternative selected, some resources would not be directly adversely affected. However, other resources would likely be affected directly or indirectly in a minor to moderate degree across the range of alternatives. In addition, some resources would be affected, even potentially significantly so, and mitigation could be required to avoid, reduce, rectify, minimize, compensate, or mitigate losses of resources, values or associated uses. The following provides a comparison of effects on various resources and explains how each alternative type of land use development could affect the resource (see Table S-1).

Under **Alternative A**, No Action, the MSR study area would remain in federal ownership and be managed under the 1996 Plan. A 9-acre parcel of TVA property allocated in the 1996 Plan for development opportunities is located in Sheffield just west of Hatch Boulevard. It lies outside the scope of this proposed land disposal, sale, and redevelopment action. Therefore, current land uses on the potentially affected property are not likely to change for the foreseeable future. Any future proposals for use consistent with the 1996 Plan would likely require additional environmental reviews. TVA would retain and continue to monitor certain SWMU areas and comply with ADEM regulations under all alternatives (see Section 2.1). Management and use of other areas of remnant waste and SWMUs would continue in accordance with applicable regulations, including some additional waste stream generation and waste disposal. Groundwater monitoring would continue and the potential for local effects could continue; however, no off-site impacts are expected. NRHP-eligible historic properties would remain in TVA ownership and management, and many would likely remain unused. Some unoccupied buildings and structures could continue to deteriorate and become an environmental or safety concern. No additional socioeconomic benefits would likely be recognized from development of the property.

Under **Alternative B**, the MSR study area would be sold, and the new owner would be required to use the property for conservation purposes and LID. There would be a deliberate emphasis on protecting and maintaining sensitive resources such as floodplains and wetland areas and historic properties. TVA would continue to own and manage the monitored SWMU areas under all the Action Alternatives (i.e., Alternatives B through F). SWMUs cleaned up to industrial screening levels could be sold for appropriate development or reuse consistent with the Master Plan. Under this alternative, the likelihood of additional on-site contamination from site development is low. With adherence to applicable restrictions, the likelihood of additional exposure to hazardous material would similarly be low. Groundwater extraction from the MSR study area for drinking water usage would be prohibited under this and all the Action Alternatives. Compared to the other Action Alternatives, the activities and development under this alternative would likely require the least amount of land use change and intensity of development. A greater amount of green space, naturally appearing landscape character, and recreation opportunity, probably substantially more, would be available under this alternative compared to the other Action Alternatives. More emphasis on invasive plant control and enhancement of wildlife habitat could become a management focus.

Table S-1. Summary of Potential Effects by Alternative[1]

Resource Issues	Alternative A (No Action)	Alternative B (Conservation)	Alternative C (Commercial/Retail and Residential)	Alternative D (Industrial)	Alternative E (Mixed Use)
		Alternative F (Unrestricted Use)			
Solid and Hazardous Waste: Zone A[2] (approximately 300 acres including monitored SWMUs)	Negligible	Potential indirect beneficial effects if Zone A is used for certain low-impact development	Potentially significant impacts; could require additional remediation for commercial, retail, or residential uses	Minor if used for industrial purposes	Potentially significant impacts; could require additional remediation for commercial, retail, or residential uses
Solid and Hazardous Waste: Zone B (approximately 90 acres at phosphate storage area)	Negligible	Use of utility corridor unlikely under Alternative B; if proposed, project would be evaluated the same as under Alternative D, E, or F	Use of utility corridor unlikely under Alternative C; if proposed, project would be evaluated the same as under Alternative D, E, or F	Potentially significant health effects unless personal exposure is limited to no more than 500 hours per year; if proposed, projects would be evaluated for potential worker exposure	
Solid and Hazardous Waste: Zone C (approximately 1,000 acres where contamination is not known to occur)	Negligible	Minor impacts with low potential for exposure to any remaining contaminants	Minor impacts with low potential for exposure to any remaining contaminants	No increased human health or environmental exposure risks would be anticipated	Minor impacts with low potential for exposure to any remaining contaminants

Resource Issues	Alternative A (No Action)	Alternative B (Conservation)	Alternative C (Commercial/Retail and Residential)	Alternative D (Industrial)	Alternative E (Mixed Use)
		Alternative F (Unrestricted Use)			
Solid and Hazardous Waste: Zone D (approximate 100-foot-by-100-foot area used as a low-level radioactive waste burial site)	Negligible	Impacts minor and similar to those in Zone C unless there is subsurface soil disturbance			
Geology	No changes in existing geological conditions	No impacts likely; development would likely occur in areas where the local geology would be unaffected	Increased potential for groundwater changes; no adverse impacts; development would likely occur in areas where the local geology would be unaffected	No adverse impacts; development would likely occur in areas where the local geology would be unaffected; could possibly result in greater or likely similar impacts as Alternative C	No adverse impacts; development would likely occur in areas where the local geology would be unaffected; less impact to geological resources than Alternative C or D
Groundwater	Minor effects (no evidence of adverse impacts to potential off-site groundwater users or other receptors)	No adverse effects on health and safety; TVA will not allow removal of groundwater for drinking water from anywhere on the MSR study area under any of the Action Alternatives; some potential for contamination from spills or leaks under Alternative D			

Resource Issues	Alternative A (No Action)	Alternative B (Conservation)	Alternative C (Commercial/Retail and Residential)	Alternative D (Industrial)	Alternative E (Mixed Use)
		Alternative F (Unrestricted Use)			
Archaeological Resources	No adverse effects likely	Potential adverse effects to three archaeological sites and two cemeteries; two sites would be mitigated through stipulations in the MOA between TVA and the Alabama SHPO, and one site would be avoided; two cemeteries would be managed in accordance with state law			
Historic Resources (Architecture)	Future undertakings involving historic properties would be evaluated; conditions could worsen	Adverse impacts would be mitigated through applicable stipulations in MOA; adaptive reuse of buildings and structures addressed in agreement			
Socioeconomic Resources	No impact or change in current conditions; any potential benefit would be foregone	Minor impacts with potential quality of life benefits	Small (minor) positive effect	Significant increase in income and employment; impacts could be moderate to large with potentially negative quality of life influence	Potentially significant increase in income and employment; impacts could be moderate with potential quality of life benefits
Environmental Justice	No effects	Potential impacts would be small (minor); any disproportionate impacts would be less than under Alternative C and could be greater than the economic effects likely under	Potential impacts would be small (minor); Alternative C likely would have the greatest disproportionate impacts to minority and low-income populations	Potentially significant positive effects on local income and employment; all segments of population likely to benefit; disproportionate impacts to minority and low-income	Potentially significant increases in regional employment and income; increased employment opportunities for minority and low-income individuals; disproportionate impacts would be smallest under these alternatives

Resource Issues	Alternative A (No Action)	Alternative B (Conservation)	Alternative C (Commercial/Retail and Residential)	Alternative D (Industrial)	Alternative E (Mixed Use)
		Alternative F (Unrestricted Use)			
		Alternatives A, D, E, and F		individuals would be less than for Alternatives B and C, but greater than Alternatives E and F	
Land Use	Possible minor changes in current land use	Some changes; much green space and recreational opportunities likely retained; effects of LID could be further minimized if existing buildings are reused	Minor impacts; could likely have greater changes in land use than Alternatives A and B but less than expected under Alternative D, E, or F	Greater intensity but effects minor impacts in context; similar to those under Alternative C; overall, could have greater impacts than any of the other Action Alternatives	Minor impacts; could likely have greater impacts than Alternatives A and B but could be comparable to or perhaps less than those anticipated under Alternative C or D; effects of Alternatives E and F similar
Air Quality	No additional effects	Minor impacts; less than those associated with Alternative C, D, E, or F	Minor temporary effects from construction activities; potentially greater than Alternative A or B, likely less than Alternative D but similar to Alternatives E and F	Minor, no adverse, impacts with regulation; could be greater than Alternative A, B, C, E, or F	Minor impacts with regulation; potentially greater than Alternative A, B, or C; effects likely less than Alternative D
Global Climate Change	No incremental impacts expected	Increased vegetative cover could sequester carbon dioxide; minor climate change benefit	Increased emissions of greenhouse gases expected; could be greater than expected under Alternative A or B	Increased emissions of greenhouse gases expected; has the greatest potential not only to impact climate but also to be	Increased emissions of greenhouse gases expected similar to that under Alternative C

Resource Issues	Alternative A (No Action)	Alternative B (Conservation)	Alternative C (Commercial/Retail and Residential)	Alternative D (Industrial)	Alternative E (Mixed Use)
		Alternative F (Unrestricted Use)			
		expected if vegetation cover is increased	but less than under Alternatives D, E, and F	impacted by climate change	
Soils and Prime Farmland	No effects	Minor impacts	Minor impacts; higher potential for conversion of farmland to nonfarmland uses compared to Alternatives A and B	Minor impacts; greatest potential for impacts to soils and prime farmland	Minor impacts; similar to those under Alternatives C and potentially less than those under Alternative D
Surface Water Quality	No impacts	No significant impacts; presence of green space would reduce potential for introduction of runoff into surface waters	Minor impacts likely greater than those under Alternatives A and B	No significant impacts; similar to or potentially greater than those anticipated under Alternative C, E, or F	Insignificant impacts, similar but potentially less than those compared to Alternative C or D
Wetlands	No impacts	Minor impacts; least potential for effects among Action Alternatives	Minor impacts; greater potential to affect compared to Alternative A or B	Minor impacts; greater potential to affect compared to Alternative A or B; similar to effects under Alternative C, E, or F	Minor impacts; greater potential to affect compared to Alternative A or B; similar to effects under Alternative C or D
Floodplains	No impacts likely	Low potential for impacts	Minor impacts, potentially greater than effects likely under Alternative A or B	Minor and insignificant effects similar to those under Alternative C	Minor and insignificant impacts, potentially greater effects under Alternative A or B and similar to those expected under Alternative C or D

Resource Issues	Alternative A (No Action)	Alternative B (Conservation)	Alternative C (Commercial/Retail and Residential)	Alternative D (Industrial)	Alternative E (Mixed Use)
		Alternative F (Unrestricted Use)			
Aquatic Ecology - Fish and Aquatic Life	No impacts	No impacts likely	No impacts; potential for effects is greater than Alternative A or B and similar to that under Alternatives D, E, and F	No impacts; potential for effects is similar or slightly greater than those under Alternative C, E, or F	No impacts; potential is similar to Alternatives C and D
Aquatic Ecology - Aquatic Endangered and Threatened Species	No effects				
Terrestrial Ecology - Plants	No significant impacts	Potentially beneficial impacts	Loss of American chestnut orchard research could have significant effects on species restoration in the southern portion of its range; elimination of forested areas could adversely affect habitat capable of supporting two state-listed plants		
Terrestrial Ecology - Wildlife	No effects; no change in current conditions	Potential slight improvement in wildlife habitat and long-term availability of habitats	Minor impacts; local reduction of wildlife diversity; reduced amount and suitability of wildlife habitats compared to Alternative A or B	Moderate impacts; potentially similar to those under Alternative C; greater than those anticipated under Alternatives A and B and potentially similar or greater than those expected under Alternatives E and F	Minor impacts; greater than those under Alternatives A and B; potentially similar to those under Alternative C and less than those anticipated under Alternative D
Terrestrial Ecology - Endangered and Threatened	No effects on federally listed plants or animals	No effects on federally listed plants or animals	Potential negative effects on state-listed plant habitat; potential indirect	Potential negative effects on state-listed plant habitat; potential indirect effects on	Positive or negative effects on state-listed plant habitat could occur; potential indirect effects on federally listed animal habitats and no effects

Resource Issues	Alternative A (No Action)	Alternative B (Conservation)	Alternative C (Commercial/Retail and Residential)	Alternative D (Industrial)	Alternative E (Mixed Use)
		Alternative F (Unrestricted Use)			
Species			effects on federally listed animal habitats; no effects on any federally endangered or threatened animals or plants or designated critical habitat	federally listed animal habitats; no effects on any federally endangered or threatened animals or plants or designated critical habitat	on any federally endangered or threatened animals or plants or designated critical habitat (same as those under Alternative C or D)
Natural Areas	No impacts to any officially designated natural areas				
Recreation	No impacts	Minor potential for loss of recreational use opportunities; among the Action Alternatives, would most likely preserve or increase the amount of open space and areas in a relatively natural character	Potentially significant loss of recreational use opportunities	Potentially significant loss of recreational use opportunities	Minor to moderate loss of recreational use opportunities
Transportation	Significant impacts expected due to increased traffic in the area during build-out to year 2035 under all the alternatives, including No Action				

Resource Issues	Alternative A (No Action)	Alternative B (Conservation)	Alternative C (Commercial/Retail and Residential)	Alternative D (Industrial)	Alternative E (Mixed Use)
		Alternative F (Unrestricted Use)			
Scenic Resources	No impacts likely	Minor impacts; less potential for effects compared to Alternative C, D, E, or F	Minor impacts; potential for effects similar to Alternatives D, E, and F	Minor impacts; potentially greater compared to Alternative B; likely similar to Alternatives C, E, and F	Minor impacts; potentially greater compared to Alternative B; likely similar to Alternatives C and D
Navigation	No impacts; use of the utility corridor is very unlikely	No impacts; use of the utility corridor is unlikely		Minor impacts; potential for effects is greater than under Alternative B, C, E, or F; could increase use of nearby port facilities	Minor impacts; potential for effects is less than under Alternative B, C, or D; could increase use of nearby port facilities
Noise	No impacts	Minor impacts	Minor impacts; potentially greater effects than under Alternative B	Minor impacts; likely greater effects compared to Alternative C, E, or F	Minor impacts; likely less effects compared to Alternative D; similar to Alternative C

[1] See Chapter 4 for discussions of potential indirect and cumulative effects on various resources across the range of alternative land uses.
[2] TVA would also comply with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and RCRA, as appropriate.

In compliance with Section 106 of the NHPA, adverse effects on archaeological and architectural resources are subject to mitigation under stipulations included in a memorandum of agreement (MOA) between TVA and the Alabama SHPO. TVA is encouraging adaptive reuse of certain historic buildings under all the Action Alternatives.

Land use change is expected to be less under Alternative B compared to Alternatives C, D, E, or F. Other than the potential for positive quality of life impacts, socioeconomic benefits would likely be minor. Disproportionate impacts to disadvantaged populations would be less than those under Alternative C; they potentially could be greater than the effects likely under Alternatives A, D, E, and F due to fewer opportunities to create jobs in the local area.

Under **Alternative C**, the MSR study area would be sold and required to be used for commercial, retail, and residential purposes. Industrial uses would not occur. Some open green space would probably be designed into the landscape consistent with the Master Plan. Development anticipated under Alternative C would generate solid wastes, but the amount of hazardous wastes would likely be minor, and the potential for on-site contamination would be low. The opportunity for exposure to remaining on-site contaminants would be greater under Alternative C compared to Alternatives A and B but potentially the same or less than that likely under Alternatives D, E, and F. Mitigation, including the potential for additional cleanup of some SWMUs and the potential for additional evaluation and study would further reduce the potential risks. See discussion under Alternative B regarding mitigation of adverse effects on historic properties.

Overall, because most of the development would likely be a transfer of locations within the area and would add little to the overall economy of the area, the potential economic effects under Alternative C would be minor. Because most of the development would otherwise occur elsewhere in the local area, few new employment opportunities for minority or low-income individuals would result; thus, this alternative would likely have the greatest disproportionate impact on those populations. Implementation of Alternative C could likely have greater impacts on land use than Alternatives A and B but less than those expected if Alternative D, E, or F were implemented.

Under **Alternative D**, the MSR study area would be sold and required to be used for industrial purposes in accordance with the Master Plan. The potential for generation of wastes, including hazardous waste, would likely be greater under Alternative D than under the other Action Alternatives. The likelihood of additional on-site contaminant generation (i.e., waste streams) would likely be highest under this alternative compared to the other Action Alternatives. Because all land within the MSR study area has been extensively investigated and, as appropriate, sampled, assessed, and remediated where necessary to industrial screening levels and because only industrial uses would occur, no additional cleanup would likely be required or anticipated under this alternative. Furthermore, because industrial-type developments would likely provide short-term employee occupancy substantially isolated from soil contact, no increased human health or environmental exposure risks are anticipated. See discussion under Alternative B regarding mitigation of adverse effects on historic properties.

Because investors from outside the area or region could be attracted to the site and the immediate area, implementing Alternative D would likely have the greatest overall economic effect and result in additional opportunities for growth. Increases in employment and income under Alternative D are likely to be moderate to large. However, under this alternative, there could be some decrease in the overall attractiveness of the area, with a corresponding negative impact on the quality of life due to increased traffic, noise, and congestion and the loss of scenic and recreation opportunities in the area. Overall, disproportionate impacts to minority and low-income individuals would be less than those for Alternatives B and C but greater than those under Alternative E or F.

Under **Alternative E**, the MSR study area would be sold and required to be used for a mixture of conservation and LID; commercial, retail, and residential; and industrial purposes in accordance with the Master Plan. This mixture of site development would generate solid waste, and some hazardous wastes could be produced as a result of industrial by-products. However, the generation of large quantities of hazardous waste is not likely, and the potential for additional site contamination from development is relatively low. Mitigation, including the potential for additional cleanup of some land, and the potential for additional evaluation and study would further reduce this potential risk. Most of the land could be developed for any type of land use, thus requiring no additional cleanup. See discussion under Alternative B regarding mitigation of adverse effects on historic properties.

Well-designed and planned business and industrial facilities would provide increased income and job opportunities while maintaining and possibly enhancing the overall attractiveness of the area. Increases in employment and income under Alternative E are likely to be moderate. The development activities following adoption of Alternative E would provide a similar increase in employment opportunities for minority and low-income individuals as described under Alternatives C and D. Scenic values and recreation opportunities would continue to contribute to quality of life in the area. Therefore, disproportionate impacts to minority and low-income populations likely would be smallest under this alternative and under Alternative F.

Under **Alternative F**, the MSR study area would be sold, but no restrictions would be placed on its future land uses. Development would be guided by the Master Plan. As discussed earlier, under Alternative F, the property would likely be used or developed for one or more of the uses described under Alternatives B, C, or D, or the mixture of land uses under Alternative E. Therefore, impacts of development under Alternative F are likely to be similar to those described under Alternative E above and the range of effects bounded by those described under Action Alternatives B, C, D, and E.

POTENTIAL MITIGATION AND COMPLIANCE MEASURES

Mitigation measures are actions taken to avoid, minimize, rectify, reduce, compensate, or mitigate for adverse impacts to the environment. The following measures would be taken to reduce the potential for adverse effects under all the Action Alternatives unless noted otherwise. Depending upon the specific types of land use actions, their locations on the property, and supporting activities following transfer of the property, some mitigation would likely be required by other federal, state, and local authorities in order to acquire necessary permits and other authorizations. TVA could also require additional mitigation for future actions affecting wetlands, streams, and areas within the limits of the 100-year floodplain along Pond Creek and the Tennessee River.

The following are routine and nonroutine measures to which future landowners could implement voluntarily or which would probably be required of future landowner(s) by agencies other than TVA. These include measures usually required by agencies to comply with other federal, state, or local regulations to authorize such actions and activities. These provisions would also be taken into account during the development of the Master Plan.

- Future owners would utilize appropriate best management practices (BMPs) during construction and operation of the property. These BMPs may include the following measures:
  - Appropriate engineering and construction BMPs would be used to avoid introduction of material into and to prevent the formation of sinkholes.
  - Construction BMPs would be used to control air emissions from open construction areas and unpaved roads. Roadways would be sprayed with water as needed to reduce fugitive dust emissions.
  - Appropriate construction BMPs would be used to reduce storm water runoff.
  - Additional BMPs like open space design, well-connected and designed streets, and storm water planning would comply with applicable local regulations, laws, or ordinances.
- Prior to construction, future owners are advised to conduct an on-site survey of soil gas, and no closed structures should be constructed where data indicate that there would be intrusion and potential accumulation of volatile organic compounds.
- Future owners, in the spirit of EO 13112, could use the following voluntary measures to avoid introduction and spread of nonnative invasive plant species:
  - Limiting the introduction of weed seeds
  - Ensuring that all equipment is free of weed seeds before moving to another location
  - Using weed-free riprap or rock for projects to prevent the introduction of seeds
  - Detecting and eradicating small patches of weeds early
  - Minimizing the disturbance of desirable plants along trails, roads, and waterways
  - Maintaining desired plant communities through good management
  - Monitoring high-risk areas such as transportation corridors and bare ground
  - Revegetating disturbed sites with native or noninvasive plants
- Future owners could establish and maintain a secondary buffer around the forested wetland area.
- Future owners could remove dense stands of invasive plants to improve habitat quality for birdlife.
- The retention of existing vegetation (trees), via the measures below, in combination with limiting new roadway intersections (i.e., curb cuts) could reduce the potential for disturbance and maintain the park-like setting for viewers using TVA land and facilities along, and north of, Reservation Road.
  - Except where maintained within the existing road right-of-way, a vegetative buffer, measured 150 feet from the edge of the pavement, could be maintained along both sides of Reservation Road within the MSR study area from the intersection of Hatch Boulevard to the Wilson Dam Road overpass.
  - Except where maintained within the existing road right-of-way, a vegetative buffer, measured 150 feet from the edge of the pavement, could be maintained

along Hatch Boulevard from the intersection of Reservation Road, southward for a distance of 500 feet.

  - Except where maintained within the existing road right-of-way, a vegetative buffer, measured 150 feet from the edge of the pavement, could be maintained along Wilson Dam Road from the Reservation Road overpass, southward for a distance of 2,000 feet.
  - No more than four additional curb cuts (i.e., new roadway entrances onto the area) could be made along Reservation Road.

- Analysis of potential transportation impacts determined that the level of service (LOS) failures at Hatch Boulevard at Second Street could likely be mitigated with the strategic addition of turn lanes. However, the LOS failures on Hatch Boulevard would require solutions that are more comprehensive. The following are two overall potential mitigation approaches:
  - **Option 1**: Realign the U.S. Highway (US) 43/72 designation through Hatch Boulevard and relocate Jackson Boulevard to Birmingham Road.
  - **Option 2**: Incorporate an additional access point to the MSR between the Tennessee River and Hatch Boulevard and construct grade-separated flyover for southbound US 43/72 through traffic at Hatch Boulevard.
- Measures to reduce the effects of noise could include vegetation buffers, establishing and maintaining a noise-reduction zone (i.e., calculated noise-reduction zone) between the source and receptor of nuisance sounds (i.e., industrial developments), strategically positioned or constructed physical sound barriers, enclosures for the heavy construction equipment and production machinery, proper interior acoustics, and the muffler sound suppression systems for trucks and other heavy equipment.

TVA would comply with the following applicable laws, regulations, EOs, and obligations associated with existing agreements.

- TVA would warrant in the sale deed that the property has been cleaned up to the extent believed necessary to protect human health and the environment and that the United States will perform any cleanup that becomes necessary in the future as a result of contamination that occurred prior to the sale.
- Approximately 17 acres of land has been remediated (i.e., cleaned up) to industrial screening level. No land within the area covered by the existing RCRA permit, 2,260 acres, would be sold or transferred from federal ownership unless the land is conveyed at the unrestricted use level or with the appropriate environmental covenants and restrictions in the deed, transfer, or other conveyance document. Additional land use restrictions may be applicable as required by Alabama's Uniform Environmental Covenants Act.
- Consistent with TVA implementation procedures for EO 11990, all future owners shall avoid construction within wetland areas without TVA approval. As appropriate, all future owners shall conduct a wetland delineation of any site proposal for development. Unless there is no practicable alternative, development may not occur in identified wetland areas.

- Consistent with TVA implementation procedures for EO 11988, all future owners shall avoid construction of obstructions within the limits of the 100-year floodplain without appropriate local government authorization and approval under Section 26a of the TVA Act. Unless there is no practicable alternative, development may not occur in floodplain areas.
- TVA will comply with the terms and conditions of a September 18, 2001, agreement with the Alabama Department of Transportation and Federal Highway Administration regarding use of Transportation Enhancement Project funds for construction of the 1-mile segment of the National Recreation Trail Complex trail located on the south side of Reservation Road.
- TVA would honor the terms and conditions of its agricultural licenses on land tracts on the MSR study area through and until the date of cancellation prior to any land transfer.
- Additional land use restrictions may be applicable as required by Alabama's Uniform Environmental Covenants Act and would be enforced by ADEM.

TVA would be responsible for requiring, monitoring, and enforcing the following mitigation measures. To the extent practicable, this could be accomplished by placing conditions in the land transfer agreement and coordinating with ADEM's Environmental Covenants Act, where applicable. Section 106 of the NHPA requires that TVA consult with the Alabama Historical Commission SHPO before funding, authorizing, or carrying out any undertaking that is included in or eligible for inclusion in the NRHP. In addition, see elements common to all the Action Alternatives in Section 2.1.

- The only permissible use of the phosphate slag storage area is for a utility corridor to the Tennessee River to support any needed infrastructure development on the MSR study area. TVA would not transfer this land for future development but would make it available under specific use agreements, such as easements. Because of environmental and reservoir operations constraints along the left-descending (south bank) shoreline of the Tennessee River in the vicinity of the utility corridor, TVA would not approve a barge terminal, commercial dock, or other similar shoreline facility.
- Total annual exposure to any person within the phosphate slag storage area is to remain restricted to no more than 500 hours per year.
- If conditions at the slag storage area are altered and it becomes necessary to reevaluate radiation exposure, TVA would verify in consultation with the Alabama Department of Public Health any change to the phosphate slag storage area that would allow increased exposure times. This would include any effort to mitigate radioactive levels at the site through the use of soil cover or caps of various materials.
- If it becomes necessary through the proposed use of the phosphate slag storage area for subsurface infrastructure enhancements (e.g., buried pipeline), TVA would conduct further radiological measurement and monitoring to determine a worker's potential exposure to ensure safety.
- No subsurface disturbance or other excavation of buried materials would be allowed within the low-level radioactive waste burial site.

- TVA would not allow removal of groundwater for drinking water (i.e., potable use purposes) from anywhere on the MSR study area.
- TVA would adhere to the stipulations in the final executed MOA between TVA and the Alabama SHPO (Appendix A) to mitigate for the loss of NRHP-eligible properties. Such mitigation includes imposition of architectural controls and design guidelines on new owners and consideration of these properties in the Master Plan. TVA would adhere to required measures through inclusion of requirements in the transfer deed.
- Site 1CT495, the remnants of Wilson Power Plant foundations, shall be avoided during any construction in the utility corridor to the Tennessee River.
- In the event of construction within the utility corridor, TVA would take into account the location of the Rockpile Hiking Trail and the paved trail complex on the north side of Reservation Road and, to the extent practicable, avoid trail closure or reduce effects of trail usage through planning or other design features. This section of the Rockpile trail crosses the skimmer wall built as part of the Wilson Power Plant. Because there is an inlet behind (landward) of the wall, some forms of water access accommodations could be accommodated without impacting the trail or the fishing activity that occurs in this area. Conversely, water access needs that would require breach or removal of the skimmer wall would sever the existing trail and also adversely impact shoreline fishing.
- An approximate 900-foot section of paved National Recreation Trail Complex, including a protective corridor, on the Multipurpose Building parcel would be (a) retained by TVA, (b) preserved and managed for public recreation use under an agreement (e.g., easement) between TVA and a new landowner, or (c) relocated to skirt the boundaries of the Multipurpose Building parcel.
- Prior to any TVA land or buildings being transferred from federal ownership under any of the Action Alternatives, TVA would assure that any required environmental due diligence assessments on existing buildings' interiors (i.e., construction materials) are completed.

PREFERRED ALTERNATIVE

The Environmentally Preferred Alternative is Alternative B because there would be a deliberate effort under that alternative to conserve sensitive resources, i.e., wetlands and floodplains, and to encourage the establishment of environmentally friendly developments. However, TVA has determined that selection of any of the action alternatives would present an acceptable range of environmental impacts and risks. Accordingly, TVA has selected Alternative F as its Preferred Alternative based on anticipated benefits to the community and business considerations consistent with the TVA Act, the TVA Land Policy, and other applicable requirements. The adoption of Alternative F would provide the greatest opportunity for economic benefits to the area and region, would reduce TVA's O&M costs and environmental footprint, and would encourage reuse of some historic buildings and structures in the MSR study area. Implementation of Alternative F, consistent with the Master Plan, would also leave future land use decisions to the local community.

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ACRONYMS, ABBREVIATIONS, UNITS OF MEASURE, AND SYMBOLS

≤	Less Than or Equal To
μg/L	Micrograms Per Liter
μg/m^3	Micrograms Per Cubic Meter
μrem/hr	Microrem Per Hour, one-thousandth of a millirem, a standard unit of radiation dose equivalent
°C	Degree Celsius
°F	Degree Fahrenheit
§	Section
§§	Sections
1996 Plan	1996 *Muscle Shoals/Wilson Dam Reservation Land Use Plan Final Environmental Assessment*
AADT	Annual Average Daily Traffic
ADCNR	Alabama Department of Conservation and Natural Resources
ADEM	Alabama Department of Environmental Management
ADPH	Alabama Department of Public Health
ALDOT	Alabama Department of Transportation
APE	Area of Potential Effects
AOWR	Alabama Office of Water Resources
BMPs	Best Management Practices
CAA	Clean Air Act
CCC	Civilian Conservation Corps
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	Cubic Feet Per Second
CH_4	Methane
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CWA	Clean Water Act
dB	Decibel
dBA	A-Weighted Decibel
DNL	Day/Night Sound Levels
DOE	U.S. Department of Energy
EA	Environmental Assessment
e.g.	Latin term, *exempli gratia,* meaning “for example”
EIS	Environmental Impact Statement
EmA	Emory Silt Loam Soils
EO	Executive Order
EPRI	Electric Power Research Institute
ERC	Environmental Research Center
et al.	Latin term, *et alii* (masculine), *et aliae* (feminine), or *et alia* (neuter), meaning “and others”
et seq.	Latin term *et sequential*, meaning “and the following”
FHWA	Federal Highway Administration
FPPA	Farmland Protection Policy Act
FRP	Flood Risk Profile
FWW	Florence Wagon Works
g/cm^3	Grams per cubic centimeter
GCC	Global Climate Change
GHG	Greenhouse Gases
GSA	Geological Survey of Alabama

HCM	Highway Capacity Manual
HPA	Habitat Protection Area
hr	Hour
HSWA	Hazardous and Solid Waste Amendments to RCRA
Hz	Hertz
ID	Identification
i.e.	Latin term, *id est,* meaning “that is”
IPCC	Intergovernmental Panel on Climate Change
K-40	Potassium-40; a radioisotope of potassium
K_d	Distribution (or adsorption) coefficient; a measure of the tendency of a chemical to adsorb to soil
Kg	Kilogram
Lb	Pound
LID	Low-Impact Development
LLRWBS	Low-Level Radioactive Waste Burial Site
LOS	Level of Service
LQG	Large Quantity Generator
Master Plan	Comprehensive master plan for redevelopment of the approximately 1,400-acre MSR property
MCL	Maximum Contaminant Level
mg/L	Milligrams Per Liter
MGD	Millions of Gallons per Day
MOA	Memorandum of Agreement
mrem	Millirem, one-thousandth of a rem, a standard unit of radiation dose equivalent
MSA	Metropolitan Statistical Area
MSHD	Muscle Shoals Historic District
msl	Mean Sea Level
MSR or Reservation	Muscle Shoals Reservation
NAAQS	National Ambient Air Quality Standards
NACD	Northwest Alabama Cooperative District
NEP	Nonessential Experiment Population
NEPA	National Environmental Policy Act
NFDC	National Fertilizer Development Center
NFERC	National Fertilizer and Environmental Research Center
NGVD	National Geodetic and Vertical Datum
NHA(s)	National Heritage Area(s)
NHPA	National Historic Preservation Act
NNL	National Natural Landmark
N_2O	Nitrous Oxide
NO_2	Nitrogen Dioxide
NOA	Notice of Availability
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NRI	Nationwide Rivers Inventory
NSR	New Source Review
NWR	National Wildlife Refuge
O_3	Ozone
O&M	Operations and Maintenance
P_4	Chemical abbreviation for elemental (or white) phosphorus
Pb	Lead
Pb-210	Lead-210, a Radioisotope of Lead
pCi/L	Pico-Curies Per Liter, a measure of radioactivity per liter of liquid
PCB(s)	Polychlorinated Biphenyl(s)
PCM	Postclosure Monitoring

PDW	Phosphate Development Works
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter Having a Diameter of Less Than 2.5 Microns
PM_{10}	Particulate Matter Having a Diameter of Less Than 10 Microns
PNNL	Potential National Natural Landmark
POC	Point of Compliance
Po-210	Polonium-210, a Radioisotope of Polonium
ppb	Parts Per Billion
ppm	Parts Per Million
PRG(s)	Preliminary Remediation Goal(s)
PSD	Prevention of Significant Deterioration
PSS2	Power Service Shop No. 2
PUA	Pruitton and Sullivan Soils
Ra-226	Radium-226, a Radioisotope of Radium
RAL	RCRA Action Limit
RCRA	Resource Conservation and Recovery Act
rem	Roentgen Equivalent in Man, a unit of radiation dose used to measure the effects of ionizing radiation on humans commonly expressed in units of one-thousandths over a specific period of time (1,000 millirems equal 1 rem)
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
Rn-222	Radon-222, a Radioisotope of Radon
ROD	Record of Decision
SEDA	Shoals Economic Development Authority
SHPO	State Historic Preservation Officer
SO_2	Sulfur Dioxide
SR	State Route
SVOC(s)	Semivolatile Organic Compound(s)
SWA	Small Wild Area
SWMUs	Solid Waste Management Units
TACF	The American Chestnut Foundation
TEDE	Total Effective Dose Equivalent
TMDL	Total Maximum Daily Load
TRM(s)	Tennessee River Mile(s)
TSD	Treatment, Storage, and Disposal
TVA	Tennessee Valley Authority
U-238	Uranium-238
U.S.	United States
US	U.S. Highway
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USNP2	U.S. Nitrate Plant No. 2
USNPS	U.S. National Park Service
VOC(s)	Volatile Organic Compound(s)
WCK	Westinghouse, Church, Kerr, and Company
WHPA	Well Head Protection Area
WMA	Wildlife Management Area

GLOSSARY OF TERMS

Adsorb	To collect (a gas, liquid, or dissolved substance) in condensed form on a surface
Aquifer	A permeable geologic unit capable of transmitting significant quantities of water to wells
Alluvial Deposits	Earthen material (soil) made up of silt and clay and larger particles of sand and gravel left by river flow or flooding
Aquitard	Less permeable geologic unit incapable of transmitting significant quantities of water to wells
Biotransformation	Process whereby bacteria biologically break down a chemical compound into other compounds
Brownfield Site	Real property (i.e., land), which the expansion, redevelopment, or reuse of may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant
By-Product	A secondary or incidental product deriving from a manufacturing process, a chemical reaction, or biochemical pathway
Chlorofluorocarbon	Compound consisting of chlorine, fluorine, and carbon; widely used as refrigerants and suspected of affecting the ozone layer
Clerestory	The upper part of a wall containing windows for supplying natural light to a building
Contaminant	Any substance that when added to water (or another substance) makes it impure and unfit for consumption or an intended use
Disposal	The sale, transfer, conveyance, grant, abandonment, or modification of land (fee simple sale) or landrights (lease, easement, retained rights in a deed, flowage easement, transmission right-of-way, etc.)
Downgradient	The direction that groundwater flows; similar to "downstream" for surface water
Embayment	An indention in a shoreline forming an open bay or cove
Fissure	A long, narrow, deep crack
Groundwater	Water found in the spaces between soil particles and cracks in rocks underground; groundwater is a natural resource that is used for drinking, recreation, industry, and growing crops
Greenfield Site	Real property that has not previously been used for commercial or industrial activities and is presumed free of contamination (undeveloped lands such as fields or forests)
Hydrofluorocarbon	Compound consisting of hydrogen, fluorine, and carbon, which do not contain chlorine or bromine and, therefore, do not deplete the ozone layer
Impaired Waters	State 303(d) listing of waters (water bodies including streams, rivers, lakes, and reservoirs) which do not fully support their designated uses
Impervious	In hydrologic terms, the ability to repel water, or not let water infiltrate

Karst	A geologic formation of irregular limestone that dissolves, forming deep fissures and sinkholes and is characterized by underground caves and streams
Leachate	Liquids that have percolated through a soil and that carry substances in solution or suspension
Lintel	A horizontal structural beam spanning an opening, such as between the uprights of a door or a window, and which supports a wall
Natural Attenuation	Natural processes, including biotransformation, dispersion and dilution, which reduce contaminant concentrations during groundwater transport
Piezometer	A small-diameter observation well used to measure the hydraulic head of groundwater in aquifers
Plume	In groundwater, a plume is an underground pattern of contaminant concentrations created by the movement of groundwater beneath a contaminant source
Quoin	The external corner of a building; usually differentiated from the adjoining walls by material, texture color, size, or projection
Remediation	Containment, treatment, or removal of contaminated groundwater or contaminated soil
Section 26a	Section 26a of the TVA Act requires that TVA's approval be obtained prior to the construction, operation, or maintenance of any dam, appurtenant works, or other obstruction affecting navigation, flood control, or public lands or reservations along, across, or in the Tennessee River or any of its tributaries. TVA jurisdiction under Section 26a is implemented through Section 26a regulations (18 CFR Part 1304). TVA's Section 26a geographical jurisdiction extends to the limits of the Tennessee River watershed. With regard to the range of construction and development activities along the shoreline, an obstruction is any man-made physical condition that during its continuance after completion, impounds, checks, hinders, restricts, retards, diverts, or otherwise interferes with the movement of water or of objects on or in the water.
Seepage	The slow movement of water into or out of a body of surface or subsurface water
Sustainability	A means of configuring activity so that society, its members and its economies, are able to meet their needs and express their greatest potential in the present while preserving biodiversity and natural ecosystems in the very long term
Vernacular	Term used in architecture to categorize methods of construction that uses locally available resources and traditions to address local needs

CHAPTER 1

1.0 PURPOSE OF AND NEED FOR ACTION

1.1 Purpose

The Tennessee Valley Authority (TVA) is a wholly owned federal corporation and instrumentality of the United States (U.S.), established in 1933 by the U.S. Congress primarily to develop and manage certain resources of the Tennessee Valley region. Today, TVA is the nation's largest publicly-owned producer of electric power, serving about 9 million people in seven southeastern states. TVA is also a regional economic development agency and a steward of the Tennessee River basin and various lands in the Tennessee Valley. TVA's power program has been self-financing since 1959, and TVA has not received federal appropriations (taxpayer dollars) in support of its nonpower programs and projects since 1999.

TVA assumed custody and control of the 3,036-acre Muscle Shoals/Wilson Dam Reservation in Colbert County, Alabama, in 1933 when Congress directed its transfer to TVA from the U.S. War Department. TVA has since managed 2,600 acres of this nonreservoir property as the Muscle Shoals Reservation (MSR or Reservation). The Reservation is located in northwest Alabama in an area generally referred to as the "Shoals" or the "Quad Cities" (Figure 1-1). Since acquisition of the land, TVA's need for this amount of property at this location has changed. TVA's programs have changed over time Valleywide, and Muscle Shoals employee populations have declined. From a business perspective, TVA has proposed that an approximately 1,400-acre portion (study area) of its MSR (Figure 1-2) is no longer essential to its needs. Local public and private sector developers have been requesting use of this land for many years. In accordance with its economic development mission, TVA believes sale (i.e., disposal) and redevelopment of this property would help stimulate and grow the local and regional economy. Transferring this portion of the Reservation from TVA ownership would also help TVA reduce its operations and maintenance (O&M) costs and reduce its environmental footprint. Accordingly, TVA proposes to dispose of approximately 1,400 acres of its MSR. TVA has prepared this environmental impact statement (EIS) in accordance with Council on Environmental Quality (CEQ) regulations and TVA procedures for implementing the National Environmental Policy Act (NEPA) in order to assess and document the potential environmental effects of this proposal.

1.2 Background

The U.S. War Department constructed U.S. Nitrate Plant No. 2 (USNP2) between February and October 1918 to produce nitrates for World War I munitions. The construction of Wilson Dam was started in 1918 and was completed in 1925. Wilson Steam Plant, the largest of its kind when it was constructed in 1918, provided electric power to USNP2 during the war effort. In 1933, these facilities were transferred to TVA custody and control. TVA immediately began converting the nitrate facilities to produce fertilizers. From those days through the early 1940s, TVA developed and distributed fertilizers to help improve agriculture in the Tennessee Valley region. During World War II, TVA converted its fertilizer production facilities back to the manufacture of munitions as well as synthetic rubber.

Figure 1-1. General Locator Map of the Muscle Shoals Reservation, Colbert County, Alabama

Figure 1-2. The Approximately 1,400-Acre Muscle Shoals Reservation Study Area

These facilities supplied more than 60 percent of the elemental phosphorus needed for munitions and produced more than 200,000 tons of calcium carbide for the manufacture of synthetic rubber (Lord, Aeck, and Sargent Architecture 2009). During the Korean Conflict, TVA again produced munitions essential to that military effort.

In 1952, TVA began operation of two plants on the MSR for the U.S. Army: a chlorine plant and the Phosphate Development Works (PDW), which produced methyl phosphonous dichloride and methyl phosphonic dichloride, components used in the manufacturing of a nerve agent. In 1954, the chlorine plant was sold to a private company. In 1958, the PDW ceased operations and was placed on standby; in 1992, the PDW was demolished.

For over 50 years, TVA operated a fertilizer research and development facility at Muscle Shoals. It became internationally recognized for its fertilizer research, demonstrations, production, and patents. About 75 percent of fertilizers and fertilizer technology used around the world today were developed or improved during the 1950s to 1970s by scientists and engineers at TVA. An investment of $41 million in fertilizer research through 1981 returned $57 billion to U.S. agriculture, excluding benefits of the technology to the rest of the world. Thus, a benefit-to-cost ratio of more than $20 to $1 was recognized (International Fertilizer Development Center 2008).

In the early 1960s, the Muscle Shoals fertilizer complex was named the National Fertilizer Development Center (NFDC). While TVA had long been involved in identifying and addressing environmental issues related to fertilizer development and use since NFDC's inception, by 1988 TVA's environmental thrust began to become the focal point of the NFDC's mission. In January 1990, to emphasize its environmental commitment, TVA changed the name of the NFDC to the National Fertilizer and Environmental Research Center (NFERC). In May 1990, TVA closed the large-scale fertilizer production facilities and transitioned them to small-scale prototype plants. Through 1993, these facilities were used in experimental production of more environmentally friendly fertilizer products or in production of fertilizers by utilizing industrial by-products. By February 1994, a major refocusing of the NFERC's activities to environmental research, development, and technology transfer was complete. At that time, the name of the Muscle Shoals facility was changed from NFERC to the TVA Environmental Research Center (ERC), as it remains today. The ERC is located on an approximately 590-acre site south of the Tennessee River and is part of the MSR study area. The complex is currently comprised of numerous buildings, laboratories, greenhouses, pilot-scale plants, constructed wetlands research facilities, and other grounds, infrastructure, and support facilities.

After TVA fertilizer development production operations were shut down, intermediate products, raw materials, and various quantities of unneeded chemicals and equipment were stored on site. Prior to the passage of the Resource Conservation and Recovery Act (RCRA) in 1976, there were very few environmental laws governing waste handling and disposal practices. In keeping with industry standards at that time, TVA stored waste on site in pits, stockpiles, drums, and other such designed containments. Storage, handling, use, and disposal of some of these various chemicals on site resulted in the release of and the presence of some remnant contamination.

In 1988, as a result of a TVA-initiated RCRA facilities investigation and plans for a cleanup, the U.S. Environmental Protection Agency (USEPA) and the Alabama Department of Environmental Management (ADEM) initially identified 193 areas of potentially contaminated sites. These sites, also known as solid waste management units (SWMUs), resulted from these historical operations at the ERC. Later in the investigation, 12 more SWMUs were discovered, bringing the total number of SWMUs to 205.

Another SWMU, bringing the total number of SWMUs to 206, included an inert construction-demolition landfill. The landfill was approved for disposal of such materials as roofing, rocks, bricks, soils, asphaltic concrete adhering to concrete, wood ash, wood, metal, glass, plastic, and fiberglass. The landfill was operated from 1992 to 2004, but because of the nature of the material disposed of there, it was not included in the RCRA facilities investigation. In accordance with Administrative Code R. 335-13-4-.20, by letter dated September 5, 2005 (Bryant 2005), ADEM approved the final closure of this landfill in 2005.

Staffing and Building Space Reductions

Valleywide, TVA's employee population has decreased over the years, resulting in an excess of office and related ancillary space. TVA has been actively disposing of unused space under its custody and control since 2001 in support of lowering operating costs and has since reduced its total corporate office and ancillary space by more than a million square feet.

Approximately 2,800 workers once occupied the TVA power service shops, heavy equipment, land management, laboratory, corporate, and other facilities on the Muscle Shoals/Wilson Dam Reservation at the peak of operations in the late 1970s. Currently, less than 700 employees are stationed on the MSR study area. Although several attempts to lease or sell space on the Reservation have been met with limited success, TVA continues to consolidate its operations and vacate buildings that no longer meet the current business direction or that are inefficient and costly to operate. TVA has reduced its facility operating expense by about 40 percent over the last 10 years, and further office consolidations are planned here.

From a business perspective, TVA needs to reduce its O&M costs. In accordance with its Environmental Policy, it is also TVA's goal to reduce its environmental footprint. The MSR study area (see Figure 1-2) contains approximately 1.2 million square feet of office and laboratory space. These buildings and structures, some with historic value, are in various states of usage and condition. Staff consolidations occurred in 2010, and additional relocations on the Muscle Shoals/Wilson Dam Reservation are being considered as TVA continues to optimize the use of space and make efficient use of its resources.

One lease and numerous licenses are in effect on the MSR study area. The lease, which expires in 2015, is to the State of Alabama Department of Revenue for use of a portion of the former Public Power Institute building. If this portion of the MSR study area has not been disposed of by 2015, TVA could consider entering into another lease for the same purposes. The current lease is likely transferable to a new owner. TVA has also issued a number of licenses on the property for a variety of uses. These licenses likely are not transferable to a new owner and would be terminated at the time of disposal.

Some buildings on the property are known to contain potentially hazardous materials commonly used during construction or appropriate maintenance at that time. As a result of contaminants (e.g., lead paint, asbestos) potentially present in existing buildings and structures, including those that possess historic value, future remedial actions may need to be taken prior to or in the course of reuse or demolition of such buildings and structures. Indoor contaminants could cause potential hazards to human health from exposure. Many vacant and some partly occupied buildings on the MSR study area have not been thoroughly assessed for the safety of future occupants. Given that TVA is somewhat uncertain which buildings might ultimately be sold or reused, potentially substantial outlays of TVA funds to conduct such assessments would be premature and not ready for decision at this time. Such building assessments and resultant information are not presently available and are not included in evaluations presented in this EIS. As long as these buildings remain in federal ownership, TVA would continue to maintain them in accordance with applicable standards. Prior to transfer from federal ownership under any of the Action Alternatives, TVA would assure that any required environmental due diligence assessments on existing buildings are completed (see elements common to all the Action Alternatives in Section 2.1).

Land Sale Justifications

As part of its mission, TVA has a duty to manage its land wisely for present and future generations. In November 2006, the TVA Board of Directors approved the TVA Land Policy (http://www.tva.gov/river/landandshore/land_policy.htm) to govern the retention, disposal, and planning of interests in real property. As stated therein, it is TVA's policy to manage the lands under its control to protect the integrated operation of the TVA reservoir and power systems, to provide for appropriate public use and enjoyment of the reservoir system, and to provide for continuing economic growth in the Valley. Consistent with this policy, TVA proposes to dispose of approximately 1,400 acres of the MSR to allow redevelopment and reuse of this property. Disposal and subsequent redevelopment of this land, likely through partnerships with local governments, can help foster economic development in the Shoals area in support of TVA's economic development mission. Disposal of this property would also, as noted above, reduce TVA's related O&M costs and simultaneously facilitate the local governments' goals of furthering economic development.

In recent years, TVA has received numerous inquiries from a variety of governmental, nongovernmental, and community groups interested in the availability of MSR land, buildings, and facilities for development. The inquiries to date about other possible uses of this land have come mainly from local governments and developers and involved use of specific individual parcels of land at key locations around the perimeter of the area. In some cases, TVA has transferred property to the surrounding communities for business development. However, if TVA continued a piecemeal approach to property disposal at the MSR, economic development of the area would lack strategic direction. Such piecemeal development could also reduce the overall value of the property for the community; thus, the highest and best use of the property to the community would perhaps not be realized in the future. In addition, TVA could likely be left with an industrial brownfield site at the interior core of the MSR that would have limited access and potential for future use. To maximize economic benefits to the region and to avoid the likelihood of an interior brownfield site remaining in TVA ownership, TVA is working with the Shoals area community, the Northwest Alabama Cooperative District (NACD), and other appropriate local, state, or federal authorities to develop a comprehensive master plan (Master Plan) for the holistic redevelopment of the approximately 1,400-acre area of MSR property.

The cities of Florence, Muscle Shoals, Sheffield, and Tuscumbia and the counties of Colbert and Lauderdale comprise the NACD. The NACD was created in 2009 and represents the interests of the people of the area through their elected officials. The NACD is working in partnership with TVA on the potential redevelopment of the MSR study area. As noted above, TVA is working with NACD, as well as with local people, interest groups, private developers, and others, to create the Master Plan. This would help to provide a framework and focus and to establish standards and provide guidance to allow more effective long-term planned development. The Master Plan would reflect the objectives of the particular alternative selected by the TVA Board of Directors (see Section 2.1).

Consideration of site capability and suitability of various areas, portions, and parcels on the MSR study area, along with any restrictions on potential land uses, would be incorporated into the Master Plan to guide the development of the MSR study area. The Master Plan could be strengthened and enforced by local zoning laws or other appropriate land use ordinances.

The NACD could work with state or federal government agencies or other local authorities such as SEDA (http://www.seda-shoals.com/), the Northwest Alabama Council of Local Governments (http://www.nacolg.com/), Top of Alabama Regional Council of Governments (http://tarcog.org/), and similar regionally based organizations in developing the Master Plan for development of the MSR.

1.3 The Decision

TVA must decide whether to declare this approximately 1,400-acre property unnecessary to carry out future business plans and projects (i.e., surplus) and whether to sell it for future development. Although TVA would ultimately make available for sale all 1,400 acres of this nonreservoir property, TVA may sell the land in multiple parcels over time rather than as one large parcel in one sale. If the entire property is not sold or transferred to a single purchaser as one large parcel, TVA may make interim use of the unsold portions or parcels of the idle land during the anticipated 20-year plus development build-out period. Such interim land uses would likely represent ongoing TVA uses consistent with the TVA 1996 *Muscle Shoals/Wilson Dam Reservation Land Use Plan Final Environmental Assessment* (1996 Plan) for the property, or they may also include other public or private uses or partnerships consistent with the Master Plan.

Disposal decisions for the MSR study area and buildings would be made by the TVA Board of Directors or its designee. In accordance with the TVA Land Policy, the decisions regarding the sale of this property would be based primarily on business considerations consistent with the TVA Act and other applicable requirements.

1.4 National Environmental Policy Act Process

TVA has prepared this final EIS in accordance with NEPA (42 USC §§ 4321 et seq.), CEQ regulations for implementing NEPA (40 Code of Federal Regulations [CFR] §§ 1500-1508), and TVA's procedures for implementing NEPA. The NEPA process requires federal agencies to consider the impact of their proposed actions on the environment before making decisions. If an action is expected to have a significant impact on the environment, the agency proposing the action must develop a study for public and agency review. This study, called an EIS, is an analysis of the potential impacts to the natural and human environment from the proposed action, as well as from a range of reasonable alternatives. CEQ regulations (40 CFR § 1505.1) require federal agencies to make environmental review documents, comments, and responses a part of each agency's administrative record.

Internal scoping was conducted by TVA to determine the extent of the geographic area and the possible environmental resource issues to be considered in the environmental review. In compliance with 40 CFR § 1501.7, TVA prepared and issued a notice of intent (NOI) to prepare this EIS. The NOI was published on June 18, 2009 (74 *Federal Register* 116). This NOI briefly described the proposed action, reasonable alternatives, and probable environmental issues to be addressed in the EIS (see Section 1.5.2).

The completed draft EIS was distributed to interested individuals, groups, and federal, state, and local agencies on January 5, 2011. It was also transmitted to the USEPA, which published a notice of availability (NOA) in the *Federal Register* on January 14, 2011. The draft EIS public comment period began with the publication of the NOA by USEPA in the *Federal Register.* During the public comment period, TVA held a public meeting as a forum to obtain comments on the draft EIS on February 3, 2011 (see Section 1.5.3). Notice of the public meeting was distributed through appropriate media and direct mailings. At the close of the draft EIS public comment period, TVA responded to the comments received and incorporated any required changes in this final EIS. Notification of the completion of the final EIS will be sent to those who received the draft EIS, submitted comments on the draft EIS, or asked to be included on the mailing list.

The TVA decision on the proposed disposal of the property will be made no sooner than 30 days after the NOA of the final EIS is published in the *Federal Register*. This decision will be based on various factors, including the anticipated environmental impacts, as documented in the final EIS, along with cost, schedule, technology and other considerations. TVA then will issue a record of decision (ROD). The ROD normally includes: (1) what the decision was; (2) the rationale for the decision; (3) what alternatives were considered; (4) which alternative was considered environmentally preferable; and (5) any required mitigation measures and monitoring and enforcement requirements.

1.5 Scope of the Analysis

1.5.1 Geographic Scope

The MSR study area site lies adjacent to the cities of Muscle Shoals and Sheffield. It is primarily bounded by Second Street (State Route [SR] 184) to the south, Hatch Boulevard (U.S. Highway [US] 43/72) to the west, Wilson Dam Road (SR 133) to the east, and Reservation Road to the north (see Figure 1-2).

The MSR study area also includes three areas north of Reservation Road: two existing facilities (the Western Area Radiological Laboratory and Multipurpose Building) and the phosphate slag storage area. The rest of the MSR property north of Reservation Road, which includes a hiking trails system and other public use facilities, is not proposed for disposal and would continue to be available for public use and enjoyment. The proposed land disposal also excludes TVA property located along Reservation Road east of Wilson Dam Road (SR 133) and north of River Road (Figure 1-3). TVA would also retain land in the vicinity of monitored SWMUs, as well as retain for the foreseeable future land south of Reservation Road used by the International Fertilizer Development Center and TVA Employees Credit Union under long-term easement agreements (see Figure 1-2).

The Muscle Shoals Reservation Redevelopment Environmental Impact Statement Final Scoping Report (TVA 2009) provides a more detailed description of the geographic bounds of the study area.

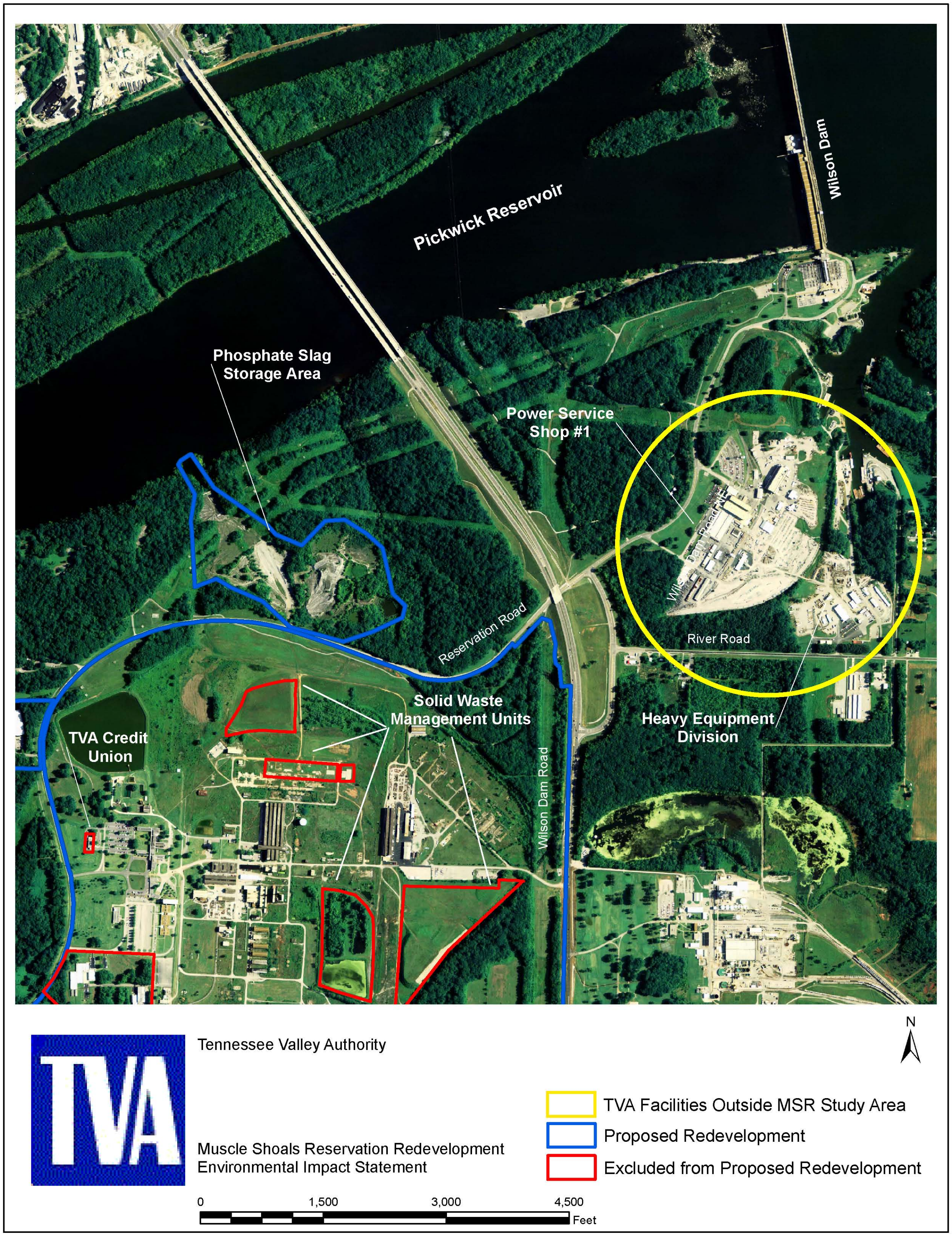


Figure 1-3. TVA Facilities Outside the Muscle Shoals Reservation Study Area

1.5.2 Public Scoping

During summer 2009 and following internal scoping, TVA asked the public to help refine the scope of this EIS, to determine potential alternative uses for the MSR lands to be redeveloped, and to identify environmental issues to be addressed. The major public involvement steps are listed below.

June 18, 2009	An NOI was published in the *Federal Register* informing other agencies and the public of TVA's intent to prepare the EIS. Project-related scoping information, including a site map, the NOI, a mailing list sign-up sheet, notice of the public scoping meeting, and an online comment form, was posted on the TVA Web site (http://www.tva.com/environment/reports/muscle_shoals/index.htm). The public comment period officially opened.
July 9, 2009, and July 13, 2009	An announcement of the July 14, 2009, public scoping meeting was published in two local newspapers: The *Times Daily* (Florence) and *The Huntsville Times*.
July 11, 2009	An announcement of the July 14, 2009, public scoping meeting was published in *Standard & Times/Lauderdale County News*.
July 14, 2009	A public scoping meeting was held at Muscle Shoals High School and was attended by about 100 people.
June 18, 2009, to August 5, 2009	TVA held a 48-day scoping comment period, which resulted in the receipt of 90 comments from 82 commenters. One hundred-forty people provided names and addresses for the mailing list to receive notification of other project-related information to be made available during the environmental review process.

In addition, newspaper articles on the MSR redevelopment project were published, primarily at http://www.timesdaily.com, prior to, during, and following the comment period by the news media largely from early May 2009 to October 2009. Various local interest groups also published editorials and other articles about the project.

Other useful information about the MSR study area was made available to the public early in the process. Following its completion in October 2009, TVA posted the results of the commissioned *Adaptive Re-Use Study* (Lord, Aeck, and Sargent Architecture 2009) on the project Web site. This study evaluates the importance, condition, and adaptability of buildings in the MSR study area potentially eligible for listing in the National Register of Historic Places (NRHP). It also examines the viability of these buildings based on current and foreseeable market trends in the region and provides a draft concept plan illustrating examples of how the historic buildings might be reused as a part of a larger redevelopment effort. This information will help TVA in its work with the Shoals community, the NACD, and others on the Master Plan, as well as during consultations with the Alabama State Historic Preservation Officer (SHPO), the Advisory Council on Historic Preservation, federally recognized tribes, and other consulting parties in this undertaking, which has the potential to affect historic properties. This consultation process is required to comply with the National Historic Preservation Act (NHPA) and is an integral part of this EIS.

Issues and Resources Addressed in Detail

The resources listed below have been identified during scoping as those likely to be directly affected by the implementation of the project alternatives and/or constrain any eventual site redevelopment. The existing conditions of these resources and the potential for impacts resulting from the various redevelopment alternatives are described in more detail in Chapters 3 and 4.

- Air Quality, Greenhouse Gases, and Global Climate Change (Sections 3.8 and 4.8)
- Aquatic Ecology, including Aquatic Endangered and Threatened Species (Sections 3.13 and 4.13)
- Environmental Justice (Sections 3.6 and 4.6)
- Floodplains (Sections 3.12 and 4.12)
- Geology (Sections 3.2 and 4.2)
- Groundwater (Sections 3.3 and 4.3)
- Historic and Archaeological Resources (Sections 3.4 and 4.4)
- Land Use (Sections 3.7 and 4.7)
- Natural Areas (Sections 3.15 and 4.15)
- Navigation (Sections 3.19 and 4.19)
- Noise (Sections 3.20 and 4.20)
- Recreation (Sections 3.16 and 4.16)
- Scenic Resources (Sections 3.18 and 4.18)
- Socioeconomic Resources (Sections 3.5 and 4.5)
- Soils and Prime Farmland (Sections 3.9 and 4.9)
- Solid and Hazardous Waste (Sections 3.1 and 4.1)
- Surface Water Quality (Sections 3.10 and 4.10)
- Terrestrial Ecology, including Endangered and Threatened Species (Sections 3.14 and 4.14)
- Transportation (Sections 3.17 and 4.17)
- Wetlands (Sections 3.11 and 4.11)

Issues and Resources Not Addressed in Detail

Some comments submitted during scoping dealt with vacant or unused buildings and facilities on private land in the surrounding area. These private buildings and lands are outside the scope of TVA's federal control and responsibility and are not addressed in detail in this environmental review. The EIS does consider the potential of these buildings and lands to influence the development of the MSR study area. Comments regarding other nonenvironmental issues, such as appreciation or critiques of TVA processes and guidelines, have been forwarded to the appropriate TVA organization for attention and are not addressed further in this environmental review.

1.5.3 Public Review of the Draft Environmental Impact Statement

The Muscle Shoals Reservation Redevelopment draft EIS was issued to the public on January 5, 2011, and the notice of its availability was published in the *Federal Register* on January 14, 2011. This initiated a 45-day public comment period, which closed on February 28, 2011.

TVA provided the draft EIS or postcard notification of its availability to individuals on the mailing list, agencies, organizations, interests groups, and institutions. The draft EIS was posted on the TVA Web site and placed in 13 public libraries from Huntsville, Alabama (Madison County), to Iuka, Mississippi (Tishomingo County). A news release and public notices (paid advertisements) were published in four newspapers announcing the February 3, 2011, public meeting. This included one newspaper of statewide circulation for Spanish-speaking stakeholders and three local newspapers. Commenters were given the opportunity to provide their comments online or by e-mail, fax, commercial mail, or telephone. Commenters could also sign up online to be included on a project mailing list to receive additional information; about 140 individuals signed up.

On February 3, 2011, TVA held a public meeting at the Muscle Shoals High School to receive comments on the draft EIS. About 80 people, representing various personal and organizational interests, registered and participated in the meeting. Twenty written and oral comments were received at the meeting, and many ideas were exchanged with TVA staff experts.

At the end of the comment period, a total of 146 comment submissions on the draft EIS, which included letters, e-mails, oral statements, and comments through the project Web site, had been received. These submissions were carefully reviewed and synthesized into 186 individual comment statements to which TVA has provided responses in this final EIS (see Appendix B, Public Comments and TVA Responses).

Some individuals stated a preference for certain alternatives presented in the draft EIS, while others expressed concerns about TVA's purpose and need for the proposal; effects on certain environmental resources, including historic buildings and structures, health and safety, socioeconomics, and environmental justice; specific future land uses; the role of the Master Plan and how and when it would be developed; and the adequacy of the review. Agencies expressed concerns primarily about effects on environmental resources, lack of project details of future land uses, cumulative effects analysis, and health and safety (see Appendix B). No new issues were raised during the comment period. However, as a result of the comments, TVA made several changes to the final EIS.

Some comments on the draft EIS suggested that TVA was not giving appropriate consideration to its stewardship responsibilities as it relates to the potential to sell and allow redevelopment of the MSR study area property. TVA has prepared a Natural Resource Plan, with accompanying EIS, to establish a strategy for managing its environmental stewardship projects (biological, cultural, recreation, and water resources) over the next 20 years. The final plan and EIS can be viewed at http://www.tva.gov/environment/reports/nrp/index.htm.

1.6 Other Pertinent Environmental Reviews or Documentation

The following environmental reviews are relevant to the proposed action, given the local and regional nature of anticipated effects of the proposed disposal and redevelopment. These reviews address actions in the vicinity of the MSR study area. Several include a review and evaluation of issues and impacts similar to those addressed in this EIS, which relies upon or tiers from information contained in these documents.

Pickwick Reservoir Land Management Plan Final Environmental Impact Statement (TVA 2002)
This environmental review updated the 1981 *Pickwick Reservoir Land Management Plan* (TVA 1981) for TVA-managed public land on Pickwick Reservoir in Alabama, Mississippi, and Tennessee. It also allocated additional unplanned land not considered in the 1981 plan. The 2002 EIS also reflected new information and TVA policies, and serves as a guide for land use approvals, water use facility permitting, and resource management on Pickwick Reservoir. The EIS evaluated three alternative land plans. Under the selected alternative, the 19,237 acres planned are allocated as follows: 16,291 acres as natural resource conservation (Zone 4), sensitive resource management (Zone 3), and TVA project operations (Zone 2); 1,327 acres as developed recreation (Zone 6) uses such as marinas, campgrounds, parks, and boat ramps; 1,085 acres as residential lake access (Zone 7), and 534 acres as industrial or commercial use (Zone 5). The final EIS may be viewed at http://www.tva.gov/environment/reports/pickwickplan/index.htm. The MSR is not considered reservoir property and was not included in this plan.

Muscle Shoals/Wilson Dam Reservation Land Use Plan Final Environmental Assessment (TVA 1996)
In 1996, TVA developed the *Muscle Shoals/Wilson Dam Reservation Land Use Plan*. This planning effort focused on identifying how much of both reservations, totaling approximately 3,040 acres, was needed for TVA use. It also identified portions of the reservations that could be made available for use by others to meet non-TVA needs. As a result of public input, a large percentage of the land, particularly on the north side of Reservation Road, was allocated for public recreation and open space (see Section 2.1.1). In this plan, most of the land south of Reservation Road was allocated to ERC-related uses, and about 12 acres were allocated for non-TVA regional economic development opportunities. Of those 12 acres, a 3-acre tract of land in Florence, north of the Tennessee River, is occupied by the Marriott Shoals Hotel and Spa and Convention Center (formerly Renaissance Tower). The other remaining TVA property allocated for development opportunities is a 9-acre parcel of land in Sheffield that lies near an electrical substation, just west of Hatch Boulevard and north of Second Street.

The continued use of this land use plan represents the No Action Alternative in the current EIS, and land outside the current MSR study area would remain subject to this plan until superseded by a future planning effort (see Section 2.1.1).

Final Environmental Impact Statement: Patton Island Bridge and Approaches Crossing the Tennessee River and Connecting the Cities of Florence and Muscle Shoals, Lauderdale and Colbert Counties (Federal Highway Administration [FHWA] 1991)
In 1991, the FHWA issued a final EIS on the Patton Island Bridge project (now known as Singing River Bridge). TVA was a cooperating agency in the preparation of this document. Subsequently, TVA issued a ROD on September 20, 1994, on its decision to provide a permanent easement over 63.7 acres of TVA-managed public land for the bridge and highway approaches, and to provide approval under Section 26a of the TVA Act for the bridge over the Tennessee River at Tennessee River Mile (TRM) 258. The final EIS concluded that implementation of the Patton Island Bridge project would not have substantial land use impacts. The south shoreline of Patton Island was found to be a valuable fish spawning area and mussel sanctuary. Mussels, federally listed as

endangered, inhabiting the Tennessee River in the vicinity of the bridge were relocated to a suitable area prior to the placement of bridge piers. No adverse impacts to aquatic resources were expected from implementing the project as long as best management practices (BMPs) were used to control erosion and sedimentation.

Bridge construction was completed in 2002. This six-lane bridge, connecting Muscle Shoals and Florence via SR 133, provides an improved level of service (LOS) and safety and an increased volume of traffic. Compared to O'Neal Bridge (North Jackson Highway) and Wilson Dam (via northeast Wilson Dam Road), it also provides greater accessibility from Colbert and Lauderdale counties along this reach of the Tennessee River.

City of Florence, Alabama, Wastewater Treatment Plant Expansion Environmental Assessment (TVA 1997)
The City of Florence, Alabama, requested that TVA grant a permanent easement over approximately 121.8 acres of TVA public land abutting the Cypress Creek Wastewater Treatment Plant for the purpose of making improvements in the facility. The requested land is part of the area identified in the *Pickwick Reservoir Land Management Plan* (TVA 1981) as Planned Tracts XPR-74PT and XPR-75PT (Parcel No. 33 in TVA 2002). The environmental assessment (EA) analyzed the environmental consequences of two alternatives: the No Action Alternative and the proposed Action Alternative to upgrade the existing facility by adding an additional 20 million gallons per day (MGD) of wastewater treatment capacity. The EA concluded that implementation of the proposed Action Alternative would not result in significant impacts. TVA selected the Action Alternative, and the proposed upgrades, in anticipation of continued development and growth in the Florence area, have been completed.

Florence Wagon Works Site Remediation at Pickwick Reservoir, Wilson Dam Reservation Environmental Assessment (TVA 1998a)
This EA evaluated the environmental impacts of TVA's proposed corrective action plan and alternatives to conduct remediation at the former site of the Florence Wagon Works (FWW). The FWW site is located on TVA-managed reservoir land in Lauderdale County, Alabama, in the city of Florence on the north bank of the Tennessee River at TRM 258.6R (right bank). Lead contamination was identified at the site in the fall of 1994 during a preliminary survey of the area for a proposed historic riverside trail route. The contamination at the site was caused by paint and other chemicals used during the operation of the FWW plant. The EA describes and documents the health and ecological basis for TVA's decision and evaluates the environmental consequences of the proposed corrective action and alternatives. The proposed remediation action was designed to reduce the level of lead (the principal chemical of potential concern) below the health-based cleanup level of 500 parts per million (ppm). This work has been completed.

Barton Industrial Site Environmental Assessment (TVA 1998b)
This EA evaluated the environmental effects of developing the Barton industrial site as an industrial park. TVA proposed to lend $1.85 million to the Shoals Economic Development Authority (SEDA) for the purchase and development of a 1,284-acre industrial site at Barton, Alabama, 12 miles west of Tuscumbia in western Colbert County. Future development would be based on specific projects centered on industries proposing to locate in the park.

Barton Site Expansion Environmental Assessment (TVA 1999)
This EA evaluated the environmental impacts of expanding the Barton industrial site. TVA proposed to lend SEDA $560,000 of Economic Development Loan funds to refinance the purchase of two parcels of land known as the McWilliams property and the Blankenship property (approximately 320 acres). These parcels bordered the Barton industrial site in Colbert County, Alabama. TVA also proposed to issue Section 26a approvals for the development of a port facility and to approve a permanent industrial easement for an access road and approximately 20 acres of TVA property needed to develop the port.

TVA made a loan from its Economic Development Loan Fund through SEDA for purchase of the Barton industrial site in 1996 for $1,910,000. TVA made a second loan in 2005 for $291,000 to the Colbert County Commission to purchase property at the Barton site.

This investment by TVA resulted in the creation of over $1 billion in investment and 750 new jobs at the Barton industrial site with the location of SCA Tissue and National Alabama Corporation, both international companies. These projects illustrate examples of TVA working with local government and community-based organizations in northwest Alabama to promote and encourage economic development initiatives.

Memphis to Atlanta Corridor Study, Mississippi/Alabama State Line to Interstate 65, Colbert, Franklin, Lauderdale, Lawrence, Limestone, and Morgan Counties, Project DPS - A002, Final Environmental Impact Statement (FHWA and Alabama Department of Transportation [ALDOT] 2003)
This EIS was prepared by the FHWA and ALDOT, and cooperating agencies included the National Park Service, U.S. Army Corps of Engineers (USACE), and TVA. The EIS assessed the impacts for a proposal to build a controlled access highway from the Mississippi/Alabama state line to Interstate 65, a distance of approximately 75 miles. Five alternative highway corridors were considered. Corridor A was selected as the preferred corridor. Four reasonable and feasible build alternatives were evaluated with respect to costs, social economic impacts, and environmental consequences. The Preferred Build Alternative, Alternative C1, crosses Redstone Arsenal and TVA properties on Pickwick, Wheeler, and Guntersville reservoirs. Implementation of Alternative C1 would require approval by TVA under Section 26a of the TVA Act and land use agreements for multiple parcels of TVA-managed land. If this project comes to fruition, it would provide a major interstate transportation route across North Alabama connecting two major cities. The preferred route would traverse the Muscle Shoals area along portions of existing U.S. Highway (US) 72. Lack of such a major transportation route is believed to be a contributing factor to the absence of development, particularly industrial development, in the area.

1.7 Potentially Necessary Federal and State Permits or Approvals

TVA is subject to the requirements of permits issued by the State of Alabama covering current use and operations on the MSR study area property. This includes a National Pollutant Discharge Elimination System (NPDES) Permit for point source discharge via the Central Ditch to Pond Creek and a RCRA postclosure permit for access control, maintenance, and certain monitoring associated with on-site cleanup of contaminated sites on the property completed in 2001. The RCRA Permit, AL3 640 090 004, is applicable to 2,260 acres of TVA-managed land and covers the entire MSR study area. TVA must renew it at 10-year intervals. The first renewal application was submitted to ADEM in May 2010. Following discussions with ADEM and a visual site inspection in October 2011, permit renewal approval is expected by mid-year 2012, after release of this final document.

The proposed land sale itself would not require TVA to acquire any permits or other federal approvals or authorizations. TVA would comply with applicable provisions of RCRA, including required coordination with ADEM, and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in disposing of the property.

The list below identifies regulations, programs, permits, approvals, or other authorizations from federal or state authorities that may be required of new property owners or developers:

- Approvals from TVA under Section 26a of the TVA Act are required for private or public development proposals that would affect Pond Creek, the Tennessee River, or their respective 100-year floodplains.
- Authorization(s) under Section 404 of the Clean Water Act (CWA) or Section 10 of the Rivers and Harbors Act, administered by the USACE, are required for disposal of dredge or fill material in waters of the U.S. or construction with the potential to obstruct navigation.
- ADEM administers the following programs under Title 22 Alabama Code, Chapters 22, 28, or 30, for which permits or other authorizations may also be required:

    1. Water quality certification under Section 401 of the CWA could be required of new property owners or developers as a part of the process required for permitting development in wetlands or waters of the U.S. or the state of Alabama.
    2. Under the General Permit for Construction Storm Water under Section 1342 (ADEM Administrative Code, Chapter 335-6-9) of the CWA, an operator/owner registration is required prior to any land-disturbing activity on the project site exceeding 1 acre and up to 5 acres in size in accordance with ADEM guidelines. Individual NPDES Permit coverage is required for disturbance of sites equal to or greater than 5 acres.
    3. An NPDES Permit would be required under Section 402 of the CWA for point source discharge into waters of the U.S. or state of Alabama.
    4. Underground storage tanks are regulated under RCRA.
    5. Underground injection control, regulated under the Safe Drinking Water Act, requires ADEM permits.
    6. ADEM's Division of Air Pollution Control Program administers the Clean Air Act, requires appropriate permits, and prescribes regulations to protect and enhance the public health and welfare through the development and implementation of coordinated statewide programs for the prevention, abatement, and control of air pollution.
    7. ADEM's Division of Solid Waste Program establishes criteria for the disposal of solid waste and the design, location, operation, closure and postclosure of landfill units.
    8. ADEM's Division of Hazardous Waste Program provides comprehensive management of the generation, transportation, treatment, storage, and disposal of hazardous wastes.

9. ADEM's Division of Brownfield Redevelopment and Voluntary Cleanup Program provides a mechanism for the implementation of a cleanup program that encourages applicants to voluntarily assess, remediate, and reuse rural and urban areas of actual or perceived contamination.
10. Authorization or permits would be required from ADEM, Colbert County Health Department, or other appropriate health department to install and operate septic system facilities.

- Local government agencies or offices may require approval of certain types of development, e.g., building permits and plats, in compliance with certain regulations, zoning laws, or other applicable ordinances.

CHAPTER 2

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

The alternatives for the sale and redevelopment of approximately 1,400 acres of MSR land and associated infrastructure are described in this chapter. Five Action Alternatives are evaluated in detail, along with the No Action Alternative. This chapter includes a description of these alternatives, a comparison of the alternatives and a summary of the potential environmental effects of implementing each alternative. The last section in this chapter identifies TVA's Preferred Alternative.

This final EIS contains a new Action Alternative and the definitions of Alternatives B through E have been changed somewhat from those in the draft EIS. Based on comments received on the draft EIS (see Appendix B), many readers misunderstood the Action Alternatives presented in the draft EIS and believed that TVA would actually restrict or limit future land uses under the Action Alternatives mentioned (e.g., Alternative C would only allow development for commercial, retail, and residential uses). In fact, an element common to all of the Action Alternatives presented in the draft EIS was that TVA would not allocate any MSR land for particular uses; those decisions would instead be determined under the Master Plan. The uses associated with each of the Action Alternatives were intended to be likely scenarios of the types of development that could occur in the future, rather than imposed uses. Regardless of the intent, the comments TVA received on the draft EIS made clear that the public misinterpreted this fundamental aspect of the Action Alternatives. In response to this misunderstanding, TVA has modified its Action Alternatives. Action Alternatives B through E now impose specific use requirements on MSR lands that TVA sells. TVA has also added a new Action Alternative (Alternative F, Unrestricted Land Use Alternative) that represents a future sale of the MSR study area without a requirement for any particular future land use. These changes in the alternatives are described in more detail below.

2.1 Alternatives

TVA proposes to dispose of approximately 1,400 acres of its MSR to allow redevelopment of the property by others. The MSR study area is surrounded by the cities of Sheffield, Muscle Shoals, Tuscumbia, and Florence. Redevelopment of the centrally located MSR study area, for the purposes of adjacent community growth and development, could reduce the need for the development of greenfield sites which would likely result in greater environmental impacts. TVA supports sustainable land uses, low-impact development (LID) (http://www.epa.gov/owow/NPS/lid/), and planning that promotes the smart growth goals of these cities. The proposed redevelopment would likely utilize the existing infrastructure and road systems and promote the development of a site that does not presently contribute directly to the tax bases of the local municipalities.

The six alternatives described below are intended to address a reasonable range of likely future land uses of the MSR study area. In this EIS, TVA evaluated the potential direct, indirect, and cumulative effects of disposal and redevelopment on resources in the development impact area and compared those anticipated effects. The Master Plan, being developed in concert with local governments and public input, would eventually be used under all of the Action Alternatives to guide the actual on-site development of the MSR study area.

The alternatives evaluated in this EIS include a No Action Alternative and five Action Alternatives. Under Alternative A, the No Action Alternative, TVA would not dispose of the MSR study area but would continue to use this part of the MSR for program purposes and potential development opportunities consistent with the 1996 Plan. Under the five Action Alternatives (Alternatives B, C, D, E, and F), TVA would declare the 1,400-acre MSR study area unnecessary to carry out future business plans and projects and would dispose of it for future development (see Section 1.3). It is TVA's intent to sell all of the 1,400-acre study area (with the exclusions as noted in Figure 1-2), although the sale may occur through multiple sales of portions of the area rather than through one sale of the entire area. TVA's preference would be to sell the property as a whole to a single buyer or entity. Under any of the Action Alternatives, TVA would dispose of and make available for sale the entire property but would consider selling it over time in parcels of presently unknown size or location.

For various reasons, including potential engineering or environmental constraints and economic drivers, some portion(s) of the property may not attract a buyer. If the entire property is not sold or transferred to a single purchaser initially, TVA will continue to manage any retained or unsold parcels in accordance with the 1996 Plan and may utilize these parcels in the interim during the anticipated 20-year plus development build-out period. TVA will continue to reexamine and evaluate its needs on the Reservation through regular and routine business planning and consider the unsold parcels while continuing to recognize their value and development potential. During its evaluations, TVA would consider among its objectives for the remaining property both adequate space for any expansion of TVA operations and the optimization of economic development in the area. Interim uses would likely represent ongoing TVA uses consistent with the 1996 Plan for the property, but they might also include other public or private uses or partnerships in accordance with specific use agreements, consistent with the Master Plan.

Under the Action Alternatives, the MSR study area would likely be sold at public auction in accordance with Section 31 of the TVA Act and would be developed in accordance with guidelines described in the Master Plan. The sale would not include the phosphate slag storage area, which may be made available by easement for a utility corridor only. TVA would also consider potential transfers of the property to other federal agencies, as appropriate and as consistent with the Master Plan. Under any of the Action Alternatives, TVA anticipates an approximate 20-year plus development build-out of this property.

Four of the Action Alternatives vary by the type of post-sale land uses required. These land uses range from conservation and LID uses under Alternative B to commercial, retail, and residential uses under Alternative C to industrial uses under Alternative D. Alternative E involves a required mixture of the land uses included under Alternatives B, C, and D above and generally described below. Under Alternative F, TVA would sell the 1,400-acre MSR study area with no particular required future land use. Although TVA would not require a particular type of future land use or uses under Alternative F, it is reasonably foreseeable that the property would be developed for one or more of those uses described in Action Alternatives B, C, D, and E. TVA believes that the property would likely be developed for mixed or multiple types of uses. Under any Action Alternative, the property would be subject to restrictions that are necessary to protect historic properties, mitigate other potential environmental impacts, protect TVA's statutory, programmatic, and other interests, and ensure continued ongoing operational requirements (see elements common to all Action Alternatives in this section).

If the TVA Board of Directors, or its designee, selects one of the Action Alternatives, the property would be transferred from federal ownership. Subsequent to its disposal, the property would be subject to local governmental provisions, including annexation, taxation, and other appropriate regulation.

TVA and/or the NACD would lead the development of the Master Plan and help facilitate further community involvement in the project. Under all the Action Alternatives, the Master Plan would be relied on to guide future land use decisions. Key considerations in developing the Master Plan would include appropriate site capability and suitability analyses and the avoidance of valued natural resources and incompatible land uses. The environmental information summarized in this EIS would be a key input to the process of developing the Master Plan. The Master Plan would be implemented by local governments, through zoning or other available means. Cooperation of the developer (the new owner) within the context of these guidelines is expected.

The following elements are common to all Action Alternatives:

1. Due to naturally occurring radiation inherent to the slag, TVA would make the land in the vicinity of the phosphate slag storage area available only as a utility corridor for construction, maintenance, and operation of utilities or other support facilities or infrastructure to the Tennessee River. No development of occupied facilities, such as housing, would be allowed. Currently, access to the phosphate slag storage area is restricted and limited to less than 500 hours per year per person; however, the area is suitable for infrastructure enhancements potentially necessary for development that could locate south of Reservation Road. TVA would not transfer this land for future development but would make it available under specific use agreements, such as easements. Because of environmental and reservoir operations constraints along the adjacent (south) bank of the Tennessee River, TVA would not approve a barge terminal, commercial dock, or other similar shoreline facility.
2. TVA would encourage the adaptive reuse of existing buildings and structures including those that possess historical values. Historic buildings and structures eligible for the NRHP and effects of future uses are addressed in a memorandum of agreement (MOA) with the State of Alabama to mitigate the potential loss of such properties or their eligibility. Such mitigation includes imposition of architectural controls and design guidelines on new owners and consideration of these properties in the Master Plan. TVA would adhere to required measures through inclusion of requirements in the transfer deed(s).
3. As a result of contaminants (e.g., lead paint, asbestos) potentially present in existing buildings and structures, including those that possess historical values, future remedial actions may need to be taken prior to or in the course of reuse or demolition of such buildings and structures. From the perspective of potential human exposure to contaminants, vacant buildings on the MSR study area have not been thoroughly assessed for the safety of future occupants. Prior to the transfer of buildings from federal ownership under any of the Action Alternatives, TVA would assure that any required environmental due diligence assessments on existing building interiors (i.e., construction materials) are completed.
4. TVA would retain the four SWMU areas that are being managed under the current RCRA postclosure permit. Under the ADEM RCRA Permit, these four SWMU areas

have long-term monitoring requirements and restrictions on use. In addition, TVA would retain in the deed, transfer, or other conveyance document access rights necessary for the purpose of meeting these long-term monitoring requirements and conducting groundwater monitoring and visual inspections of these areas.

5. Approximately 17 acres of land has been remediated (i.e., cleaned up) to industrial screening levels. No land within the area covered by the existing RCRA Permit (2,260 acres), which includes these 17 acres, would be sold or transferred from federal ownership unless the land is conveyed at the unrestricted use level or with the appropriate environmental covenants and restrictions in the deed, transfer, or other conveyance document.
6. TVA would not allow removal of groundwater for drinking water (i.e., potable use purposes) from anywhere on the MSR study area. Furthermore, TVA would advise potential buyers that, prior to construction of enclosed structures, soil gas data should be collected from above the water table in areas of historical volatile organic compounds (VOCs) contamination of groundwater to determine if a pathway for vapor intrusion is present.
7. TVA would only dispose of land within the limits of the 100-year floodplain with a covenant in the deed, transfer, or other conveyance document requiring that any proposal for future use be subject to TVA review and approval under Section 26a of the TVA Act prior to construction. Any proposals that would affect floodplains would be evaluated in accordance with Executive Order (EO) 11988.
8. TVA would only dispose of federal wetlands with a covenant in the deed, transfer, or other conveyance document requiring that any proposal for future use, whether or not they fall under TVA's Section 26a jurisdiction, would be subject to TVA review and approval prior to the placement of fill or construction. Such proposals would be evaluated in accordance with EO 11990.
9. A Master Plan would be produced by TVA, NACD, and/or other appropriate local, state, or federal authorities, with public input, to guide land use development in accordance with deed restrictions and applicable local laws, regulations, and ordinances. TVA would assure development of and ultimately approve the Master Plan.
10. License agreements with TVA would be canceled prior to transfer of the property, but a new owner(s) may choose to continue those uses under new licenses or agreements.
11. A 1-mile segment of the paved National Recreation Trail Complex extending south of Reservation Road could be affected by future development under any of the Action Alternatives. Therefore, prior to any transfer of the affected land from federal ownership, TVA would consult with ALDOT and FHWA to obtain the needed written authorization. A prorated share of revenues would also be dispersed to these agencies as appropriate upon sale of the affected property.
12. TVA would include in any deed, transfer, or other conveyance document any such restrictions, conditions, and covenants deemed necessary to protect TVA's statutory, programmatic, and other interests.
13. Under any of the Action Alternatives, the remaining 1,640 acres of Muscle Shoals/Wilson Dam Reservation land outside the MSR study area would continue to be managed by TVA in accordance with the 1996 Plan.

14. Under all the Action Alternatives, TVA would encourage inclusion of all segments of the population representative of the Muscle Shoals community and Colbert and Lauderdale counties to participate in the comprehensive master planning process to help assure equitable distribution of the benefits from development of the Reservation property.

2.1.1 Alternative A – The No Action Alternative

Under the No Action Alternative, TVA would not declare the MSR study area surplus to its needs. The property would not be sold or transferred but would remain in federal ownership under the custody and control of TVA. If Alternative A were selected, TVA would continue to manage the property in the MSR study area and utilize portions for program purposes and regional economic development partnerships consistent with the 1996 Plan allocations unless and until it is superseded by another plan at some future time. If other future land sales, transfers, or disposal actions were considered by TVA, those actions would require independent environmental reviews at that time.

TVA would likely continue its current invasive species removal plan for control of invasive plant species on the Reservation and would allow The American Chestnut Foundation (TACF) research to continue. Visual buffers established along roads and trails and the vegetative buffer established along the Pond Creek corridor would remain. There would be no change in the public recreation and open space presently available on the Reservation north of Reservation Road. Although TVA would continue its required monitoring program, the potential for existing solid and hazardous waste facilities to impact groundwater would continue. Because current land uses would likely remain the same, hazards to people from exposure to contaminants are not expected to change. Agricultural use licenses over approximately 182 acres of land on the MSR study area would likely continue in accordance with their terms. The land use allocations shown in Figure 2-1 would remain unchanged and in effect under Alternative A.

2.1.2 Alternative B – Conservation Alternative

Under Alternative B, TVA would declare the 1,400-acre MSR study area surplus to its needs and sell it with the requirement that it be used in the future only for conservation of natural resources and/or for sustainable LID. Other types of land uses, such as heavy industry, residential development, and commercial development, would not be allowed.

Types of LID likely under this alternative include those that generate minimal waste streams and have a small environmental footprint. Thus, the reuse of existing buildings and infrastructure would be preferred over new construction under this alternative. Likewise, any new construction would occur preferably on previously disturbed sites (brownfield sites) or impervious surfaces rather than on “greenfield” sites. TVA would encourage any new construction to incorporate green building principles, i.e., Leadership in Engineering and Environmental Design Certification, green infrastructure or LID (http://www.usgbc.org/), perhaps through its involvement in the Master Plan development process.

Under this alternative, some natural resources could be integrated into an overall conservation theme. This could involve inclusion of some land with valued resources, such as streams, floodplains, wetlands, woodlots, and grasslands, into areas of future parks, visual or noise buffers, or green space. On-site developments including new building and construction such as office or business complexes, educational institutions, or light industry (i.e., tertiary and quaternary industry -- see general description in Section 2.1.4) could incorporate LID practices into their integrated design. This could include development site

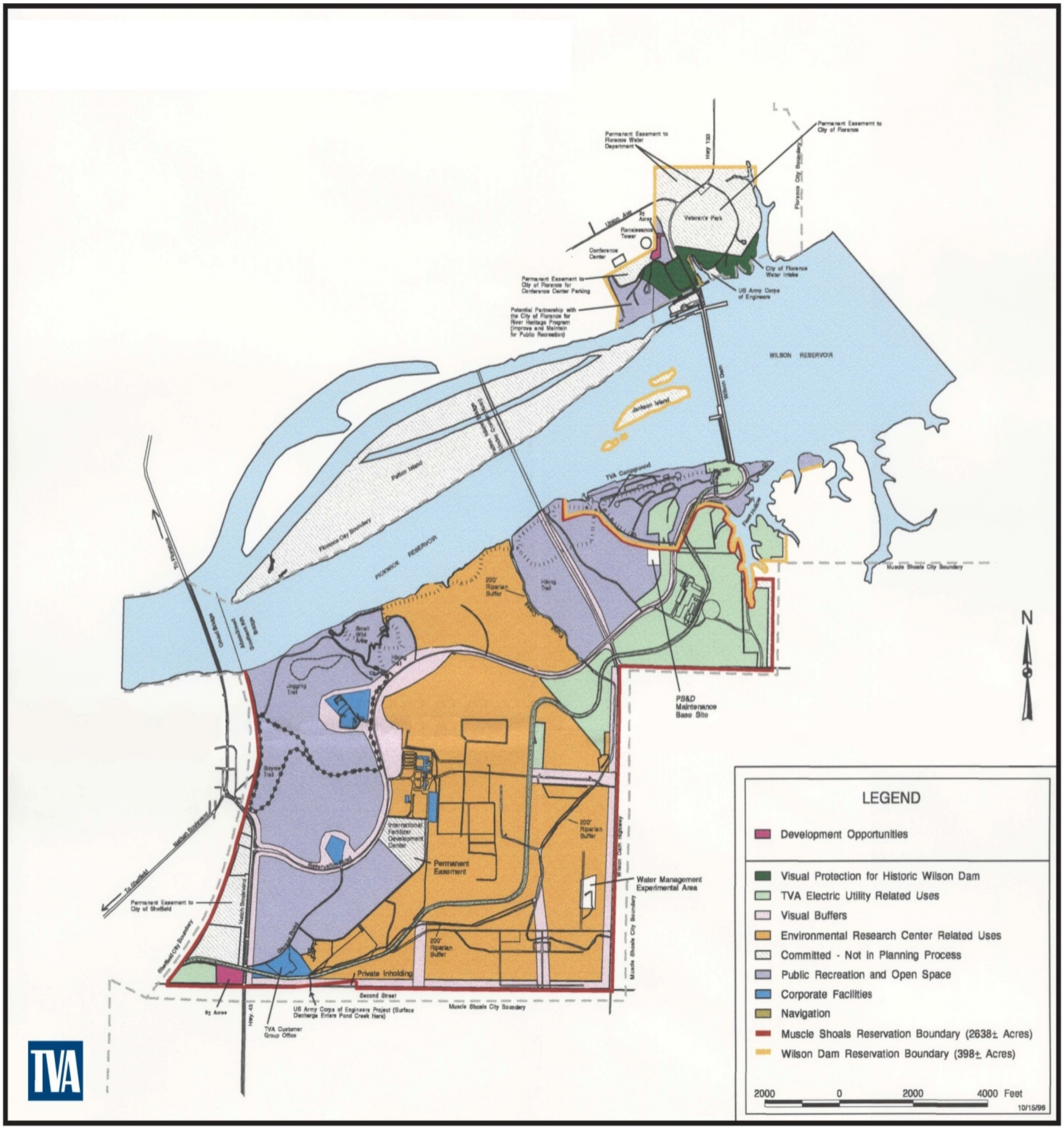


Figure 2-1. Land Allocations in the 1996 Muscle Shoals/Wilson Dam Reservation Land Use Plan

planning, hydrological analysis, integrated management, sediment and erosion control, and public outreach.

See Section 2.1 for the elements common to all the Action Alternatives. These elements include special provisions, commitments, directives or mitigation measures that TVA would assure are implemented regardless of the Action Alternative chosen.

Typical examples of future land uses under this alternative could include:

- Recreation opportunities including parks, greenways, and trails
- Nature and historic interpretation
- Open green space
- Wildlife viewing and management
- Botanical gardens
- Nursery and horticultural production areas
- Green energy research and development
- Environmental education
- Ecotourism

Uses would be focused on the types of sustainable development known to be compatible with existing resources and other environmental amenities that occur on or near the MSR study area, including historic buildings and structures, fields and forests, wetlands, and wildlife and their habitats.

Under Alternative B, there would likely be more open green space than developed areas. Conservation and recreation uses that currently occur on the property including wetlands, floodplains, wildlife habitat, farmland, TACF Research Orchard, Pond Creek, nature trails, birding, and other green space areas would likely remain under this alternative. Invasive species such as kudzu and Chinese privet that dominate understory vegetation in some areas could be controlled by continuing partnerships with local volunteers.

2.1.3 Alternative C – Commercial, Retail, and Residential Alternative

Under Alternative C, TVA would declare the 1,400-acre MSR study area surplus and sell it with the requirement that it be used in the future only for a mixture of commercial, retail, and residential uses. Other uses (e.g., heavy industrial uses) would be prohibited.

See Section 2.1 for the elements common to all the Action Alternatives. Typical examples of future land uses likely under this alternative could include:

- High-density businesses
- Malls
- Theaters
- Government buildings
- Health care institutions and medical facilities
- Restaurants
- Department stores
- Convenience stores
- Car washes
- Gas stations
- Miniwarehouses or self-storage buildings

- Residential buildings and structures
- Retail shopping center developments
- Community centers
- Religious and educational institutions

Uses might also include lower-density commercial recreation facilities such as resorts, athletic fields, stadiums, campgrounds, fairgrounds, and parks.

Various types of home sites and residential developments from lower-density, single-family residential-dwelling types to high-density multifamily (e.g., duplexes, townhouses, condominiums, and apartments) dwellings would be considered appropriate under this alternative. Depending on the extent of on-site development, expansion of existing infrastructure (i.e., electric, water, sewer, or gas lines, and roads) could be necessary.

Under Alternative C, most of the MSR study area is suitable for commercial, retail, and residential uses. Consequently, it could take on a suburban or urban character.

2.1.4 Alternative D – Industrial Alternative

Under Alternative D, TVA would declare the 1,400-acre MSR study area surplus to its needs and sell it with the requirement that it be used in the future only for industrial development purposes. Other uses, including residential, commercial, retail, and conservation, would not be allowed. See Section 2.1 for the elements common to all the Action Alternatives.

Industry can be generally defined as any type of economic activity producing goods or services for consumers. It is generally part of a chain—from raw materials to finished product, finished product to service sector, and service sector to consumer. Types of industry include primary, secondary, tertiary, and quaternary. Primary industry generally involves obtaining raw materials or securing natural resources and includes such activities as quarrying, mining, growing (farming), forestry (harvesting), or aquaculture (fishing).

Secondary industry generally involves producing a product from primary industry that is processed or manufactured into another product. Examples of processing of raw materials (where raw materials are changed into something different) include milling metals from ores, refining oil, meat processing, lumber milling, metal fabrication, wheat or corn processing, and road and home construction.

Tertiary industry provides a service. It can involve a wide range of services instead of making a product. Typical examples of service industries include distribution and transportation; construction; processing and packaging of goods; and various institutional and government services such as civil service, educational administration, and fire and police protection.

Quaternary industry generally involves a small group of research and development industries. It is considered the newest industrial sector (often linked with tertiary) and is growing rapidly due to developments in information technology and communication. Research and development focuses on ideas for new products and improvements to existing ones. It focuses on the latest technology, and examples include designing new computers, researching new medicines and medical equipment, genetically modifying plants and animals for farming and other purposes, new forms of communication through satellites and fiber optics, and green technology and other energy research and development.

Although primary industrial use is much less likely to occur on the MSR study area because of the lack of exploitable resources, potential environmental constraints, and public opposition, any of the types of industrial uses described above could occur on the property at some future time at any location. Depending on the extent of on-site development, expansion of existing utility infrastructure (i.e., electric, water, sewer, or gas lines, and roads) could be necessary. Under Alternative D, the utility corridor, designed to accommodate this infrastructure, would have a greater probability, particularly as compared to Alternatives B and C, of being needed to support the industries located on the south side of Reservation Road.

All land within the MSR study area could be used for industrial purposes, including the utility corridor (see Section 4.1.1). Under this alternative, the amount of land actually used or required by future industries could vary from a few hundred acres to the entire MSR study area. Depending on the number of industries and the extent of industrial development, the character of the MSR study area could range from that of a maintained open area with some industrial development to that of an industrial park.

2.1.5 Alternative E – Mixed Use Alternative

Under Alternative E, TVA would declare the 1,400-acre MSR study area surplus to its needs and sell it with the requirement that it be used for a mixture of the following uses:

- Conservation and sustainable LID
- Commercial, retail, and residential uses
- Industrial uses

Potential site development under this alternative would generally include the mixture of land uses described under Alternatives B through D above. Because a singular use would be required under Alternatives B and D, conservation and LID and industrial development, respectively, would likely be accommodated in proportionally smaller areas under Alternative E. Similarly, commercial, retail, and residential land use would also likely be proportionally less than under Alternative C. Because of the likelihood of a variety of well-planned land uses and potentially extensive use of the MSR study area, expansion of existing utility and transportation infrastructure (i.e., electric, water, sewer, or gas lines, and roads) could be necessary. This could include use of the utility corridor in the vicinity of the phosphate slag storage area. See Section 2.1 for the elements common to all the Action Alternatives.

2.1.6 Alternative F – Unrestricted Land Use Alternative

Under Alternative F, TVA would declare the 1,400-acre MSR study area surplus and dispose of the property without land use restrictions other than those designed to protect TVA's program interests or to meet legal or environmental requirements (see elements common to all Action Alternatives in Section 2.1). TVA would not specify that land on the MSR study area be used for a particular purpose, but instead would allow future uses on the property to be driven by environmental resources and constraints taken into account in development of the Master Plan and subsequent local zoning laws or other appropriate land use ordinances.

Under this alternative, the future uses of the property are likely to be a combination of those uses described in Action Alternatives B, C, D, and E. Although TVA would not require a particular type of land use or uses under Alternative F, the property would be used or developed for one or more of those reasonably foreseeable uses. Based on varied suitable uses of the property, market conditions, potential resource conflicts, the sample conceptual master plan prepared by Lord Aeck Sargent, public comments received on the draft EIS, and other relevant information, the most likely future use of the property appears to be a mixture of uses similar to those reflected in Alternative E. Thus, those same uses would likely occur under Alternative F even in the absence of a specific deed provisions requiring such uses.

2.2 Comparison of Alternatives

Regardless of the alternative selected, some resources would not be directly adversely affected by the proposed land sale and subsequent development. However, other resources would likely be affected directly or indirectly in a minor to moderate degree across the range of alternatives. In addition, some resources would be affected, even potentially significantly so, and mitigation could be required to avoid, reduce, rectify, minimize, compensate, or mitigate losses of resources, values, or associated uses. The following paragraphs provide a comparison of effects on various resources and explain how each alternative type of land use development could affect the resource. Table 2-1, which follows the comparison, displays a summary of potential effects by alternative.

Under Alternative A, No Action, the MSR study area would remain in federal ownership, and current land uses are not likely to change for the foreseeable future. Any future proposals for use consistent with the 1996 Plan would likely require additional environmental reviews. TVA would retain and continue to monitor certain SWMU areas and comply with ADEM regulations (see Section 2.1). Management and use of other areas of remnant waste and SWMUs would continue in accordance with applicable regulations including some additional waste stream generation and waste disposal. Groundwater monitoring would continue, and the potential for local effects could continue; however, no off-site impacts are expected. NRHP-eligible historic properties (i.e., buildings, structures, and archaeological sites) would remain in TVA ownership and management, and many would likely remain unused. Some unoccupied buildings and structures could continue to deteriorate and become an environmental or safety concern. No additional socioeconomic benefits would likely be recognized. Land under agricultural use license would probably remain available for sod crop production, thus maintaining some productive use of prime farmland on the Reservation. Because of pollutants entering upstream as well as regulated discharge, surface water quality in Pond Creek would likely remain poor and potentially unchanged. Current recreational opportunities, including birding, walking, jogging, and hiking, would continue to be available on accessible parts of the MSR study area. Vegetation and invasive plant management, and control activities are expected to continue. Environmental amenities such as aquatic life, threatened and endangered species, wetlands, floodplains; visual and naturally appearing landscape character; and terrestrial wildlife and their habitats would generally remain unchanged or continue under present management in accordance with the 1996 Plan. Without some roadway improvements, transportation and related traffic congestion, particularly at major intersections, are expected to grow increasingly worse over the next 20 years (or Action Alternatives build-out period) even under Alternative A. Visual resources would likely remain unaffected, and noise levels could likely gradually increase with corresponding level of traffic.

Under Alternative B, the MSR study area would be sold, and the new owner(s) would be required to use the property for conservation purposes and LID. There would be a deliberate emphasis on protecting and maintaining sensitive resources such as wetlands and historic properties. TVA would continue to manage monitored SWMU areas. SWMUs cleaned up to industrial screening levels could be sold for appropriate development or reuse. Under this alternative, the likelihood of additional on-site contamination from site development is low. With adherence to applicable restrictions, the likelihood of additional exposure to hazardous material would similarly be low. Groundwater extraction from the MSR study area for drinking water usage would be prohibited under this and all the Action Alternatives (i.e., Alternatives B through F). Compared to the other Action Alternatives, the activities and development under this alternative would likely require the least amount of land use change and intensity of development. A greater amount of green space, naturally appearing landscape character, and recreation opportunity, probably substantially more, would be available under this alternative compared to the other Action Alternatives. More emphasis on invasive plant and wildlife habitat could become a management focus. In compliance with Section 106 of the NHPA, adverse effects on archaeological and architectural resources are subject to mitigation under stipulations included in an MOA between TVA and the Alabama SHPO (Appendix A). TVA is encouraging adaptive reuse of certain historic buildings under all the Action Alternatives. The impacts of implementing Alternative B on air quality are expected to be similar to or slightly greater than those likely under Alternative A but less than those expected under Alternatives C, D, E, and F. Implementing Alternative B would have a beneficial effect on the anticipated amount of greenhouse gases (GHG) and any contribution to cumulative global climate change (GCC).

Land use change is expected to be less under Alternative B compared to Alternative C, D, E, or F. Other than the potential for positive quality of life impacts, socioeconomic benefits would likely be minor. Disproportionate impacts to disadvantaged populations would be less than those under Alternative C; they potentially could be greater than the effects likely under Alternatives A, D, E, and F. Current recreational opportunities, including birding, walking, jogging, and hiking, could continue to be available in accessible areas. Vegetation and invasive plant management and control activities are expected to continue.

Areas of wetlands and floodplains would only be developed consistent with EO 11990 and EO 11988 under all the Action Alternatives. Environmental amenities such as aquatic life and threatened and endangered species in the Tennessee River would not be affected. The visually pleasing and naturally appearing landscape character on the study area and terrestrial wildlife and their habitats could generally continue somewhat unaffected in less disturbed areas. The designated natural area (Old First Quarters Small Wild Area [SWA]), as described in Section 4.15, would not be directly affected. Without some roadway improvements, transportation and related traffic congestion would worsen, in some cases significantly, as described under all the alternatives.

Because only conservation and sustainable LID would be allowed under Alternative B, the production of waste streams would likely be less than from implementation of other development alternatives, particularly industries that could locate on the MSR study area under Alternatives D, E, and F. Nevertheless, anticipated uses under Alternative B would likely result in low risks of direct, indirect, or off-site and cumulative impacts.

Under Alternative C, the MSR study area would be sold, and TVA would require that the property be used for commercial, retail, and residential purposes. Some open green space would probably be designed into the landscape; however, industrial uses would not occur.

Development anticipated under Alternative C would generate solid wastes, but the amount of hazardous wastes would likely be minor and the potential for on-site contamination would be low. The opportunity for exposure to remaining on-site contaminants would be greater under Alternative C compared to Alternatives A and B but potentially the same or less than that likely under Alternatives D, E, and F. Mitigation, including the potential for additional cleanup of some previously remediated SWMUs, and the potential for additional evaluation and study would further reduce this potential risk.

Overall, because most of the development would likely be a transfer of locations within the area and would add little new development for outside the area to the overall economy of the area, the potential economic effects under Alternative C would be minor. Because most of the development would otherwise occur elsewhere in the local area, few new employment opportunities for minority or low-income individuals would result; thus, this alternative would likely have the greatest disproportionate impact on those populations. Implementation of Alternative C could likely have greater impacts on land use than Alternatives A and B but less than those expected if Alternative D, E, or F were implemented.

The combination of uses allowed under Alternative C could result in low to moderate risks of direct, indirect, or off-site and cumulative impacts. Under Alternative C, impacts from emissions of pollutants would likely be less than or similar to those likely under Alternatives D, E, and F. However, the combination of commercial, retail, and residential use development would result in greater impacts compared to Alternative B. The potential for use of the utility corridor for construction of utilities or other support facilities or infrastructure would likely be reduced compared to Alternatives D, E, and F but would remain higher compared to Alternative B. It is unlikely that this utility corridor could be needed under Alternative B or C.

Under Alternative D, the MSR study area would be sold with the stipulation that it would be used for industrial purposes. The potential for generation of wastes, including hazardous waste, would likely be greater under Alternative D than under the other Action Alternatives. The likelihood of additional on-site contaminant generation (i.e., waste streams) would likely be highest under this alternative compared to the other Action Alternatives. Because all land within the MSR study area has been extensively investigated and, as appropriate, sampled, assessed, and remediated where necessary to industrial screening levels and because only industrial uses would occur, no additional cleanup would likely be required or anticipated under this alternative. Furthermore, because industrial-type developments would likely provide short-term employee occupancy substantially isolated from soil contact, no increased human health or environmental exposure risks are anticipated.

Because investors (i.e., new money) from outside the area or region could be attracted to the site and the immediate area, implementing Alternative D would likely have the greatest overall economic effects and could result in additional opportunities for growth. Increases in employment and income under Alternative D are likely to be moderate to large. However, under this alternative, there could be some decrease in the overall attractiveness of the area, with a corresponding negative impact on the quality of life due to increased traffic, noise, and congestion and the loss of scenic and recreation opportunities in the area. Overall, disproportionate impacts to minority and low-income individuals would be less than those under Alternatives B and C, but greater than those under Alternative E or F.

Anticipated uses under Alternative D would likely result in moderate to high risks of direct, indirect, and cumulative impacts. These types of uses would likely result in the greatest potential impacts from air, land, and water emissions compared to the other alternatives. Because there would be more site disturbance from construction and some operational effects, industrial development would result in greater overall environmental impacts compared to Alternative B, C, E, or F. The potential for use of the utility corridor for construction of utilities or other support facilities or infrastructure would likely be highest under this alternative compared to anticipated uses under the other Action Alternatives.

Under Alternative E, the MSR study area would be sold with the requirement that it would be used for a mixture of conservation and LID; commercial, retail, and residential; and industrial purposes. This mixture of site development would generate solid waste, and some hazardous wastes could be produced as a result of industrial by-products. However, the generation of large quantities of hazardous waste is not likely, and the potential for additional site contamination from development is relatively low. Mitigation, including the possible need for additional cleanup of some land, and the potential for additional evaluation and study would further reduce this potential risk. Most of the land could be developed for any type of land use and, thus, require no additional cleanup.

Well-designed business and industrial facilities would provide increased income and job opportunities while maintaining and possibly enhancing the overall attractiveness of the area. Increases in employment and income under Alternative E are likely to be moderate. The development activities following adoption of Alternative E would provide a similar increase in employment opportunities for minority and low-income individuals as described under Alternatives C and D. Scenic values and recreation opportunities would continue to contribute to quality of life in the area. Therefore, disproportionate impacts to minority and low-income populations would be smallest under this alternative and likely as well as under Alternative F.

Such development could likely result in moderate to high risks of direct, indirect, or off-site and cumulative impacts. Because there would be more site disturbance from construction and some operational effects, mixed use development under this alternative would result in greater impacts compared to Alternative B. The potential use of the utility corridor for construction of utilities, other support facilities, or infrastructures would likely be similar to Alternatives D and F. Less open green space would likely be retained as compared to Alternative B but potentially more than that likely under Alternatives C and D.

Under Alternative F, the MSR study area would be sold, but no restrictions would be placed on its future land uses. As discussed earlier, under Alternative F, the property would likely be used or developed for one or more of the uses described under Alternative B, C, or D or the mixture of land uses under Alternative E. Therefore, impacts of development under Alternative F are likely to be similar to those described under Alternative E above and the range of effects bounded by those described under Action Alternatives B, C, D, and E.

Table 2-1. Summary of Potential Effects by Alternative[1]

Resource Issues	Alternative A (No Action)	Alternative B (Conservation)	Alternative C (Commercial/Retail and Residential)	Alternative D (Industrial)	Alternative E (Mixed Use)
		Alternative F (Unrestricted Use)			
Solid and Hazardous Waste: Zone A[2] (approximately 300 acres including monitored SWMUs)	Negligible	Potential indirect beneficial effects if Zone A is used for certain low-impact development	Potentially significant impacts; could require additional remediation for commercial, retail, or residential uses	Minor if used for industrial purposes	Potentially significant impacts; could require additional remediation for commercial, retail, or residential uses
Solid and Hazardous Waste: Zone B (approximately 90 acres at phosphate storage area)	Negligible	Use of utility corridor unlikely under Alternative B; if proposed, project would be evaluated the same as under Alternative D, E, or F	Use of utility corridor unlikely under Alternative C; if proposed, project would be evaluated the same as under Alternative D, E, or F	Potentially significant health effects unless personal exposure is limited to no more than 500 hours per year; if proposed, projects would be evaluated for potential worker exposure	
Solid and Hazardous Waste: Zone C (approximately 1,000 acres where contamination is not known to occur)	Negligible	Minor impacts with low potential for exposure to any remaining contaminants	Minor impacts with low potential for exposure to any remaining contaminants	No increased human health or environmental exposure risks would be anticipated	Minor impacts with low potential for exposure to any remaining contaminants

Resource Issues	Alternative A (No Action)	Alternative B (Conservation)	Alternative C (Commercial/Retail and Residential)	Alternative D (Industrial)	Alternative E (Mixed Use)
		Alternative F (Unrestricted Use)			
Solid and Hazardous Waste: Zone D (approximate 100-foot-by-100-foot area used as a low-level radioactive waste burial site)	Negligible	Impacts minor and similar to those in Zone C unless there is subsurface soil disturbance			
Geology	No changes in existing geological conditions	No impacts likely; development would likely occur in areas where the local geology would be unaffected	Increased potential for groundwater changes; no adverse impacts; development would likely occur in areas where the local geology would be unaffected	No adverse impacts; development would likely occur in areas where the local geology would be unaffected; could possibly result in greater or likely similar impacts as Alternative C	No adverse impacts; development would likely occur in areas where the local geology would be unaffected; less impact to geological resources than Alternative C or D
Groundwater	Minor effects (no evidence of adverse impacts to potential off-site groundwater users or other receptors)	No adverse effects on health and safety; TVA will not allow removal of groundwater for drinking water from anywhere on the MSR study area under any of the Action Alternatives; some potential for contamination from spills or leaks under Alternative D			

Resource Issues	Alternative A (No Action)	Alternative B (Conservation)	Alternative C (Commercial/Retail and Residential)	Alternative D (Industrial)	Alternative E (Mixed Use)
		Alternative F (Unrestricted Use)			
Archaeological Resources	No adverse effects likely	Potential adverse effects to three archaeological sites and two cemeteries; two sites would be mitigated through stipulations in the MOA between TVA and the Alabama SHPO, and one site would be avoided; two cemeteries would be managed in accordance with state law			
Historic Resources (Architecture)	Future undertakings involving historic properties would be evaluated; conditions could worsen	Adverse impacts would be mitigated through applicable stipulations in MOA; adaptive reuse of buildings and structures addressed in agreement			
Socioeconomic Resources	No impact or change in current conditions; any potential benefit would be foregone	Minor impacts with potential quality of life benefits	Small (minor) positive effect	Significant increase in income and employment; impacts could be moderate to large with potentially negative quality of life influence	Potentially significant increase in income and employment; impacts could be moderate with potential quality of life benefits
Environmental Justice	No effects	Potential impacts would be small (minor); any disproportionate impacts would be less than under Alternative C and could be greater than the economic effects likely under	Potential impacts would be small (minor); Alternative C likely would have the greatest disproportionate impacts to minority and low-income populations	Potentially significant positive effects on local income and employment; all segments of population likely to benefit; disproportionate impacts to minority and low-income	Potentially significant increases in regional employment and income; increased employment opportunities for minority and low-income individuals; disproportionate impacts would be smallest under these alternatives

Resource Issues	Alternative A (No Action)	Alternative B (Conservation)	Alternative C (Commercial/Retail and Residential)	Alternative D (Industrial)	Alternative E (Mixed Use)
		Alternative F (Unrestricted Use)			
		Alternatives A, D, E, and F		individuals would be less than for Alternatives B and C, but greater than Alternatives E and F	
Land Use	Possible minor changes in current land use	Some changes; much green space and recreational opportunities likely retained; effects of LID could be further minimized if existing buildings are reused	Minor impacts; could likely have greater changes in land use than Alternatives A and B but less than expected under Alternative D, E, or F	Greater intensity but effects minor impacts in context; similar to those under Alternative C; overall, could have greater impacts than any of the other Action Alternatives	Minor impacts; could likely have greater impacts than Alternatives A and B but could be comparable to or perhaps less than those anticipated under Alternative C or D; effects of Alternatives E and F similar
Air Quality	No additional effects	Minor impacts; less than those associated with Alternative C, D, E, or F	Minor temporary effects from construction activities; potentially greater than Alternative A or B, likely less than Alternative D but similar to Alternatives E and F	Minor, no adverse, impacts with regulation; could be greater than Alternative A, B, C, E, or F	Minor impacts with regulation; potentially greater than Alternative A, B, or C; effects likely less than Alternative D
Global Climate Change	No incremental impacts expected	Increased vegetative cover could sequester carbon dioxide; minor climate change benefit	Increased emissions of greenhouse gases expected; could be greater than expected under Alternative A or B	Increased emissions of greenhouse gases expected; has the greatest potential not only to impact climate but also to be	Increased emissions of greenhouse gases expected similar to that under Alternative C

Resource Issues	Alternative A (No Action)	Alternative B (Conservation)	Alternative C (Commercial/Retail and Residential)	Alternative D (Industrial)	Alternative E (Mixed Use)
		Alternative F (Unrestricted Use)			
		expected if vegetation cover is increased	but less than under Alternatives D, E, and F	impacted by climate change	
Soils and Prime Farmland	No effects	Minor impacts	Minor impacts; higher potential for conversion of farmland to nonfarmland uses compared to Alternatives A and B	Minor impacts; greatest potential for impacts to soils and prime farmland	Minor impacts; similar to those under Alternatives C and potentially less than those under Alternative D
Surface Water Quality	No impacts	No significant impacts; presence of green space would reduce potential for introduction of runoff into surface waters	Minor impacts likely greater than those under Alternatives A and B	No significant impacts; similar to or potentially greater than those anticipated under Alternative C, E, or F	Insignificant impacts, similar but potentially less than those compared to Alternative C or D
Wetlands	No impacts	Minor impacts; least potential for effects among Action Alternatives	Minor impacts; greater potential to affect compared to Alternative A or B	Minor impacts; greater potential to affect compared to Alternative A or B; similar to effects under Alternative C, E, or F	Minor impacts; greater potential to affect compared to Alternative A or B; similar to effects under Alternative C or D
Floodplains	No impacts likely	Low potential for impacts	Minor impacts, potentially greater than effects likely under Alternative A or B	Minor and insignificant effects similar to those under Alternative C	Minor and insignificant impacts, potentially greater effects under Alternative A or B and similar to those expected under Alternative C or D

Resource Issues	Alternative A (No Action)	Alternative B (Conservation)	Alternative C (Commercial/Retail and Residential)	Alternative D (Industrial)	Alternative E (Mixed Use)
		Alternative F (Unrestricted Use)			
Aquatic Ecology - Fish and Aquatic Life	No impacts	No impacts likely	No impacts; potential for effects is greater than Alternative A or B and similar to that under Alternatives D, E, and F	No impacts; potential for effects is similar or slightly greater than those under Alternative C, E, or F	No impacts; potential is similar to Alternatives C and D
Aquatic Ecology - Aquatic Endangered and Threatened Species	No effects				
Terrestrial Ecology - Plants	No significant impacts	Potentially beneficial impacts	Loss of American chestnut orchard research could have significant effects on species restoration in the southern portion of its range; elimination of forested areas could adversely affect habitat capable of supporting two state-listed plants		
Terrestrial Ecology - Wildlife	No effects; no change in current conditions	Potential slight improvement in wildlife habitat and long-term availability of habitats	Minor impacts; local reduction of wildlife diversity; reduced amount and suitability of wildlife habitats compared to Alternative A or B	Moderate impacts; potentially similar to those under Alternative C; greater than those anticipated under Alternatives A and B and potentially similar or greater than those expected under Alternatives E and F	Minor impacts; greater than those under Alternatives A and B; potentially similar to those under Alternative C and less than those anticipated under Alternative D
Terrestrial Ecology - Endangered and Threatened	No effects on federally listed plants or animals	No effects on federally listed plants or animals	Potential negative effects on state-listed plant habitat; potential indirect	Potential negative effects on state-listed plant habitat; potential indirect effects on	Positive or negative effects on state-listed plant habitat could occur; potential indirect effects on federally listed animal habitats and no effects

Resource Issues	Alternative A (No Action)	Alternative B (Conservation)	Alternative C (Commercial/Retail and Residential)	Alternative D (Industrial)	Alternative E (Mixed Use)
		Alternative F (Unrestricted Use)			
Species			effects on federally listed animal habitats; no effects on any federally endangered or threatened animals or plants or designated critical habitat	federally listed animal habitats; no effects on any federally endangered or threatened animals or plants or designated critical habitat	on any federally endangered or threatened animals or plants or designated critical habitat (same as those under Alternative C or D)
Natural Areas	No impacts to any officially designated natural areas				
Recreation	No impacts	Minor potential for loss of recreational use opportunities; among the Action Alternatives, would most likely preserve or increase the amount of open space and areas in a relatively natural character	Potentially significant loss of recreational use opportunities	Potentially significant loss of recreational use opportunities	Minor to moderate loss of recreational use opportunities
Transportation	Significant impacts expected due to increased traffic in the area during build-out to year 2035 under all the alternatives, including No Action				

Resource Issues	Alternative A (No Action)	Alternative B (Conservation)	Alternative C (Commercial/Retail and Residential)	Alternative D (Industrial)	Alternative E (Mixed Use)
		Alternative F (Unrestricted Use)			
Scenic Resources	No impacts likely	Minor impacts; less potential for effects compared to Alternative C, D, E, or F	Minor impacts; potential for effects similar to Alternatives D, E, and F	Minor impacts; potentially greater compared to Alternative B; likely similar to Alternatives C, E, and F	Minor impacts; potentially greater compared to Alternative B; likely similar to Alternatives C and D
Navigation	No impacts; use of the utility corridor is very unlikely	No impacts; use of the utility corridor is unlikely		Minor impacts; potential for effects is greater than under Alternative B, C, E, or F; could increase use of nearby port facilities	Minor impacts; potential for effects is less than under Alternative B, C, or D; could increase use of nearby port facilities
Noise	No impacts	Minor impacts	Minor impacts; potentially greater effects than under Alternative B	Minor impacts; likely greater effects compared to Alternative C, E, or F	Minor impacts; likely less effects compared to Alternative D; similar to Alternative C

[1] See Chapter 4 for discussions of potential indirect and cumulative effects on various resources across the range of alternative land uses.
[2] TVA would also comply with CERCLA and RCRA, as appropriate.

2.3 Potential Mitigation Measures

Mitigation measures are actions taken to avoid, minimize, rectify, reduce, compensate, or mitigate for adverse impacts to the environment. The following measures would be taken to reduce the potential for adverse effects under all the Action Alternatives unless noted otherwise. In the course of obtaining necessary permits and other authorizations from other federal, state, and local authorities, the new owner(s) of the property may be subject to various mitigation requirements. These requirements would depend upon the specific types of land use actions, their locations on the property, and supporting activities following transfer of the property. TVA could also require additional mitigation for future actions affecting wetlands, streams, and areas within the limits of the 100-year floodplain along Pond Creek and the Tennessee River.

The following are routine and nonroutine measures to which future landowners could implement voluntarily or which would probably be required of future landowner(s) by agencies other than TVA. These include measures usually required by agencies to comply with other federal, state, or local regulations to authorize such actions and activities. These provisions would also be taken into account during the development of the Master Plan.

- Future owners would utilize appropriate BMPs during construction and operation of the property. These BMPs may include the following measures:
    - Appropriate engineering and construction BMPs would be used to avoid introduction of material into and to prevent the formation of sinkholes.
    - Construction BMPs would be used to control air emissions from open construction areas and unpaved roads. Roadways would be sprayed with water as needed to reduce fugitive dust emissions.
    - Appropriate construction BMPs would be used to reduce storm water runoff.
    - Additional BMPs like open space design, well-connected and designed streets, and storm water planning would comply with applicable local regulations, laws, or zoning ordinances.
- Prior to construction, future owners are advised to conduct an on-site survey of soil gas, and no closed structures should be constructed where data indicate that there would be intrusion and potential accumulation of VOCs.
- Future owners, in the spirit of EO 13112, could use the following voluntary measures to avoid introduction and spread of nonnative invasive plant species:
    - Limiting the introduction of weed seeds
    - Ensuring that all equipment is free of weed seeds before moving to another location
    - Using weed-free riprap or rock for projects to prevent the introduction of seeds
    - Detecting and eradicating small patches of weeds early
    - Minimizing the disturbance of desirable plants along trails, roads, and waterways
    - Maintaining desired plant communities through good management
    - Monitoring high-risk areas such as transportation corridors and bare ground
    - Revegetating disturbed sites with native or noninvasive plants

- Future owners could establish and maintain a secondary buffer around the forested wetland area.
- Future owners could remove dense stands of invasive plants to improve habitat quality for birdlife.
- The retention of existing vegetation (trees), via the measures below, in combination with limiting new roadway intersections (i.e., curb cuts) could reduce the potential for disturbance and maintain the park-like setting for viewers using TVA land and facilities along, and north of, Reservation Road.
  - Except where maintained within the existing road right-of-way, a vegetative buffer, measured 150 feet from the edge of the pavement, could be maintained along both sides of Reservation Road within the MSR study area from the intersection of Hatch Boulevard to the Wilson Dam Road overpass.
  - Except where maintained within the existing road right-of-way, a vegetative buffer, measured 150 feet from the edge of the pavement, could be maintained along Hatch Boulevard from the intersection of Reservation Road, southward for a distance of 500 feet.
  - Except where maintained within the existing road right-of-way, a vegetative buffer, measured 150 feet from the edge of the pavement, could be maintained along Wilson Dam Road from the Reservation Road overpass, southward for a distance of 2,000 feet.
  - No more than four additional curb cuts (i.e., new roadway entrances onto the area) could be made along Reservation Road.
- Analysis of potential transportation impacts determined that the LOS failures at Hatch Boulevard at Second Street could likely be mitigated with the strategic addition of turn lanes. However, the LOS failures on Hatch Boulevard would require solutions that are more comprehensive. The following are two overall potential mitigation measures:
  - **Option 1**: Realign the US 43/72 designation through Hatch Boulevard and relocate Jackson Boulevard to Birmingham Road
  - **Option 2**: Incorporate an additional access point to the MSR between the Tennessee River and Hatch Boulevard, and construct grade-separated flyover for southbound US 43/72 through traffic at Hatch Boulevard
- Measures to reduce the effects of noise could include vegetation buffers, establishing and maintaining a noise-reduction zone (i.e., calculated noise-reduction zone) between the source and receptor of nuisance sounds (i.e., industrial developments), strategically positioned or constructed physical sound barriers, enclosures for the heavy construction equipment and production machinery, proper interior acoustics, and the muffler sound suppression systems for trucks and other heavy equipment.

TVA would comply with the following applicable laws, regulations, EOs, and obligations associated with existing agreements.

- TVA would warrant in the sale deed that the property has been cleaned up to the extent believed necessary to protect human health and the environment and that the

U.S. will perform any cleanup that becomes necessary in the future as a result of contamination that occurred prior to the sale.

- Approximately 17 acres of land has been remediated (i.e., cleaned up) to industrial screening level. No land within the area covered by the existing RCRA Permit, 2,260 acres, would be sold or transferred from federal ownership unless the land is conveyed at the unrestricted use level or with the appropriate environmental covenants and restrictions in the deed, transfer, or other conveyance document. Additional land use restrictions may be applicable as required by Alabama's Uniform Environmental Covenants Act.
- Consistent with TVA implementation procedures for EO 11990, all future owners shall avoid construction within wetland areas without TVA approval. As appropriate, all future owners of federal wetlands conveyed by TVA shall conduct a wetland delineation of any site proposal for development. Unless there is no practicable alternative, development may not occur in identified wetland areas.
- Consistent with TVA implementation procedures for EO 11988, all future owners shall avoid construction of obstructions within the limits of the 100-year floodplain without appropriate local government authorization and approval under Section 26a of the TVA Act. Unless there is no practicable alternative, development may not occur in floodplain areas.
- TVA will comply with the terms and conditions of a September 18, 2001, agreement with the ALDOT and FHWA regarding use of Transportation Enhancement Project funds for construction of the 1-mile segment of the National Recreation Trail Complex trail located on the south side of Reservation Road.
- TVA would honor the terms and conditions of its agricultural licenses on land tracts on the MSR study area until the date of cancellation prior to any land transfer.
- Additional land use restrictions may be applicable as required by Alabama's Uniform Environmental Covenants Act and would be enforced by ADEM.

TVA would be responsible for requiring, monitoring, and enforcing the following mitigation measures. To the extent practicable, this could be accomplished by placing conditions in the land transfer agreement and coordinating with ADEM's Environmental Covenants Act, where applicable. Section 106 of the NHPA requires that TVA consult with the Alabama Historical Commission SHPO before funding, authorizing, or carrying out any undertaking that is included in or eligible for inclusion in the NRHP. In addition, see elements common to all the Action Alternatives in Section 2.1.

- The only permissible use of the phosphate slag storage area is for a utility corridor to the Tennessee River to support any needed infrastructure development on the MSR study area. TVA would not transfer this land for future development but would make it available under specific use agreements, such as easements. Because of environmental and reservoir operations constraints along the left-descending (south bank) shoreline of the Tennessee River in the vicinity of the utility corridor, TVA would not approve a barge terminal, commercial dock, or other similar shoreline facility.
- Total annual exposure to any person within the phosphate slag storage area is to remain restricted to no more than 500 hours per year.

- If conditions at the phosphate slag storage area are altered and it becomes necessary to reevaluate radiation exposure, TVA will verify in consultation with the Alabama Department of Public Health (ADPH) any change to the phosphate slag storage area that would allow increased exposure times. This would include any effort to mitigate radioactive levels at the site through the use of soil cover or caps of various materials.
- If it becomes necessary through the proposed use of the phosphate slag storage area for subsurface infrastructure enhancements (e.g., buried pipeline), TVA would conduct further radiological measurement and monitoring to determine a worker's potential exposure to ensure safety.
- No subsurface disturbance or other excavation of buried materials would be allowed within the low-level radioactive waste burial site (LLRWBS).
- TVA would not allow removal of groundwater for drinking water (i.e., potable use purposes) from anywhere on the MSR study area.
- TVA would adhere to the stipulations in the final executed MOA between TVA and the Alabama SHPO (Appendix A) to mitigate for the loss of NRHP-eligible properties. Such mitigation includes imposition of architectural controls and design guidelines on new owners and consideration of these properties in the Master Plan. TVA would adhere to required measures through inclusion of requirements in the transfer deed.
- Site 1CT495, the remnants of Wilson Power Plant foundations, shall be avoided during any construction in the utility corridor to the Tennessee River.
- In the event of construction within the utility corridor, TVA would take into account the location of the Rockpile Hiking Trail and the paved trail complex on the north side of Reservation Road and, to the extent practicable, avoid trail closure or reduce effects of trail usage through planning or other design features. This section of the Rockpile trail crosses the skimmer wall built as part of the Wilson Power Plant. Because there is an inlet behind (landward) the wall, some forms of water access accommodations could be accommodated without impacting the trail or the fishing activity that occurs in this area. Conversely, water access needs that would require breach or removal of the skimmer wall would sever the existing trail and also adversely impact shoreline fishing.
- An approximate 900-foot section of paved National Recreation Trail Complex, including a protective corridor, on the Multipurpose Building parcel would be (a) retained by TVA, (b) preserved and managed for public recreation use under an agreement (e.g., easement) between TVA and a new landowner, or (c) relocated to skirt the boundaries of the Multipurpose Building parcel.
- Prior to any TVA land or buildings being transferred from federal ownership under any of the Action Alternatives, TVA would assure that any required environmental due diligence assessments on existing buildings interiors (i.e., construction materials) are completed.

2.4 Preferred Alternative

The Environmentally Preferred Alternative is Alternative B because there would be a deliberate effort to conserve sensitive resources, i.e., wetlands and floodplains, and to encourage the establishment of environmentally friendly developments. However, TVA has determined that selection of any of the action alternatives would present an acceptable range of environmental impacts and risks. Accordingly, TVA has selected Alternative F as its Preferred Alternative based on anticipated benefits to the community and business considerations consistent with the TVA Act, the TVA Land Policy, and other applicable requirements. The adoption of Alternative F would provide the greatest opportunity for economic benefits to the area and region, would reduce TVA's O&M costs and environmental footprint, and would encourage reuse of some historic buildings and structures in the MSR study area. Implementation of Alternative F, consistent with the Master Plan, would also leave future land use decisions to the local community.

CHAPTER 3

3.0 AFFECTED ENVIRONMENT

This chapter of the EIS describes the nature, extent, and importance of environmental resources in their existing setting on the MSR study area and adjacent areas. It provides a baseline for the assessment of potential effects of alternative future land uses described in Chapter 2. Some resources or features unlikely to affect or be affected by the alternatives (e.g., climate and geology) are described briefly. Other resources or features identified during the scoping process as important issues are described in greater detail.

3.1 Solid and Hazardous Waste

3.1.1 Regulatory History and Investigations of Hazardous Wastes

After various production facilities were shut down on the MSR, intermediate products and raw materials accumulated, and various quantities of unneeded chemicals and equipment were stored on site. Prior to passage of RCRA in 1976, there were very few environmental laws governing how waste should be handled and disposed. In keeping with industry standards at that time, TVA stored such waste on site in pits, stockpiles, drums, and other containments.

The Hazardous and Solid Waste Amendments (HSWA) of 1984 expanded RCRA by requiring corrective action for the release of hazardous wastes and constituents from a treatment, storage, and disposal (TSD) facility. The goal of the corrective action process is to ensure that hazardous waste and hazardous constituent releases associated with TSD facilities are remediated, regardless of when the waste was produced.

In the mid-1980s, TVA applied for a RCRA HSWA TSD Permit to maintain a drum storage facility at the ERC and to perform research on hazardous waste streams. As a result, USEPA and ADEM initiated a RCRA Corrective Action Program at ERC, and 205 SWMUs, areas of potential contamination, were identified and investigated over a 15-year period.

This process of implementing the Corrective Action Program involves the following ordered sequence of steps: (1) RCRA Facility Assessment (RFA), (2) RCRA Facility Investigation (RFI), (3) the Corrective Measures Study (CMS), and (4) Corrective Measures Implementation (CMI). Additionally, a potential fifth step, Postclosure Monitoring (PCM), occurs at facilities where waste remains in place after the facility is closed. Several SWMU areas at ERC were carried through the final CMI, along with the phosphorus entombment areas (SWMUs 17-37). These SWMU areas contain hazardous wastes and, therefore, will be subject to PCM (see Section 3.1.1.2).

3.1.1.1 Sites Investigated During the Resource Conservation and Recovery Act Investigation

The HSWA TSD Permit application initiated the RFA to identify all potential environmental hazards at the ERC site. The RFA findings were presented in September 1988. In July 1989, USEPA issued an HSWA TSD Permit for the ERC.

Sixty-two of 205 investigated SWMUs were identified as having a moderate, high, or unknown potential for release of hazardous waste; this potential requires an RFI. During the RFI, each of the 62 SWMUs was evaluated to identify the extent of each site's contamination. A summary of the RFI of those SWMUs, the findings, and the recommendations are included in Appendix C. The RFI Final Report (TVA 1998c) recommended that 35 SWMUs be carried forward to the third step in the RCRA process, the CMS.

3.1.1.2 Primary Areas of Concern

After several years of sitewide extensive sampling, risk assessments, and remediation, consistent with the facilities investigation process, four areas were identified as requiring PCM because of remaining contamination:

Ash Settling Pond (SWMU 104). This site covers approximately 17.5 acres and contains about 800 tons of phosphorus beneath pond sediment, capped with water. The ash settling pond was constructed in the 1930s during the operation of the phosphorus furnaces and was in use until 1976 when the furnaces were shut down. The furnaces produced elemental phosphorus to support both national defense and agricultural programs. Fly ash and bottom ash were deposited in the pond from 1976 to 1986. The implemented corrective measures consist of maintaining appropriate water levels to keep the ash covered, conducting quarterly inspections, and monitoring groundwater for possible contamination.

Phosphate Development Works Landfill (SWMU 108). The entire SWMU covers about 27.4 acres, but the focus is on 9 acres, which started as a U.S. Army landfill. TVA operated the landfill from 1953 to 1957 under an MOA with the U.S. Army. During this period, undetermined amounts and types of wastes from PDW were disposed in the landfill. An attempt was made to halt general dumping in this area in 1977, but general construction materials, phosphorous slag, off-grade chemical fertilizers, and possibly skimmer-trough machine oil were disposed of at SWMU 108 through the early 1980s. General construction waste from the demolition of TVA's elemental phosphorous production facilities was disposed in the landfill until the site was closed in 1984. Implemented corrective measures include modifications to the existing cap, conducting quarterly inspections, and monitoring groundwater for possible contamination.

Precipitator Dust Piles (SWMU 112) and Trestle Drum Storage Area (SWMU 194). SWMU 112 consists of six piles of waste, covering a 14.4-acre site. The piles contain approximately 20,000 tons of phosphorous-laden precipitator dust from the furnaces operated at ERC. During the environmental investigations, no contaminants were found at SWMU 194. However, the boundary of SWMU 112 overlaps with SWMU 194, so both sites were included for the analysis of SWMU 112 contamination. Implemented corrective measures include installing a RCRA cap for SWMU 112/194, conducting quarterly inspections, and ongoing groundwater monitoring for possible contamination.

Phosphorus Entombment Areas (SWMUs 17-37). The phosphorus entombment areas were registered as CERCLA sites prior to the RCRA process at the ERC being initiated. For this reason, these areas were not investigated as part of the RCRA process; they were, however, identified as SWMUs 17-37 and included in the PCM Program. Phosphorus sludge by-product from furnace operations was collected in concrete pits, sumps, and railcars. Approximately 2,535 tons of phosphorus sludge and other phosphorus compounds remain on a 4.9-acre site after a portion of the sludge was recycled. The remaining material was covered with limestone and encapsulated in reinforced concrete. Implemented corrective measures include conducting quarterly inspections and ongoing groundwater monitoring for possible contamination.

The postclosure groundwater and surface water monitoring program began in August 2003. Samples were collected quarterly for the first two years and annually thereafter. Data results are reported annually to ADEM and USEPA. The locations of these four SWMU areas of primary concern are shown in Figure 1-2. Table 3-1 lists the size of the areas that are subject to ADEM PCM requirements.

Table 3-1. Areas of Solid Waste Management Units Undergoing Postclosure Monitoring

SWMU	Size (acres)
Phosphorus Entombment Areas (SWMUs 17-37)	4.13 (West) 0.80 (East)
SWMU 112/194	14.39
SWMU 104	17.46
SWMU 108	27.37
Total	**64.15 Acres**

3.1.1.3 Other Solid Waste Management Units of Concern

In addition to the SWMUs and phosphorus entombments listed above, 31 SWMUs (Table 3-2) were evaluated and closed during the RCRA Corrective Action Program using industrial clean-up standards instead of residential standards. TVA assumed that the future use of the site would remain industrial; therefore, cleanup to industrial standards avoided unnecessary remediation costs. Using industrial clean-up standards permits higher contamination levels to remain in soil but limits exposure to what an industrial worker would normally encounter (i.e., 40 hours/week for 50 weeks/year) as opposed to residential standards, which allow virtually unrestricted access to a site. The SWMUs evaluated with industrial standards are shown in Figure 3-1. All other SWMUs south of Reservation Road, with the exception of the SWMUs identified in Tables 3-1 and 3-2, were determined to contain levels of chemical contaminants at or below residential screening levels. This indicates that most of the land is suitable for unrestricted development.

Table 3-2. List of Solid Waste Management Units Evaluated With Industrial Screening Levels

SWMU Number	SWMU Name	Size	
		Square Feet	Acres
5	Outdoor Drum Storage Area No. 1	75,000	1.72
7	Furnace Building	27,000	0.62
9	Tank Car Wash Pit	9,800	0.23
10	Tank Car Washing Sumps	5,100	0.12
42 and 43	Phosphate Fertilizer Storage Building and Sulfur Cake Storage Area	102,400	2.35
53	Carpenter Shop Outdoor Drum Storage Area	1,600	0.037
59	PDW Service Pit	2,050	0.05
83	PDW Area 307 Drum Storage Area	7,650	0.17
84	PDW Surface Drainage Ditch	500	0.01
92	Ammonia From Coal Drum Storage Area No. 2	9,500	0.22
100	Ammonia From Coal Project Equalization Basin	38,550	0.89
105	Plant Drainage Ditch	2,250	0.052
106	Central Ditch	150,000	3.4
107	Scrap Yard	189,500	4.3
110	Coal Pile Run-Off Ditch	5,600	0.13

SWMU Number	SWMU Name	Size	
		Square Feet	Acres
117	Old Ammonia Plant	20,000	0.46
122	Building 321 Outdoor Drum Storage Area	22,500	0.52
128	Building 404 Outdoor Drum Storage Area	6,500	0.15
131	Waste Oil Storage Area	2,491	0.06
137	Building 407 Outdoor Drum Storage Area	2,000	0.05
141	Building 509 Drum Storage Area	31,692	0.73
151	Ammonia Plant Oil/Washer Separator	1,092	0.025
165	Urea Plant Waste Oil Accumulation Area No. 2	100	0.002
166	Urea Plant Waste Oil Catch Basin	100	0.002
168	Urea Plant Oil and Ammonia Sump	100	0.002
169	Urea Plant Oil Accumulation Area No. 4	100	0.002
196	Ammonia Pumping Station	19,600	0.45
197	Power Service Shop No. 2 West Wall	192	0.004
198	North End Storm Sewer	1,150	0.026
201	Ammonia From Coal Drum Storage Area No. 4	15,150	0.34
	Total		**17.12**

3.1.1.4 Other Waste Sites Not Included in the Resource Conservation and Recovery Act Investigation

There are two additional sites within the MSR study area that have contained, or presently contain, materials that may be considered hazardous but are not subject to the RCRA Corrective Action Program. These are SWMU 114 (the phosphate slag storage area) and the LLRWBS. SWMU 114 was not included because of the RCRA regulation exemption for ore and mineral processing wastes and materials. The LLRWBS was not included because it is regulated by the U.S. Nuclear Regulatory Commission (NRC) and not by the RCRA process.

<u>SWMU 114 (Phosphate Slag Storage Area)</u>

Phosphate slag, which is primarily calcium silicate, is a hard, refractory, water insoluble, coarse, sandlike material (TVA 1998c). Slag is created as a by-product when phosphate ore is burned to produce phosphorus. From 1934 to 1975, at least 250,000 tons per year of this slag were created from the production of phosphorus and phosphoric acid for fertilizer production.

The 90-acre phosphate slag storage area is located north of Reservation Road. This area now contains the remnants of an estimated 1.6 million tons of phosphate slag. The site is divided into two sections by an unimproved road; the stockpile to the east of the road forms a rough rectangle and is approximately 44 acres in size. The stockpile area to the west of the road is approximately 46 acres in size (May and Boyle 1990).

The Bevill Exclusion Amendment was added to RCRA in 1980 to exclude "solid waste from the extraction, beneficiation, and processing of ores and minerals" from regulation as hazardous waste [40 CFR § 261.4(b)(7)]. Phosphate slag is covered by this exclusion because the slag was derived from phosphate ore used in the production of elemental phosphorus. Because of this exclusion status, the USEPA determined that SWMU 114 did not require an RFI when issuing the ERC's HSWA TSD Permit.

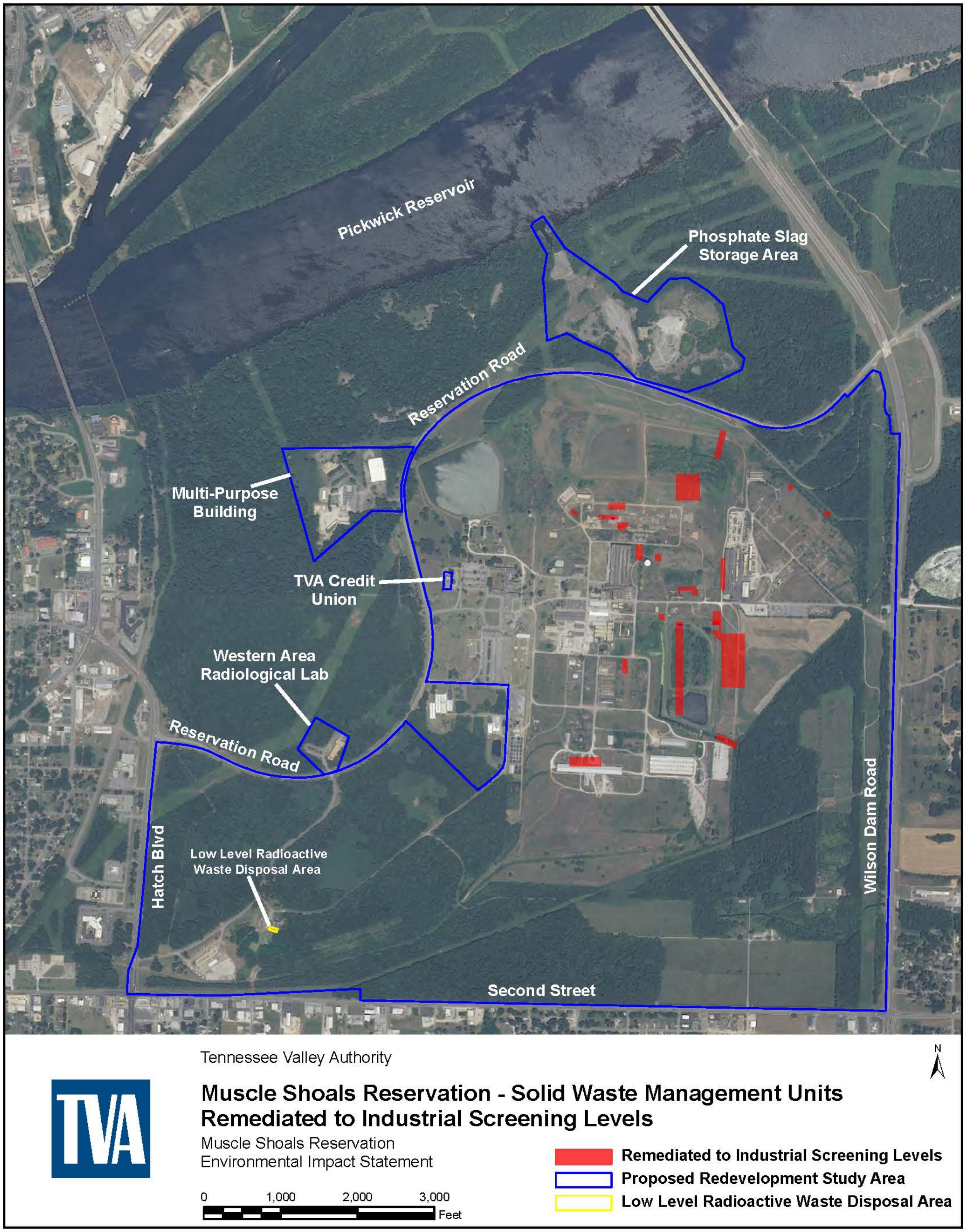


Figure 3-1. Locations of Solid Waste Management Units Closed With Industrial Screening Levels

The primary health concern at the phosphate slag storage area is radiation. Raw phosphate ore used in the production process contains naturally occurring radiation. During the production of phosphoric acid from ore, this radiation was concentrated in the slag by-product.

Table 3-3 lists some common sources and associated typical levels of radiation exposures for the average person. Radiation is energy that is transmitted (i.e., radiated) from a source as the source decays. A rem (roentgen equivalent in man) is a unit of radiation dose used to measure the effects of ionizing radiation on humans. This unit of dose is most commonly expressed in units of thousandths of a rem, or millirem (1,000 microrems [μrem] equal 1 millirem and 1,000 millirems [mrem] equal 1 rem). See Acronyms, Abbreviations, Units of Measure, and Symbols in the preface of this final EIS. In addition to the sources of radiation listed in Table 3-3, soil and bedrock are natural radiation sources that vary geographically.

Naturally occurring radiation in raw phosphate ore used in the production process is the primary human health concern. For example, in Ohio, natural radiation in soil and rocks contributes about 60 mrem per year of radiation exposure. In Colorado, exposure is about 105 mrem per year. Natural radiation varies with area according to the types of rock and mineral features found in the vicinity (different geologic features have different natural radiation emissions).

Table 3-3. Levels of Radiation Exposures by Typical Source for the Average Person Across the United States and by MSR Phosphate Slag Storage Area

Typical Exposure (mrem/year)	Source
0.1	Sleeping next to another person in the bed
0.2	Drinking a quart of Gatorade each week
0.3	Combustible fuels (e.g., coal, natural gas, and liquefied petroleum)
0.5	Eating 0.5 pound of Brazil nuts
1	Television receivers
1 to 6	Domestic water supplies
1.5	Each cross-country airline trip (one way)
2	Use of gas mantles
4	Highway and road construction materials
5	Foods grown on lands in which phosphate fertilizers are used
6	Each dental x-ray
7.5	Spouses of recipients of certain cardiac pacemakers
110	Each computerized tomography of the head and body
150	Each nuclear medicine examination of the lung
245	Each upper gastrointestinal tract series
405	Each barium enema
438	MSR phosphate slag storage area exposure 24 hours/day for one year
509	Each nuclear medicine examination of the thyroid
650	Each nuclear medicine examination of the brain
1,300	Average cigarette smoker

A 2002 survey measured the levels of radiation at the phosphate slag storage area. The radiation is concentrated where the slag is located. Two dose measurements 1 meter above the ground were taken each at the eastern and western slag stockpile areas. Recorded measurements were 50 microrems per hour (µrem/hr) or 0.05 millirem per hour (mrem/hr), at all four sampling points. Using the maximum measured dose of 0.05 mrem/hr and assuming a person stayed on the site 24 hours a day for 365 days, exposure at the slag storage area would yield a dose of 438 mrem/year.

In December 2009, TVA and the ADPH, Office of Radiation Control, conducted a radiation monitoring survey of the phosphate slag storage area. This survey was in response to comments provided by ADPH in July 2009, indicating concerns about the specific location of this area and about whether it could be more extensive than shown in TVA's public scoping information. During this survey, the western boundary of the phosphate slag storage area was confirmed, and a reading of 42 µrem/hr (0.042 mrem/hr), the highest measured value, was recorded. Survey readings were measured consistent with the 2002 survey mentioned above. The boundaries of the phosphate slag storage area extend from the old rail spur on the west to Pond Creek on the east.

ADPH is responsible for the protection of the public in Alabama from excess exposure to ionizing radiation. ADPH recently adopted a radiation protection standard of 25 mrem per year on July 21, 2010, which is the standard currently in effect for the NRC and the U.S. Department of Energy (DOE). If residual radioactivity does not exceed the threshold of 25 mrem per year, the NRC considers a site acceptable for unrestricted use; the DOE agrees with this threshold for all pathways of exposure. TVA, in compliance with this standard, limits access to the phosphate slag storage area to fewer than 500 hours per year per person. Additional soil cover can be used to allow longer exposures.

Low-Level Radioactive Waste Burial Site (LLRWBS)

The LLRWBS is a 0.23-acre fenced area (approximately 100-foot by 100-foot) located approximately a mile southwest of the ERC, near the old TVA Greenhouse Complex on the MSR study area (see Figures 3-1 and 3-2). It is vegetated, stable, and lies between the greenhouse buildings and the former TVA Garage, which is now the TVA Muscle Shoals Customer Service Center. This LLRWBS was originally authorized by the Atomic Energy Commission (pre-NRC) on July 15, 1964, and operated under a license issued to TVA's Office of Agricultural and Chemical Development from 1966 until January 29, 1981, when federal regulations changed and the burial site was closed. As described in Section 3.3.2.8, one monitoring well was installed at the LLRWBS in August 1996 to support an assessment of the environmental effects of the facility required by the NRC. Measured constituents were below instrument detection limits, and the site posed no human health risks. There continues to be no monitoring requirement for this site.

Low-level radioactive by-product material buried at the site was generated from agricultural experiments for fertilizer development and various lab analyses. The waste mainly consisted of isotopes of phosphorus, zinc, manganese, carbon, and sulfur. A small amount of waste containing uranium from quality control checks conducted at the Power Service Center on nonirradiated fuel pellets was also buried at the site.

LLRWBS waste material was buried in 40, 2-foot-diameter auger holes completed to depths of 10 feet in residual clay overburden during the area's 15 years of use. The lower 6 feet of each hole was then filled with radioactive waste material, and the remaining 4 feet of each hole was backfilled with clay soil. Records of each burial including location, date and type, and activity of the waste isotopes have been maintained by TVA.

Photograph taken by: Stacy McCluskey, November 22, 2010

Figure 3-2. Access Restricted Low-Level Radioactive Waste Burial Site

In response to NRC's "Branch Technical Position on Screening Methodology for Assessing Prior Land Burials of Radioactive Waste" (NRC 1997), TVA submitted two reports to the NRC, dated September 5, 1995 (Williams 1995) and September 4, 1997 (Sorrelle 1997). The 1995 report included a description of the burial site and the radioactive material that remains. The September 1997 report contained a dose-to-the-public site assessment and concluded that radioactive material removal was not necessary (see Appendix D). These reports were prepared assuming the LLRWBS would remain undisturbed and in TVA ownership.

In 1997, using RESRAD (RESidual RADioactivity) radiological dose calculating software, TVA showed the maximum aboveground dose to be 0.0000025 mrem (0.0025 microrem), which is far below current NRC and USEPA regulatory standards. TVA proposed that no additional remediation of the site was required and requested unrestricted access for the site. A letter from the NRC dated April 30, 1999 (Decker 1999), stated that no further remediation was required, and the site was released for unrestricted use (see Appendix D).

This unrestricted use only applies to the soil surface at grade above the existing clay cap. It does not apply to subsurface or belowground development such as building foundations, basements, or trenching or excavation activities associated with underground utilities that could disturb or eliminate the shielding effects of the soil cap. TVA could retain ownership of the LLRWBS, dispose of it with a deed restriction designed to prevent subsurface disturbance, or clean it up and properly dispose of the low-level radioactive material buried there prior to transferring the property to another owner in the future.

3.1.2 Current Permit Status

The current RCRA HSWA TSD Permit covers 2,260 acres, which encompasses the entire MSR study area. This entire permit area is subject to ADEM HSWA Permit/USEPA Identification No. AL3 640 090 004. ADEM currently monitors and oversees all activities performed under the permit and has indicated that no land can be sold or transferred within the existing permit area unless it is either remediated to unrestricted use levels or regulated with the appropriate environmental covenants. TVA will be working with ADEM to develop the appropriate strategies to release the property from the provisions of the RCRA Permit, and ADEM has indicated that the permit should not prevent land in the study area from being sold or transferred out of federal ownership. The current RCRA permit over the study area would not limit potential future land use alternatives being considered in this EIS (see Section 4.1).

As indicated in Section 1.7, the first RCRA permit renewal application was submitted from TVA to ADEM in May 2010. Approval is anticipated by mid-2012.

3.2 Geology

General Geologic Setting and Stratigraphy

The MSR study area is located within the Interior Low Plateau Physiographic Province, commonly referred to as the Eastern Highland Rim. The Highland Rim consists of flat-lying carbonate rocks of Mississippian age. The project area is located generally along the flat river valley on the southern shore of the Tennessee River (Pickwick Reservoir). There is very little change in topography within the MSR study area.

The geology of the project area is homogeneous throughout. The entire project area is underlain by Tuscumbia Limestone. The apparent thickness of the formation in this province varies. Underlying the Tuscumbia Limestone and exposed nearer the shore of the Tennessee River is the Fort Payne Chert. The Fort Payne Chert is a very light to light-olive-gray limestone. Commonly present below the Fort Payne is a light-olive-gray claystone or shale (Maury Formation), which is mapped with the Fort Payne. The apparent thickness of the Fort Payne Chert in this province also varies.

The carbonate rocks that form the Eastern Highland Rim have formed a karst terrain. The term “karst” refers to carbonate rocks (e.g., limestone) in which groundwater flows through solution-enlarged channels and bedding planes within the rock. Karsts are characterized by sinkholes, springs, disappearing streams, and caves, as well as by rapid, highly directional groundwater flow in discrete channels or conduits. Several sinkholes occur within the Tuscumbia Limestone surrounding the MSR and three small sinkholes occur on the MSR study area (Figure 3-3; U.S. Geological Survey 1977).

3.3 Groundwater Resources

3.3.1 General Hydrostratigraphy and Structure

The MSR study area is located in the Interior Low Plateau Physiographic Province (see Section 3.2) along the southwestern flank of the Nashville Dome. Mississippian-aged limestone rocks underlie the MSR study area. These rocks generally dip to the south-southwest at about 25 to 30 feet per mile. However, bedrocks at the MSR dip to the southeast at about 30 feet per mile (Raymond 1992). The relevant subsurface units underlying the MSR study area are shown on Figure 3-4. Exploratory drilling on the MSR study area has not penetrated Paleozoic rocks below the Chattanooga Shale.

3.3.1.1 Overburden

The MSR study area is covered by a thick layer of unconsolidated soil and rock material about 40 to 100 feet. The upper 10 to 50 feet are typically composed of silty, sandy clay. In places, the clay contains small amounts of cherty limestone fragments. A relatively thin layer less than 10 feet of debris and gravel may occur in some places on the top of the silty clay zone. The bottom half of the overburden consists of a mixture of silty clay and various amounts of residual rock fragments. The rock fragments are mostly weather-resistant chert and cherty limestone, which are similar to the underlying bedrock. Tests suggest that groundwater moves vertically through the clayey soil matrix at approximately 10^{-6} centimeters per second. These tests also suggest that the horizontal groundwater movement is approximately 10 times faster than the vertical (i.e., downward) movement.

Alluvial deposits are generally limited to narrow areas along Pond Creek and other streams, particularly along downstream reaches closest to the Tennessee River. The alluvium typically consists of mixed layers of clay, silt, sand, and gravel.

The transition between the overburden and underlying limestone bedrock layer is gradual. This limestone layer has weathered, producing a layer of material above bedrock, referred to as the epikarst zone, which consists of cherty gravel in a matrix of silty clay. This highly weathered zone possesses voids and hollow spaces where residual material has been passed through to the deeper bedrock drainage network. The epikarst zone is about 3 to 5 feet thick across the MSR study area.

3.3.1.2 Tuscumbia-Fort Payne Aquifer System

The Tuscumbia Limestone and the Fort Payne Chert are a major regional aquifer system in northwestern Alabama. The Tuscumbia Limestone is the uppermost bedrock layer beneath the MSR study area. It is exposed along the south bank of the Tennessee River and along the valleys of the larger tributaries (Harris et al. 1963). Tuscumbia Limestone is about 50 feet thick in the local area. It is a light gray, fine to medium crystalline limestone and contains abundant fossils and light colored chert (Thomas 1967).

The Fort Payne Chert, the next layer, is comprised of thin layers of light gray to blue-gray, finely crystalline, siliceous limestone containing abundant chert. The thickness ranges from 162 to 207 feet. The Fort Payne Chert underlies the entire MSR study area, and the upper portion of the formation is exposed along the south bank of the Tennessee River.

The Tuscumbia-Fort Payne aquifer system is highly permeable in places because of numerous bedrock fractures and joints. These openings generally occur at depths of less than 100 feet (Fry 1981) and allow the rapid movement of groundwater. Because weathering of the carbonate bedrocks diminishes with depth, the upper portion of this aquifer has higher permeability than the deeper portions.

Within the deeper Fort Payne formation, groundwater movement occurs along fractures and bedding planes. The network of bedrock fractures varies considerably in the vicinity of the MSR study area. Therefore, prediction of groundwater movement within the deeper bedrocks is much more difficult than in the shallow bedrock.

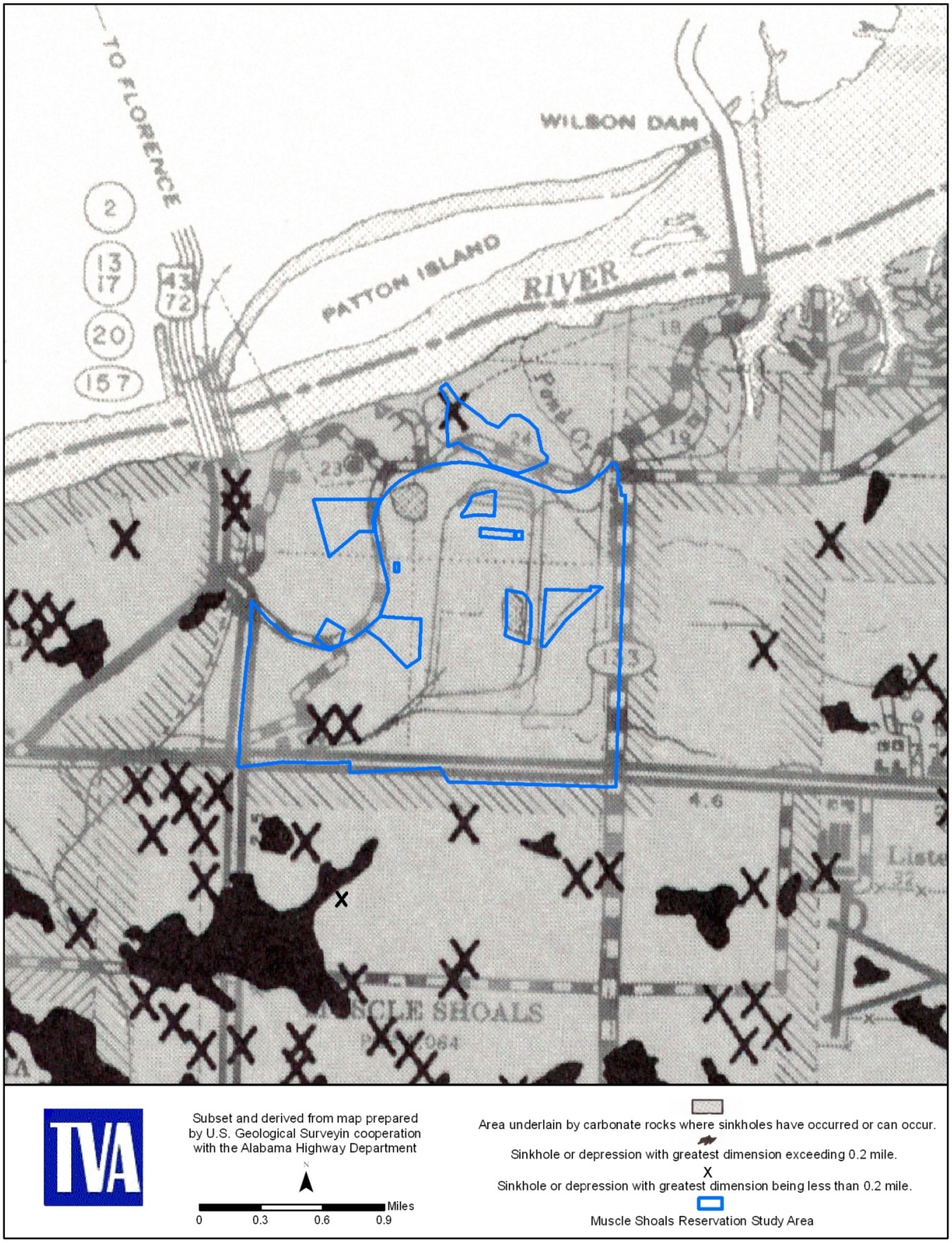


Figure 3-3. Sinkhole Locations on the Muscle Shoals Reservation Study Area

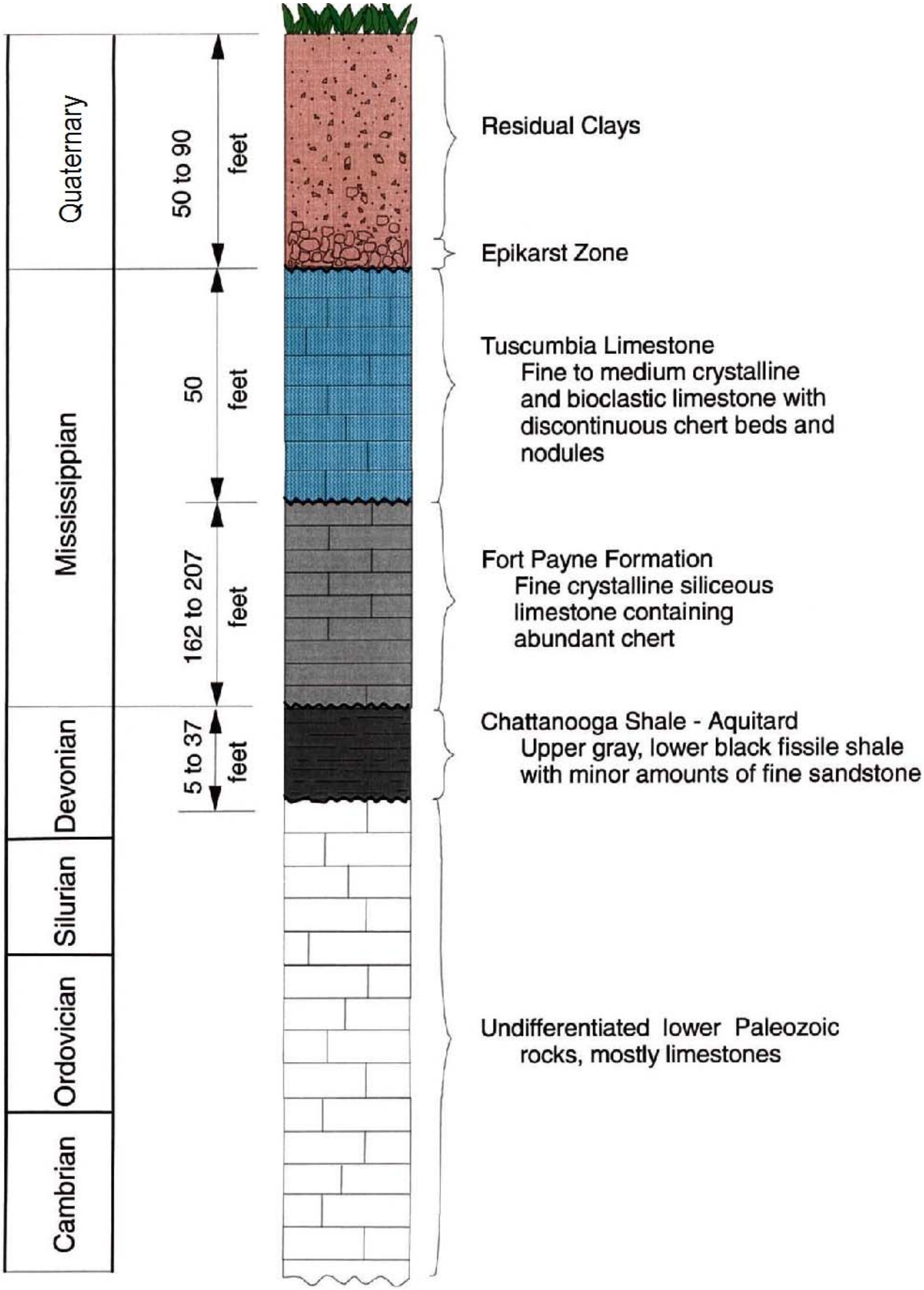


Figure 3-4. Generalized Stratigraphic Column for the Muscle Shoals Reservation Study Area

3.3.1.3 Chattanooga Shale

The Chattanooga Shale is comprised mainly of black shale and minor amounts of fine-grained sandstone. The Chattanooga Shale overlies the older undifferentiated Paleozoic rocks (see Figure 3-4). It does not outcrop in the region, but on-site drilling suggests that the Chattanooga Shale underlying the region is 5 to 37 feet thick. It ranges from 250 to 450 feet below the surface in the MSR study area (Julian et al. 1993). The Chattanooga Shale likely forms an aquitard below the Tuscumbia-Fort Payne aquifer, which restricts the further downward movement of groundwater to the underlying Paleozoic aquifers.

3.3.1.4 Groundwater Occurrence and Movement

Groundwater typically occurs beneath the MSR study area within the residual or alluvial overburden. Exceptions occur in certain areas, particularly areas close to the river, where the water table is found in upper bedrock. The water table generally ranges from approximately 0 to 90 feet below ground surface depending on location and time of year. The principal source of recharge is infiltration of precipitation, e.g., rainwater. Average net recharge from precipitation varies but ranges from 5 to 15 inches/year for the region (Curtis 1953; Bossong and Harris 1987; Golder Associates 1990). Additional lateral groundwater recharge of the Tuscumbia-Fort Payne aquifer occurs from upgradient areas along the eastern boundary of the MSR study area. On-site recharge may include leaky water and sewage lines, segments of streams such as Pond Creek, and impoundments such as the ash settling pond and water supply reservoir. The relative contribution of these artificial sources of recharge is small compared to natural recharge from precipitation and lateral inflow.

Infiltrating precipitation generally moves vertically downward through the overburden and drains into the epikarst zone, where flow becomes primarily horizontal through a network of discrete fractures enlarged by limestone dissolution. Localized areas of upward flow occur near some streams, topographic lows, and areas that receive direct recharge to the bedrock flow system (Julian et al. 1993).

The majority of groundwater flows northwestward and ultimately discharges to the Tennessee River either as springs or as diffused seepage through the riverbed (see Figure 3-5). Dye trace tests conducted at Wells F and G suggest groundwater may also flow to the southwest toward Tuscumbia Big Spring (also known as Tuscumbia Spring); however, tests were inconclusive because dye was not detected at Tuscumbia Spring. Although the southeast corner of the MSR study area lies within the well head protection area (WHPA) for Tuscumbia Spring (Raymond 1997), the location of dye injection points, as well as all existing MSR solid/hazardous waste facilities, fall outside of the WHPA (Figure 3-6).

The dye tracing studies and lineament surveys indicate an extensive network of enlarged fractures in the epikarst zone and upper bedrock. Results of dye trace tests at the MSR study area and in the Muscle Shoals area indicate that rapid horizontal groundwater movement and high dilution occur in the bedrock. Dye velocities ranging from 30 to 1,100 feet/day were observed following dye tracer injections at MSR Wells G and F1. Velocities of several miles/day have been estimated for areas south of the MSR study area. As shown on Figure 3-5, dye was detected at monitoring wells located northwest, northeast, and southwest of the dye injection well. Results of these tests support the notion that groundwater movement in upper bedrock follows large fractures in the bedrock. Results of flow meter tests consistently show a zone up to 5 feet thick of relatively high permeability corresponding to the epikarst zone. The horizontal hydraulic gradients are generally consistent across the MSR study area (Julian et al. 1993).

3.3.2 Groundwater Quality

Groundwater quality on the MSR study area has been affected by nearly 100 years of industrial activity and from other off-site industrial activities located hydraulically upgradient. A description of the solid and hazardous waste facilities located at MSR, including past industrial activities producing the waste, chemical characteristics of industrial waste products, and disposal facility descriptions and closure requirements, is provided in Section 3.1.

Beginning in the 1980s, TVA initiated a series of investigations to characterize groundwater quality and movement beneath the Reservation. The initial investigations focused on groundwater conditions beneath the PDW landfill (SWMU 108). SWMU 108 is one of the largest waste disposal areas on MSR and contains inorganic, organic, and radiological wastes. In response to USEPA's RCRA Facility Assessment Report (Kearney 1988), comprehensive environmental and corrective action studies (Young and Julian 1991; Julian et al. 1993; TVA 1998c) were performed at SWMU 108 and other SWMUs found to contain hazardous wastes. Other relevant off-site groundwater investigations include groundwater contaminant investigations performed on industrial properties located upgradient of the MSR study area (G&E Engineering 1991; Golder Associates 1990; CH2M Hill 1986) and regional groundwater studies covering the Muscle Shoals area (Chandler and Moore 1991; Raymond 1992; Harris et al. 1963).

The postclosure monitoring (PCM) of SWMU areas 108, 104, and 17-37 began in August 2003 following completion of required RCRA cleanup and waste stabilization actions. Quarterly monitoring was performed at these facilities from August 2003 to August 2005, followed by annual monitoring. Groundwater data acquired during the PCM period along with results of the past on-site and off-site groundwater investigations provide the basis for the following characterization of groundwater quality on the MSR study area.

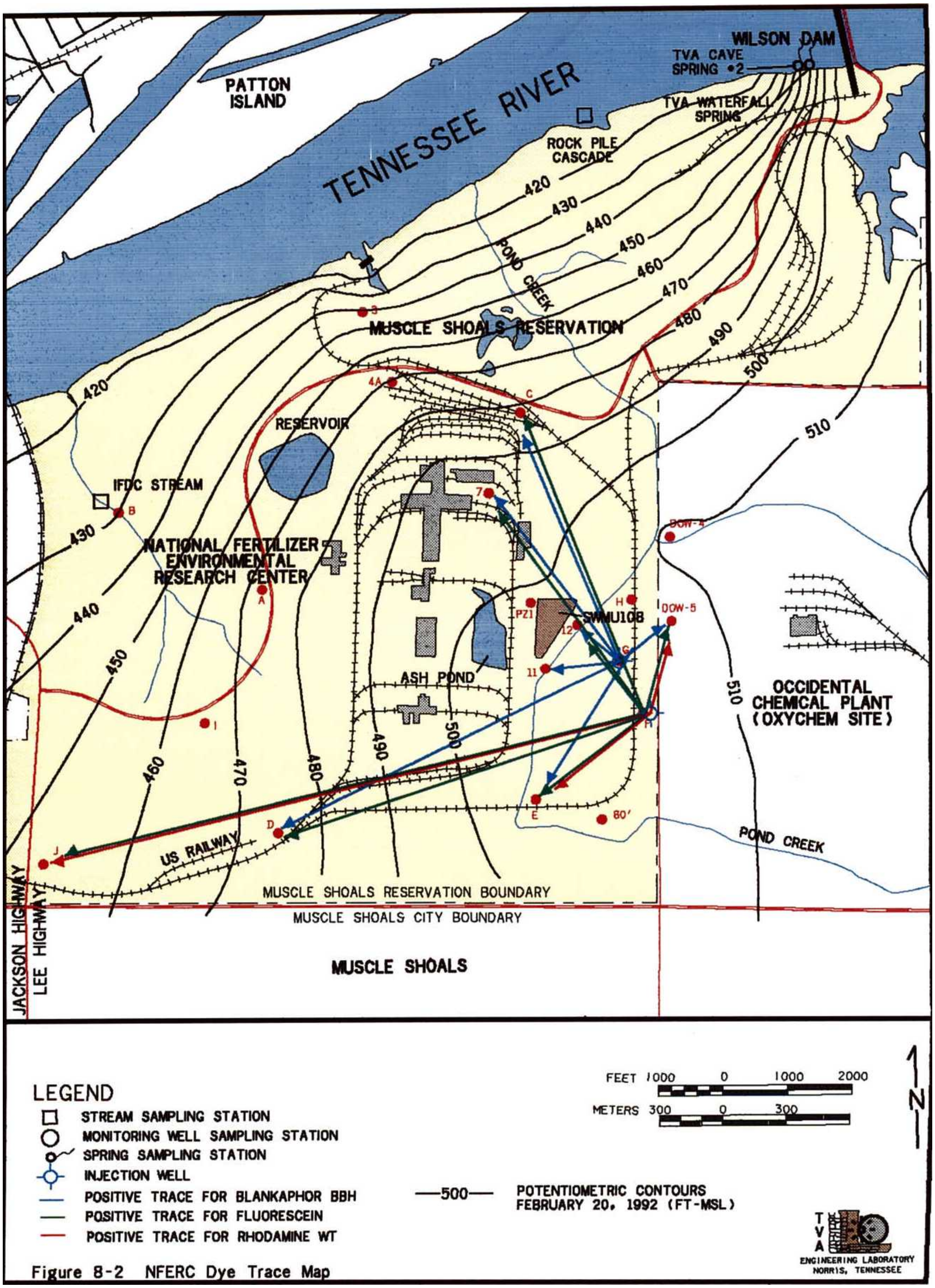


Figure 3-5. Horizontal Movement of Groundwater on the Muscle Shoals Reservation

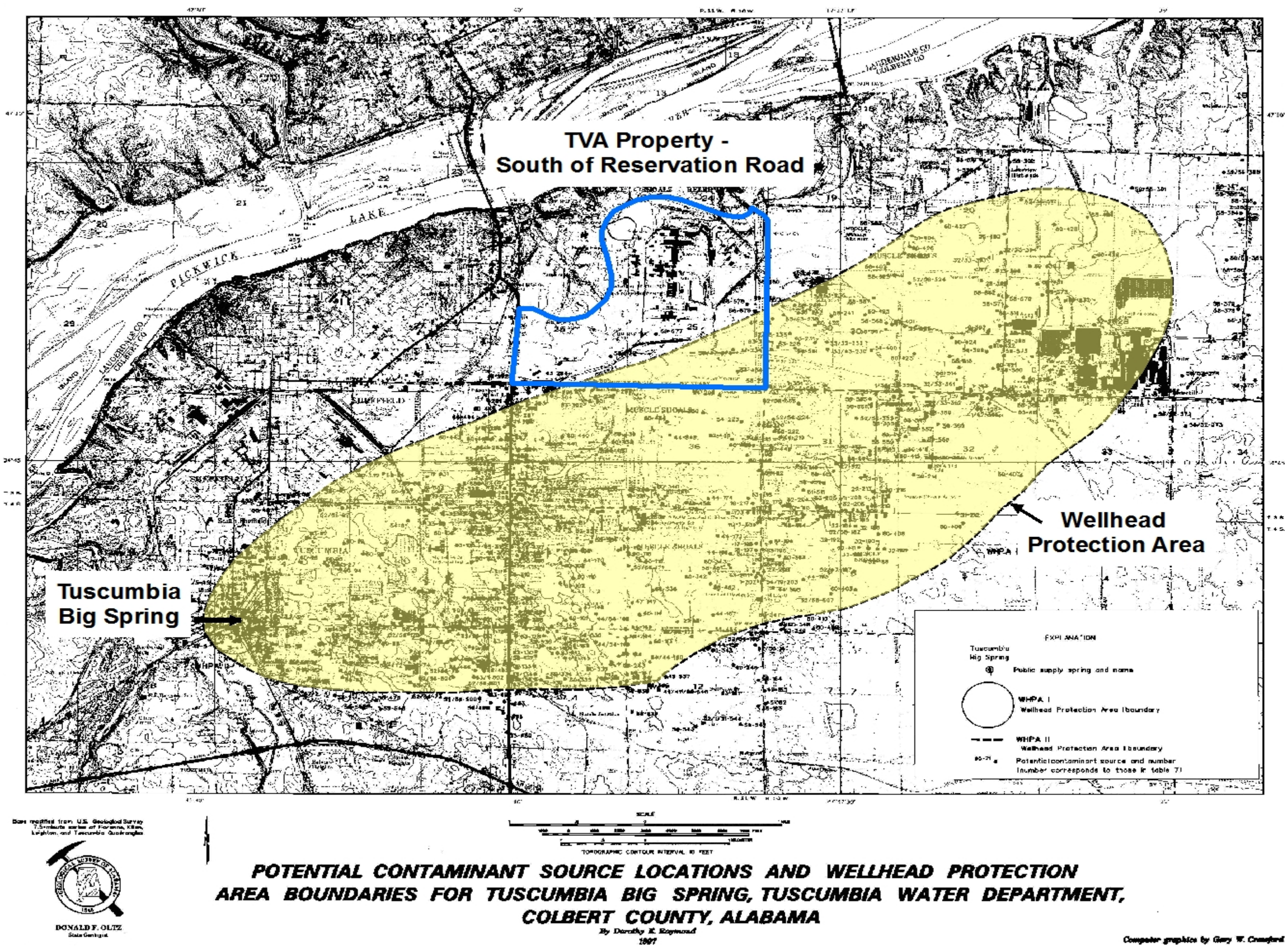


Figure 3-6. **Tuscumbia Big Spring Wellhead Protection Area**

3.3.2.1 Solid Waste Management Unit 108 (Phosphate Development Works Landfill)

A chronology of water quality investigations conducted at SWMU 108 between 1985 and 1997 is presented in Appendix E. Water quality sampling included only four monitoring wells from 1985 to 1987, and three of these wells were screened near or in bedrock. Well locations are shown on Figure 3-7. No water quality surveys were conducted in 1988, and surveys were conducted at only five shallow wells during 1989. The first comprehensive groundwater investigation was conducted from 1989 to 1990 (Young and Julian 1991). Thirteen wells were sampled during July 1990 for selected organic, inorganic, and radiological constituents. These wells were screened at different depths within the overburden and epikarst zone. Water and sediment were also sampled at several locations along Pond Creek in the vicinity of SWMU 108. Monitoring results are summarized in Table E-3 of Appendix E. Subsequent monitoring and analyses were performed in July 1991 at four wells for radionuclides and a broad spectrum of the different groups of hazardous compounds listed in Appendix IX of the *Interim Final RFI Guidance Manual of U.S. Environmental Protection Agency* (Table E-2 of Appendix E). Results for detected VOCs in samples collected between 1987 and 1997 are summarized in Table E-4 of Appendix E. Nitrate sampling was performed on several occasions between 1989 and 1997 at selected wells surrounding SWMU 108 (Table E-5 of Appendix E). Extensive sampling of 31 wells screened within the overburden and epikarst zone at SWMU 108 was performed in 1997 for contaminants of potential concern identified in TVA 1998c, including VOCs, nitrate-nitrite, cadmium, lead, and phosphate and total phosphorous (Table E-6 of Appendix E).

A summary of historical (1987-1997) groundwater data exceeding RCRA action levels in wells surrounding SWMU 108 is provided in Table E-7 of Appendix E. Elevated metal (including aluminum, arsenic, barium, chromium, copper, iron, and mercury) concentrations in all wells, except W9, W11, and W12, were shown by Young and Julian (1991) to be biased by the presence of suspended solids in groundwater samples derived from soil clay particles, which naturally contain metals. They further demonstrated that organic contaminant levels were positively correlated with suspended solids content and suggested that organics adsorbed (i.e., the binding of molecules or particles to a surface) to suspended soils particles present in samples likely biased organic measurements in samples showing high turbidity. Nitrate exceeded the maximum containment level (MCL) in 9 of 13 wells sampled in July 1990 (Table E-5 of Appendix E). Nitrate, which is unaffected by the presence of suspended material in samples, was attributed to leaching of off-grade nitrate fertilizers and nitric acid production wastes deposited in SWMU 108. While organic contaminants were detected in sediment samples from Pond Creek upstream of SWMU 108, no organics or elevated concentrations of inorganic contaminants were found in Pond Creek water samples collected at or downstream of SWMU 108. Contamination of stream sediments was attributed to off-site industrial contamination.

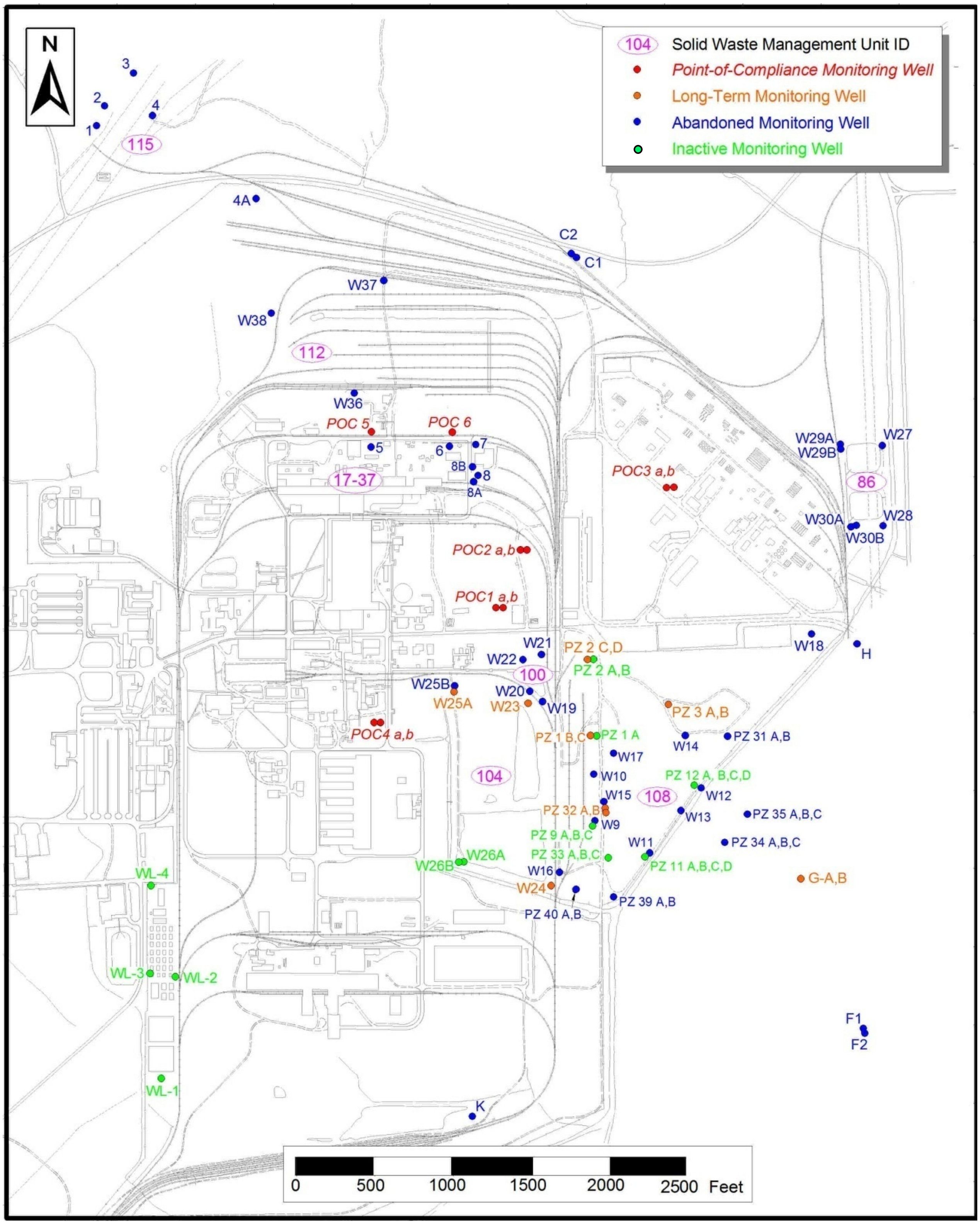


Figure 3-7. Location of Monitoring Wells on the Muscle Shoals Reservation

SWMU 108 was closed under a monitored natural attenuation closure program. This program was approved by ADEM on the basis of biogeochemical modeling analyses, which showed that concentrations of contaminants of concern present in leachate seepage entering groundwater beneath the facility would be reduced to acceptable levels before reaching streams or springs (TVA 1998c). The contaminants of potential concern at SWMU 108 are eight VOCs including tetrachloroethylene and carbon tetrachloride and their daughter products chloroform, trichloroethylene, cis-1,2 dichloroethylene, trans-1,2 dichloroethylene, chlorodibromomethane, and vinyl chloride. The monitoring network includes three pairs of staged, point-of-compliance (POC) wells, POC1A/B through POC3A/B, located 800 to 1,200 feet downgradient (i.e., the groundwater version of “downstream” surface water) of the SWMU 108 boundary (see Figure 3-7). The “A” well of each POC well pair was completed in soil overburden and the “B” well in bedrock. Eight additional noncompliance piezometer wells, located close to SWMU 108, are monitored to detect evidence of natural biodegradation of the VOCs present in the landfill. VOC monitoring results are evaluated against ADEM action limits listed in Table F-1 of Appendix F. SWMU 108 is considered in compliance, provided VOC action limits are not exceeded at the POC wells.

Postclosure groundwater monitoring at SWMU 108 began in August 2003. Monitoring was conducted approximately quarterly between August 2003 and August 2005 and annually thereafter (TVA 2003). The most recent VOC sampling event at SWMU 108 was performed in August 2009. None of the VOCs have exceeded ADEM action limits at POC monitoring wells during the postclosure period; in the past, however, tetrachloroethylene and several other VOCs have been detected in POC wells completed in bedrock (Table F-2 of Appendix F).

Contaminant plumes associated with the eight VOCs have been relatively stable since at least 2004. This stability is illustrated on Figures 3-8 and 3-9, which show the horizontal and vertical distributions of tetrachloroethylene concentration in the SWMU 108 vicinity for the August 2004 and August 2009 sampling events. For reference, Figure 3-10 shows the monitoring network, the August 2009 groundwater potentiometric surface, and inferred groundwater flow directions in the SWMU 108 vicinity. Differences between the spatial distributions of tetrachloroethylene in 2004 and 2009 in the horizontal and vertical dimensions are small, suggesting that the tetrachloroethylene plume is neither advancing nor dissipating. The lack of VOC plume movement during the PCM period is further indicated by the stability of the other VOC plumes and by the temporal stability of VOC concentration series (Appendix F).

Viewed in historical context, the absence of significant change in overall levels of tetrachloroethylene and other VOCs in the SWMU 108 vicinity during the PCM period is not unexpected. The period of active landfill operations at SWMU 108 occurred from 1953 to 1984; however, disposal of organic solvents was reportedly discontinued in 1977. Consequently, solvents such as tetrachloroethylene have been subject to natural chemical breakdown processes for more than 30 years. Currently, the rate at which dissolved phase VOCs are entering groundwater beneath the landfill is apparently roughly equal to the rate of natural breakdown, resulting in near-stable VOC plumes.

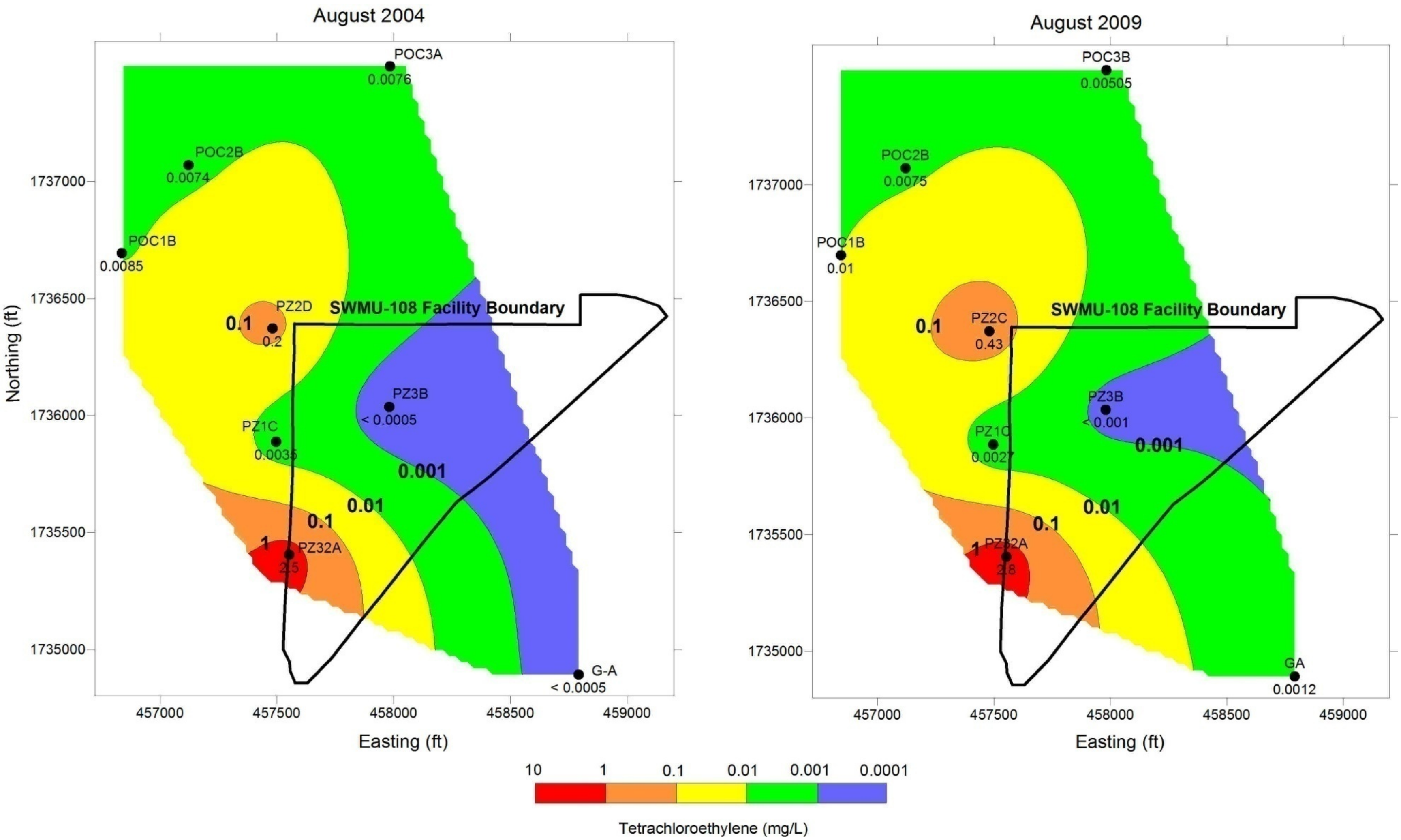


Figure 3-8. Horizontal Distribution of Tetrachloroethylene, August 2004 and August 2009

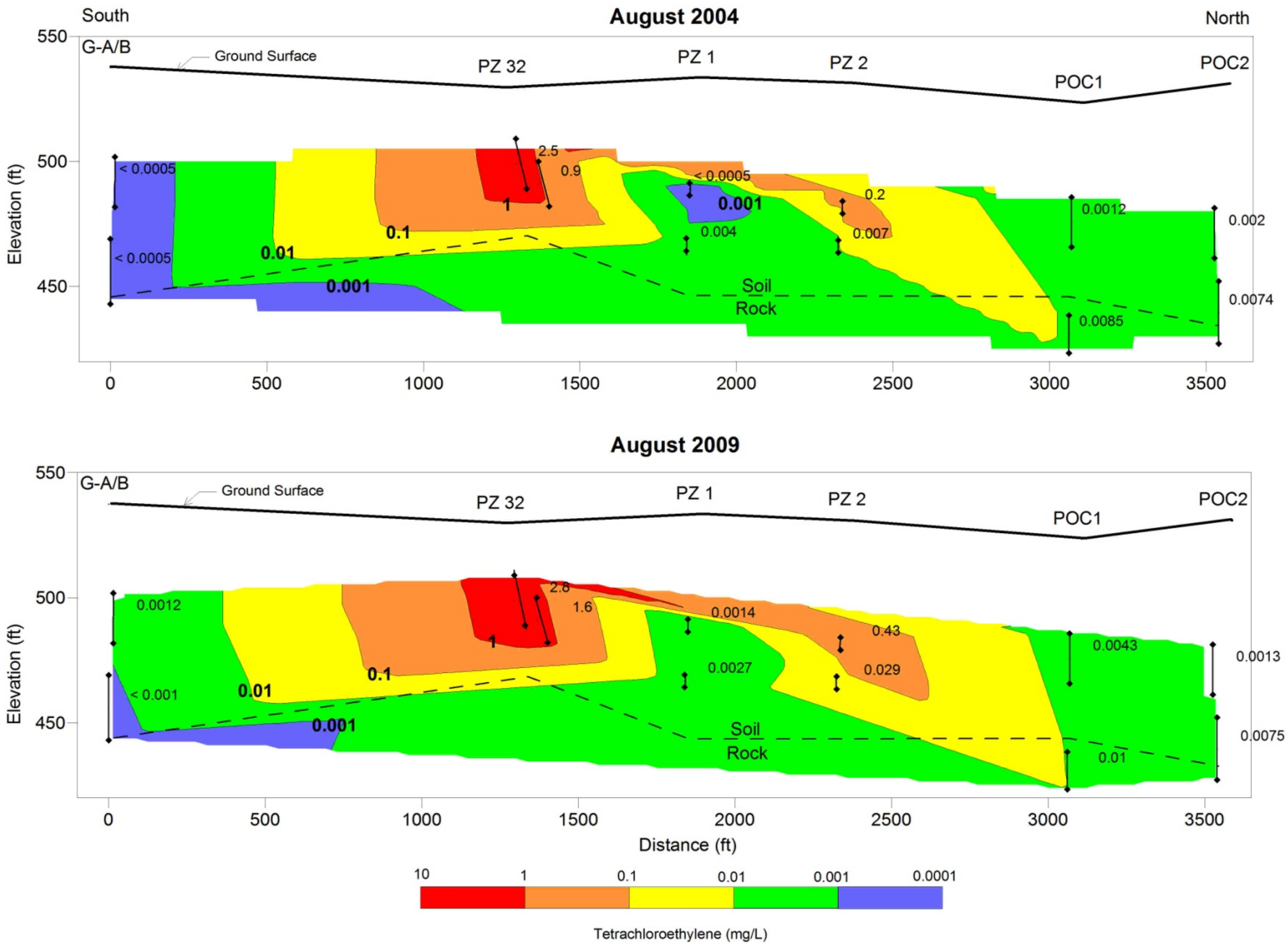


Figure 3-9. Vertical Distribution of Tetrachloroethylene, August 2004 and August 2009

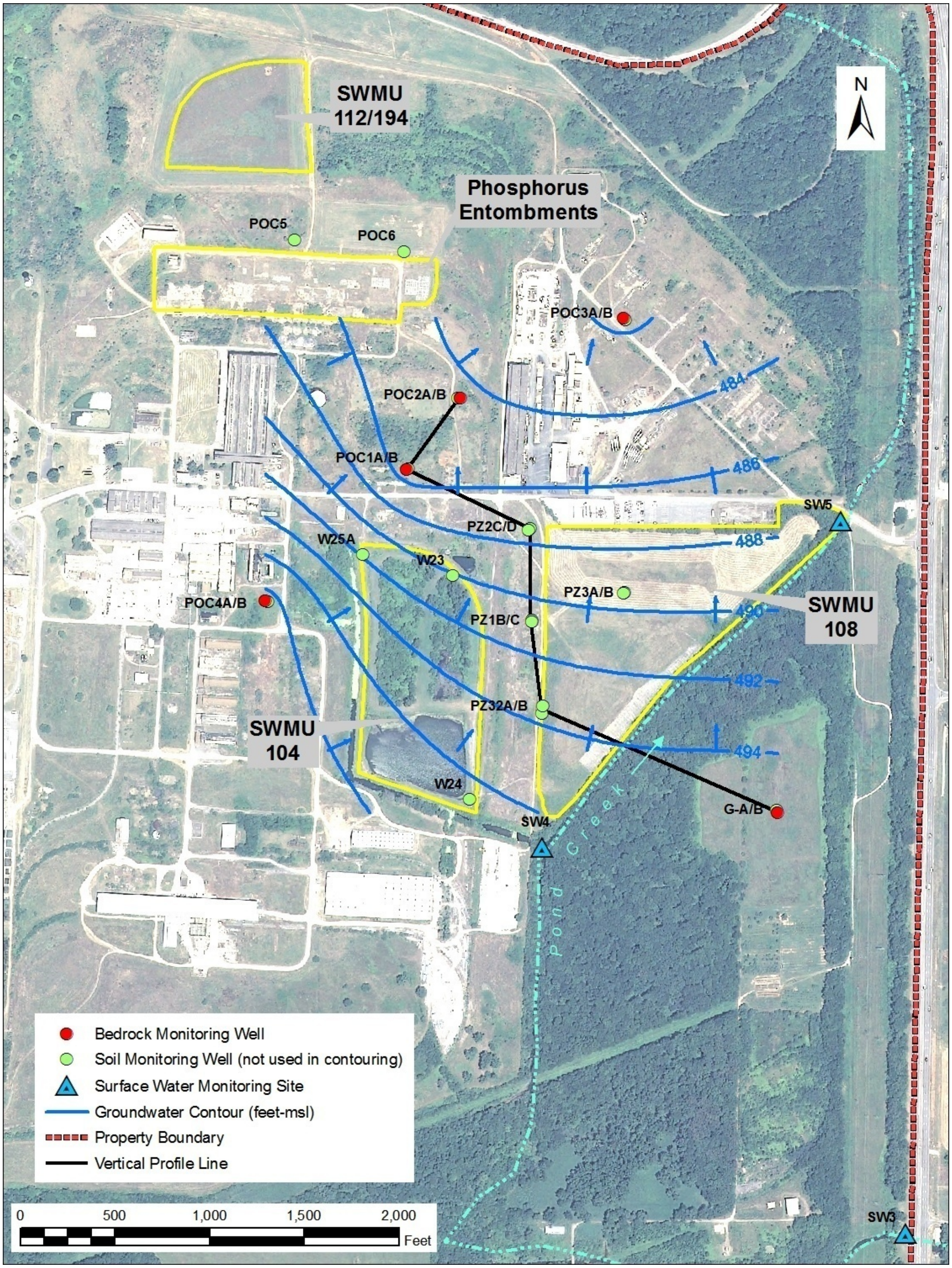


Figure 3-10. August 2009 Shallow Bedrock Potentiometric Surface Map at Solid Waste Management Unit 108

In conjunction with the groundwater monitoring program at SWMU 108, three sampling sites (SW3, SW4, and SW5) on Pond Creek are monitored for tetrachloroethylene as shown in Figure 3-10. Historically, the highest tetrachloroethylene concentrations and frequency of detections have generally been observed at upstream (off-site) location SW3, followed by SW4 and SW5. The spatial trend of decreasing tetrachloroethylene concentrations and detections in the downstream direction suggests an off-site source of tetrachloroethylene. Since 2006, however, SW5 has been the only monitoring station to show any detectable tetrachloroethylene levels. Although data continue to indicate an off-site tetrachloroethylene source, an on-site source cannot be ruled out.

3.3.2.2 Solid Waste Management Unit 104 (Ash Settling Pond) and Solid Waste Management Units 17-37 (Phosphorus Entombments)

The ash settling pond was constructed to contain potential spills from the elemental phosphorus production facility and to settle out phosphorus-containing solids from the waste stream. The phosphorus entombments are in the production plant's former furnace areas, within existing pits and sumps.

The potential contaminant of concern associated with these SWMUs is white phosphorous (P_4). The monitoring program for SWMU 104 includes two POC wells (POC 4A/B) located approximately 500 feet downgradient of the SWMU boundary and three noncompliance wells (W23, W24, and W25A) completed in shallow soils in the immediate vicinity of the SWMUs.

Groundwater monitoring at SWMUs 17-37 is conducted at two shallow overburden monitoring wells (POC5 and POC6), located approximately 100 feet downgradient of the facility boundary. PCM has been performed at SWMU 104 and SWMUs 17-37 since August 2003. Monitoring was conducted approximately quarterly between August 2003 and August 2005 and annually thereafter. No P_4 has been detected in groundwater samples from POC and noncompliance monitoring wells during the PCM period (Appendix G). Analytical detection limits for P_4 have varied from 0.023 to 0.25 micrograms per liter (µg/L) during the monitoring period.

The absence of P_4 in groundwater is expected due to its limited mobility in subsurface environments. Once P_4 dissolves in groundwater, it oxidizes to form phosphates that are quickly removed by processes of adsorption complexation (i.e., a combination of two or more substances), and precipitation (i.e., the formation of a solid) as the water flows through the soil (Nikandrov and Smirnov 1983; Campbell 1977; Brady 1974).

P_4 may occur in groundwater in two ways, ionic P_4 and particulate P_4. The rate at which the P_4 oxidizes to phosphates depends on the amount of available dissolved oxygen and water temperature. The higher the level of dissolved oxygen is, or the higher the temperature is, the faster the rate of oxidation is. For ionic P_4, the half-life ranges from 42 hours to 125 days (Spangord et al. 1985; Nikandrov and Smirnov 1983). For particulate P_4, the half-life may be as high as 2.4 years (Spangord et al. 1985). In the case of the particulate P_4, an oxidized phosphate layer will form on the particle making it reactive with soil to form compounds that immobilize the particulates.

Once the phosphates are formed in the water, they will quickly react with cations (e.g., calcium, magnesium, iron, and aluminum) dissolved in the water or as part of the soil matrix to form insoluble compounds. Therefore, the P_4 will be precipitated from the water column as insoluble phosphates. These are not likely to redissolve or migrate due to the very low solubility of metal phosphates.

3.3.2.3 Solid Waste Management Unit 86 (Phosphate Development Works Lagoons)

The two former PDW lagoons were located just northeast of SWMU 104 (Figure 3-7). The lagoons were designed to receive wastewater treatment effluent and storm water runoff and were constructed with a bentonite clay bottom liner and a capacity of 2.5 million gallons. Plant effluent contained chloride, phosphate, elemental phosphorus, oils, and grease. The production facilities at PDW ended operation in 1957. From 1957 until 1993, the lagoons handled only rainwater runoff. In September 1996, the dike next to Pond Creek was removed to prevent the lagoons from holding rainwater.

In November 1992, groundwater samples were collected from Wells W27 through W30, which were drilled at the corners of the SWMU (see Figure 3-7). The samples were analyzed for semi-VOCs (SVOCs), pesticides, and polychlorinated biphenyls (PCBs). No SVOCs or pesticides were detected in any of the samples; however, the chemical analysis on the water samples had a limited ability to detect the presence of several compounds. The chemical tests needed a higher concentration of those compounds even to detect them in the sample than the concentration designated as an “action limit” threshold (i.e., the chemical level for a compound that requires cleanup is lower than the amount actually needed to detect the compound in the first place).

An additional set of groundwater samples taken from Wells W27 through W30 in February 1993 for PCBs and pesticide analysis showed no detectable PCBs or pesticides, but again detection limits exceeded action limits in several cases (TVA 1998c).

3.3.2.4 Solid Waste Management Unit 100 (Ammonia From Coal Project Equalization Basin)

SWMU 100 received ammonia from coal project wastewater containing 0 to 200 ppm ammonia, 1 ppm sulfur, 2 ppm cyanide, and 100 to 2,000 ppm chemical oxygen demand. Surface runoff from the ammonia from the coal project plant area was also routed to the basin. The equalization basin associated with this SWMU had a capacity of 380,000 gallons and was lined with a 2-foot-thick compacted clay base covered with a 36-millimeter flexible membrane liner. Two upgradient monitoring wells (19 and 21) and two downgradient monitoring wells (20 and 22), all completed within the residual overburden, were installed around SWMU 100 in January 1991. Inferred groundwater movement in the SWMU 100 vicinity varied from westward to southwestward based on snapshots of water levels at Wells 19-22 performed in September 1991 and February 1997 (TVA 1998c).

Wells 19-22 were sampled in February 1996 for VOCs, SVOCs, pesticides, PCBs, and metals. Groundwater samples from downgradient Wells 20 and 22 exhibited chromium concentrations of 0.11 and 0.9 milligrams per liter (mg/L), which exceeded the chromium screening level. Screening level exceptions were also indicated at Wells 20 and 22 for lead (0.05-0.11 mg/L) and vanadium (0.11-0.35 mg/L). In addition, samples from Well 22 showed exceedences for beryllium (0.005 mg/L), cadmium (0.009 mg/L), and nickel (0.1 mg/L). Elevated concentrations of these trace metals were attributed to sample bias resulting from the presence of suspended soil particulate containing naturally occurring trace metals in unfiltered groundwater samples (TVA 1998c).

3.3.2.5 Solid Waste Management Unit 115 (Ammonia From Coal Gasification and Purification Plant Coal Slag Landfill)

This landfill was constructed to dispose of solid wastes generated by SWMU 115. The landfill is lined with 2 feet of compacted clay and measures approximately 400 feet long by 150 feet wide and 15 feet deep. The landfill contains only wastes generated by the

Ammonia From Coal Gasification and Purification Plant and ancillary waste treatment processes. Disposed wastes include slag generated from the gasification of coal and wastewater treatment sludge. This landfill has received no waste since October 1985.

One upgradient (Well 4) and three downgradient monitoring wells (Wells 1, 2, and 3) were installed prior to placing any waste in the landfill. Groundwater flow is generally in a northwesterly direction in conformity with the placement of the wells. Groundwater samples were collected from each well in April 1996 and analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. No constituent or hazardous characteristics were detected in groundwater samples at concentrations higher than screening levels (TVA 1998c).

3.3.2.6 Solid Waste Management Unit 112/194 (Precipitator Dust Piles/Trestle Drum Storage Area)

SWMU 112/194 contains approximately 20,000 tons of phosphate containing precipitator dust from electric furnace elemental phosphorus operations, which ended in 1976. Precipitator dust sampling in November 1984 identified phosphorus pentoxide, elemental phosphorus, potassium oxide, silica dioxide, cadmium, lead, and the radionuclides radium-226, lead-210, polonium-210, uranium, and potassium-40. Groundwater investigations began at SWMU 112/194 in April 1997 with installation and sampling of monitoring Wells 36, 37, and 38, all of which were completed in residual overburden to depths ranging from 40 to 49 feet below grade (see Figure 3-7). Water level monitoring of these wells indicated westward movement of groundwater toward the Tennessee River. Wells were sampled for elemental phosphorus, gross alpha, gross beta, total radium, lead-210, polonium-210, potassium-40, total uranium, radon-222, and total lead and thallium (TVA 1998c).

Elemental phosphorous was below the detection level of 0.02 µg/L at all wells. Total lead and thallium concentrations were below the detection levels (0.001 and 0.002 mg/L, respectively) at Wells 36 and 37 but exceeded the RCRA action levels (0.015 and 0.002 mg/L, respectively) at Well 38. Although total lead and thallium values in Well 38 were 0.34 and 0.004 mg/L, respectively, dissolved (filtered) lead and thallium concentrations at Well 38 were below the detection levels. Lead and thallium strongly adsorb to clay particles. Results of groundwater sampling for dissolved lead and thallium suggest that they are being attenuated by low permeability clays underlying the site. Based on these results, no meaningful contamination of groundwater by lead and thallium was indicated at SWMU 112/194 (TVA 1998c).

Groundwater monitoring results from SWMU 112/194 indicated six radionuclides exceeded calculated preliminary remediation goals (Appendix H). These radionuclides included potassium-40, lead-210, polonium-210, radon-222, total radium, and total uranium. The RFI final report (TVA 1998c) concluded that groundwater downgradient of SWMU 112/194 appeared to be affected by radionuclide contaminants and that contamination probably originated from the precipitator dust piles. SWMU 112 was capped in accordance with RCRA standards in order to minimize future generation of contaminated leachate from the facility.

3.3.2.7 Solid Waste Management Unit 114 (Phosphate Slag Storage Area)

SWMU 114 contains approximately 1.6 million tons of phosphorus slag by-product from past phosphorus and phosphoric acid for fertilizer production. Phosphate slag contains calcium oxide, silicon dioxide, aluminum oxide, fluorine, potassium monoxide, phosphorus, ferric oxide, sodium oxide, and manganese monoxide. Phosphate slag also contains elevated levels of naturally occurring radioactive materials consisting mainly of radium-226.

The U.S. Bureau of Reclamation performed water sampling in the vicinity of the phosphate slag stockpiles in conjunction with chemical and radiological characterization of phosphate wastes (May and Boyle 1990). Five water samples were collected. These included one from a depression on the top of the east slag pile (Sample 1W), one from a groundwater seep flowing to Pond Creek (2W), and three samples (3W-5W) from Pond Creek (Appendix I). Each sample was analyzed for the presence of 32 elements, including 16 metals. Samples 1W and 2W, which were assumed to be representative of seepage from the slag pile, exceeded drinking water MCLs for chromium, mercury, and fluoride. Pond Creek Sample 4W also indicated an MCL exceedence for mercury. Complete water sampling results are given in Appendix I. Waste characterization studies found nothing to indicate that the phosphate slag was hazardous (May and Boyle 1990).

3.3.2.8 Low-Level Radioactive Waste Burial Site

The LLRWBS is located in the southwestern corner of the MSR study area and operated from 1966 to January 1981 (see Section 3.1.1.4). The currently inactive facility primarily received wastes from TVA's fertilizer research and radioanalytical laboratory quality control programs. A total of 51 different radionuclides were buried at the site (see 1997 letter in Appendix D).

A single monitoring well (LLRWBS-MW1) was installed at the LLRWBS in August 1996 to support an assessment of the environmental effects of the facility required by the NRC. The well was completed to a depth of approximately 61 feet in residual overburden. Depth to groundwater measured at this well on April 29, 1997, was approximately 51 feet below ground surface, thus indicating radioactive waste materials were stored approximately 40 feet above the water table. MW1 was sampled for tritium and carbon-14 in November 1996 and May 1997. Because tritium was deposited at the burial site in the form of tritiated water, it is highly mobile in the subsurface and should be detected before the other radionuclides, particularly metals, which tend to adsorb to soils. Liquid scintillation analysis indicated both tritium and carbon-14 were below instrument detection limits for both samples, i.e., less than 795 and less than 652 pico-curies per liter (pCi/L), respectively, for the November 1996 sample and less than 250 and less than 387 pCi/L for the May 1997 sample (W. L. Raines, TVA, personal communication, April 25, 2010).

As part of an assessment of the environmental effects of the inactive LLRWBS conducted in 1997 (see 1997 letter in Appendix D), a health risk analysis was performed to evaluate the total effective dose equivalent (TEDE) for a maximally exposed individual, assuming the individual's drinking water was derived from a hypothetical well located at or downgradient of the burial site. The predicted TEDE was 0.55 mrem during 1983 and 0.0000025 mrem during 1997. No future increase in dose after 1997 was indicated. Predicted TEDEs were well below current NRC and USEPA regulations.

3.3.2.9 Off-Site Groundwater Investigations

Several off-site studies of groundwater quality in the surrounding Muscle Shoals region were performed by other organizations during the 1980s and early 1990s. These included investigations at the Occidental Chemical Corporation site (G&E Engineering Inc. 1991) and the former Ford plant site (Golder Associates 1990) and regional studies by the Geologic Survey of Alabama (Chandler 1986; Chandler and Moore 1991; and Chandler et al. 1990).

The Occidental Chemical chlor-alkali production plant borders MSR to the east. In 2008, Occidental ended its chlor-alkali mercury cell production and decommissioned the plant. Occidental continues to manufacture potassium carbonate. The groundwater investigations at the Occidental site confirmed the presence of plumes of mercury, cadmium, and chloride with elevated chloride concentrations that probably extend downgradient onto MSR property. The mercury concentrations in groundwater samples ranged from below 2 to 280 µg/L; cadmium concentrations from below 5 to 250 µg/L; and chloride concentrations from 1 to 170,000 mg/L (G&E Engineering Inc. 1991). Laboratory analysis of groundwater samples from the deep wells revealed mercury concentrations ranged from less than 0.2 to 20 µg/L; cadmium levels from less than 5 to 21 µg/L; and chloride from 102 to 16,400 mg/L. The former Ford plant, approximately 1.5 miles east of the MSR study area, used on-site evaporation and drying ponds for wastewater during its operation. The prevalent compounds identified at the Ford site were VOCs, including tetrachloroethane, trichloroethane, 1,2-dichloroethene, and vinyl chloride. Other compounds detected in the groundwater at the site include PCBs (PCB-1242), dense nonaqueous phase liquids, ethyl benzene, xylene, cyanide, zinc, and arsenic. Based on regional groundwater gradients and results of dye trace studies performed at the Occidental and Ford plant sites, subsurface contaminants originating at these neighboring industrial plants probably affect groundwater quality in the Tuscumbia-Fort Payne aquifer system beneath the MSR study area (Julian et al. 1993).

Chandler (1986) and Chandler and Moore (1991) evaluated effects of storm water drainage (Class V) wells on groundwater quality in the Muscle Shoals area. These studies found that high color and turbidity in samples of groundwater and surface water runoff entering the drainage wells accounted for the water quality problems associated with the drainage wells. Consequently, numerous storm water drainage wells located upgradient of MSR also likely influence groundwater quality in the bedrock aquifer beneath MSR.

3.3.2.10 Summary

Groundwater quality investigations at MSR have focused primarily on several of the larger SWMUs found to contain hazardous waste during the RFA/RFI process. Examination of the monitoring data from these investigations indicates groundwater quality has been unaffected in the vicinity of SWMUs 17-37, 104, or 115, all of which showed no RCRA action limit (RAL) exceedences in monitoring wells samples. Groundwater also appears unaffected at the LLRWBS, where limited sampling of one well at the site showed no detectable tritium, the most mobile of the stored wastes.

Groundwater monitoring results for SWMUs 86 and 100 were generally favorable but somewhat uncertain for some constituents. Preclosure groundwater monitoring in the SWMU 86 locality indicated no SVOC, PCB, or pesticide RAL exceedences. However, analytical detection limits were greater than RALs for some constituents, leaving the question of RAL exceedences open for those constituents. RAL exceptions were indicated for heavy metals (i.e., beryllium, cadmium, chromium, nickel, vanadium) in preclosure groundwater sampling results for SWMU 100. However, evidence was presented in the RFI report (TVA 1998c) indicating that elevated concentrations of metals were likely biased by the presence of soil particulates containing naturally occurring metals in unfiltered groundwater samples.

Although groundwater beneath and in the region downgradient of SWMU 108 is affected by waste leachate, the monitored natural attenuation closure program approved for this facility allows for elevated VOC concentrations, provided that VOC action limits are not exceeded at the POC monitoring wells. Postclosure groundwater monitoring indicates the presence of tetrachloroethylene and several other VOCs in downgradient POC monitoring wells, but concentrations have consistently been below ADEM action limits. Other overburden monitoring wells (not designed for compliance purposes) located in the immediate vicinity of

SWMU 108 continue to show elevated VOC concentrations. However, concentrations in these wells and the POC wells have remained relatively stable during the postclosure period. The stability of the VOC plumes during the past six years indicates that the rates at which dissolved VOCs are transported via groundwater away from the landfill are roughly equal to rates of natural attenuation of VOCs. Similar attenuation of nitrate and other contaminants detected in groundwater during preclosure investigations is expected. Periodic sampling of Pond Creek in the vicinity of SWMU 108 continues to indicate an off-site source of the low concentrations of tetrachloroethylene observed in samples, although some contribution of tetrachloroethylene from SWMU 108 cannot be ruled out.

Preclosure groundwater investigations at SWMUs 114 and 112/194 indicated some evidence of groundwater contamination. Limited groundwater monitoring at SWMU 114 suggested phosphate slag deposits might be affecting local groundwater and possibly Pond Creek water quality. Sampling of seepage from the phosphate slag storage area showed MCL exceedences for chromium, mercury, and fluoride. A water sample collected from Pond Creek directly downgradient of the phosphate slag storage area also showed a mercury MCL exception. Groundwater monitoring results for samples from SWMU 112/194 Wells 36-37 indicated six radionuclides exceeded calculated preliminary remediation goals (Appendix H). These radionuclides included potassium-40, lead-210, polonium-210, radon-222, total radium, and total uranium.

Given the prevailing westward groundwater gradients on the eastern side of the MSR study area, subsurface contamination originating at the neighboring Occidental Chemical Plant and former Ford plant sites has probably affected groundwater quality in the Tuscumbia-Fort Payne aquifer system beneath the MSR study area. Investigations confirmed the presence of cadmium, mercury, and chloride plumes beneath the Occidental site, which likely extend onto the MSR study area. A range of VOCs, chlorinated solvents, PCBs, and heavy metals were detected in groundwater at the Ford site. Many of the contaminants identified at elevated concentrations in groundwater beneath these upgradient properties are similar to contaminants found in MSR groundwater samples collected from bedrock monitoring wells, e.g., VOCs and heavy metals. However, the extent to which off-site contaminant sources contribute to groundwater contaminant levels at MSR is unknown and would be difficult to quantify with certainty using available information.

3.3.3 Local Groundwater Use

The groundwater use survey focused on wells and springs located on the south side of the Tennessee River and within approximately 5 miles of the MSR study area. Records of water-supply wells registered with the Geological Survey of Alabama (GSA) were obtained for the region and are summarized in Appendix J. The Alabama Office of Water Resources (AOWR) also provided a listing of large public, industrial, and irrigation well users in Colbert County from the 2005 national water use inventory coordinated by the U.S. Geological Survey (Tom Littlepage, AOWR director, personal communication, July 2009). AOWR data are presented in Appendix J. Additional water use information was obtained from the Julian et al. (1993) report.

A map showing the density of wells and springs within the vicinity of the MSR study area is shown as Figure 3-11. Precise well/spring location information is not available from GSA records; only township-range-section locations are recorded for each well. These data were used to determine the number of wells within each 1-square-mile map section shown on Figure 3-11. A total of 62 water supply wells and one public water supply spring are indicated within the 5-mile survey area. Approximately half of the wells were constructed prior to 1980. Some (perhaps many) of these wells are likely no longer used because of the widespread availability of public water in the Tuscumbia-Sheffield-Muscle Shoals region. Well depths in the survey region range from 66 to 250 feet, with a median depth of 120 feet. The Tuscumbia-Fort Payne aquifer system is the source for all wells listed in the AOWR records within the 5-mile survey area. In most cases, GSA records do not identify the source aquifer. However, well depth information and drillers' logs (where available) indicate most wells are completed in the Tuscumbia-Fort Payne aquifer. Approximately 40 percent of the listed wells are used for industrial and commercial supply, 35 percent for private (or residential) supply, and 24 percent for irrigation. Given the age of many of the private wells listed in GSA records and the local availability of public water, many of these wells are likely no longer used for potable water supply.

Tuscumbia Spring (also known as Big Spring) is the largest known public groundwater supply in the area and is located about 4 miles southwest of the MSR study area (see Figure 3-11). Tuscumbia Spring serves the city of Tuscumbia, several adjoining areas outside of Tuscumbia, and the Littleville Water Department. Total withdrawals by the Tuscumbia Water Treatment Plant average 1.8 MGD (David Thornton, Tuscumbia Utilities manager, personal communication, May 6, 2010). The source of the spring is the Tuscumbia-Fort Payne aquifer. Average flow of Tuscumbia Spring is 42 MGD. However, seasonal variation of discharge is high, which is characteristic of most springs originating in karstic limestone. Chandler and Moore (1991) estimate a recharge area for Tuscumbia Spring of approximately 84 square miles, based on the regional recharge rate of 11.4 inches/year estimated by Curtis (1953) and mean spring flow of 42 MGD. Other public groundwater supplies located outside of the survey area include the Hawk Pride Mountain water system and the Leighton Water and Sewer Board system. The Hawk Pride Mountain system, located approximately 8 miles southwest of the MSR study area, operates two wells completed in the Tuscumbia-Fort Payne aquifer system. Combined pumpage from both wells in 2005 averaged approximately 1.08 MGD. The Leighton system, approximately 9 miles southeast of the MSR study area, consists of one Tuscumbia-Fort Payne well that produced pumpage averaging approximately 0.23 MGD in 2005. Other public water systems serving the MSR region, which include the Muscle Shoals Water Department and Colbert County Water Department, withdraw water from intakes on the Tennessee River.

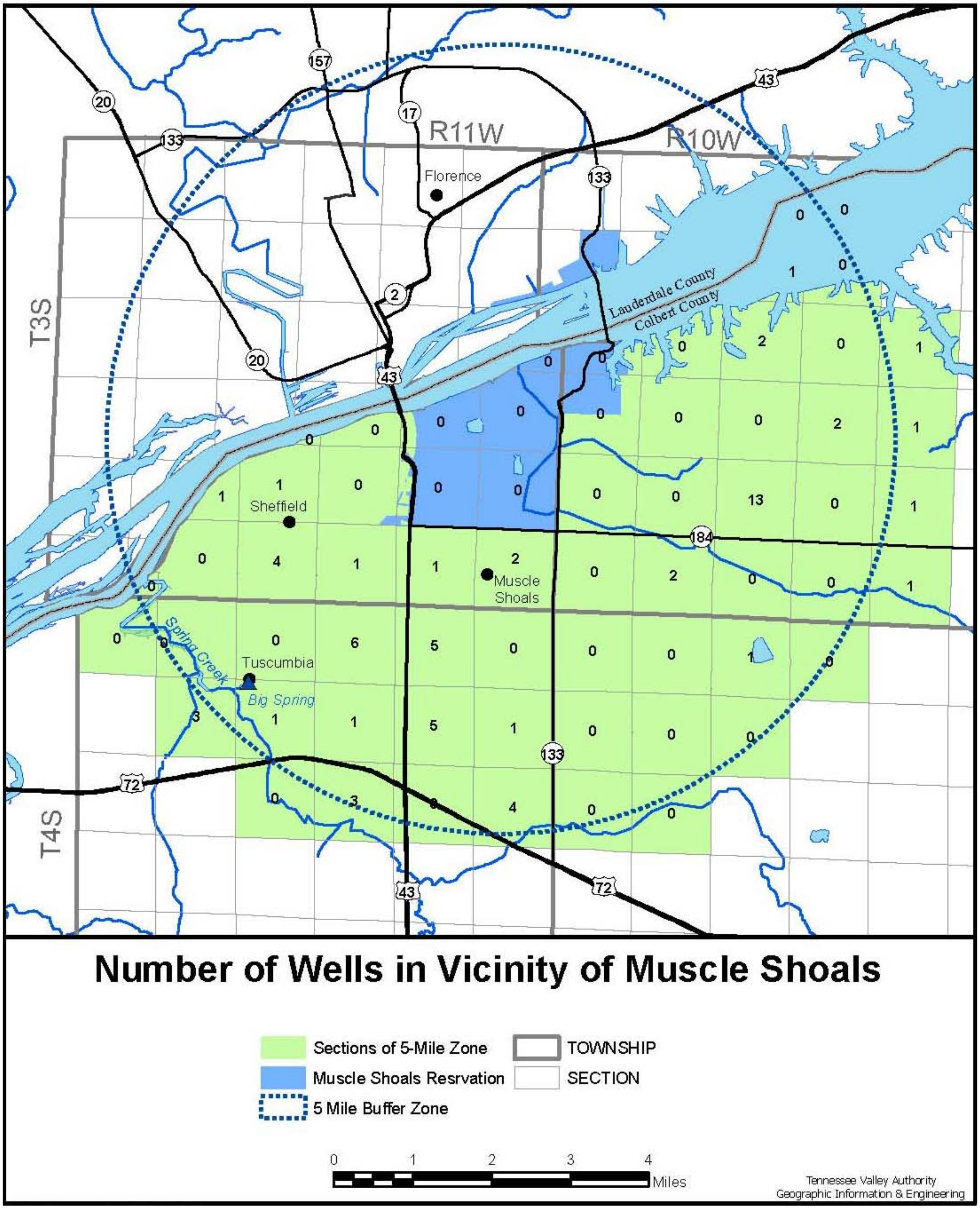


Figure 3-11. Groundwater Supply Wells in the Vicinity of the Muscle Shoals Reservation Study Area

3.4 Historic and Archaeological Resources

Cultural resources include properties such as prehistoric and historic archaeological sites, historic sites where important events or activities may have occurred, and buildings and structures that may be associated with significant events, people, or designers or of particular importance for research. Often, when there are many resources within a contiguous area, a historic district can be established to express the continuity and concentration of resources. Generally, properties determined to be eligible for listing in the NRHP meet one or more the following National Register Criteria for Eligibility:

- Criterion A: Properties associated with events that have made a significant contribution to the broad patterns of our history
- Criterion B: Properties associated with the lives of persons significant in our past
- Criterion C: Properties that embody the distinctive characteristics of a type, period, or method of construction, that represent the works of a master, that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction
- Criterion D: Properties that have yielded, or may be likely to yield, information important in prehistory or history

As a federal agency, TVA is required to examine the potential effects of its undertakings (i.e., proposed actions) on any cultural resources that may be included in or be eligible for inclusion in the NRHP. When these effects are determined to be adverse, TVA is required to take measures to mitigate the adverse effects. Cultural resources subject to this requirement include any historic properties that have historic significance to their community, the state, or the nation.

In accordance with Section 106 of the NHPA of 1966, as amended, TVA consulted the Alabama Historical Commission on the potential fate of the historic properties on the MSR study area. A critical step in the Section 106 consultation process is establishing the area of potential effects (APE). The APE is the geographic area or areas within which an undertaking may cause changes in the character or use of historic properties, if any such properties exist. The APE for the MSR redevelopment project is the approximately 1,400-acre project study area as shown in Figure 3-12 as well as in Appendix A of the Memorandum of Agreement (MOA; see Appendix A to this EIS) between TVA and the Alabama SHPO. The Alabama SHPO concurred with this APE determination in its June 14, 2010, letter. The Alabama SHPO also provided concurrences and comments on other parts of TVA's proposed undertaking (see Appendix K). TVA has identified seven historic contexts within which properties eligible for the NRHP occur in the study area. These contexts are listed in Table 3-4 with resource or historic chronology and context descriptions. Numerous individual buildings and structures are included within these larger resource types (i.e., district, complexes, or sites).

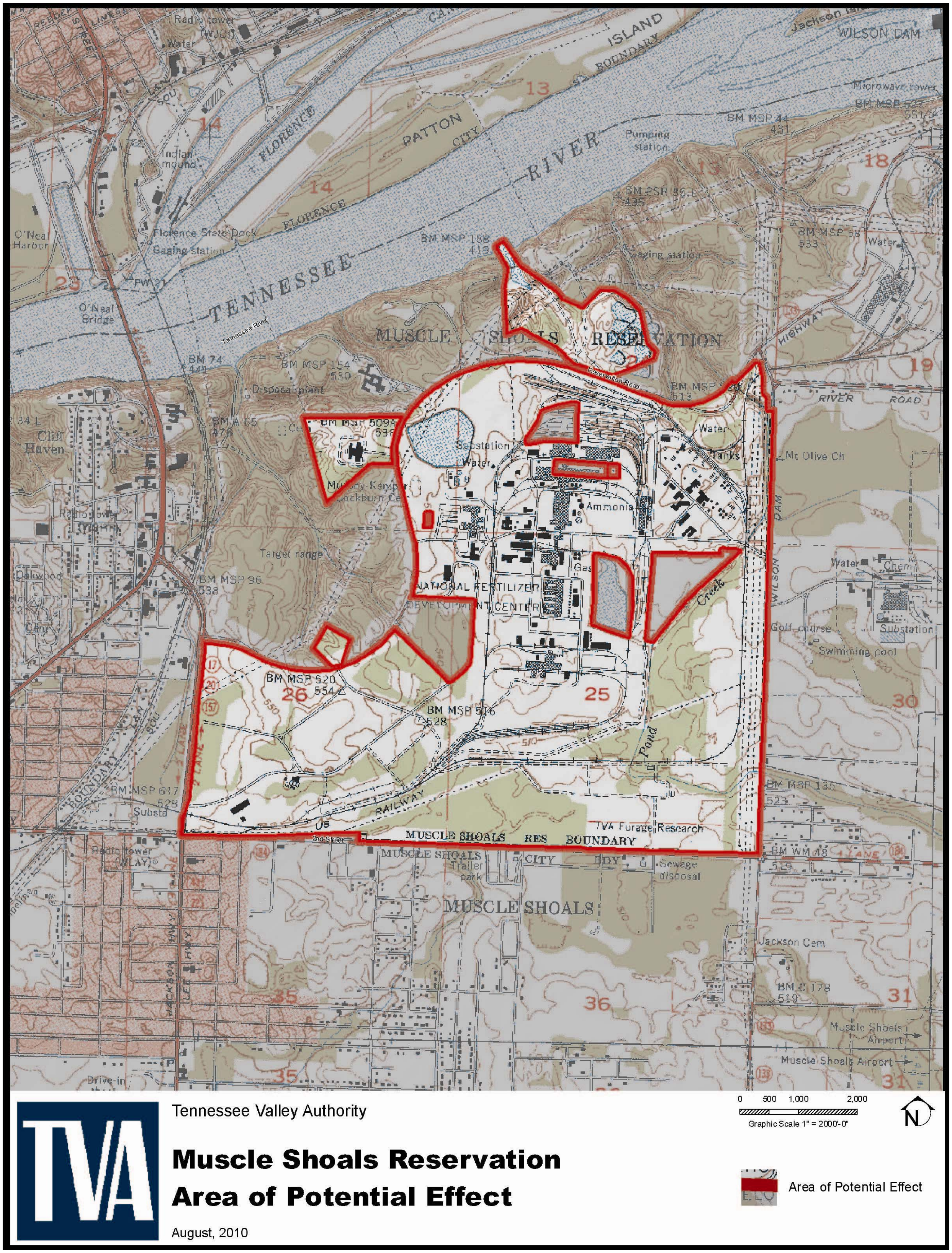


Figure 3-12. Area of Potential Effect, Muscle Shoals Reservation Study Area

Table 3-4. Eligible Properties Within the Muscle Shoals Reservation Study Area of Potential Effects

Resource Name	Resource Number	Resource Type	NRHP Status
Muscle Shoals Historic District	N/A	Historic District	Eligible
National Fertilizer Development Center (USNP2)	N/A	Building Complex	Eligible
TVA Greenhouse Research Complex	N/A	Building Complex	Eligible
TVA Environmental Research Center Building	N/A	Building Complex	Eligible
Foundations of Steam Plant Near TRM 258	1CT495	Historic Site	Contributing
Construction Village No. 2	1CT500	Historic Site	Contributing
Recreation Area (Village No. 2)	1CT575	Historic Site	Contributing

N/A = Not applicable

3.4.1 Archaeology

The prehistoric sequence of human occupation in north Alabama has been explored since the 19th century. The archaeological survey and excavations that took place during the construction of TVA's Guntersville, Wheeler, and Pickwick reservoirs began the systematic, scientific study of Native American occupation in this part of the Tennessee River Valley. Detailed reviews of the sequence of occupation can be found in Walthall (1980) and Futato (1983). Precontact archaeological cultures in Alabama are usually divided into five temporal units: the Paleo-Indian Period, the Archaic Period, the Gulf Formational Period, the Woodland Period, and the Mississippian Period.

3.4.1.1 The Paleo-Indian Period

The Paleo-Indian Period extends from approximately 10,000 to 8000 B.C. In Alabama, it is the first human occupation and is characterized as having a low population density and mobile lifestyle. Typically, small bands of Native Americans were thought to follow large migratory herd animals such as mammoth, mastodon, and bison. Undisturbed Paleo-Indian sites are rare, but there is growing evidence that they exploited a diverse range of animals and plants available in the southeastern U.S. The climate during this time was transitioning from cool temperatures favoring boreal forests and abundant open grasslands to a warmer, humid climate favoring deciduous forests. Usually, given the great age of these sites, only stone tools remain as evidence of their transitory occupation of the Tennessee River Valley. Stone projectile points designated as Clovis, Cumberland, Quad, and Beaver Lake are often used to identify sites of this age. Nearby Paleo-Indian sites such as Quad and the Stanfield-Worley bluff shelter attest to the fact that north Alabama was home to the earliest humans in the Southeast.

3.4.1.2 Archaic Period

During the Archaic Period (8000 to 1000 B.C.), population is thought to have increased and mobility to have decreased. As a more modern environment developed, Native Americans practiced seasonal migration to take advantage of plant and animal resources available, but in smaller territories. This is most obvious at the many shell middens that are found adjacent to the Tennessee River. It is unlikely that any group settled permanently in these areas but returned seasonally or annually to exploit freshwater mussels. In addition to mussels, archaic peoples exploited a wide variety of nuts, plants, fish, waterfowl, and terrestrial mammals. Stone tools are still the most obvious tool left behind to support these theories. The diversity of shapes and sizes of projectile points and knives increased during this period. This is seen in the variety of names used by archaeologist to put them into types (e.g., Kirk, Palmer, Eva, Morrow Mountain, Ledbetter, Pickwick, and Little Bear Creek points). Most were used at the end of large spears, but toward the end of this period, they became smaller and may have been on thin spears thrown with the use of an atlatl. The atlatl is a hooked stick that extends the length of the arm, thereby increasing the force of the throw. Ground stone tools in the shapes of adzes and axes from this period were also found. Archaic sites are more abundant than those established in the previous Paleo-Indian Period. Fortuitous discoveries on Little Bear Creek offer tools made of bone and antler, such as pins, beads, and awls. At the very end of the Archaic Period, early ceramic vessels in the shape of wide-mouth beakers were used.

3.4.1.3 The Gulf Formational Period

The Gulf Formational Period (2500 to 200 B.C.) overlaps the more commonly used Archaic Period. Walthall and Jenkins (1976) first identified the period by the arrival of fiber-tempered, slab-built ceramic vessels, probably from the Gulf and southern Atlantic coasts. Called “Wheeler” ceramics, they were first used in the project area around 1000 B.C. Most are plain, but punctuations, simple stamping, and dentate stamping of the exterior vessel surface are sometimes found on these items. Toward the end of this period, ceramics tended to be tempered with sand and built from coils of clay. These items, known as “Alexander” ceramics, can have elaborately decorated, punctuated, and incised exterior surfaces. The way Native Americans made their living during this period is similar to the latter part of the Archaic Period. This was a seasonal round of hunting terrestrial, aquatic, and avian creatures, while also gathering a wide variety of edible plants, berries, and nuts. Walthall (1980) asserts that during the latter part of this period, one begins to see evidence of trade between different regions. He points out that graves found in the Pickwick Reservoir have shell beads made from Gulf Coast marine creatures. Steatite and sandstone pipes from east central Alabama and copper beads that may have come from the upper Midwestern U.S. also provide evidence of trade.

3.4.1.4 The Woodland Period

The Woodland Period (200 B.C. to A.D. 900) is characterized by increasing population and sedentism (i.e., staying in one place). Much occurred during this period. Production of ceramics flourished with respect to size, shape, and decoration. Materials added to clay improved its workability. Firing characteristics shifted from fiber to sand, crushed limestone, and even crushed potsherds called “grog.” There is evidence that Native Americans began to domesticate native plants such as squash, goosefoot, sunflower, sumpweed, and maygrass during this period. These never reached the state of full intensive cultivation, but there is evidence that people were moving around in smaller territories and intensifying their use of plants and animals in their territory. They probably helped to propagate the plants that provided useful nutrition and fibers. Maize (corn) has occasionally been found in late Woodland Period sites but appears to be just one of a number of plant foods in the diet.

During the middle of the Woodland Period, intentional burials in or under earthen mounds were practiced. Sometimes the individuals buried in these mounds were accompanied with clearly ceremonial objects sometimes made from nonlocal raw materials like obsidian, raw copper, and Gulf coast marine shell. There was some differentiation among the people of the Woodland Period, as not everyone was buried with exotic artifacts. Perhaps individuals achieved higher social status through exceptional hunting skills or superior knowledge of the healing properties of plants. In north Alabama, this period is called “Copena,” and is characterized by burial mounds, long-distance exchange, and differential distribution of ceremonial objects.

Toward the end of the Woodland Period, projectile points small enough to have been actual arrowheads are found. There have been some suggestions that the bow and arrow had as much to do with increasing conflict between Woodland communities as they were improvements in hunting technology. At the end of the Woodland Period, burials were not in earthen mounds, and rarely did objects made from exotic materials accompany the dead.

3.4.1.5 The Mississippian Period

Walthall (1980) defines the Mississippian Period in Alabama as lasting from A.D. 900 to 1500. Archaeological cultures attributed to the Mississippian Period stretch from the upper Midwest through the South. The Spiro site in Oklahoma is one of the westernmost manifestations, and the Town Creek site in North Carolina is one of the easternmost. In Alabama, the Moundville site along the Black Warrior River is the best known Mississippian center, but an equally large Mississippian center, Bottle Creek, is found in the swamplands of the Tensas River just north of Mobile, Alabama.

Characteristics common to most of these Mississippian manifestations are the development of high-quality, thin-walled ceramics using crushed shell as a tempering agent. Many of the utilitarian pots were plain, but others had complex incised designs on the exterior surface. Although most Mississippian sites are small villages adjacent to floodplain fields of corn, beans, and squash, this period is also characterized “by the construction on or around a central plaza, of large earthen platforms that served as substructures for temples, elite residences, and council buildings” (Walthall 1980). Native American population density seems to be at its greatest at this time, and intensive agriculture was practiced to support this population as well as an elite group devoted not to food production but to politico-religious governance of large territories. The production of nonfunctional objects for politico-religious ceremonies also reached a peak during this period. The similarity of symbols and objects at Mississippian centers throughout the East has given rise to the idea that there was a “Southeastern Ceremonial Cult.” The shared iconography includes stylized depictions of peregrine falcons, bilobed arrows, sun circles, and forked eye designs that are found on different raw materials such as marine conch shells, ceramic pots, stone statues, and ground stone objects such as axes. In the Southeastern U.S., the Mississippian Period represents the height of precontact Native American art, politics, ceremony, and functional technology.

Protohistoric and Contact Period

In the 17th and 18th centuries, early European-American accounts of the Muscle Shoals area indicate that it was an area used by the Creek, Chickasaw, and Cherokee tribes. Each group appears to have claimed it as hunting territory, and there is evidence of intertribal conflicts in the Tennessee Valley in north Alabama. Groups of Cherokee, lead by historically known individuals, such as Dragging Canoe and Doublehead, settled in this area after the American Revolution because of strife with American settlers in the upper Tennessee River Valley.

American settlers made attempts to claim Indian land in the late 1700s with mixed success. The organization of the Mississippi Territory in 1798 and the development of the Natchez Trace (just west of Muscle Shoals) into a wagon road increased pressures on native tribes to cede land to white settlers. The Treaty of 1816 granted the land in the Muscle Shoals area to the U.S. In the following 30 years, land speculation and failed settlement were common, but by the 1830s, Florence was successfully established north of the Tennessee

River and Tuscumbia south of the river. Much of the early commercial life of these towns was based upon river traffic and the low water rocky shoals that blocked the movement of large ships further up river. Canals and railroads provided some solutions, but by the 1850s, south Florence and Tuscumbia were major ports for the transport of cotton down river to Memphis and New Orleans.

Because of the strategic location of both rail and boat traffic in the Muscle Shoals area, it was a focus of conflict during the Civil War. In 1862 and 1863, there were frequent clashes between Union and Confederate forces trying to control railroad bridges and river harbors. In November 1864, Muscle Shoals was the crossing point of Stewart's Corps of Hood's Army of Tennessee as they retreated from Atlanta and sought to reclaim Middle Tennessee.

After the Civil War, Sheffield grew as a result of the development of the iron furnaces in this area. Rail access led to the development of other industries in the area, including a rolling mill, cotton oil factory, and meat packing plant. Sheffield was also the location of railroad shops for the Memphis and Charleston Railroad and, subsequently, the Southern Railway system. These facilities attracted other industries to the Florence area north of the river such as a stove foundry, sawmill, cotton press, and brewery. The FWW was begun on the north shore of the river on land still controlled by TVA; it operated successfully through World War I.

Although there were attempts to harness Muscle Shoals' hydroelectric potential in 1903, it was the advent of World War I that stimulated Congress and President Wilson to authorize the National Defense Act in 1916. This act called for the construction of nitrate plants to produce ammunition for the war effort. These plants were to be powered by hydroelectric dams. Muscle Shoals was chosen as the location of one of these dams and two production plants in 1917.

Originally, Wilson Dam was designed to provide power for the two nitrate plants, but its construction took four years. Therefore, a coal-fired steam plant was constructed on the river's edge just north of the USNP2. Construction of the dam, steam plant, and two nitrate plants required 25,000 to 30,000 laborers and engineers. Wilson Dam Village No. 2 was constructed south of the river within the MSR study area during 1918 to house and feed the large influx of workers. Descriptions in the *Florence Times* (presently the *Times Daily*) indicate that streets were laid out, and a sewer system was constructed. Residences in this village were segregated into white and black areas commensurate with the Jim Crow laws of Alabama at that time. Residences included single-family, duplex, barracks, and tent platforms (D'Angelo et al. 2007).

Recent Archaeological Research

There have been two large-scale cultural resource surveys on the MSR in the 21st century. The first, in 2002, was in response to a land use request from the surrounding municipalities of Muscle Shoals, Florence, Tuscumbia, and Sheffield for a permanent recreation easement for the development of the Robert Trent Jones Golf Course by the Retirement Systems of Alabama. This request was subsequently withdrawn.

This survey, conducted by TRC, covered approximately 1,087 acres of the Muscle Shoals/Wilson Dam Reservation located primarily north of Reservation Road and north of the Tennessee River (Pietak et al. 2002). One survey area, Tract IV, was south of Reservation Road in the southwestern portion of the Reservation (Pietak et al. 2002). As a result of this survey, the consultants recommended that most of the MSR study area be designated as a historic district. Within the Muscle Shoals Historic District (MSHD), five historic contexts—a prehistoric mortuary complex, the Civil War, Wilson Dam (1916-1933), the New Deal (1933-1942), and TVA's development of Muscle Shoals after the New Deal (1942-1970)—were identified. The first two contexts, a prehistoric mortuary complex and the Civil War, include archaeological resources while the other contexts include aboveground architectural resources (i.e., buildings and structures). Because a large number of buildings and structures, as a whole, demonstrate significant historic events associated with the area, the MSHD was recognized by the Alabama SHPO in October 2007 as eligible for listing in the NRHP.

The archaeological survey identified 44 previously unrecorded sites and reidentified eight sites that were previously recorded. These sites included prehistoric mortuary sites, Civil War fortifications (e.g., pits, trenches, and earthworks), the foundation of the steam plant, Civilian Conservation Corps' (CCC) features, and ground-level features from Wilson Dam Village No. 2.

Three archaeological sites were identified in the 2002 TRC survey that fall within the APE for the current proposed action. Site 1CT331 had been previously recorded, but little was known about it. TRC encountered fragments of chert derived from stone tools mixed with construction materials from the aforementioned steam plant. TRC concluded that the upper portions of this site nearer the ground surface had been disturbed but that there could be undisturbed buried deposits. Formal deep excavations at this site were completed in February 2010, and site 1CT331 is smaller than first thought. After consultation with the Alabama SHPO, site 1CT331 has been determined ineligible for listing in the NRHP (Laird et al. 2010).

Site 1CT495 constitutes the visible remains of the coal-fired steam plant built to provide electricity to the USNP2. This plant was removed in 1968, and only small portions of the foundation remain. This site is considered a contributing element to the MSHD and, therefore, eligible for listing in the NRHP.

Site 1CT500 encompasses most of what remains of Wilson Dam Village No. 2. Pietak et al. (2002) notes most of the site as having "been subject to extensive surface disturbance, during the village's initial construction phase, during subsequent razing in the 1950s, as well as during more recent [pre-1966] power line and road construction." The report notes that the area is filled with debris, bush piles, and evidence of grading. However, some features, such as a road system, curbs, drains, fire hydrants, manholes, and partial foundations, remain. Although greatly disturbed, site 1CT500 is considered a contributing element of the MSHD and, therefore, eligible for listing in the NRHP.

In the summer of 2006, TRC undertook a cultural resources survey of the portions of the MSR study area not covered in the 2002 survey (D'Angelo et al. 2007). In this survey, approximately 1,040 acres were examined, primarily south of Reservation Road. In addition to verifying the boundaries of site 1CT500, the survey identified three additional sites, 1CT573, 1CT574, and 1CT575.

Site 1CT573 is a surface scatter of historic and modern trash. This site was determined to be ineligible for listing in the NRHP. Site 1CT574 is a 4,500-square-meter prehistoric lithic scatter that initially was considered potentially eligible. Subsequent formal excavations at this site revealed no intact cultural features or strata. Therefore, site 1CT574 has been determined ineligible for listing in the NRHP (D'Angelo 2009a). Site 1CT575 is composed of surface picnic or recreational features associated with the "Little Cuba" (segregated

African American) section of Wilson Village No. 2. Remaining features are a gravel road, the chimney and footings of a pavilion, foundations of a washroom, and barbeque pits (D'Angelo et al. 2007). This site is considered to be a contributing element of the larger MSHD and, therefore, eligible for listing in the NRHP.

TRC (D'Angelo et al. 2007) also noted the historic Murphy-Kemper-Cockburn Cemetery adjacent to Reservation Road. Although not eligible for listing in the NRHP, TRC advises avoidance of these graves. A cemetery associated with the Little Cuba Village was not identified during the 2006 survey. Subsequently, TVA personnel, using historic maps and pedestrian surveys, were able to identify multiple rectangular depressions on a hill in the Little Cuba area. Limited excavations verified that these are historic graves (D'Angelo 2009b). Nearby large depressions, however, turned out to be drainage features and a soil borrow area. Therefore, the longtime rumored mass burial graveyard site has not been found.

In summary, as a result of survey and testing in the MSR study area in the first decade of the 21st century, there remain three archaeological sites that are eligible for listing in the NRHP, sites 1CT495, 1CT500, and 1CT575. Sites 1CT500 and 1CT575 have been identified as the remains of Wilson Village No. 2 and show substantial disturbance. Site 1CT495 is the foundation remains of the coal-fired steam plant adjacent to the Tennessee River. These three sites are eligible for listing in the NRHP as contributing elements of the MSHD.

3.4.2 Architecture

Historic architectural resources within the proposed APE have been identified in previous TRC survey reports (Pietak et al. 2002; D'Angelo et al. 2007; D'Angelo 2009a, 2009b; and Laird et al. 2010). The 2002 research resulted in a recommendation for the development of the five previously described historic contexts (see Recent Archaeological Research above). As a part of the current TVA land disposal action, TVA exchanged correspondence and received a letter of concurrence from the Alabama SHPO on these and other reports in October 2007 (see Appendix K). TVA used these multiple reports and letters, along with more detailed information (Lord, Aeck, and Sargent Architecture 2009), during the preliminary consultation period with the Alabama SHPO.

There are 51 NRHP-eligible buildings and structures within the MSR study area, as well as a number of buildings and structures that are not eligible for listing in the NRHP. In 2007, TVA consulted with the Alabama SHPO, receiving concurrence on 21 buildings and structures that were determined to be ineligible for listing in the NRHP and ineligible as contributing elements to the MSHD. Since that time, TVA has removed these 21 noneligible and noncontributing buildings and structures.

In 2009, TVA commissioned the firm of Lord, Aeck, and Sargent Architecture to prepare an independent inventory and analysis of 45 of the NRHP-eligible buildings within the MSR study area. This study, titled *Muscle Shoals Reservation Adaptive Re-Use Study*, focused on the following:

- Existing architectural and structural conditions of each building and the flexibility of each building for uses other than its original function
- Viability of the buildings based on current and foreseeable market trends in the region

- Development of a draft concept plan illustrating examples of how the historic buildings might be reused in a larger redevelopment effort

As a result of the findings included in this study, TVA recommended four additional buildings (Table 3-5) as ineligible for listing in the NRHP. Therefore, 51 of the 92 buildings on the MSR study area have been determined eligible for listing in the NRHP.

Table 3-5. Additional Buildings and Structures Recommended by TVA as Not Eligible for Listing in the National Register of Historic Places and Not Contributing to the Muscle Shoals Historic District

Building Name	Building Number*	Approximate Square Footage*	Reason for Recommendation
Office Service Warehouse	134	41,896	Extensive alteration and loss of historic context
Substation No. 1	4	9,894	Extensive alteration and loss of historic context
Phosphate Development Works Warehouse	15	15,159	Loss of historic context
2A Nitrate House	86	9,711	Extensive alteration

*Source: Architectural and Historic Assessment, Lord, Aeck, and Sargent Architecture 2009

TVA used the data collected in the *Adaptive Re-Use Study* to further evaluate structural and architectural conditions, as well as the relative adaptability for reuse of each building considered in the study. The existing eligible aboveground properties within the APE are associated with the Wilson Dam, New Deal, and TVA contexts of the MSHD. These contexts are expressed as two dominant architectural types: Industrial Army Vernacular and New Deal/TVA. Considering the two significant architectural styles and periods of context, TVA recommended the exclusion of a portion of the extant aboveground properties from the Section 106 consultation due to the extent of deterioration of some buildings and structures. This exclusion would also apply to those buildings and structures that were not readily adaptable for uses other than their original function. See Section 4.4 for discussion of the results of the Section 106 consultation process for eligible buildings and structures.

Industrial Army Vernacular

The buildings associated with this architectural style comprise the remaining features of the original USNP2. Built in just over eight months during 1918, the plant was planned as a strategic production facility for munitions-grade nitrates, capable of producing over 100,000 tons of ammonium nitrate per year. The Air Nitrates Corporation oversaw the design and construction of 73 buildings, 2,165 temporary buildings, and 190 structures during the accelerated construction schedule. The design and use of materials suggest the expediency with which USNP2 was constructed. Most of the facilities were designed and built by the largest subcontractor, Westinghouse, Church, Kerr, and Company (WCK) of New York. Only a small portion of the buildings and structures were dedicated to the production of ammonium nitrate. Most were used in support of the production facility and included permanent and temporary housing and barracks, medical facilities, dining halls, storage, washrooms, dry goods markets, and entertainment facilities. The extant WCK buildings have the following character-defining features:

- Rectangular massing
- Low slope roofs with monitor and clerestory

- Exposed structural steel columns
- Hollow clay tile masonry units with brick quoins
- Hopper windows
- Precast concrete sills and lintels

The buildings are oriented on a defined axis from north to south, as was the production of materials when the plant was operational. The general arrangement of USNP2 is shown in Figure 3-13. Photographs of general arrangement/fenestration and details of materials are shown in Figures 3-14 through 3-17. These buildings are eligible for listing in the NRHP under Criterion A as a building complex and as a contributing element to the MSHD. Table 3-6 includes a listing of the industrial army vernacular buildings that make up the USNP2 Complex.

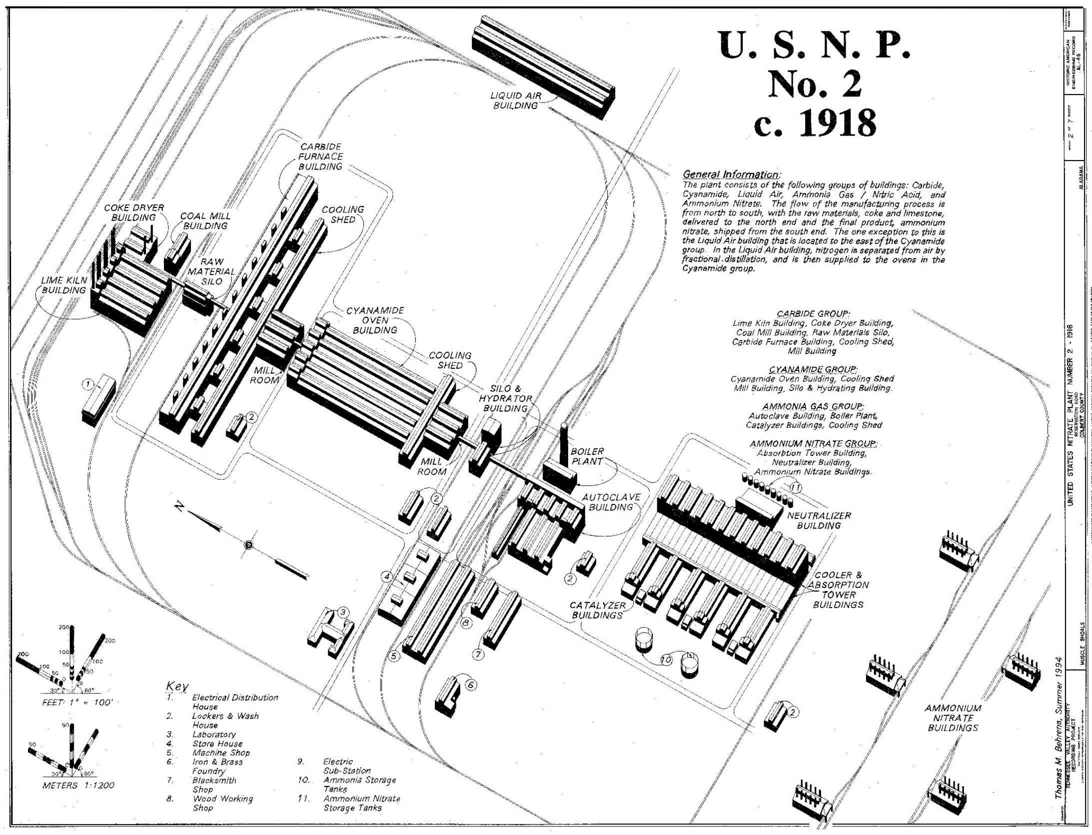
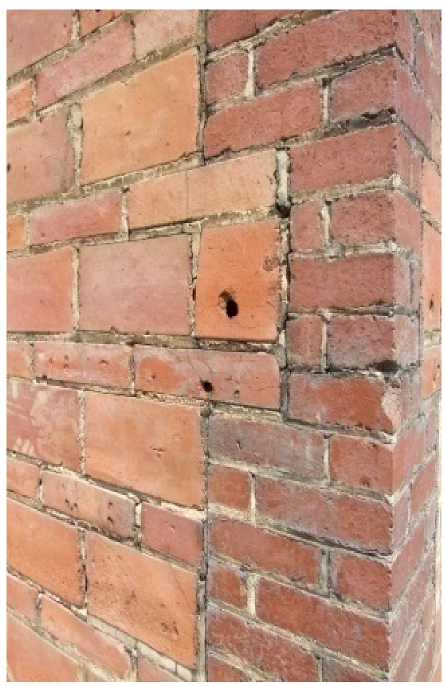


Figure 3-13. Orientation and Arrangement of Original National Fertilizer Development Center (USNP2) Facilities, ca. 1918

Photograph taken by: Jon Riley, April 2009

Figure 3-14. Example of Precast Sills/Lintels and Hopper Windows in Catalyzer Building No. 5



Photograph taken by: Jon Riley, April 2009

Figure 3-15. Example of Hollow Clay Tile Masonry and Brick Quoins in the Raw Materials Lab

Photograph taken by: Jon Riley, April 2009

Figure 3-16. Example of Precast Sills/Lintels in the Raw Materials Lab

Photograph taken by: Jon Riley, April 2009

Figure 3-17. Example of Monitor Roof With Clerestory in the Nitrate House No. 5

Table 3-6. Extant Buildings and Structures Representing the Industrial Army Vernacular Style

Building Name	Building Number	Approximate Area (square feet)
Old Filtration Building	1C	6,524
Reservoir Pumping Station	1D	5,342
Drum Storage Area Building	5	2,174
Raw Material Lab	6	3,711
Power Service Shop No. 2	16	59,878
Lime and Nitrogen Building	22	131,749
Project Operations Office	25	7,029
Chemical Plant Warehouse	33	37,849
Machine Shop	37	42,554
Engineering Lab	39	18,007
Sheet Metal Shop	41	6,622
Pipe Shop	42	10,933
Project Operations Bath House	44	12,370
Pilot Plant Building	47	14,895
Paint Storage Building	48	606
Autoclave Building	50	15,693
Tin Shop	53	4,718
Lime and Nitrogen Hydrating Building	54	1,228
Boiler House and Stack	56	4,305
Substation No. 2	57	996
Substation No. 4	68	1,352
Catalyzer Building No. 1	69	10,827
Catalyzer Building No. 2	70	11,546
Catalyzer Building No. 3	71	11,103
Catalyzer Building No. 4	72	11,099
Catalyzer Building No. 5	73	11,165
Catalyzer Building No. 6	74	10,999
Substation No. 5	72A	1,446
Substation No. 6	74A	1,446
Nitric Acid Tanks (2 tanks)	76	N/A
3A Nitrate House	79	9,397
5A Nitrate House	81	8,594
Cuba Yard Railroad Scales	93	N/A
Greenhouse Complex (eight individual buildings and structures)	118	7,917
Flume, Water Plant	N/A	N/A
Sidewalks	N/A	N/A
Narrow Gauge Rail System	N/A	N/A
Bus Bar Terminal	N/A	N/A

Source: Architectural and Historic Assessment, Lord, Aeck, and Sargent Architecture 2009

New Deal and TVA

The World War I armistice was signed shortly after partial testing of the USNP2 facility was begun, and the future of the plant was uncertain. It was not until 1933 at the signing of the TVA Act that the USNP2 began operating near its full capacity. During the massive mobilization and construction period that followed the creation of TVA, the TVA Board of Directors recruited Hungarian-born Roland Wank as chief architect. Wank had only been in the U.S. for around nine years when TVA was created, but during that time, he had enjoyed success at the architectural firm of Fellheimer and Wagner. Employing a design philosophy borrowing heavily from art deco and international styles, Wank immediately had an impact on design and construction at TVA. Although he left TVA to return to private practice in 1944, his influence remained through contract design work for TVA, specifically at the Reservation through conceptual designs for water plant facilities, medical facilities, and the ERC.

The eligible buildings associated with this architectural style exhibit strong design elements from the international style, which was popular during the early part of the 20th century, including:

- Linear, rectangular massing
- Flat roof (see Figure 3-18)
- Asymmetrical façade (see Figure 3-19)
- Windows set flush with outer walls (see Figure 3-18)
- Precast concrete window surrounds

These buildings are located immediately to the west of the USNP2 site. These buildings are eligible for listing in the NRHP under Criteria A and C as a building complex and as contributing elements to the MSHD (Table 3-7). The ERC Building is individually eligible for listing in the NRHP under Criterion B. An additional explanation of the ERC's historical significance is contained in Appendix L (Ezzell 2008).

Photograph taken by: Jon Riley, April 2009

Figure 3-18. Example of Flat Roof, Flush Windows of the Old Medical Building

Photograph taken by: Jon Riley, February 2009

Figure 3-19. Example of Asymmetrical Façade of the Environmental Research Center Building

Table 3-7. Extant Buildings and Structures Representing the New Deal and TVA Style

Building Name	Building Number	Approximate Area (square feet)
Chemical Feed House	1A	1,967
Filter Building	1B	3,721
Environmental Research Center Building	17A	69,137
Service Building	17B	21,269
Old Medical Building	21	7,561

Source: Architectural and Historic Assessment, Lord, Aeck, and Sargent Architecture 2009

3.5 Socioeconomic Resources

3.5.1 Regional Overview

The MSR study area is located in Colbert County, Alabama. The 2009 population of Colbert County is estimated to be 54,639 (see Table 3-8). Colbert and Lauderdale counties, adjacent and north of the Tennessee River, form the Florence-Muscle Shoals, Alabama Metropolitan Statistical Area (MSA). For purposes of this study, the MSA and other counties adjacent to Colbert County are considered a part of the potential impact area, along with Limestone County, Alabama, due to its proximity and relatively easy access to the MSR. So defined, the impact area consists of the following counties where the socioeconomic effects of the potential MSR redevelopment would likely be realized:

- Colbert, Alabama
- Lauderdale, Alabama
- Franklin, Alabama
- Lawrence, Alabama
- Limestone, Alabama
- Tishomingo, Mississippi

The estimated 2009 population of the impact area is 307,041 (Table 3-8). Population trends suggest that the population of Colbert County is likely to be about 57,000 and the impact area about 336,000 by the year 2020.

Table 3-8. Population and Economic Characteristics

	Colbert County	Impact Area	Alabama	United States
Population				
Estimate, 2009	54,639	307,041	4,708,708	307,006,550
Projection, 2020	57,010	335,768	5,115,863	341,509,922
Employment and Income, 2008				
Total Employment	30,511	151,858	2,640,717	181,755,100
Farm (%)	2.4	4.4	1.9	1.5
Manufacturing (%)	13.2	13.3	11.1	7.8
Per Capita Personal Income	$29,314	$29,544	$33,655	$40,166

Sources: U.S. Census Bureau (http://factfinder.census.gov/home/saff/main.html?_lang=en); U.S. Bureau of Economic Analysis (http://www.bea.gov/regional/reis/); population projections are linear trend, 1990-2009

Both farming and manufacturing account for a larger share of employment in the area than the Alabama and national averages (Table 3-8). Farming accounts for 2.4 percent of total employment in Colbert County and 4.4 percent in the impact area, compared to 1.9 percent statewide and 1.5 percent nationally. Manufacturing accounts for 13.2 percent of the total in Colbert County and 13.3 percent in the impact area, compared to 11.1 percent statewide and 7.8 percent nationally.

Average income levels in Colbert County and in the impact area are lower than the Alabama and national levels (Table 3-8). In 2008, per capita personal income in Colbert County was $29,314, which is slightly lower than the impact area average of $29,544 and noticeably lower than the Alabama average of $33,655 and the national average of $40,166.

3.5.2 Study Area Population

The MSR study area is generally bounded by Hatch Boulevard, Second Street, Wilson Dam Road (SR 133), and Reservation Road (see Figure 1-2). The entire site is included in Census Tract 207.01, Block Group 1. This block group had a total population of 681 (U.S. Census Bureau 2000). None of this population, however, is within the Reservation boundaries. The population in this block group is largely located in the area near the Tennessee River to the northeast of the MSR study area, east of Wilson Dam Road (SR 133). None of the blocks directly north of the site in Colbert County are populated.

The Reservation is bordered by other parts of Census Tract 207.01 to the north, east, and west, and by Census Tract 207.02 to the south. It is close to Census Tract 201 to the west and northwest. The areas adjacent to the site on the south and nearby to the west and northwest are densely populated enough to be considered part of the Florence Urban Area. Nearby areas to the west include parts of Census Tract 207.01, Block Group 1. Areas along and near the northern boundary are also in Census Tract 207.01, Block Group 1. Census Tract 207.01, Block Groups 1 and 2, adjoin the eastern boundary of the site. Along the southern boundary, the site adjoins Census Tract 207.02, Block Groups 2 and 3. Census Tract 207.02, Block 1000, lies immediately southwest of the site. Population, as of the 2000 Census of Population, is shown in Table 3-9 for populated blocks around the site.

Table 3-9. Population, Blocks Adjacent to Muscle Shoals Reservation Site, 2000*

Direction From Site	Census Tract	Block	Total Population
West	207.01	1000	4
East	207.01	2035	57
East	207.01	2053	5
East	207.01	2055	2
East	207.01	2057	30
East	207.01	2058	23
East	207.01	2059	17
East	207.01	2061	23
South	207.02	2018	9
South	207.02	3005	6
South	207.02	3006	24
South	207.02	3007	1
South	207.02	3009	152
South	207.02	3013	9
South	207.02	3024	11
South	207.02	3025	5
South	207.02	3027	69
South	207.02	3028	69
South	207.02	3029	39
South	207.02	3030	98
Southwest	207.02	1000	9

*Unpopulated blocks are not listed. Source: U.S. Census Bureau, Census of Population, 2000 (http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=DEC&_submenuId=datasets_1&_lang=en)

3.5.3 Potential Development Sites

Several sites in the Shoals area (Colbert and Lauderdale counties) are currently available for industrial development purposes, most of which include existing buildings with relatively small acreage (http://www.tvaed.com/solutions.htm). There are presently five known sites in these two counties with at least 200 acres each of land available. The partially developed Barton industrial site in western Colbert County (see Section 1.6) is among these sites. The largest of these, however, would provide only about 300 contiguous acres. To the east, Lawrence County has three relatively large sites available for industrial use. The largest available tract is Alabama Highway 20-Mallard-Fox Industrial Park West, which offers up to 1,251 acres. The Lawrence County Road 150-Courtland Hood Harris and the Alabama Highway 20-Lawrence Industrial Airpark sites offer about 1,000 acres and 500 acres, respectively. However, neither of the latter two sites has rail access. Somewhat farther away, roughly 40 miles from Colbert County, Limestone County has several large sites including Alabama's first certified automotive megasite (2,010 acres) near Interstate 65 just west of Huntsville.

The MSR study area includes approximately 1,400 acres, with the capability of providing much larger sites than are currently available elsewhere in Colbert County. Norfolk Southern Corporation provides rail access to Tuscumbia, Muscle Shoals, and Sheffield with yards and spur lines servicing local nearby businesses including the Occidental Chemical facilities just east of Wilson Dam Road. An additional short spur line could be constructed to enhance the MSR infrastructure. The MSR study area could be used for one or a few relatively large employers, or for a cluster of related facilities.

Based on TVA staff observations of the current land use, economic activity, and presence of vacant or undeveloped property in the Muscle Shoals community and Colbert County area, there appears to be ample land and market incentives (Lord, Aeck, and Sargent Architecture 2009) to attract and accommodate new or expanded commercial, retail, and residential development. Such development, which typically can occur on less acreage than required for industrial sites, could increase urban sprawl and reduce opportunities for economic development if located on the MSR study area. Development on the MSR study area could be better planned and controlled through implementation of the anticipated Master Plan and, thus, potentially be more attractive to new tenants and customers. Given the amount of public land along the Tennessee River including parks and recreation lands, the amount of conservation land appears relatively stable and would likely remain available for such use in the foreseeable future. This includes such land on the MSR north of Reservation Road.

3.5.4 In-lieu-of-Tax Payments

TVA pays annual in-lieu-of-tax payments to the Tennessee Valley states, including Alabama, based, in part, on the value of its power properties in the state. The State of Alabama, under state law, then redistributes most of its receipts to the counties and municipalities served by TVA, including Colbert County and its municipalities, based on the value of all TVA power properties in Colbert County, including Colbert Fossil Plant and power properties on the MSR study area. The value of power assets associated with the MSR is small, less than one-half of 1 percent of the value of TVA power assets in the county. If the MSR study area is transferred from federal ownership, it would then be subject to annexation and taxation by local governments.

3.6 Environmental Justice

Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, provides that certain federal agencies make the achievement of environmental justice a part of its mission “to the greatest extent practicable and permitted by law.” Pursuant to the EO, these agencies must determine whether their activities will have adverse human health or environmental effects on minority and low-income populations. As a matter of policy, TVA typically addresses environmental justice issues in its NEPA reviews. A part of this process includes involvement of a broad scope of people potentially affected by a federal action in the public involvement and agency decision-making process.

TVA conducted public scoping and informed people in the Shoals community of its land disposal and redevelopment proposal during summer 2009. Following notification in the area of the proposed action, a public meeting was held at Muscle Shoals High School on July 14, 2009. In addition, a 48-day comment period was made available from June 18, 2009, to August 5, 2009. Interested parties were encouraged to provide input via phone, letter, e-mail, or the Internet. Comments were considered and summarized in a final Scoping Report in December 2009, which was posted on the project Web site (see Section 1.5.2). See Section 1.4 for a description of the NEPA Process and Section 1.5.3 for a discussion of further public involvement in the draft EIS review process. TVA has considered all input from persons or groups regardless of race, income status, or other social and economic characteristics.

Minority and Low-Income Populations
Minority populations are a relatively low share of the total in Colbert County as well as in the impact area (e.g., Colbert, Lauderdale, Franklin, Lawrence, and Limestone counties, Alabama, and Tishomingo County, Mississippi). In Colbert County, the estimated minority population share in 2009 was 19.9 percent of the total, well below the 32.0 percent in Alabama and the 34.9 percent nationally. The impact area, considered to be the same as that defined for the socioeconomic analysis in Section 3.5.1, as a whole has a minority share of 17.8 percent, somewhat lower than Colbert County (Table 3-10).

The poverty level in Colbert County is lower than the state average and the impact area as a whole and just slightly lower than the national level. For 2008, the poverty level in Colbert County is estimated to be 12.7 percent of the population, compared to 15.2 percent in the impact area and 15.9 percent in Alabama. Those below the poverty level nationally made up 13.2 percent of the population in 2008 (see Table 3-10).

Table 3-10. Minority and Low-income Populations

	Colbert County	Impact Area	Alabama	United States
Minority Population (%), 2009	19.9	17.8	32.0	34.9
Below Poverty Level (%), 2008	12.7	15.2	15.9	13.2

Source: U.S. Census Bureau 2009a and 2009b

The MSR study area is in Census Tract 207.01, Block Group 1, parts of which also border it on the north and the west. It is bordered on the east by Tract 207.01, Block Group 2, and on the south by Tract 207.02. As of the 2000 Census of Population, Census Tract 207.01 had a minority population of 996, 16.8 percent of the total population of 5,918 (see Table 3-11). In Census Tract 207.02, minority population was 1,524, about 16.9 percent of the total population of 9,019. In blocks immediately around the site, minority populations were less than other populations (about 11.6 percent of total population), as was the total population of 662. Minority population shares in the local area in 2000 were well below the state and national levels of 29.7 and 30.9 percent, respectively, and slightly below the county level of 19.1 percent.

Table 3-11. Minority and Low-Income Populations in Areas Adjacent to the Muscle Shoals Reservation Site, 2000

Population Area	Total Population	Percent Below Poverty Level	Minority Population	Percent Minority
West of Site				
CT 207.01	5,918	11.7	996	16.8
BG 1	681	18.0	44	6.5
Block:				
1000	4	-	0	0.0
East of Site				
CT 207.01	5,918	11.7	996	16.8
BG 2	1,150	25.3	535	46.5
Blocks:				
2035	57	-	23	40.4

Population Area	Total Population	Percent Below Poverty Level	Minority Population	Percent Minority
2053	5	-	5	100.0
2055	2	-	0	0.0
2057	30	-	9	30.0
2058	23	-	0	0.0
2059	17	-	0	0.0
2061	23	-	0	0.0
South of Site				
CT 207.02	9,019	6.1	1,524	16.9
BG 2	1,436	3.7	314	21.9
Blocks:				
2018	9	-	0	0.0
BG 3	3,169	5.1	622	19.6
Blocks:				
3005	6	-	0	0.0
3006	24	-	0	0.0
3007	1	-	0	0.0
3009	152	-	9	5.9
3013	9	-	9	100.0
3024	11	-	6	54.5
3025	5	-	2	40.0
3027	69	-	2	2.9
3028	69	-	1	1.4
3029	39	-	0	0.0
3030	98	-	11	11.2
Southwest of Site				
CT 207.02	9,019	6.1	1,524	16.9
BG 1	1,021	10.6	118	11.6
Block:				
1000	9	-	0	0.0
Total, Adjacent Blocks	662	-	77	11.6

- = Not available
CT = Census tract
BG = Block group

Overall, the area around the site has relatively low poverty levels, as of the 2000 Census of Population. Census Tracts 207.01 and 207.02 had relatively low poverty levels of 11.7 percent and 6.1 percent, respectively. These were lower than the county level at that time of 14.0 percent, the state level of 16.1 percent, and the national level of 12.4 percent. Among the block groups around the site, Census Tract 207.01, Block Groups 1 and 2, had higher poverty rates of 18.0 and 25.3 percent, respectively. However, Census Tract 207.02, Block Groups 2 and 3, had much lower poverty levels of 3.7 and 5.1 percent, respectively (see Table 3-11). (Poverty data are not available for individual blocks.)

3.7 Land Use

Land use/land cover of the MSR study area was determined from aerial photography flown in March 2010 and geographic information system analyses (Figures 3-20 and 3-21). About 12 percent of the study area is developed, and over 60 percent is vegetated. Wetlands cover approximately 12 percent of the land area, including almost 3 acres of man-made wetlands constructed for experimental projects over the years. Pasture and hay land accounts for nearly 12 percent of the land use, with ponds or other open water covering close to 2 percent of the land. Most of the barren land is the phosphate slag storage area on the northern side of Reservation Road. Approximately 182 acres of land in the MSR study area, classified as grassland/herbaceous or pasture/hay, are included in TVA's agricultural land use licensing program. These tracts are licensed for local agribusiness production (see Section 3.9).

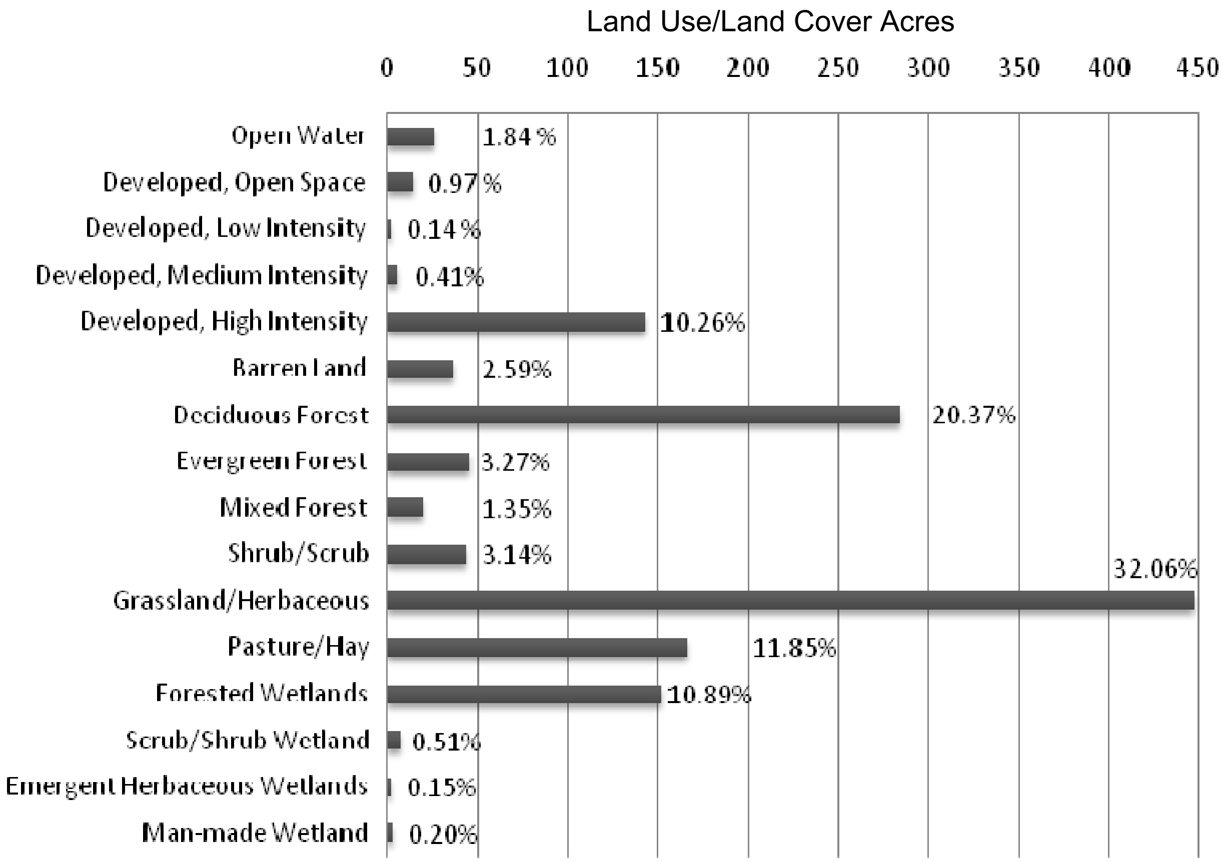


Figure 3-20. Land Use/Land Cover Acreage and Percent of the Muscle Shoals Reservation Study Area

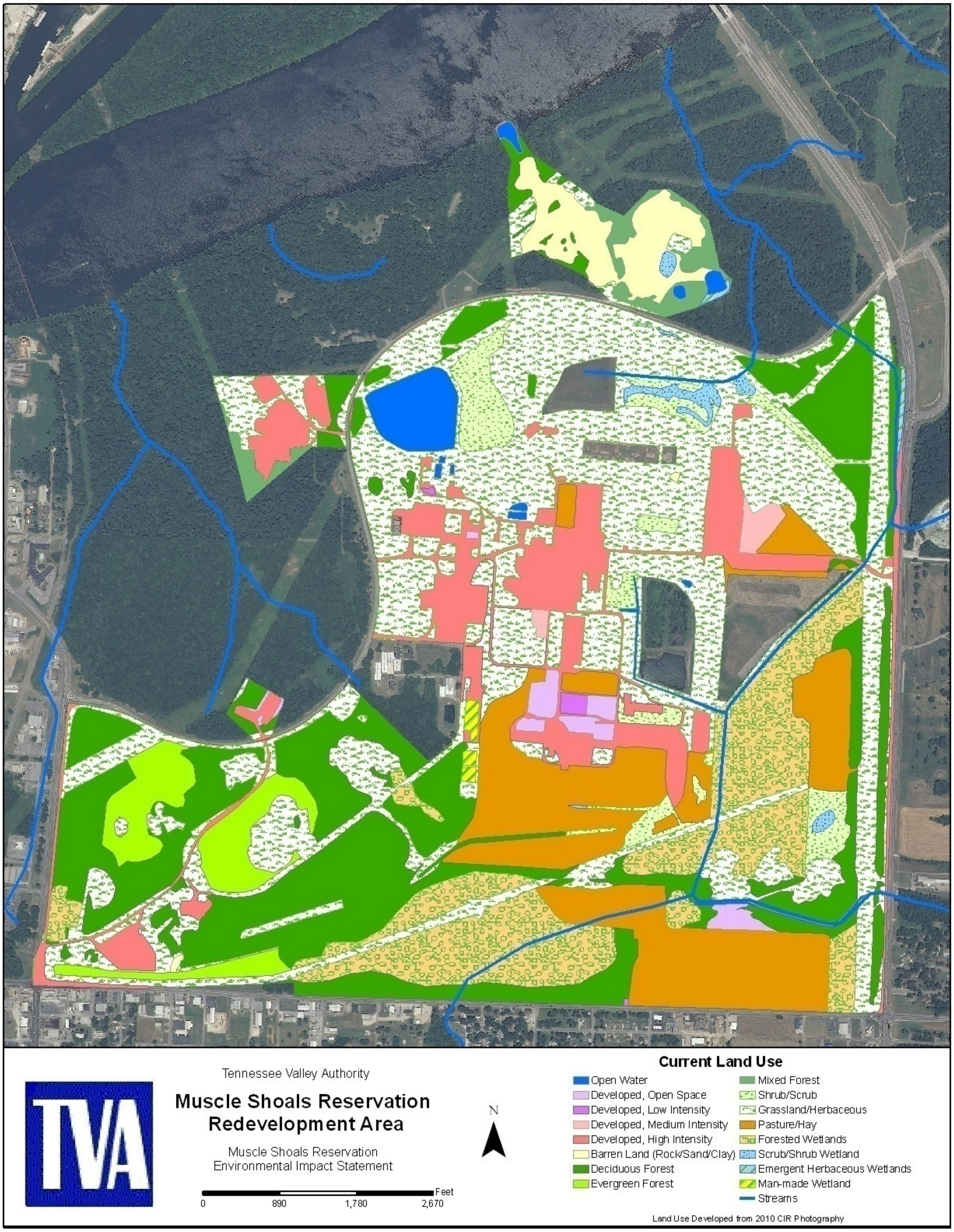


Figure 3-21. Land Use for the Muscle Shoals Reservation Study Area

An estimated 64 acres of four monitored SWMUs are present on the MSR study area, and these four areas would be retained by TVA. These areas were impacted by the disposal of waste material from past operations. These areas are classified as approximately 76 percent undeveloped, containing forest, scrub-shrub, and grassland, and 17 percent developed, including some maintained grassy open areas. The remaining 7 percent of this land is divided among pasture/hay, ponds, forested wetlands, and barren areas.

The City of Muscle Shoals' zoning of lands adjacent to the eastern boundary of the MSR study area is mostly heavy industrial, bounded by some residential parcels on the north and south. The primary occupant of the industrial area is Occidental Chemical Corporation, manufacturer of alkalis and chlorine (USEPA 2010). The Muscle Shoals Wastewater Plant is located across the street from the southern boundary of the study area. This narrow strip along Second Street is dominated by general business zoning, with about 16 parcels zoned for mobile homes. South of this business district is a large residential area that includes single-family homes and apartments.

The city of Sheffield is situated on the western side of the MSR study area, north of the city of Muscle Shoals. All the area adjacent to the MSR study area is zoned as general business.

The MSR study area is not currently within the corporate limits of any of the surrounding cities and not zoned by them. Development within the MSR study area would offer no known conflicts with any plans, programs, or activities of the Shoals Economic Development Authority, Northwest Alabama Council of Local Governments, Top of Alabama Regional Council of Governments, or any other similar county-level planning or economic development organizations. TVA is working with the newly formed NACD, comprised of representatives from the cities of Florence, Muscle Shoals, Sheffield, and Tuscumbia, and Colbert and Lauderdale counties, on this potential land disposal and redevelopment project.

3.8 Air Quality, Greenhouse Gas Emissions, and Global Climate Change

3.8.1 Air Quality

Through its passage of the Clean Air Act (CAA), Congress has mandated the protection and enhancement of our nation's air resources. National Ambient Air Quality Standards (NAAQS) establish concentration limits in the ambient air for the following criteria pollutants to protect the public health and welfare:

- Sulfur dioxide (SO_2)
- Ozone (O_3)
- Nitrogen dioxide (NO_2)
- Particulate matter whose particles are less than or equal to 10 micrometers (PM_{10})
- Particulate matter whose particles are less than or equal to 2.5 micrometers ($PM_{2.5}$)
- Carbon monoxide (CO)
- Lead (Pb)

The primary NAAQS were promulgated to protect public health, and the secondary NAAQS were established to protect the public welfare from any known or anticipated adverse effects associated with the presence of pollutants in the ambient air. A listing of the NAAQS is presented in Table 3-12. Areas in violation of the NAAQS are designated as nonattainment areas. Any new sources of air pollution to be located in or near these areas may be subject to more stringent air permitting requirements than are new sources in attainment areas. The USEPA promulgated new, more restrictive standards for particulate matter in 2006 and for 8-hour O_3 in 2008 (USEPA 2008a). In 2009, USEPA issued its “endangerment finding” that GHGs such as carbon dioxide (CO_2) contribute to air pollution that may endanger public health and welfare. This endangerment finding compelled USEPA to issue GHG emission standards for new motor vehicles, which in turn had the effect of making GHGs subject to air permitting requirements, effective January 2, 2011. USEPA will phase in the permitting requirements for emissions of GHGs from stationary sources in at least three phases.

The feasibility of new development at the MSR study area may be affected by several air quality considerations. One of the factors is regulatory status or attainment of air quality standards. Sources locating in clean air areas are subject to the Prevention of Significant Deterioration (PSD) New Source Review (NSR) rules, whereas those locating in or affecting areas failing to attain air quality standards must comply with nonattainment NSR rules. An overriding constraint in either NSR program is that no source of air pollution may cause or significantly contribute to a violation of an ambient air quality standard. The MSR study area is not presently subject to nonattainment NSR analysis because the site is not currently located in a nonattainment area for any of the criteria pollutants. The only nearby current nonattainment area is the Birmingham area, where Jefferson, Shelby, and Walker counties are in partial nonattainment for $PM_{2.5}$. However, USEPA’s proposal to decrease the 8-hour “primary” O_3 standard to a level within the range of 0.060-0.070 ppm, or any future tightening of air quality standards, could impact the Shoals area.

PSD regulations restrict the increment by which ambient pollutant levels may increase due to emissions from major new sources, or the modification of existing sources, and require the use of best available control technology on such sources. PSD regulations include protection of national parks and wilderness areas that are designated as PSD Class I air quality areas. A new or expanding major air pollutant source (i.e., the generator of the pollutant) is required to estimate the potential impact of its emissions on the air quality of any nearby Class I area, as specified by the state or local air regulatory agency, with input from the federal land manager(s) having jurisdiction over the given Class I area(s). The closest PSD Class I areas are the Sipsey Wilderness Area in Alabama (about 50 miles away) and the Cohutta Wilderness Area in Georgia (about 230 miles away) (USEPA 2009a). Generally, dispersion modeling is required to demonstrate that pollution levels would not increase beyond the allowable increments. For the site considered in this EIS, ambient air quality data necessary for PSD analysis purposes are available.

The air quality in the vicinity of the MSR study area is generally good. Table 3-13 shows the results of ambient air quality monitoring of criteria pollutants that are considered representative of the site. Colbert County is currently in attainment for all criteria pollutants.

Table 3-12. National Ambient Air Quality Standards

Pollutant	Primary Standards[a]		Secondary Standards[b]	
	Level	Averaging Time	Level	Averaging Time
Carbon Monoxide (CO)	9 ppm (10 mg/m^3)	8-hour [1]	None	
	35 ppm (40 mg/m^3)	1-hour [1]		
Lead (Pb)	0.15 $\mu g/m^3$ [2]	Rolling 3-Month Average	Same as Primary	
	1.5 $\mu g/m^3$	Quarterly Average	Same as Primary	
Nitrogen Dioxide (NO_2)	53 ppb [3]	Annual (Arithmetic Average)	Same as Primary	
	100 ppb	1-hour [4]	None	
Particulate Matter (PM_{10})	150 $\mu g/m^3$	24-hour [5]	Same as Primary	
Particulate Matter ($PM_{2.5}$)	15.0 $\mu g/m^3$	Annual [6] (Arithmetic Average)	Same as Primary	
	35 $\mu g/m^3$	24-hour [7]	Same as Primary	
Ozone (O_3)	0.075 ppm (2008 standard)	8-hour [8]	Same as Primary	
	0.08 ppm (1997 standard)	8-hour [9]	Same as Primary	
	0.12 ppm	1-hour [10]	Same as Primary	
Sulfur Dioxide (SO_2)	0.03 ppm	Annual (Arithmetic Average)	0.5 ppm	3-hour [1]
	0.14 ppm	24-hour [1]		
	75 ppb [11]	1-hour	None	

Source: USEPA 2011

ppm = parts per million
ppb = parts per billion
mg/m^3 = milligrams per cubic meter
$\mu g/m^3$ = micrograms per cubic meter

(a) Standards set to protect public health
(b) Standards set to protect public welfare
(1) Not to be exceeded more than once per year
(2) Final rule signed October 15, 2008
(3) The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard
(4) To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb (effective January 22, 2010).
(5) Not to be exceeded more than once per year on average over 3 years.
(6) To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 $\mu g/m^3$.
(7) To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 $\mu g/m^3$ (effective December 17, 2006).
(8) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm (effective May 27, 2008).
(9) (a) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.
(b) The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as USEPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.
(c) USEPA is in the process of reconsidering these standards (set in March 2008).
(10) (a) USEPA revoked the 1-hour ozone standard in all areas, although some areas have continuing obligations under that standard ("anti-backsliding").
(b) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is ≤ 1.
(11) Final rule signed June 2, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb.

Table 3-13. Ambient Concentrations of Criteria Air Pollutants in the Vicinity of the MSR Study Area Compared With Air Quality Standards

Pollutant	Level of Standard (ppm)[a]	One-Year Maximum or Mean	
		Concentration (ppm)[a]	Percent of Standard
O_3 (New Standard)	4th Highest 8-hour average (0.075)	0.062[c]	83
SO_2	Maximum 3-hour average (0.5)	0.036[b]	7
	Maximum 24-hour average (0.14)	0.007[b]	5
	Annual mean (0.030)	0.002[b]	7
NO_2	Annual mean (0.053)	0.006[d]	11
CO	Maximum 1-hour average (35)	8.7[e]	25
	Maximum 8-hour average (9)	2.6[e]	29
PM_{10} (Old Standard)	Maximum 24-hour average (150 μg/m^3)	34(μg/m^3) [g]	23
$PM_{2.5}$ (New standard)	Annual average (15 μg/m^3)	9.14 (μg/m^3) [f]	61
	24-hour average (35 μg/m^3)	21.3 (μg/m^3) [f]	61
Pb	Quarterly mean (1.5 μg/m^3)	0.0193 (μg/m^3) [h]	1

[a] - ppm unless otherwise noted
[b] - SO_2 values for Colbert Fossil Plant, Colbert County, Alabama, 2007
[c] - O_3 values for Muscle Shoals, Colbert County, Alabama, 2009
[d] - NO_2 values for Muscle Shoals, Colbert County, Alabama, 2002
[e] - CO values for Birmingham, Jefferson County, Alabama, 2009
[f] - $PM_{2.5}$ values for Muscle Shoals, Colbert County, Alabama, 2009
[g] - PM_{10} values for Huntsville, Madison County, Alabama, 2009
[h] - Pb value for Birmingham, Jefferson County, Alabama, 2006

3.8.2 Greenhouse Gas Emissions and Global Climate Change

Relationship of Greenhouse Gases and Global Climate Change

GCC and its relationship to GHGs is an item of intense international study as well as of importance to TVA. In common usage, “global warming” often refers to the warming of the earth that can occur as a result of emissions of GHGs to the atmosphere. Global warming can occur from a variety of both natural and man-made causes. “Climate change” refers to any substantive change in measures of climate, such as temperature, precipitation, or wind. The two terms are often used interchangeably, but climate change is broader as it conveys that there are other changes in addition to rising temperatures.

Certain substances present in the atmosphere act like the glass in a greenhouse to retain a portion of the heat that is radiated from the surface of the earth. The common term for this phenomenon is the “greenhouse effect,” and it is essential for sustaining life on earth. Both man-made and natural processes produce GHGs. Water vapor and, to a lesser extent, water droplets in the atmosphere are responsible for 90 to 95 percent of the greenhouse effect. The most abundant long-lived GHGs are CO_2, methane (CH_4), and nitrous oxide (N_2O). Several classes of halogenated substances that contain fluorine, chlorine, or bromine are also GHGs. However, for the most part, they are solely a product of industrial activities. According to numerous sources, increases in the earth’s average surface temperatures are linked in part to increasing concentrations of GHGs, particularly CO_2, in the atmosphere. This has been a cause for concern among scientists and policymakers. This phenomenon has been studied internationally since 1992 by the United Nations Framework Convention on Climate Change, Intergovernmental Panel on Climate Change (IPCC).

The global carbon cycle is made up of large carbon sources and sinks. Billions of tons of carbon in the form of CO_2 are absorbed by oceans and living biomass (i.e., carbon sinks) and are emitted to the atmosphere annually through natural and man-made processes. According to the IPCC (2007), since the Industrial Revolution (i.e., about 1750), global atmospheric concentrations of CO_2 have risen about 36 percent, principally due to fossil fuel use.

Greenhouse Gas Emissions
The primary GHG emitted by human activity is CO_2 produced by the combustion of coal and other fossil fuels. Coal- and gas-fired electric power plants and automobiles are major sources of CO_2 emissions in the U.S. (U.S. Energy Information Administration 2009). Other important sources include gas combustion used for heating buildings. Indirectly, buildings that utilize large quantities of electric power contribute to CO_2 emissions because of the fuel combustion required for power generation. Forests and other vegetated landforms represent sinks of CO_2.

GHG emissions are also affected by development activities associated with land or forest clearing and land use changes; construction activities involving use of fossil-fuel-powered equipment (e.g., bulldozers, loaders, haulers, trucks, generators, etc.); increases in demand for electric power due to greater industrial, residential, or commercial activity; changes to amounts and patterns of traffic flow; or by the incorporation of parks or recreational areas that can serve as potential "sinks" for the storage of CO_2.

Worldwide man-made annual CO_2 emissions are estimated at 30 billion tons, with the U.S. responsible for about 20 percent. U.S. electric utilities, in turn, emit 2.2 billion tons, roughly 40 percent of the U.S. total. Figure 3-22 shows how TVA's approximately 73 million tons of annual CO_2 emissions in 2009 from energy production ranks in terms of worldwide, national, and industry emissions. This amount is down from 104 million tons produced by TVA in 2008.

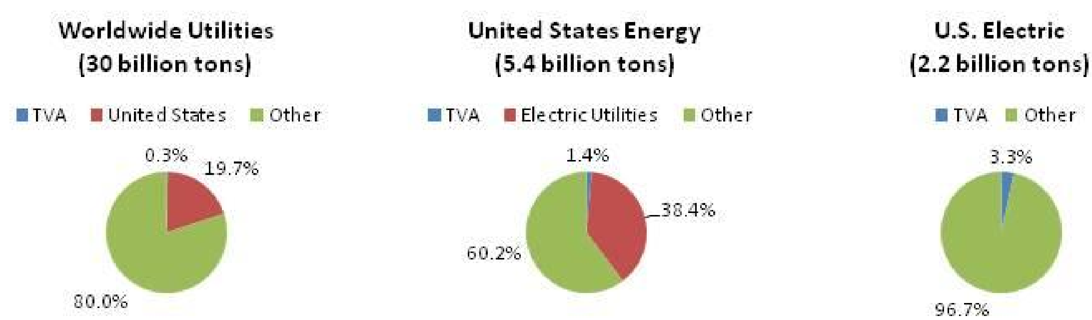


Figure 3-22. 2009 Man-Made Carbon Dioxide Emission Percentages

Regional Climate Change in the Southeast and the Tennessee River Valley
Compared to the rest of the U.S., the climate of the Southeast is warm and wet, with high humidity and mild winters. Average annual temperature across the southeastern U.S. did not change significantly over the last century; however, since 1970, annual average temperature has risen about 2 degrees Fahrenheit (°F). The greatest seasonal increase in temperature has been during the winter months. Since the 1970s, the number of freezing

days in the Southeast has declined by four to seven days per year for most of the region. Average autumn precipitation has increased by 30 percent for the region since 1901. There has been an increase in heavy downpours in many parts of the region, while at the same time, the percentage of the region experiencing moderate-to-severe drought increased over the past three decades.

In order to understand future climate scenarios in the TVA region better, TVA contracted with the Electric Power Research Institute (EPRI) to prepare a report on the impacts of GCC on various resources throughout the Tennessee Valley, including water and air that could be reasonably anticipated to occur over the 21st century (EPRI and TVA 2009). Emphasis was placed on the near future (through 2050), as higher uncertainty exists for longer-range predictions. The basis for this report is the United Nations IPCC's *Fourth Assessment Report*, published in 2007, that assumes a medium GHG emissions projection (the A1B scenario), which does not reflect additional efforts to reduce GHG emissions. The TVA region spans two large model regions, the Central and Eastern North America regions. Temperature forecasts for the Tennessee Valley are similar for the two model regions and predict an increase in annual mean temperatures in the Valley of about 0.8 degrees Celsius (°C) (1.4°F) from 1990 to 2020 and up to 4.0°C (7.2°F) by 2100. Precipitation forecasts for the two model regions are more variable. In the Central Region (the western portion of the Tennessee Valley), winter precipitation is forecast to increase by 2.6 percent from 1990 to 2020 and by 3.6 percent by 2100. Central region summer precipitation is forecast to decrease by 6.1 percent from 1990 to 2020 and by 3 percent by 2100. In the eastern region, winter precipitation is forecast to increase by 11.3 percent from 1990 to 2020 and by 13 percent by 2100. No change in Eastern Region summer precipitation is forecast from 1990 to 2020 or by 2100. It is important to note that these forecasts are based on coarse-scale model results, and localized downscaled analyses are needed for finer scale results.

To help improve its working knowledge and internal expertise, research underway includes the evaluation of carbon capture technologies. TVA is conducting a small-scale, terrestrial carbon sequestration pilot project in the Tennessee Valley. Environmental stewardship will be an integral part of this project. Mixed vegetation (trees, native warm season grasses, and legumes), as opposed to a monoculture, will be used to support biodiversity and provide habitat for wildlife (TVA 2011).

Other Regional Patterns and Influences on Local Climatology

The TVA MSR in northwest Alabama is located west of the southern Appalachian region, and its climate is not influenced by major topographical features. In fact, Muscle Shoals is fairly flat, and this characteristic is conducive to nocturnal fog formation and flooding problems during heavy rains. The relatively narrow width of the Tennessee River at Muscle Shoals does not result in a detectable lake breeze. However, warm river water temperatures in autumn and early winter also contribute to nighttime fog formation. Local weather is dominated much of the year by the Azores-Bermuda anticyclonic circulation shown in the annual normal sea level pressure distribution. This circulation over the southeastern U.S. is most pronounced in the fall and is accompanied by extended periods of fair weather and widespread atmospheric stagnation. In winter, the normal circulation pattern becomes more varied as the eastward-moving migratory high and low pressure systems, associated with the midlatitude westerly current, bring alternating cold and warm air masses into the area with resultant changes in wind direction, wind speed, atmospheric stability, precipitation, and other meteorological elements. In summer, the migratory systems are less frequent and less intense, and the area is under the dominance of the western edge of the Azores-Bermuda anticyclone with a warm moist air influx from the

Atlantic Ocean and the Gulf of Mexico. Generally, Muscle Shoals experiences a temperate climate with adequate rainfall throughout the year, hot and humid summers, and cool, damp winters.

3.9 Soils and Prime Farmland

The approximately 1,400 acres that comprise the MSR study area have several areas either not covered by soil or covered by soil that is unusable for various reasons. Approximately 64 acres are unusable for any purpose because these areas are managed as SWMUs under RCRA. These areas contain buried hazardous waste and are capped to prevent precipitation from percolating through the waste material (see Sections 3.1 and 4.1). Consequently, these areas are restricted and cannot be disturbed. About 165 acres are developed to some degree, and these areas are largely covered by pavement and buildings (see Section 3.7 and Figure 3-21).

According to the Natural Resources Conservation Service (NRCS) *Soil Survey of Colbert County, Alabama* (Bowen 1994), the urban area covers 289.5 acres of the MSR study area. Since the following description of soils is based on the NRCS soil survey, the 289.5 acres of urban area is excluded from the discussion of soils. The soil survey provides little information concerning the suitability of urban areas for various uses. Approximately 29 acres of the MSR study area are covered by water, which includes a water treatment plant reservoir and several small man-made ponds. Excluding these areas, approximately 1,080 acres from the total 1,400-acre MSR study area are considered soil that could be impacted by this proposed redevelopment.

Within the 1,080 acres of soils in the MSR study area that could be affected by development, 182 acres are included in TVA's agricultural land use licensing program. Vegetation in these areas, maintained by the licensees, is dominated by fescue fields included in 20 separate tracts that range in size from about 5 to 40 acres. The soils in nearly all of these licensed areas are considered prime farmland and are best suited for agricultural purposes (see Section 3.9.2). These licensed tracts occur in three areas: adjacent to the ERC, on the southern boundary along Second Street, and on the eastern boundary along Wilson Dam Road. These three areas contain much of the nonforested, easily accessible farmland.

3.9.1 Soils

The soils that make up the MSR study area are a mixture of upland and floodplain soils. They were formed from cherty limestone and limestone, and the lower floodplain soils have high amounts of alluvium, while the soil at higher elevations is primarily residuum. The well-drained areas, adjacent to the ERC complex and south of Reservation Road, are nearly level or gently sloping and are well suited for farming and only slightly limited for building and recreational purposes. The areas north of Reservation Road have moderate to severe limitations for farming due to their steep slope and the presence of many small stones in the surface layers. Along the western, southern, and eastern boundaries, i.e., along Hatch Boulevard, Second Street, and Wilson Dam Road, the soils have moderate to severe limitations for farming due to frequent flooding or excessive moisture. Some of the better-drained areas along these borders have been urbanized.

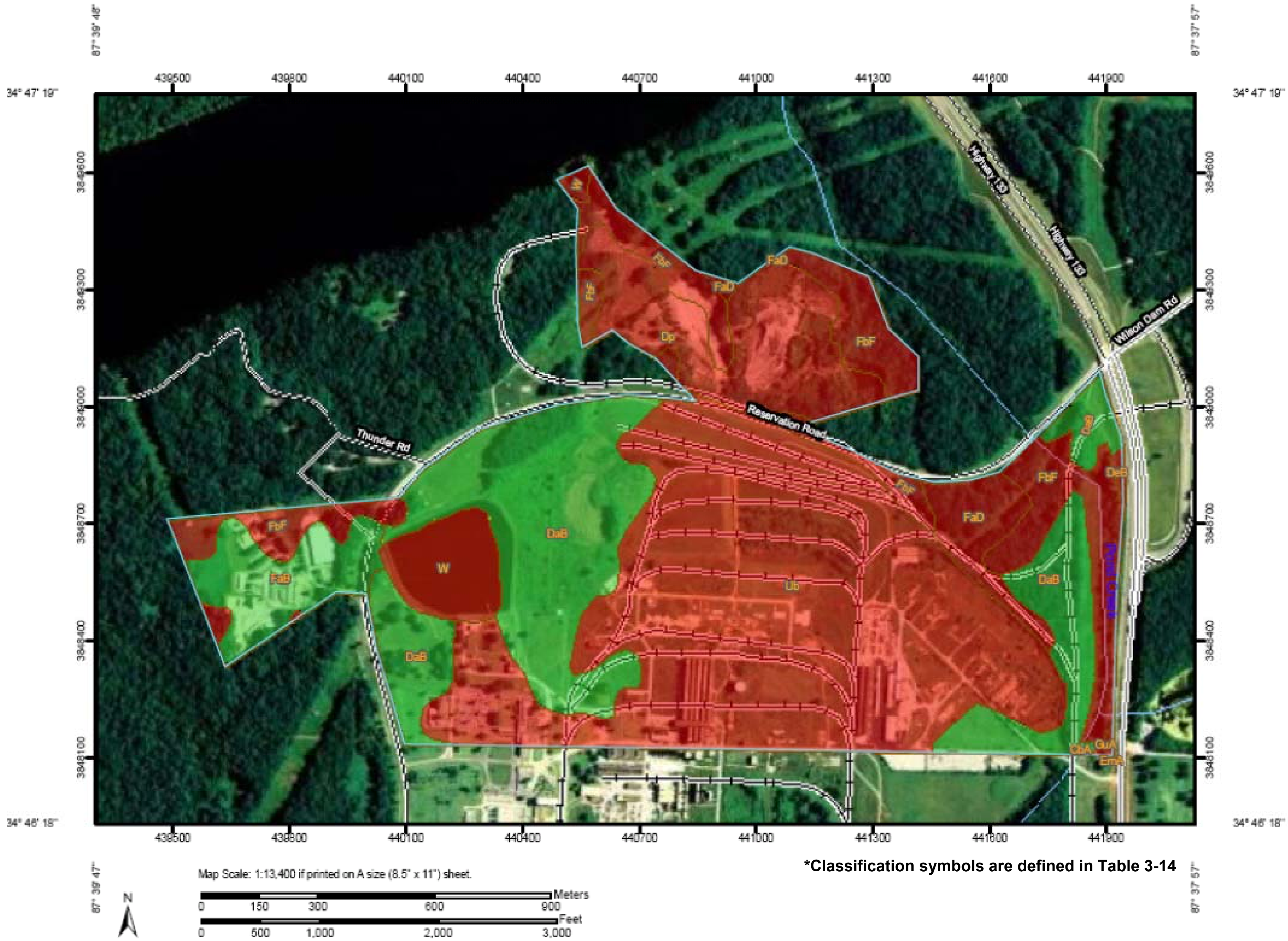
A list of soils described in the NRCS soil survey is provided as Table 3-14. The soil classification maps for the MSR study area are shown in Figures 3-23 and 3-24 for the northern and southern portions of the MSR study area. These maps were prepared using the U.S. Department of Agriculture (USDA) NRCS's Web Soil Survey.

Approximately 46 acres of the MSR study area is covered by a phosphate slag storage area, a legacy from phosphorus fertilizer production. This area lies north of Reservation Road (within a 90-acre area) and is designated as barren land (see Section 3.7). According to the NRCS land classifications, this barren land is considered a dump. It is not suitable for any type of farming.

Table 3-14. Soil Classification – Summary by Map Unit – Muscle Shoals Reservation Study Area

Soil Symbol	Soil Description	Acres	Percent	Rating
CbA	Chenneby silt loam, 0 to 2% slopes, occasionally flooded	132.7	9.5	All areas are prime farmland
DaB	Decatur silt loam, 2 to 6% slopes	478.4	34.2	All areas are prime farmland
DaC2	Decatur silty clay loam, 6 to 10% slopes, eroded	23.8	1.7	Not prime farmland
DeB	Decatur-Urban land complex, 2 to 8% slopes	51.9	3.7	Not prime farmland
DkA	Dickson silt loam, 0 to 3% slopes	11.1	0.8	All areas are prime farmland
Dp	Dumps	45.6	3.3	Not prime farmland
EmA	Emory silt loam, 0 to 2% slopes, ponded	13.1	0.9	Prime farmland if drained
EnA	Emory-Urban land complex 0 to 1% slopes	0.9	0.1	Not prime farmland
EtB	Etowah silt loam, 2 to 6% slopes	13.3	1.0	All areas are prime farmland
FaB	Fullerton cherty silt loam, 2 to 6% slopes	33.8	2.4	All areas are prime farmland
FaD	Fullerton cherty silt loam, 6 to 15% slopes	14.7	1.1	Not prime farmland
FbF	Fullerton-Bodine complex, 15 to 45% slopes	95.3	6.8	Not prime farmland
GuA	Guthrie silt loam, 0 to 2% slopes, frequently flooded	99.4	7.1	Not prime farmland
PUA	Pruitton and Sullivan silt loams, 0 to 2% slopes, occasionally flooded	65.0	4.7	Prime farmland if protected from flooding or not frequently flooded during the growing season
Ub	Urban land	289.5	20.7	Not prime farmland
W	Water	29.3	2.1	Not prime farmland
Totals for Muscle Shoals Reservation Study Area		**1,397.8**	**100.0**	

Source: Bowen (1994)



*Classification symbols are defined in Table 3-14

Figure 3-23. Soil Classifications for the Northern Section of the Muscle Shoals Reservation Study Area

Figure 3-24. Soil Classifications for the Southern Section of the Muscle Shoals Reservation Study Area

There are 14 soil types in the MSR study area. Detailed descriptions are provided in Appendix M. Although they appear to be scattered over the MSR study area, the soils are grouped in a concentric fashion in terms of their physical properties. Reservation Road, which generally forms the northern boundary of the MSR study area, follows the contour of a broad ridge. On this ridge lies the best soil from an agricultural standpoint due to its depth, silty texture, good drainage, and gentle slope. North of the ridge, the quality of the soil declines due the undulating terrain and the abrupt slope toward the Tennessee River (Pickwick Reservoir). Encircling the broad ridge to the west, south, and east are floodplain soils that are poorly drained and become increasingly moist (wet) from the ridge and approach the highways, which form the western, southern, and eastern boundaries. Much of the land along the highways that forms these borders is urban complex soils. These soils are located on the better-drained areas along the periphery of the MSR study area. A large part of the ridge, on which the best soil in the MSR study area lies, is considered urban due to the buildings, pavement, and roads associated with the ERC and research-related facilities.

3.9.2 Prime Farmland

Prime farmland is defined by the USDA as land that has the best combination of chemical and physical characteristics for producing food, feed, forage, fiber, and oilseed crops. To be considered prime farmland, it cannot be urban, built up, or covered by water. See list of soils on the MSR study area and prime farmland classification in Table 3-14 above.

Concern regarding the conversion of prime farmland to urban or industrial use prompted the passage of the 1981 Farmland Protection Policy Act (FPPA). This act requires that all federal agencies evaluate impacts to farmland prior to permanently converting the land to a nonagriculture land use. Form AD1006, “Farmland Conversion Impact Rating,” must be completed by federal agencies with assistance from the NRCS before action is taken.

Including the soils that are prime farmland if protected from flooding (Pruitton and Sullivan soils [PUA]) or drained (Emory silt loam [EmA], 0 to 2 percent slopes, ponded), about 53 percent (about 747.4 of the 1,400 acres) of the MSR study area is prime farmland. Another 21 percent of the MSR study area (289.5 acres) is classified as urban land. The ERC complex is classified as urban land because it is primarily buildings and pavement. Because this area is surrounded by prime farmland, primarily Decatur silt loam, 2 to 6 percent slopes, much of the soil beneath the ERC complex was likely prime farmland.

In other parts of Colbert County, these soils are primarily used for growing cultivated crops or pasture. Prime farmland soils around buildings and adjacent to Reservation Road are maintained as turf and are landscaped with trees and ornamentals. All of the prime farmland soils are level or gently sloping, well drained, and not prone to flooding. The two soils that are conditionally prime farmland (PUA and EmA) have the same capability as the prime farmland soils. The capability classes range from Class I (highest capability) to Class VIII (lowest capability). All of the prime farmland soils in the MSR study area are considered Class II. The two wet soils, PUA and EmA, are Class IIw. The suffix “w” denotes that water may interfere with plant growth. The suffix “s” denotes that the soil is shallow or stony. The other prime farmland soils have the capability class of IIe. The suffix “e” means that the soil may be susceptible to erosion.

The soils not considered prime farmland are those that occur on steep slopes, are too wet, or have been urbanized. In the capability rating system, wet soils have a capability class of V, and sloping or steep soils have capability classes of III, IV, VI, VII, or VIII. The Guthrie silt loam is Class Vw. All the other nonprime farmland soils are classified as Class IVe except for the Fullerton-Bodine complex, 15 to 45 percent slope, which is classified as Class VII. Fullerton is Class VIIe, and Bodine is Class VIIs. The phosphate slag storage area is Class VIIIs. The urban complex soils are not assigned a capability class.

Colbert County NRCS Soils Specialist Milton Tuck was asked to provide input for a Farmland Conversion Impact Rating. His input is shown in Form AD-1006 (see Appendix N). On a scale of 0 to 100 points, the *Relative Value of Farmland to Be Converted* is 55 points. This score was added to the score from the site assessment completed by TVA for this evaluation. The *Total Site Assessment* score was 34 points. This score was relatively low due to the large percentage of urbanized land around the site and the large acreage that had already been converted to industrial use. In the past, the ERC, although called a research facility, contained several small-scale industrial processes. Because only small portions of the total area (13 percent) have been farmed in recent times, the relative farming value of the land also is reduced.

The total points for farmland conversion associated with the potential TVA land disposal and redevelopment is 89 points. A score of 160 or higher implies that the land's value for farming is high enough to recommend that it not be converted to nonfarm use.

3.10 Surface Water Quality

The MSR is located along the southern shore of the Tennessee River (Wilson Dam tailwater-upper Pickwick Reservoir). In addition to the Tennessee River, two streams are located on or adjacent to the MSR study area. Pond Creek flows north through the eastern section of the property and enters the Tennessee River approximately 1 mile downstream of Wilson Dam at TRM 258.06. An unnamed tributary to the Tennessee River drains the western portion of the Reservation. However, most of the watershed of this stream lies outside of the MSR study area. The Tennessee River and Pond Creek are the two surface water bodies that could be affected by changes in land use on the MSR study area. There is also a water supply reservoir and several small man-made ponds located on the MSR study area. None of these have outlets and do not discharge water to other surface water bodies.

3.10.1 Tennessee River

During 2003, tributary embayments located on Guntersville, Wheeler, Wilson, and Pickwick reservoirs of the Tennessee River basin were intensively monitored. Water quality monitoring of the main stem reservoirs of the Tennessee River system is conducted by TVA through its Reservoir Vital Signs Monitoring Program. Objectives of the program are to provide basic information on the "health" or integrity of the aquatic ecosystem in each TVA reservoir and to provide screening level information for describing how well each reservoir meets the "fishable" and "swimmable" goals of the CWA. Sampling activities involve examination of appropriate physical, chemical, and biological indicators in the forebay, midregion, and headwater areas of each reservoir. Initiated in 1990, the TVA program provides results of monitoring activities to ADEM on an annual basis through program reports (ADEM 2005).

TVA monitored Pickwick Reservoir annually from 1991 through 1994 to establish baseline data on the reservoir's ecological health under a range of weather and flow conditions. Pickwick is now evaluated every other year. The overall ecological condition in Pickwick Reservoir rated "fair" in 2010. Pickwick has scored about the same every year, either "high fair" or "good," depending primarily on chlorophyll concentrations, which are affected by reservoir flows, and conditions in the Bear Creek embayment, which generally rates lower than at other monitoring locations on the reservoir. The inflow rating, which is based on fish and bottom life, was "good" in 2010 and contributed to the overall higher score for the reservoir that year.

The average annual flow estimates for the Tennessee River at Pond Creek is approximately 50,000 cubic feet per second (cfs). The estimated annual low flow for the Tennessee River at Pond Creek is 6,750 cfs. The proposed utility corridor across the phosphate slag storage area could provide access to the Tennessee River approximately 1.5 miles downstream of Wilson Dam.

3.10.2 Pond Creek

The State of Alabama's antidegradation policy provides for protection of high-quality waters that constitute an outstanding national resource (Tier 3), waters whose quality exceeds the levels necessary to support propagation of fish, shellfish, and wildlife, and recreation in and on the water (Tier 2), and existing instream water uses and the level of water quality necessary to protect the existing uses (Tier 1) (ADEM 2010). Pond Creek is classified as Agricultural and Industrial Water Supply. Pond Creek is a Tier 1 stream, and there are no total maximum daily loads (TMDL) calculated for this stream at this time. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards.

Sections 305(b) and 303(d) of the federal Clean Water Act direct states to monitor and report the condition of their water resources. Pond Creek is on the most recent 303(d) list for impairment due to organic enrichment and metals (arsenic, cyanide, and mercury) (ADEM 2008). The ADEM Water Quality Branch evaluated Pond Creek for the Muscle Shoals Wastewater Treatment Plant (NPDES Permit No. AL0024180). ADEM indicated that the organic enrichment and metals impairment do not appear to be related to nutrient loading. The ADEM Water Quality Branch believes that the low dissolved oxygen issues in Pond Creek are due to natural conditions of low flow, low slope, and slow stream velocities. The probable sources for both the organic enrichment and metals impairments are listed as nonirrigated crop production, urban runoff/storm sewers, and natural/wildlife.

The unnamed tributary that drains the western portion of the site has not been assessed because only small portions of the extreme headwaters of this stream lie within the MSR study area.

3.10.3 Current Muscle Shoals Reservation Water Withdrawals

TVA has owned and operated a 2.0 MGD potable water treatment plant on the MSR since the 1930s. The potable water treatment plant is situated near and draws water from the Tennessee River and distributes it throughout the MSR. The TVA facility also requires large volumes of nonpotable process water, which is supplied by two large water intake structures located on the Tennessee River. The intakes are known as the PDW intake pumping station and the Fleet Hollow intake pumping station. The PDW pumping station is located downstream of Wilson Dam, and the Fleet Hollow pumping station is situated upstream of the Wilson Dam. Both stations incorporate multiple pumps with screening capability. Each station is capable of pumping 29 MGD. TVA has all the required operating and environmental permits from the State of Alabama and USEPA to own and operate the two intakes, the potable water plant, and associated distribution piping system for both facilities. The permits are valid, active, and in good standing.

3.11 Wetlands

Wetlands, as defined in EO 11990, are those areas that are inundated by surface water or groundwater with a frequency sufficient to support and under normal circumstances does or would support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, mud flats, and natural ponds. EO 11990 directs federal agencies to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. In addition, activities in wetlands are regulated under the authority of the federal CWA and various state water quality protection regulations.

Wetlands are ecologically important because of their beneficial effect on water quality, their moderation of flow regimes by retaining and gradually releasing water, their value as wildlife habitat, and as areas of botanical diversity. Wetlands are typically transitional ecosystems between terrestrial and aquatic communities.

Nonjurisdictional wetlands are wetlands that lack one of the three criteria (prevalence of wetland vegetation, hydric soils, and wetland hydrology) used to identify wetlands that are regulated by state and federal regulations. In the project area, nonjurisdictional wetlands typically lack hydric soils but will have a prevalence of wetland vegetation and undergo saturation or inundation long enough to drive the composition of the plant community. Jurisdictional wetlands, as the name suggests, fall under the jurisdiction of state and federal wetland regulations as described in Section 4.11. Nonjurisdictional wetlands are not regulated by state or federal law but are afforded protection under EO 11990. The EO's definition of wetlands is based primarily on a prevalence of wetland vegetation.

Wetlands on the MSR were identified primarily via National Wetland Inventory maps, remote sensing and aerial photography interpretation, and limited ground surveys. No distinction was made between jurisdictional and nonjurisdictional wetlands.

In accordance with TVA procedures for implementing EO 11990 in *Instruction IX, Environmental Review* (TVA 1983), TVA must evaluate the effect of the proposed action on natural and beneficial wetland values and alternatives that would eliminate or minimize such effects. TVA must then determine whether there is a practicable alternative that will avoid affecting wetlands. If there is no practicable alternative to development in wetlands, then all practical measures to minimize impacts to wetlands must be incorporated into plans to develop these areas. TVA does not transfer federally owned wetlands to nonfederal ownership without assurances that future impacts from development would be avoided or minimized.

Estimates of wetland types and extent of occurrence (i.e., location and size) on the MSR study area were determined using aerial photography flown in March 2010 and resulting land use/land cover analysis and interpretation of this photography. Results of TVA's photointerpretation are shown in Table 3-15 and Figure 3-21. The 2.75 acres of constructed wetlands are the result of past research projects. Because of the timing of the photography and nature of this data collection, the size of area representing wetlands on the MSR study area could be liberal and overestimate the actual acreage of wetlands present on the ground. However, as mentioned below, some field verification was undertaken.

Table 3-15. Wetlands by Type, Size, and Percent on the Muscle Shoals Reservation Study Area

Wetland Type	Acreage	Percent of Area
Forested wetlands	152.07	10.89
Scrub-shrub wetlands	7.10	0.51
Emergent herbaceous wetlands	2.03	0.15
Man-made wetlands	2.75	0.20
TOTAL	**163.95**	**11.75**

During spring 2010, field surveys were completed to verify the aerial estimates and provide more details about the wetland habitats present on site. Common vegetation associated with wetlands on the MSR study area includes water oak (*Quercus phellos*), willow oak (*Quercus nigra*), sweet gum (*Liquidambar sytraciflua*), sycamore (*Platanus occidentalis*), black willow (*Salix nigra*), Chinese privet (*Ligustrum sinense*), red maple (*Acer rubrum*), green ash (*Fraxinus pennsylvanica*), alder (*Alnus serrulata*), sedges (*Carex* spp.*),* soft rush (*Juncus effusus)*, green dragon (*Arisaema dracontium)*, cattail (*Typha latifolia*), smartweed (*Polygonum* spp.), and jewelweed (*Impatiens capensis*).

Although they are heavily impacted by invasive species, primarily Chinese privet, the MSR study area wetlands provide valuable habitat for wildlife, including resident and migrant birds. This provides an especially important function within the context of what is primarily an urbanizing environment. These wetlands also provide important flood retention functions.

3.11.1 Regional Wetland Resources

The MSR study area is located within the Interior Plateau Level III ecoregion, as defined by Griffith et al. (2001). See more detailed description of this ecoregion in Section 3.14.1. Wetlands comprise approximately 0.70 percent of the total land cover in this ecoregion (Loveland and Acevedo 2006). In terms of wetland type, data prepared for the TVA *Reservoir Operations Study* (TVA 2004) provide general estimates of the type and extent of wetland acreage associated with specific TVA reservoirs. These data indicate the most common type of wetlands on and near the MSR study area is forested wetlands. Forested wetlands are generally associated with floodplains of rivers and streams. Emergent and scrub-shrub wetlands are relatively common and are typically found on reservoir shorelines and coves. Wetlands are more common in the western part of the Tennessee River system due to the flatter topography and broader floodplain areas.

3.11.2 Regional Trends

At present, there are approximately 3.6 million acres of wetlands in Alabama (USDA 2009). Most of these wetlands are associated with river systems. General trends in wetland loss in the Southeast and in Alabama indicate that forested, emergent, and scrub-shrub wetlands have suffered a net loss in acreage over the last 10 years. This is primarily due to transportation impacts, the continued growth of urban/suburban development associated with continued population growth, and to a lesser degree, agriculture and timber harvesting (Hefner et al. 1994; Dahl 2006; Keeland et al. 1995). Agricultural practices cause a continuing net loss of approximately 24,000 acres of wetlands per year (USDA 2009). However, recent research has indicated that there is an overall gain in wetland resources in Alabama and nationwide (Sifneos et al. 2009). This trend reflects an overall increase in ponds created as agricultural impoundments and shallow ponds associated with urban and suburban development. Additionally, compensatory mitigation for the loss of emergent wetlands has contributed to the trend (Dahl 2006). However, regionally there is still an overall acreage loss in both forested and scrub-shrub wetland habitat types.

3.12 Floodplains

The approximately 1,400-acre MSR study area includes TVA's property identified as the phosphate slag storage area (potential utility corridor) at about TRM 257.7 and property along Pond Creek from the mouth at TRM 258.06 upstream to Wilson Dam Road at Mile 2.7. Areas lying within the limits of the 100-year floodplain can occur along Pond Creek (Figure 3-25) and along the Tennessee River. TVA's Section 26a jurisdiction applies to obstructions across, along, or in the Tennessee River or any of its tributaries.

Pond Creek begins east of Muscle Shoals and flows mainly through undeveloped, relatively flat land before passing through the industrial areas in the Listerhill community and Muscle Shoals. Pond Creek has an average fall of 2 feet per mile. The Pond Creek drainage area at its mouth is 22 square miles (Federal Emergency Management Agency 2010). As shown in Figure 3-25, on the MSR study area, there is an estimated 114 acres within the floodplain of Pond Creek below elevations identified below. This does not include a small area at the mouth of Pond Creek along the Tennessee River.

In accordance with TVA procedures for implementing EO 11988 (Floodplain Management) in *Instruction IX, Environmental Review* (TVA 1983), TVA must evaluate the effect of the proposed action on natural and beneficial floodplain values and alternatives that would eliminate or minimize such effects.

TVA must then determine whether there is a practicable alternative that would avoid affecting floodplains. If there is no practicable alternative to development in the floodplain, then all practical measures to minimize impacts to floodplains are incorporated into plans to develop these areas.

Figure 3-25. Estimated 114-Acre Pond Creek Floodplain Within the Muscle Shoals Reservation Study Area

At TRM 257.7, the 100-year flood elevation is 431.6 feet mean sea level (msl). The 100-year floodplain is the area that would be inundated by the 100-year flood. The Flood Risk Profile (FRP) elevation at TRM 257.7 is 433.7 feet msl. At this location, the FRP elevation is equal to the 500-year flood elevation and is used to control flood-damageable development for TVA projects and on TVA Lands. The Tennessee River 100-year flood elevation at the mouth of Pond Creek (TRM 258.06) is 432.6 feet msl, and the FRP elevation is 434.8 feet msl. On Pond Creek, computed flood elevations are available from Mile 1.42 to 2.70 (Wilson Dam Road). The 100-year flood elevations along Pond Creek vary from 511.3 feet msl at Mile 1.42 to 514.6 feet msl downstream of Wilson Dam Road at Mile 2.70. The 500-year flood elevations vary from 513.0 feet msl at Mile 1.42 to 515.9 feet msl at Mile 2.70. All elevations are NGVD (National Geodetic and Vertical Datum) 1929. Tabulations of the Pond Creek 100- and 500-year flood elevations are included in Table 3-16.

Table 3-16. Pond Creek Flood Profiles - Muscle Shoals Reservation Study Area

Pond Creek Mile	100-Year Flood Elevation (feet) [1]	500-Year Flood Elevation (feet) [1]
1.42	511.3	513.0
1.56	511.8	513.5
1.67	512.1	513.8
1.78	512.5	514.2
1.82	512.6	514.4
1.88	512.7	514.5
1.90	512.7	514.5
1.94	512.8	514.5
2.02	512.9	514.6
2.06	512.9	514.6
2.08	512.9	514.6
2.20[2,4]	513.0	514.7
2.20[3]	514.1	515.5
2.39	514.3	515.6
2.70[2,5]	514.6	515.9

[1]All Elevations are NGVD 1929
[2]Downstream of bridges
[3]Upstream of bridges
[4]Landmark is U.S. railway
[5]Landmark is Wilson Dam Road (SR 133)

In Muscle Shoals, Pond Creek and numerous sinkholes tend to overflow during rainstorms and cause serious flood damage to residences and businesses. In spring 1973, heavy flood damage occurred in Muscle Shoals, Alabama, as water rose in the “Old Gusmus Pond” sink area (TVA 1974). The combination of 8 inches of rain, runoff from the local area draining into the sink, and overflow from Pond Creek exceeded outflow capacity of the sink. Although the rainfall and the overflow from Pond Creek ended on March 17, 1973, the floodwaters rose in the sink until the morning of March 19, 1973, and did not drop below the floor of the lowest building until April 2, 1973. At the crest, floodwaters were up to 2.5 feet deep in 18 businesses and up to 2 feet deep in 15 homes and a housing project. Water surrounded many other businesses and homes and damaged several mobile homes. The

Southgate Mall Shopping Center was completely surrounded by water, 0.5 foot below the floor levels. The shopping center was closed for about a week (TVA 1974).

Muscle Shoals, Sheffield, Tuscumbia, Florence, Colbert County, and Lauderdale County participate in the National Flood Insurance Program. They have adopted the 100-year flood as the basis for their floodplain regulations, and all development would be consistent with these regulations. There is a published floodway beginning at Mile 2.57 on Pond Creek and continuing upstream of the land disposal and redevelopment area.

3.13 Aquatic Ecology

3.13.1 Fish and Aquatic Life

The MSR is located along the southern shore of the Tennessee River (Wilson Dam tailwater—Pickwick Reservoir). Two streams are located on or adjacent to the MSR study area. Pond Creek generally flows north through the eastern section of the property and enters the Tennessee River approximately a mile downstream of Wilson Dam (see Section 3.12). An unnamed tributary to the Tennessee River drains the western portion of the MSR study area. However, most of the watershed of this stream lies outside the Reservation. Several man-made ponds are located here, and generally, these ponds support relatively poor aquatic communities due to impacts from past industrial fertilizer operations on the MSR study area.

Pond Creek is listed on the Alabama 303(d) list as impaired (see Section 3.10). Impaired waters are those that do not presently fully support their designated uses. The most recent TVA aquatic life survey of Pond Creek (TVA unpublished data 2007) supports this listing. While Pond Creek has adequate physical habitat, both the fish and benthic macroinvertebrate community conditions indicated severe impairment of this stream. The unnamed tributary that drains the western portion of the site has not been assessed because only small portions of the extreme headwaters of this stream lie within the MSR study area (see Figure 3-25).

Both Pond Creek and the unnamed tributary stream flow into the Tennessee River (Wilson Dam tailwater—Pickwick Reservoir). This portion of the Tennessee River supports a very diverse aquatic community, including several mussel species listed as endangered or threatened. The Wilson Dam tailwater has been designated by the U.S. Fish and Wildlife Service (USFWS) as a Nonessential Experimental Population (NEP) area for 16 federally listed mussel species and one federally listed snail species (USFWS 2001). The harvest of freshwater mussels in this section of the river is restricted by the State of Alabama. The shoreline portion of the area considered for a utility corridor is located in this reach of the Tennessee River, approximately 1 mile downstream of Wilson Dam. A more detailed description of the reach of the river designated for the Tennessee River/Wilson Dam NEP is provided in Section 3.15.

No invasive fish or other aquatic life is known from or reported from Pond Creek, on-site ponds, or any other creek or river tributaries.

3.13.2 Aquatic Endangered and Threatened Species

Numerous species listed under the Endangered Species Act as endangered, threatened, or candidates for listing have been reported from or are known to occur in this reach of the Tennessee River (Wilson Dam tailwater—Pickwick Reservoir) in Colbert County, Alabama (see Table 3-17). No state or federally listed aquatic animal species are known or likely to occur in Pond Creek. Due to the level of impairment of Pond Creek, it is not expected to support any state- or federally listed aquatic species (see Section 3.10). Pond Creek and the unnamed tributaries that drain other parts of the Reservation are too small to support any of the listed mussel species present in the main stem Tennessee River.

Table 3-17. State- and Federally Listed Species Known to Occur in Colbert County, Alabama

Common Name	Scientific Name	Alabama Status (Rank)	Federal Status
Crustaceans			
Alabama blind cave shrimp	*Palaemonias alabamae*	PROT (S1S2)	END
Troglobitic crayfish	*Procambarus pecki*	TRKD (S2)	-
Troglobitic crayfish	*Cambarus jonesi*	SPCO (S2)	-
Mussels			
Black sandshell	*Ligumia recta*	TRKD (S2)	-
Cumberland combshell	*Epioblasma brevidens*	PROT (S1)	END
Deertoe	*Truncilla truncata*	TRKD (S1)	-
Dromedary pearlymussel	*Dromus dromas*	PROT (S1)	END
Fanshell	*Cyprogenia stegaria*	PROT (S1)	END
Kidneyshell	*Ptychobranchus fasciolaris*	TRKD (S1)	-
Monkeyface	*Quadrula metanevra*	TRKD (S3)	-
Ohio pigtoe	*Pleurobema cordatum*	TRKD (S2)	-
Pink mucket	*Lampsilis abrupta*	PROT (S1)	END
Pink papershell	*Potamilus ohiensis*	TRKD (S3)	-
Purple lilliput	*Toxolasma lividus*	TRKD (S2)	-
Pyramid pigtoe	*Pleurobema rubrum*	PROT (S2)	-
Rabbitsfoot	*Quadrula cylindrica cylindrica*	PROT (S1)	CAND
Ring pink	*Obovaria retusa*	PROT (S1)	END
Rock pocketbook	*Arcidens confragosus*	TRKD (S3)	-
Rough pigtoe	*Pleurobema plenum*	PROT (S1)	END
Round pigtoe	*Pleurobema sintoxia*	TRKD (S1)	-
Sheepnose	*Plethobasus cyphyus*	PROT (S1)	-
Spectaclecase	*Cumberlandia monodonta*	PROT (S1)	CAND
Slabside pearlymussel	*Lexingtonia dolabelloides*	PROT (S1)	CAND
Spike	*Elliptio dilitata*	TRKD (S1)	-
Tennessee pigtoe	*Fusconaia barnesiana*	TRKD (S1)	-
Wavy-rayed lampmussel	*Lampsilis fasciola*	TRKD (S1S2)	-
White heelsplitter	*Lasmigona complanata*	TRKD (S2S3)	-
White wartyback	*Plethobasus cicatricosus*	PROT (S1)	END
Snails			
Anthony's river snail	*Athearnia anthonyi*	PROT (S1)	END
Round-rib elimia	*Elimia nassula*	TRKD (S1)	-
Slowwater elimia	*Elimia interveniens*	TRKD (S2)	-
Spiral hornsnail	*Pleurocera brumbyi*	TRKD (S2)	-

Common Name	Scientific Name	Alabama Status (Rank)	Federal Status
Varicose rocksnail	*Lithasia verrucosa*	TRKD (S3)	-

- = No Protection
Federal status abbreviations: CAND = Candidate for federal listing; END = Endangered
State status abbreviations: PROT = Protected; TRKD = Tracked by the state natural heritage program; SPCO = Special concern
State rank abbreviations: S1 = Critically imperiled, often with five or fewer occurrences; S2 = Imperiled, often with less than 20 occurrences; S3 = Rare or uncommon, often with less than 80 occurrences; S#S# = Occurrence numbers are uncertain

3.14 Terrestrial Ecology

3.14.1 Vegetation

The MSR study area occurs in the Eastern Highland Rim of the Interior Low Plateau ecoregion. Within the Eastern Highland Rim, Mississippian-aged limestone, chert, shale, and dolomite predominate, and springs, sinks, and caves have formed by solution of the limestone. Natural vegetation is transitional between the oak-hickory type to the west and the mixed mesophytic forests of the Appalachian ecoregions to the east. Much of the original bottomland hardwood forests have been inundated by impoundments. The flatter areas in the east and on both sides of the Tennessee River have very deep, well-drained, reddish soils that are intensively farmed (Griffith et al. 2001).

Approximately 1,206 acres (86 percent) of the 1,400-acre MSR study area has the following land cover: barren land, deciduous forest, evergreen forest, mixed forest, scrub-shrub forest, grassland/herbaceous, pasture/hay, forested wetland, scrub-shrub wetland, emergent herbaceous wetland, and man-made wetland (Figures 3-20, 3-21). The remaining 13.6 percent (190.3 acres) is occupied by varying intensities of developed areas or by open water.

Three Alabama Champion trees, the largest of their species in the state, also occur within 5 miles of the MSR study area. These three Champion trees include black walnut (*Juglans nigra*), paper mulberry (*Broussonetia papyrifera*), and tree-of-heaven (*Ailanthus altissima)*. The Champion paper mulberry tree is growing on TVA land but is outside the MSR study area. The former Alabama Champion American chestnut tree occurs within the MSR study area. As of April 2010, it has been heavily infested with the chestnut blight; however, live sprouts still persist. According to the Alabama Forestry Commission (2009), a larger American chestnut was found recently in Talladega County, making the MSR tree the second largest in the state.

Deciduous, evergreen, and mixed forests cover about 25 percent of the MSR study area and contain loblolly pine, American elm, hackberry, sweetgum, wild black cherry, and various oaks and hickories along with tree-of-heaven in the canopy. Common understory vegetation includes pokeweed, Japanese honeysuckle, Chinese privet, Virginia creeper, wild grape, greenbriers, and poison ivy. Scrub-shrub communities occur along fencerows, edges of small woodlots and larger woodlands, railroad rights-of-way, and roadsides. Commonly encountered species include callery pear, Chinese privet, persimmon, sumacs, multiflora rose, honey-locust, kudzu, red bud, tree-of-heaven, blackberry, Virginia creeper, Japanese honeysuckle, and poison ivy.

Grassland/herbaceous and pasture/hay cover over 43 percent of the MSR study area. Hay production, which occurs under agricultural license, contains fescue, clovers, orchard grass, Johnson grass, Bermuda grass, and numerous broad-leaved weeds. Seventeen acres have been converted to areas of native warm season grasses with big blue stem, eastern gama grass, little blue stem, Indian grass, sideoats grama grass, and switch grass. Successional fields consist of broomsedge, callery pear, joe-pye-weed, iron weed, coreopsis, lespedeza, various asters, and several native grass species along with saplings of persimmon, sumacs, red bud, honey-locust, multiflora rose, and blackberries.

Forested wetlands are found as riparian woodlands in low-lying areas and along Pond Creek. These areas are dominated by water and willow oak and also contain American sycamore, river birch, hackberry, winged elm, sweetgum, and hop hornbeam.

Scrub-shrub, emergent herbaceous and man-made wetland communities are dominated by black willow, buttonbush, silky dogwood, and tag alder. Herbaceous species such as arrowhead, cardinal flower, cattails, jewelweed, poison hemlock, water plantain, water-willow and several species of grasses, rushes, and sedges are commonly found.

The American Chestnut Research Orchard

In 1994, TVA and the Alabama Chapter of TACF entered into an agreement to collaborate on research to assist in the development of blight-resistant American chestnut trees. An approximately 4-acre area of a larger managed field was dedicated to this project. When TVA federal appropriations ended in the late 1990s, TACF continued to conduct active research at this site (see Figure 3-26).

TACF Research Orchard has produced American/Chinese chestnut hybrids that are a critical component to the national effort to reintroduce this extirpated keystone species back into the forests of the Appalachians (U.S. Forest Service [USFS] 2009). According to Morris et al. (2006), the goal of the Alabama orchards is to produce trees whose genomes would be compatible with the regional environment. Seedlings obtained from these hybrids would likely have a better chance of survival when reintroduced into Alabama forests. Similar breeding and restoration programs are being conducted across the historical range of the American chestnut. In addition, preliminary research has shown that American chestnut was among the fastest-growing hardwoods of the eastern U.S. and would be of great use to help mitigate accelerated global warming through the uptake and storage of carbon (Diamant 2005). These results are of great interest to those who could benefit from planting American chestnut to help offset emissions, while providing excellent wildlife habitat and high value timber and contributing to the restoration of the species (Diamant 2005).

Figure 3-26. Location of The American Chestnut Foundation Research Orchard on the MSR Study Area

Invasive Plants

Most lands in and around the TVA power service area have been affected by the introduction of nonnative plants. Nonnative plants are known to occur across southern Appalachian forests, accounting for 15 to 20 percent of the documented flora (USFS 2008).

Not all nonnative species pose a threat to native ecosystems and the Tennessee Valley region. Many species introduced by European settlers are naturalized additions to our flora and are considered nonnative noninvasive species. These "weeds" have very little negative impacts to native vegetation. Examples of these are Queen Anne's lace and dandelion. However, other nonnative species are considered invasive and do pose threats to the natural environment. EO 13112 defines an invasive species as any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem and whose introduction does or is likely to cause economic or environmental harm or harm to human health (USDA 2007). According to NatureServe (2009), invasive species are the second-leading threat to imperiled native species.

Much of the native vegetation within and surrounding the MSR study area has been altered by previous land use. A few of the more commonly encountered invasive plant species occurring within the project area include autumn olive, callery (Bradford) pear, Chinese privet, crown vetch, Japanese honeysuckle, Johnson grass, kudzu, mimosa, multiflora rose, sericea lespedeza, and tree-of-heaven. Most of the invasive species found on the MSR study area are considered a severe threat to the natural environment and are of high priority to TVA for control or eradication. Many of these species are abundant throughout Colbert County.

3.14.2 Wildlife

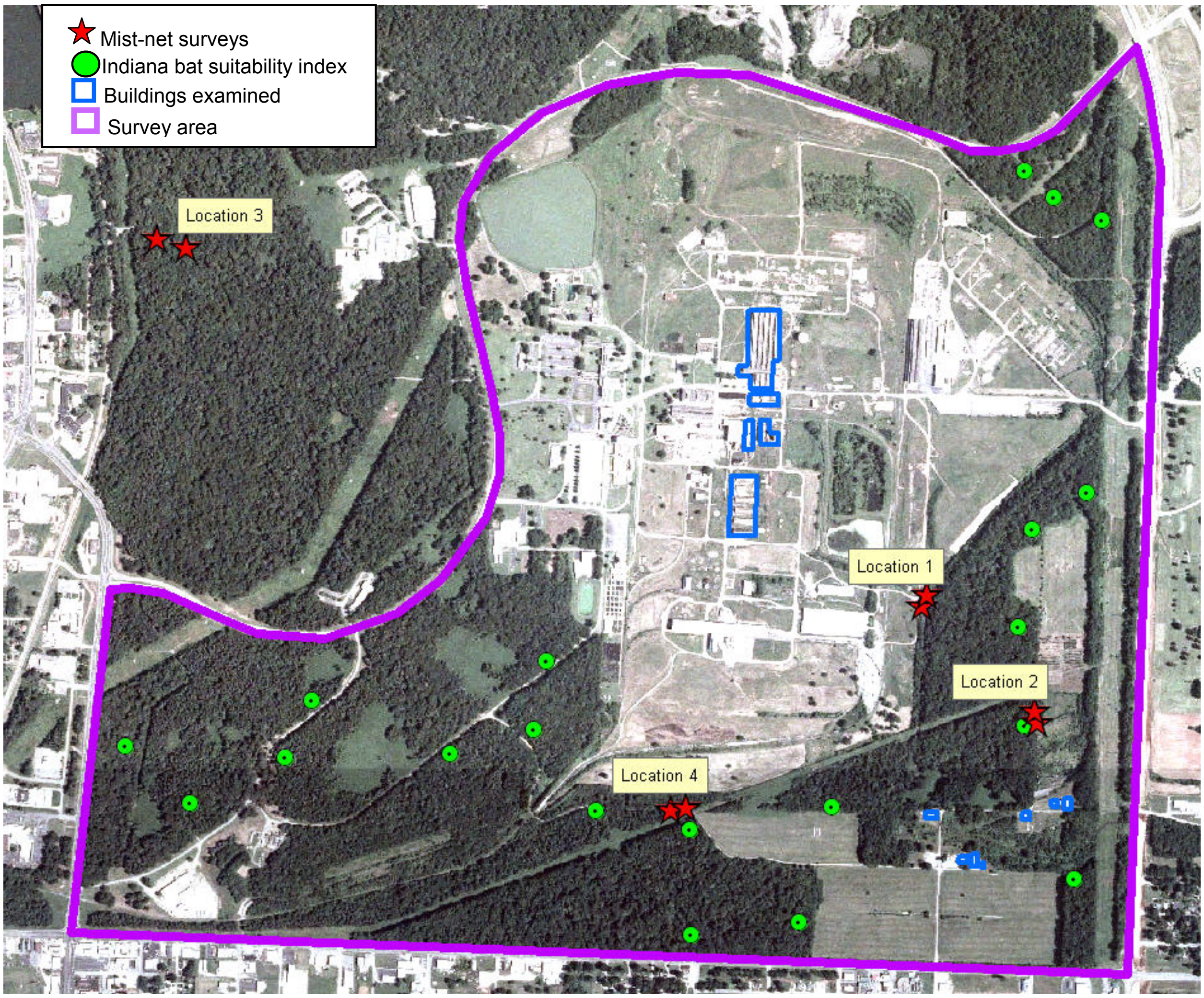
Habitats occurring in the MSR study area vary from areas of barren lands to forested tracts dominated by deciduous forests. Review of land use/land cover data reveals that approximately 36 percent of the MSR study area is comprised of forested habitats including forested wetlands. This habitat (501 acres) is largely characterized as upland deciduous and mixed forest and forested wetlands (see Figure 3-20). Approximately 47 percent of the MSR study area is comprised of early successional habitats (scrub-shrub, pasture/hay, and grasslands). Some narrow riparian zones, including Pond Creek, cross the property, and a few small ponds and a reservoir occur on the MSR study area. This diverse habitat provides for diverse animal communities. There have been few surveys for mammals (other than bats), reptiles, and amphibians. Those species with known distribution ranges within the MSR study area are listed in Appendix O.

Forested habitats on the Reservation are used by a variety of wildlife. Numerous species of migratory songbirds migrate through the area during spring and fall and reside in the MSR study area during summer months. Common species include northern cardinal, brown-headed cowbird, eastern towhee, blue jay, Carolina chickadee, tufted titmouse, American redstart, yellow-rumped warbler, and magnolia warbler. Mammals such as raccoon, opossum, nine-banded armadillo, white-tailed deer, eastern cottontail, eastern gray squirrel, and gray fox are common in these areas.

An approximately 4-acre forested wetland section in the southwestern corner of the MSR study area is mixed with several acres of forest edge, abandoned fields, and privet- and kudzu-infested areas. Smaller isolated areas of forested wetlands also occur in this area. The diversity of habitats attracts many bird species during fall migration. Surveys of the southwestern area conducted since 2002 have recorded a total of 132 bird species. Approximately 200 bird species have been recorded on the entire Reservation (Appendix O). Most numerous are gregarious species such as American robin and brown-headed cowbird. Of the migrant songbirds, magnolia warbler and American redstart are most abundant. Thirty-two species of warblers, seven species of vireos, five species of thrushes, and nine species of flycatchers have been recorded. Due to the large numbers and diversity of migrants in this location, active bird watching occurs here between late August and mid-October (also see Section 3.16). More than 250 species of resident and migratory birds have been recorded on the MSR and other TVA land from Wilson Dam to Hatch Boulevard, including Jackson and Patton Islands, and along the Tennessee River in the vicinity of Wilson Dam.

Forested tracts in the MSR study area have been surveyed for bats in recent years (Fiedler et al. 2007). Locations of these surveys are provided in Figure 3-27. Eastern pipistrelle bats, red bats, and big brown bats were captured during TVA surveys and are considered common on these properties. Twenty abandoned buildings were examined for colonies of bats; none were located.

Forested wetlands provide habitat for a mixture of amphibians and reptiles; however, these areas are somewhat degraded, especially on the western portion of the properties due to their proximity to the nearby highway and the prevalence of dense understory/midstory dominated by exotic species. Chinese privet is common on the MSR study area (Figure 3-28).



Source: Fiedler et al. 2007

Figure 3-27. 2007 Bat Survey Locations on the Muscle Shoals Reservation Study Area

Source: Fiedler et al. 2007

Figure 3-28. Typical Upland Forested Area With Thick Privet Understory on the Muscle Shoals Reservation Study Area

Early successional habitats on the MSR study area are partially comprised of areas maintained by agricultural licenses. These areas are dominated by fescue fields that offer lower-quality habitat for wildlife. In contrast, a small portion of the early successional habitats have been converted to warm season grasses, which provide excellent habitat for wildlife, especially birds and small mammals that occur in the MSR study area. Common birds found in early successional habitat and associated hedgerows include mourning dove, eastern kingbird, indigo bunting, prairie warbler, common yellowthroat, white-throated sparrow, red-winged blackbird, and American goldfinch. Grassland communities within the MSR study area are inhabited by birds such as northern bobwhite, American kestrel, eastern bluebird, common yellowthroat, savannah sparrow, vesper sparrow, dickcissel, and bobolink.

Fragmentation of habitat is currently present both within the proposed redevelopment area boundary and the area north of Reservation Road. Such fragmentation is in the form of existing rights-of-way, roads, agricultural use, industrial use, and other disturbances. These areas also are surrounded by land use practices (commercial, residential, etc.) outside the Reservation that have smaller tracts of forests and fragmented habitat also used by wildlife. Species of terrestrial animals that continue to use these habitats have either evolved or adapted to such conditions to fulfill all or a part of their life cycles.

Open water habitats on the property attract a variety of wading birds and some species of migrant, resident, and transitory gulls and other waterfowl. Common species that occupy or use the area include double-crested cormorant, great blue heron, ring-billed gull, wood ducks, bufflehead, ring-necked duck, and lesser scaup.

An April 2010 review of the TVA Natural Heritage database indicated that six caves are reported in the region. No caves occur on the MSR study area. No unique terrestrial habitats were observed on these tracts during field investigations associated with bat surveys (Fiedler et al. 2007).

3.14.3 Terrestrial Endangered and Threatened Species

3.14.3.1 Vegetation

An April 2010 review of the TVA Natural Heritage database indicated that there are no federally listed plants on the MSR study area; however, one federally listed as threatened plant, the lyrate bladderpod, is reported from Colbert County, Alabama. Habitat to support populations of this federally listed plant does not occur within or adjacent to the MSR study area. Six state-listed plants are known to occur within 5 miles of the MSR study area (see Table 3-18). Two of these, Dutchman's breeches and false rue-anemone, are known to occur on the Reservation but not within the MSR study area. Descriptions of these plant species and their habitats are provided below.

Table 3-18. Species of Conservation Concern Within 5 Miles of the Muscle Shoals Reservation and Federally Listed Species Known to Occur in Colbert County, Alabama

Common Name	Scientific Name	Alabama Status (Rank)	Federal Status
Alabama lipfern	*Cheilanthes alabamensis*	SLNS (S3)	-
Blue-eyed Mary	*Collinsia verna*	SLNS (S1)	-
Dutchman's breeches	*Dicentra cucullaria*	SLNS (S2)	-
False rue-anemone	*Enemion biternatum*	SLNS (S2)	-
Lyrate bladderpod	*Lesquerella lyrata*	SLNS (S1)	LT
White trout-lily	*Erythronium albidum*	SLNS (S1S2)	-
Yellowwood	*Cladrastis kentukea*	SLNS (S3)	-

- = No Protection
Federal status abbreviation: LT = Listed threatened
State status abbreviation: Alabama does not give status to state-listed species; SLNS = No state status
State rank abbreviations: S1 = Critically imperiled, often with five or fewer occurrences; S2 = Imperiled, often with less than 20 occurrences; S3 = Rare or uncommon, often with less than 80 occurrences; S4 = Apparently secure in the state with many occurrences; S#S# = Occurrence numbers are uncertain

Lyrate bladderpod is a member of the mustard family and federally listed as threatened. This species is endemic to two counties in northeast Alabama where it grows in gladelike habitat that exhibits various levels of disturbance, including unimproved pastures, fallow or cultivated fields, and roadside rights-of-way (USFWS 1990). Habitat capable of supporting this species does not occur within the MSR study area.

Dutchman's breeches occurs at the edge of its range in north Alabama. Populations in and around the MSR study area are frequently encountered. This species is a member of the poppy family. It is known to occur in the Old First Quarters SWA on the Reservation north of Reservation Road but outside the MSR study area.

False rue-anemone, a member of the buttercup family, is a northern species that reaches the limit of its range in north Alabama. It often is found growing with Dutchman's breeches in rich woods and coves. Habitat capable of supporting this species does occur within the Reservation proper but has not been reported within the MSR study area.

3.14.3.2 Wildlife

An April 2010 review of the TVA Natural Heritage database indicated that there are no records of federally or state-listed terrestrial animals within the MSR study area. However, TVA field surveys revealed that the federally listed Indiana and gray bats could occur in or near the proposed project area (see more information below). Two other federally listed species and one federally protected species are recorded from Colbert County, Alabama. These are the gray bat, red-cockaded woodpecker, and bald eagle (see Table 3-19). Within a 3-mile radius, there is a record of one Alabama state-listed species (Table 3-19). Some species identified as having conservation concern occur in the MSR study area (Mirarchi 2004). These animals of conservation concern, which include 2 federally endangered bats, are denoted in Tables O-1, O-2, and O-3 in Appendix O. Most of these species have no official status; however, two species, the gray and Indiana bats, are federally listed. No designated critical habitat for any federally listed species occurs within the study area.

Table 3-19. Protected Terrestrial Animals in the Vicinity of the Muscle Shoals Reservation Study Area

Common Name	Scientific Name	Alabama Status	Federal Status
Alligator snapping turtle*	*Macrochelys temminckii*	PROT	-
Red-cockaded woodpecker	*Picoides borealis*	PROT	END
Bald eagle	*Haliaeetus leucocephalus*	PROT	Federally Protected
Gray bat	*Myotis grisescens*	PROT	END
Indiana bat	*Myotis sodalis*	PROT	END

- = No Protection
Federal status abbreviation: END = Endangered
State status abbreviation: PROT = Protected
* Record is considered unreliable (Jim Godwin, aquatic biologist, Alabama Natural Heritage Program, personal communication, April 2009)

Alligator snapping turtles require large aquatic features such as rivers and reservoirs. Suitable habitat for this species does not occur within the MSR study area.

Red-cockaded woodpeckers form colonies in mature pine, or pine-oak savannahs, with an open understory. These areas are usually maintained by frequent landscape disturbance (i.e., fire). No such habitat was found within the project area. The species historically occurred in Colbert County in 1890. Red-cockaded woodpeckers are now considered extirpated from northern portions of Alabama.

Bald eagles roost and nest in forested habitat near large bodies of water such as rivers and reservoirs. This species nests along the Tennessee River on nearby Wheeler, Wilson, and Pickwick reservoirs. While numbers of breeding bald eagles continue to increase in the vicinity, densities of bald eagles are lower in the vicinity than in other portions of the Tennessee River Valley, especially on Guntersville and Kentucky reservoirs. Bald eagles are not known to nest within the MSR study area. A pair recently nested in the vicinity, below Wilson Dam. This species is observed regularly foraging in the tailwater of Wilson Dam during winter months.

Gray bats roost in caves year-round and migrate between summer and winter roosts during spring and fall. Five gray bat caves occur within 10 miles of the project area. These are Collier Cave (4.7 miles), Key Cave (6.5 miles), McKinney Cave (7.4 miles), Baker Cave (8.0 miles), and Bat Cave (8.6 miles). Gray bats are locally common in the area and forage regularly over nearby Wheeler, Wilson, and Pickwick reservoirs and associated tributaries. Results of mist-net surveys show that this species forages through stream and road corridors within the MSR study area. No caves were found in the project area during field investigations, and no evidence of roosting bats was found in abandoned buildings on site (Figure 3-27). Gray bats use the project area for foraging, and an abundance of foraging habitat occurs locally and in the surrounding landscape.

Indiana bats hibernate in caves and form roosts in mature forests with open understories, available roosts, and nearby water sources. Historical records were reported from Saltpeter Cave (20 miles away and now underwater) and an abandoned chalk mine (26 miles west of MSR). Recent investigations by researchers at Auburn University did not find Indiana bats in the chalk mine. Although no caves suitable for hibernating bats were found during field investigations, forested habitat in the MSR study area potentially provides suitable foraging and summer habitat for this species. Habitat suitability assessments and mist-net surveys were performed throughout the MSR study area. No Indiana bats were captured during mist-net surveys, and all forested habitat sample points ranked as low quality for Indiana bats (Figure 3-27). Therefore, this species is very unlikely to use habitat within the project area.

3.15 Natural Areas

Natural areas include TVA- and non-TVA-managed areas, ecologically significant sites, and Nationwide Rivers Inventory (NRI) streams. Managed areas include lands held in public ownership that are managed by an entity (e.g., TVA, USDA, USFS, State of Tennessee, Colbert County) to protect and maintain certain ecological and/or recreational features. Ecologically significant sites either are tracts of privately owned land that are recognized by resource biologists as having important environmental resources or are identified tracts on TVA lands that are ecologically distinct in attributes or character but are not specifically managed by TVA's Natural Areas Program. NRI streams are free-flowing segments of rivers recognized by the U.S. National Park Service (USNPS) as possessing outstandingly remarkable natural or cultural values. There are no NRI streams or Wild and Scenic Rivers within 3 miles of the MSR study area.

Fourteen formally designated natural areas occur within 3 miles of the MSR study area (Figure 3-29). Of the 14, six are located on or immediately adjacent to the MSR study area. The Muscle Shoals National Recreational Trail (also known as Reservation Road Trail) and an associated trail complex border Reservation Road and also occur partially within the MSR study area. The Tennessee River/Wilson Dam NEP, the Wilson Dam Tailwater Restricted Mussel Harvest Area, and the Trail of Tears National Historic Trail are located immediately adjacent to and north of the phosphate slag storage area, which is within the scope of the MSR study area. The Old First Quarters SWA and the Potential National Natural Landmark (PNNL) are located on the MSR immediately adjacent to and north of the Multipurpose Building Complex, but are outside the MSR study area. The objective of the USNPS National Natural Landmarks (NNL) Program is to identify and recognize nationally significant natural areas throughout the U.S. and to encourage their continued preservation. Additional information is available at http://www.nature.nps.gov/nnl/.

Muscle Shoals National Recreational Trail (Reservation Road Trail) Complex is a 15-mile loop greenway urban trail/bikeway for public use located on part of the MSR, largely north of Reservation Road, in Lauderdale and Colbert counties. It is a designated National Recreation Trail System Trail (Sabrina L. Melton, recreation specialist, TVA, personal communication, July 13, 2011; National Recreation Trails Program 2009) and connects numerous historical sites on the Reservation while not infringing upon them (see Section 3.16). Buildings and structures dating to the early 1900s, which were part of the war effort, are featured and accessible by the trail. The two trails built by the CCC in the 1930s, the Rockpile Hiking Trail and the Old First Quarters SWA Trail, contain a historic aspect of the Muscle Shoals National Recreation Trail Complex. These trails exhibit stone stairs, erosion-control check dams, small footbridges, and benches built by the CCC. An informal forest/wetland trail complex used for interpretational nature walks adjacent to and south of Reservation Road and east of Hatch Boulevard is located in the southwest quadrant of the MSR study area. The Rockpile and Reservation Road trails are designated as part of the northwest loop of the North Alabama Birding Trail.

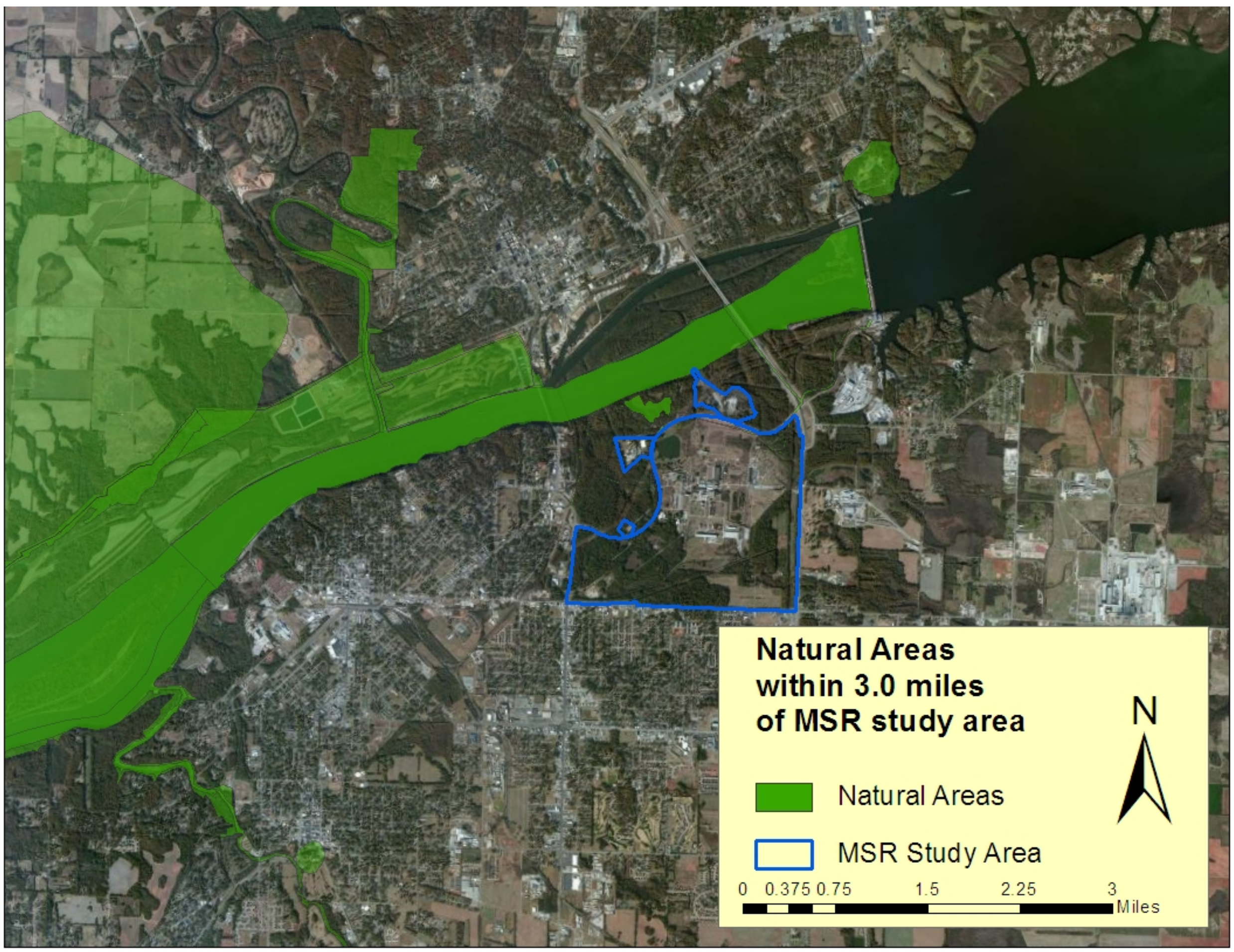


Figure 3-29. Natural Areas Occurring Within 3.0 Miles of the Muscle Shoals Reservation Study Area

The Tennessee River/Wilson Dam NEP is a specific reach (or stream segment) of the Tennessee River extending from the base of Wilson Dam at TRM 259.4 to the backwaters of Pickwick Reservoir at TRM 246. It includes the lower 5 river miles of all tributary streams that enter the Wilson Dam tailwater. This segment of the river, located in both Lauderdale and Colbert counties, has been designated by the USFWS for reintroduction of 16 federally listed as endangered mussels and one federally listed as endangered aquatic snail into historical habitat in this and other such reaches of the river.

Wilson Dam Tailwater Restricted Mussel Harvest Area is a section of Pickwick Reservoir that is designated and managed by Alabama Department of Conservation and Natural Resources (ADCNR) Division of Game and Fish. The taking, catching, killing, or any attempt to take, catch, or kill freshwater mussels is prohibited in this area. This restricted area is located in Lauderdale and Colbert counties in Alabama and extends from Wilson Dam downstream to the upper end or head of Seven Mile Island.

Trail of Tears National Historic Trail was designated by the USNPS to commemorate the 1838 historic passage of thousands of Cherokee Indians from their homelands in the Southeast to Indian Territory in the West to what is now Oklahoma. Many Cherokee people perished during this journey. There are land and water components of the trail crossing through north Alabama in Colbert and Lauderdale counties. The water component used by the Cherokees to canoe is located on Pickwick Reservoir/Tennessee River immediately north of the phosphate slag storage area. The land component of the trail is located approximately a mile north of Muscle Shoals/Wilson Dam Reservation across Pickwick Reservoir (Tennessee River).

Old First Quarters SWA and PNNL is an area with exceptional natural, scenic, and aesthetic qualities featuring a trail for public use that is part of the trail complex located on Muscle Shoals/Wilson Dam Reservation north of Reservation Road. This 25-acre SWA and PNNL features spring wildflower displays, foot trails, an intermittent stream, wooden bridges, and scenic bluffs overlooking Pickwick Reservoir, and historic stone stairs and check dams built by the CCC in the 1930s. This area is under consideration by the USNPS for designation as an NNL to recognize the national importance of this natural area.

Muscle Shoals National Heritage Area (NHA) includes six counties in northwestern Alabama designated in 2009 as an NHA. This NHA includes Colbert and Lauderdale counties. NHAs are designated by Congress for natural, cultural, historic, and recreational resources and intended to encourage historic preservation and appreciation of the history and heritage of the area. The MSR study area is within the boundaries of the Muscle Shoals NHA. There are currently 49 NHAs throughout the U.S. The local coordinating entity for the NHA is the Muscle Shoals Regional Center, located at the University of North Alabama in Florence.

Eight additional formally designated natural areas occur within 3 miles of the Reservation. McFarland Park is located approximately 0.5 mile northwest of the Reservation across Pickwick Reservoir. Veterans Park is located approximately 1.3 miles northeast of the Reservation across Wilson Dam and Reservoir. The Seven Mile Island State Wildlife Management Area (WMA) is located approximately 1.5 miles west of the Reservation. Florence Municipal Park and Wildwood Park are located approximately 1.8 and 2.1 miles, respectively, northwest of the Reservation across Pickwick Reservoir. Key Cave Aquifer Hazard Area is located approximately 2.6 miles west, and Tuscumbia Spring PNNL is located approximately 2.8 miles southwest of the Reservation. Coffee Bluff TVA Habitat Protection Area (HPA) is located approximately 3.0 miles to the west of the Reservation.

McFarland Park is a 327-acre public park located along the north side of the Tennessee River in Lauderdale County and is host to numerous festivals and special events. This park is managed by the City of Florence Parks and Recreation, and it features playgrounds, lighted walking trails, a floating restaurant, lighthouse, beach area, picnic tables, boat slips, boat ramp, and camping facilities.

Veterans Park is a 95-acre public park located across the Tennessee River on Wilson Dam Reservation lands in Lauderdale County adjacent to Wilson Dam. This park is owned by TVA and managed by the City of Florence Parks and Recreation under a permanent recreation easement. It features playgrounds, tennis courts, softball fields, picnic shelters, a disc golf course, and campsites.

Seven Mile Island State WMA is approximately 4,700 acres of public land in Lauderdale County that consists of a maze of islands, shallow water, sloughs, wetlands, swamps, riverine forests, cliffs, caves, agricultural lands, and reverting agricultural lands. This WMA is owned by TVA but is under easement to and managed by ADCNR Division of Game and Fish for waterfowl hunting and other recreational activities such as hiking and camping.

Florence Municipal Park is an approximate 72-acre public park located in Lauderdale County that features picnic facilities and a skate park. This park is managed by the City of Florence Parks and Recreation.

Wildwood Park is an approximate 286-acre park located in Lauderdale County that features picnic tables, nature trails, pavilions, mountain biking trails, and a canoe and kayak ramp. This park is managed by the City of Florence Parks and Recreation.

Key Cave Aquifer Hazard Area consists of approximately 2,300 acres of hardwood forests, croplands, and sinkholes surrounding Key Cave that acts as an aquifer recharge area. The area's sinkholes are an integral component of groundwater recharge to the caves. The area directly north of Key Cave was identified as a potential high hazard risk area for contaminants released to the groundwater. Within this large area is Key Cave National Wildlife Refuge (NWR) managed by USFWS in cooperation with TVA. This refuge consists of 1,047 acres of land and contains designated critical habitat for federally listed Alabama cavefish (*Speoplatyrhinus poulsoni)* and a priority-one maternity cave for the federally listed gray bat. Priority-one caves are considered major hibernacula, the most important maternity colonies for these bats. Another cave present in the vicinity, approximately 1.5 miles northeast of Key Cave, Collier Cave, provides habitat for these endangered species as well. This area also supports Neotropical migratory birds, raptors, white-tailed deer, wild turkey, and other wildlife. Both caves are on the northern shore of Pickwick Reservoir in a limestone karst area that contains several sinkholes and underground cave systems. Other activities on these areas include wildlife observation, hiking, photography, and hunting. Entry into the caves for research is by permit only.

Tuscumbia Spring PNNL is a geological feature consisting of a cave spring that provides habitat for the Tuscumbia darter (*Etheostoma tuscumbi*a). This spring-dwelling darter, endemic to the Tennessee River drainage, has become extinct in Tennessee. It remains in only three Alabama springs. The NNL Program was established in the 1970s by the USNPS to identify nationally significant examples of ecologically pristine or near pristine landscapes or other unique natural features. This feature, while meeting the criteria for listing, has not yet been registered as an NNL.

Coffee Bluff TVA HPA consists of approximately 250 acres of land along Pickwick Reservoir that features bluffs, waterfalls, caves, ravines, scenic views, and a variety of plant life and wildlife. Key Cave and Collier Cave are located within the HPA. This HPA, located to the south of the Key Cave Aquifer Hazard Area, serves as a buffer for Key Cave and Collier Cave located there.

Other naturally appearing landscapes and research areas, which occur within portions of the MSR study area proposed for redevelopment, include the following: native grass plots south of Reservation Road and east of the water supply reservoir, forested and other types of wetland areas, an informal trail complex located in the southwestern corner of the redevelopment property, forested areas throughout the Reservation, and TACF Research Orchard (see Section 3.14.1) located on the eastern portion of the property parallel to Wilson Dam Road (SR 133). The native grass plots, forested areas containing informal trails, and TACF Research Orchard provide wildlife habitat as well as additional recreational and research opportunities for the public. These areas, within the MSR study area, were all substantially previously disturbed by land uses from the industrial and other supporting activities and programs of TVA and others. These lands, which have been managed by TVA over the years, provide a variety of services from aesthetically pleasing ornamental trees and forests to large areas of mowed and maintained grassland (see Sections 3.7 and 3.14).

3.16 Recreation

The Muscle Shoals/Wilson Dam Reservation and vicinity is a regionally significant recreation and open space resource that attracts users from within and outside of the Shoals communities and Colbert and Lauderdale counties area. Recreational use opportunities on the Reservation, largely outside the MSR study area and north of Reservation Road, include walking, jogging, bicycling, hiking, fishing, power and nonpower boating, wildlife and nature observation, and picnicking (see Sections 3.14.2 and 3.15). Recreational facilities and popular features available to the public on or in the vicinity of the larger 3,000-acre Muscle Shoals/Wilson Dam Reservation are described in Section 3.15.

The Muscle Shoals National Recreational Trail (Reservation Road Trail) Complex, designated as a National Recreation Trail by the Secretary of the Department of the Interior, includes a total of approximately 15 miles of trails (Sabrina L. Melton, recreation specialist, TVA, personal communication, July 13, 2011; National Recreation Trails Program 2009). Major elements of the complex include an 8-mile-long paved trail, designed to accommodate walking, jogging, and bicycling, that generally parallels Reservation Road and approximately 7 miles of unpaved foot trails. Unpaved foot trails include the Rockpile Hiking Trail that parallels the Tennessee River (Wilson Dam tailwater), the Southport Historical Trail, the Old First Quarters SWA Trail, and an exercise trail. Both the Rockpile and Old First Quarters SWA trails were originally built by the CCC in the 1930s. A central parking area and restrooms have been built at the trailhead by TVA to accommodate users of the trail complex. Although the trail complex on the Muscle Shoals/Wilson Dam Reservation carries the National Recreation Trail designation, its continuing management and maintenance are the responsibility of TVA. It is estimated that the trail complex receives 35,000 visits annually (National Recreation Trails Program 2009) (Figure 3-30).

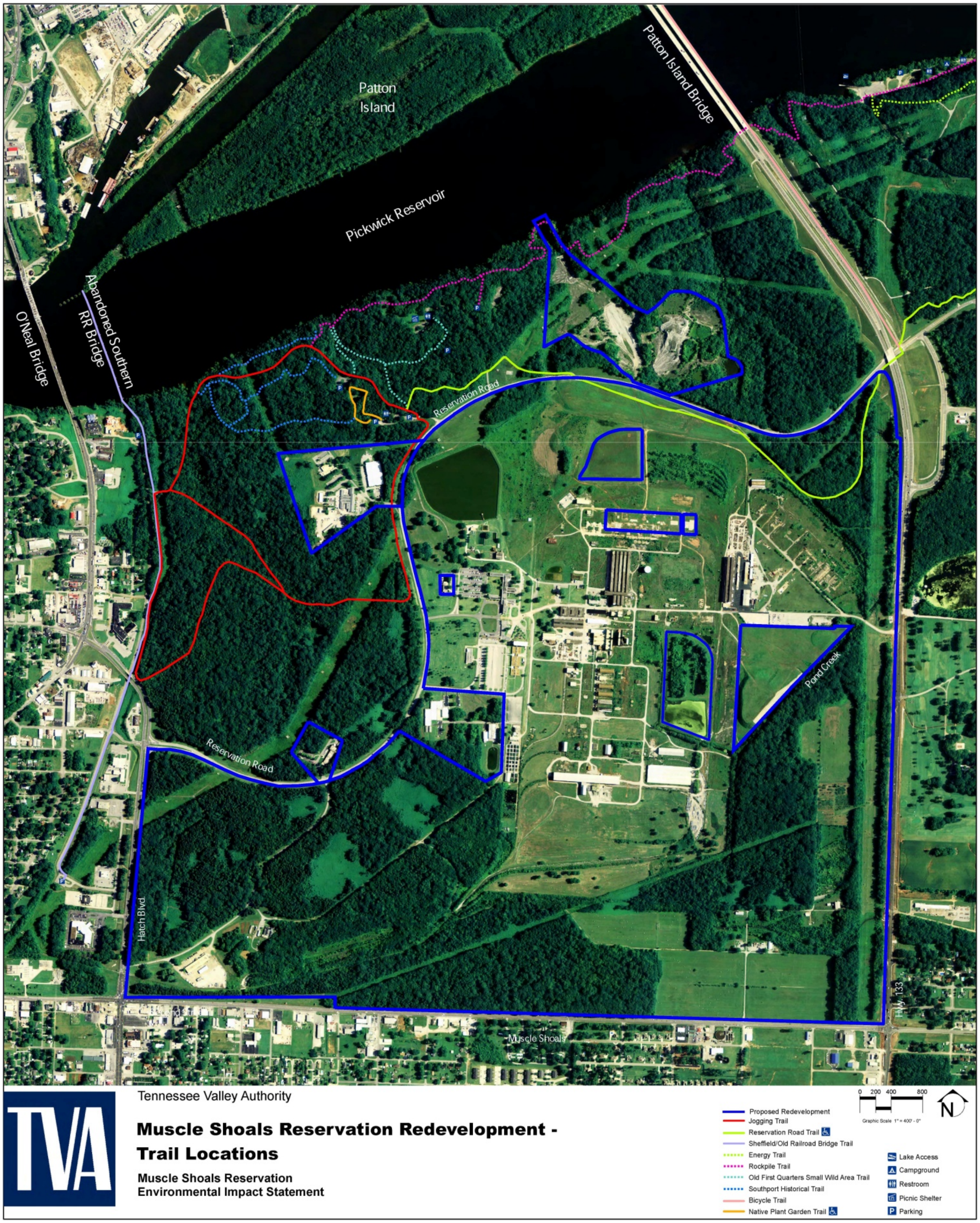


Figure 3-30. Trail Locations in the Vicinity of the Muscle Shoals Reservation Study Area

The Muscle Shoals Trail Complex also connects to a network of off-reservation trails. It connects and enhances the City of Sheffield's Rails to Trails project on the south side of the Tennessee River and the City of Florence's River Heritage Trails on the north side. These trails are linked by a pedestrian/bikeway crossing of the river via the Patton Island Bridge (also known as Singing River Bridge). Combined, these trails make it possible to travel by nonmotorized means to and from several locations in the Florence, Muscle Shoals, and Sheffield communities.

The importance of the trail system as a recreation resource is likely to increase in the future. Based on public surveys conducted as part of the 2008-2012 Alabama Statewide Comprehensive Outdoor Recreation Plan, walking for pleasure is the most popular outdoor recreation activity among Alabama residents. Survey results also indicate the demand and need for additional trails to accommodate walking, hiking, and bicycling are increasing statewide as well as within the state planning region that includes the MSR study area.

While the majority of MSR recreational use takes place north of Reservation Road and outside the boundaries of the proposed MSR study area, sections of two trails, which are part of the National Recreation Trails Complex, are located within this area. These include two segments of the paved walk/bike trail along Reservation Road and a section of the Rockpile Hiking Trail along the Tennessee River.

The 1-mile segment of the trail complex is part of a 2.2-mile trail extension completed at its present location just south of and along Reservation Road in 2003. The project was accomplished with monies contributed by an FHWA transportation project enhancement grant administered by ALDOT in 2001 (Agreement for a Transportation Enhancement Project between the State of Alabama and Tennessee Valley Authority, Colbert County, Reservation Road Bike/Pedestrian Trail Project No. STPTE-TE01[918], TVA Contract No. 00004014). Based on this agreement, no change in use or ownership of real property acquired or improved with funds provided under the terms of this agreement will be permitted without written approval from ALDOT and FHWA.

In addition, the portion of the proposed redevelopment area located north of Reservation Road and fronting the Multipurpose Building complex includes a 900-foot section of the original paved trail constructed by TVA in the 1970s. The trail is located between Reservation Road and the existing buildings within the complex.

As previously mentioned, the Rockpile Hiking Trail parallels the Tennessee River where a 300-foot section could be crossed by construction associated with the utility corridor (in the vicinity of the slag storage area) such as a water intake or gas pipeline. This section of the trail, which is used heavily for shoreline fishing and by hikers, crosses an inlet via a concrete skimmer wall constructed as part of the old Wilson power plant facility (see Figure 3-30).

Some informal recreation use also occurs on the MSR study area south of Reservation Road within the proposed redevelopment area (see description of naturally appearing landscapes in Section 3.15). In particular, some of the land and old abandoned road networks located on the southwestern part of the Reservation (roughly defined as the area bounded by Second Street on the south, the TVA Customer Service Center on the west, Reservation Road on the north, and the International Fertilizer Development Center on the east) are used for walking and jogging. In addition, nature observation is common in this area. During the fall months, the area attracts small groups of bird watchers from Alabama, Georgia, and Tennessee (see description of seasonal birdlife use of the southwest portion of property in Section 3.14.2). The location of this informal recreational use area and the trail segments located within the MSR study area are shown in Figure 3-30.

Wilson Dam Reservation, approximately 400 acres of land, which adjoins the northeastern boundary of the MSR, lies on both sides of the Tennessee River at Wilson Dam. This area serves primarily to protect the integrity of the dam itself while also affording recreational use to the public. It also includes recreation facilities developed and maintained by TVA. Veterans Park, on the north side of the river and under a permanent recreation easement to the City of Florence, occupies a portion of this reservation.

In addition to portions of the paved trail and the eastern section of the Rockpile Hiking Trail, Wilson Dam Reservation south of the river includes the Rockpile Recreation Area that provides for overnight camping and day use activities, including bank fishing. A boat launching ramp provides access to the river (Wilson Dam tailwater). There is also a boat launching ramp in Fleet Hollow on the eastern edge of Wilson Dam Reservation that provides access to the waters above Wilson Dam. These facilities are located outside of the proposed MSR study area.

The Tennessee River (Wilson Dam tailwater) that defines the northern boundary of the MSR is also a highly valuable recreation resource. Its waters receive heavy boating and bank fishing use, and the area is a renowned recreational fishery. Based on recreation use data collected in 2002 as part of TVA's *Reservoir Operations Study*, the Wilson Dam tailwater receives an estimated 169,000 recreation visits annually (TVA 2004).

3.17 Transportation

This section describes the highway transportation network, traffic counts, and levels of service (LOS) in the vicinity of the MSR study area. As previously stated, the MSR study area is located in Colbert County, Alabama, near the cities of Muscle Shoals and Sheffield and is bounded generally by Wilson Dam Road to the east, Second Street to the south, Hatch Boulevard to the west, and Reservation Road to the north (see Section 1.5).

3.17.1 Data Collection

Data collection included an analysis of historical traffic counts conducted by ALDOT, counts of turning movements at nine intersections near the MSR study area, and reviews of the roadway characteristics. Planned transportation projects in the immediate vicinity were also considered. The analysis focused on two different types of traffic counts—annual average daily traffic (AADT) counts and peak period turning movement counts. AADT counts are reported annually by ALDOT. The transportation study area includes the MSR study area, and all traffic counts locations are indicated on Figure 3-31.

Roadway Inventory

An inventory was conducted to determine various existing roadway characteristics, including lane configurations at each intersection and the type of traffic control (i.e., traffic signal, stop sign, yield sign, free flow).

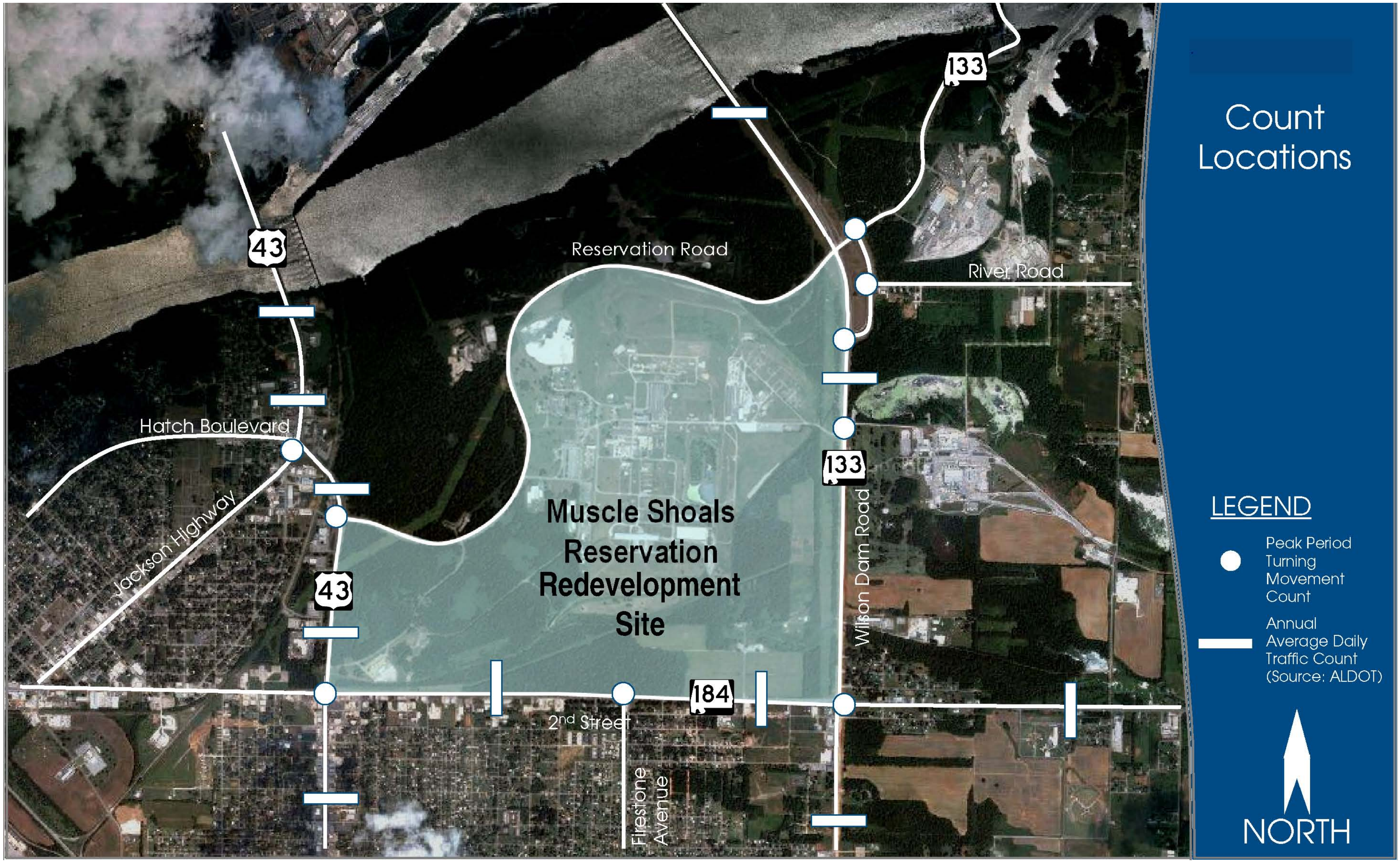


Figure 3-31. Transportation Study Area and Count Locations

Hatch Boulevard – This roadway consists of two major segments, one that travels north-south bordering the west side of the MSR study area and one that is primarily east-west beyond its intersection with Jackson Highway (see Figure 3-31). Through its north-south alignment, Hatch Boulevard is an urban principal arterial where a four-lane divided section is utilized with an AADT of 26,000 vehicles per day. The speed limit is posted at 45 miles per hour. This segment of Hatch Boulevard carries the US 43 and US 72 route designations. On the east-west segment, Hatch Boulevard is a two-lane urban minor arterial with a posted speed limit of 35 miles per hour. A challenge to motorists on Hatch Boulevard is associated with its alignment at the intersection with Jackson Highway, where the east-west segment transitions into the north-south segment. Traffic movement at this intersection is controlled by traffic signals and southbound through-vehicles following the US 43/72 route designation are forced to make a left turn. Likewise, northbound through-vehicles wishing to stay on the US 43/72 route designation must make a right turn. Forcing a large majority of vehicles into turning at this intersection causes congestion problems.

US 43/72 – While the US 43/72 route designation is placed on Hatch Boulevard through the majority of the transportation study area, there is another US 43/72 segment in the northwest corner. This segment, between the Hatch Boulevard-Jackson Highway intersection and the Tennessee River, is an urban principal arterial utilizing a seven-lane section (six through-lanes and one two-way, left-turn lane). The AADT is about 42,000 vehicles per day near the O'Neal Bridge over the Tennessee River.

Wilson Dam Road – This roadway is a north-south urban minor arterial that forms the east boundary of the MSR study area. Wilson Dam Road was recently widened to a six-lane section with a center turn lane, serving an AADT between 10,000 and 14,000 vehicles per day. The speed is posted at 55 miles per hour. For the majority of the MSR study area, Wilson Dam Road carries the SR 133 route designation.

Second Street – This four-lane urban principal arterial travels east and west and forms the southern border of the MSR study area. The roadway serves between 9,000 and 14,000 vehicles per day with a posted speed limit of 45 miles per hour. Throughout the transportation study area, Second Street carries the SR 184 route designation.

Reservation Road – This road is a two-lane rural minor arterial that travels east to west within the MSR. On the east end of the site, it carries the SR 133 route designation. The posted speed limit is 45 miles per hour.

River Road – This road is a two-lane rural minor arterial that travels east to west east of the MSR study area. The posted speed limit is 45 miles per hour.

Firestone Avenue – This two-lane collector travels south to north. It is located south of the MSR study area. The posted speed limit is 25 miles per hour.

Jackson Highway – This roadway is a four-lane undivided urban minor arterial that travels southwest to northeast west of the MSR site. The posted speed limit is 45 miles per hour.

Background Traffic

Background traffic is defined as the traffic that would exist in the future regardless of whether the MSR study area is redeveloped or not. This was determined by using historical AADT counts conducted annually by ALDOT since 2000. Historical AADT counts conducted in the vicinity of the MSR study area were used to determine historical traffic growth trends in the region. These trends were then analyzed to determine a reasonable and sustainable growth rate of 1.90 percent to forecast future traffic conditions regardless of whether the MSR study area is redeveloped (URS Corporation 2010). The 1.90 percent growth rate was applied to the existing traffic counts to determine conditions in the year 2035.

Existing Conditions

In order to determine a baseline of existing conditions in the MSR study area, an analysis of typical weekday peak hour congestion was conducted at the MSR study area intersections. Site-specific peak period turning movement counts were conducted. A count program for nine locations was developed to focus on those intersections most likely to be impacted directly by redevelopment at the MSR study area. Counts were conducted during a typical week (April 5-9, 2010) when local schools were in session. Each location was counted for a total of eight hours during three peak periods, i.e., 6:00 to 9:00 a.m., 11:00 a.m. to 1:00 p.m., and 4:00 to 7:00 p.m. The count data were analyzed to determine a number of important factors for the analysis including a.m. and p.m. peak hour turning movement counts, peak hour factors, and traffic distribution patterns.

The a.m. and p.m. peak period turning movement counts were summarized at each intersection to determine the peak hour turning movement traffic volumes within each peak period. The peak hour factor and peak hour truck percentages were collected from the turning movement counts. The peak hour factor was determined for each intersection turning movement and represents a ratio of traffic volume in the peak hour to the traffic volume in the peak 15 minutes. The peak hour truck percentage representing the ratio of heavy vehicles such as 18-wheel trucks and school buses (i.e., not pickup trucks) to all vehicles in the peak hour was also determined for each intersection turning movement.

The turning movement counts were also used to estimate the distribution pattern of traffic entering and leaving the MSR study area. This was determined by analyzing all eight hours of turning movement counts and determining the amount of vehicles entering and exiting the MSR study area at each study area entry/exit point relative to other entry/exit points. The resulting traffic distribution percentages, indicated in Figure 3-32, were applied within the project analysis to estimate the number of new vehicles that would be generated by each Action Alternative at each of the MSR study area intersections.

3.17.2 Level of Service Determination

Highway Capacity Manual (HCM) methodology (Transportation Research Board 2000) was followed to identify potential traffic flow problem areas in the vicinity of the MSR study area using the data described above in Section 3.17.1. The HCM provides a qualitative method to measure traffic flow and motorists perceptions of traffic flow. Six LOS are defined and given letter designations from A to F, with LOS A representing the best conditions (free flow) and LOS F representing the poorest conditions (severe congestion) as shown in Figure 3-33. The HCM defines LOS by type of intersection being analyzed, i.e., signal controlled (traffic light) versus unsignalized (stop or yield sign). The average control delay includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. LOS thresholds for unsignalized and signalized intersections are shown in Figure 3-33. Typically, LOS E and LOS F are defined as undesirable and indicate the need for transportation improvements. Nine intersections in the immediate vicinity of MSR were analyzed for LOS during a.m. and p.m. peak hours (see Table 3-20).

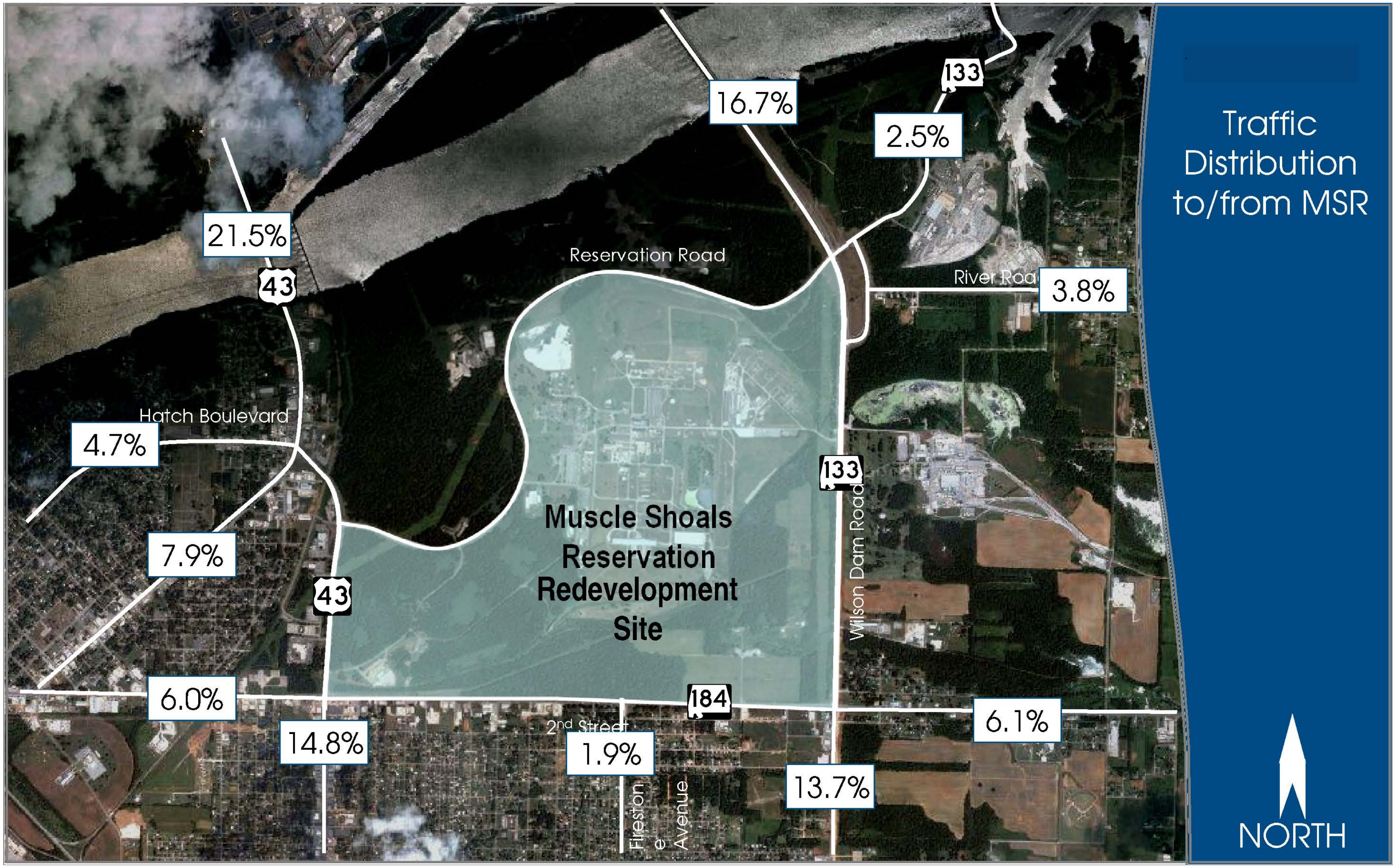


Figure 3-32. Traffic Distribution To and From the Muscle Shoals Reservation Transportation Study Area

LOS Thresholds for Unsignalized Intersections

Level of Service	Average Control Delay (sec/vehicle)
A	≤ 10.0
B	> 10.0 and ≤ 15.0
C	> 15.0 and ≤ 25.0
D	> 25.0 and ≤ 35.0
E	> 35.0 and ≤ 50.0
F	> 50.0

LOS Thresholds for Signalized Intersections

Level of Service	Average Control Delay (sec/vehicle)
A	≤ 10.0
B	> 10.0 and ≤ 20.0
C	> 20.0 and ≤ 35.0
D	> 35.0 and ≤ 55.0
E	> 55.0 and ≤ 80.0
F	> 80.0

Figure 3-33. Level of Service Designations

Table 3-20. Current Levels of Service for Intersections in the Vicinity of the Muscle Shoals Reservation

Location	A.M. LOS	P.M. LOS
Hatch Boulevard at Jackson Highway	C	**E**
Hatch Boulevard at Reservation Road	A	A
Hatch Boulevard at Second Street	C	B
Second Street at Firestone Avenue	B	B
Second Street at Wilson Dam Road	C	C
Wilson Dam Road at MSR Access	C	**E***
Wilson Dam Road at Access Road	A	A
Access Road at River Road	B	B
Access Road at Reservation Road	A	B

Bolded Letters representing LOS mean that improvements to the roadways are needed.
* No observations at this intersection indicate actual LOS E or F conditions; see text for explanation.

Overall, the results indicate minimal current congestion in the vicinity of the MSR study area. Two locations indicate LOS E conditions during the p.m. peak hour. The first location is at the intersection of Hatch Boulevard and Jackson Highway, where US 43/72 through-traffic is forced to turn right or left in order to stay on the US 43/72 route designation. The congestion is caused primarily because these movements are the major movements at this intersection, and it is difficult for a traffic signal to provide enough green light time to process heavy turn volumes. The second intersection noted is the unsignalized access point to the MSR off Wilson Dam Road. As an unsignalized intersection, only the stop-controlled movement was analyzed (in this case, the eastbound movement). Despite relatively low volumes (10 vehicles turning left and 18 vehicles turning right), the analysis indicated LOS E conditions. This is due primarily to a limitation in the software analysis in which a constant flow of traffic is assumed on the major roadway, which results in few gaps for vehicles to turn. As a result, when unsignalized intersection results indicate LOS E or F conditions, field observations often indicate minimal, if any, congestion. No observations at this intersection indicate actual LOS E or F conditions.

3.18 Scenic Resources

Scenic resources are evaluated based on existing landscape character, positions and distances of available views, sensitivity of viewing positions (scenic visibility), human perceptions of landscape beauty/sense of place (scenic attractiveness), and the degree of visual unity and wholeness of the natural landscape in the course of human alteration (scenic integrity). A description of the "Scenic Value Criteria for Scenery Inventory and Management" is found in Appendix P.

Within the MSR study area, the landform slopes gently from the west, along Reservation Road, to the east at Pond Creek. There are varying types of vegetation, land uses, and aboveground construction within the MSR study area. All these elements may be considered both separately and as interrelated parts to characterize the landscape. These elements can affect how the landscape is perceived from specific viewing positions or as a whole. This perception can result in an association with the landscape, creating a sense of place.

In a broad context, the MSR study area may be classified into the following four landscape character types:

- Urban
- Rural
- Pastoral
- Naturally appearing

These landscape character types are expressed as a range from areas exhibiting dense human concentration or alteration (i.e., urban) to areas exhibiting predominantly natural qualities where human alteration may not be discernable (i.e., naturally appearing). The occurrence of these existing landscape character types across the site is shown in Figure 3-34.

Urban Landscape Character

The urban landscape character expressed within the MSR study area comprises about 605 acres (around 43 percent of the total acreage of the site). See Figure 3-35 for an example of this landscape character. These areas of urban landscape character include: (1) the USNP2 plant site, (2) the Western Area Radiological Laboratory building site, (3) the Multipurpose Building and Office Service Warehouse Annex Complex site, (4) the TVA Customer Service Center area, and (5) most of the phosphate slag storage area.

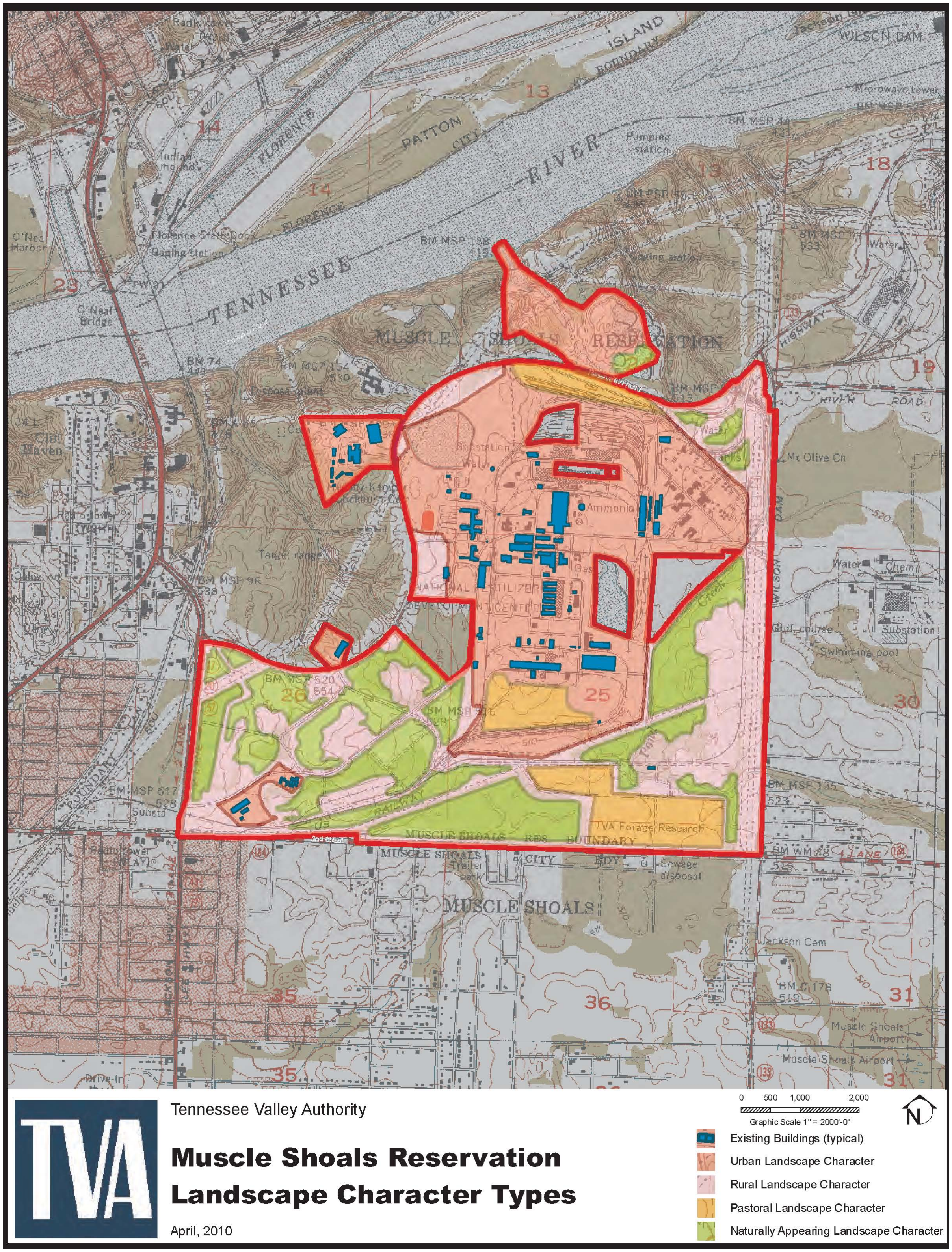


Figure 3-34. Landscape Character Types on the Muscle Shoals Reservation Study Area

Photograph taken by: Jon Riley, May 2009

Figure 3-35. Example of Urban Landscape Character on the Muscle Shoals Reservation Study Area

In these areas, scenic attractiveness is minimal. The landforms have been graded to relatively uniform slopes. Vegetation in these areas consists of maintained turf and landscape plantings or sparse groupings of emerging woody vegetation. The scenic integrity of these areas is generally very low. Landforms and vegetation patterns have been heavily altered, and the built environment dominates the landscape. The scenic visibility has a low sensitivity, due to restrictions on access for TVA project operations where the number of views are restricted to those who work at locations along Reservation Road and those who travel this two-lane road. Duration of view may vary between constituent groups and would be very low for passing motorists and much higher for employees. The viewing distance is restricted primarily to the foreground (up to 0.5 mile) viewing distance. These areas have a poor scenic value class.

Rural Landscape Character

Rural landscape character comprises approximately 415 acres of the MSR study area (approximately 30 percent of the total acreage). The rural landscape character of the study area is expressed as rights-of-way, thin bands of mature trees, lower areas near some portions of Pond Creek, and portions of the former construction village which have reverted to expanses of lower growing herbaceous vegetation (see Figure 3-36 for an example). Vegetation patterns are important features of this landscape character type. From positions outside the MSR study area, mature trees serve to screen views of the urban landscape character expressed to the interior of the site. The topography is gently sloping to flat, and vegetation patterns range from maintained turf and forest edges along some rights-of-way to moderately dense scrubby vegetation along portions of Pond Creek. The scenic attractiveness within these areas is common, and the scenic integrity is moderate.

Photograph taken by: Jon Riley, May 2009

Figure 3-36. Example of Rural Landscape Character on the Muscle Shoals Reservation Study Area

Generally, the scenic visibility is of moderate sensitivity. The number of viewers increases substantially to include motorists travelling Wilson Dam Road, Hatch Boulevard, and Second Street. Residents and employees of businesses located across these collector and arterial streets are also included in the expanded constituent viewer groups. Visitors to the Reservation for informal recreation add to the number of viewers in these areas (see Section 3.16). Frequency and duration of views within these constituent groups vary substantially. The viewing distance is varied, with some views restricted to the foreground viewing distance and some opening into the middleground (0.5 mile to 4 miles) viewing distance. The scenic value class for these areas is good.

Pastoral Landscape Character

The pastoral landscape character expressed within the boundary of the MSR study area comprises roughly 106 acres (approximately 7 percent of the total acreage). These areas are identifiable at the north of the MSR study area, along Reservation Road, at the south near the experimental farm area, and toward the southern portion of the USNP2 site. The topography of these areas has been uniformly graded, and the areas have been under cultivation for an indeterminate period of time. Vegetation consists of grasses and other lower-growing herbaceous material. Taller shrubs or trees may line the periphery of the pastoral fields near roadways, fences, streams, or where topography recedes to lower elevations and may be subject to inundation with water (see Figure 3-37 for an example). Scenic attractiveness is common, and scenic integrity is moderate to low. Due to the limited number of viewers and the frequency and duration of available views, scenic visibility for these areas has a moderate to low sensitivity. Viewing distance remains within the foreground viewing distance, as adjacent land uses and/or mature trees prevent views beyond 0.5 mile. The resulting scenic value class for these areas ranges from fair to good.

Photograph taken by: Jon Riley, May 2009

Figure 3-37. Example of Pastoral Landscape Character on the Muscle Shoals Reservation Study Area

Naturally Appearing Landscape Character

Areas expressing a naturally appearing landscape character show little evidence of human alteration (see Figure 3-38 for an example). These areas occur only where there are sufficient contiguous identical or similar landscape character types to firmly establish the naturally appearing context. Within the MSR study area, there are around 270 acres (20 percent of the total acreage) of areas exhibiting a naturally appearing landscape character. These naturally appearing landscapes occur primarily at the periphery of the property, away from the core of operations. Although crossed by rights-of-way and spotted with large areas of kudzu, the southwest corner of the Reservation contains much of the naturally appearing landscapes (also see Section 3.14). The composition of vegetation and the patterns of vegetation in the landscape are prominent features in the naturally appearing landscapes within the MSR study area. These areas separate and isolate views of other landscape character types expressed within the MSR study area. The topography in these areas is gently sloping, and the vegetation is dense, consisting of a variety of deciduous and evergreen trees, native and nonnative shrubs and small flowering trees, and a variety of herbaceous plants. Scenic attractiveness in these areas is common, and scenic integrity is generally high. Scenic visibility for the naturally appearing landscapes within the MSR study area is moderate to high. The number of available views within these segments of the MSR study area is low, although much of the area viewed from Hatch Boulevard and Second Avenue is of naturally appearing landscapes. The level of concern, i.e., how people feel about what they perceive is happening in their immediate environment, for these naturally appearing landscapes is moderate to high (see Scenic Visibility in Appendix P). Frequency and duration of views within these areas is generally low. The viewing distance is kept to the foreground viewing distance. The scenic value class for these areas is good.

Photograph taken by: Jon Riley, May 2009

Figure 3-38. Example of Naturally Appearing Landscape Character on the Muscle Shoals Reservation Study Area

Summary

The scenic value of the MSR study area, when considered as a whole, is defined by the existing landscape character and the context in which people view the landscape. Generally, the primary constituent viewer group consists of those who view the MSR study area in context with the adjacent urban and suburban development associated with the cities of Muscle Shoals, Sheffield, Tuscumbia, and Florence. This results in the perception of a rural to naturally appearing landscape character. Collectively, the scenic value class is good.

3.19 Navigation

Pickwick Reservoir was impounded by the construction of the Pickwick Landing Lock and Dam and was opened to commercial navigation in 1938. Additional improvements completed in 1948 provided a commercially navigable waterway upstream to Wilson Dam. Today, Pickwick Reservoir is an important link in the Tennessee River system, which provides 800 miles of slack-water navigation from Paducah, Kentucky, to Knoxville, Tennessee, and includes several navigable tributaries such as the lower Hiwassee and Clinch rivers. The Tennessee-Tombigbee Waterway enters Pickwick Reservoir at TRM 415.0. The Tennessee River Waterway is in turn linked to the 12,000-mile National Inland Waterway in several places and supports local, national, and international commerce. Approximately 54 million tons of commodities move on the Tennessee River system annually. On average, nearly 11.5 million tons of that traffic passes through Wilson Lock each year (USACE 2007). The Florence-Lauderdale County Port Authority, a major multimodal port, is located at TRM 256.5 on the right-descending riverbank. On average, over 270,000 tons per year of commodities are shipped into and out of the port, including goods such as corn, fertilizer, and aluminum (USACE 2007).

The MSR study area is located just downstream of Wilson Lock and Dam, on the south side of Patton Island and on the left-descending (south bank) bank of the Tennessee River. Wilson Main Lock is 110 feet by 600 feet. An Auxiliary Lock with two 60- by 360-foot chambers operates in tandem adjacent to the Main Lock. All commercial navigation traffic moving through this area uses the back channel of Patton Island, or “Florence Canal,” to access the lock. Florence Canal stretches from TRM 256.5 up to Wilson Lock at TRM 259.4 near the right-descending riverbank. The primary boat traffic on the south side of Patton Island, in the vicinity of the MSR study area, is recreational vessels (see Section

3.16). This portion of the river is immediately downstream of the spillways and hydroelectric generator discharge outlets of Wilson Dam.

3.20 Noise

Noise is normally described as continuous, intermittent, or impulsive. Continuous noise is produced by machinery that operates without interruption in the same mode (for example, blowers, pumps, and processing equipment). Intermittent noise occurs in cycles that increase or decrease rapidly with the duration of each cycle being measured. The noise from impacts or explosions (for example, pile drivers, punch presses, or gunshots) is called impulsive noise. Impulsive noise is brief and abrupt, and its startle effect causes greater annoyance than would be expected from a simple measurement of sound pressure level. Additionally, low-frequency noise has significant acoustic energy in the frequency range of 8 to 100 hertz (Hz). Noise in this range is typical for large diesel engines, trains, ships, and power plants. Because this noise range is hard to muffle, it spreads easily in all directions and can be heard for miles (Brüel and Kjær 2010).

Noise is usually measured in decibels (dB) on a logarithmic scale; therefore, increasing the noise level by 5 dB results in a noise level perceived by the human ear to be twice as loud as the original source. Noise frequencies below 500 Hz tend to be more disruptive with vibrations contributing to their effective range. Frequencies above 1,000 Hz tend to diminish more quickly with less disruptive effect (Cowan 1994).

Noise levels are also measured using an “A-weighted” version of the decibel scale. This scale closely follows the frequency response of sound detections by the human ear. The ear is most sensitive to frequencies below 1,000 Hz. Most people hear frequencies between 600-1,000 Hz. Very high and very low noise frequencies are not perceptible to the human ear. Thus, the A-weighted decibel (dBA), a measurement in which sound in frequencies above and below the range of human hearing are filtered out, is often more appropriately used for environmental noise assessments (Cowan 1994).

Noise levels exceeding 85 dBA are considered harmful to human hearing, while moderate noise levels can increase blood pressure, interfere with communication, disrupt sleep, and cause stress. Even low levels of noise can cause human annoyance and frustration (U.S. Department of Labor, Occupational Health and Safety Administration, 2008). Table 3-21 shows typical causes or sources of noise generation and levels or ranges of noise associated with them.

Table 3-21. Typical Sources and Associated and Characterized Noise Levels From Generally Recognized Activities

Source	Associated Noise Levels
Painful	
Rock music (peak)	150 dB
Firearms, air raid siren, jet engine	140 dB
Jackhammer	130 dB
Jet plane take-off, amplified rock music at 4-6 feet, car stereo, band practice	120 dB

Source	Associated Noise Levels
Extremely loud	
Rock music, model airplanes	110 dB
Timpani and bass drum rolls	106 dB
Snowmobile, chain saw, pneumatic drill	100 dB
Lawnmower, shop tools, truck traffic, subway	90 dB
Very loud	
Alarm clock, busy street	80 dB
Busy traffic, vacuum cleaner	70 dB
Conversation, dishwasher	60 dB
Moderate	
Moderate rainfall	50 dB
Quiet room	40 dB
Faint	
Whisper, quiet library	30 dB

Source: American Speech-Language-Hearing Association 2010

The outdoor acoustical environment varies dynamically in magnitude and character in most communities. The sound level variation can be temporal (dependent on time of day or seasonal), spectral (depending on the source), or spatial (depending on one's location). In urban areas, noise sources are innumerable, but studies illustrate that transportation systems and associated vehicle traffic are the worst offenders, with construction and industrial plant operations following closely behind (Bell and Bell 1994). The most important factors affecting environmental noise propagation are the type of source (point or line), distance from source, atmospheric absorption, wind, temperature and temperature gradient, obstacles such as barriers and buildings, ground absorption, reflections, humidity, and precipitation.

Noise sources are considered either point sources or line sources. If the dimensions of a noise source are small compared with the distance to the listener, it is called a point source. For example, fans and chimneystacks are point sources. The sound energy spreads out spherically, so that the sound pressure level is the same for all points at the same distance from the source, and decreases by 6 dB per doubling of distance. This holds true until ground and air attenuation noticeably affect the noise level. For example, an 89-dBA noise level measured at 1 foot from a point source would decrease to 55 dBA at a distance of 50 feet (The Engineering ToolBox 2005).

If a noise source is narrow in one direction and long in the other compared to the distance to the listener, it is called a line source. It can be a single source such as a long pipe carrying a turbulent fluid, or it can be composed of many point sources operating simultaneously, such as a stream of vehicles on a busy road. The sound level spreads out cylindrically, so the sound pressure level is the same at all points at the same distance from the line, and decreases by 3 dB per doubling of distance (Brüel & Kjær 2010).

Industrial construction, industrial plant operations, and commercial land development are processes that produce noise. Noise pollution (or environmental noise) is displeasing human-, animal- or machine-created sound that disrupts the activity or balance of human or animal life. The source of most human-produced outdoor noise worldwide is transportation systems, stationary sources, and construction equipment and operations (Cowan 1994).

As mentioned in Section 3.7, current land use within the MSR study area represents a park-like setting with 60 percent of the area covered in landscaping or various stages of vegetation growth that is reverting to mature natural vegetation. Most vehicular traffic accessing TVA facilities uses Reservation Road to access the property from Wilson Dam Road (SR 133) or Hatch Boulevard (US 72/43). Reservation Road is generally a fairly tranquil low-traffic volume roadway carrying two lanes of traffic in a southwesterly to northeasterly orientation. Reservation Road has a speed limit of 45 miles per hour.

Second Street and Hatch Boulevard are four-lane highways, and traffic on these thoroughfares is generally heavier and more continuous than Reservation Road traffic, especially during the daylight hours. The speed limit for these highways is 45 miles per hour. Wilson Dam Road, along the eastern boundary of the MSR study area, has six lanes, and traffic is generally heaviest along this major Shoals area thoroughfare among those bordering the site. The speed limit is 55 miles per hour on the northern portion of this road but decreases to 45 miles per hour on the southern portion.

Since the early 1980s, virtually all industrial activities conducted by TVA on the MSR (and associated noise) have ceased. However, there are four active industrial shops along with semi-tractor trailer truck traffic associated with the delivery of goods and the transport of equipment and materials. Three of the shops are located behind the ERC in the center of the MSR study area, while the fourth (Power Shop #2) is located along SR 133 (northeast Wilson Dam Road), east of and outside the study area (see Figure 1-3).

USEPA has established noise assessment guidelines based on an equivalent sound level day/night (DNL). This represents a 24-hour average sound level with 10 dB added to hours between 10 p.m. and 7 a.m. to account for increased nighttime sensitivity to noise. USEPA recommends a guideline of DNL less than 55 dBA to protect the health and well-being of the public with an adequate margin of safety.

Muscle Shoals/Wilson Dam Reservation background noise level estimates have been previously developed by TVA. These estimates were made during the height of TVA work activity on the property when about 1,000 employees reported to work daily. The DNL was estimated to be approximately 54 dBA based on the population density of the area (Committee on Hearing, Bioacoustics and Biomechanics 1977). This would reflect a daytime average of 59 dBA and a nighttime average of 45 dBA in 1977.

From 1977 through 1980, approximately 950 TVA employees occupied the MSR study area. Currently, TVA's daily workforce on the MSR study area is 600 to 700 employees. The reduction in employees reporting to work on the MSR reduces the overall daytime environmental noise level. The current reduced use of the Reservation by TVA employees, combined with the increase in recreational uses, affirms that estimated noise measurements made in 1977 are applicable to this analysis.

Daytime point source noise level measurements made around the perimeter of the MSR study area are contained in Table 3-22. The monitoring times were selected to provide measurements when vehicular traffic around the MSR study area was relatively active.

Table 3-22. Muscle Shoals Reservation Point Source Noise Measurements Taken May 20, 25, and 28, 2010

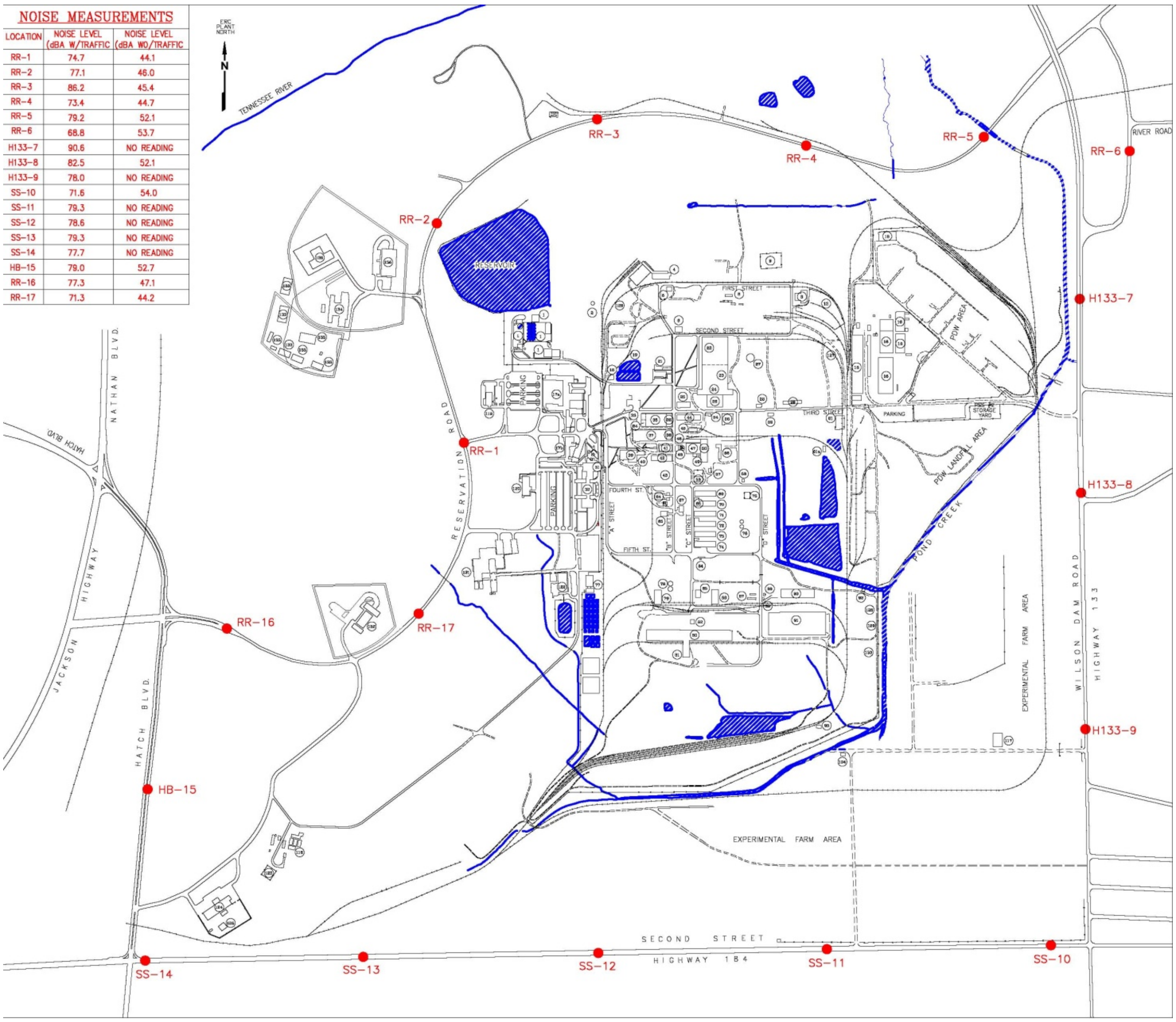
Location	Time	Noise Level (dBA) With Traffic	Noise Level (dBA) Without Traffic
May 20, 2010			
RR-1	11:29 A.M.	69.2	43.7
RR-2	11:37 A.M.	77.0	46.2
RR-3	11:42 A.M.	76.9	50.4
RR-4	11:48 A.M.	73.4	50.2
RR-5	11:52 A.M.	76.2	50.3
RR-6	11:55 A.M.	77.2	54.3
H133-7	12:00 P.M.	79.1	57.2
Average background noise level measurements for this date		**75.57**	**55.33**
May 25, 2010			
RR-1	10:54 A.M.	74.7	44.1
RR-2	10:57 A.M.	77.1	46.0
RR-3	10:59 A.M.	86.2	45.4
RR-4	11:02 A.M.	75.2	44.7
RR-5	11:05 A.M.	79.2	52.1
RR-6	11:07 A.M.	68.8	53.7
H133-7	11:11 A.M.	90.6	No Reading
H133-8	11:14 A.M.	82.5	52.1
H133-9	11:17 A.M.	78.0	No Reading
SS-10	11:20 A.M.	71.6	54.0
SS-11	11:23 A.M.	79.3	No Reading
SS-12	11:25 A.M.	78.6	No Reading
SS-13	11:27 A.M.	79.3	No Reading
SS-14	11:30 A.M.	77.7	No Reading
Average background noise level measurements for this date		**78.48**	**49.01**
May 28, 2010			
HB-15	11:16 A.M.	79.0	52.7
RR-16	11:20 A.M.	77.3	47.1
RR-17	11:25 A.M.	71.3	44.2
Average background noise level measurements for this date		**75.87**	**48.00**
Average Background Noise Level Measurements for May 20, 25, and 28, 2010		**76.64**	**50.78**

Abbreviations: RR = Reservation Road; H133 = Highway (SR) 133; SS = Second Street; HB = Hatch Boulevard

Source: Noise levels measured using an EXTECH 407790 Sound Level Meter, Serial # 090510293, calibrated with an EXTECH 407744 Sound Level Calibrator, Serial # H.179025, on 5/20/2010 at 09:45 A.M. by D. Keith McPeters, Certified Safety Professional (CSP).

Note: Noise level measurements were made every 0.4 mile starting at the north side of the ERC entrance following the perimeter of the MSR study area site.

Figure 3-39 illustrates the approximate locations of the point source noise measurements made around the perimeter of the MSR study area. The population of Colbert County, the location of the proposed redevelopment property, slightly decreased from 2000 compared to the 2009 estimate (U.S. Census Bureau 2000). The two factors of decreased population of the surrounding area and the reduced TVA MSR workforce support a minimal external environmental noise impact (i.e., noise generated on the MSR site) and would support the 1977 DNL estimates. However, based on the point source sound level measurements made around the perimeter of the MSR study area, travel patterns and daytime traffic noise levels have increased at the property boundaries since prior estimates in the area were developed.



NOISE MEASUREMENTS

LOCATION	NOISE LEVEL (dBA W/TRAFFIC	NOISE LEVEL (dBA WO/TRAFFIC
RR-1	74.7	44.1
RR-2	77.1	46.0
RR-3	86.2	45.4
RR-4	73.4	44.7
RR-5	79.2	52.1
RR-6	68.8	53.7
H133-7	90.6	NO READING
H133-8	82.5	52.1
H133-9	78.0	NO READING
SS-10	71.6	54.0
SS-11	79.3	NO READING
SS-12	78.6	NO READING
SS-13	79.3	NO READING
SS-14	77.7	NO READING
HB-15	79.0	52.7
RR-16	77.3	47.1
RR-17	71.3	44.2

Figure 3-39. Approximate Locations of the Point Source Noise Measurements Taken Near the Muscle Shoals Reservation Study Area

Along with Reservation Road, three other roadways border the MSR study area. Hatch Boulevard, Second Street, and SR 133 (Wilson Dam Road) are the three major thoroughfares bordering the land under consideration along the west, south, and east sides, respectively. These roadways are populated with businesses and housing developments. Hatch Boulevard has a large hotel, two restaurants, a National Guard Armory, and other businesses. Second Street has a residential neighborhood, a car wash, a trailer park, commercial buildings, and other businesses adjacent to the south side of the MSR study area. SR 133 has an abandoned golf course, the Occidental Chemical plant, and a few businesses along its eastern right-of-way. These multiple-use businesses and dwellings represent the closest sensitive receptors bordering the MSR study area that would be exposed to noise generated from the site (i.e., external noise receptors).

The Northwest Alabama Regional Airport at Muscle Shoals is a little more than a mile from the southeast corner of the MSR study area. Because of its size, the airport can accommodate small to medium size airplanes. Approaching and departing planes regularly pass over the MSR area and would also be an external source of noise at MSR.

Internal noise receptors include on-site workers. People still work in the ERC as well as the office areas behind the ERC. Other internal receptors include recreational users and various species of wildlife found on and near the MSR study area. Recreational use of the Reservation land currently consists of walking/bicycling trails, bird watching wetland areas, wild animal habitats, and public fishing areas. Many of the recreational use areas (walking trails, fishing areas, picnic grounds) lie to the north of the proposed project area along Reservation Road.

CHAPTER 4

4.0 ENVIRONMENTAL CONSEQUENCES

This chapter presents the potential environmental consequences that could occur to the various resources from the adoption of each of the six alternatives (see Sections 2.1.1 through 2.1.5), including the No Action Alternative. The sections in this chapter address the same resource areas as those described in Chapter 3 (Affected Environment) and are presented in the same order. Within each section, any general discussion is followed by an evaluation of the effects of adopting each alternative and, as appropriate, a brief comparison among them. All of this information is summarized in Section 2.2 and in Table 2-1.

To facilitate the analysis of potential environmental effects of development of the MSR study area, TVA developed a range of reasonable alternatives. Under the No Action Alternative, TVA would retain the MSR, and essentially, no new development on the study area would occur. Under the Action Alternatives, TVA would dispose of the property. With the exception of Alternative F, the various Action Alternatives stipulate the types of future development and, thus, provide a framework for considering potential impacts from development.

Obviously, the type of development (e.g., residential, commercial, industrial) is a factor in predicting potential development-related effects. However, the extent and intensity of development (regardless to type) also have a bearing on the likelihood of potential effects. Additionally, the specific nature of certain types of development, especially industrial development, can affect the potential of that development to have adverse environmental effects. For example, industries with small waste streams or low energy demands would likely have less potential to generate adverse environmental effects than manufacturing facilities with large waste streams and high transportation needs.

Although the various alternatives provide a framework for postulating the types of future development on the MSR study area, the precise amount of that development and the nature of such development remain speculative. Therefore, TVA has necessarily taken a qualitative approach in determining and describing potential direct, indirect, and cumulative effects. Additionally, TVA has assumed that the eventual implementation of the Master Plan will guide development on the MSR and its implementation will tend to avoid at least some, if not most, potential adverse development-related effects. Nevertheless, TVA has identified site-specific resources on the MSR and appropriate measures to avoid or mitigate potential adverse effects to these resources.

4.1 Solid and Hazardous Waste

ERC is currently classified under RCRA as a Large Quantity Generator (LQG). This classification applies to facilities that generate 2,200 pounds (1,000 kilograms [kg]) or more of hazardous waste or more than 2.2 pounds (lb) (1.0 kilograms) of acute hazardous waste in any one month. As an LQG, ERC is assigned a unique USEPA identification (ID) number from USEPA (ID Number AL3 640 090 004). This ID number is used, in part, to help track hazardous waste generation of LQGs. Because the Power Service Shop No. 2 (PSS2) is adjacent to the ERC and is also owned by TVA, it shares the same USEPA ID number with ERC. The ERC is specified in TVA's plan for compliance with EO 13514, Federal Leadership in Environmental, Energy, and Economic Performance, which relates to reduction of waste and pollutants before they enter the waste stream (TVA 2010).

Material contained in the SWMUs is not counted toward hazardous waste generation at ERC because it is not considered newly generated. Under the LQG hazardous waste regulations, waste may be stored temporarily for up to 90 days on site before being shipped off site for disposal.

All hazardous waste generated at ERC is manifested and sent to an off-site TSD facility that is permitted by ADEM/USEPA to manage hazardous waste or sent to an approved designated facility (e.g., recycling facility). The current waste streams generated by ERC are largely the result of clean up of laboratories and chemicals no longer in use or needed and wastes from PSS2 project activities. The waste from PSS2 shop is comanaged with waste from ERC. Typical waste streams include outdated chemicals, paint, paint thinners, sandblast media, protective clothing, and oily debris. Over the previous six years, an average of 1,927 kg (or 4,248 lb) each year of hazardous waste was generated for USEPA ID Number AL3 640 090 004 (both from ERC and PSS2). The amounts ranged from 4,273 kg (or 9,420 lb) in 2005 to 1,420 kg (or 3,131 lb) in 2010. Approximately 42 percent of the hazardous waste stream generated in 2010 was due to laboratory cleanouts and closing of laboratory space. In support of EO 13514 and TVA's *Strategic Sustainability Performance Plan*, as TVA continues to close ERC laboratory facilities, the generation of hazardous waste will continue to decline.

As indicated in Section 3.1.2, the entire MSR study area plus additional lands north of Reservation Road (2,260 acres) is currently subject to ADEM HSWA Permit/USEPA ID Number AL3 640 090 004. Although this permit applies to land within the MSR study area that is not known to have contained hazardous waste, the contiguous property is nevertheless subject to the permit provisions. ADEM has provided the following guidance regarding the possible disposal and transfer of the MSR study area.

1. The footprint or permitted area cannot be reduced until TVA has a buyer for the property, and that part of the RCRA permitted area is no longer owned by TVA.
2. The RCRA HSWA Permit should not encumber the sale of any property; however, no land can be sold or transferred from within the existing permit area unless remediated to a level that would allow unrestricted use or transferred with appropriate covenants to protect human health and the environment. Such environmental covenants are outlined in ADEM Administrative Code Chapter 335-5-1 and are attached to and run with the land. Examples of covenants include groundwater development restrictions, use controls, engineering controls, and exclusion requirements. ADEM has authority through the civil court system to enforce these types of covenants.
3. A legal description of the land by survey would be required, and the covenants would be filed with the County Probate Office, pursuant to Section 12 of the Alabama Uniform Environmental Covenants Act.
4. Once a parcel of land is sold, TVA would submit a minor permit modification that indicates the land is no longer owned by the U.S. and under the custody and control of TVA. This is the mechanism for removing parcels of land from the current RCRA HWSA Permit.
5. Sites without any existing hazardous waste could be removed from the permit once a buyer is identified, and the land is removed from the permit via a permit modification. Although it is not TVA's intent, if land containing hazardous waste (i.e., the four SWMU areas included in the ongoing postclosure monitoring program) is transferred, the RCRA HSWA Permit would also be transferred to

the new owner. The new owner would then be required to meet the financial obligations and other regulatory requirements outlined in RCRA. Presently, government agencies are exempt from the financial obligation requirements.

These measures and circumstances would apply to all Action Alternatives (i.e., Alternatives B through F). As required by law, TVA would warrant in the sale deed(s) that the property has been cleaned up to the extent necessary to protect human health and the environment and that the U.S. will perform any cleanup that becomes necessary in the future.

4.1.1 Evaluation of Environmental Impacts

Two aspects of potential effects with respect to solid and hazardous wastes were considered. These included the generation of additional solid and hazardous waste from future development on the MSR study area and the potential for exposure to such wastes or remnant contamination during potential future on-site development.

In the future, once the land is privately owned, conservation, commercial, retail, residential, industrial, or a combination of these development types could occur. To the extent such development occurs, TVA expects construction and operational waste streams generated from the MSR study area property to consist largely of ordinary routine solid waste capable of being disposed of in local landfills. Operational waste streams that may be found at industrial sites could consist of wastes containing heavy metals, oily debris, lighting waste, construction debris, and petroleum-based chemicals related to transportation. This waste would be collected, managed, and disposed in accordance with applicable federal, state, and local laws and regulations. Because of the way this waste would be handled as well as the potential for unmitigated exposure to on-site contamination, TVA expects indirect and cumulative effects of MSR redevelopment, including industrial, over the 20-year plus build-out period to likely be insignificant.

Hazardous and Solid Waste Zones

To assess impacts to portions and to all of the MSR study area from disturbance of buried wastes and the likelihood of exposure of the public to these wastes, the MSR study area was divided into zones. These zones were based on the level of contamination previously detected, proximity to other areas determined contaminated, and areas not eligible for transfer due to postclosure monitoring requirements. This resulted in creation of four zones (A, B, C, and D), which were used in assessing the potential impacts of alternative future uses of the MSR study area. A brief description of each zone is included below. They are also illustrated in Figure 4-1.

Zone A – Zone A is comprised of the four postclosure monitored SWMU areas, which are not proposed for transfer by TVA, and the 31 SWMUs that were remediated to industrial standards. Although the area for the industrial remediated SWMUs (approximately 17 acres) and the area for the postclosure monitored SWMUs (approximately 64 acres that would be retained by TVA) are each relatively small, they are located near each other. Thus, potential effects of future use of this area were evaluated together. Zone A encompasses approximately 300 acres and is located in the northeast quadrant of the MSR study area. Access to Zone A is currently restricted by a fence. Exposure to soil in Zone A must not exceed that which a typical industrial worker encounters while on site at 40 hours per week for 50 weeks or 2,000 hours each year. Impacts of future industrial land uses are

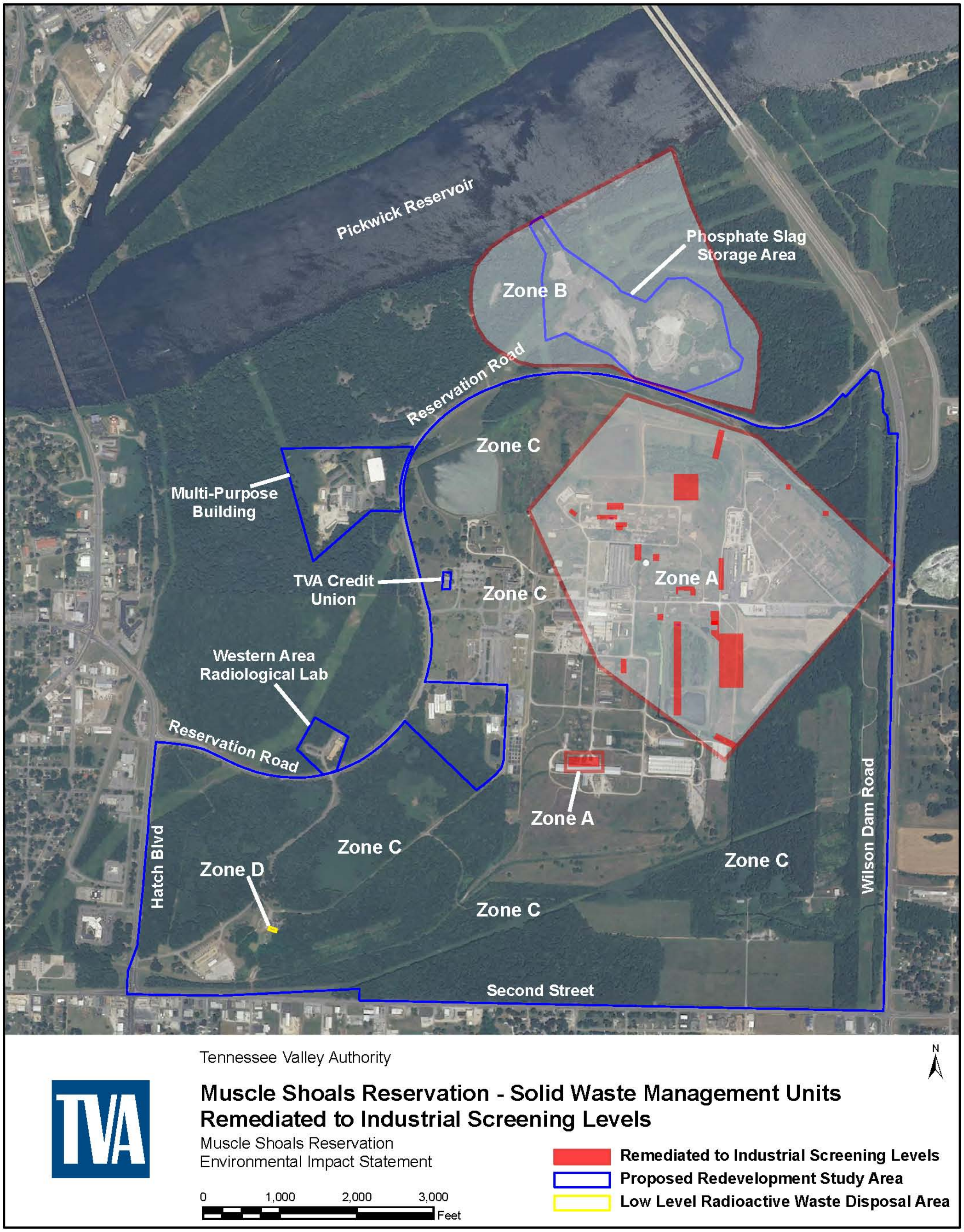


Figure 4-1. Areas of Known Contamination on the Muscle Shoals Reservation Study Area

likely to be minor but could be potentially significant if the area were used for residential purposes but not remediated for residential use standards. Therefore, without additional cleanup, land in Zone A would not be suitable for long-term occupancy such as that presented by a residential scenario.

Unless additional remediation takes place, most of the land in Zone A would remain unsuitable for residential purposes. In addition to the fenced postclosure monitoring areas, access through right-of-way easements for the purpose of conducting groundwater monitoring and visual inspections of these areas would be maintained by TVA under all Action Alternatives (see elements common to all alternatives in Section 2.1).

Zone B – Zone B consists of the phosphate slag storage area, which is located entirely north of Reservation Road. As indicated in Section 3.1.1.4, approximately 1.6 million tons of phosphate slag are stored in this 90-acre area. Because of the naturally occurring radiation from the slag, human exposure in this zone is presently limited to 500 hours per year. Currently, vehicular access to Zone B is restricted. Zone B would be considered only for use as access to the Tennessee River for potential infrastructure enhancements necessary for the development of areas south of Reservation Road under all the Action Alternatives. This area would not be sold or transferred in fee or be made available for development similar to those described in the project Action Alternatives. Without potentially substantial and costly remediation, exposure from residential development and permanent occupation of property in Zone B could result in significant health risk-related impacts.

Zone C – Zone C includes all land south of Reservation Road that is not within Zones A and D and not known to be previously contaminated. It is approximately 1,000 acres in size. The area was not used for any known fertilizer or other chemical handling, storage, or development activities conducted by TVA. This property is suitable for unrestricted use.

Zone D –As indicated in Section 3.1.1.4, the 1999 NRC decision to release the LLRWBS for unrestricted use assumed the site would remain in TVA ownership, its use would not change, and subsurface soil disturbance would not occur. TVA has three options with respect to the LLRWBS (Zone D): (1) retain ownership of the 0.23-acre LLRWBS, (2) dispose of it with deed restrictions designed to prevent future subsurface disturbance, or (3) potentially clean up (i.e., remediate) the property prior to disposing of it, thereby eliminating the need for deed restrictions.

1. Under the retention option, TVA would add this area to the approximately 64 acres of land in four monitored SWMU areas inside the MSR study area that it has decided to retain in federal ownership. This site, however, is small, surrounded by land in Zone C suitable for development, and located some distance from the other SWMUs that will be retained. This could make it difficult to maintain future access to, manage, and administer this property in the event of its retention. However, if the site remains undisturbed and undeveloped, it would not contribute to waste generation or potential human exposure risk.
2. Under the restriction of subsurface disturbance option, no subsurface development or subsurface soil disturbance would be permitted on the LLRWBS. TVA would include necessary provisions in the sale deed to prohibit such disturbance of the LLRWBS at the time of transfer of land containing this small parcel. The recorded transfer instrument with such provisions would run with the land and be available, via chain of title search, to the public and other potential future land purchasers.

TVA would assume responsibility for monitoring this mitigation strategy until proper permanent development of the property occurs. Because of the low radioactivity level of the buried material, even in the unlikely event that the material was disturbed and a pathway for exposure created, there would only be a minimal risk to human health or the environment.

3. Under the LLRWBS cleanup prior to transfer option, TVA could remove the radioactive material and responsibly dispose of it at an appropriate site designated to receive and permanently dispose of such waste. Such a cleanup, likely to residential screening levels, is presently estimated to cost about $200,000 to $600,000 (2010 dollars) depending upon the management of the excavated material and its ultimate disposal (James B. Colagross, radiation safety officer, TVA, personal communication, September 28, 2010). Because of these costs, the future timing of and strategy for such a cleanup is highly uncertain at this time. TVA would likely contract for such a removal and subsequent disposal through an appropriately authorized vendor that would already possess or acquire any needed NRC decommissioning license or other necessary federal, state, or local permits or authorizations. If cleaned up and given its size, use of the site would contribute very minor amounts of waste generation and would no longer have the potential to pose any future health risk.

Zone D is the small (100-foot-by-100-foot) fence-restricted area known as the LLRWBS (see Figure 3-2). This site contains low-level radioactive wastes buried from 1966 to 1981. Because these wastes were buried at least 6 feet below grade and were capped with 4 feet of clay, no surface radiation exposure is present above background levels (see Appendix D). Subsurface development and disturbance, such as excavation for building foundations, basements, or underground utilities, would expose workers to low levels of radiation from the buried wastes and would be prohibited. Surface development (e.g., parking lots, concrete slab placement to support some types of commercial, retail, or industrial development) could be permitted. Development, such as concrete or asphalt would actually enhance the shielding effect between the surface of the ground and the buried wastes.

As it relates to Zone D, under the TVA retention option discussed in item No. 1 above, the property would not be sold or developed. Therefore, there would be no potential for effects on future users of the property. Under the site cleanup (i.e., remediation) prior to transfer option as discussed in item No. 3 above, the small acreage of land in Zone D would be suitable for the variety of uses evaluated under all of the Action Alternatives. Under this scenario, no effects from exposure to workers or future users of the property would occur. Analysis under Zone D below considers the potential effects of exposure to contaminants if the site were developed with restrictions on subsurface disturbance.

In addition, the exposure to workers developing and constructing infrastructure enhancements in the phosphate slag storage area (Zone B) would be evaluated for specific proposals for land use plans. Such use of this utility corridor could more likely occur under Alternatives D, E, and F. Therefore, measures to protect worker health and safety would be incorporated into an appropriate mitigation strategy, and potential effects would be minor and insignificant.

The Master Plan, which would eventually be used to guide development, could take into account the potential availability and use of this small site under these various options recognizing the current limitation of its use, as applicable, across the range of alternatives.

4.1.1.1 Alternative A

Under the No Action Alternative, TVA would continue to manage and use the MSR study area for program purposes and economic development in accordance with the 1996 Plan. TVA would continue to receive similar amounts of hazardous waste for disposal and would maintain its classification as an LQG. Because there would be no foreseeable change from current conditions or use of the property, the potential effects of implementing Alternative A on the areas included within Zones A, B, C, and D would be negligible with no increased human health or environmental exposure risks.

4.1.1.2 Alternative B

Adoption of Alternative B would result in the requirement that the land be used in the future for conservation of natural resources and some forms of sustainable low-impact development. Use of some land for small scale, low-impact commercial or light industrial development (i.e., tertiary or quaternary), by its very nature, would not likely result in the generation of large-scale waste streams or significant amounts of solid and hazardous wastes. Thus, the likelihood of additional on-site contamination from site development under Alternative B is low with implementation of applicable measures. The likelihood of additional exposure to hazardous materials stored or remaining in Zones A through D is described below.

Zone A

As previously indicated, Zone A contains approximately 64 acres of land in postclosure monitored SWMUs, which would be retained in federal ownership, and approximately 17 acres cleaned up to industrial screening levels. Depending upon the type of development likely to occur, if any, specific areas of contamination in Zone A would be avoided, or their use would be restricted through covenants. This area could be subject to intermittent and infrequent visitation, but there would be no permanent occupancy. This would have the effect of reducing the potential for human exposure to any remaining hazardous constituents. In addition to the fenced areas, access through right-of-way easements for the purpose of conducting groundwater monitoring and visual inspections would be maintained.

Generally, implementation of Alternative B could result in some indirect beneficial effects if land in Zone A were used for certain low-impact development such as light industry. This largely brownfield area, within the immediate vicinity of the postclosure monitored SWMUs and the SWMUs remediated to industrial standards, could possibly be subject to increased visitation and the resultant opportunity for human exposure. Additional site remediation might be necessary. This additional remediation could result in beneficial effects if the existing contamination were further removed and disposed, allowing more frequent human exposure in this area.

Zone B

Zone B contains the phosphate slag storage area. Currently, exposure to an individual from access to this area is limited to no more than 500 hours per year. As stated previously, the phosphate slag storage area would only be made available for utility access to the Tennessee River, e.g., water intakes. Although the type of development anticipated under Alternative B could feasibly require a utility corridor, this need is unlikely. Thus, under Alternative B, Zone B would likely remain undeveloped and undisturbed. Nevertheless, personal exposure would remain restricted to no more than 500 hours per year. However, the exposure to workers developing and constructing infrastructure enhancements in the phosphate slag storage area would be evaluated for specific proposals for land use plans. Because Zone B is likely to remain unused for utility access and, if so, specific proposal review and exposure rates further evaluated and mitigated, effects of any approval would be minor.

Zone C

Under Alternative B, conservation and sustainable LID could likely be accommodated on properties within Zone C, as this land is not known to be previously contaminated. No provisions would have to be made for this land, which is currently suitable for residential and other high-occupancy development. Uses such as public parks, wildlife viewing areas, hiking trails, or other recreation-oriented green spaces could easily be accommodated in suitable undeveloped areas (e.g., wetlands, forests, fields, and other naturally appearing landscapes). Because no contaminants are known to occur here, low-impact development areas such as green energy research and development, education, or ecotourism could likely be placed in Zone C with no adverse impact.

Because most property usage would likely be light to moderate and transient in nature, impacts from adoption of Alternative B from waste generation would likely be minor. Some emphasis on solid waste reduction, reuse, or recycling could be expected. These anticipated minor effects could be further reduced if existing buildings, particularly those with no potentially hazardous interior construction material, and infrastructure were adaptively reused. Because land for some low-impact development would be made available and this would result in the presence of additional people on the property, opportunity for exposure to remaining on-site contaminants would be greater compared to Alternative A but probably less than under Alternatives C, D, E, and F. The number of people on the site would probably be larger under these alternatives compared to Alternative A.

Zone D

As indicated above, Zone D is small and has fence-restricted access. Potential effects from the development of Zone D for conservation and LID under Alternative B would result in no effects if used with restrictions on subsurface development. If land in Zone D were sold but subsurface disturbance prohibited, development compatible with Alternative B could occur as long as the shielding effect of the existing cap is not compromised. No radiation exposure would result from surface use at grade, so impacts anticipated under this alternative would be minor.

4.1.1.3 Alternative C

Under Alternative C, there would be a requirement that the MSR study area be used for commercial, retail, and residential development, which would likely result in the construction of shops, theaters, stores, businesses, and homes. This development would likely result in the construction of additional areas of paved surfaces necessary for parking, the receiving and distribution of shipments of materials, and for roads. However, on-site industrial development would not occur under Alternative C. Although the commercial, retail, and residential development anticipated under Alternative C could generate a low to moderate amount of solid nonhazardous wastes, these are not the types of developments that typically generate amounts of hazardous waste requiring regulatory compliance. Types of commercial establishments that handle regulated chemicals or substances, such as gasoline, might require local, state, or federal regulation. Such developments are expected to comply with applicable regulations and, overall, result in minor environmental effects.

Therefore, the amount of hazardous wastes and effects of managing such wastes are expected to be minor. Thus, the potential for on-site contamination under Alternative C would be low. Anticipated potential exposures to hazardous materials are described below by zone.

Zone A

Zone A property subject to sale or transfer has been remediated to industrial standards. Use of this land for commercial, retail, or residential uses would probably require additional extensive remediation, as this property is considered acceptable for a worker exposure scenario that consists of five days per week for 50 weeks per year.

Except for the postclosure-monitored SWMU areas, which will be retained in federal ownership, most of the contamination contained in such areas in Zone A is the result of chemicals in the top foot of soil. Building foundations and flooring along with the large paved surfaces would be an effective barrier to contact with surface soil. Human exposure to soil, other than by employees, would generally be occasional to infrequent. Due to the suitability of Zone A sites for industrial uses, no permanent occupancy is expected. In addition to the fenced areas, access through right-of-way easements for the purpose of TVA conducting groundwater monitoring and visual inspections would be maintained.

Initially, commercial, retail, and residential construction activities would have the potential for generation of dust and accumulation of construction debris or petroleum-related chemicals to be released to the environment (see Section 4.1). BMPs and good environmental stewardship practices would be effective in mitigating this potential effect. Temporary occupancy with exposure limits no longer than five days per week for 50 weeks per year would not result in adverse impacts to on-site workers. Additional site cleanup of construction of physical barriers between potential receptors and contaminated soil could increase exposure time and reduce the potential significance of effects. Resident development on some parts of Zone A could expose permanent occupants to the potential for significant health effects.

Zone B

Development within the 90-acre phosphate slag storage area would be restricted under Alternative C; therefore, no direct adverse effects would occur. Zone B would be considered for use as access to the Tennessee River for potential infrastructure enhancements necessary for the development of areas south of Reservation Road. Use of Zone B under Alternative C as a utility corridor would not generate significant additional exposures. However, restrictions would be required to prevent disturbance of buried contaminants during construction of any facilities located within Zone B and to limit exposures to no more than 500 hours per year. Therefore, the exposure to workers developing and constructing infrastructure enhancements in the phosphate slag storage area would be evaluated for specific land use proposals. Prior to any land use approvals, TVA would ensure worker safety from radiation exposure while temporarily on site; thus, effects would be minor.

Zone C

Because land within Zone C is not known to be contaminated, Zone C property is considered suitable for residential use and for retail and commercial development. Such development could generate minimal amounts of nonhazardous waste. Certain types of retail establishments (convenience and gasoline retail businesses) might require stringent monitoring requirements if residents were located nearby. Such developments are expected to comply with applicable state and local regulations and, overall, result in minor environmental effects. Because little or no hazardous waste would likely be generated on site, the potential for expose and adverse effects would be minor.

Because development under Alternative C in Zone C would likely result in the presence of additional people on the MSR study area, the risk of exposure to any contaminants generated on site would be greater compared to Alternatives A and B but potentially the same or less than that likely under Alternatives D, E, and F.

Zone D

The potential effects from development of Zone D for commercial, retail, and residential use under Alternative C could generally be similar to those resulting from development within Zone C. If land in Zone D were sold but subsurface disturbance restricted, commercial, retail, and residential development under Alternative C could occur with minor effects. As long as subsurface disturbance or underground development was restricted, potential adverse health risk from radiological exposure would be minor. Under Alternative C, if development occurs on the existing soil surface (grade), the LLRWBS could be safely developed for the suitable desired uses.

4.1.1.4 Alternative D

Under Alternative D, TVA would stipulate that the MSR study area be used for industrial purposes. This development could range from heavy to light industry, involve extensive land disturbance, and intense land use. It would also likely result in the construction of additional areas of paved surfaces and potentially cause secondary effects from emissions. The amount of solid and hazardous waste that would be generated would depend on the nature of industries that could locate on the area. Nevertheless, the potential for generation of wastes, including hazardous waste resulting from the development of the MSR study area for industrial use, would likely be greater under Alternative D than under the other Action Alternatives. Industries would be required to construct and operate within regulatory standards imposed by other federal or state agencies to limit their environmental impacts. The likelihood of additional on-site contaminant generation (i.e., waste streams) would likely be highest under Alternative D compared to the other alternatives. The discussion below addresses likely exposure within Zones A through D.

Zone A

The Zone A properties subject to transfer have been remediated to screening levels that make them suitable for industrial use. Therefore, this use of Zone A would be compatible with development under Alternative D. Within the 300-acre industrial remediated area, the 64 acres allocated for postclosure-monitored SWMU areas including the phosphorus entombment area, which would be unusable for any other purpose, would be retained by TVA under all the Action Alternatives. In addition to the fenced areas, access through right-of-way easements for the purpose of conducting groundwater monitoring and visual inspections would be maintained. Thus, development of Zone A areas for industrial uses under Alternative D is not expected to result in additional disturbance of buried wastes or unsafe levels of exposure to these materials within Zone A. Because of isolating effects of ground-level development above the soil, potential effects of workers' exposure are expected to be minor.

Zone B

The phosphate slag storage area (Zone B) would be used only for a utility corridor to the Tennessee River. The potential effects of development within Zone B under Alternative D would be similar to those anticipated under Alternative C. However, the need for a utility corridor would likely be higher under Alternative D due to the possibility of additional process water intake or discharge. As a condition of future reviews, the exposure to workers developing and constructing infrastructure enhancements in the phosphate slag storage area will be evaluated for specific land use proposals. Prior to any land use approvals, TVA would ensure worker safety from radiation exposure while temporarily on site; thus, effects would be minor.

Zone C

Land in Zone C is suitable for industrial use, and TVA would require it be used for industrial uses under Alternative D. Potential effects of industrial development would depend on the nature of the industry and the extent of development. Industrial use would require adherence to current environmental laws and regulations designed to restrict levels of land, water, and air emissions and could necessitate environmental monitoring. Because Zone C is suitable for unrestricted use and industrial-type developments would likely provide short-term employee occupancy substantially isolated from soil contact, no increased human health or environmental exposure risks are anticipated.

Although industry is largely regulated, heavy industrial development would present a potential for direct, indirect, and cumulative effects from environmental (air, land, and water) emissions, generation of hazardous waste, and accidental environmental releases. If regulatory compliance were achieved, effects would still likely be minor.

Zone D

The potential impacts of industrial development in Zone D could generally be similar to those from developing areas of Zone C. If land in Zone D were sold but subsurface disturbance restricted, industrial development under Alternative D could occur with minor effects. Because no surface-level radiation exposure would result, direct and indirect impacts from use of the LLRWBS for industrial uses associated with implementing Alternative D could be similar to those expected under Alternatives B and C. Because this site is small and, with restrictions, no other resources would be adversely affected, impacts of industrial use would be minor.

4.1.1.5 Alternative E

TVA would require that the MSR study area be used for a mixture of conservation, industrial, commercial, retail, and residential development purposes under Alternative E. Use of the site for conservation-oriented and industrial purposes would be somewhat less than that expected under Alternatives B and D. The mixture of site development under Alternative E would generate solid waste, and some hazardous wastes could be produced as a result of industrial by-products. However, because primary or heavy industry would be less likely in the mix of other uses, the generation of large quantities of hazardous waste is not likely. Such waste management would likely be regulated. Incorporating guidance for the Master Plan also suggests that land use development types considered incompatible would not likely be located adjacent to one another without adequate spacing or buffers. Therefore, the potential for additional site contamination from development under Alternative E is relatively low. The discussion below addresses likely exposure within Zones A through D.

Zone A

Under Alternative E, the portion of Zone A remediated to industrial use standards would be suitable only for industrial uses. Development of Zone A land for other uses would probably require additional remediation. Cleanup of this land for some conservation, LID, commercial, retail, or residential uses would probably require additional extensive remediation; Zone A property is only acceptable for a worker exposure scenario that consists of five days per week for 50 weeks per year. Such cleanup would likely involve the removal of a large volume of contaminated soil or other remedial technologies that would be costly. However, in light of use restrictions to minimize occupancy time on site, if used for appropriate industrial purposes or further remediated, potential effects from radiation exposure would be minor.

Zone B

The phosphate slag storage area (Zone B) would be used only for a utility corridor to the Tennessee River. Although a utility corridor across Zone B could be required under Alternative E, the likelihood of this is somewhat less than that under Alternative D because of the reduced likelihood or extent of industrial-type development. However, as under Alternative D, potential exposure to workers in the phosphate slag storage area will be evaluated for specific land use proposals. Therefore, with restrictions or appropriate mitigation, potential for adverse impacts to worker safety from exposure are minimal.

Zone C

Property within Zone C would be suitable for the mixed use development associated with Alternative E. Because there are no known contaminants affecting this portion of the MSR study area property, such development under Alternative E would not pose undue risks of exposure to contaminants.

Zone D

The potential impacts of mixed use development in Zone D could generally be similar to those from developing areas of Zone C. If land in Zone D were sold but subsurface disturbance restricted, mixed use development under Alternative E could occur. Because no surface-level radiation exposure would result, direct and indirect impacts from use of the LLRWBS for a mixture of uses associated with implementing Alternative E could be similar to those expected under Alternatives B, C, D, and F, and impacts would be minor.

4.1.1.6 Alternative F

As described in Chapter 2, Section 2.1.6, the reasonably likely future uses of the property under Alternative F are those described in Action Alternatives B, C, D, and E and would, therefore, result in a mixture of one or more of those uses or a mixed use reflected in Alternative E. As indicated under Alternative E, use of the site for conservation-oriented and industrial purposes could be somewhat less than that expected under Alternatives B and D. The mixture of site development under Alternative F would also likely generate solid waste, and some hazardous wastes could be produced as a result of industrial by-products. However, the generation of large quantities of hazardous waste is similarly not likely. Therefore, the potential for additional site contamination from development under Alternative F is relatively low.

Because a mixture of uses under Alternative F is expected to be similar to that under Alternative E, the anticipated effects across Zones A through D would be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

4.2 Geology

Because of the underlying depth and homogeneous geology throughout the MSR study area, no disturbance of deeper deposits would likely occur. In addition, because site suitability would be taken into account prior to construction, no significant impact to geological resources from development is expected under any of the project alternatives (see Sections 3.2 and 3.3.1). Detailed site-specific studies consistent with the Master Plan would likely be performed by future landowners or developers to determine the suitability of prospective building sites for the proposed uses. Sound engineering and construction

BMPs would be applied under appropriate state or local laws and regulations to avoid building on potentially unstable sites (e.g., karst terrain). No mining, mineral extraction, or petroleum exploration, drilling, or deep excavation that could cause or contribute to bedrock subsidence are anticipated. Therefore, no indirect or cumulative geological impacts are anticipated from site development under any of the alternatives, including No Action.

4.2.1 Alternative A

Under the No Action Alternative, the MSR study area would remain in federal ownership under the control of TVA. Thus, no foreseeable additional impacts to the existing geological conditions are expected.

4.2.2 Alternative B

Implementation of Alternative B would result in the requirement that the land in the MSR study area be used in the future for conservation of natural resources. Additionally, under this alternative, some forms of sustainable low-impact development would be allowed. Under this alternative, the geological character of the area would probably be preserved, and no development would likely occur in areas where the local landforms of concern (e.g., sinkholes) could be affected.

4.2.3 Alternative C

Under Alternative C, TVA would require the new owner(s) to use the property for commercial, retail, and residential uses purposes. Under Alternative C, based on the type and extent of development, there could be less green space than developed areas compared to Alternative D and possibly Alternatives E and F. Expected loss of pervious surfaces, due to construction of buildings, roads, parking lots, and sidewalks would prevent or slow rain from filtering through the soil. This would cause additional runoff of water (and possibly pollutants) into storm drains and streams. Because the underlying strata are limestone, this could affect the natural surface drainage and flows that form dissolution openings such as sinkholes. Additional on-site development could increase the possibility of a sinkhole developing or existing sinkholes that have been filled by sediment collapsing. Assuming sufficient geological testing occurs, however, this is unlikely. BMPs could be implemented to reduce the likelihood of sediment and/or runoff entering into these karst features. This could reduce the potential for adverse impacts on human health and property damage from new or enlarged sinkholes.

4.2.4 Alternative D

Under Alternative D, use of the MSR study area would be restricted to industrial purposes. Based on the type and extent of development, there could be less green space than developed areas under this alternative compared to Alternative B and possibly compared to Alternatives E and F. This could result in the construction of additional buildings and potentially even less pervious surfaces than under Alternative C. Because of additional weight associated with larger buildings on the property, adoption of Alternative D could possibly result in greater or likely similar impacts as Alternative C to geologic features.

4.2.5 Alternative E

Under Alternative E, TVA would require that the MSR study area be used for a mixture of conservation, commercial, retail, residential, and industrial uses. Actions undertaken following the adoption of Alternative E would likely result in similar impacts to geologic features as under Alternatives C, D, and F. Furthermore, because additional acreage could remain in conservation uses and industrial development would likely be less than anticipated under Alternative D, adoption of Alternative E could result in less impact to geological resources compared to Alternatives C and D.

4.2.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses that could occur. However, as described in Chapter 2, Section 2.1.6, the reasonably likely future uses of the property under Alternative F are those described in Action Alternatives B, C, D, and E and would, therefore, result in a mixture of one or more of those uses or a mixed use reflected under Alternative E.

Because of the underlying depth and homogeneous geology throughout the MSR study area, no disturbance of deeper deposits would likely occur under Alternative F. It is expected that development would not contribute to sinkhole formation. Therefore, impacts of mixed use development under Alternative F are likely to be similar to those described under Alternative E above and the range of effects bounded by the analysis described under Action Alternatives B, C, D, and E.

4.3 Groundwater Resources

A primary concern under each of the alternatives is the potential for groundwater impacts from existing solid/hazardous waste facilities, which have indicated past evidence of local groundwater contamination. These facilities include SWMU 108 (VOCs and nitrate), SWMU 112/194 (six radionuclides), and SWMU 114 (chromium, mercury, and fluoride). Any release of contaminants from these disposal facilities could be transported by groundwater to the Tennessee River, tributary streams, and springs. Similarly, site development has the potential to affect groundwater recharge, especially if large areas of impervious surfaces (i.e., paved areas or areas occupied by buildings) are prevalent. Likewise, spills or other surface contamination can cause groundwater contamination.

The presence of VOCs in groundwater in the area downgradient of SWMU 108 could result in intrusion of VOC vapors into basements or lower levels of any future enclosed structures constructed in this area. VOC concentrations of a few mg/L observed in wells on the margins of SWMU 108 are sufficiently high to be of concern. The approximate area of VOC vapor concern extends downgradient from the northern and western boundaries of SWMU 108 to a line connecting the POC monitoring well clusters POC1A/B, POC2A/B, and POC3A/B (see Figure 3-10). The probability of vapor intrusion in this area appears low. Historical monitoring of POC wells indicates that VOCs in the area of concern are primarily found in bedrock and at low concentrations (see Appendix F). Additionally, soil cover is relatively thick in the area, ranging from approximately 70 to 80 feet, which would reduce the potential for VOCs primarily present in bedrock to reach surface structures. Nevertheless, USEPA (2008b) indicates that buildings within approximately 100 feet of a volatile contaminant source in groundwater or soil are at potential risk of vapor intrusion. Thus, there is a possibility of VOC vapor intrusion into any enclosed building constructed under any of the Action Alternatives. Therefore, under all of the Action Alternatives, TVA would advise potential buyers that, prior to construction of enclosed structures, soil gas data should be collected from above the water table in areas of historical VOC groundwater contamination to determine if a pathway for vapor intrusion is present.

Disposal of the MSR study area under any of the Action Alternatives would include the imposition of property deed covenants that would prohibit the future development of wells used for potable water supply. However, no restrictions would be placed on construction of wells for nonpotable purposes. The restriction on potable groundwater use is necessary to prevent the use of potentially contaminated groundwater beneath certain areas on the MSR study area for potable purposes, i.e., human consumption, bathing, or livestock consumption. While groundwater beneath certain areas of the MSR study area is likely potable, some areas, such as the area beneath and downgradient of SWMU 108, exhibit contaminated groundwater. Restricting future groundwater development for potable use in all parts of the MSR study area would eliminate the possibility that groundwater withdrawals in uncontaminated areas might induce movement of groundwater from contaminated areas toward active water-supply wells. Therefore, particularly given the availability of supplies through public water systems serving the MSR region (see Section 3.3.3) and the surrounding communities' decreased reliance on well water, off-site exposure to contaminated groundwater is very unlikely.

Groundwater contamination was rigorously evaluated in the RFI Final Report (TVA 1998c) using data gathered during comprehensive hydrogeologic field investigations. Numerical models were used to evaluate the transport and fate of contaminants from existing SWMU 108 and SWMU 112/194 disposal facilities and assess the impacts to potential groundwater receptors. Preclosure conditions were assumed in simulations of both facilities. The addition of landfill covers, designed in accordance with RCRA requirements during facility closure, substantially reduced infiltration of precipitation into both facilities compared to preclosure infiltration. Therefore, preclosure simulations summarized below represent conservative, worst-case estimates of the transport and fate of contaminants from SWMU 108 and SWMU 112/194. Potential effects of SWMU 114 on groundwater and groundwater receptors (not covered in RFI) are also discussed.

SWMU 108

Past groundwater studies identified nitrate and several VOCs (primarily tetrachloroethylene) as originating from SWMU 108, and data collected were sufficient to allow a delineation of the extent of contamination at the site (TVA 1998c). Numerical flow and transport modeling was performed to assess the potential impacts of these contaminants on surface water and groundwater resources in the SWMU 108 locality. Sampling results from Pond Creek sediments upstream and adjacent to the site suggested that VOCs identified in stream sediments, although below RALs, probably originated at SWMU 108. Polyaromatic hydrocarbon contaminants in Pond Creek sediments were found at all sampling locations, and results indicated off-site and possible on-site sources related to coal and coal-combustion by-products.

A groundwater flow and contaminant transport model of the MSR site was developed in connection with the RFI to evaluate the transport and ultimate fate of nitrate and VOC contaminants associated with SWMU 108. The model was applied to three underground layers of variable thickness. The two upper layers represented overburden, and the lower layer represented the highly transmissive epikarst zone. Aquifer testing and dye tracing at MSR suggest that groundwater flow in bedrock was relatively limited. Although the Tuscumbia limestone is a significant aquifer in the region, flow meter profiles indicate very few transmissive fractures in shallow bedrock at the site; consequently, bedrock beneath the epikarst zone was not represented in the model. Details regarding the model setup, boundary conditions, hydraulic/transport parameters, and flow-model calibration were reported in the ERC RFI Final Report, Sections 2.27 and 2.30 (TVA 1998c).

Conservative transport simulations were conducted for nitrate assuming an initial condition of 250 mg/L beneath SWMU 108. This concentration is equivalent to the highest measured value at the site. The simulation period of 20,000 days (approximately 55 years) for modeling represents the life of the landfill. At the end of the 10,000-day simulation period, the limit of the 10 mg/L nitrate level (i.e., the MCL) was within 2,400 feet of SWMU 108. Model predictions after this time show reductions in nitrate concentrations. Nitrate contamination from SWMU 108 is not expected to extend beyond the MSR study area boundaries at values in excess of the MCL (10 mg/L). The overall extent of contaminant migration is limited by hydrodynamic dispersion and dilution. In the event that nitrate contaminants from SWMU 108 reach the Tennessee River, concentrations would be reduced to immeasurable levels.

Contaminant transport simulations were conducted for tetrachloroethylene at initial concentrations of 20 mg/L, which is equal to the highest measured concentration in groundwater at the site based on November 1997 sampling results. The time interval for this simulation (4,000 days) was roughly equivalent to the period for which monitoring has been conducted at the site. According to the simulation, after 2,000 days, the predicted tetrachloroethylene plume (to the RAL of 5 µg/L) would move horizontally a maximum of about 2,000 feet in the epikarst zone. Modeling results at subsequent time intervals show significant declines in tetrachloroethylene concentrations due to biodecay. At the end of 4,000 days, only small concentrations (less than 20 µg/L) of residual tetrachloroethylene remained in the groundwater system, and RAL concentrations were exceeded only in the immediate area of SWMU 108.

Additional simulations were performed conservatively assuming a constant level of tetrachloroethylene (20 mg/L) beneath SWMU 108. The constant source transport simulation was run for a period of 8,000 days (about 22 years). The predicted tetrachloroethylene plume at 6,000 days reached a point of equilibrium where the contaminant concentrations increased no further in the downgradient direction. Contaminant migration at this point was about 3,000 feet from the center of contaminant mass to the 5 µg/L concentration boundary. Essentially no changes in plume dimensions or concentrations occurred after this time. Although conservative, the results of constant source model simulations indicate that the RAL concentration (5 µg/L) of tetrachloroethylene is expected to extend no more than 3,000 feet from SWMU 108 after 6,000 days.

Transport simulations indicated that natural attenuation processes (i.e., dilution, dispersion, and biodegradation) would prevent tetrachloroethylene from reaching potential downgradient receptors at concentrations exceeding the MCL of 5 µg/L. Furthermore, TVA can infer from the tetrachloroethylene simulations that natural attenuation processes will also reduce concentrations of the other seven VOCs to levels below their action limits before they reach potential receptors. Past monitoring shows that these VOCs occur at concentrations ranging from one to four orders of magnitude (i.e., 10 to 10,000 times) lower than that of tetrachloroethylene.

Tetrachloroethylene is the most prevalent of VOCs at SWMU 108. Although modeling did not specifically address other VOCs, the site monitoring programs assure that groundwater contamination from SWMU 108 remains at acceptable levels and near the facility. The monitored natural attenuation programs for SWMU 108 provides for routine monitoring of VOC and other constituents as described in Section 3.3.2.1. The monitoring plan was implemented in 2003, and routine monitoring is required for a period of 30 years. If POC monitoring wells indicate VOC concentrations are exceeding RALs (see Appendix F), available data will be examined collectively to determine additional investigation requirements at the site. If necessary, alternative remedial measures will be implemented.

SWMU 112/194

Groundwater monitoring results for samples collected in April 1997 from SWMU 112/194 Wells 36-37 indicated six radionuclides exceeded calculated preliminary remediation goals

(PRGs) (see Appendix H). These radionuclides included potassium-40, lead-210, polonium-210, radon-222, total radium, and total uranium. The transport and fate of these radionuclides were evaluated using the same basic groundwater flow and contaminant transport model of the MSR site used in the SWMU 108 evaluations (Julian 1999). Table 4-1 presents the half-lives and adsorption distribution coefficients (K_d) for each radionuclide used in the simulations. A constant concentration source term equal to the highest measured groundwater concentration from Table H-2 in Appendix H was applied to the model. Conservatively, the model recharge (6 inches/year) assumed preclosure conditions without the RCRA closure cap. The spatial dimensions of the source term were the same for all simulations. Source term concentrations for each nuclide were selected as the highest measured concentration for each radionuclide listed in Table H-2 in Appendix H. Simulations for all radionuclides were performed for a period of 500 years. At the time of flow and transport model development, RCRA action levels did not exist for radionuclides of concern. Model-predicted radionuclide concentrations were compared to risk-based PRGs shown in Table 4-1.

Table 4-1. Characteristics of Radionuclides

Nuclide	Atomic Number	Half-Life	Geometric Mean, K_d (g/cm^3)	Preliminary Remediation Goal[a] (pCi/L)
K-40	19	1.277E+09 years	75	3.81E+00
Pb-210	82	22.26 years	550	7.05E-02
Po-210	84	138.38 days	3,000	1.46E-01
Rn-222	86	3.83 days	None	NC
Ra-226	88	1600 years	9,100	1.61E-01
U-238	92	4.468E+09 years	1,600	5.87E-01

Source: TVA 1998c
Abbreviations:
g/cm^3= Grams per cubic centimeter; K_d = Distribution coefficient; K-40 = Potassium-40; Pb-210 = Lead – 210
pCi/L = Pico-curies per liter; Po-210 = Polonium-210; Ra-226 = Radium-226; Rn-222 = Radon-222
U-238 = Uranium-238
[a] Under the commercial/industrial land use scenario, risk-based PRGs for radionuclides in groundwater are based on residential exposures (USEPA 1991, Equation 10, page 35).

The downgradient movement of potassium-40 is higher than for any nuclide modeled due to its relatively low ability to be absorbed by other materials and its long half-life. Simulation results indicate potassium-40 movement is primarily downward through the overburden to the epikarst zone, after which the plume moves horizontally through the epikarst toward the Tennessee River. Potassium-40 was predicted to migrate approximately 1,000 feet downgradient of the northern boundary of SWMU 112 at a concentration of 1E-06 mg/L. This is two orders of magnitude (10 to 100 times) less than the corresponding PRG of 5.46E-04 mg/L. Uranium-238, with its relatively long half-life, reached the epikarst, but lateral movement was limited to less than 400 feet downgradient of the northern boundary of SWMU 112/194 at a concentration of 1E-07 mg/L. This is three orders of magnitude (1,000 times) less than the PRG of 8.51E-04 mg/L for uranium-238. Migration of lead-210, polonium-210, radon-222, and radium-226 after 500 years was limited to the overburden without reaching the epikarst zone, mainly due to their short half-lives and/or high capacity to be absorbed by other substances.

Conservative model simulations suggest that radionuclide transport is restricted to the immediate vicinity of SWMU 112 at concentrations that are much less than the PRGs. Simulations indicate only limited vertical and horizontal migration from SWMU 112.

Potassium-40 exhibits the most significant migration potential due to a relatively low absorption capacity and long half-life. However, soil adsorption, hydrodynamic dispersion, and dilution limit the overall extent of contaminant migration. In the likelihood that radionuclide contaminants from SWMU 112 reached the Tennessee River, concentrations would be reduced to immeasurable levels due to dilution by the river.

SWMU 114

Water samples collected from a depression on the top of the east slag pile (Sample 1W) and from a slag pile seep flowing to Pond Creek (Sample 2W) indicated concentrations of cadmium, mercury, and fluoride that exceeded MCLs (see Appendix I). A third water sample (4W) obtained from Pond Creek immediately below the east slag pile also showed a mercury concentration above the MCL. As indicated in Appendix I, groundwater gradients in the slag pile area are northwestward, indicating the Tennessee River would be the primary receptor of seepage emerging from the base of the unlined slag piles. Dilution of leachate seepage entering the river, even under low-flow river conditions, would reduce contaminant concentrations to immeasurably low levels. For example, assuming a net recharge rate of 15 inches/year (the upper end of recharge estimates) (also, see Section 3.3.1.4) over the 90-acre phosphate slag storage area, slag leachate contaminant concentrations would be reduced by a factor of about 60,000 after mixing with low flow (approximately 9,560 cfs) for the Tennessee River. Higher flows would tend to dilute the leachate further.

4.3.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Under this plan, Muscle Shoals and Wilson Dam Reservation property would continue to be used for various potential governmental and nongovernmental purposes including economic development opportunity. The property on the north side of Reservation Road would continue to be allocated for TVA programs including public recreation and open space.

Although past industrial activities have affected groundwater quality in localized areas on the MSR study area, groundwater investigations indicate no evidence of adverse impacts to potential off-site groundwater users or other receptors such as streams or springs. Postclosure monitoring at SWMU 108 indicates that application of the approved Monitored Natural Attenuation Program for SWMU 108 has been successful in assuring regulatory compliance. VOC plumes appear stable, suggesting that the rate at which contaminants are entering the groundwater system beneath SWMU 108 is approximately equal to the rate at which VOC contaminants are being naturally attenuated by biodegradation, dilution, and dispersion. In addition, long-term fate and transport simulations indicate that contaminant concentrations would never exceed RALs beyond a distance of approximately 3,000 feet downgradient of the facility boundary. Should contaminants reach the Tennessee River (the nearest potential downgradient receptor), concentrations would likely be at immeasurable levels. Likewise, postclosure groundwater monitoring of SWMUs 17-37 and 104 has not detected elemental phosphorus.

Modeling indicates that migration of radionuclides observed in groundwater samples at SWMU 112/194 would be limited to the near-field area downgradient of these facilities at concentrations exceeding their PRGs. Should contaminants reach the Tennessee River (nearest potential downgradient receptor) concentrations would be reduced to immeasurable levels. Although groundwater sampling and analysis for SWMU 114 are limited, contaminant concentrations associated with the facility are expected to be at immeasurable levels mixing with the Tennessee River.

The potential for off-site migration of contaminants from existing solid/hazardous waste landfills under Alternative A is low. Prevailing groundwater gradients indicate that any contamination from these landfills would migrate toward the Tennessee River, where contaminants would be diluted to immeasurable levels. Impacts to off-site groundwater users are not expected based on available information regarding groundwater flow in the site vicinity. The existing solid/hazardous waste landfills lie outside of the WHPA of Tuscumbia Big Spring (see Figure 3-11), the only known public groundwater supply in the vicinity of the MSR study area. Present groundwater supply well development in the Muscle Shoals-Tuscumbia-Sheffield area is limited due to the widespread availability of public water service. Furthermore, given the availability of public water, the possibility of extensive future groundwater development in the vicinity of the MSR study area that might alter groundwater-flow patterns in the area appears remote.

4.3.2 Alternative B

Under Alternative B, the MSR study area would be required to be used for conservation of natural resources and some forms of sustainable low-impact development. Because activities that could affect groundwater flow or conditions are not likely, potential groundwater quality impacts of future low-impact development associated with this alternative are expected to be negligible.

The potential long-term impacts to groundwater quality associated with existing solid/hazardous waste disposal areas described under Alternative A would also apply to Alternative B.

4.3.3 Alternative C

Development of the MSR study area under Alternative C could result in the construction of shops, stores, businesses, and residential housing. Implementation of this alternative would likely result in the construction of large areas of pavement associated with roads and parking lots. Potential impacts to local groundwater resources from future commercial, retail, and residential activities include releases of storm water containing contaminants, e.g., petroleum products, nutrients, or pesticides, to groundwater via surface infiltration. Application of measures in appropriate storm water permits and subsequent implementation of BMPs are expected to minimize the likelihood of such occurrences.

In addition to potential effects from future commercial and retail land use, implementation of Alternative C could also potentially contribute to groundwater effects associated with existing solid and hazardous waste facilities (see Section 4.3.1). However, as mentioned above, compliance with regulatory controls would make this additional contribution of pollutants unlikely.

Because a variety of development types could occur under Alternative C, there is a potential for the construction of more buildings and structures and generation of additional pollutants under Alternative C compared to Alternative A or B.

4.3.4 Alternative D

Under Alternative D, TVA would require that the MSR study area be used for industrial development. Potential impacts to groundwater resources in the MSR vicinity associated with this alternative include future soil and groundwater contamination resulting from manufacturing and industrial processes. On-site waste storage/disposal would likely take place during construction and operation of the industry. Activities necessary for industrial operation occasionally result in spills, leaks, or other unintended releases to the environment. Common industrial contaminants include heavy metals, construction debris, and petroleum-based chemicals related to transportation.

Releases of such industrial contaminants, particularly in liquid form, to ground surface could eventually leach into groundwater beneath the MSR study area, where they would be transported downgradient to groundwater receptors. Depending on location of the release, the ultimate receptor of any contaminated groundwater might be the Tennessee River, an on-site tributary stream, or a spring located either on or off the MSR study area. The magnitude of the potential impact would depend on the nature of the contaminant(s) involved, the magnitude of the release, the ultimate groundwater receptor(s), and the effectiveness of any measures taken by the landowners to mitigate the release.

In addition to potential impacts of future industrial land use, actions resulting from the implementation of Alternative D also include potential groundwater impacts associated with existing solid/hazardous waste facilities as described in Section 4.3.1. With implementation of likely required regulatory controls, potential long-term impacts to groundwater quality would be essentially the same as those anticipated under Alternatives C but greater than those under Alternatives A and B.

4.3.5 Alternative E

Under Alternative E, the MSR study area would be used for a mixture of conservation and low-impact development, industry, commercial and retail development, and residential construction. The potential impacts to local groundwater resources associated with proposed mixed land use activities would be comparable to those expected under the other Action Alternatives. However, the extent and degree of these effects would depend in large part on the types of waste streams generated by future on-site industrial operations, the amount of wastes generated, waste-handling procedures, the amount of pervious and impervious surfaces, and the location of this development with respect to the SWMU areas. Generally, the potential for groundwater effects under Alternative E would be similar to that anticipated under Alternatives C and D, and effects could likely be greater than those expected under Alternatives A and B because industrial development would not be allowed.

4.3.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses that could occur.

Because mixed use development under Alternative F is expected to be similar to that under Alternative E, the potential environmental effects with respect to hazardous wastes generated from such development would likely be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

4.4 Historic and Archaeological Resources

Consistent with Section 106 of the NHPA, historic properties, both archaeological and architectural, can be adversely affected by federal agency undertakings that directly disturb them. Such disturbance could occur through demolition and removal, excavation, substantial site alteration, or indirect effects on their visual setting or character as a result of nearby changes. Because adverse impacts associated with the transfer of eligible historic properties on the Reservation (within the APE) are expected from this undertaking, an MOA has been finalized and executed to identify actions to be taken by TVA and others to avoid, minimize, or mitigate these effects. These eligible properties are listed in Appendix B to the MOA and locations of each shown on a topographic map in Appendix C to the MOA (see

Appendix A to this EIS). Such NRHP-eligible federally owned properties cannot be transferred to nonfederal ownership without compliance with Section 106.

In compliance with Section 106 of the NHPA, TVA evaluated potential effects of its proposed undertaking on eligible historic properties. TVA and the Alabama SHPO agreed that TVA's proposed action constituted a federal undertaking. The Alabama SHPO also concurred that the APE would be the approximately 1,400 acres proposed for transfer.

During TVA's early consultation with the Alabama SHPO, 51 historic buildings and structures within the boundary of the APE were identified as eligible for listing in the NRHP (see Figure 3-12, Section 3.4.2, and Appendix C of Appendix A to this EIS). TVA has completed consultation with the Alabama SHPO on the eligibility of these historic architectural properties (buildings and structures) on the MSR study area. Potential indirect and cumulative effects on eligible architectural resources are taken into account in the executed MOA. Adverse effects on architectural resources would also be mitigated through future implementation of design guidelines and architectural controls for new construction within a reasonable distance of these eligible properties.

In addition, historic archaeological sites 1CT495, 1CT500, and 1CT575 have been identified as part of the MSHD and, therefore, are eligible for the listing in the NRHP. Adverse effects on sites 1CT500 and 1CT575 would be mitigated as a part of an agreed-upon stipulation to collect oral histories of Wilson Village No. 2 from former residents (Appendix A). Potential adverse effects on site 1CT495 shall be dealt with through avoidance of the remaining Wilson Power Plant foundations during any construction in the utility corridor to the Tennessee River. These stipulations, along with those to address historic architectural properties, are included in the MOA.

In consultation with the Alabama SHPO, terms, conditions, commitments, and other necessary stipulations to treat or mitigate adverse effects on historic resources are memorialized in the final executed MOA. As appropriate, these stipulations would apply to all the Action Alternatives, i.e., Alternatives B, C, D, E, and F, under which the land would be transferred from federal ownership. With the application of necessary and appropriate mitigation, potential effects to historic properties across the Action Alternatives would be insignificant.

The MOA contains specific time frames within which specific actions or activities would be completed (see complete detailed description of all stipulations in the MOA in Appendix A). Following is a summary of the actions TVA would undertake:

- TVA shall inventory all original records associated with the design, construction, and operation of the USNP2 and all NFDC facilities comprised of buildings of the first and second architectural periods. Additionally, TVA shall catalog these records in a searchable electronic database and provide the original materials and the database to the Special Collections Department of Collier Library at the University of North Alabama so that these records are appropriately curated.

- TVA shall prepare an NRHP Registration Form (NPS 10-900) for USNP2/NFDC Historic District. The nomination form and supporting information shall be prepared by individuals who meet the professional qualification standards as published in the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation. Listing in the NRHP would tend to encourage and facilitate use of the Federal Tax Credits available for the rehabilitation of historic properties.

- A comprehensive Master Plan for the redevelopment of the MSR Property will be formulated and developed by TVA in partnership with the NACD and/or other appropriate local governments or development entities, with opportunities for public input and with input from the Alabama SHPO. The Master Plan shall include design guidelines for new construction located within a reasonable distance from those buildings that define architectural features of the first and second architectural periods. Additionally, the Master Plan shall incorporate architectural controls for other buildings based on the Secretary of the Interior's standards for the treatment of historic properties. These design guidelines and architectural controls will be made a part of any instrument that transfers the property out of federal ownership and will be enforceable by TVA and/or potentially by appropriate local government(s) or local historic commissions. TVA shall complete certain tasks prior to the transfer of the MSR property, in whole or in part, and submit an annual report updating the status of this stipulation to the consulting parties.

- TVA shall prepare documentation equivalent to Historic American Building Survey Level II for some properties. This level of documentation shall include:

    - Selected existing drawings of primary plans, elevations, and details in digital format and printed as ink on archival material

    - Selected photographs of each principal elevation and all significant interior spaces in digital format with large format negatives and 8-inch by 10-inch archival prints

    - Selected history and description of each building (one page) printed as ink on archival paper

- TVA shall curate any documentation produced as a result of this stipulation with the Special Collections Department of Collier Library at the University of North Alabama.

- Until such time as certain properties have been transferred from federal ownership in accordance with the terms of this agreement, TVA will provide architectural and structural condition assessments, including information on the status of the project and property disposal.

- Historic archaeological sites 1CT500 and 1CT575 have been identified as the remains of Wilson Village No. 2 and are eligible for listing in the NRHP. The proposed undertaking will have an adverse effect on sites 1CT500 and 1CT575. Both archaeological sites have had extensive survey and recordation. To augment the archaeological and documentary information on Wilson Village No. 2, TVA will collect oral histories from a sample of the remaining inhabitants of Wilson Village No. 2. These oral histories shall be transcribed and collated into a descriptive report and curated with the Special Collections Department of Collier Library at the University of North Alabama.

4.4.1 Archaeology

Archaeological resources can be affected directly from ground disturbance associated with clearing, site preparation, and construction. Adverse indirect effects to these resources can occur due to changes in the aesthetic character of the local setting. Such direct and indirect effects to archaeological resources could occur under any of the Alternatives, including No Action.

Different degrees of site preparation could occur under the different alternatives with Alternative B likely being less extensive and less intensive. Conversely, with regard to potential land use and necessary site preparation, Alternatives C, E, and F could be greater in extent and intensity compared to Alternative B but similar or somewhat less than Alternative D. Thus, some alternatives would be inherently more likely to have greater effects than others would on archaeological resources. Regardless, adverse effects on eligible archaeological sites would be mitigated or avoided.

Alabama state laws would apply to the historic cemeteries known within the APE. These laws, along with the Master Plan, would guide potential future land uses that could affect two locally important cemeteries.

4.4.1.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development opportunities. Under this alternative, land uses, as indicated in the 1996 Plan, would not likely have an adverse effect on the three NRHP-eligible archaeological sites (i.e., 1CT495, 1CT500, and 1CT575) and the two locally important cemeteries (Cuba and Murphy-Kemper-Cockburn) described in Section 3.4. TVA would conduct any additional needed site-specific environmental reviews, including cultural resources assessment, if an action is proposed on the MSR study area that has the potential to affect archaeological resources (belowground properties) or cemeteries in the future.

4.4.1.2 Alternative B

If actions under Alternative B have little or no associated earth-disturbing characteristics, there would be little chance that development under this alternative would have an adverse effect on archaeological sites 1CT495, 1CT500, and 1CT575 and on the Cuba and Murphy-Kemper-Cockburn cemeteries. Prior to any action, including potential land transfer, TVA would assure that unavoidable adverse effects were mitigated consistent with the final executed MOA. If these archaeological sites are proposed for ecotourism, recreational activities, or other low-impact developments involving intensive or extensive earth disturbance at any of these sites, adverse effects could likely occur. Any such activities that could cause unavoidable disturbance at any of these cemetery sites could necessitate the relocation of the graves, in accordance with applicable state laws, if the cemeteries could not be avoided. Unavoidable adverse impacts on eligible archaeological sites are addressed in the final executed MOA.

4.4.1.3 Alternative C

Use of the MSR study area for commercial, retail, or residential development, as required under Alternative C, could result in adverse effects on archaeological sites 1CT500 and 1CT575 and on the Cuba Cemetery and the Murphy-Kemper-Cockburn Cemetery. The need to route utilities through site 1CT495 is unlikely under this alternative; therefore, there would be no anticipated effect on what remains of the Wilson Steam Plant foundations. Measures to mitigate for adverse effects on historic properties affected by the proposed development are documented in the final executed MOA with the Alabama SHPO (see executed MOA in Appendix A). These measures include potential data recovery at the three archaeological sites. Alabama state laws apply to the historic cemeteries. Any activities that could cause an unavoidable disturbance to any of these cemetery sites could necessitate the relocation of the graves, in accordance with applicable state laws, if the cemeteries could not be avoided.

4.4.1.4 Alternative D

Industrial development, as required under Alternative D, could result in unavoidable adverse effects on the three NRHP-eligible archaeological sites (1CT495, 1CT500, and 1CT575) and the two locally important cemeteries (Cuba and Murphy-Kemper-Cockburn). Unavoidable adverse archaeological impacts would be mitigated through measures included in the MOA. Mitigation of adverse affects on cemeteries in accordance with Alabama state laws and historic buildings and structures as stipulated in the executed final MOA (Appendix A), as described under Alternatives B and C, would be required.

Any utilities requiring open trenching, shallow directional boring, or the placement of poles within site 1CT495 would result in an adverse effect. Avoidance by careful routing around or substantially below (through directional drilling) this site could avoid the adverse effect. If this were not possible, mitigation through data recovery and archival study would be required, as stipulated in the MOA.

4.4.1.5 Alternative E

Development of the MSR study area for mixed use following the adoption of Alternative E would likely adversely affect archaeological sites 1CT495, 1CT500, and 1CT575 and the Cuba and the Murphy-Kemper-Cockburn cemeteries. Such effects could be avoidable but, if not, would be mitigated. Alabama state laws apply to the historic cemeteries. Mitigation agreed upon for treatment of archaeological sites in the final executed MOA (Appendix A), as described under Alternatives B, C, and D, would be required to compensate for adverse effects.

4.4.1.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses that could occur.

Development of the MSR study area following the adoption of Alternative F would likely adversely affect archaeological sites 1CT495, 1CT500, and 1CT575 and the Cuba and the Murphy-Kemper-Cockburn cemeteries. Such effects could be avoidable but, if not, would be mitigated. Alabama state laws apply to the historic cemeteries. Mitigation agreed upon for treatment of archaeological sites in the final executed MOA (Appendix A), as described under Alternatives B, C, D, and E, would be required to compensate for adverse effects.

4.4.2 Architecture

The primary source of direct adverse effects to architectural resources on the MSR study area is the potential demolition of eligible buildings and structures. Over the long term, removal of historic buildings and structures, especially those that are obsolete or unsuitable for adaptive reuse, could occur under any of the alternatives, including the No Action Alternative. Indirect effects to these resources could occur if there are major changes in the visual character or the historic setting of these resources. Although reuse of existing historic buildings on the MSR would likely involve certain structural changes and alterations to the structure, reuse is preferred to demolition of the building and is encouraged by TVA.

Consultation with the Alabama SHPO has been completed and a final executed MOA is included in Appendix A. In accordance with this final MOA, impacts on historic properties are expected to be similar across the range of Action Alternatives.

4.4.2.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development opportunities. Future undertakings that have the potential to affect eligible historic architectural resources (aboveground properties) would continue to be evaluated on a case-by-case basis. TVA would consult with the Alabama SHPO and other consulting parties, as required, if new TVA undertakings are pursued. As appropriate, TVA would work with the consulting parties to address potential adverse impacts to NRHP-eligible properties.

4.4.2.2 Alternative B

Under Alternative B, TVA would require that the MSR study area be used for conservation and sustainable LID uses. Depending on the Master Plan, the objectives of the future property owner(s), and the extent of development, this could result in some stabilization, preservation, rehabilitation, or restoration (i.e., reuse) of a number of aboveground properties eligible for listing in the NRHP. If it occurs, such restoration would likely result in beneficial effects on historic architectural resources. A conservation approach would potentially result in increased exposure, use, and appreciation of the historic architectural resources within the MSR study area. If, however, development under this alternative results in adverse impacts to eligible historic buildings and structures, TVA will adhere to the stipulations in the final executed MOA to mitigate the adverse impacts.

4.4.2.3 Alternative C

Under Alternative C, TVA would require that the MSR study area be used for commercial, retail, and residential development. Depending on the extent of the proposed development, this could result in an adverse effect on historic buildings and structures eligible for listing in the NRHP. Measures to mitigate adverse effects of such historic properties are included in Section 2.3. Stipulations jointly developed with the Alabama SHPO to address adverse impacts are included in the final executed MOA. The stipulations are summarized in Section 4.4 above. TVA will adhere to these stipulations in the final executed MOA to mitigate adverse effects associated with this alternative.

4.4.2.4 Alternative D

Under Alternative D, TVA would require that the MSR study area be used for industrial development. Depending on the extent of the proposed development, this could result in an adverse effect on the properties eligible for listing in the NRHP. Through implementation of stipulations in the final executed MOA (see Appendix A), TVA would mitigate adverse impacts as described under Alternative C.

4.4.2.5 Alternative E

Under Alternative E, TVA would require that the MSR study area be used for mixed use, a combination of conservation and low-impact development and commercial, retail, residential, and industrial uses. Similar to Alternative B, C, and D, some portion of the existing aboveground historic architectural resources would likely be conserved while other NRHP-eligible resources could be adversely affected. Through implementation of stipulations in the final executed MOA (see Appendix A), TVA would mitigate adverse impacts as described under Alternatives C and D.

4.4.2.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses that could occur.

Similar to Alternative B, C, D, and E, some portion of the existing aboveground historic architectural resources would likely be conserved through adaptive reuse while other NRHP-eligible resources could be adversely affected. Through implementation of stipulations in the final executed MOA (see Appendix A), TVA would mitigate adverse impacts as described under Alternatives B, C, D and E.

4.5 Socioeconomic Resources

Several sites in the Shoals area (Colbert and Lauderdale counties) are currently available for industrial development purposes, most of which include existing buildings with relatively small acreage (see Section 3.5.3). Several large industrial sites are also available in the counties surrounding the MSR study area. In addition, there appears to be ample land and market incentives (Lord, Aeck, and Sargent Architecture 2009) to also attract and accommodate new or expanded commercial, retail, and residential development on smaller areas of vacant or undeveloped property in the Muscle Shoals community and Colbert County area. The potential for attracting new jobs and economic expansion opportunities from outside the region is a key to regional economic development and growth. The MSR study area has some potential advantages and attractions if land use is well planned in a holistic and coordinated manner.

TVA anticipates that socioeconomic effects of this development over the 20-year-plus build-out time frame could ultimately extend to the adjoining multicounty region from Limestone County, Alabama, to Tishomingo County, Mississippi. Based on the analysis below, differing levels of positive indirect and cumulative impacts are likely to occur under each of the Action Alternatives. Significant indirect and cumulative effects likely could occur under Alternatives D, E, and F.

4.5.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Existing private sites, vacant lots, and buildings on private land surrounding the MSR study area could continue to be available for development purposes (see Section 3.5). There would be no foreseeable changes in development capabilities and opportunities in the area. Therefore, if Alternative A were selected, there would be essentially no change in the current local socioeconomic conditions due to TVA actions associated with this proposal. However, under Alternative A, any beneficial economic effects that could be achieved by adopting an Action Alternative would not be recognized.

4.5.2 Alternative B

Under Alternative B, TVA would require the new owner(s) of the MSR study area to use the property for conservation and sustainable LID uses. Potential development following the selection of this alternative would have little or no effect on current economic development opportunities, including the quantity or mix of land and existing buildings available on the MSR study area or in the county and surrounding area for business and economic development purposes. However, such development would likely improve the overall quality of life in the area and increase the region's attractiveness as a place to live and to locate businesses. It could also aid in increasing visitation to the area, resulting in some increase in local income and employment. Other than the increase in quality of life, social and economic impacts would likely be relatively minor.

4.5.3 Alternative C

Potential commercial, retail, and residential development under Alternative C would result in the location of new residences and businesses on the site. Some households and businesses might be drawn to the site in lieu of locations outside the Shoals area. However, most of the development would likely be a transfer of locations within the area and would add little to the overall economy of the area. Such development would need to be well planned and attractive; otherwise, it could decrease the overall appeal of the area. It could also have noticeable impacts on quality of life in the area due to the loss of scenic and recreation opportunities in the area. Overall, the potential economic effects under Alternative C would likely be minor, but positive.

4.5.4 Alternative D

Under Alternative D, the MSR study area would be required to be used for industrial purposes. Implementation of Alternative D could have a significant positive effect on income and employment in the area if much of it were used for industrial purposes. Because investors from outside the area or region could be attracted to the site and the immediate area, implementing this alternative would likely have the greatest overall economic effects and result in additional opportunities for growth. Increases in employment and income under Alternative D are likely to be moderate to large.

However, under Alternative D, there could be some decrease in the overall aesthetics of the area, with a corresponding negative impact on the quality of life due to increased traffic, noise, and congestion and the loss of scenic and recreation opportunities in the area.

4.5.5 Alternative E

Well-planned and well-executed development of the property for the required mixed use under Alternative E could result in significant increases in employment and income in the region, along with enhanced quality of life for residents, while resulting in additional opportunities for sustainable growth. Amenities such as walking trails, natural scenery, river views, and abundant trees would continue to be major contributors to quality of life and to enjoyment of the area. Well-designed business and industrial facilities would provide increased income and job opportunities while maintaining and possibly enhancing the overall attractiveness of the area. Increases in employment and income under Alternative E are likely to be moderate.

4.5.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses that could occur.

Well-planned and well-executed development of the property for unrestricted land use under Alternative F could result in significant increases in employment and income in the region. Consistent with the Master Plan, this could occur while maintaining or possibly enhancing other quality of life attributes, similar to that described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E. Increases in employment and income under Alternative F are also likely to be moderate.

Summary

Greater positive economic impacts to the local area are likely under the Action Alternatives as compared to Alternative A. Actions subsequent to the adoption of Alternative D would likely have the greatest beneficial economic impact, although impacts anticipated under Alternative E or F could be similar and/or possibly greater than those under Alternative D. Implementation of Alternative B would have some positive economic impact due to increased overall attractiveness of the area as a place to visit and do business. Anticipated development under Alternative C would have the smallest positive economic impact because it would most likely attract or relocate development that would have located elsewhere in the local area if the MSR study area were not available.

Development anticipated under Alternative C would have the smallest positive effect on the quality of life as a result of the anticipated attraction or relocation to the MSR of development that would have otherwise located elsewhere in the local area and could have an overall negative impact due to losses in amenities such as recreation opportunities, open space, and scenic quality. Potential effects of adopting Alternative D on quality of life likely would be mixed, with decreases in the overall attractiveness of the area in combination with potential increases in the standard of living for some residents. Negative impacts could be lessened if developments were planned and designed to minimize losses in scenic values and recreational opportunities in accordance with the anticipated Master Plan. Under Alternative A, the No Action Alternative, the current situation would continue, and therefore, there would be no directly attributable effect on quality of life. Development and land use under Alternative B would have little negative impact on quality of life and could result in an overall increase in quality of life for area residents while providing some new economic opportunities. Development of the MSR study area under Alternative E or F could result in the largest increases in quality of life in the area, both by enhancing the attractiveness of the MSR study area and by providing new employment opportunities in an attractive setting.

Potential Future Taxation

Based on TVA's current contribution to the local tax base, the impact on in-lieu-of-tax payments to the State of Alabama from the sale or transfer of the proposed approximate 1,400-acre portion of the MSR would be small (see Section 3.5). If the MSR study area land were transferred from federal ownership to private landowners, the new owners would likely pay property taxes to local governments. How and to what extent the property is ultimately developed is uncertain at this time and would be guided by the Master Plan. However, compared to the property's present contribution to the local tax base, TVA anticipates that its future contribution to the local tax base could be larger.

4.6 Environmental Justice

EO 12898 (Environmental Justice) provides that fair treatment and meaningful involvement be afforded all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. A primary goal of environmental justice is for certain federal agencies to make its achievement a part of its mission "to the greatest extent practicable and permitted by law" by identifying and addressing disproportionately high and adverse human health or environmental effects of its activities. The following analyses address the potential environmental justice effects of possible alternative types of development.

Based on the analysis below, similar to the overall anticipated socioeconomic effects, positive indirect and cumulative environmental justice impacts could likely occur under the Action Alternatives. Significant indirect and cumulative effects on minority and low-income populations could occur under Alternatives D, E, and F. Inclusion of all segments of the population in the planning (i.e., Master Plan) and MSR study area development process could help assure equitable distribution of the benefits.

4.6.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Because there would be no foreseeable change in current uses and access to the property, there would be no effects with respect to environmental justice.

4.6.2 Alternative B

Under Alternative B, the MSR study area would be used for conservation of natural resources and for sustainable LID. Selection of this alternative is likely to increase the overall quality of life in the area and improve its attractiveness as a place to visit, to live, and to locate businesses (see Section 3.5). Minority and low-income populations would receive some of the benefits of these amenities. While potential increases in employment and income resulting from development of the MSR study area under Alternative B are expected to be small, the extent to which disadvantaged populations would benefit could be enhanced by their active involvement in the planning and decision-making processes.

Implementation of Alternative B would provide enhanced recreation opportunities and scenic quality, which would be available to minority and low-income persons. However, while this would provide some new jobs, the number would be relatively small. The number of new jobs resulting from Alternative B would likely be fewer than under the other action alternatives. While this would likely result in fewer job opportunities for minority and low income workers, they would likely not be disproportionately impacted.

4.6.3 Alternative C

Implementation of Alternative C would likely result in the required land uses, location of new residences and businesses on the site. However, as discussed in Section 4.5, the total economic impact would be small over the long term under Alternative C.

Minority populations likely would share in the benefits of development, but the net effect would be minor. Most residential development likely would be in the middle price ranges, providing no direct housing benefit to low-income populations. Low-income populations might benefit directly or indirectly from any increase in construction and other employment. However, any such benefits would be minor.

Few new employment opportunities, including those for minority or low-income individuals, would result. Scenic and recreation opportunities in the area would be disproportionately lessened for these groups, especially low-income families and individuals who are likely to have less access to alternative forms of recreation. In addition, development likely under this alternative would provide few job opportunities that would not otherwise be available in the surrounding area.

4.6.4 Alternative D

Under Alternative D, the MSR study area would be used for industrial development. If much of the property were used for industrial purposes, it could have a significant positive effect on income and employment in the area (see Sections 3.5 and 4.5.4). Minority and low-income workers would also likely benefit. Benefits to these groups would depend, in part, on the type of jobs created by the industries. Access to needed training for all potential workers could greatly assist in assuring equal access and opportunities. Such training might need to involve basic skills as well as job-specific training.

Use of all the property for industrial purposes could have negative impacts on the quality of life in the area by reducing the attractiveness of recreational use of the property. These impacts would tend to be greater for low-income populations because they are less likely to have access to alternatives forms of recreation. However, adverse impacts to recreation are expected to be low to moderate (see Section 4.16.4).

Development actions likely under Alternative D have the potential to provide a relatively large number of jobs across a wide range of skill and education levels, which would benefit all segments of the local population, including minority and low-income populations. On the other hand, some recreation opportunities and scenic value are likely to be lost. Overall, disproportionate impacts to minority and low-income individuals would be less than those for Alternatives B and C, but greater than those under Alternative E or F.

4.6.5 Alternative E

Under Alternative E, well-planned and well-executed development of the property for the required mixed use could result in significant increases in employment and income in the region, along with enhanced quality of life for residents (see Section 3.5 and Section 4.5.5). Amenities such as walking trails, natural scenery, and abundant trees could continue to be major contributors to the quality of life and to enjoyment of the area. At the same time, well-designed business and industrial facilities would provide increased income and job opportunities while maintaining and possibly enhancing the overall attractiveness of the area.

All segments of the population would likely benefit from such development. Whether minority and low-income populations would benefit proportionately would depend on the type of development and uses that occur.

Minority populations likely would share in the benefits of development, but the net effect would be small. Most residential development likely would be in the middle price ranges, providing no direct housing benefit to low-income populations. Low-income populations might benefit directly or indirectly from any increase in construction and other employment. However, any such benefits would be small.

The development activities following adoption of Alternative E would provide a similar increase in employment opportunities for minority and low-income individuals as described under Alternatives C and D. Scenic values and recreation opportunities would continue to contribute to quality of life in the area. Therefore, disproportionate impacts to minority and low-income populations would be smallest under this alternative.

4.6.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses that could occur.

Well-planned and well-executed development of the property for unrestricted land use under Alternative F could result in significant increases in employment and income in the region. As under Alternative E, minority populations likely would share in the benefits of development, but the net effect would be small. Benefits to low-income populations would similarly be small. The disproportionate impacts to minority and low-income populations would similarly be small under this alternative.

4.7 Land Use

Land use and zoning laws are made up of a set of regulations and policies that implement community goals and protect community resources while attempting to guide new development. Zoning regulations affect all new construction, most alterations, commercial occupancy changes, property line changes, and most site development activity including some tree cutting and landscaping. These regulations are enforced by various federal, state, and local laws. Land use dictates where people live, work, and recreate. Among other factors, land use affects the availability of goods and services, travel patterns, aesthetic quality, perceived levels of congestion, and how people interact with one another. Changes and conflicts in land use can occur when development is replaced or new development is built that is incompatible with current development or inconsistent with current local land use planning, zoning, or other applicable laws or ordinances. How the mix of land uses could change on the MSR study area, dictated by the demands and available supply of goods and services, is considered in the alternatives evaluated and would be taken into account in the Master Plan (also see Section 4.5).

Future land use changes generally affect the potential extent of green space loss, extent of build-out, location, and juxtaposition of new development on the landscape, likely reuse of existing buildings, acceptable noise levels, needed visual buffers, availability of recreation facilities, and other desirable environmental characteristics of the community. As indicated in Section 3.7, the adjoining communities of Sheffield and Muscle Shoals have zoning ordinances. As mentioned in Section 3.12, the local cities and counties in the Shoals area participate in the National Flood Insurance Program and, thus, regulate development of floodprone areas. Local government development and peoples' participation in the master planning process would ultimately determine the types and mix of land uses and their potential locations across the MSR study area.

4.7.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. No foreseeable changes to existing land use are likely on the MSR study area under Alternative A. Thus, any direct, indirect, and cumulative impacts from land use changes, if any, under Alternative A would be negligible. If proposals that would necessitate land use changes were proposed in the future, such requests would be subject to appropriate environmental reviews prior to any decision.

4.7.2 Alternative B

Adoption of Alternative B would require that the land be used for conservation and sustainable LID. Given that more than one-half of the current land cover of the MSR study area includes forest, scrub-shrub vegetation, or grassland, the property readily lends itself to conservation uses such as parks, hiking trails, wildlife viewing areas, and wildlife habitat management areas. Some low-impact development, including commercial uses such as education or research that can be more easily and compatibly integrated into the existing environs, would likely have minimal environmental impacts to land use. These anticipated effects could be further minimized if existing buildings and infrastructure are reused.

Green spaces, combined with some development such as that described above and in Section 2.1.2, could be allocated through the Master Plan process. Such use would be compatible with local laws and ordinances, while maintaining or potentially enhancing the current level and variety of outdoor experiences. Based upon past estimates of recreational use in the area (Section 3.16), there is probably sufficient demand for more opportunities for outdoor enthusiasts, including birders, fishers, and walkers. Based upon the presence of surrounding urbanizing areas, such use would tend to enhance the quality of life of area residents and maintain forests, wetlands, wildlife, and other valued resources.

4.7.3 Alternative C

Adoption of Alternative C would require that the land be used for commercial, retail, and residential uses. This type of development can cause a loss of pervious surfaces, which could contribute to additional surface water runoff and increase the risk of flooding. Standard engineering and construction BMPs to reduce runoff and allow groundwater recharge could include vegetation buffers and the addition of infiltration basins. Any potential for increased flood risks would also be evaluated by local regulators. Locations for certain types, styles, and prices of residential homes and supporting goods and services providers could be addressed in the Master Plan. As mentioned in Section 3.5, commercial, retail, and residential markets in the area would likely provide opportunities for growth.

Although commercial, retail, and residential development of the site along with supporting infrastructure development and needed landscaping would fairly dramatically alter the character of a large part of the area compared to its present use, these future uses would be compatible with surrounding local land use laws and regulations for Sheffield and Muscle Shoals. These types of development would not be incompatible with any known local, regional, or state plans or planning efforts presently underway.

With compliance to applicable state regulations regarding erosion control, storm water management, and BMPs, the potential impacts of implementing Alternative C on land use would likely be minimal. Given the current and projected level (Section 3.5) of similar development in the area and the surrounding Shoals community, indirect and cumulative effects would also likely be minimal. Implementation of Alternative C could likely have greater impacts on land use than Alternatives A and B and less than those expected under Alternative D. However, potentially similar impacts are expected if Alternative E or F is implemented. Both Alternatives E and F could likely involve some conservation but also some industrial development.

4.7.4 Alternative D

Adoption of Alternative D would require that the land in the MSR study area be used for industrial use, which would tend to increase the amount of impervious surfaces common in industrial areas. This could increase the need for storm water control measures to mitigate runoff and reduce the risk of localized flooding. As stated under Alternative C, implementation of standard engineering and construction BMPs could mitigate potential flood risks.

The MSR study area provides a large site (approximately 1,400 acres) and some existing infrastructure that could be used to support industrial development compared to presently known sites in the area and northwest Alabama region (Section 3.5). Other environmental factors (e.g., air quality attainment area, flat topography, nearby water-based transportation) generally make this land potentially attractive for this type of land use. However, depending on the type and extent of industrial development, greater or lesser levels of emissions and indirect or cumulative effects could be anticipated. Given the mix of similar but dispersed industries in the surrounding and adjoining area (e.g., Occidental Chemical Corporation, Monarch Tile Inc.), as well as the past industrial use of a sizeable portion of the area, future industrial use would not be an incompatible use. Evaluation of the project's compatibility, however, would be subject to state and local laws and regulations. Future land uses associated with Alternative D would not be incompatible with any presently known local, regional, or state agency plans. Similar to Alternative C, the locations and extent of certain types of industrial developments could be addressed in the Master Plan.

Because of the greater intensity of land use associated with industrial development, the potential effects of development under Alternative D on current land use could change the aesthetic character of the MSR site. Furthermore, such use, if developed extensively, could increase the potential for greater effects on wetlands, floodplains, water quality, forest (plants), and wildlife. However, given the context of surrounding land use, such change in land use would probably still be minor and similar to those expected under Alternative C. Overall, implementation of Alternative D could likely have greater impacts on land use than any of the other Action Alternatives.

4.7.5 Alternative E

Adoption of Alternative E would require that the land be used for a mixture of conservation, commercial, retail, residential, and industrial uses. The inclusion of conservation uses in a mixed use development could reduce the overall potential for adverse effects from urban runoff created by land use change. The risks of potential flooding could be similar or somewhat less than that expected under Alternative C or D. A mixed use development would likely be compatible with applicable state and local laws and regulations and would not conflict with any presently known local, regional, or state plans, programs, or activities.

The amount of change in land use on the MSR study area would depend on the extent and variety of future development on the site as influenced by the Master Plan. Because of the diversity of possible development options or types under Alternative E, implementation of this alternative would likely result in more and a greater intensity of changes in local land use than that expected under Alternative A or B. Changes in land use could be comparable to, or perhaps less, than those anticipated under Alternative C or D and likely similar to Alternative F.

4.7.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses that could occur. See Sections 2.1.6 and 4.2.6 for discussion of the rationale regarding the relationship between the alternatives and analysis undertaken.

Adoption of Alternative F would allow for unrestricted land uses consistent with the Master Plan. Similar to Alternative E, because of the diversity of possible development options or land use types under Alternative F, implementation of this alternative would likely result in more and a potentially greater intensity of changes in local land use than that expected under Alternative A or B. Changes in land use could be comparable to, or perhaps less than, those anticipated under Alternative C or D and would likely be similar to Alternative E.

4.8 Air Quality, Greenhouse Gas Emissions, and Global Climate Change

4.8.1 Air Quality

Implementation of Alternative B, C, D, E, or F would all have associated transient air pollutant emissions during the construction phase. Impacts from construction activities would be somewhat unique to each alternative. Construction-related air quality impacts are primarily related to land clearing, site preparation, and the operation of internal combustion engines.

Land clearing, site preparation, and vehicular traffic over unpaved roads and the construction site result in the emission of fugitive dust particulate matter (PM) during the site preparation and active construction periods. The largest fraction (greater than 95 percent by weight) of fugitive dust emissions would be deposited within the construction site boundaries. The remaining fraction of the dust would be subject to transport beyond the property boundary. If necessary, emissions from open construction areas and unpaved roads could be mitigated by spraying water on the roadways as needed to reduce fugitive dust emissions by as much as 95 percent (Buonicore and Davis 1992).

Combustion of gasoline and diesel fuels by internal combustion engines (vehicles, generators, construction equipment, etc.) would generate local emissions of PM, nitrogen oxides, CO, VOCs, and SO_2 during the site preparation and construction periods. The total amount of these emissions would generally be small and would result in minimal off-site impacts under all Action Alternatives.

Air quality impacts from construction activities would be temporary and would depend on both man-made factors (e.g., intensity of activity, control measures, etc.) and natural factors (e.g., wind speed, wind direction, soil moisture, etc.). However, even under unusually adverse conditions, these emissions would have, at most, a minor, transient impact on off-site air quality and would be well below the applicable ambient air quality standard. As indicated in Section 3.8, Colbert County is currently in attainment for all criteria pollutants.

Emissions from operational activities, especially industrial emissions, would be subject to regulatory requirements. TVA anticipates that future developers would acquire all necessary state and federal permits and those future on-site operations would comply with applicable air quality laws and regulations. Overall, the air quality impacts of construction-related activities under Alternative B would have the least effect on air quality compared to Alternatives C, D, E, and F.

4.8.1.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Because no foreseeable changes to existing land use would occur on the MSR study area, no additional impacts on air quality in the area are anticipated as a result of the adoption of the No Action Alternative.

4.8.1.2 Alternative B

Adoption of this alternative would require that the MSR study area be used for conservation of natural resources and sustainable LID as described in Section 2.1.2. Thus, no major sources of air pollution are likely under this alternative. Indirect and cumulative impacts on local or regional air quality during construction under this alternative would likely be minor and controlled as described above. Cumulative air quality impacts beyond the construction phase would be insignificant. Impacts of implementation of Alternative B are expected to be similar to or slightly greater than those likely under the No Action Alternative but less than those potentially associated with Alternatives C, D, E, and F.

4.8.1.3 Alternative C

Adoption of this alternative would require that the MSR study area be used for a combination of commercial, retail, and residential development purposes. Indirect and cumulative impacts on air quality during construction under this alternative are likely to have a greater impact than those anticipated under Alternative A or B.

Implementation of Alternative C would facilitate construction of commercial, retail, and residential development, which would generate additional vehicular travel. Gasoline and diesel emissions, from personal vehicles and construction vehicles and equipment, related to this alternative would be controlled to meet current applicable regulatory requirements such as those found in USEPA 40 CFR Part 80 (USEPA 2007), which provides regulations concerning fuel and fuel additives. Due to fuel regulations and the intermittent nature of the vehicle emissions, the resulting air quality impacts would be minor.

Through its permitting and authorizations processes, the ADEM Division of Air Pollution Control Program prescribes regulations to protect and enhance the public health and welfare through the development and implementation of coordinated statewide programs for the prevention, abatement, and control of air pollution. Air emissions identified from proposed commercial or retail development associated with this alternative would be reviewed to determine if they could be mitigated by control technology, emission-reduction strategies, or avoidance. For any air quality impacts that cannot be mitigated, a full air quality analysis would be required. The nature and scope of that analysis would be defined by a protocol document. The emissions from sources associated with this alternative would be controlled to meet current applicable regulatory requirements. Thus, resulting impacts would likely be minor; however, they would likely be less than those expected under Alternative D and similar to Alternatives E and F.

4.8.1.4 Alternative D

Adoption of this alternative would require that the MSR study area be used for industrial development purposes. Indirect and cumulative impacts on air quality during construction could be greater than Alternative A, B, C, E, or F. Under Alternative D, air quality impacts during construction would be temporary and would not result in significant long-term air quality impacts.

Implementation of Alternative D would facilitate construction of industrial development, which would generate additional vehicular travel. Gasoline and diesel emissions, from personal vehicles and construction vehicles and equipment, would be controlled to meet current applicable regulatory requirements such as those found in USEPA 40 CFR Part 80 (USEPA 2007), which provides regulations concerning fuel and fuel additives. Due to fuel regulations and the intermittent nature of the vehicle emissions, the resulting air quality impacts would be minor.

ADEM regulations would be imposed through its permitting processes to protect and enhance the public health and welfare by controlling potentially hazardous air pollution. Air emissions identified from proposed industrial development associated with this alternative would be reviewed by the state to determine if they could be mitigated by control technology, emission-reduction strategies, or avoidance. Such development could be expected to meet applicable emissions standards, and thus, if compliant, environmental effects would likely be reduced.

4.8.1.5 Alternative E

Adoption of Alternative E would require that land in the MSR study area be used for a mixture of conservation, commercial, retail, residential, and industrial uses. As described under Alternatives B, C, and D, there would be some impacts to air quality during the site preparation and construction phases under any of these alternatives. Consistent with state air pollution control regulatory and enforcement authority, impacts would be mitigated to acceptable legal limits as described above. Potential impacts to air quality from proposed conservation, commercial, retail, residential, and industrial development under Alternative E could be greater than those anticipated under Alternative A or B and potentially would be similar to those under Alternative C, D, or F.

4.8.1.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses that could occur.

As described under Alternatives B, C, D, and E above, there would be some impacts to air quality during the site preparation and construction phases under any of these alternatives.

Guided by implementation of the Master Plan and consistent with state air pollution control regulatory and enforcement authority, impacts would be mitigated to acceptable legal limits as described above. Thus, impacts to air quality from the anticipated mix of land uses under Alternative F could be greater than those anticipated under Alternative A or B and would more likely be similar to those under Alternative C, D, or E.

4.8.2 Greenhouse Gas Emissions and Global Climate Change

As discussed previously in Section 3.8.2, worldwide man-made annual CO_2 emissions are estimated at 30 billion tons, with the U.S. responsible for 20 percent. U.S. electric utilities, in turn, emit 2.2 billion tons, roughly 40 percent of the U.S. total. Figure 4-2 shows how TVA's approximately 73 million tons of annual CO_2 emissions from its 2009 energy production ranks in terms of worldwide, national, and industry emissions and how the wide range of potential alternatives, from minor sources of less than 25,000 tons to a large industrial source, compare to TVA's emissions.

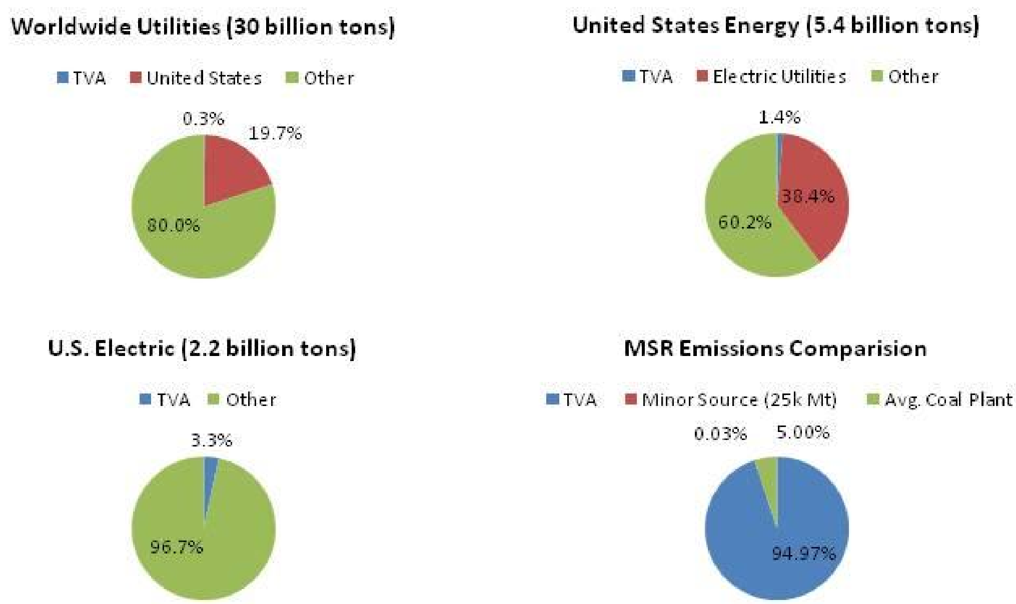


Figure 4-2. 2009 Carbon Dioxide Emission Percentages and Muscle Shoals Reservation Estimates

Amounts of GHG emissions can be estimated, but linkages to specific effects on climate change in particular geographical areas are typically speculative. There are primarily two ways in which proposals, actions, or decisions affecting land use can interact with GHGs and GCC. The first is the potential contribution to emission of GHGs, predominantly varying with the type and amount of land use change; number and size of buildings and infrastructure constructed; the energy demand associated with use of those buildings; the impact of the redevelopment on traffic patterns around and through the property; changes in barge, rail, and truck traffic potentially influenced by activities on the property; and changes to the vegetation cover. Additional energy demand and traffic would increase CO_2 emissions. Removal of vegetation cover for buildings, parking lots, roads, and other open areas would reduce the CO_2 sink offered by any lost vegetation and would contribute an imperceptible amount globally to higher CO_2 levels in the atmosphere. On the other hand, any redevelopment such as for a park or other recreation uses could result in greater vegetation cover and an increased sink for (removal of) CO_2. Construction and operation of large industrial facilities would be subject to forthcoming GHG emission control requirements. The potential for recruiting a large heavy industry with high GHG emissions, such as a major new fossil power generation facility, and resultant land use changes on the MSR study area is remote. Global atmospheric levels of GHGs would not be changed by any detectable amount by implementation of any of the alternatives. Any new GHG emissions would, however, contribute to the cumulative total amounts of GHGs.

Depending on the nature of the proposed land use, climate change can impact specific proposals or activities that could be considered in the future under each alternative. Vulnerability is defined by the IPCC as "the propensity of human and ecological systems to suffer harm and their ability to respond to stresses imposed as a result of climate change effects" (Adger et al. 2007). For instance, higher air and water temperatures resulting from climate change can influence processes for maintaining compliance with environmental and safety standards at various industrial plants, as well as the efficiency of plant operations. Changes in the temporal distribution of precipitation across the region may require changes in water resource practices that could impact all of the alternatives. Adjustments made due to rising temperatures and water supply changes are examples of adaptation or reducing vulnerability to climate change effects. The potential for recruiting a large heavy industry with high GHG emissions, such as a major new fossil power generation facility, and resultant land use changes on the MSR study area is remote.

Implementation of any of the Action Alternatives would cause some emissions of GHGs associated with transient air pollutant emissions during the construction phase, and potential long-term emissions and changes in land surface characteristics unique to each alternative. The amounts of GHG emissions released would depend on the type and magnitude of redevelopment undertaken (Table 4-2). The range in impacts is potentially broad, with a benefit in reducing or actually possibly offsetting GHGs associated with Alternative B, to the greatest emission of GHGs associated with Alternative D. Without complete information regarding the specific type and amount of redevelopment that would occur on the MSR study area, it is highly speculative to estimate more than the potential for GHG emissions associated with each alternative and, even more so, to predict climate changes. However, TVA has evaluated reasonably foreseeable impacts related to each alternative. Depending on the type and location of future proposals for redevelopment, additional site-specific environmental review may be necessary (e.g., project requiring approval from TVA under Section 26a), and all projects would be subject to applicable federal and state regulations and permitting requirements.

Table 4-2. Emission Factor Estimates

Use	Emissions
Electricity use	7.18×10^{-4} metric tons CO_2 / kilowatt-hour
Passenger vehicles	5.23 metric tons CO_2 equivalent / vehicle / year
Home energy use	11.75 metric tons CO_2 / home / year
Coal-fired power plant emissions	3,850,479 metric tons CO_2 / power plant / year

Source: http://blog.sprlaw.com/2010/03/ceq-proposes-nepa-guidance-on-climate-change/

Emissions related to construction activities including land clearing, site preparation, demolition of certain structures, and adaptation of others and combustion of gasoline and diesel fuels by internal combustion engines would likely be less under Alternative B and similar under Alternatives C, D, E, and F. The total amount of these emissions would be relatively minor with no discernable link or effect to particular changes in global climate.

Effects on Local Climatology

In addition, climate change and GHG-related effects could be exacerbated by changes in local climate driven by other mechanisms. One potentially perceptible impact of MSR redevelopment on local climate could come directly from changes in the land surface. The impacts of land surface characteristics on local climate are well documented. The term "local" refers to areas within about half a mile of the Reservation. Increases in buildings and pavement contribute to warming of the surface due to greater absorption of solar radiation during the day, longer retention of the absorbed heat during the night, and the increase in waste heat released near the ground from building energy use (especially by heating systems, air conditioning systems, and electric lighting). Other energy use by industrial equipment also generates waste heat. These various factors contribute to the "urban heat island" effect that causes large urban centers to be consistently warmer than their rural outskirts. Therefore, any redevelopment that increases the near-surface energy balance will lead to a local warming effect and higher air temperatures by roughly 1-3ºF (0.5-1.5ºC) depending on weather and time of day. These increases can require greater demand for air conditioning during the warmer months of the year but lower heating requirements during winter.

The opposite effect is possible if Reservation redevelopment were to lead to greater vegetation cover, especially forest cover. Forests are naturally cooler than their surroundings during the day in summer because of the influence of moisture evaporation from trees. This phenomenon occurs to a lesser extent for surfaces covered by lower vegetation (i.e., grasses and shrubs). Increased vegetation cover is being considered by major cities in an effort to reduce cooling demand during the summer (to reduce power usage, GHG emissions, and air pollution formation). Thus, if vegetation cover were to increase from redevelopment, then it could have a small beneficial effect on both the local climate (providing a cooling effect in summer) and could be a new source of CO_2 removal.

4.8.2.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Because no foreseeable changes to existing land use would occur on the MSR study area, no incremental impacts on emission of GHGs or the potential use for climate change are anticipated as a result of the implementation of the No Action Alternative. If other land sale, transfer, or disposal actions were to be considered by TVA, additional appropriate environmental reviews would be required at that time. Climate change predictions are speculative in nature. However, scenarios considered in the EPRI study prepared for TVA (EPRI and TVA 2009) reflect the current state of knowledge and would be unlikely to result in changes to TVA management of current activities on the Reservation. See discussion in Section 3.8.2.

4.8.2.2 Alternative B

Adoption of this alternative would require that the MSR study area be used for conservation of natural resources and sustainable LID as described in Section 2.1.2. Temporary contributions of GHGs during construction of this alternative would likely be minor as described above.

Beyond the construction phase, implementing this alternative would have a negligible beneficial effect on the amount of GHGs and any contribution to cumulative global climate impacts. Conversion to conservation and LID uses could lead to a minor decrease in levels of GHG emissions by way of CO_2 storage through on-site forest restoration or regrowth at sites that are currently treeless. Global atmospheric levels of GHGs would not be changed by any detectable amount. The USEPA estimates that a medium-growth coniferous tree, planted in an urban setting, will sequester approximately 23.2 pounds of carbon over 10 years, or 0.039 metric ton of CO_2 per tree (USEPA 2009b).

4.8.2.3 Alternative C

Adoption of this alternative would require that the MSR study area be used for a combination of commercial, retail, and residential development purposes. Implementation of Alternative C would facilitate construction of commercial, retail, and residential development, which during their operational lifetime would generate additional power demand and vehicular traffic, resulting in increased CO_2 emissions. Removal of vegetation cover for buildings, parking lots, roads, and other open areas would also reduce the CO_2 sink currently afforded by the lost vegetation and would contribute an imperceptible amount globally to higher CO_2 levels in the atmosphere. With proper planning that includes retention of forests and other green space, clustered high-density housing, and nearby retail and commercial developments readily accessible to residents, the mixed use development under Alternative C could result in reduced GHG emissions compared to other developments in the surrounding area.

The proposed level of 25,000 metric tons or more CO_2 equivalent per year is a key indicator as to whether projected impacts will require further analysis (CEQ 2010). Actions under this alternative are unlikely to produce emissions greater than this guidance level.

The implementation of this alternative would likely result in generation of more GHGs than Alternative A or B, similar to Alternative E or F, and less than those generated by Alternative D. In the context of regional, national, or global emissions of GHGs, the contribution of Alternative C would still be considered minor, and a relationship to a particular impact to climate in any particular area would be speculative and unidentifiable.

4.8.2.4 Alternative D

Adoption of this alternative would require that the MSR study area be used for industrial development purposes. Generation of GHGs during construction of this alternative could be greater than the levels anticipated under Alternative A, B, C, E, or F. Alternative F could likely involve some level of conservation but also, compared to Alternative D, some reduced level of industrial development.

Similar to Alternative C, implementation of Alternative D would facilitate construction of industrial development, which during its operational lifetime would generate additional power demand and vehicular traffic, resulting in increased CO_2 emissions. Removal of vegetation cover for buildings, parking lots, roads, and other open areas will reduce the CO_2 sink offered by the lost vegetation and contribute an imperceptible amount globally to higher CO_2 levels in the atmosphere. Depending upon the types of industries developed on the MSR study area, this alternative would likely create the largest potential for generation of GHGs, whether they be in the form of CO_2 (carbon-based fuel combustion) or other gases like chlorofluorocarbons and hydrofluorocarbons, widely used as refrigerants. Industrial use would likely result in the largest increase in mobile-source emissions because residential and retail use would likely redistribute current vehicle traffic, whereas the addition of new jobs could bring additional workforce to the local area. Industrial use could also lead to increased rail and/or barge traffic, which collectively result in increased GHG emissions.

The relative contribution to generation of GHGs associated with Alternative D has a broad range, dependent upon the type of industry that could develop. Obviously, industry such as coal-fired power plants would greatly exceed the proposed guidance level of 25,000 metric tons or more of CO_2 per year, demonstrating the need for further analysis (CEQ 2010). However, the location of a coal-fired power plant on the MSR study area is highly unlikely. Future proposed industrial development would be subject to current federal and state regulations and permitting requirements.

Depending upon the type of industry developed on the MSR study area, industrial development under Alternative D has the greatest potential not only to generate GHGs but also to be impacted by climate change. Higher air and water temperatures or changes in availability of water supply resulting from climate change can influence processes for maintaining compliance with environmental and safety standards at certain industrial plants, affect the efficiency of plant operations, influence the attractiveness of the site for certain industries, or even be a determinant as to whether certain types of industrial development could occur. Thermal effects on rivers are typically considered in association with nuclear and fossil power projects or some large secondary industries.

4.8.2.5 Alternative E

Under Alternative E, the MSR study area would be used for a mixture of conservation, commercial, retail, residential, and industrial uses. As described under Alternatives B, C, and D, there would be some impacts to levels of GHGs generated under any of these alternatives, ranging from small benefits associated with Alternative B, to generation of moderate amounts of GHGs associated with Alternative D, relative to the other alternatives. Cumulative impacts to generation of GHGs from the mix of proposed conservation, commercial, retail, residential, and industrial development under this alternative would be encompassed by and intermediate with regard to those described above for Alternatives B, C, and D.

Because the likelihood for industrial development is somewhat less under both Alternatives E and F than the potentially extensive industrial development possible under Alternative D, the potential effects of adopting Alternative E or F are likely less than those anticipated under Alternative D and likely similar to those expected under Alternative C. However, those effects would likely be greater than expected under Alternative A or B.

4.8.2.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale, and no restrictions would be placed on the types of future land uses that could occur.

As described under Alternatives B, C, D, and E above, there would be some impacts to levels of GHGs generated under any of these alternatives, ranging from small benefits associated with Alternative B, to the potential for generation of moderate amounts of GHGs associated with Alternative D, relative to the other alternatives. Cumulative impacts to generation of GHGs from the mix of proposed conservation, commercial, retail, residential, and industrial development under this alternative are likely to be similar to those under Alternative E and would be bounded by the effects described above for Alternatives B, C, D, and E.

4.9 Soils and Prime Farmland

The main mechanism by which potential effects to soils and prime farmlands can occur is the direct conversion of arable land to other uses that preclude its use for agriculture. Much of the prime farmland within the MSR study area was previously converted to nonfarm use prior to the enactment of the FPPA in 1981. The prime farmland within this study was determined to have a relative value below the threshold for warranting protection under the FPPA (see Figures 3-23 and 3-24). Therefore, conversion of the remainder of the Reservation to nonfarming uses would have minor effects.

The degree of potential impacts on soils and prime farmland depends on the amount, location, and intensity of development under the different Action Alternatives. For the purpose of analysis, the assumption was made that more intensive development would likely take place in areas that are already developed, especially within the ERC complex. Development could involve the construction of new structures or the reuse of existing structures. This assumption is based on the fact that the ERC complex is well suited for development due to the existing infrastructure. Some areas may be converted to other uses, including recreational and open space uses. The relative farming value of the soils in these areas would not necessarily be diminished by this type of conversion because these uses would not preclude their future use for agricultural purposes. Regardless, consultation with NRCS determined that conversion of prime farmland soils would not result in significant effects (see Section 3.9 and relative value of farmland discussion below).

Under the Action Alternatives, the fate of areas currently used for farming (hay production) under an agricultural use license agreement (see Section 3.9), if developed, would depend on the alternative future uses chosen by the developer and/or sanctioned in the Master Plan. Prior to the sale of any land covered by this license, however, such use would likely be terminated by TVA with a 30-day written notice. In accordance with the license, in the event of such cancellation, TVA would determine the value of any losses sustained by the licensee and provide reasonable compensation. This could include prorated refund of any unearned license payment made during the licensing period.

As indicated in Section 3.9, the *Relative Value of Farmland to Be Converted* is 55 points and the *Total Site Assessment* score was 34 points; total points for farmland conversion associated with the potential TVA land disposal and redevelopment is 89 points. This score was relatively low due to the large percentage of urbanized land around the site and the large acreage that had already been converted to industrial use. Because of this low score, the land's value for farming is not high enough to recommend that it not be converted to nonfarm use. Because only small portions of the total area have been farmed in recent years (e.g., 182 acres licensed for hay), the relative farming value of the land also is reduced. Farmland is abundant across Colbert County and the region. Therefore, direct effects on prime farmland under any of the Action Alternatives are considered minor. The indirect and cumulative effects of this conversion would generally be inconsequential.

4.9.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Under this alternative, no foreseeable changes in land use on currently arable land are likely to occur. Thus, there would be very minor (if any) impacts to the soils and farmland on the MSR study area from adoption of the No Action Alternative. Those tracts under agricultural license would likely remain available for use in the future under Alternative A.

4.9.2 Alternative B

Development actions following the adoption of Alternative B would have minimal effects on soils and prime farmland, as conservation of natural resources would be encouraged. Under this alternative, areas that are currently being used to grow hay or being maintained as turf could possibly be converted to other natural or LID areas, thus eliminating or minimizing the removal of nutrients from the soil via harvesting of hay or by other means. Under this alternative, areas currently supporting turf, hay, or forest are unlikely to be developed, as there is ample space for needed structures within the developed areas.

Under this alternative, enhancements could be made to existing natural wetlands, and areas prone to flooding adjacent to these areas could be incorporated into the wetlands. This action could result in these areas being precluded from agricultural uses and converted to nonfarming purposes; however, these poorly drained areas have limited farming value.

4.9.3 Alternative C

Implementation of Alternative C would result in some effect to soil and prime farmland, as there would likely be some development of areas that are currently supporting turf, hay, or forest. Areas where the soils have low capacity would probably be spared, as these areas tend to be less suitable for development. As occurred when the ERC complex was built, the prime farmland areas would most likely be prime sites for development due to their superior drainage and gentler slope relative to sites having nonprime farmland soils.

Potential impacts to soil and farmland under this alternative could be reduced by promoting sustainable development or development that preserves large amounts of green space within the developed areas. A large portion of the soils and prime farmland in the MSR study area is well suited for recreational purposes. Implementation of Alternative C would have a higher potential for the conversion of a greater amount of farmland to nonfarmland uses compared to Alternatives A and B.

4.9.4 Alternative D

Adoption of this alternative would likely present the greatest potential for impacts to soils and prime farmland because the prime farmland and best soils offer the best sites for industrial development. However, potential effects to soil and prime farmland could be reduced by utilizing as much as possible of the ERC complex for development or reuse of existing buildings.

4.9.5 Alternative E

The potential effects of adopting Alternative E with respect to soils and prime farmland are similar to or potentially less than those expected under Alternatives C and D depending upon the nature and extent of development (i.e., at build-out). Conservation is included among the activities for which the land would be made available under Alternative E along with a somewhat smaller amount of industrial development area (compared to Alternative D). However, the degree of potential effects would depend on the amount of green space that is preserved or left undeveloped. Therefore, adoption of this alternative would likely have less impact on soil and prime farmland than Alternative D, similar effect under Alternative C, but a greater effect than Alternative A or B.

4.9.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development without restriction as to the types of future land uses that could occur.

Adoption of Alternative F would likely have less impact on soil and prime farmland than Alternative D, greater effects than Alternative A or B, and effects similar to those expected under Alternatives C and E. Otherwise, the effects of implementing Alternative F would be the same as those bounded by the analysis under Action Alternatives B, C, D, and E.

4.10 Surface Water Quality

As indicated in Section 3.10, surface water resources on the Reservation are limited. Only the Tennessee River, Pond Creek, and an unnamed tributary to the Tennessee River are located on or adjacent to the MSR study area. The river and unnamed tributary stream are located north of Reservation Road and little or no development would occur adjacent to them. Other than Pond Creek, its floodplain, and some adjacent wetland, most of the land subject to development has vegetation and flat topography and would generally not be prone to erosion (see Figure 3-21).

Because Pond Creek is an impaired stream, particular attention would be given by developers to avoid making poor water quality conditions worse. Certain alterations or discharges into Pond Creek would require authorizations from federal, state, or local agencies, including TVA. Pond Creek and associated floodplain and wetland areas could be considered for green space or LID allocation in the development of the Master Plan. This could conserve habitat and valued resources from the potential negative effects of various land use developments. During site clearing and construction, exposed soils are more prone to erosion from rainfall and wind. If not controlled by appropriate construction BMPs, excess runoff can enter nearby surface waters, causing siltation and a degradation of water quality. As mentioned in Section 2.1, elements common to all the Action Alternatives (i.e., Alternatives B, C, D, E, and F) are generally described below:

- Any future development at the MSR study area would be subject to conditions required by state and federal permitting guidelines. Any proposals that would affect Pond Creek, the Tennessee River, or their respective 100-year floodplains in the future would be subject to additional individual environmental review and approval under Section 26a of the TVA Act. Under all the alternatives, proposals reviewed would be approved only with measures so the impacts to wetlands and floodplains (in accordance with EO 11990 and EO 11988, respectively) would be avoided, minimized, or mitigated to insignificant levels (also see Sections 4.3 and 4.12). Mitigation measures, if necessary, would be designed and implemented to avoid making poor water quality in Pond Creek worse.

- Any development on the Tennessee River would be limited to the potential utility corridor in the vicinity of the phosphate slag storage area described in this EIS (see Section 2.1). All development on the river or Pond Creek would be subject to state and federal permits, including the TVA Section 26a review process. Therefore, any future riverfront development would be subject to further environmental review and impacts analysis. Furthermore, TVA would not sell or transfer this land in fee for future development of this corridor but would make it available under specific use agreements, such as easements. Because of environmental and reservoir operations constraints along the left-descending (south bank) shoreline of the Tennessee River in the vicinity of the utility corridor, water use facilities such as a commercial dock or barge terminal, would not be approved.

4.10.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Because no foreseeable changes to existing land use would occur due to TVA actions associated with this proposal, no significant impacts to surface waters or water quality would occur under Alternative A.

4.10.2 Alternative B

Under Alternative B, conservation of natural resources would be required along with some forms of sustainable LID. Buildings, roads, parking lots, and sidewalks prevent rain from percolating through the soil, and this can result in additional runoff of water and the entry of pollutants into storm drains and streams. Increased impervious surface from future low-impact development could result in larger volumes of storm water runoff entering Pond Creek, which could increase bank erosion and potentially impact water quality. However, many of the adverse effects of buildings and pavement could be mitigated by replacing some standard surfaces with alternatives such as pervious concrete (porous pavement) and green roofs or roof gardens. Additional BMPs to reduce runoff and allow groundwater to recharge could include greenways and the addition of infiltration basins.

LID could minimize the need for construction of buildings and additional paved surfaces typically associated with implementation of commercial, retail, residential, and industrial alternatives. As a result, potential indirect and cumulative adverse impacts to surface water quality from vegetation removal, construction-related soil disturbance, and storm water runoff from impervious surfaces would be reduced compared to potential development under the other Action Alternatives. Pervious surfaces retained due to conservation measures and less development would improve water quality by filtering sediments from storm water runoff.

Adoption of Alternative B would likely result in more natural landscape conditions and retention of natural features such as forest and wetlands on the MSR study area. This could also likely have the result of reducing surface water runoff into Pond Creek and the Tennessee River and could improve aquatic conditions in Pond Creek. No significant direct, indirect, or cumulative impacts to surface water quality are expected as a result of implementing this alternative. The potential effects to water quality under Alternative B would be minor and potentially positive and similar or potentially less than those anticipated under Alternative A.

4.10.3 Alternative C

Implementation of Alternative C would likely result in more land disturbance on the MSR study area than the amount expected under Alternative A or B. The level and intensity of impacts to surface water quality would depend on the site-specific development plan. Commercial development could include use of the utility corridor.

Impervious cover in a development can range from approximately 10 percent in low-density subdivisions (fewer than two homes per acre) to more than 70 percent in high-density industrial and commercial areas (Schueler and Holland 2000). Adoption and implementation of this alternative has a greater potential for causing direct, indirect, or cumulative effects on surface water quality in Pond Creek and in the Tennessee River compared to Alternatives A and B. Implementation of appropriate BMPs (Muncy 1999) within disturbed areas would reduce the potential for these effects. As discussed above, all future development on the MSR study area would be subject to state and federal permit conditions that would tend to reduce the potential for adverse effects to surface water and the aquatic communities in Pond Creek. Thus, resulting impacts would likely be minor.

If construction occurs consistent with applicable state and federal authorizations, no significant direct, indirect, or cumulative impacts on surface water quality are expected to result from development of the MSR study area under Alternative C.

4.10.4 Alternative D

Implementation of Alternative D would likely result in more land disturbance on the MSR study area than from implementing any of the other alternatives. Therefore, adoption of this alternative has the greatest potential to affect surface water quality. As stated above, the effect of increased impervious surfaces is also of concern in industrial development areas. The need for larger buildings and the increased demand for roads and parking areas required by a greater reliance on shipping and delivery of goods can greatly increase the need for storm water control measures to mitigate the runoff. Storm water runoff BMPs can be structural or nonstructural and range in complexity from the practice of urban forestry techniques and establishment of grassed swales to the installation of permeable concrete pavement, porous asphalt, and bioretention (rain gardens), as well as overall infrastructure planning.

Industrial development south of Reservation Road could be supported by use of the Tennessee River utility corridor area. Industrial development could also require water withdrawals from or discharges to the Tennessee River, thus potentially requiring authorization from ADEM, TVA, and USACE.

If construction occurs consistent with applicable state and federal authorizations and if BMPs are properly designed and used, no significant direct, indirect, or cumulative impacts on surface water quality are expected to result from development of the MSR study area under Alternative D. Generally, potential effects associated with Alternative D would be similar to or potentially greater than those anticipated under Alternatives C, E, and F.

4.10.5 Alternative E

Site development following the adoption of Alternative E would likely result in more land disturbance on the MSR study area compared to Alternative B. Conservation and LID; commercial, retail, residential, and industrial development would likely be accommodated in smaller areas under Alternative E compared to Alternatives B and D. However, implementation of this alternative, similar to Alternatives C and D, may create additional impervious surfaces from new buildings and parking lots. This could result in additional storm water runoff to Pond Creek and ultimately the Tennessee River.

The inclusion of conservation with commercial, retail, residential, and industrial uses in a mixed use development would introduce a natural source for mitigating some of the effects of urban runoff created by land use change. Protecting natural features such as wetlands and including conservation easements, forested buffers, and parks as part of the development’s conservation use could play an important part in reducing the impacts of impervious surfaces. Innovative site designs like those discussed in Alternatives C and D, combined with the implementation of additional BMPs like open space design, well-connected and designed streets, and storm water planning would alleviate most of the potential runoff problems resulting from mixed use development.

If construction occurs consistent with applicable state and federal authorizations and if BMPs are properly designed and used, no significant direct, indirect, or cumulative impacts to surface water quality are expected to result from development of the MSR study area under Alternative E. Generally, potential effects to surface water associated with Alternative E would likely be similar, but potentially less, compared to those described in Alternatives C and D.

4.10.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses that could occur.

The effects of implementing Alternative F with respect to surface water quality would likely be similar those attributed to Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E. Consideration in the Master Plan development and use of BMPs and other mitigative measures through the regulatory review and permitting process would minimize the potential for adverse water quality effects under Alternative F.

4.11 Wetlands

Activities in wetlands are regulated under Section 404 of the CWA and are addressed in federal EO 11990, Protection of Wetlands. Under Section 404, the USACE established a permit system to regulate activities that result in the discharge of "dredge or fill material" into the "waters of the U.S." This requires that authorization under either a Nationwide General Permit or an Individual Permit be obtained to conduct specific activities in wetlands. The regulatory review process for jurisdictional wetlands involves a standard sequence of avoidance, minimization, and mitigation of wetland impacts. Permit applicants must avoid wetlands wherever practicable, minimize impacts, and mitigate impacts according to USACE district guidelines. Public review of Section 404 permits is a part of the regulatory review. Mitigation planning is in many cases site-specific but in most cases will consist of the purchase of credits in a USACE-approved mitigation bank. Additionally, Section 401 of the CWA requires water quality certification by the state (i.e., Alabama) for projects permitted by the federal government (Strand 1997). EO 11990 and TVA procedures implementing the EO provide that agencies, once a no practicable alternative determination is made, minimize wetland destruction, loss, or degradation and preserve and enhance natural and beneficial wetland values, while carrying out their responsibilities, including the disposal of federal land.

Under all of the Action Alternatives (i.e., Alternatives B through F), in order to assure compliance with EO 11990, TVA would include specific language in the deed, transfer, or other conveyance documents for the property describing the presence of wetlands and requiring that any proposal for future land-based improvements or water use facilities in a wetland area would be subject to TVA review and approval prior to construction. In the course of these future reviews of specific proposals, TVA would evaluate the potential impacts to the wetland(s) resulting from such proposals, including those outside the floodplain, and assure compliance with EO 11990 and its requirement for a "no practicable alternative" determination and minimization of impacts.

Approximately 39 acres of forested wetlands on the MSR study area are located in low-lying areas within the limits of the 100-year floodplain of Pond Creek and one connected unnamed stream drainage. Proposed development here would require additional environmental reviews prior to approval under Section 26a or the deed covenants. Approximately 125 acres of various types of wetlands occur at locations outside or at elevations higher than the 100-year floodplain area (see Table 4-3 and Figure 4-3). Wetlands outside the floodplain would be delineated by the new landowner. Proposed development in these wetlands would require additional environmental reviews prior to approval under the deed covenants.

Table 4-3. Wetlands by Types and Acres Within the Limits of the 100-Year Floodplain on the Muscle Shoals Reservation Study Area

Type	Acres
Wetlands Within 100-Year Flood Zone	
Forested wetlands	38.68
Wetlands Outside 100-Year Flood Zone	
Forested wetlands	113.39
Scrub-shrub wetland	7.10
Emergent herbaceous wetlands	2.03
Man-made wetland	2.74
TOTAL	**125.26**
TOTAL Wetland Acres	**163.94**

If specific development were proposed in advance of a property sale and subsequent environmental reviews were conducted prior to the sale, TVA could require specific conditions and restrictions (see Section 4.11.3 below) in the deed, transfer, or other conveyance document so that improvements or facilities proposed to be constructed on any part of the property would avoid or minimize adverse impacts on wetlands. Potential adverse wetland impacts could also be minimized by mitigation as determined through the CWA permitting process. Wetland locations could be considered in the Master Plan development process. Because of the potential to avoid or mitigate wetlands, the overall effects of adverse alteration could be minimized or reduced to insignificance levels. TVA would work with other federal and appropriate state agencies in the course of reviews for these authorizations.

The primary source of potential direct impacts to wetlands associated with development of the MSR study area is the amount of ground-disturbing activities and vegetation removal within wetlands. The potential for adverse impacts to wetlands and to wetland functions and values increases with the amount of ground disturbance from an activity. Indirect impacts to wetlands can occur from the encroachment of adjacent development. For example, runoff from impervious surfaces and lawns can affect wetland hydrology, including recharge. Contaminants from nearby industrial, commercial, retail, or residential sources can also impact wetlands.

4.11.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Current operations on the MSR study area are not adversely affecting the existing wetlands, and no foreseeable future actions that would adversely affect wetlands are anticipated. Although changes in existing wetlands or in the functions of those wetlands are possible, the chances of such events are remote, and such changes are very unlikely to be the result of TVA actions on the MSR. Thus, no impacts to the wetlands present on the MSR study area are anticipated as a result of adoption of the No Action Alternative.

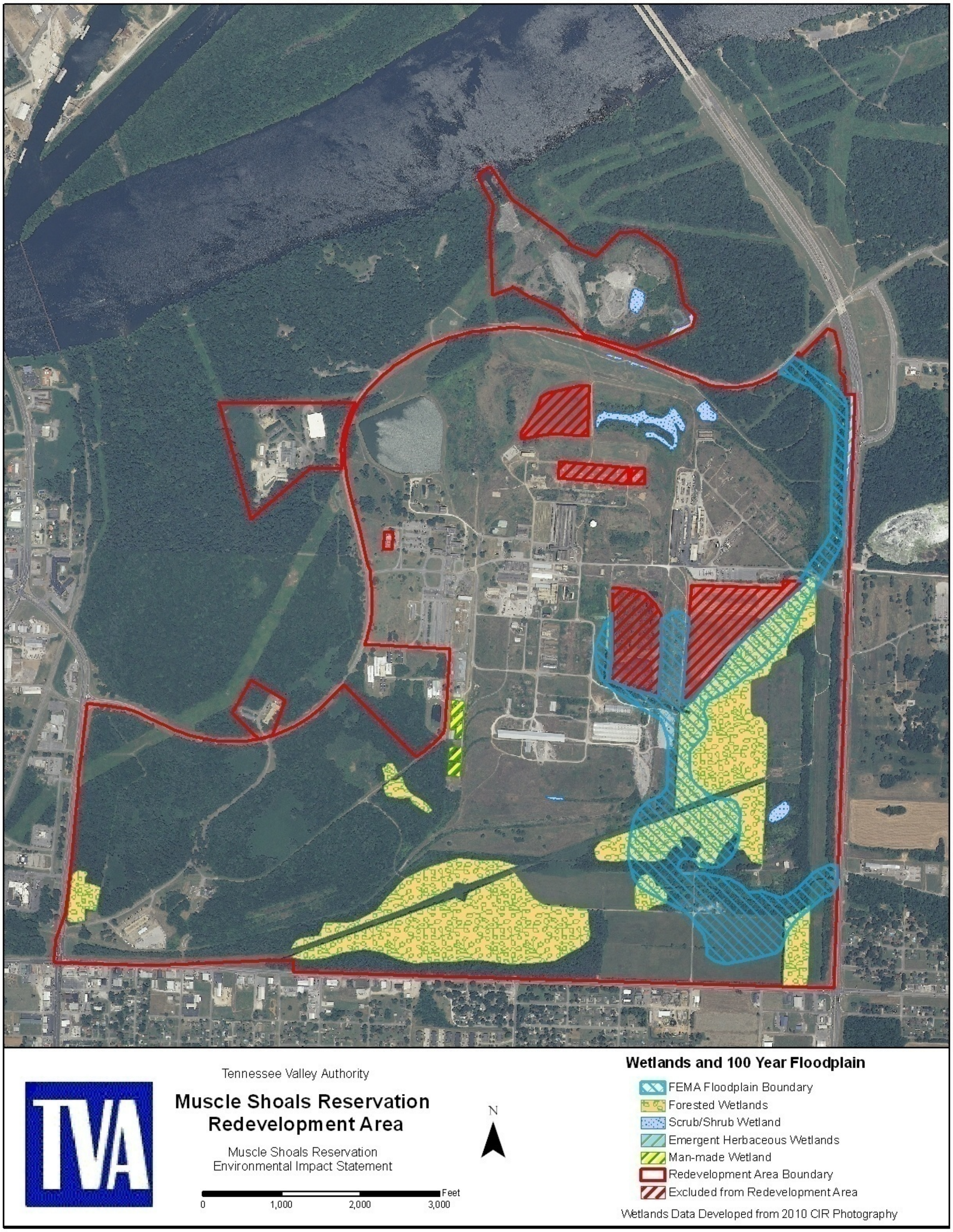


Figure 4-3. Wetlands Inside and Outside the Limits of the 100-Year Floodplain

4.11.2 Alternative B

Adoption of Alternative B would require that the MSR study area be used for conservation of natural resources and sustainable LID as described in Section 2.1.2. Development on the site would be generally compatible with existing sensitive natural resources including wetlands. In support of conservation of natural resources, wetlands present on the MSR study area could be protected or even enhanced under this alternative by limiting potential for development in these areas. Similarly, Pond Creek and associated floodplain and wetland areas could be considered for green space or LID allocation in the development of the Master Plan.

While no site-specific sustainable development plans are available at this time, adoption of Alternative B would likely have impacts similar to those expected under Alternative A and the least amount of potential impacts to wetlands compared to the other Action Alternatives.

4.11.3 Alternative C

Adoption of Alternative C would require that the MSR study area be used for a combination of commercial, retail, and residential uses. Through a requirement in the conveyance document for future reviews of any proposed construction in wetlands, impacts to wetlands would be minimized or mitigated in concert with reviews by other regulators. Some development would affect wetlands if plans show that no practicable alternative to site-specific development constraints exist. Such potential adverse wetland impacts would be offset or mitigated through project reviews for federal or state permits (i.e., Section 404 or Section 401) required for deposition of dredge or fill material or alterations of waters of the state or U.S. via some form of the following (which TVA would independently review for adequacy):

- Compensatory mitigation at an appropriate ratio including acquisition of mitigation bank credits and in-lieu-fee programs (if available)
- Off-site creation, restoration, or enhancement of wetlands
- On-site, in-kind replacement of wetlands

While mitigation would reduce the impact of wetland loss, there is the potential for a temporary loss of wetland function from the construction associated with future projects within the MSR study area. Because specific project details are unknown at this time, this loss is difficult to quantify. Because Alternative C involves a wide range of possible development activities, the potential to affect wetlands is greater under this alternative than under Alternative A or B. Due to the nature of development under Alternative C (e.g., multi-use, with individual components of varying sizes), Alternative C would allow for more avoidance than under Alternative D.

4.11.4 Alternative D

Under Alternative D, TVA would require the new owner(s) of the MSR study area to use it for industrial development. Under Alternative D, there would be impacts to wetlands if site-specific industrial development can show that there is no practicable alternative to wetland impacts. Direct impacts would be mitigated via the same mechanisms as listed under Alternative C. Wetland impacts under this alternative would likely have one or a small number of large, heavily impacted industrial sites. Because of the potential intensity of industrial development, indirect impacts to wetlands associated with potential contaminants and runoff under this alternative could be greater than those under Alternatives B, C, and E.

4.11.5 Alternative E
Under Alternative E, the MSR study area would be required to be used for a mixture of conservation, commercial, retail, residential, and industrial uses of the MSR study area. With about 12 percent (164 acres) of the MSR study area land cover being wetlands, the conservation component of Alternative E could provide a mechanism to preserve these areas and set them aside from potential development. This could be considered in the Master Plan. However, if these areas were available for commercial, retail, residential, or industrial uses, and if the developers could show that there is no practicable alternative, implementation of Alternative E would result in impacts to wetland resources on the MSR study area. Direct and indirect impacts would be mitigated via the same mechanisms as listed under Alternative C.

4.11.6 Alternative F
Under Alternative F, the MSR study area would be made available for sale, and no restrictions would be imposed as to the types of future land uses that could occur.

Similar to Alternative E, implementation of Alternative F could result in impacts to wetland resources currently found on the MSR study area. The effects of implementing Alternative F would likely be similar to Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E. Regardless, given potential for avoidance or mitigation of direct and indirect adverse wetland effects, direct impacts would be minimized or mitigated.

Cumulative Impacts
Large-scale analysis of land cover data over time and by ecoregion indicates an overall loss of forested wetland habitat in the Interior Plateau ecoregion. This loss is associated primarily with urbanization and agriculture. Emergent and scrub-shrub wetland acreage has remained relatively stable over the last 20 years, with some gain in open water (ponds) habitats (Dahl 2006).

General trends in wetland loss in Alabama follow this same pattern. Data collected by the USFWS indicate that palustrine forested wetlands have suffered a net loss in acreage over the last 10 years, primarily due to agricultural development. Additional losses are due to transportation impacts and the growth of urban and suburban developments associated with continued population growth (Hefner et al. 1994). Prior to impoundment, the Tennessee River system had extensive areas of forested wetlands that were lost when dams were constructed and these floodplain areas were inundated.

While wetlands only occupy less than 1 percent of the total land area of the Interior Plateau ecoregion, they comprise about 12 percent of the total acreage of the MSR study area. Thus, these wetland areas are locally important within the context of regional wetland resources. Through development and implementation of the Master Plan, TVA expects that some wetlands would be avoided or adverse effects minimized or mitigated. Such avoidance could involve incorporation of wetland areas into green space, parks, or visual or noise buffers. Any net loss to function or spatial extent of these wetlands would have cumulative wetland effects.

4.12 Floodplains
Floodplains are areas that are prone to flooding. Thus, construction of permanent or temporary structures, as well as other activities, in floodplain areas can endanger life and property. Additionally, such actions in floodplains can cumulatively restrict the flow of floodwaters and worsen the effects of flooding. EO 11988 (Floodplain Management)

requires federal agencies to consider and take appropriate measures to minimize adverse effects of their actions to beneficial floodplain functions.

Under all of the Action Alternatives (i.e., Alternatives B through F), TVA would dispose of land with a requirement in the deed, transfer, or other conveyance document that any proposal for future land-based improvements or water use facilities in the floodplain would be subject to TVA review and approval prior to construction. All proposed development within the limits of the 100-year floodplains, regardless of the alternative, is subject to TVA's Section 26a jurisdiction. Therefore, TVA would evaluate the potential direct, indirect, and cumulative impacts to the floodplain resulting from such proposals and assure compliance with EO 11988 and its requirement for a "no practicable alternative" determination and minimization of impacts. Areas within the 100-year floodplain on the property occur in low-lying areas in association with the Pond Creek drainage (see Figures 3-25 and 4-3) and along the Tennessee River.

During its review, TVA would identify ways of minimizing impacts including project design features and specifications, avoidance, or offsetting cuts or flood storage volume replacements consistent with other applicable regulation. As a result of this review, TVA would fulfill the requirements of EO 11988 and ensure that adverse floodplain impacts would be minimized. Surrounding cities and counties participate in the National Flood Insurance Program and, thus, regulate development of flood-prone areas to minimize effects. Therefore, development of the area would be consistent with the requirements of the National Flood Insurance Program and the applicable local floodplain regulations.

4.12.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Case-by-case evaluations of proposed actions would be undertaken to ensure that future actions are consistent with EO 11988. Any actions requiring Section 26a approval would be subject to individual environmental review. Because no foreseeable changes in land use are anticipated under the No Action Alternative, no effects to floodplains or their functions are likely due to TVA actions associated with this proposal.

4.12.2 Alternative B

Under Alternative B, a substantial portion of the available land on the MSR study area would likely be planned and used for resource management and conservation or other LID activities. Thus, the potential for adverse impacts to natural and beneficial floodplain values would be low. For those portions of the study area property located within the limits of the 100-year floodplains of the Tennessee River and Pond Creek (Figure 3-25), TVA would review all proposed development under Section 26a of the TVA Act and complete appropriate environmental review prior to construction. Approval under Section 26a of such development would include the imposition of any necessary conditions and mitigation to minimize adverse effects to floodplain values to the extent practicable. Thus, any such approval would be consistent with the requirements of EO 11988.

4.12.3 Alternative C

Under Alternative C, the MSR study area would be used for commercial, retail, and residential uses. The level and intensity of development under this alternative could be more than that likely under Alternative B. Therefore, the potential for adverse impacts to natural and beneficial floodplain values under Alternative C would be minor but potentially greater than those expected under Alternative A or B. However, the requirement for future review under Section 26a of proposed construction in the 100-year floodplain also applies to this alternative and would help ensure that potential impacts to floodplain values would be minor and insignificant.

4.12.4 Alternative D

The potential for adverse impacts to natural and beneficial floodplain values under Alternative D would be somewhat similar to those expected under Alternative C. The level and intensity of development under this alternative could be more and greater than under Alternatives B and C. Steps outlined under Alternative B, which would ensure that potential impacts to floodplain values would be minor and insignificant, would also apply to this alternative.

4.12.5 Alternative E

The potential for adverse impacts to natural and beneficial floodplain values under Alternative E would be greater than those expected under Alternatives A and B and likely somewhat less than that expected under Alternatives C and D. The level and intensity of development under this alternative could be similar to Alternative C but somewhat less than under Alternative D. However, the requirement for future review under Section 26a for proposed construction in the 100-year floodplain outlined under Alternative B would also apply to this alternative and would ensure that potential impacts to floodplain values would be minor and insignificant.

4.12.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale, and no restrictions or stipulations would be imposed on the types of future land uses that could occur.

Similar to Alternative E, implementation of Alternative F could result in impacts to natural and beneficial floodplain values currently found on the MSR study area. The effects of implementing Alternative F would likely be similar to Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E. Regardless, the potential for adverse impacts to natural and beneficial floodplain values under Alternative F would be minimized.

4.13 Aquatic Ecology

Fish and Aquatic Life Including Endangered and Threatened Aquatic Species

Aquatic life can be adversely affected by actions that cause degradation of water quality. Examples of such actions include runoff from construction sites and the introduction of contaminants from spills or waste streams. Additionally, the introduction of invasive species can affect local aquatic life.

Because there are few perennial streams, including the 303(d) listed as impaired Pond Creek, on the MSR study area, the diversity and abundance of common fish and aquatic life are low. The nearby Tennessee River, north of the study area, is much richer with common and rare aquatic life as described in Section 3.13.

Also, see Section 4.14.3 for discussion of terrestrial endangered and threatened species and mention of US Department of Interior, Office of Environmental Policy and Compliance concerns about aquatic species in the Tennessee River. Its letter included comments from the USFWS.

In order to minimize the effects of future development on aquatic life, the following conditions would apply to all Action Alternatives (Alternatives B, C, D, E, and F):

- Any future development on the upland portion of the MSR study area (i.e., that area south of Reservation Road) would be subject to state and federal permitting laws and regulations. Compliance with conditions authorizing disturbances associated with development in or near water bodies would reduce the potential for adverse impacts to water quality and habitats in Pond Creek.

- Development on the Tennessee River would be limited to the utility corridor. All development creating obstructions on the river would be subject to state and federal permits, including future approval from TVA under Section 26a of the TVA Act. Any future riverfront development would be subject to an independent environmental review and impacts analysis. Because of the large number of endangered and threatened species present in the Tennessee River, TVA would formally consult with the USFWS under Section 7 of the Endangered Species Act on any future project identified as having adverse effects on protected aquatic habitat or species in the Tennessee River. As a result of this consultation, any authorization to proceed with approving any facilities or structures would involve compliance with provisions of an incidental take permit and reasonable and prudent mitigation measures.Alternative A.

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Because no foreseeable changes to existing land use are expected on the MSR study area, no additional effects to surface waters or water quality are likely. No impacts to the aquatic communities in Pond Creek or the unnamed tributary of the Tennessee River are anticipated from implementing the No Action Alternative due to TVA actions associated with this proposal. In the event that a different land use is proposed at some time in the future, additional environmental review would be performed for that proposal, and impacts would be mitigated as appropriate.

4.13.1 Alternative B

Development of the MSR study area following the adoption of Alternative B would likely result in improved landscape conditions on the property from an overall ecological perspective. There are few streams on the MSR study area, but there are several man-made ponds. The type of development stipulated under Alternative B would likely have the result of reducing surface water runoff into Pond Creek and could improve aquatic conditions in Pond Creek. Thus, no direct, indirect, or cumulative adverse effects to surface water quality or to aquatic communities (including endangered and threatened species) are likely under this alternative.

4.13.2 Alternative C

Development activities resulting from the implementation of Alternative C would likely result in more land disturbance on the MSR study area than is expected under Alternative A or B. Depending on the nature and extent of uses ultimately proposed, disturbance under this alternative would likely be similar to that anticipated under Alternatives D, E, and F. Commercial development could include use of the utility corridor. As discussed above, in addition to the Master Plan, all future development on the MSR study area would be subject to authorizations from federal, state, or local agencies, including TVA. The resultant permit conditions would reduce the potential for adverse surface water impacts and impacts on aquatic communities in Pond Creek. Due to use of BMPs, topography, distance from the Tennessee River, and amount of vegetation between the study area largely south of Reservation Road, no direct, indirect, or cumulative impacts to aquatic resources (including endangered and threatened species) are likely to result from upland development of the MSR study area.

Actions resulting from the adoption of this alternative would have a greater potential for direct, indirect, or cumulative effects on aquatic resources on Pond Creek and in the Tennessee River compared to Alternatives A and B. As with all the Action Alternatives, any construction of obstructions that would directly affect the Tennessee River or its 100-year floodplain would be subject to additional individual environmental review. As stated above, TVA would formally consult with the USFWS regarding projects having potentially adverse effects on endangered and threatened aquatic species in the Tennessee River.

4.13.3 Alternative D

Anticipated development under Alternative D would likely result in more land in industrial use and potentially greater intensity of disturbance on the MSR study area than that expected under Alternative B. Disturbance under Alternative D would likely be similar or perhaps somewhat greater than that expected under Alternatives C and E. Industrial development could include use of the utility corridor. Industrial development could also require water withdrawals from or discharges to the Tennessee River. As discussed under Alternative C above, development on the area would be subject to state and federal permit conditions that would reduce the potential for adverse impacts on surface water and aquatic life in Pond Creek or the Tennessee River.

Development of the MSR study area under Alternative D has the highest potential to affect aquatic resources in the Tennessee River (including endangered and threatened aquatic species). As part of its environmental review of proposed projects subject to Section 26a approval, TVA would formally consult with the USFWS regarding projects having potentially adverse effects on federally listed aquatic species in the Tennessee River. Therefore, similar to Alternative C, no direct, indirect, or cumulative adverse effects to these resources are likely to occur as a result of upland development of the MSR study area.

4.13.4 Alternative E

Implementation of Alternative E and the resultant mixed land use would likely result in more land disturbance on the MSR study area than adoption of Alternative B. Disturbance under this alternative would likely be similar to that associated with Alternatives C and D. As discussed above, all future development on the MSR study area would be subject to state and federal permit conditions that would tend to reduce the potential for adverse surface water impacts and impacts on aquatic communities in Pond Creek and the Tennessee River. Any construction of obstructions that would directly affect the Tennessee River (e.g., industrial water withdrawals or discharges) would be subject to individual environmental review under Section 26a of the TVA Act. Actions subsequent to the adoption of this alternative could potentially affect aquatic resources in the Tennessee River (including endangered and threatened aquatic animals) because of the potential need for industrial use of the utility corridor. TVA would formally consult with the USFWS under Section 7 of the Endangered Species Act on any future project identified as having adverse effects on protected aquatic habitat or species in the Tennessee River. Therefore, similar to Alternatives C and D, no direct, indirect, or cumulative adverse effects to these resources are likely to occur as a result of upland development of the MSR study area under Alternative E.

4.13.5 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses that could occur.

With the implementation of BMPs and other routine measures, TVA anticipates that there would be no effects on aquatic ecology, fish, and aquatic life including endangered and threatened species, under Alternative F. Because mixed use development under Alternative F is expected to be similar to that under Alternative E, the potential environmental effects with respect to aquatic life from development would likely be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

Aquatic Invasive Species

Asian freshwater clam *(Corbicula fluminea),* zebra mussel *(Dreissena polymorpha),* and invasive aquatic plants such as hydrilla *(hydrilla verticillata)* are known from the Tennessee River. Future land uses on the study area associated with any of the alternatives under consideration would likely have no potential for changes to the status of aquatic invasive species in the Tennessee River. Because no known invasive aquatic species are currently present in the MSR study area and no effects on populations in the Tennessee River are expected, the implementation of either the No Action or any of the Action Alternatives is not likely to contribute to the introduction or spread of any of these or other aquatic invasive species. Any development along the shoreline of the Tennessee River would be addressed under future permitting and additional environmental reviews.

4.14 Terrestrial Ecology

4.14.1 Plants

The primary cause of potential effects to plant communities under any of the alternatives is site disturbance. Construction of buildings and facilities, including necessary site clearing and preparation, results in the removal of existing plant cover and can change the suitability of the site for certain plant life. The extent of changes in the plant community would depend on the particular proposed land use. The 4-acre TACF Research Orchard is an interim use of that site and is not the only research orchard in the historic range of the species (see Section 3.14.1). Continued use and availability of this site for research would be addressed in the Master Plan under any of the Action Alternatives.

Under the No Action Alternative, a change in land use at the 4-acre TACF Research Orchard is not likely, and research at the site would continue. However, the loss of the orchard through transfer of ownership or change in land use of the site under any of the Action Alternatives would result in a loss of research opportunity and the loss of potential application of research results in conserving American chestnut trees in the region.

4.14.1.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. According to the 1996 Plan, the site where TACF conducts research is allocated for ERC-related uses. Because the terrestrial communities found on the MSR study area are generally common and representative of the region and the current removal plan for control of invasive species on the reservation would likely continue, no significant impacts to the terrestrial ecology of the MSR study area are anticipated as a result of implementing Alternative A.

4.14.1.2 Alternative B

Adoption of Alternative B would require that the land in the MSR study area be used for conservation of natural resources and sustainable LID. Under this alternative, through the master planning process, TACF Research Orchard could continue to occupy the same 4-

acre site, or possibly a larger area, for research to contribute to the development of blight-resistant hybrid chestnut trees.

With over 43 percent of the land cover presently in grasslands, pastures, hayfields, and early successional areas, implementation of Alternative B could potentially provide a way to transform some of these areas into more suitable habitat for scrub-shrub and forest-dwelling wildlife. Currently, the understory of the deciduous forest is predominantly covered by invasive Chinese privet. To achieve the conservation theme under Alternative B, areas of high infestation of invasive species could be controlled, which would enable native plants (e.g., spring wildflowers) that are being outcompeted by nonnative species to return to the forest floor. Much of the current invasive species removal work occurring on the Reservation is being done by volunteer groups trying to restore the Old First Quarters SWA. Based on the likelihood of some continuing terrestrial community restorations and control of invasive species inhabiting the MSR study area by these groups, adoption of Alternative B could result in beneficial effects to terrestrial life on the MSR study area.

A former Alabama Champion American chestnut tree, heavily infested with blight and presently reduced to stump sprouts, is reported (i.e., known) to occur within the MSR study area. Because Alternative B would foster conservation of natural resources as well as the potential for areas to be conserved in accordance with the Master Plan, no impacts to the former champion trees are anticipated under this alternative.

4.14.1.3 Alternative C

Adoption of Alternative C would require that the MSR study area be used for commercial, retail, and residential uses. Although the terrestrial communities found on the MSR study area are common and representative of the region, these terrestrial ecosystems provide habitat for various species of wildlife and plants. Potential impacts to native plant communities on the MSR study area would depend on the extent of ground disturbance and permanent change of land use under Alternative C. Due to their prevalence on the MSR study area, such disturbance could foster the spread of invasive plants during and after construction. Preventive measures implemented by future landowners, potentially in concert with state regulators, could include:

- Limiting the introduction of weed seeds
- Ensuring that all equipment is free of weed seeds before moving to another location
- Using weed-free riprap or rock for projects to prevent the introduction of seeds
- Early detection and eradication of small patches of weeds
- Minimizing the disturbance of desirable plants along trails, roads, and waterways
- Maintaining desired plant communities through good management
- Monitoring high-risk areas such as transportation corridors and bare ground
- Revegetating disturbed sites with native or noninvasive nonnative plants

Common plants could be impacted by development but some plants would be retained in green spaces and undeveloped areas. However, making the land available for uses under

Alternative C would result in negative impacts to the vegetative community structure currently found on the MSR study area. Such development would likely eliminate deciduous forests that have the potential to adversely affect habitat capable of supporting state-listed plants (see Section 3.14.3.1 and Table 3-18). However, opening up some areas of dense vegetation could also allow desirable plants, e.g., wildflowers, to become reestablished.

The effects of implementing Alternative C to terrestrial vegetation are likely greater than effects anticipated under Alternatives A and B. Because affected terrestrial vegetation, even rarer species habitat, is also relatively common through the species ranges, these negative effects would not be significant.

The continued availability of TACF Research Orchard would be determined in the Master Plan. Because other alternative uses of this 4-acre site could be determined in this planning process, the research opportunities provided could be discontinued under this alternative. Loss of research results from this plot could be significant to the recovery of the American chestnut within the southern portion of its range.

Because adoption of Alternative C would require that land within the MSR study area be used for commercial, retail, and residential uses, adverse impacts to the former champion American chestnut tree site could occur if not included on land set aside by the Master Plan.

4.14.1.4 Alternative D

Under Alternative D, the MSR study area would be used for industrial development. Similar to Alternative C, potential impacts to native plant communities on the MSR study area would depend on the extent of ground disturbance. As indicated in Alternative C, common plants could be similarly impacted under this alternative. However, making the land available for industrial development would result in negative impacts to the vegetative community structure and likely would eliminate deciduous forests that have the potential to adversely affect habitat capable of supporting state-listed plants (see Section 3.14.3.1 and Table 3-18). However, opening up some areas of dense vegetation could allow desirable plants to become reestablished as mentioned in Alternative C.

As indicate under Alternative C, adoption of this alternative has the potential to negatively impact the site of a former American chestnut champion tree unless it's set aside by the Master Plan. The preventive measures described under Alternative C to minimize the effects of the potential spread of a number of invasive plants on the Reservation could also be implemented under Alternative D. Implementation of Alternative D would likely have similar impacts to Alternatives C, E, and F but greater impacts than Alternatives A and B. The use of TACF Research Orchard could be discontinued under this alternative, depending on the land use allocations resulting from the Master Plan. The significance of this effect could be similar to that described under Alternative C.

4.14.1.5 Alternative E

Adoption of Alternative E would require that the MSR study area be used for a mixture of conservation, commercial, retail, residential, and industrial uses. Depending on the action taken on particular parcels of land, potential impacts to the terrestrial life of the area could have positive or negative effects. With over 43 percent of the land cover in grasslands, pastures, hayfields, and early successional areas, common plants could be impacted by development. Some common plants could be retained in conservation areas identified as a part of the Master Plan. However, making the land available for mixed use would result in negative impacts to the vegetative community structure currently found on the MSR study area and likely would eliminate some deciduous forests that have the potential to adversely affect habitat capable of supporting state-listed plants (see Section 3.14.3.1 and Table 3-18). However, opening up some areas of dense vegetation could allow desirable plants to become reestablished as mentioned under Alternative C.

Preventive measures to minimize the effects of the potential spread of invasive plants, also described under Alternative C, could be implemented under Alternative E. Implementation of Alternative E could likely have less impacts compared to Alternative D, similar impacts to Alternatives C and F, but greater impacts than Alternatives A and B. Similar to Alternative B, C or D, adoption of Alternative E has the potential to negatively impact the site of a former American chestnut champion tree unless it's set aside by the Master Plan. The Master Plan would address the continued use of the 4-acre TACF Research Orchard. However, under this alternative, there would be a mixture of land uses, including conservation actions. Thus, although other uses could feasibly occur on the orchard site, such uses may not be likely under Alternative E. The significance of this effect could be similar to that described under Alternative C.

4.14.1.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses.

With the implementation of BMPs, various buffer zones, possible efforts to discourage the spread of nonnative plants, and conservation of green space from the Master Plan, TVA anticipates that there would be minor effects on common plants under Alternative F. The potential environmental effects to terrestrial plants from development would likely be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

4.14.2 Wildlife

Wildlife is potentially affected by the same mechanisms that affect plant life (see Section 4.14.1). The disturbance or removal of vegetative cover affects habitat suitability for many animal species. This has less of an effect on more mobile species that can move to nearby areas having suitable habitat. Some less mobile animals could be lost or displaced completely by various degrees of site disturbance. Eventually, competition for available suitable habitat among and between species results in equilibrium and typically some species population reductions. Any clearing of forested habitat that occurs as a result of development within the MSR study area would contribute to further habitat fragmentation. Given the current extent of habitat fragmentation present, species present within the study area are already exposed to some degree to the effects of habitat fragmentation. Therefore, no significant impacts of additional development are expected.

To reduce potential effects on birds that visit the area, some land in the southwest portion of the MSR study area used by migratory birds could be integrated into plans for open green space (e.g., park) likely included in the Master Plan.

4.14.2.1 Alternative A

Under Alternative A, there would be no foreseeable changes in land use, land cover, or available wildlife habitats as a result of this proposal. Therefore, adoption of Alternative A would not likely result in changes to the wildlife on the MSR study area.

4.14.2.2 Alternative B

Under Alternative B, TVA would require that the MSR study area be used for conservation uses and LID. Implementation of this alternative could result in the continuation of volunteer programs in public parks or other green spaces to expand early successional fields and more intensive removal of invasive species of plants that currently degrade the overall quality of wildlife habitats in the MSR study area. The southwestern section of the MSR study area could be incorporated into additional green space maintenance under this alternative. Therefore, the mixed habitat area could remain available to benefit resident and migratory birds. Adoption of this alternative could result in minor but beneficial impacts to terrestrial wildlife resources.

Actions that could occur following the adoption of Alternative B would likely result in improved wildlife habitat conditions within the study area and the long-term availability of habitats, making it potentially somewhat more beneficial than Alternative A.

4.14.2.3 Alternative C

The MSR study area would be used for commercial, retail, and residential development under Alternative C. Potential impacts to wildlife communities on the MSR study area would depend on the extent of development. Depending on the spatial extent and nature of the potential development, adoption of this alternative would result in a reduction in the amount and change in the vegetative community structure and suitability of some wildlife habitat, the displacement of some wildlife species into adjacent forested habitats, and the direct mortality of some less mobile wildlife. Some species would continue to use portions of the MSR study area, but overall diversity of species and numbers of individuals would likely be lower. The resident wildlife species on the MSR study area are typical of the region, and the quality of habitats in the MSR study area would remain representative of those common in the region.

Adoption of Alternative C and the subsequent construction and operation of commercial, retail, and residential developments could reduce wildlife diversity, resulting in adverse impacts at a local level. In particular, the forested wetland area in the southwest portion of the MSR study area would likely be attractive for commercial or retail development because of its location adjacent to Hatch Boulevard. Some migrant birds could be forced to seek out suitable habitats at other locations in the area or region to support their needs, and some individual birds could perish. Development of this area could significantly affect important migrant bird habitat there. Compensatory mitigation for the loss of any forested wetlands, which appear to be an important component of this habitat, as a result of development would likely be required consistent with requirements of the CWA. However, because similar habitat does not occur on the remainder of the TVA land on the Muscle Shoals/Wilson Dam Reservation, compensatory mitigation for the loss of bird habitat and recreation opportunity (i.e., bird watching) would be difficult to accomplish on the MSR study area. However, potential habitat loss from the MSR study area site would not likely adversely impact these bird populations or the recreational opportunity created on a regional scale.

With respect to wildlife resources, the potential impacts of adopting Alternative C would likely be greater than those anticipated under Alternative A or B and potentially similar or less than those expected under Alternatives D, E, and F. Impacts of development under Alternative C could be reduced elsewhere in the area or region when losses of portions of the forested wetland habitats on the area are avoided or mitigated by the Master Plan.

4.14.2.4 Alternative D

Under Alternative D, use of the MSR study area would be restricted to industrial uses. The spatial extent and the intensity of potential industrial development would likely be similar to that described under Alternative C. The extent could range from sparse to dense, and intensity of development could range from light to severe, depending upon the type of industry that locates on the MSR study area. As acknowledged under Alternative C, impacts of forested wetland habitat loss in the southwest portion of the study area could significantly affect migrant birdlife and recreation opportunity at the local level. Impacts of development under Alternative D could be reduced elsewhere in the area or region when losses of portions of the forested wetland habitats on the area are mitigated. Potential effects under Alternative D could range between beneficial or minor to extensive, significant, direct, adverse impacts; given habitat loss in the context of existing surrounding development, effects would more probably be moderate. Therefore, potential impacts to terrestrial wildlife resources under Alternative D would be similar to, or perhaps greater than, those described under Alternative C.

Impacts of actions subsequent to the adoption of Alternative D could also be greater than those anticipated under Alternatives A and B and potentially similar or greater than those expected under Alternatives E and F. Similar to Alternative C, impacts of development under Alternative D could be reduced elsewhere in the area or region when losses of portions of the forested wetland habitats on the area are avoided or mitigated.

4.14.2.5 Alternative E

Under Alternative E, the spatial extent and the intensity of potential mixed use development would likely be similar to that described under Alternative C. Implementation of Alternative E could also result in a similar range of effects as those described under Alternative D. As acknowledged under Alternative C, impacts of forested wetland habitat loss in the southwest portion of the study area could significantly affect migrant birdlife and recreation opportunity at the local level. The potential impacts to wildlife from development under Alternative E could be reduced elsewhere in the area or region when losses of portions of the forested wetland habitats on the area are mitigated.

The potential effects of implementing Alternative E would likely be greater than those anticipated under Alternatives A and B. However, potential effects under Alternative E would likely be similar to those expected under Alternative C and perhaps less than those anticipated under Alternative D because this alternative has a conservation component that would tend to reduce the severity of potential adverse effects to wildlife.

4.14.2.6 Alternative F

Under Alternative F, no restrictions on the types of future land uses would be imposed.

TVA anticipates that the potential for adverse impacts to nonendangered terrestrial animals under Alternative F would likely be similar to those expected under Alternative E. As previously stated regarding common plants, some land set aside for conservation in the Master Plan could minimize effects on common terrestrial life under Alternative F. The potential environmental effects to terrestrial animals from development would likely be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

4.14.3 Terrestrial Endangered and Threatened Species

One federally listed as threatened plant is reported from Colbert County, Alabama, and no federally listed plants or habitat capable of supporting such species are known from the

MSR study area. Although several state-listed plants (see Table 3-18) are known to occur within 5 miles of the MSR study area, none are known from the site. However, habitat capable of supporting two state-listed plants could occur on the study area.

Plants considered of conservation concern are identified in Section 3.14.2.1 and Table 3-18. Animals of conservation concern, which include 2 federally endangered bats, are identified in Section 3.14.2.3 and denoted in Tables O-1, O-2, and O-3 in Appendix O. Neither plants nor animals have official protection status. Of the protected animal species listed in Section 3.14.3.2, only the gray bat occurs on the MSR study area. Several populations of gray bats occur in the region, and this species forages throughout much of the Tennessee River Valley. This species exits roost sites at sunset and forages over large areas of the Tennessee River (Best et al. 1995). Gray bats make brief foraging flights up tributary streams and creeks that branch from the Tennessee River, including creeks that cross the MSR study area. The proposed actions have minor potential for impacting this species, as gray bats readily forage along streams in forested or nonforested habitats. Because of the availability and accessible foraging habitat nearby and elsewhere within its range, the adoption of any of the proposed alternatives would not result in cumulative impacts to gray bats or other listed species of terrestrial animals.

As explained above, under all the Action Alternatives, TVA would further evaluate any future actions by others that could modify streams, their adjoining shorelines, wetland areas, and land within the limits of the 100-year floodplain and conduct any needed additional environmental reviews. This process would tend to reduce the potential for adverse effects to rare or listed wildlife species.

Under all the Action Alternatives, TVA has determined that future land uses implemented on the MSR study area would have no effect on any federally endangered or threatened terrestrial animals or plants or any designated critical habitats. As indicated in Section 4.13 Aquatic Ecology, because of the large number of aquatic endangered and threatened species present in the Tennessee River, all future development subject to approval from TVA under Section 26a of the TVA Act would be reviewed. TVA would formally consult with the USFWS under Section 7 of the Endangered Species Act on any project identified as having adverse effects on protected aquatic habitat or species in the river. As a result of this consultation, any authorization to proceed with approving any facilities or structures would involve compliance with provisions of an incidental take permit and reasonable and prudent mitigation measures. In its e-mail and attached letter of February 28, 2011, the US Department of the Interior, Office of Environmental Policy and Compliance, acknowledged that development with the highest potential to affect aquatic resources in the Tennessee River would be addressed as part of TVA's environmental review of proposed projects subject to Section 26a of the TVA Act, and as such be subject to Section 7 review under the Endangered Species Act.

4.14.3.1 Plants

4.14.3.1.1 Alternative A

Under Alternative A, there would be no foreseeable changes in land use, land cover, or rare plant habitat as a result of this proposal. Currently, the continued spread of invasive plant species, especially Chinese privet, is a major threat to habitats potentially suitable for supporting rare plant communities. Volunteers currently partner with TVA to control and remove invasive plants on the Reservation. If these practices for controlling invasive plants continue, no significant adverse impacts to rare plant communities on the MSR study area are anticipated as a result of implementing the No Action Alternative. Given the abundance of some of these invasive plants in the area and region, effects of this work are probably of benefit locally. Such removals of competing plants allow for more desirable species, such as wild flowers, to inhabit the site.

4.14.3.1.2 Alternative B
Adoption of Alternative B would require that the MSR study area be used for conservation and LID. Based on field investigations and database queries, there are no observations or known records of federally or state-listed plant species occurring within the MSR study area. However, two state-listed plants (Dutchman's breeches and false rue-anemone) are known to occur in the Old First Quarters SWA north of Reservation Road and outside the MSR study area. Habitat capable of supporting these two plant species could be present within the MSR study area. However, no impacts on rare plants or populations are anticipated under this alternative.

4.14.3.1.3 Alternative C
Based on field investigations and database queries, there are no observations and no known records of federally or state-listed plant species occurring within the MSR study area. Because adoption of Alternative C would require that land within the MSR study area be used for commercial, retail, and residential uses, adverse impacts to rare plant habitat could occur. The nature and intensity of these effects would depend on the spatial extent and characteristics of the potential development and the effectiveness of the Master Plan in avoiding potential adverse effects to plant species. The potential effects to threatened and endangered plant habitat from implementing Alternative C could likely be greater than those anticipated under Alternatives A and B and similar or less than those anticipated under Alternative D, E, or F.

4.14.3.1.4 Alternative D
There are no observations or known records of federally or state-listed plant species occurring within the MSR study area. However, habitat capable of supporting Dutchman's breeches and false rue-anemone could be present within the MSR study area. Because much of the study area could be disturbed or converted to permanent industrial uses under Alternative D, adoption of this alternative has the potential to result in negative impacts to rare plant habitat. Depending on the amount of industrial development, potential effects under this alternative would likely be similar to or greater than those expected under Alternative C and similar or greater than those anticipated under Alternative E or F. Implementation of the Master Plan could also reduce effects of this alternative as mentioned under Alternative C.

4.14.3.1.5 Alternative E
Depending on the action taken on particular parcels of land, potential impacts to the terrestrial plant life of the area could have positive or negative effects under this alternative. Habitat capable of supporting two state-listed plants could be present within the MSR study area. The potential impacts of adopting Alternative E on sensitive plant habitat are expected to be less than those anticipated under Alternative D but similar to those associated with the implementation of Alternative C. The potential effects of adopting this alternative are expected to be greater than those anticipated under Alternative A or B. If areas recognized as potential habitat for rare plant populations are set aside for natural resource conservation or other green space in the Master Plan, then implementation of Alternative E would have no adverse effects to unique or state-listed threatened and endangered plant species.

4.14.3.1.6 Alternative F
Under Alternative F, there would be no restrictions on the types of future land uses that could occur on the MSR study area.

The potential for adverse impacts to unique or state-listed threatened and endangered plant species under Alternative F would likely be similar to those expected under Alternative E. Some land set aside for conservation in the Master Plan could minimize effects on rare plant habitat under Alternative F. The potential environmental effects to such plant communities from development would likely be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

Cumulative Impacts
Because no federally listed or state-listed endangered or threatened plants occur on the MSR study area, no direct, indirect, or cumulative effects on such species would occur under any of the alternatives. None of the Action Alternatives involve specific measures to control invasive plants such as Chinese privet and kudzu, which are both abundant throughout the area and region. Efforts to control these plants are underway by volunteers under Alternative A and would likely be encouraged under Alternative B. The absence of measures to control such invasive plants under any of the alternatives could lead to the reestablishment and spread of these species to additional sites on the MSR study area, the Reservation, and adjacent properties. Depending upon the future land uses on the nonfederal property, implementation of voluntary measures identified in Section 4.13.1.3 could minimize or reduce the direct, indirect, and cumulative effects of the spread of these plants on the area and adjoining properties.

4.14.3.2 Wildlife

4.14.3.2.1 Alternative A
Currently, there are no ongoing activities on the MSR study area that cause adverse effects to any federally or state-listed or protected wildlife species. With the exception of occasional foraging by gray bats, there are no known occurrences of terrestrial threatened or endangered wildlife species on the site. Under the No Action Alternative, there would be no additional effects to listed or protected wildlife species because no foreseeable changes to existing land use would occur on the MSR study area. Under this alternative, future proposals would be considered under a new and separate environmental review to determine their impact on gray bats and other threatened and endangered species.

4.14.3.2.2 Alternative B
Adoption of Alternative B would require that the land in the MSR study area be used for conservation of natural resources and sustainable LID. Under Alternative B, as a part of conservation efforts on the area, dense stands of invasive plants could be removed from areas adjacent to streams in the MSR study area, including Pond Creek. This could result in creating additional foraging habitat along stream corridors and more foraging opportunities for gray bays that use this area. Under Alternative B, potential effects on rare species' habitat are expected to be similar to or less than those expected under Alternative A if removal of invasive plants continues.

4.14.3.2.3 Alternative C
Under Alternative C, although unlikely with implementation of the Master Plan, habitats surrounding streams where gray bats forage could be modified at levels ranging from minor to extensive. Gray bats readily forage along streams in urban or rural settings; thus, no direct adverse impacts to gray bats are expected. Adoption of this alternative could result

in indirect impacts to gray bats, as modifications to the surrounding landscape could affect sources of food along Pond Creek and other streams in the MSR study area. However, given the low number of gray bats foraging along streams in the MSR study area, the extensive foraging range of gray bats, and the abundance of foraging habitat available locally (i.e., habitat on the Wilson Dam tailwater and associated creeks) and regionally (upper Pickwick and lower Wilson reservoirs), no effects on gray bats are expected from planned commercial, retail, and residential development of the property. As previously mentioned, to help minimize disturbance to the area along Pond Creek, a corridor of land for conservation or green space purposes could be set aside, thus potentially reducing effects of nearby development.

Under Alternative C, potential effects on rare bats or their habitat are expected to be less than those anticipated under Alternative D and the same or similar to those likely under Alternative E or F. Depending on the spatial extent and intensity of development, wetland avoidance or mitigation would likely reduce indirect and cumulative effects of any potential habitat loss. Implementation of the Master Plan could set aside this habitat in a conservation area or corridor.

4.14.3.2.4 Alternative D

The potential impacts to threatened and endangered wildlife from activities under Alternative D would likely be greater than or similar to those from implementing Alternatives C and E. Because gray bats only occasionally forage over streams on the MSR study area, no direct impacts to this species are expected. Shifts or reductions of food sources could indirectly impact gray bats. However, as indicated under Alternative C, given the low number of bats and the availability of ample foraging opportunities nearby, effects on gray bats from stream modifications in the MSR study area are not expected.

Under Alternative D, potential impacts to habitat for rare species are expected to be similar or greater than those described under Alternative C.

4.14.3.2.5 Alternative E

The potential effects to protected wildlife, including the gray bat, from implementing Alternative E would be the same or similar to those expected from implementing Alternative C or D. No direct impacts to gray bats are expected for reasons mentioned previously. Shifts or reductions of food sources could indirectly affect gray bats. However, given the low number of gray bats in the area and because there are ample opportunities to forage elsewhere nearby, no effects on this species from the development in the MSR study area are expected. Under this alternative, bat usage could approach levels afforded under Alternative B, depending upon the type, extent, and intensity of development.

Under Alternative E, potential impacts on rare species' habitat are expected to be less than those anticipated under Alternative D and the same or similar to those likely under Alternative C or F.

4.14.3.2.6 Alternative F

The potential effects to listed or protected wildlife, including the gray bat, from implementing Alternative F would be the same or similar to those expected from implementing Alternative C, D, or E. No direct impacts to gray bats are expected for reasons mentioned previously. Shifts or reductions of food sources could indirectly affect gray bats. However, given the low number of gray bats in the area and because there are ample opportunities to forage elsewhere nearby, no effects on this species from the development in the MSR study area are expected. Under this alternative, bat usage could approach levels afforded under Alternative B, depending upon the type, extent, and the intensity of development.

Cumulative Impacts

Common resident wildlife is generally abundant both locally and regionally. The acreage of rural upland landscapes in the area, including public land, with habitats suitable to supporting these species, appears somewhat stable. This habitat is being slowly affected by agricultural and forestry operations and residential, business, and infrastructure development in northwest Alabama from west of Huntsville to Iuka, Mississippi. Some migratory bird populations, particularly Neotropical migrants and others that rely on wetland habitats, including those on the Muscle Shoals/Wilson Dam Reservation, are declining. As mentioned in Section 3.11 and although regionally there have been losses in both forested and scrub-shrub wetland habitat types, there is an overall gain in wetland resources in Alabama and nationwide (Sifneos et al. 2009). Because much of the MSR study area contains existing development and represents a small fraction of the available habitat in the surrounding counties and region, cumulative impacts on resident wildlife including birds, under any of the Action Alternatives (B, C, D, E, or F) would be insignificant.

4.15 Natural Areas

The Old First Quarters SWA, which lies north of Reservation Road, is the only designated natural area on Muscle Shoals Reservation (see Section 3.15). Because this SWA is outside the scope of this EIS, it would not be directly affected by any proposed development, regardless of the alternative selected. Although not recognized as designated natural areas by TVA, some vegetated (e.g., woodlots) and reverting (e.g., scrub-shrub) land within the MSR study area appears natural in its character and has potential value as wildlife habitat. Other nearby designated natural areas, trails (Section 4.16), and naturally appearing landscapes can be directly or indirectly affected by development. Sources of potential adverse effects range from direct elimination and replacement to changes in the aesthetic and natural character from noise, presence of nearby buildings or structures, and odors.

Nearby construction or the presence of additional impervious surfaces such as paved areas could result in runoff to the natural area or changes in surface water quality. Nearby development can also reduce use of some areas by wildlife and decrease the desirability of the site for recreational use. Additionally, some of the informal naturally appearing landscapes could be used for development sites. However, there are no designated natural areas on the MSR study area proper.

4.15.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Under this alternative, the visual buffers established along major roads and the reservation trail complex as well as a vegetative buffer established along the Pond Creek corridor would remain. This buffer also serves to reduce the effects of noise. There would be no foreseeable change in the recreational use of or status and protection of the Old First Quarters SWA in the vicinity of the MSR study area. Therefore, no formally designated or informal naturally appearing landscape would be directly or indirectly affected. No cumulative effects to these resources would result from adoption of this alternative.

4.15.2 Alternative B

Under Alternative B, the MSR study area would be used for conservation of natural resources and LID. Conservation of informal naturally appearing landscapes (i.e., native grass areas, areas of forests and wetlands, green space, and TACF Research Orchard), combined with LID within the MSR study area, would likely allow these landscapes to remain in their current relatively natural state with the potential to be used as outdoor classrooms for public use and research. Conservation efforts and LID would likely reduce the potential for aesthetic and scenic values of formal natural areas and naturally appearing landscapes from being diminished while preserving the parklike setting of the MSR study area.

Conservation or LID uses would likely have a low potential for indirect adverse impacts to nearby natural areas (i.e., the Old First Quarters SWA, Wilson Dam Tailwater Restricted Mussel Harvest Area, Tennessee River/Wilson Dam NEP, and the MSR trail complex); thus, vegetation removal and construction-related soil disturbance would be reduced. Additionally, any short-term degradation of water quality associated with storm water runoff from impervious surfaces would likely be less under this alternative than under the other Action Alternatives. Pervious surfaces retained due to conservation measures and less development would improve water quality by filtering sediments from storm water runoff. Under this alternative, a priority would be placed on protecting and enhancing the natural character of the area while allowing less intrusive forms of development. Maintaining and preserving the trail complex located within the boundaries of the MSR study area, including the corridor of native grass plantings and vegetative buffers that protect the trails' integrity, would tend to reduce any impacts to these natural areas caused by LID.

Because designated natural areas and naturally appearing landscapes adjacent to and within the MSR study area could benefit from enhanced conservation efforts and LID, the potential effects to natural areas could be beneficial under Alternative B and potentially greater than those expected under Alternative A. Because enhanced conservation efforts paired with LID would foster the preservation of plant and animal communities, the implementation of Alternative B would reduce the potential for water quality degradation and maintain aesthetic and scenic values for both naturally appearing landscapes and designated natural areas within and adjacent to the MSR study area. The potential cumulative effects to natural areas and naturally appearing landscapes would be positive under Alternative B compared to the effects expected from development under the other Action Alternatives.

4.15.3 Alternative C

Commercial, retail, and residential development required under Alternative C would likely indirectly affect the nearby designated natural area and trails due to potential increased traffic volume and higher levels of noise. These conditions would tend to decrease the overall experience of users of the adjacent SWA and MSR trail complex. Informal trails, native grass areas, and TACF Research Orchard could be directly affected by new development. Although outside boundary of the SWA, the section of the Rockpile Hiking Trail that is included in the MSR trail complex may be indirectly affected if development of the phosphate slag storage area occurs as part of implementation of a utility corridor to the Tennessee River. The level and intensity of impacts to the Rockpile Hiking Trail would depend on the site-specific plan of development. Potential effects to the trail would be long-term and moderately adverse if the trail is permanently divided or if portions of the trail become inaccessible to the public due to development. These indirect impacts would be reduced to short term and minor if implementation of the utility corridor incorporates the trail into the plan. These indirect effects are expected to be greater than those likely to occur under Alternative A or B.

Locations of designated natural areas would also be taken into account in the development of the Master Plan.

4.15.4 Alternative D

Depending on the degree and intensity of industrial development required under Alternative D, the formally designated natural area and trails near the MSR study area could be indirectly affected due to potentially increased emissions, visual intrusion, increased traffic volume, and higher levels of noise. These would diminish the overall experience of users of the adjacent SWA and MSR trail complex. Other nearby designated natural areas, including four parks, a WMA, TVA HPA, and NWR could be impacted indirectly due to increased emissions that could decrease the aesthetic quality of these areas during peak operating times. Informal naturally appearing landscapes including trails, the native grass areas, and TACF Research Orchard would likely be directly affected by new development. These landscapes within the MSR study area may be permanently altered by industrial development. Potential loss of trails and wildlife habitat associated with informal naturally appearing landscapes within the redevelopment area may occur. These indirect effects are expected to be greater than those likely to occur under Alternatives A, B, and C.

The potential indirect effects of adopting this alternative on the Rockpile Hiking Trail and other sections of the MSR trail complex, including the portion that extends south of Reservation Road onto the MSR study area and other informal naturally appearing landscapes, would likely be the same as those described under Alternative C.

4.15.5 Alternative E

Under Alternative E, the balance between development and conservation efforts could benefit natural areas in the vicinity of the MSR study area by setting aside areas for conservation that would make available additional recreational opportunities and encourage use of the SWA and MSR trail complex. Depending on the intensity and degree, development of commercial, retail, residential, and industrial areas could also have some indirect adverse impacts on natural areas in the vicinity of the MSR study area due to an overall increase in development and associated increases in traffic, noise, and other forms of disturbance as described under Alternative D.

Indirect effects of development under Alternative E on the Rockpile Hiking Trail and other sections of the MSR trail complex and other landscapes would be the same as those described in Alternatives C and D.

4.15.6 Alternative F

The potential for direct, indirect, and cumulative adverse impacts to the designated natural area, Old First Quarters SWA, and other natural landscapes under Alternative F would likely be similar to those expected under Alternative E. Some land set aside for conservation in the Master Plan could minimize effects on natural areas and trails under Alternative F. The potential environmental effects to such areas from development would likely be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

4.16 Recreation

Recreational opportunities are affected by development in various ways, depending on the type of development (e.g., residential or mixed as opposed to industrial) and the proximity of that development to the recreational feature or resource. Potential effects of development occur primarily as the loss of facilities, lost recreational opportunity, or a reduction in the quality of the recreational experience.

A utility corridor could be constructed across the 90-acre phosphate slag storage area under any of the Action Alternatives, but it is more likely under Alternatives D, E, and F. Depending on the level and type of development that occurs, use of a utility corridor for utilities or other supporting infrastructure could adversely affect the segment of the Rockpile Hiking Trail that crosses this corridor. As noted in Section 3.16 (see Figures 3-30 and 4-4), this section of the Rockpile trail crosses the skimmer wall built as part of the Wilson Power Plant. Because there is an inlet behind (landward of) the wall, some forms of water access could possibly be accommodated without impacting the trail or fishing that commonly occurs in this area. Conversely, water access needs that would require breach or removal of the skimmer wall would sever the existing trail and also adversely impact shoreline fishing access.

Use of the utility corridor at the slag storage area could also potentially affect recreational use of the Wilson Dam tailwater (Tennessee River) shoreline along its left-descending (south) bank opposite the lock access channel and Florence port. However, because a commercial dock or a barge terminal could affect reservoir operations and navigation (see Section 4.19) and be subject to flooding or impact endangered species, such a proposal at this location would not be approved by TVA.

A 1-mile segment of the paved National Recreation Trail Complex that was extended south of Reservation Road in 2003 (and, therefore, is within the proposed redevelopment study area) could be affected by future development under any of the Action Alternatives. This trail segment, and the adjacent native vegetation planted and currently managed to provide a buffer for the trail, could be negatively affected by adjacent development and related increases in vehicular traffic and traffic noise. Furthermore, because the trail crosses Reservation Road at two locations, increased traffic along this route could increase hazards associated with trail users attempting to cross the road. As described in Section 3.16, a transportation project enhancement grant was used to partially fund construction of this portion of the trail. In the formal agreement with ALDOT and FHWA, TVA is required to obtain written approval if the land on which these improvements are made is sold or the recreational use is changed. Therefore, prior to any transfer of the affected land from federal ownership, TVA would consult with ALDOT and FHWA and obtain the needed written authorization.

The 900-foot section of the paved trail that crosses the Multipurpose Building portion of the proposed redevelopment study area could also be affected under any of the Action Alternatives. Increases in motorized traffic entering and exiting this parcel could negatively impact trail use including a decrease in user safety.

Closure of any of the trail segments outlined above would greatly reduce the integrity and usability of the TVA trails complex. Because TVA's system of trails—especially the paved trail—is an integral and vital part of a larger trail system that extends into the city of

Figure 4-4. Recreation Sites Within the Muscle Shoals Reservation Study Area

Sheffield and across the river into the Florence community, such actions would also trigger cumulative negative impacts on nonmotorized recreation and transportation systems within a multicity and multicounty area. To reduce the potential for adverse effects to recreational opportunities or facilities such as those outlined above, the following measures could be employed under any of the Action Alternatives (i.e., Alternatives B, C, D, E, and F).

1. The 1-mile segment of paved trail located on the south side of Reservation Road, including the corridor of native vegetative plantings along each side of the trail, (a) may be preserved and maintained in TVA ownership for its current recreational usage or, with the concurrence of ALDOT and FHWA, (b) could be preserved and managed for public recreation use under an agreement (e.g., easement) between TVA and the new landowner or other responsible party for the development area, or (c) upon agreement with ALDOT and FHWA, could be relocated to the north side of Reservation Road if the area on the south side is needed for other purposes under any of the Action Alternatives. Option (c) would eliminate the two existing crossings of Reservation Road by the trail and, thus, enhance public safety. However, because this alignment would require construction of a bridge over Pond Creek, this approach could involve considerable expense.
2. The 900-foot section of paved trail, including a protective corridor, on the Multipurpose Building parcel could be (a) retained by TVA, (b) preserved and managed for public recreation use under an agreement (e.g., easement) between TVA and a new landowner, or (c) relocated to skirt the boundaries of the Multipurpose Building parcel.
3. Development of the phosphate slag storage area as part of a utility corridor to the Tennessee River could also include potential impacts to the Rockpile Hiking Trail and the paved trail complex along Reservation Road. Impacts of severing these trails could be temporary, and mitigated through rerouting the trail, or permanent causing a loss of future recreational use opportunity. Depending on the nature of utility corridor facilities construction, efforts would be made to avoid trail closure or reduce effects of trail usage through planning or other design features (such as reconstruction of segments of the disrupted trail and/or revegetation of the trail corridor). This could help to maintain the integrity and character of the trail and trail environs.

The future availability of land within the MSR study area for potential recreational use could be integrated into plans for open green space (e.g., parks) depending on the land use allocations resulting from the Master Plan development process.

4.16.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Under this alternative, there would be essentially no foreseeable change in current access to recreation facilities or the availability of these facilities. Thus, recreational availability, quality, and activity patterns are not expected to change. Use opportunities on trails and other recreation facilities along with informal use of some of the MSR properties both north and south of the Reservation Road would likely continue. According to Alabama's Statewide Comprehensive Outdoor Recreation Plan, demand for access to trails to accommodate walking, hiking, and bicycling is likely to increase statewide.

4.16.2 Alternative B

Development following the implementation of Alternative B, conservation and LID, would likely have a positive effect on recreational use on the MSR study area. Implementation of this alternative would make the MSR study area available for protecting and enhancing the natural character of the area, which is a key factor in its attraction as an outdoor recreation resource. Adoption of Alternative B could also result in additional recreation enhancement to supplement recreation facilities north of Reservation Road and help meet future recreation needs in the area. This could occur in association with continuation of volunteer programs and establishment of new or expansion of existing public parks or other green spaces.

Implementation of this alternative would also likely result in preservation and/or improvement of areas of the MSR that currently receive informal recreation use such as walking, jogging, and nature observation. Likewise, the types and levels of development such as green energy research, education, and ecotourism envisioned under this alternative would be less impacting than some other types of development expected to occur under the other Action Alternatives. Thus, implementing Alternative B would likely preserve or increase the overall amount of open space and areas in a relatively natural character across the area.

Although adoption of Alternative B could enhance recreational use of the MSR overall, there is some potential for negative impacts on recreational use areas and facilities that are located within the proposed MSR study area boundaries. The recreational trail located north of Reservation Road that continues south of the road onto the northeast corner of the property as well as the trail along the river near the phosphate slag storage area could both be affected. Although the use of the phosphate slag storage area for a utility corridor is unlikely under this alternative, these potential impacts could include those described above (Section 4.16) involving the 1-mile segment of the National Recreation Trail Complex and a shore segment of the Rockpile Hiking Trail along the Tennessee River (see Figure 3-30). TVA would obtain approval from ALDOT and FHWA prior to selling land associated with the trail complex and, to the extent practicable, avoid or reduce construction and operational impacts on the Rockpile Hiking Trail and the 900-foot section of the paved trail that passes through the Multipurpose Building portion of the proposed redevelopment area.

All three of these trail segments could remain unaffected or potentially enhanced through consideration of local recreational needs and use values through the Master Plan development process. Within the context of the recreation resources protection efforts outlined above, the cumulative effect of adopting this alternative on recreation would likely be positive.

4.16.3 Alternative C

Development of the MSR study area for commercial, retail, and residential use as required under Alternative C could cause significant negative impacts on public recreational use of the area. Such effects would be greater than those anticipated under Alternative B. Potential development associated with Alternative C would likely change the character of the MSR study area from open space and areas in a relatively natural character to developed, resulting in the area being less attractive for recreation. Increases in traffic levels and associated traffic noise could also make the area less suitable for outdoor recreation and could increase the potential for conflicts between trail users and vehicular traffic, especially at the two points where the paved trail crosses Reservation Road.

The three potential recreation-related impacts outlined under the discussion of Alternative B (i.e., potential effects associated with the development of the phosphate slag storage area as a utility corridor and the two segments of the Reservation Road trail within the MSR study area) would also apply to this alternative.

A third potential effect under this alternative relates to recreation use that currently occurs within the southwestern section of the MSR (see description under Sections 3.14 and 3.16). Modifications within this area resulting in the loss of existing vegetative cover or old road networks could have a negative effect on joggers and walkers that regularly use this area and a significant adverse effect on seasonal (e.g., spring and fall) bird-watching opportunities.

Implementation of the following measure, through execution of the Master Plan, could substantially reduce the potentially most adverse impacts on recreational use of the MSR study area:

- Informal trail networks within the southwestern portion of the MSR study area that are eliminated due to implementation of Alternative C could be replaced with trails that offer similar recreation opportunities at suitable locations north of Reservation Road or at other public parks or natural areas in the vicinity.

- Some recreational activities, such as fall bird watching, may not be available on other sections of the MSR study area due to the unique character of the southwestern area of the proposed redevelopment area and the unique population of bird species that are present in this area during the fall.

4.16.4 Alternative D

The potential impacts of future development under Alternative D are expected to be greater than those under Alternative B and similar to those under Alternative C. However, some types of industrial development and operations could produce additional noise or other environmental emissions that might result in some additional adverse impacts on nearby recreational areas as compared to Alternative C. The implementation of the mitigation measures described previously could substantially reduce the potential direct and indirect impact of this alternative on recreational opportunities and the quality of the experience. However, depending on the nature and extent of potential industrial development under this alternative, there could be significant negative impacts on the open space character and public recreation use of the MSR study area under Alternative D.

The potential recreation-related impacts outlined under Alternative C and the corresponding commitments would also apply to Alternative D. These commitments would reduce the potential direct impacts of this alternative. However, the expected reduction in open space areas; potential loss of areas currently managed for and available to the public for informal recreation, including the birding area on the southwestern portion of the property; increase in motorized traffic flows on area roads as well as on additional road networks that could be constructed; and increased noise levels would result in low to moderate adverse impacts on recreation. This could increase the potential for negative cumulative effects compared to Alternatives A and B.

4.16.5 Alternative E

The potential for more balanced development and conservation efforts envisioned under Alternative E would likely result in continued maintenance and protection of existing recreation facilities and activities and could also result in maintaining areas currently used for informal recreation and other low-impact activities available to and considered important to the public. However, development of commercial/retail, residential, and industrial areas could also likely have moderate negative impacts on recreational users due to the overall increase in development and associated increases in traffic and noise that would likely take place within the MSR study area. Depending on the intensity and location of residential, commercial, and industrial use areas, loss of open space and loss of areas currently managed to accommodate informal recreation use could also occur. Green spaces and buffer zones of vegetation, barriers, and effective use of juxtaposition and spacing of development and infrastructure could help reduce visual and noise effects.

The potential impacts of adopting and implementing Alternative E are expected to be greater than those anticipated under Alternative B and similar to those expected under Alternative C or D. The potential recreation-related impacts outlined under Alternative C and the corresponding commitments would also apply to Alternative E. As previously indicated under Alternative D, these commitments would reduce the potential direct, indirect, and cumulative impacts of this alternative.

4.16.6 Alternative F

The potential for direct, indirect, and cumulative adverse impacts to recreation resources under Alternative F would likely be similar to those expected under Alternative E. As indicated above, some land set aside for conservation in the Master Plan could minimize effects on recreation under Alternative F. The potential environmental effects from such development would likely be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

4.17 Transportation

In a letter dated August 18, 2009 (Brown 2009), ALDOT notified TVA of two projects under study its long range planning that could affect TVA land in the vicinity of the MSR study area. Only one verifiable project is noted in the study area, which is the widening of Second Street from four to five lanes (effectively constructing a center turn lane) between Hatch Boulevard and Wilson Dam Road. As this project does not add capacity (because turn lanes already exist at the major intersections on Second Street except Firestone Avenue), it has limited applicability to the transportation impact analysis. This project is referenced as Project #5 in the *Shoals Area 2030 Long Range Transportation Plan* (Skipper Consulting Inc. 2005).

ALDOT has indicated plans to widen US 72 (Hatch Boulevard) between Jackson Highway and Second Street to six lanes if warranted by traffic growth. A specific timeline has not been determined for this project. Additionally, there are long-term plans possibly to provide an interstate facility from Memphis, Tennessee, to Atlanta, Georgia, using an alignment on or similar to US 72. Implementation of this project was not assumed primarily because its timeline and likelihood are not defined. However, if such a project were to move forward, it could affect traffic flow on surface streets in the Muscle Shoals area. Some of the regional through traffic on Hatch Boulevard, Second Street, and Wilson Dam Road would likely divert to such a facility.

Future conditions were analyzed for the year 2035, a conceptual year in which the proposed MSR redevelopment would likely be complete. Future traffic volumes were estimated. To estimate the traffic that would likely occur whether the MSR study area is redeveloped or not (also known as “background traffic”), a 1.90 percent linear annual growth rate was utilized (see Section 3.17.1). To estimate the traffic volumes that would be generated by the MSR study area redevelopment alternatives (i.e., "project traffic"), land use and certain nonbinding assumptions for each alternative were made. All trips estimated to be generated in each alternative are considered "new" project trips. The assumptions were then utilized to conduct a trip generation analysis based on the rates and equations published in the standard Institute of Transportation Engineers' (2008) reference *Trip Generation User's Guide*. The estimated trips under each Action Alternative are presented in Table 4-4.

Table 4-4. Trip Generation Under Alternatives B Through E

Alternative	Project Trips on External Roadway			
	A.M. Peak Hour		P.M. Peak Hour	
	Enter	Exit	Enter	Exit
Alternative B	3,626	591	876	3,779
Alternative C	2,151	1,353	2,130	2,986
Alternative D	3,054	1,596	783	3,832
Alternative E	3,526	1,089	1,677	4,367

The resulting estimated new project trips for each alternative were assigned to the local roadway network utilizing existing traffic distribution patterns to estimate the total (background + project) number of peak-hour vehicles at each intersection in the year 2035, which were then analyzed to determine future LOS.

4.17.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. The existing intersection LOS for Alternative A is shown in Table 4-5

Table 4-5. 2035 Alternative A Intersection Level of Service

Location	A.M. LOS	P.M. LOS
Hatch Boulevard at Jackson Highway	D	**E**
Hatch Boulevard at Reservation Road	A	B
Hatch Boulevard at Second Street	D	D
Second Street at Firestone Avenue	B	B
Second Street at Wilson Dam Road	**E**	**E**
Wilson Dam Road at MSR Access (unsignalized, eastbound approach)	**F**	**F**
Wilson Dam Road at Access Road	B	**E**
Access Road at River Road	B	C
Access Road at Reservation Road	B	C

Bolded letters representing LOS mean that improvements to the roadways are needed.

The results indicate that the existing roadway network, even without redevelopment of the MSR study area, cannot accommodate the estimated increases in traffic over the next 25 years at several locations. To determine whether new land uses would have an adverse impact, the estimated traffic levels under the Action Alternatives were compared to those anticipated under Alternative A. In order to compare the Action Alternatives to Alternative A in the year 2035, potential roadway improvements were identified that could improve LOS conditions under Alternative A. The potential improvements are depicted in Table 4-6. At the intersection of Wilson Dam Road and the MSR Access Road, the LOS failure indicated by the analysis is likely due to the limitations in the analysis, and no improvements were recommended. As shown in Table 4-7, these improvements would improve conditions to LOS D or better and, to the degree feasible, should be considered in the future as necessary.

Table 4-6. Transportation Improvements Under Alternative A

Location	Improvements
Second Street at Wilson Dam Road	• Dedicated eastbound right-turn lane • Dedicated westbound right-turn lane • Additional westbound left-turn lane
Wilson Dam Road at Access Road	• Additional southbound left-turn lane
Hatch Boulevard at Jackson Highway	• Additional southbound left-turn lane (would require widening Hatch Boulevard southbound to three lanes south of the intersection)

Table 4-7. Intersection Level of Service Under Alternative A With Suggested Improvements*

Location	A.M. LOS	P.M. LOS
Hatch Boulevard at Jackson Highway	C	D
Hatch Boulevard at Reservation Road	A	B
Hatch Boulevard at Second Street	D	D
Second Street at Firestone Avenue	B	B
Second Street at Wilson Dam Road	D	D
Wilson Dam Road at MSR Access (unsignalized, eastbound approach)	**F**	**F**
Wilson Dam Road at Access Road	A	C
Access Road at River Road	B	C
Access Road at Reservation Road	B	C

*Expected in 2035
Bolded letters representing LOS mean that improvements to the roadways are needed.

4.17.2 Action Alternatives

Using the total trip volumes for Alternatives B through E, a LOS analysis was provided for each of the five Action Alternatives. To accommodate the new trips, three additional signalized access points to the MSR study area (one each on Wilson Dam Road, Hatch Boulevard, and at the intersection of Second Street at Firestone Avenue) were assumed for the analysis. In addition, redevelopment of the MSR study area was assumed to include upgrading the current access point to the MSR on Wilson Dam Road to include signalization. A signal warrant analysis and permit approval by ALDOT and/or any appropriate review agencies would be needed at the time of the MSR redevelopment.

In addition, to compare to the No Action Alternative with LOS D or better conditions, the improvements identified in Table 4-6 were assumed to be implemented by state or local agencies by the year 2035. The intersection LOS for Alternatives B through E is shown in Table 4-8.

Table 4-8. Intersection Level of Service Under Alternatives B, C, D, and E*

Location	Alternative B		Alternative C		Alternative D		Alternative E	
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
Hatch Boulevard at Jackson Highway	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**
Hatch Boulevard at Reservation Road	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**
Hatch Boulevard at Access Point	B	C	B	C	C	C	C	D
Hatch Boulevard at Second Street	**E**	**F**	**E**	**F**	**F**	**F**	**E**	**F**
Second Street at Firestone Avenue	B	C	B	C	C	C	D	C
Second Street at Wilson Dam Road	D	D	D	D	D	D	D	D
Wilson Dam Road at MSR Access	A	B	A	A	B	B	B	A
Wilson Dam Road at Access Road	A	B	A	A	B	B	A	B
Access Road at River Road	B	D	B	C	D	D	B	C
Access Road at Reservation Road	B	B	C	B	C	C	C	C

*Expected in 2035
Bolded letters representing LOS mean that improvements to the roadways are needed.

The results indicate LOS failure under all the Action Alternatives at three intersections all along Hatch Boulevard corridor. In particular, the LOS failures along Hatch Boulevard at Jackson Highway and Reservation Road are severe, based on the observed average delays of over 200 seconds, despite the assumed improvement of triple southbound left-turn lanes at Hatch Boulevard and Jackson Highway. In effect, the analysis indicates that the combination of the "background traffic" (including the large number of vehicles that have to turn left or right to stay on the US 43/72 route designation at Hatch Boulevard and Jackson Highway) and the estimated new trips associated with the MSR study area would severely impact the Hatch Boulevard corridor. Overall, the transportation impacts of redevelopment of the MSR study area from Alternatives C and E would be greater compared to Alternatives B and D because these alternatives would likely generate more trips to and from the MSR study area.

Under Alternative F, the MSR study area would be developed with no restrictions on the types of future land uses that could occur. As described in Sections 2.1.6 and 4.2.6, the reasonably likely future uses of the property under Alternative F are those described in Action Alternatives B, C, D, and E and would, therefore, result in a mixture of one or more of those uses or a mixed use reflected in Alternative E. Therefore, impacts of development under Alternative F on transportation are likely to be similar to those described under Alternative E and within the range of effects bounded by those described under Action Alternatives B, C, D, and E.

4.17.3 Potential Mitigation Strategy

Based on the results of the Alternative B, C, D, and E analysis, a determination was made that the LOS failures at Hatch Boulevard at Second Street could likely be mitigated with the strategic addition of turn lanes. However, the LOS failures on Hatch Boulevard would require more comprehensive solutions. Two overall potential mitigation approaches were developed:

Option 1: Realign the US 43/72 designation through Hatch Boulevard and relocate Jackson Boulevard to Birmingham Road (Table 4-9).

Option 2: Incorporate an additional access point to the MSR between the Tennessee River and Hatch Boulevard and construct grade-separated flyover for southbound US 43/72 through traffic at Hatch Boulevard (Table 4-10).

Table 4-9. Mitigation Option 1 for the MSR Study Area

Location	Improvements
Hatch Boulevard at 2nd Street	• Dedicated westbound left-turn lane. • Dedicated eastbound right-turn lane.
Hatch Boulevard at Jackson Highway	• Realign US 43/72 approaches to major north-south movement forming a new T-intersection with Hatch Boulevard on the eastbound approach. Jackson Highway would be relocated to utilize Birmingham Street to intersect with US 43. • Three through lanes for northbound and southbound approaches to US 43/72. Would require widening Hatch Boulevard to six lanes south of the intersection. • Northbound and westbound dual left-turn lanes.
Hatch Boulevard at Reservation Road	• Realign Jackson Highway to intersect with Hatch Boulevard on the eastbound approach (currently Birmingham Street). • Eastbound triple left-turn lanes. Would require widening Hatch Boulevard to six lanes north of the intersection. • New eastbound through lane. • Dedicated eastbound right-turn lane. • Additional westbound and southbound right-turn lanes to provide dual-turn lanes. • Dual dedicated southbound right-turn lanes with free-flow conditions (would require three receiving westbound lanes on Birmingham Street that would likely merge into two lanes).

Table 4-10. Mitigation Option 2 for the MSR Study Area

Location	Improvements
Hatch Boulevard at 2nd Street	• Dedicated westbound left-turn lane. • Dedicated eastbound right-turn lane.
Hatch Boulevard at Jackson Highway	• Construct a two-lane flyover over the intersection for southbound US 43/72 traffic, which would merge with a single lane carrying eastbound through (from Hatch Boulevard) and northbound right (Jackson Highway) traffic south of the intersection to create three lanes on Hatch Boulevard southbound toward Reservation Road. • Widening of Hatch Boulevard to six lanes between Jackson Highway and Reservation Road. • Provide an additional westbound left-turn lane.
Hatch Boulevard at Reservation Road	• Reconfigure the westbound right-turn channelized movement into a free flow (which would tie into a six-lane Hatch Boulevard north toward Jackson Highway).

Location	Improvements
US 43/72 at New MSR Access	• New signalized access to the MSR on US 43/72 between Hatch Boulevard and the Tennessee River. • Provide dual westbound left-turn lanes. • Dedicated channelized free-flow westbound right-turn lane. • Three through lanes northbound and southbound (north of the intersection, this would need to, along with the receiving lane from the westbound right turn lane, taper into two lanes northbound and southbound to tie into the O'Neal Bridge). • Provide dual southbound left-turn lanes.

Access improvement to the MSR study area for Alternative A, as shown in Table 4-6, were assumed to occur along with the mitigation options. These two mitigation strategies were tested using transportation analysis software. The results of utilizing these improvements for Alternatives B through E are provided in Tables 4-11 and 4-12. In addition, these improvements would require diversion of traffic volumes under each of the alternatives, including Alternative F.

Table 4-11. Mitigation Option 1 Intersection Level of Service Under Alternatives B, C, D, and E*

Location	Alternative B		Alternative C		Alternative D		Alternative E	
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
Hatch Boulevard at Jackson Highway	B	B	B	B	B	B	B	B
Hatch Boulevard at Reservation Road	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**
Hatch Boulevard at New Access Point	B	C	B	C	B	C	B	D
Hatch Boulevard at Second Street	C	C	C	D	C	D	C	D
Second Street at Firestone Avenue	B	B	B	C	C	C	B	C
Second Street at Wilson Dam Road	D	C	D	D	D	D	D	D
Wilson Dam Road at New Access Point	B	A	A	A	A	B	A	B
Wilson Dam Road at MSR Access	A	B	A	A	A	B	A	B
Wilson Dam Road at Access Road	A	C	A	C	A	C	A	C
Access Road at River Road	B	B	B	B	B	B	B	C
Access Road at Reservation Road	B	B	B	B	C	B	B	B

*Expected in 2035
Bolded letters representing LOS mean that improvements to the roadways are needed.

Table 4-12. Mitigation Option 2 Intersection Level of Service Under Alternatives B, C, D, and E*

Location	Alternative B		Alternative C		Alternative D		Alternative E	
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
US 43/72 at New Access Point	B	A	A	B	B	A	B	A
Hatch Boulevard at Jackson Highway	B	B	B	B	B	B	B	B
Hatch Boulevard at Reservation Road	C	C	B	C	C	C	C	D
Hatch Boulevard at New Access Point	A	A	A	A	A	A	A	B
Hatch Boulevard at Second Street	C	D	C	D	C	D	C	D
Second Street at Firestone Avenue	B	B	B	B	B	B	B	B
Second Street at Wilson Dam Road	D	C	C	C	D	C	D	C
Wilson Dam Road at New Access Point	A	A	A	A	A	A	A	A
Wilson Dam Road at MSR Access	B	A	A	A	A	A	A	B
Wilson Dam Road at Access Road	A	C	A	C	A	C	A	C
Access Road at River Road	B	B	B	B	B	B	B	B
Access Road at Reservation Road	B	B	B	B	B	B	B	B

*Expected in 2035

The modeling results for Option 1 indicate that these improvements would upgrade all of the intersections on US 43/72 considerably, including improving Hatch Boulevard at Jackson Highway to a LOS B. However, the intersection of Hatch Boulevard and Reservation Road would continue to operate at LOS F, despite significant reductions in average delay.

In contrast, the modeling results for Option 2 indicate that the improvements tested would mitigate all observations of LOS E or F in the vicinity of the site. Therefore, this option is recommended over the improvements in Option 1. However, given a variety of unknowns (e.g., alternative selection, the feasibility of particular improvements in terms of cost and engineering, community preferences, etc.), both options should be considered as potential mitigation strategies by transportation officials at Colbert County or ALDOT. TVA would rely on local and state authorities to consider these strategies or others ways for minimizing future development effects on traffic and would not be responsible for implementing or funding any particular strategy. Anticipated changes in traffic levels and volume would also be taken into account in the development of the Master Plan.

Indirect and Cumulative Effects

Because of the volumes of new traffic potentially generated by the year 2035 under any of the alternatives, but more so under Alternatives C, D, E or F, TVA anticipates that indirect and cumulative effects on the local transportation network within a mile or so from the MSR study area could also be significant. However, because of current improvements to Wilson

Dam Road, including its likely future widening from East Avalon south to US 72/20 (Alternate), as well as unscheduled but planned local ALDOT projects, local cumulative impacts are expected to be more moderate within a few miles from the site. At this distance along major routes, the influence of traffic associated with the redevelopment site could be assumed to return to normal volumes at those locations. If the major interstate (Memphis – Atlanta) becomes a reality, it could affect traffic flow on surface streets in the Muscle Shoals area. Thus, traffic-related congestion could be minimized and further reduce long-term cumulative effects of the potential redevelopment. Transportation impacts from this redevelopment proposal would likely cause insignificant impacts within Colbert County and the multicounty region, regardless of the adopted alternative.

4.18 Scenic Resources

Potential impacts to scenic resources were examined based on anticipated changes likely to occur on the existing landscape and the landscape character after alteration. Identifying these changes in the landscape character was based on commonly held perceptions of landscape beauty and the aesthetic sense of place.

The slope and vegetation patterns of a landscape can be determining factors in the relative ability of a particular landscape to accept human alteration with varying impacts to the scenic attractiveness and scenic integrity. For example, a landscape that is relatively level (i.e., flat) and densely forested has a much greater capacity to absorb change than does a landscape that is steeply sloping and sparsely vegetated or vegetated with lower-growing herbaceous vegetation. These characteristics are expressed in the general landscape character of the MSR study area where the topography is flat to gently sloping and vegetation types and patterns are diverse yet dense to sparse.

The 1996 Plan recommended the establishment of certain visual buffers, which continue to serve their visual management and protection purpose, along Reservation Road and the length of all transportation corridors surrounding the MSR (see Figure 2-1). Similarly, the Master Plan would likely involve the establishment of appropriate buffers to separate various land uses and to reduce potential impacts associated with scenic resources and noise. In addition, given current land use and urban landscape character over much of the interior of the site observable from Reservation Road, as well as recommended buffer zones, the extent and magnitude of visual alteration to the existing landscape from implementing any of the Action Alternatives would not change the scenic value class beyond the threshold of significance.

Creation or supplementation (i.e., additional plantings) of existing vegetative buffers would not be required. However, existing vegetation included within the buffer areas as shown in Figure 4-5, which should be considered in the Master Plan, could remain or be allowed to mature. The retention of these vegetative buffers, as identified below and in Section 2.3, in combination with limiting new roadway intersections (i.e., curb cuts) could reduce the potential for disturbance and maintain the park-like setting for viewers using TVA land and facilities along, and north of, Reservation Road. See a photograph of a segment of the maintained right-of-way along both sides of Reservation Road in Figure 3-35.

The measures described below could be used to reduce the potential for adverse effects to visual resources under the Action Alternatives and would be considered in development of the Master Plan.

- Except where maintained within the existing road right-of-way, a vegetative buffer, measured 150 feet from the edge of the pavement, shall be maintained along both sides of Reservation Road within the MSR study area from the intersection of Hatch Boulevard to the Wilson Dam Road overpass (Figure 4-5).

- Except where maintained within the existing road right-of-way, a vegetative buffer, measured 150 feet from the edge of the pavement, shall be maintained along Hatch Boulevard from the intersection of Reservation Road, southward for a distance of 500 feet (see Figure 4-5).

- Except where maintained within the existing road right-of-way, a vegetative buffer, measured 150 feet from the edge of the pavement, shall be maintained along Wilson Dam Road from the Reservation Road overpass, southward for a distance of 2,000 feet (see Figure 4-5).

- No more than four additional curb cuts (i.e., new roadway entrances onto the area) shall be made along Reservation Road.

4.18.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Potential effects to scenic resources associated with the adoption and implementation of this alternative were previously addressed in the 1996 Plan. No additional foreseeable actions that could have visual effects beyond those considered in the 1996 Plan are anticipated under the No Action Alternative.

4.18.2 Alternative B

Requiring the MSR study area land to be used for resource conservation and sustainable LID under Alternative B could result in enhanced opportunities for public use of the MSR property while maintaining or enhancing the landscape character. Any low-impact development occurring on the area under Alternative B is expected to adhere to the standards established in the Master Plan regarding visual buffers to mitigate potential adverse effects to scenic resources. Because the visual quality of the area would likely be increased, adoption of this alternative would likely result in a beneficial effect on scenic resources within the MSR study area. Although visual buffering would occur, potential development under Alternative B could result in similar or slightly greater visual impacts than those likely under Alternative A. However, actions under Alternative B would likely result in a less discernable impact to existing scenic resources and landscape character compared to development under Alternatives C, D, E, and F.

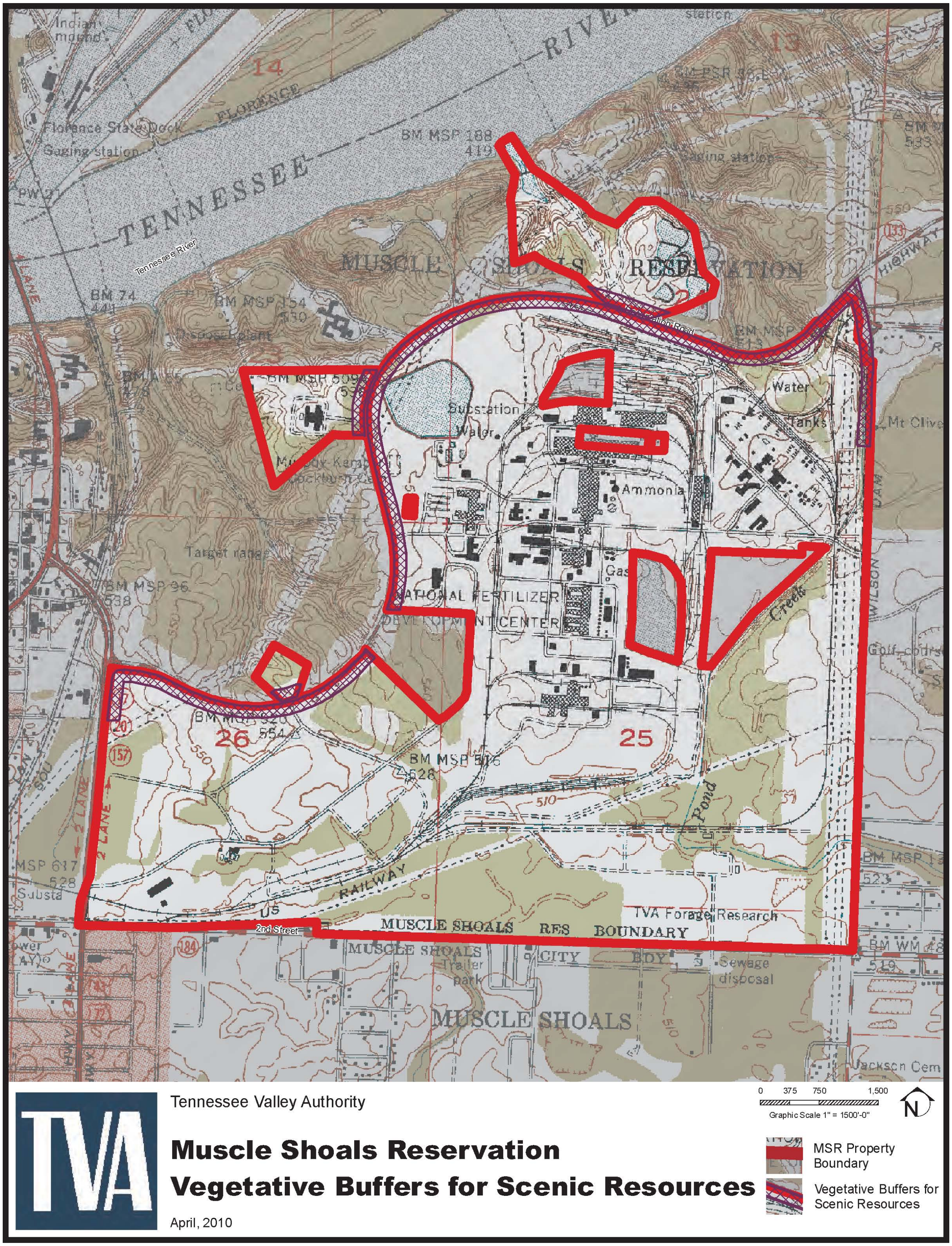


Figure 4-5. Proposed Vegetation Buffers for Scenic Resources

4.18.3 Alternative C

The MSR study area would be required to be used for commercial, retail, and residential land uses under Alternative C. This could result in a discernable change in the existing landscape character, depending on the location, density, context sensitivity, and phasing of development. Proposed development could take place over nearly the entire MSR study area. These types of development could affect areas of rural, pastoral, and naturally appearing landscape character. Vegetation would likely be removed or reduced to allow for development and the expansion of infrastructure associated with this alternative. The topography within the MSR study area could be uniformly graded to facilitate construction and expansion of utilities and services within the site. The measures identified above or in the Master Plan standards, applicable to Alternatives B, C, D, E, and F, if implemented, could mitigate impacts to scenic resources. With such mitigation, implementation of this alternative would not likely result in a significant impact to scenic resources. Eventual development activities under Alternative C would likely result in a more discernable impact to existing scenic resources and landscape character as compared to Alternatives A and B. However, with the implementation of appropriate standards, development under this alternative would result in impacts similar to those associated to Alternatives D, E, and F.

4.18.4 Alternative D

Adoption of Alternative D would require that the property be used for industrial purposes. Depending on the type of industry that could locate on site, development under this alternative could result in adverse effects to existing scenic resources within the MSR study area. Removal of existing trees and extensive site grading and surfacing could affect the scenic integrity of portions of the MSR study area having a rural, pastoral, or naturally appearing landscape character. Discharges, emissions, smoke or vapor plumes, odors, noise, and/or waste light could also be generated, depending on the size and type of industry located on the MSR study area.

The measures and potential Master Plan standards identified above, which are applicable to Alternatives B, C, D, E, and F, could mitigate impacts to scenic resources. Thus, implementation of this alternative would not necessarily result in a significant impact to scenic resources. Site development under Alternative D would likely result in greater impacts compared to those expected under Alternatives A, B, E, and F. However, with the implementation of appropriate measures, potential effects under Alternative D would be similar to those likely under Alternative C.

4.18.5 Alternative E

Under Alternative E, TVA would require that the MSR study area be used for a mixture of commercial, retail, residential, and industrial land uses. Depending on the composition of land uses as well as their size, density, and location, implementation of Alternative E could result in the partial removal of existing woody vegetation and moderate site grading. Conversely, adoption of this alternative could result in the protection or enhancement of areas expressing a rural or naturally appearing landscape character potentially associated with desirable conservation, retention of forests, parks development, or other green space initiatives.

The measures or potential Master Plan standards mentioned above could mitigate adverse impacts to scenic resources. With the appropriate implementation of these measures, development under this alternative would not result in a significant impact to scenic resources. Implementation of Alternative E would likely result in a more discernable impact to scenic resources as compared to Alternatives A and B. However, with mitigation, proposed actions subsequent to the adoption of this alternative would result in impacts similar to those likely under Alternatives C, D, and F.

4.18.6 Alternative F

The potential for direct, indirect, and cumulative adverse impacts to scenic resources under Alternative F would likely be similar to those expected under Alternative E. As indicated above, some land set aside for conservation or vegetative buffers in the Master Plan could minimize effects on scenic resources under Alternative F. The potential environmental effects from such development would likely be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

Indirect and Cumulative Effects

Implementation of any of the Action Alternatives would result in increased development within the MSR study area. This increase would likely vary by alternative. Implementation of Alternative B or C would likely result in low- to moderate-density development, whereas development under Alternatives D, E, and F would likely result in more moderate- to high-density development. Although roadways are presently heavily traveled, these variable intensities of development could result in associated varying degrees of discernable future increases in traffic on the roadways that bound the property. The amount of on-site traffic, particularly on Reservation Road, and disturbance is expected to increase over time under all the alternatives, including the No Action Alternative (see Section 4.17.1). With mitigation, these increases could likely be absorbed into traffic densities, transportation improvements, and travel patterns over time and would not significantly cumulatively affect scenic resources.

Similar to the incremental increase in traffic associated with the Action Alternatives, increases in discernable levels of night sky brightness could occur with heavier levels of development. While this potential exists, incremental increases in night sky brightness associated with these alternatives would not significantly indirectly or cumulatively affect scenic resources due to the existing levels of night sky brightness created by the four neighboring cities.

4.19 Navigation

As indicated in Section 3.19, the Florence-Lauderdale County Port Authority's barge terminal, the major navigation channel, and Wilson Dam Lock are located on the right-descending (north) riverbank opposite the MSR study area. Potential river navigation effects could be a concern primarily along the left-descending (south) shoreline, particularly in the vicinity of the utility corridor (across the slag storage area).

The five Action Alternatives (particularly Alternatives D, E, and F) involve the potential use of land in the study area for a utility corridor to the Tennessee River. Future use of this property has the potential to interfere with commercial and recreational navigation if it involves the placement of structures in or on the Tennessee River. Such structures could likely include water or sewage outfalls, water intakes, or other types of pipelines. The likelihood of needing such water access or water use facilities would vary by the nature of potential development under each of the Action Alternatives.

Any proposed facility or shoreline alteration on the Tennessee River would be subject to state and federal authorization, including TVA review and approval under Section 26a. Because of environmental and reservoir operations constraints along the left-descending (south) shoreline of the Tennessee River in the vicinity of the utility corridor, TVA would not approve a barge terminal, commercial dock, or other similar shoreline facility. However, the Florence-Lauderdale County Port Authority, a major multimodal port, is located at TRM 256.5 on the right-descending (north) riverbank opposite the MSR study area site. The Wilson Dam lock is also on the north riverbank. Depending on the type and extent of future development on the MSR property, materials, goods, and products shipped to or from the site would contribute to an increase in commercial barge traffic on the north bank.

The Tennessee River channel between the dam and O'Neal Bridge, in the vicinity of the south bank, is unsuitable for commercial navigation for the following reasons:

- The shoreline in this area and any potential water use facilities would be susceptible to high flows that are produced when Wilson Hydro Plant is generating or spilling during flood control operations, as well as fluctuations in water surface elevations that result from hydro units being turned on and off.

- Wave wash or prop wash from passing vessels can cause damage to shoreline facilities.

- Existing structures over the river including O'Neal Bridge at TRM 256.4 (US 72/43 or North Jackson Highway) and particularly the old Southern Railroad trestle at TRM 256.5, toward the river's south side, would pose hazards to any increased number or size of vessels motoring upstream to the area of the utility corridor site (see Figure 4-6).

- Water depths at this location may be too shallow for certain types of operations without dredging or excavation.

4.19.1 Alternative A
Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Development of the utility corridor or along Tennessee River shoreline at the site of the phosphate slag storage area would not likely occur under this alternative. Thus, no additional effects to navigation are anticipated under this alternative and use of the utility corridor to the river is unlikely.

4.19.2 Alternative B
Sustainable, low-impact development as required under Alternative B is unlikely to require use of the utility corridor or to affect the Tennessee River. Thus, there are no foreseeable impacts to navigation under Alternative B. However, in the unlikely event that some water access or development on the riverfront is necessary under Alternative B, TVA would review such future requests under Section 26a on a case-by-case basis. Approval of these requests would likely be contingent on the implementation of necessary measures to reduce the potential for adverse effects to navigation.

4.19.3 Alternative C
The need for shoreline alterations or water use facilities associated with commercial, retail, and residential development under this alternative is unlikely. Thus, potential navigation-related effects are unlikely. The potential for high flows, fluctuating water surface elevations, and increased commercial or recreational boating traffic may require restrictions or limitations to be placed on the type or size of shoreline facilities allowed, if any, under this alternative. All such requests would require independent review and Section 26a approval by TVA.

Figure 4-6. Existing O'Neal Bridge and the Old Southern Railroad Trestle

4.19.4 Alternative D

Industrial use of the MSR study area under Alternative D would increase the likelihood that the utility corridor and supporting infrastructure development would be needed. The potential for adverse navigation impacts associated with shoreline alterations or water use facilities that may be requested to support the industrial uses of the property, such as a pipeline or intakes, are greatest under Alternative D compared to Alternative A, B, C, E, or F. These potential effects are related to the extent of potential industrial development that could occur south of Reservation Road given that the MSR study area would not be available for other types of land uses. All requests for such uses at this location along the

Tennessee River would require independent review and Section 26a approval by TVA as described in Alternatives B and C. As previously mentioned, TVA would not allow development of a barge terminal, commercial dock, or other similar shoreline facility along this shoreline of the Tennessee River (see Section 4.19). Under this alternative, an increase in navigation traffic could occur at nearby port facilities.

4.19.5 Alternative E

Under Alternative E, shoreline development or water use facilities such as a pipeline or intakes could be requested to support mixed use development of the MSR study area. Such water use facilities could adversely impact navigation, and the potential for effects is similar to or slightly less than those under Alternative D. All requests for shoreline alterations or water use facilities at this location would be subjected to independent review and Section 26a approval by TVA as described above. As mentioned in Alternative D, the river shoreline in the vicinity of the utility corridor would not be approved for water use facilities such as a commercial dock or barge terminal (also see Section 2.1.6). Under this alternative, an increase in navigation traffic could occur at nearby port facilities.

4.19.6 Alternative F

The potential for direct, indirect, and cumulative adverse impacts to navigation traffic under Alternative F would likely be similar to those expected under Alternative E. Even under a likely mix of alternative land uses (unrestricted), some use of the utility corridor would likely be needed to support an industrial development component on the MSR study area. Similar use as described under Alternative D would minimize effects on navigation under Alternative F. The potential environmental effects from such development would likely be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

Indirect and Cumulative Effects

In regard to potential indirect or cumulative effects on navigation, TVA expects such effects to be none or inconsequential. Because the main river channel and Wilson Lock access are on the opposite side (right-descending or north bank) of the Tennessee River, commercial navigation traffic and patterns under the action alternative (Alternatives B through F) are not expected to change. As described above, the Florence Port, located opposite the MSR study area site, would serve the needs of developers to move materials, goods, and products by barge to or from the site. Commercial barge traffic could increase and likely be accommodated with existing facilities. Therefore, no adverse indirect or cumulative effects on commercial navigation are expected. Because much of the left-descending shoreline would remain allocated to Public Recreation and Open Space and industrial development of the MSR study area would likely be less under Alternative A, no indirect or cumulative effects on commercial navigation are expected.

Construction and operation of industrial support infrastructure, such as a pipeline or intake, could adversely affect recreational navigation in the immediate area, so under any of the Action Alternatives (particularly Alternative D, E, or F), effects on recreational navigation are expected to be cumulatively minor and regionally insignificant. Such future proposals for shoreline infrastructure development would be independently reviewed under Section 26a and approved only with mitigation, as appropriate.

4.20 Noise

Generally, noise refers to unwanted sound, especially sound that creates an annoyance or disruption of normal activities. Typical noise sources include construction activities, equipment operation, and vehicular traffic. The amount of noise at a particular location can be reduced by the use of strategically placed physical barriers, vegetation screens, separation of the source and the receptor by distance, and enclosing the noise source. The noise effects on a particular receptor are a function of the location (i.e., perspective) of the noise source, both of which can be subject to change.

4.20.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Therefore, the foreseeable level of new external noise generated is not expected to change as a result of this proposal.

4.20.2 Alternative B

Under Alternative B, TVA would require the new owner(s) of the MSR study area to use the property for conservation and sustainable LID uses. Development under both Alternatives A and B would largely retain or resemble the reservation’s current environmental state and recreational opportunities without introducing substantial additional noise generation sources to the environment. Therefore, implementation of Alternative B would add little or no contribution to the noise levels currently existing on the proposed MSR redevelopment study area and would not likely negatively affect TVA employees, wildlife, or the recreational users and other visitors (i.e., receptors) to the area.

4.20.3 Alternative C

Adoption of Alternative C would require that the MSR study area be used for commercial, retail, and residential uses. Depending upon the nature, location, and intensity of these developments, implementation of Alternative C could introduce additional noise from such sources as increased traffic flow, construction noise, and increased residential population noise. These impacts could disturb internal noise receptors (i.e., TVA employees and other workers) on the property as well as recreational users nearby and wildlife and their communication and breeding habits. Recent studies on birds nesting along roads and highways found that increased traffic noise could hamper detection of songs by birds of the same species, making it more difficult for birds to establish and maintain territories, attract mates, and maintain pair bonds, and possibly leading to reduced breeding success in noisy habitats (Parris and Schneider 2008). In some less common instances, birds demonstrate a high tolerance for environmental noise that poses no threat. However, based on the current level of background noise along major roadways around the property and any likely future expansion and substantive traffic increases, these impacts on people and wildlife are not expected to be significant.

During its peak use between 1977 and 1980, the MSR property was typically occupied by approximately 950 TVA employees. Currently, the number of TVA employees commuting by vehicle to the Reservation is approximately 600 to 700. Given the drop in vehicular traffic from reduced employment, the noise impacts associated with the additional people and traffic from development under Alternative C would probably not be significant. Because of normal daytime background noise levels and the presence of existing commercial development, particularly along Hatch Boulevard and portions of Second Street, external receptors around the area would not likely be exposed to a significant increase in the overall level of new noise generated. These multiple use businesses and dwellings represent the closest sensitive receptors bordering the MSR study area that would be exposed to noise generated from the site (i.e., external noise receptors).

Most noise caused by new commercial development would likely occur during daylight hours. Because of the distance between generators and sensitive residential receptors along other portions and south of Second Street, noise from new commercial development would not cause a significant level of annoyance. Existing daytime background noise levels around the property averaged nearly 80 dBA measured during the morning hours between May 20, 2010, and May 28, 2010 (see Section 3.20 Noise). The resulting DNL noise levels, including noise generated from new sources, would probably remain at or near the 1977 average levels of 55 dBA daytime and 45 dBA nighttime. Development under Alternative C would likely have greater potential noise effects compared to Alternatives A and B, potentially less than Alternative D and possibly similar impacts compared to those likely under Alternative E or F.

4.20.4 Alternative D

The MSR study area would be used for industrial purposes under Alternative D. Noise level increases of 5 to 20 dBA DNL are conceivable during plant construction and operations, depending on the type of industrial development ultimately locating on the site. Under Alternative D, heavier types of industry (e.g., metal factories, mills, other production facilities) that could occupy the site, along with the heavier truck or rail traffic and machinery operations associated with these industries, would pose the greatest risk of significantly increased noise impacts from the redevelopment project.

The study area already contains several potential development locations bordered by evergreen and deciduous forests. If these forested areas were left intact and if the proposed industrial developments were located with noise abatement in mind, these forests and strips of vegetation would tend to reduce the noise anticipated under Alternative D. Vegetation buffers potentially addressed in the Master Plan to reduce the effects of noise could be the same as those intended to maintain or enhance scenic values on the property (also see Section 4.18). Additionally, maintaining a noise-reduction zone between the industrial developments and the potentially impacted wildlife on the reservation would reduce the potential for disturbance or harm to these resources. A calculated noise-reduction zone (see Section 3.20) and the retention of the previously mentioned forests could reduce noise associated with Alternatives C, E, and F and, even more so, with Alternative D. Other potentially acceptable mitigation measures include strategically positioned or constructed physical sound barriers or enclosures for the heavy construction equipment and production machinery, proper interior acoustics, and the muffler sound suppression systems for trucks and other heavy equipment. Development under Alternative D would likely have greater potential noise effects compared to Alternatives C, E, and F and substantially greater impacts compared to those likely under Alternative A or B.

4.20.5 Alternative E

Mixed use development required under Alternative E would potentially introduce additional noise sources, including traffic, residential noise, and industrial noise compared to the current condition. However, because the amount of industrial use would likely be less, adoption of this alternative is less likely to introduce the same level of noise as development under Alternative D. The previously discussed mitigating factors of the forests, the use of modern technology such as enclosures or barriers, and a calculated noise-reduction zone could be implemented under Alternative E. If these measures were in place, development under this alternative would not likely cause significant noise-related effects on interior or exterior receptors.

Development under Alternative E would likely have less noise effects compared to Alternative D, probably about the same as Alternative C, and potentially greater impacts compared to Alternative B.

4.20.6 Alternative F

The potential for direct, indirect, and cumulative adverse impacts from noise under Alternative F would likely be similar to those expected under Alternative E. Even under a likely unrestricted land uses scenario, other described land use components would also likely occur in lesser proportions on the MSR study area. Similar measures as described under Alternatives D and E would minimize effects of noise under Alternative F. The potential environmental effects from such development would likely be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

Indirect and Cumulative Effects

Likely on-site impacts from noise associated with the alternative future uses of the MSR study area are expected to be minor to moderately significant during any short-term commercial or residential construction and long-term operation of heavy industrial plants or facilities. The impacts depend on the type of sensitive interior or external noise receptors in the project development areas, such as people and wildlife, and the proximity of the new construction location(s), such as residential, on the MSR.

Noise would be a minor impact during operation under all the alternatives at the nearest receptor locations off site (external). Moderate, short-term direct impacts are expected at the proposed operating sites. Daytime background noise from existing commercial and industrial development would contribute to the overall levels experienced by nearby receptors. Potential indirect impacts or cumulative DNL noise effects over the long term, particularly under Alternatives C and D and potentially under Alternative E or F, would be minor with the incorporation of noise mitigating strategies such as distance, barriers, enclosures, and modern technological noise reducers. Such effects could have a greater effect on nearer residential communities south of Second Street but less effect on commercial areas west of the MSR study area. Use of noise-reduction measures could be taken into account during the Master Plan development process.

4.21 Unavoidable Adverse Effects

Unavoidable adverse impacts on some resources are expected to potentially occur as a result of transferring the TVA property to nonfederal ownership and implementation of the preferred development alternative. Depending upon the type, nature, and extent of development, these resources could include historic and archaeological resources, groundwater, surface water quality, wetlands, nonendangered aquatic life, terrestrial plants and wildlife, recreation, transportation, and scenic resources. These effects could result from land use changes, including vegetation clearing and related site disturbance and construction, increased surface water runoff, loss of recreation opportunities, increased concentrated human use and facility operation, increases in noise and land-based traffic, and improvements to existing and new road and utilities construction. Some of these adverse effects could be reduced through implementing mitigation measures described in Sections 2.1 and 2.3.

Adverse effects on public health from exposure to groundwater affected by regulated remnant contaminants could be unavoidable. TVA will prohibit use of groundwater for drinking water from any location on the MSR study area property. Monitored SWMU areas and the phosphate slag storage area would be retained in federal ownership. Parts of the MSR study area, i.e., zones, differentiated by potential amounts and types of remaining contaminants, if any, require restrictions on development and use based on levels of exposure determined to protect human health. For example, Zone A, an approximately 300-acre area, of which it was determined that about 17 acres were cleaned up to industrial screening levels, could be made available for appropriate industrial development without additional remediation. Zone B, the phosphate slag storage area, would be restricted from development and not sold in fee, but access to the property for certain uses, such as utility rights-of-way, could be considered under specific use agreements (e.g., easements). Zone C, about 1,000 acres not known to have been contaminated, could accommodate a variety of types of development. Zone D, a small 100-foot-by-100-foot fenced area of buried low-level radioactive waste, might also be used for a variety of types of development if the fill material (i.e., the soil cap) over the site is not disturbed by excavation or trenching. As required by law, TVA would warrant in the sale deed that the property has been cleaned up to the extent necessary to protect human health and the environment and that the U.S. will perform any cleanup that becomes necessary in the future.

Because portions of the approximately 1,400-acre MSR study area contain streams or lie within the limits of the 100-year floodplain or wetland areas, some additional future project-specific environmental reviews associated with actions requiring approval from TVA under Section 26a would be conducted prior to implementation of development plans by new property owners. The extent of the floodplain near prime development sites (e.g., Second Street and Wilson Dam Road) could be considered avoidable yet such area are very likely to be proposed for development (with mitigation) if there is no practicable alternative. Such planned land uses would reflect the customs and values of the local people and would be guided by the local governments through a comprehensive Master Plan along with other applicable local regulations, laws, and ordinances. Such development would only occur consistent with EO 11988.

Development under any of the five Action Alternatives (B, C, D, E, or F) would also be accomplished in accordance with transfer deed restrictions or other commitments to avoid, reduce, rectify, minimize, compensate, or mitigate adverse impacts to human health or the environment. Unavoidable adverse impacts on historic properties (i.e., buildings and structures), groundwater, and transportation could likely continue under Alternative A, No Action. Some potential adverse resource impacts such as those to surface water quality, floodplains, prime farmland, aquatic and terrestrial life, prime farmland, recreation, scenic resources, and navigation would be less likely under Alternative B. Mitigation measures would be designed and implemented to avoid further degradation of water quality in Pond Creek. Overall, implementation of the Master Plan will help strategically minimize potentially unavoidable adverse effects by guiding land use away from environmental conflicts and resources that are more sensitive.

Because of the extent and intensity of existing commercial, business, recreation, and residential development among the adjoining municipalities surrounding the MSR study area, implementation of any of the five Action Alternatives is not expected to significantly cumulatively adversely affect any resources evaluated during this study.

4.22 Relationship of Short-Term Uses and Long-Term Productivity

NEPA requires consideration of the "relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR § 1502.16). For the redevelopment of the MSR study area, short-term uses generally are those that are expected to occur within a 20-year plus build-out period, while long term refers to later decades (e.g., 30 to 50 years). Productivity is the capability of the land to provide market and amenity outputs and values for future generations. The capability of the land to sustain productivity is one factor that influences the quality of life for future generations.

Once the MSR study area is sold and transferred, it would be subject to development and changes in land use likely by private interests. In the short term, such development is anticipated to be consistent with the alternative that TVA selects. Planned development would also ultimately be implemented in accordance with a Master Plan prepared by TVA, local governments, and the Shoals communities. Such development would also be in compliance with other applicable federal, state, and local laws, regulations, and ordinances, as well as consistent with any special commitments, restrictions, or mitigation measures required by TVA to protect public health or the environment.

Sale or transfer of the land for developed uses (e.g., industrial, commercial, retail, residential, and some types of mixed use development) has the potential to decrease the productivity of land for agriculture, forestry, wildlife, some recreational activities, and management of other natural resources. The current licensing of 182 acres of agricultural land would cease prior to transfer of any of the affected property. Along with this licensed acreage, some prime farmland soils would likely be converted to nonagricultural uses. Additional potential development over the approximately 1,400-acre landscape, including access roads, parking lots, commercial, retail, and other business, as well as residential, industrial, and even certain less intensive LID, would convert and reduce the acreage of existing productive open land, fields, and forests. Although provisions to avoid, minimize, or mitigate losses of natural functions and values associated with wetlands and floodplains would be developed, some development on such land and associated losses of productivity would likely occur in the short term.

Although some, but probably a lesser amount, of land in green spaces is expected to be retained under Alternatives C, D, E, and F, development subsequent to the adoption of these alternatives would result in short- and long-term overall losses in productivity. Development under Alternatives C, E, and F would also likely have less but similar effects on long-term productivity of land not built upon (i.e., outside the direct footprint of buildings, pavement, and supporting facilities). Because of the potential from more direct intensive development as well as indirect off-site and cumulative effects, adoption of Alternative D would likely have the greatest comparative short- and long-term effects. Conversely, adoption of Alternative B would increase the likelihood of maintaining greater long-term productivity of land and sustainability of development within the MSR study area due to the anticipated conservation of natural resources including forest, fields, wetlands, and wildlife habitats. From a conservation perspective, creation or maintenance of more natural land cover would also reduce runoff, increase buffer, maintain terrestrial plants and wildlife, and protect water quality and aquatic life, thus contributing to the site's long-term productivity. Therefore, long-term productivity of the land is expected to be greatest under Alternative B.

Continued regional development trends on private lands in the surrounding counties, particularly east toward Huntsville, Alabama, could continue to contribute to a long-term gradual loss of some wetland types and the degradation of aquatic and terrestrial habitats regardless of the alternative selected.

4.23 Irreversible and Irretrievable Commitments of Resources

A commitment of resources is irreversible when options are lost to future generations. An irreversible commitment of resources suggests that a permanent or long-term—over 50 years—commitment of environmental resources would result from implementing the proposed action. Irreversible commitments of resources also generally occur from the use of nonrenewable resources, such as minerals, cultural resources, and fossil fuels, which have few or no alternative uses at the termination of the proposed action. Other factors are also considered such as resources like soils where productivity is renewable only over long time spans. Conversely, an irretrievable commitment of resources suggests that a short-term—less than 50-year—commitment of resources would result in the lost production or elimination of renewable resources such as timber, agricultural land, or wildlife habitat. Opportunities for use of these resources are foregone for the period of the proposed action, but these decisions are reversible. The use of opportunities foregone is irretrievable.

The disposal of land from the MSR study area under all the Action Alternatives would result in direct impacts to the environment. Once the land is transferred from federal ownership, it is expected that it would be developed. Construction and operation activities on this land would result in an irretrievable and irreversible commitment of natural, physical, and cultural resources.

Under the No Action Alternative, there would be no foreseeable changes of land use within the MSR study area. Thus, adoption of Alternative A would preclude any irreversible or irretrievable commitments of land resources resulting from the proposed disposal or transfer action. Adoption of Alternative B would result in some compatible LID and likely fewer irreversible or irretrievable commitments of resources. This would include the need for less raw and manufactured materials and conservation and maintenance of renewable natural resources on the site. Depending upon the nature and extent of development, construction of commercial, retail, and residential structures, facilities, and supporting infrastructure under Alternative C, E, or F would involve irreversible commitment of fuel, energy, and building materials. Similar amounts of irretrievable natural resources would likely be directly lost to site development under Alternative C, E, or F. The greatest loss of irreversible and irretrievable resources has the potential to occur under Alternative D, industrial land use.

4.24 Energy Resources and Conservation Potential

The potential for energy use and conservation savings would be similar under Alternative A or B. Depending on the nature and extent of development associated with Alternatives C, E, or F similar energy usage and potential resource conservation are expected. Greater energy usage and less conservation are likely under Alternative D, industrial land use. Any necessary mitigation of adverse effects would be imposed to minimize conservation losses associated with all the Action Alternatives. The strategically developed Master Plan would take into account the TVA selected alternative, consider establishing standards, and guide future development decisions, thus conserving energy resources.

CHAPTER 5

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Position:	Contract Environmental Scientist
Education:	B.S., Chemistry/Biology
Experience:	19 years in RCRA Corrective Action, Human Health Risk Assessment, and Solid and Hazardous Waste Management
Involvement:	Solid and Hazardous Waste

Matthew D. Williams, P.E.

Position:	Environmental Engineer
Education:	M.S., Environmental Engineering; B.S., Civil Engineering
Experience:	9 years in Hydrologic/Environmental Investigation and Analysis for Environmental and Engineering Applications
Involvement:	Groundwater

CHAPTER 6

6.0 DISTRIBUTION OF FINAL ENVIRONMENTAL IMPACT STATEMENT

The following list of agencies, officials, tribes, individuals, and libraries received either a published copy (printed copy or compact disc [CD]) of the final EIS or a Web link to an active TVA Web site from which the document can be accessed.

Federal Agencies Receiving the Final EIS (Printed Copy or CD)

National Resources Conservation Service, Alabama State Conservationist
U.S. Army Corps of Engineers, Mobile District
U.S. Army Corps of Engineers, Nashville District
U.S. Department of the Interior
U.S. Environmental Protection Agency, Region 4
U.S. Fish and Wildlife Service, Daphne Field Office
U.S. Fish and Wildlife Service, Refuge Office
U.S. Nuclear Regulatory Commission

State and Local Agencies Receiving the Final EIS (Printed Copy or CD)

Alabama Department of Agriculture and Industries
Alabama Department of Conservation and Natural Resources
Alabama Department of Economic and Community Affairs
Alabama Department of Environmental Management
Alabama Department of Labor
Alabama Department of Public Health
Alabama Department of Transportation
Alabama Forestry Commission
Alabama Historical Commission
Northwest Alabama Council of Local Governments
Shoals Economic Development Authority
Top of Alabama Regional Council of Governments

Federally Recognized Tribes (E-Mail Notification of Availability)

Absentee Shawnee Tribe of Oklahoma
Alabama-Coushatta Tribe of Texas
Alabama-Quassarte Tribal Town
Cherokee Nation
The Chickasaw Nation
Eastern Band of Cherokee Indians
Eastern Shawnee Tribe of Oklahoma
Jena Band of Choctaw Indians
Kialegee Tribal Town
Muscogee (Creek) Nation of Oklahoma
Poarch Band of Creek Indians
Seminole Tribe of Florida
Seminole Tribe of Oklahoma
Shawnee Tribe of Oklahoma

Thlopthlocco Tribal Town
United Keetoowah Band of Cherokee Indians in Oklahoma

Organizations Receiving the Final EIS or Notification of Availability

Alpha Kappa Alpha Sorority Inc.
Alpha Phi Alpha Fraternity Inc.
American Chestnut Foundation
Church of Christ, Tuscumbia
Delta Sigma Theta Sorority Inc.
First Baptist of Shoal City
Kappa Alpha Psi Fraternity Inc.
Mount Olive Missionary Baptist Church
National Association for the Advancement of Colored People
Omega Psi Phi Fraternity Inc.
Phi Beta Sigma Fraternity Inc.
Shoals Environmental Alliance
Zeta Phi Beta Sorority Inc.

Individuals Receiving Notification and Final EIS (Hard copy or CD)

Henry Allen
Killen, Alabama

Barry Auchly
Florence, Alabama

Grady Batchelor
Haleyville, Alabama

Jane Beavers
Ocean Springs, Mississippi

B. Paul Bernauer
Florence, Alabama

Don Blazer
Tuscumbia, Alabama

James Bowles
Florence, Alabama

David Bradford
Muscle Shoals, Alabama

Steve and Connie Carpenter
Tuscumbia, Alabama

Ed Castile
Montgomery, Alabama

Victor Dura
Rogersville, Alabama

Larry Gautney
Florence, Alabama

Alex Godwin
Muscle Shoals, Alabama

Lynn Greer
Rogersville, Alabama

Brenda Griffith
Florence, Alabama

Mitch Hamm
Tuscumbia, Alabama

Quinton Hanson
Florence, Alabama

Gregory J. Harber
Birmingham, Alabama

Jackie Hendrix
Florence, Alabama

Steve Holt
Florence, Alabama

Greg Jackson, M.D.
Birmingham, Alabama

Coy Johnson
Tuscumbia, Alabama

Michael Lansdell
Muscle Shoals, Alabama

Jason Lard
Florence, Alabama

James Laurent
Alabaster, Alabama

Darin Liles
Courtland, Alabama

Jim Maddox
Tuscumbia, Alabama

Rex Mayfield
Russellville, Alabama

Vernon McGee
Muscle Shoals, Alabama

Brandon Moore
Montgomery, Alabama

Stephanie Newland
Sheffield, Alabama

Jackie Norton
Sheffield, Alabama

Kathy Pigg
Pulaski, Tennessee

Tom Piper
Tuscumbia, Alabama

Jackie Posey
Town Creek, Alabama

Billy Quesenberry
Sheffield, Alabama

Edwin Quigley
Muscle Shoals, Alabama

Holly S. Rene'
Muscle Shoals, Alabama

Joel Retherford
Killen, Alabama

Tommy Riner
Cherokee, Alabama

Celia Rudolph
Muscle Shoals, Alabama

Susan Ruffrage
Florence, Alabama

David W. Sample
Florence, Alabama

Sam Scarborough
Florence, Alabama

Rick Sharp
Florence, Alabama

Linda Sherk
Vandiver, Alabama

Bill Shoemaker
Tuscumbia, Alabama

Mayda Simone
Muscle Shoals, Alabama

Paul Sisco
Asheville, North Carolina

Ronnie Smith
Huntsville, Alabama

William E. Smith
Muscle Shoals, Alabama

Janet Spahn
Tuscumbia, Alabama

Tiffany Stonecipher
Muscle Shoals, Alabama

Joseph Touchton
Auburn, Alabama

Don Walker
Muscle Shoals, Alabama

Kenneth Warhurst
Tuscumbia, Alabama

Gary Warren
Haleyville, Alabama

Marilyn Watson
Florence, Alabama

Bonnie White
Auburn, Alabama

Victoria and William White
Muscle Shoals, Alabama

Gary Dan Williams
Muscle Shoals, Alabama

Kenneth Wills
Muscle Shoals, Alabama

Jeff Wooten
Muscle Shoals, Alabama

Individuals Receiving Notification of Availability

Martin Abroms
Florence, Alabama

Dr. John D. Agricola
Gadsden, Alabama

Robert B. Alderholt
Washington, DC

Tim Alford
No Address Given

Tommy Allen
Florence, Alabama

Billy Don Anderson
Sheffield, Alabama

Margie Anderton
Killen, Alabama

J. Andrews
No Address Given

Don Armstrong
Sheffield, Alabama

Stanley Ashe
Killen, Alabama

Colin Bagwell
Huntsville, Alabama

Solomon T. Bairai
Florence, Alabama

Betty Balch
Killen, Alabama

Steven W. Barnett
Monroeville, Alabama

Janice Barrett
Town Creek, Alabama

Thomas Beane
Tuscumbia, Alabama

Noel M. Beck
Florence, Alabama

James Bedsole
Sheffield, Alabama

Robert W. Bentley
Muscle Shoals, Alabama

Andrew Bettertoa
Florence, Alabama

George Blanks
Sheffield, Alabama

Janet Blazer
Sheffield, Alabama

Susan and Chuck Bolton
Tuscumbia, Alabama

Kim Boyd
Tuscumbia, Alabama

Debbie Bradford
Muscle Shoals, Alabama

J. Lawrence Brasher
Birmingham, Alabama

Amy Brown
Muscle Shoals, Alabama

James D. Brown
Tuscumbia, Alabama

Wil Bryant
Sheffield, Alabama

Bryan Burhans
Asheville, North Carolina

Rick Busbee
Florence, Alabama

Diane Butler
Hawaii National Park, Hawaii

Caroline Cahoon-Hauser
Oldsmar, Florida

Jeff Campbell
No Address Given

Connie Carmichael
Tuscumbia, Alabama

Denise Chupp
Florence, Alabama

Darby Clark
Prattville, Alabama

David Cline
Auburn, Alabama

Leo M. Cobb
Leighton, Alabama

Carl Cole
Florence, Alabama

Jesse Coleman
Tuscumbia, Alabama

Annie Cooper
Tuscumbia, Alabama

David Cope
Florence, Alabama

David Craig
Knoxville, Tennessee

John P. Crowder
Florence, Alabama

Brenda Cummings
Florence, Alabama

Adam Daniel
Town Creek, Alabama

Paul Davison
Florence, Alabama

Lester Dean
Florence, Alabama

Dennis Deaton
Cherokee, Alabama

Lou A Demirjian
Hixson, Tennessee

Alison and Sammy Dodson
Florence, Alabama

Chris Dowdell
Bethlehem, Pennsylvania

Gary and Pam Doyle
Muscle Shoals, Alabama

Carole Driskell
Sheffield, Alabama

Tom and Sheila Dugger
Muscle Shoals, Alabama

Leslie Ecklund
Huntsville, Alabama

Ana Everett
Stone Mountain, Georgia

Penny Fitzgerald
No Address Given

Jo Ann Fowler
St. Joseph, Tennessee

Robert Freeman
Rogersville, Alabama

Rhea Tays Fulmer
Killen, Alabama

Dru Gambrell
Muscle Shoals, Alabama

Jim Gann
No Address Given

J. F. Garner
Madison, Alabama

Joe Gautney
Muscle Shoals, Alabama

Kerry Gilbert
Russellville, Alabama

Louise Gorenflo
Crossville, Tennessee

Kathy Gotcher
Moulton, Alabama

Hermon Graham
Florence, Alabama

Gil Griggs
No Address Given

Mel Grimes
Waterlou, Alabama

Gary Gronek
Muscle Shoals, Alabama

Tom Haggerty
Florence, Alabama

Rodney Hall
Muscle Shoals, Alabama

Gene Hamby Jr.
Muscle Shoals, Alabama

Savannah Handerson
Jacksonville, Florida

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Muscle Shoals, Alabama

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Sheffield, Alabama

Robert C. Haynes
Nashville, Tennessee

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Muscle Shoals, Alabama

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Ridgeland, Mississippi

Mildred Helsley
Muscle Shoals, Alabama

J. C. Hester
Tuscumbia, Alabama

Ginny Hill
Muscle Shoals, Alabama

Robert Hodge
Tuscumbia, Alabama

Audrey M. Hogan
Killen, Alabama

James Holden
No Address Given

Randall Holm
Muscle Shoals, Alabama

Joseph E. Holt
Muscle Shoals, Alabama

Jerry Howard
Phil Campbell, Alabama

Allen Hughes
Sheffield, Alabama

Bobby Irons
Florence, Alabama

Gary Jarnigan
Muscle Shoals, Alabama

Shirley L. Johnson
Muscle Shoals, Alabama

Mark Johnston
Nauvoo, Alabama

John Lawrence Kanazawa Joley
Asheville, North Carolina

Keith Jones
Muscle Shoals, Alabama

Mike Jordan
Millbrook, Alabama

Danny Killen
Florence, Alabama

Martin and Gail King
Sterrett, Alabama

Sadie King
Muscle Shoals, Alabama

Alan Kinkead
Tuscumbia, Alabama

Paul Kittle
Florence, Alabama

James E. Lehe
Homewood, Alabama

Anthony L. Leigh
Montgomery, Alabama

Neil Letson
Montgomery, Alabama

Burton Lewis
Muscle Shoals, Alabama

Brian Lindsey
Muscle Shoals, Alabama

William A. Lux
No Address Given

Paul Machtolff
Sheffield, Alabama

Jim Maddox
Tuscumbia, Alabama

David J. Malone
Nashville, Tennessee

Julie Martin
Soddy Daisy, Tennessee

Bill Matthews
Killen, Alabama

Joann Maxwell
Florence, Alabama

Greg Mays
No Address Given

Michael McCaughlin
Atlanta, Georgia

Thomas and Bonita McCay
Sheffield, Alabama

Margaret M. McCloy
Florence, Alabama

Leslie McDonald
Semmes, Alabama

Stuart W. McGregor
Tuscaloosa, Alabama

Jerome McGouyrk
Muscle Shoals, Alabama

William H. McIntyre
No Address Given

Patricia T. McMillion
Huntsville, Alabama

R.H. McNeece
Muscle Shoals, Alabama

Jonathan Melton
Muscle Shoals, Alabama

Matthew Miller
Nauvoo, Alabama

Dewey Mitchell
Florence, Alabama

Lisa M. Montgomery
Huntsville, Alabama

Chuck Morring
Florence, Alabama

Barry Morris
Florence, Alabama

David Morris
Birmingham, Alabama

Clark and Mary Ellen Mueller
Florence, Alabama

Thomas P. Murray
Florence, Alabama

Nancy Muse
Florence, Alabama

M. Nash
No Address Given

Clint Neel
Pegram, Tennessee

William Nelson
Muscle Shoals, Alabama

George W. Norris
Florence, Alabama

Lu Parberry
Florence, Alabama

Fay Parker
Waterloo, Alabama

Joan Parris
Tuscumbia, Alabama

John Paul Pearce
No Address Given

Jack Peck
Florence, Alabama

George M. Phillippi
Birmingham, Alabama

George Pillow
Killen, Alabama

Grant Posey
Town Creek, Alabama

Sharon Pullen
Muscle Shoals, Alabama

James Redwine
Vestavia Hills, Alabama

Tom Ress
Athens, Alabama

Darren Rhodes
Florence, Alabama

Amy Rhuland
Florence, Alabama

John C. Rist
Huntsville, Alabama

Katrina Robbins
Florence, Alabama

Susan Roessel
Rogersville, Alabama

Cecil Rose
Apex, North Carolina

Charles L. Rose
Sheffield, Alabama

Amit Roy
Muscle Shoals, Alabama

Don Ruggles
Muscle Shoals, Alabama

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Florence, Alabama

Mark Sandlin
Florence, Alabama

Ian Sanford
Sheffield, Alabama

Martin Schulman
Birmingham, Alabama

Jim Sexton
Florence, Alabama

Roger Shelton
Rogersville, Alabama

Dennis Sherer
Florence, Alabama

John Shipp
No Address Given

Jeff Sibley
Auburn, Alabama

Jessica Naomi Smith
Sheffield, Alabama

Mary Etoile Smith
Sheffield, Alabama

Stephen Smith
Knoxville, Tennessee

John M. Soileau
Florence, Alabama

Michael J. and Myra M. Soroczak
Muscle Shoals, Alabama

Sylvia Sorrelle
Muscle Shoals, Alabama

Wimberly Springer
Florence, Alabama

Steve Stanely
Sheffield, Alabama

Mary Stevens
Sheffield, Alabama

Gene Tackett
Tuscumbia, Alabama

Roger L. Tanner
Florence, Alabama

A. J. Thompson
No Address Given

James R. Thornton
Hampton, Virginia

Rhonda Tinsley
Montevallo, Alabama

Jackie Tipper
Tom Creek, Alabama

Jesse E. Turner
Muscle Shoals, Alabama

William Turner
Auburn, Alabama

Myra L. Valente
No Address Given

Vincent Van Pelt
Tuscumbia, Alabama

Dallas P. Vaughn
Sheffield, Alabama

Dean and Lisa Vinson
Muscle Shoals, Alabama

Mary Wakefield
Brandon, Mississippi

Bud Ward
Florence, Alabama

Tom White
Florence, Alabama

William and Victoria White
Muscle Shoals, Alabama

Joel Williams
Florence, Alabama

Ricky Williams
Muscle Shoals, Alabama

Nathan Willingham
No Address Given

Neal Willis
Muscle Shoals, Alabama

Becki Wilson
Muscle Shoals, Alabama

Debbie Wilson
Florence, Alabama

Forrest Wright
No Address Given

Chuck Yarbrough
Sheffield, Alabama

Ida Young
Sheffield, Alabama

John Young
Muscle Shoals, Alabama

Jud Young
Muscle Shoals, Alabama

Libraries

Athens-Limestone Public Library
Athens, Alabama

Decatur Public Library
Decatur, Alabama

Florence-Lauderdale Public Library
Florence, Alabama

Huntsville-Madison County Public Library
Huntsville, Alabama

Helen Keller Public Library
Tuscumbia, Alabama

Killen Public Library
Killen, Alabama

Margaret McRae Memorial Library
Tishomingo, Mississippi

Leighton Public Library
Leighton, Alabama

Lexington Public Library
Lexington, Alabama

Muscle Shoals Public Library
Muscle Shoals, Alabama

Rogersville Public Library
Rogersville, Alabama

Russellville Public Library
Russellville, Alabama

Sheffield Public Library
Sheffield, Alabama

CHAPTER 7

7.0 LITERATURE CITED

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