Section 4
Conclusions

This section summarizes ecological conditions and functioning in the project area, compares conditions across sub-watersheds, presents preliminary conclusions regarding the likely nature and causes of watershed problems, and discusses potential restoration and protection efforts.

4.1 Sub-watershed Comparisons

Selected attributes of each sub-watershed, based on the GIS analysis and visual reconnaissance discussed in Section 3, were used to develop a preliminary rating of the extent to which each sub-watershed is likely to be impacted by human activity (Table 4.1). The attributes used are summarized below.

- Total watershed disturbance is defined as the percentage of sub-watershed area with non-forested land cover. Categories are defined as follows: very low—≥ 95%; low—80-94%; moderate—60-79%; high—40-59%; very high—<40%.
- Total riparian area disturbance is defined as the percentage of the riparian corridor (100 feet on each side of streams) within a sub-watershed with a land cover other than forest. Category definitions are the same as for watershed disturbance.
- The potential pollutant impact rating is based upon the specific conductance measurements made by Equinox during the August 2005 windshield survey. The mean value was used for sub-watersheds in which more than one site was assessed. Categories are as follows: low—<40 µS/cm; moderate—40-79 µS/cm; high—≥80 µS/cm.
- Stream condition was rated based upon the channel condition rating from the windshield survey. Upstream and downstream directions were assessed separately at each site and some sub-watersheds included multiple sites. If all ratings within a sub-watershed were the same, a single rating (good, fair or poor) is recorded in Table 4.1. If ratings vary, the dominant condition is given, followed by the range of conditions in parentheses, e.g. F(F-G).
- Protected areas are defined as the percentage of National Forest land in a sub-watershed. Criteria are as follows: very low—≥ 1%; low—1-25%; moderate—25-75%; high—>75%.

Based on all information available to date, the sub-watersheds have been grouped into four classes or tiers, representing the likely degree of impact to ecological function (Figure 4.1).

- Class 1 (Very Low Impact) designates areas in which impacts are likely to be limited. These are forested sub-watersheds consisting largely of National Forest land.
- Class 2 (Low Impact) designates sub-watersheds with relatively low intensity use, where resources are likely to be in relatively good overall condition. These are areas with extensive forest cover, where much activity is restricted to narrow floodplain areas. Broader scale impacts are localized.
- Class 3 (Moderate Impact) represents areas with intermediate intensity of usage, where clearing of land is more extensive, but significant forested uplands often remain.
- Class 4 (High Impact) areas are those with the most intensive patterns of use. In most cases, these sub-watersheds include extensive bottomland areas which have been cleared for agriculture or other uses. Forested uplands generally cover only a small portion of the sub-watershed.

Table 4.1 Preliminary Impact Ratings for Sub-watersheds in the Peachtree-Martins Creek Local Watershed Planning Area

Sub-Watershed		Attribute				
ID	Name	Total Sub-Watershed Disturbance	Total Riparian Disturbance	Potential Pollution Impacts	Stream Condition	Protected Areas
Peachtree Creek Drainage						
PHW	Peachtree Headwaters	VL	VL	*	*	H
UPT	Upper Peachtree	L	L	L	F (F-G)	M
PBR	Pipes Branch	VL	VL	VL	G	H
MPT	Middle Peachtree	M	M	L	F (P-G)	L
SHW	Slow Creek headwaters	L	M	M	P	VL
SBT	Slow Creek Bottomlands	H	M	M	P (P-F)	VL
MBR	Messer Branch	H	H	L	P	VL
GSB	Graham & Snead Br	L	M	L	F (P-F)	VL
PBT	Lower Peachtree bottomlands	H	VH	M	G	VL
Hiwassee Drainage						
CMB	Calhoun & Mission Br	M	M	H	F (P-F)	L
MCB	McComb Br	H	H	L	F (F-G)	VL
FBR	Fall Br	L	L	L	F	VL
SUT	Southern UTs	M	M	*	F	VL
HCK	Hampton Creek	M	M	L	F (P-G)	VL
Martins Creek Drainage						
UMC	Upper Martins Creek	L	L	L	G	VL
MMC	Middle Martins Creek	M	H	L	P (P-F)	VL
LMC	Lower Martins Creek	L	M	M	F (F-G)	VL

Key: VL=very low, L=low, M=moderate, H=high, VH=very high, G=good, F=fair, P=poor. * = no data. See text for sources and criteria

Impacts are lowest in the Peachtree Headwaters and Pipes Branch sub-watersheds, most of which lie in the Nantahala National Forest. The most substantial impacts occur in the Peachtree Bottomlands, Slow Creek Bottomlands, Slow Creek Headwaters, Messer Branch, McComb Branch and middle Martins Creek sub-watersheds. These areas have experienced substantial channel modification and extensive clearing of streamside zones.

These classes represent broad generalizations about prevailing conditions. Sub-watersheds with relatively low overall impacts can still have sites that are highly disturbed. In some sub-watersheds (most notably Middle Peachtree, but also including others such as Calhoun-Mission Branch and Graham-Snead Branch) conditions are extremely diverse, with small streams draining substantial areas of largely forested uplands, and broader downstream valleys that are in much more intensive agricultural or developed uses.

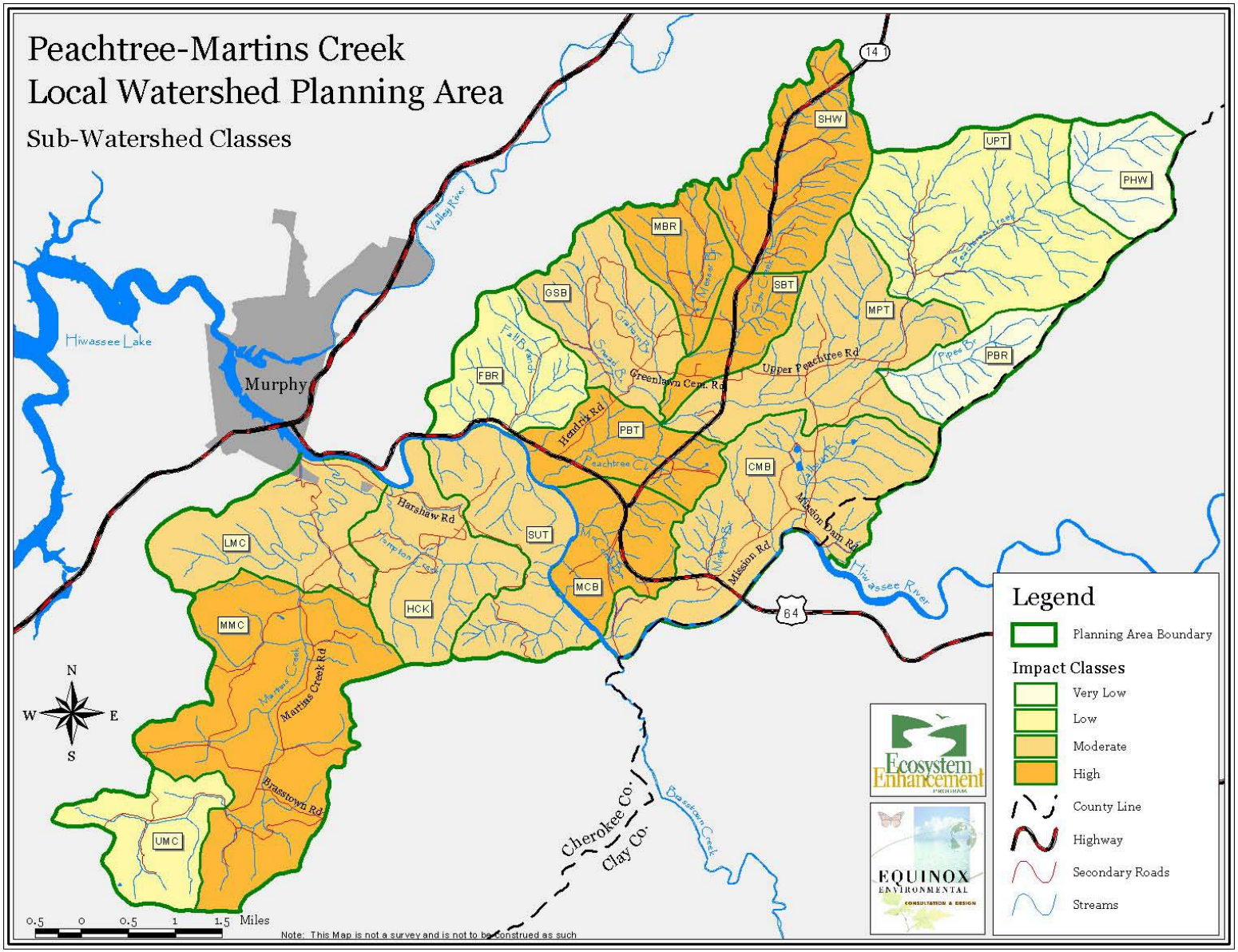

Figure 4.1 Potential Impacts to Ecological Function, by Sub-Watershed

4.2 Ecosystem Function and Major Stressors

The most likely major stressors impacting ecosystem function within the Peachtree-Martins Creek project are listed below. These were identified by the project team drawing upon GIS analyses, watershed reconnaissance, existing water quality data and professional judgment based upon land use patterns and aerial photograph interpretation.

- Direct modification of stream channels;
- Removal of woody riparian (streamside) vegetation and subsequent activity adjacent to streams;
- Sediment inputs to streams;
- Bacterial and nutrient pollution;
- Increased pollution inputs and water volume from uncontrolled stormwater;
- Contamination of groundwater by organic chemicals;
- Terrestrial habitat impacts from clearing of lowlands and fragmentation of upland forests.

Of these, channel modification and riparian vegetation removal have likely had the most widespread impacts on streams. A brief summary of each stressor and likely source activities follows.

1. Direct modification of stream channels is common in the watershed, impacting virtually all larger streams and many smaller ones, especially where bottomlands are extensive. Direct channel modification includes activities such as straightening or relocation of streams (channelization), dredging, rip-rapping or other hardening of stream banks. A review of aerial photography and visual observation of channels indicates that considerable channel modification occurred historically, although the time frame during which this took place cannot be readily determined. Historic channel modification was most likely carried out to make more land available for agricultural, and to a lesser extent, residential purposes. Some more recent activity also appears likely. Ongoing activity is likely due both to efforts to maintain existing modified channels in their altered condition, as well as to make areas more amenable to development and to attempt repair of eroded banks. The process of channel modification disturbs stream habitats and results in sediment inputs to streams. The channel form resulting from this activity is prone to instability and generally affords poor quality habitat. Modified channels that are not repeatedly disturbed can recover with time, but this can take decades and often results in the generation of large quantities of sediment.

2. The removal of woody riparian (streamside) vegetation and subsequent activity adjacent to streams is also widespread, often occurring in conjunction with channel modification. A zone of woody vegetation along streams is critical to the maintenance of adequate shading, bank stability, the supply of woody debris and other organic material (for stream habitat and food supply for aquatic organisms), the removal of pollutants from storm runoff, and the provision of habitat for terrestrial animals. Continued human activities in the impacted areas serve both to perpetuate degraded riparian conditions and as a potential source of pollution. Within the study area, the clearing of riparian areas for agriculture (cropland and pasture), residential activity (buildings and yards) and roads (both public and private) is common. Other activities (e.g. golf courses, quarries) can have important localized impacts, but are not widespread in the project area. Impacts from forest harvesting operations may also occur, though no harvesting activities were observed during the brief period available for field reconnaissance.

3. Excessive sediment input is evident in many streams in the project area, although, based on the limited observations to date, most impacts do not appear to be severe. Sediment deposition can degrade stream habitat by burying desirable cobble and gravel substrate, and can contribute to downstream impacts such as a reduction in reservoir capacity. The source of sediment impacts could not be clearly identified with the time and resources available, but based on visual observations in the study area and experience with other mountain watersheds, inputs from the following are likely important: stream bank erosion (due at least in part to channel modification and vegetation removal practices described above); ongoing construction activities; cut slopes associated with existing roads, driveways and building sites; unpaved road and driveway surfaces; and improperly managed forest harvesting activities. Sediment impacts from improperly managed cropland are also possible, but the vast majority of cultivated land in the project area is located along the Hiwassee River, and would directly impact only limited sections of tributary streams. Stream bank erosion is not uncommon, although areas of extreme erosion and bank failure do not appear to be widespread.

4. Bacterial and nutrient pollution are potential problems that merit additional investigation. No fecal coliform or nutrient data have been collected except in the Hiwassee River. Conductivity measurements made during the windshield survey do not point to widespread pollution impacts during baseflow conditions. However, livestock were observed in streams at several locations, and livestock access was evident at numerous sites. Though the Murphy sanitary sewer system serves a portion of the area, many residents are served by septic systems. The extent of straight-piping or septic system malfunction is unknown. Contamination of waters by human or animal waste may constitute a human health hazard. Excessive nutrient inputs can impact both stream organisms and contribute to eutrophication impacts in downstream reservoirs. Further investigation would be required to better characterize these water quality issues.

5. Increased pollution inputs and water volume from uncontrolled stormwater are probably important in at least some locations. Currently, the major sources of stormwater runoff are large institutional and commercial facilities in the Peachtree vicinity. Visual observation of these areas did not reveal the existence of stormwater control measures. Some newer residential developments are probably dense enough to impact streams, if subdivision design and stormwater control practices are not used to minimize these effects. Runoff from roads and more diffuse development throughout the project area may have more localized impacts.

6. Groundwater contamination by organic chemicals appears to be an issue in the Peachtree area. Spills or discharges from several facilities have been documented, although the magnitude of the problem and extent of any current surface water impacts are not clear. While the impacted areas are served by the Murphy water and sewer system, some residents may still depend on private wells for drinking water.

7. Forest removal and fragmentation are common. Some types of terrestrial habitats have been largely removed from the study area. In particular, few large tracts of intact bottomland forests remain, most having been cut decades ago when the land was cleared for agriculture. Upland forested areas (timbered at various times in the past) are common in much of the project area, though some of these areas will be increasingly affected by new construction.

In addition to these seven stressors, potential future sources of ecological impacts must also be considered. The estimated population of the project area increased by 39% from 1990 to 2000, and over the past five years the number of permits for new residential construction in

Cherokee County appears to have increased markedly. In the immediate future, the primary threats to ecological function will probably come from residential construction, including construction of associated roads. This activity may potentially increase the intensity and spatial extent of many of the stressors discussed above.

Evaluating impacts of these stressors on specific watershed functions (see Table 1.1) is beyond the scope of Phase 1 planning. However, some of the key types of functional impacts associated with the stressors discussed above are shown in Table 4.2.

Table 4.2. Key Functional Impacts Associated with Major Ecosystem Stressors

Functional Impacts	Stressor						
	Channel Modification	Riparian Area Disturbance	Sediment Inputs	Storm-water	Bacterial and Nutrient Pollution	Ground-Water Pollution	Clearing of Uplands and Lowlands
Channel Instability	X	X	X	X			
Loss of Aquatic Habitat Complexity	X	X	X	X			
Reduced Channel Shading		X					
Reduced Input of Large Wood and Smaller Organic Material		X					X
Riffle/Pool Loss or Deterioration	X		X				
Decreased Reservoir Capacity			X				
Reduced Pollutant Removal Capacity in Riparian Zone		X					
Increased Human Health Risk					X	X	
Nutrient Enrichment of Streams and Reservoirs					X		
Toxic Impacts to Surface or Ground Water				X		X	
Loss of Floodplain Habitats and Wetlands	X	X					X
Loss of Upland Habitat Diversity and Integrity							X

4.3 Restoration and Protection Needs and Opportunities

While an active search for specific restoration sites to meet NCEEP compensatory mitigation needs was not part of the Phase 1 investigation, sixteen potential stream restoration sites were observed during watershed reconnaissance. The location of these sites is described in the Atlas of Potential Restoration Sites (Appendix E), which includes photographs of each site.

As discussed above, a broader view of the issues facing the Peachtree-Martins Creek area indicates that local problems are likely due to a variety of stressors, originating from a mix of residential, institutional, commercial, industrial and agricultural activities. Solutions to these problems must therefore also be diverse, encompassing a broad assortment of practices. Potential management activities to address identified problems will be evaluated in subsequent phases of the planning process, once actual watershed conditions have been assessed in more detail and specific problem areas have been more clearly identified.

Priorities for the protection/conservation of areas that are of significant ecological value cannot be assessed very specifically with the available information. Natural heritage inventories have not yet been undertaken for either Cherokee or Clay County. Based on current information, the most obvious portions of the study area meriting consideration for conservation are relatively unimpacted bottomland parcels within the river and low stream zones. Some of these areas were probably formerly wetlands, and among the first to be cleared and ditched for timber, farming, and grazing following colonization. Typically (based on experience with similar systems in the Blue Ridge Physiographic Province), these areas were once defined by extensive mosaics of canebrakes, bogs, fens, and forested, shrub, and emergent wetlands interspersed with beaver impoundments. Such bottomlands now resemble their original structure the least of any natural communities in the mountains and have been largely extirpated from the landscape. Preservation, expansion, and restoration of any remnant wetlands should be given serious consideration.

Secondary conservation priority zones should include rare terrestrial communities as tracked by the NCNHP, remnant old growth forests, extensive forested lands, and lands bordering USFS holdings, especially when these areas contain or border wetlands or streams of interest. Protection efforts might focus on protecting portions of the representative natural communities as well as all of the very smallest rare community types.

Section 5
Recommendations for Future Assessment

This section summarizes the key areas for which data are currently inadequate or unavailable, proposes specific objectives for future assessment, and recommends activities to be conducted during upcoming phases of the planning process.

5.1 Data Gaps

The available data provide a general picture of conditions in the project area, but are often inadequate to provide the detailed and up to date information on ecological conditions necessary to develop sound management recommendations. For example: land cover data are more than 10 years old and of poor resolution; aquatic community data are available for only a few sites, and some of these have not been sampled in a decade. The specific areas for which data are limited or do not exist are the following:

1. watershed land cover and land use, in particular, accurate information on the current location and nature of developed and agricultural areas;
2. extent and condition of riparian vegetation, including the location of areas with highly modified riparian cover;
3. extent and location of channel modification;
4. channel stability and stream bank erosion;
5. extent of livestock access to streams;
6. extent of failing or inadequate septic systems;
7. upland sources of sediment;
8. condition of aquatic habitat and biological communities (lack recent data for all streams except the Hiwassee River, lower Martins Creek, and the lower and middle portions of Peachtree Creek);
9. baseflow and storm event water chemistry, including nutrient and fecal coliform (lack data for all streams other than the Hiwassee River mainstem);
10. extent and significance of groundwater contamination by organic chemicals in the Peachtree area;
11. status of rare aquatic species other than in the Hiwassee River mainstem; and
12. status of terrestrial habitats of potential natural heritage interest.

5.2 Objectives and Focus Areas for Future Assessment

The overall goal of Phase 2 is to conduct additional assessment activities in the Peachtree-Martins Creek area in order to support a more detailed appraisal of ecological conditions, more clearly identify causes and sources of degradation, identify conservation priorities, and serve as the basis for development of a management strategy (Phase 3) to address identified needs. Based on current knowledge of the planning area--including preliminary findings regarding likely stressors and source activities and a review of available data--specific objectives were developed for Phases 2 and 3 (Table 5.1). While some objectives pertain to a limited portion of the planning area, others address issues that either have broad applicability or lack sufficient data to determine a clear geographical focus at this time.

Table 5.1 Proposed Objectives for the Peachtree-Martins Creek Area Assessment

Objective	Related Stressors
A. General Ecological Objectives	
A1. More fully assess the status of fish and macroinvertebrate communities. *	multiple
A2. More fully assess aquatic habitat conditions.*	multiple
A3. Identify aquatic and terrestrial habitats that are of natural heritage value and prioritize for conservation.	multiple
A4. Develop protection strategies for high priority areas of natural heritage value.	multiple
B. Stressor-Specific Objectives Pertaining to All or Most of the Project Area	
B1. Quantify the extent of channel modification and evaluate its impacts in terms of channel erosion and stream stability.	channel modification
B2. Identify stream segments impacted by channel modification where restoration is feasible, and prioritize stream segments for restoration.	channel modification
B3. Quantify riparian area disturbance due to agricultural activities, development or other causes.	riparian area disturbance
B4. Identify stream segments impacted by the removal of riparian vegetation, or ongoing activity within the riparian zone, where restoration is feasible.	riparian area disturbance
B5. Prioritize sites for riparian vegetation enhancement, and evaluate BMPs to address other identified riparian area problems.	riparian area disturbance
B6. Quantify the extent of in-stream impacts due to excessive sediment loading.	sediment
B7. Identify upland sediment sources and evaluate strategies for reducing sediment inputs.	sediment
B8. Quantify the extent of fecal coliform and nutrient contamination. *	bacteria & nutrients
B9. Identify potential pollution sources and management measures to reduce fecal coliform and nutrient inputs. *	bacteria & nutrients
C. Objectives for Localized Stressor Impacts	
C1. Quantify potential stormwater impacts, focusing primarily on the Peachtree area (including densely developed portions of the following sub-watersheds: McComb Branch, Peachtree Bottomlands, Middle Peachtree, Slow Creek Bottomlands).	stormwater
C2. Develop strategies to mitigate identified stormwater impacts.	stormwater
C3. Quantify potential impacts of groundwater contamination from organic chemicals at known sites in the following sub-watersheds: McComb Branch, Peachtree Bottomlands, Slow Creek Bottomlands. *	organic chemicals
C4. Develop groundwater remediation strategies as needed. *	
C5. Further evaluate conductivity levels in the Hiwassee River tributary draining the Mission Quarry area. Assess the sources of high conductivity and develop management strategies if warranted. *	unknown pollutants
D. Objectives Regarding Future Threats to Ecological Function	
D1. Evaluate the extent to which increased residential construction, and other development, is likely within the project area over the next five to ten years. Quantify impacts. *	multiple
D2. Evaluate strategies to mitigate the potential ecological impacts of future development. *	multiple

*This objective is a priority of either the HRWC or one or more members of the Local Advisory Committee. See Section 5.2.1

5.2.1 Local Priorities

While the HRWC has expressed support for all of the objectives listed above, several are considered to be of particular importance. These include the following (listed in the order in which they appear in Table 5.1):

- Additional assessment of aquatic habitat and the status of fish and macroinvertebrate communities (Objectives A1 and A2);
- Evaluation of potential bacterial and nutrient contamination, and development of strategies to address these concerns, especially as they relate to waste disposal options (Objectives B8 and B9);
- Assessment of sediment and other pollution issues in the tributary draining the Mission Quarry area, and the recommendation of appropriate remediation measures (Objective C5); and
- Documentation of potential impacts from new development, with emphasis on obtaining information relevant to the crafting of local ordinances and other local strategies. (Objectives D1 and D2).

Additionally, one or more members of the Local Advisory Committee indicated that the following were high-priority objectives:

- Assessment of issues of potential public health concern, and development of strategies to address identified problems. These concerns would include potential bacterial contamination of surface waters (Objectives B8 and B9) as well as potential drinking water contamination (Objectives C3and C4).
- Documentation of the impacts of land development activities, especially erosion/sediment issues and stormwater impacts, and the development of strategies to help local government address these concerns in the near term (Objectives D1 and D2).

5.3 Recommended Assessment Approach

This section discusses the assessment activities recommended to address the objectives listed above. In general terms, recommended future assessment activities include:

- Analysis of the IPSI data base and other GIS data, to be conducted by Equinox. TVA is currently scheduled to complete the IPSI in February 2006.
- Collection of additional water chemistry and biological community data by NCDWQ.
- Field assessments and additional watershed reconnaissance, performed by Equinox with assistance from HRWC.

The recommended assessment approach for each objective is outlined below and summarized at the end of this section in Table 5.2. Details of many assessment activities (e.g., specific site locations) must be worked out prior to the initiation of Phase 2.

5.3.1 Assessment Approach for General Ecological Objectives

Field data on ecological condition (aquatic communities and habitat; rare species, both aquatic and terrestrial) are currently lacking except for a few locations in the project area. Additional field data collection is necessary to allow for a more complete picture of ecological condition and to facilitate the identification of areas meriting consideration for preservation.

Objective A1: More fully assess the status of fish and macroinvertebrate communities.
Indicators: Fish (NCIBI) and benthic macroinvertebrate (EPT taxa, total taxa, Biotic Index) metrics used by NCDWQ.
Responsible Partner: NCDWQ.
Approach: Biological community data are currently available only for the Hiwassee River and a few sites on the mainstems of Peachtree and Martins Creeks. NCDWQ should conduct fish and macroinvertebrate sampling at additional sites throughout the project area in order to more fully assess the range of existing conditions. Ideally, sites should be sampled within each sub-watershed, although NCDWQ does not have the resources to conduct such an extensive survey. Equinox staff are available to conduct fish community sampling in additional areas. See Appendix F for NCDWQ's monitoring plan.

Objective A2: More fully assess aquatic habitat conditions.
Indicators: Aquatic habitat metrics used by NCDWQ (total habitat score and component ratings).
Responsible Partner: NCDWQ, Equinox.
Approach: Habitat assessment data are currently limited to existing fish and benthic community sites. As standard practice, NCDWQ would conduct an aquatic habitat assessment at any additional sites sampled. However, it would be valuable to have habitat data for more sites than NCDWQ will have the resources to assess. In order to insure adequate spatial coverage of all portions of the project area and the full range of conditions present, it is recommended that Equinox staff conduct habitat assessments at additional locations. See Appendix F for NCDWQ's monitoring plan.

Objective A3: Identify aquatic and terrestrial habitats that are of natural heritage value and prioritize for conservation.
Indicators: presence/absence of rare communities/RTE taxa.
Responsible Partner: NCWRC, Equinox, NCDWQ.
Approach: Data on aquatic taxa exist only for the Hiwassee River (where a number of rare taxa have been identified) and a few sites on Peachtree and Martins Creeks. The NCWRC has developed monitoring priorities for taxa of concern within the project area. Equinox and NCDWQ staff should work to assist the NCWRC with the implementation of these priorities as needed. Terrestrial data are also largely unavailable, but field surveys may be beyond the scope of this assessment. The NCNHP currently plans to conduct a county natural heritage inventory in Cherokee County in 2009 or 2010. Based upon additional GIS analysis (e.g. NCGAP, IPSI and parcel data), a review of aerial photography, and limited ground reconnaissance, Equinox should prioritize areas that appear to have the highest natural heritage value and which otherwise merit conservation.

Objective A4: Develop protection strategies for high priority areas of natural heritage value.
Responsible Partner: Equinox.
Approach: Strategies for preserving the areas identified under A3 should be evaluated and recommendations made based upon feasibility and effectiveness.

5.3.2 Assessment Approach Pertaining to Area-Wide Stressors

Key stressors such as channel modification and riparian area disturbance are widespread in the project area. Given the current lack of field data, the assessment activities discussed below should ideally be carried out in all sub-watersheds. However, many activities could be scaled back in the Peachtree Headwaters and Pipes Branch Sub-watersheds, since these are largely within the Nantahala National Forest and are unlikely to be subject to management

strategies developed under this plan. The most at-risk watersheds were identified earlier (Section 4.1) and should be a major focus of activity. However, conditions in most sub-watersheds appear be quite variable, with many having both minimally impacted and heavily impacted areas. Field sites must be selected which will adequately capture this variability. The IPSI database will permit better targeting of field activities than is possible with current information.

> Channel Modification and Related Impacts <

Objective B1: Quantify the extent of channel modification and evaluate its impacts in terms of channel erosion and stream stability.
Indicators: linear feet of channelized stream; linear feet of eroding stream bank; Bank Erosion Hazard Index (BEHI); bank height ratio.
Responsible Partner: Equinox.
Approach: The IPSI being conducted by TVA will identify probable channelized stream segments and estimate linear footage of such sections. Equinox should analyze these data and perform limited field checking. The IPSI will also identify areas of eroding stream bank and estimate the length of these segments, although these data are likely to be less complete than the channelization data. Equinox should analyze these data and conduct additional field work to document the extent of bank erosion and the degree of channel instability at selected sites. The BEHI (Rosgen, 1996) should be estimated to evaluate bank stability and the bank height ratio (Rosgen, 2001) used to evaluate incision.

Objective B2: Identify stream segments impacted by channel modification where restoration is feasible, and prioritize stream segments for restoration.
Responsible Partner: Equinox.
Approach: Using the data on channel modification and impacts described under B1, as well as other supporting information (e.g. land use and parcel data), Equinox should identify priority focus areas for concentrating stream restoration activities and should prioritize stream segments to be restored. This prioritization should consider both the potential benefits of restoration as well as feasibility.

> Riparian Area Disturbance and Related Impacts <

Objective B3: Quantify riparian area disturbance due to agricultural activities, development or other causes.
Indicators: linear feet of stream with inadequate, moderate or good riparian cover.
Responsible Partner: Equinox.
Approach: The IPSI being conducted by TVA will classify riparian areas by type and width of vegetation, and will facilitate the identification of ongoing activities (e.g. residential uses, livestock pasture) in riparian areas. Equinox should analyze these data and conduct limited field checking.

Objective B4: Identify specific stream segments impacted by the removal of riparian vegetation, or ongoing activity within the riparian zone, where restoration is feasible.
Responsible Partner: Equinox.
Approach: These areas should be identified using IPSI data and field reconnaissance conducted by Equinox.

Objective B5: Prioritize sites for riparian vegetation enhancement, and evaluate BMPs to address other identified riparian area problems.
Responsible Partner: Equinox.
Approach: Given the areas identified above (B3 and B4), Equinox should identify priority focus areas for concentrating riparian area enhancement activities and prioritize specific

stream segments where riparian area enhancement should occur. This prioritization should consider both the potential benefits of restoration as well as feasibility. Where ongoing activity in the immediate riparian area is a significant issue, recommendations should be made to address identified problems.

> Sediment Impacts <

Objective B6: Quantify the extent of in-stream impacts due to excessive sediment loading.
Indicators: riffle embeddedness, mean substrate size (pebble count), riffle and pool habitat scores; sediment loads.
Responsible Partner: Equinox, NCDWQ.
Approach: Estimated sediment loads will be available from the IPSI. This will provide a basis for comparing sub-watersheds, but is not a substitute for field data on stream condition. Riffle and pool habitat scores will be available from the aquatic habitat assessments conducted by Equinox and NCDWQ (A2). This should be supplemented with pebble count and embeddedness data collected by Equinox at selected sites.

Objective B7: Identify upland sediment sources and evaluate strategies for reducing sediment inputs.
Responsible Partner: Equinox.
Approach: The IPSI will provide detailed data on land use, and the IPSI pollutant loading model will provide estimates of sediment loading from various upland and stream sediment sources. This information on sources should be supplemented by information obtained by Equinox in the course of watershed reconnaissance or other field work. Equinox should recommend strategies to address major upland sediment sources, such as construction activities, cropland and roads. Strategies to address in-stream sources of sediment will be addressed under B2.

> Bacterial and Nutrient Contamination <

Objective B8: Quantify the extent of fecal coliform and nutrient contamination.
Indicators: concentrations of fecal coliform, phosphorus and nitrogen.
Responsible Partner: NCDWQ.
Approach: NCDWQ should conduct fecal coliform and nutrient sampling at selected sites in the watershed. See Appendix F for monitoring plan.

Objective B9: Identify potential pollution sources and management measures to reduce fecal coliform and nutrient inputs.
Responsible Partner: Equinox.
Approach: Information on some specific sources will be available from the IPSI (e.g. potentially malfunctioning septic systems, locations where livestock have access to streams). The IPSI will also provide general estimates of nutrient loading from specific land uses. Equinox should develop information on the most likely sources based upon analysis of IPSI data and watershed reconnaissance. Management measures should be proposed to address major sources.

5.3.3 Assessment Approach for Localized Stressor Impacts

Potential for the most serious existing impacts from stormwater runoff and groundwater contamination appears to be limited primarily to industrial, commercial and institutional facilities in the Peachtree vicinity. This section deals with the assessment of these issues and other localized concerns.

> Stormwater Impacts <

Objective C1: Quantify potential stormwater impacts, focusing primarily on the Peachtree area.
Indicators: concentrations of metals and other pollutants; channel stability and bank erosion indicators (BEHI, bank height ratio).
Responsible Partner: NCDWQ, Equinox.
Approach: Significant stormwater impacts are most likely from the large industrial and institutional sites in the Peachtree area, potentially affecting lower Peachtree Creek, lower Slow Creek and McComb Branch. NCDWQ should collect storm samples in these areas to characterize potential problem pollutants, including metals and nutrients. Toxicity bioassays may also be useful to evaluate whether toxic conditions exist. Equinox should conduct field assessments in the streams draining these areas to characterize bank erosion and channel instability problems potentially due to increased runoff volume. See Appendix F for NCDWQ monitoring plan.

Objective C2: Develop strategies to mitigate identified stormwater impacts.
Responsible Partner: Equinox.
Approach: Equinox should conduct a brief evaluation of key sites to assess existing stormwater management practices, and should recommend additional practices where warranted.

> Groundwater Contamination >

Objective C3: Quantify potential impacts of groundwater contamination from organic chemicals at known sites in the Peachtree area.
Indicators: concentrations of organic pollutants.
Responsible Partner: NCDWQ.
Approach: NCDWQ should sample organic pollutants in streams draining the Moog Components, Western Forge and Tri-County Community College sites. Toxicity bioassays may also be useful. See Appendix F for NCDWQ monitoring plan.

Objective C4: Develop groundwater remediation strategies as needed.
Responsible Partner: NCDWQ, NCEEP.
Approach: If warranted by documented contamination levels, NCDWQ and NCEEP should work with the relevant local facilities and state/federal regulatory agencies to develop appropriate remediation strategies.

> Stream Impacts in Mission Quarry Area >

Objective C5: Further evaluate conductivity levels in the Hiwassee River tributary draining the Mission Quarry area. Assess the sources of high conductivity and develop management strategies if warranted.
Indicators: conductivity levels; concentrations of suspected pollutants.
Responsible Partner: NCDWQ, Equinox.
Approach: NCDWQ should sample conductivity in this tributary to confirm if a problem exists and follow up with additional sampling for specific pollutants if warranted. Equinox should identify pollution sources based upon field reconnaissance and GIS analysis and develop a strategy for reducing inputs.

5.3.4 Assessment Approach for Future Threats to Ecological Function

Impacts of future development on water resources are an important concern. The portion of the planning area served by the Murphy sanitary sewer system probably has the potential for the densest development activity and greatest stormwater impacts. The steeper slopes throughout the area may have the greatest potential for ongoing sediment impacts, because of the challenges associated with road construction and slope stabilization.

Objective D1: Evaluate the extent to which increased residential construction (and other development) is likely within the project area over the next five to ten years, and quantify potential impacts.
Indicators: pollutant loads (lbs./year of sediment, nitrogen and phosphorus) derived from IPSI pollutant loading model.
Responsible Partner: Equinox, HRWC.
Approach: Equinox should work with the HWRC and Local Advisory Committee members to develop alternative land use scenarios that reflect development options. The IPSI pollutant loading model should be used to estimate annual loads of selected pollutants under these scenarios.

Objective D2: Evaluate strategies to mitigate the potential impact of future development.
Responsible Partner: Equinox.
Approach: Equinox should work with the HWRC and Local Advisory Committee members to develop strategies for mitigating potential negative impacts of future development.

Table 5.2 Summary of Recommended Approaches for Detailed Assessment, Part A

Objective	Stressor	Primary Functional Area Impacted	Partner	Recommended Assessment Indicator or Approach
A. General Ecological Objectives				
A1. Assess aquatic communities	multiple	habitat	NCDWQ	-NCIBI – fish, EPT and BI – benthos (field data)
A2. Assess aquatic habitat	multiple	habitat	NCDWQ, Equinox	-NCDWQ habitat protocol (field data)
A3. Identify and prioritize areas of natural heritage interest A4. Develop protection strategies for priority natural heritage areas	multiple	habitat	NCWRC, Equinox NCDWQ Equinox	-presence/absence based upon field survey; site identification and prioritization based upon field data and GIS analysis -evaluation of alternative strategies
B. Stressor-Specific Objectives Pertaining to All or Most of the Project Area				
B1. Quantify channel modification and impacts B2. Identify focus areas for stream restoration and prioritize projects	channel modification	hydrology, habitat	Equinox	-linear feet of channelized stream and eroding banks (IPSI); BEHI, bank height ratio (field data) -site identification and prioritization based upon field data and GIS analysis
B3. Quantify riparian area disturbance B4. Identify specific impacted riparian segments B5. Recommend riparian enhancement activities	riparian area disturbance	hydrology, habitat, water quality	Equinox	-linear feet of stream with inadequate, moderate and good riparian cover (IPSI) -site identification based upon field data and GIS analysis -prioritization of sites, recommendation of riparian enhancement activities and BMPs
B6. Quantify sediment impacts B7. Recommend upland sediment reduction strategies	sediment	habitat, hydrology	Equinox, NCDWQ Equinox	-pebble count, embeddedness, riffle-pool habitat scores (field data); sediment loads (IPSI) -site identification and prioritization based upon field data and GIS analysis; evaluation of alternative strategies
B8. Quantify fecal coliform/ nutrient contamination B9. Recommend management measures to reduce fecal coliform and nutrient inputs	bacteria & nutrients	water quality	NCDWQ Equinox	-concentration of fecal coliform, nitrogen and phosphorus (field data) -source identification and prioritization based upon field data and GIS analysis; evaluation of alternative strategies

Table 5.2 Summary of Recommended Approaches for Detailed Assessment, Part B

Objective	Stressor	Primary Functional Area Impacted	Partner	Recommended Assessment Indicator or Approach
C. Objectives for Localized Stressor Impacts				
C1. Quantify stormwater impacts (Peachtree area) C2. Develop strategies to address stormwater impacts (Peachtree area)	stormwater	hydrology, habitat, water quality	NCDWQ, Equinox Equinox	-pollutant concentrations, BEHI, bank height ratio (field data) -site assessment; evaluation of alternative strategies
C3. Quantify impacts of groundwater contamination (Peachtree) C4. Develop strategy to remediate groundwater impacts(Peachtree)	groundwater contamination	water quality	NCDWQ NCDWQ, NCEEP	-pollutant concentrations in Slow Creek and McCombs Branch (field data) -work with facility managers and relevant regulatory agencies to develop remediation strategies
C5. Assess pollution in tributary draining Mission Quarry, and recommend strategy	unknown pollutants	water quality	NCDWQ, Equinox	-pollutant concentrations (field data); identify sources based upon field data and GIS analysis; develop strategy.
D. Objectives Regarding Future Threats to Ecological Function				
D1. Evaluate impacts of future development D2. Recommend strategy to address development impacts	multiple	hydrology, habitat, water quality	Equinox	-lbs./yr. of sediment, nitrogen and phosphorus, as predicted by IPSI pollutant loading model based upon alternative land use scenarios -develop management options in consultation with HRWC and Local Advisory Committee

Notes:
--Partners listed are those with primary responsibility for particular data collection, data analysis or strategy development tasks during Phases 2 and 3. IPSI data developed by TVA will be used for numerous tasks, but TVA is not listed because the IPSI will be completed prior to Phase 2. The HRWC and the LAC will play roles in source identification and by providing input on management strategies.
--Factors included under the three functional areas listed here were described in Table 1.1