Section 3
Future Threats to Watershed Function

While the causes of existing degradation in the planning area are diverse, the primary threat for future degradation is likely to come from activities associated with residential and commercial development. Significant increases in agriculture, forestry, mining and other activities are not likely in the Peachtree-Martins Creek area, and some of these may decline in the near future. New development has been substantial in recent years, a trend that is expected to continue.

This plan analyzed the extent of new development anticipated in the near future, as well as the increases in impervious cover and pollutant loads likely to result from this activity. The potential of several local policy measures to mitigate pollution load increases was also investigated.

This analysis found that:

- Substantial new development is likely to occur in the Peachtree-Martins Creek area between 2005 and 2015. The extent of land in residential use is anticipated to increase by over 40% over this period, while commercial areas are expected to increase by 77%.
- As a result, impervious cover in the planning area as a whole will increase from 3.9% to 5.5%.
- More substantial changes in impervious cover will occur in those sub-watersheds in which much of the new development is concentrated. By 2015 imperviousness in McComb Branch and Lower Peachtree will reach 17% and 13% respectively, while impervious cover in the Southern Hiwassee Tributary area will increase from 3% to 9% over the 10 year period.
- Still larger increases in imperviousness are likely for small streams experiencing development in a large portion of their drainage (e.g. Harshaw Branch, where impervious cover in the catchment may increase from 2% to 27%). Severe impacts are likely in these locations without a concerted effort to mitigate the effects of development by means of stormwater control and other measures.
- Estimates from the IPSI model indicate that between 2005 and 2015, total suspended solids (TSS) loads from residential and commercial areas can be expected to increase by 44% and 77% respectively, while TSS loads from construction activity will increase by approximately 55%. Similar increases are estimated for nitrogen and phosphorus.
- A considerable portion of these pollution increases can be avoided by the implementation of a variety of local policies, most notably post-construction stormwater control, vegetative clearing limits and enhanced erosion and sediment control during construction.

These findings are discussed further in this section. Recommended policies to address development impacts are discussed in Section 8.

3.1 Background on Development Impacts

The development of land alters environmental factors which impact water quality and other elements of ecological function in a variety of ways. As is the case with agriculture and forestry, these impacts can be significantly mitigated if appropriate management steps are taken.

Land disturbance associated with the construction phase of development - including land clearing, grading, road construction and excavation for home sites - removes vegetation and greatly increases the potential for erosion. Though generally short lived, construction can generate large amounts of sediment unless proper control techniques are used.

New development also has important long term impacts. First, vegetated areas are replaced with impervious cover. This alters watershed and stream hydrology by increasing the volume of surface runoff, as well as the velocity and peak discharge of streams. Common effects of this include accelerated stream bed and bank erosion, habitat degradation and downstream flooding. Secondly, ongoing activities associated with developed areas - from lawn fertilization to septic systems to automobile traffic - generate many pollutants that can harm aquatic life and pose human health threats. Thirdly, the drainage network constructed to allow runoff to flow from developed areas, including both open channels and storm sewers, worsens both of the above by routing runoff more quickly to streams and serving as an efficient delivery mechanism for pollutants.

3.2 Approach

Future land use was estimated for two time periods: a 5 year period extending from the month the IPSI aerial photography was flown (March 2005), and a 10 year period extending from the same month. These scenarios thus represent anticipated land use conditions in March 2010 and March 2015 and are termed the 2010 and 2015 base scenarios. Pollutant loads for each of these scenarios were estimated using the IPSI nonpoint source model (TVA, 2006). Initial modeling assumed that development would occur under current regulatory requirements. Pollutant loading was then modeled assuming the implementation of various management measures intended to mitigate potential development impacts. For these scenarios it was assumed that measures were implemented in March 2005.

Equinox worked with the Hiwassee River Watershed Coalition (HWRC) and the Local Advisory Committee (LAC) to quantify the extent and location of expected development and to develop land use scenarios for the IPSI model based upon these expectations. Equinox also worked with the HWRC and LAC to identify several strategies for mitigating potential development impacts that could be examined using the IPSI model. Details of the methods used are discussed in Appendix B.

Modeling of the pollutant loads associated with land use changes and potential management actions is intended to represent anticipated loads as closely as possible given the tools and data available. Load estimation is subject to a number of constraints however. As a spreadsheet-based screening level tool, the IPSI nonpoint source model makes many simplifying assumptions about the complex processes by which pollutant loads are generated. There is considerable uncertainty regarding how well model assumptions reflect real world processes in any particular watershed area. Given limited ability to anticipate future land use patterns and limited scientific knowledge about the effects of management policies, there are additional uncertainties associated with the land use change projections and with estimates of the likely impacts of potential management actions. Readers should exercise caution in using the estimates reported here, which should be considered rough approximations of anticipated trends in pollution loads rather than precise estimates of impact. Despite these limitations, the load estimates can be useful in assisting the LAC and members of the Peachtree-Martins

Creek community in visualizing the expected impacts of development activity as well as possible management options.

3.3 Expected Changes in Land Use

The LAC anticipated that over the next ten years (2005-2015) residential development would continue in the planning area at roughly the same rate as in the recent past. Residential development is expected to increase by approximately 1145 acres over this period, representing a 41% increase in the amount of residential land in the planning area (Figure 3.1). Commercial land is expected to increase by 373 acres, or 77%. Other land classifications (forest, crop land and pasture) will decline somewhat as additional land is converted to residential and commercial use.

It was the judgment of the LAC that new commercial development would be concentrated in the US 64 – NC 141 area (McComb Branch, Peachtree Bottomlands and Middle Peachtree sub-watersheds), as well as in the Southern Unnamed Tributary sub-watershed, along Harshaw Road near the new US 64 Bypass (Figure 3.2). New residential development is expected to be scattered more widely, though LAC members anticipated that it would be concentrated in areas south of the Hiwassee River (Martins Creek drainage and the Southern Unnamed Tributary sub-watershed) as well as in the Middle Peachtree and Fall Branch sub-watersheds (see Appendix B).

3.4 Impact of Land Use Change on Impervious Area

Equinox estimated the additional impervious area acreage likely to be added to each sub-watershed by this development activity, as well as by the US 64 Bypass currently under construction. Methods were consistent with those used by TVA to estimate 2005 impervious cover (see Appendix B).

This analysis indicates that by 2015 approximately 420 additional impervious acres will be added to the Peachtree-Martins Creek area. This represents an increase of more than 40% from the 969 acres of impervious cover estimated for 2005, raising the extent of impervious cover in the planning area from 3.9% to 5.5%. While this is not a level at which significant environmental impacts would be expected, a 40% increase in impervious cover in a 10 year period represents a substantial change for a 39 square mile area.

More importantly, much of the additional impervious cover is concentrated in a few sub-watersheds, where notable impacts are more likely (Figure 3.3). While only McComb Branch exceeded the impact threshold of 10% in 2005 (see Section 2.2.3), two additional sub-watersheds are likely to surpass or approach this level by 2015. Impervious cover in the Lower Peachtree Bottomlands (PBT) area will increase from 6% to 13%, while the Southern Hiwassee tributary area (SUT) will increase from 3% to 9%. The extent of impervious cover in the McComb Branch (MCB) sub-watershed will rise further (from 11% to 17%), indicating the likelihood of additional impacts from hydrologic change and pollution. In several other sub-watersheds (Lower Martins Creek, Upper Martins Creek, Middle Peachtree Creek and Fall Branch) the extent of impervious cover will increase by about half. While overall imperviousness in these areas remains fairly low (4 to 6%), these sub-watersheds may approach threshold levels in the future as additional development occurs here.

To illustrate the impacts of development on a more limited scale, Equinox examined a small tributary to the Hiwassee River draining approximately 250 acres in the Harshaw Road area (Figure 3.4). This tributary, termed Harshaw Branch for purposes of this plan, was largely a mix of forest and agricultural land in 2005, with an estimated imperviousness of 2.4% (about 6 acres). The area drained by this stream is now bisected by the US 64 Bypass. Additionally, most of it is contained in a large parcel identified by the LAC as likely to see mixed use development (commercial use along Harshaw Road, medium density residential use elsewhere) within the next 10 years. If this land is developed as anticipated, an additional 62 acres of roads, parking areas and rooftops will be added, raising the overall extent of impervious cover in this small drainage to approximately 27% (Appendix B). This is a level at which severe ecological and hydrologic impacts to the stream would be expected. While it is very unlikely that the Peachtree-Martins Creek area as a whole will experience levels of impervious cover this high in the foreseeable future, it is quite plausible that development intensity at or approaching this level will occur in areas drained by other small streams. *Severe impacts are likely in these situations without a concerted effort to mitigate the hydrologic and other effects of development by means of stormwater control and other measures.*

3.5 Effects of Land Use Change on Pollutant Loads

The increased development described above is expected to result in a sharp increase in pollutant loads from developed areas (Table 3.1). Between 2005 and 2015 total suspended solids (TSS) loads from completed residential and commercial areas are expected to increase by 44% and 77% respectively. TSS loads from land under construction (comparing land under construction in 2015 to land under construction in 2005) will increase by more than half (55%). The percentage increases expected for total phosphorus (TP) and total nitrogen (TN) loads from developed areas are similar (Table 3.1). Impacts on individual sub-watersheds are variable, depending upon the extent and nature of development changes. From 2005 to 2015, the largest increases in the total TSS load are expected in the following sub-watersheds:

- Upper Martins Creek – 52% increase due to residential development;
- McComb Branch – 36% increase due to commercial development;
- Moore Branch – 33% increase due to residential development;
- Peachtree Bottomlands – 32% increase due to commercial development;
- Falls Branch – 31% increase due to residential development; and
- Southern Unnamed Tributaries – 29% increase due to mixed use development;

The percentage increases in nutrient loads generally exceeded the TSS increase in these sub-watersheds. Additional sub-watershed data are presented in Appendix B.

Table 3.1 Annual Pollutant Loads for 2010 and 2015 Base Scenarios

Pollutant	Total Load	Constructed Residential Areas[1]	Constructed Commercial Areas[1]	Areas Under Construction[2]
Total Suspended Solids				
Annual Load (tons/yr)				
2005	6721.4	255.3	198.3	565.8
2010	6754.6	310.8	198.3	571.9
2015	7179.8	367.0	351.0	877.0
% Change from 2005				
2010	0.5%	21.7%	0.0%	1.1%
2015	6.8%	43.7%	77.0%	55.0%
Total Phosphorus				
Annual Load (tons/yr)				
2005	2.34	0.51	0.54	0.06
2010	2.44	0.62	0.54	0.07
2015	2.97	0.73	0.94	0.10
% Change from 2005				
2010	4.4%	21.7%	0.0%	1.1%
2015	27.1%	43.7%	75.9%	54.9%
Total Nitrogen				
Annual Load (tons/yr)				
2005	19.9	3.1	4.1	0.9
2010	20.5	3.8	4.1	0.9
2015	24.6	4.5	7.3	1.4
% Change from 2005				
2010	3.1%	22.2%	0.0%	1.1%
2015	23.7%	45.0%	76.1%	55.0%

1. Includes all developed areas where construction has been completed, including both pre 2005 and post 2005.
2. Includes areas under construction during 2005, 2010 or 2015.

3.6 Potential Impacts of Local Management Policies

3.6.1 Introduction

The results presented above are based on the assumption that new development occurs under current practices, regulations, design standards and enforcement mechanisms. Though development can result in significant increases in pollution, some of this can be mitigated through various management actions, including measures implemented by governmental agencies as well as voluntary measures undertaken by developers. The number of management policies that could be considered is large. In consultation with the LAC, six measures were represented to illustrate a range of options:

- Limiting vegetative clearing to 50% of parcels;
- Limiting vegetative clearing to 30% of parcels;
- Implementing ‘Mountain Protection” or similar standards for development at elevations over 2000 feet (for example, revegetation requirements or requirement of engineering certification based upon slope);
- Implementing a post-construction stormwater management program;

- Developing a local erosion and sediment control program with enhanced enforcement; and
- Developing road design standards to reduce the potential for ongoing road erosion.

The impact of these measures on annual pollutant loads was estimated using the IPSI model for the 2015 base scenario. An additional scenario was run to estimate the joint effect of implementing multiple measures. The nature of these measures and the manner in which they are dealt with in the model is discussed in Appendix B. Additionally, the LAC desired to explore the impact of extending sewer service along US 64 east of the Tri County Community College, extending along Mission Branch Road through the Calhoun-Mission Branch sub-watershed. This extension was included as an additional scenario.

3.6.2 Results

The effects of management policies are viewed below from two perspectives:

1. Their ability to reduce pollutant loads from the new development anticipated from 2005 to 2015 (the development activity which is assumed to be subject to these policies); and
2. Their impact on overall loads, including the loading from all developed areas, both those subject to management actions and development completed prior to 2005, which is unaffected by any of the management measures simulated.

Table 3.2 summarizes overall results from these two perspectives, while additional data on overall loads are presented in Figures 3.5, 3.6 and 3.7 for TSS, TP and TN respectively.

The management measures selected have the potential to substantially reduce the load increases that would otherwise accompany new development (Column B in Table 3.2). The impact is greatest for stormwater management measures and enhanced erosion and sediment control. As one would expect, the impact of these management policies on overall loads is much smaller (Column C in Table 3.2), since areas developed prior to 2005 are not affected by the measures, nor are the policies applicable to other sources of pollution such as agricultural activities.

If multiple policies are implemented concurrently, reductions are much higher than for any of the individual measures (Table 3.2 and Figure 3.8).

- Loads from areas under construction are reduced by 41% for all pollutants.
- TSS loads for commercial areas (including both new areas and existing areas not subject to the regulations) drop by 25%, with smaller reductions for nutrients.
- TSS loads for residential areas (including both new areas and existing areas not subject to the regulations) experience a 15% reduction, with smaller decreases for nutrients.

Table 3.2 Synopsis of Management Strategy Results

(A) Management Measure	(B) Reduction in Anticipated Pollution Load from New Development from 2005-2015	(C) Reduction in Overall Pollution Loads from Developed Areas*
(1) Vegetative Clearing Limited to 50%	• 8% reduction in all pollutants for areas under construction • 8% reduction in post construction loads for all pollutants	• 2-4% reduction in loads from developed areas (all pollutants) • 1-2% reduction in total pollutant loads (all pollutants)
(2) Vegetative Clearing Limited to 30%**	• 16% reduction in all pollutants for areas under construction • 16% reduction in post construction loads for all pollutants	• 4-7% reduction in loads from developed areas(all pollutants) • 2-4% reduction in total pollutant loads (all pollutants)
(3) Standards for High Elevation Development	• 15% reduction in loads for all pollutants for areas to which the standards apply (elevations >2000 feet)	• 1% reduction in loads from developed areas (all pollutants) • <1% reduction in total pollutant loads(all pollutants)
(4) Post-Construction Stormwater Management**	• 49% reduction for TSS • 35% reduction for TP • 21% reduction for TN	• TSS reductions: 13% for residential areas, 21% for commercial • TP reductions: 9% for residential areas, 15% for commercial • TN reductions: 6% for residential areas, 9% for commercial
(5) Erosion and Sediment Control**	• 30% reduction in TSS from areas under construction	• 4% reduction in total TSS load 1-2% reduction in total TP and TN loads
(6) Road Design Standards	• 40% reduction loads (all pollutants) from unstable road banks and ditches	• <1% reduction in total load for all pollutants
(7) Multiple Measures Implemented	• 41% reduction (all pollutants) for areas under construction • 34 to 57% reduction in post construction load, depending upon pollutant	• TSS reductions: 15% for residential areas, 25% for commercial • TP reductions: 12% for residential areas, 20% for commercial • TN reductions: 9% for residential areas, 15% for commercial

*Includes the total loading from all developed areas (or from all sources, as specified in Column C), including those subject to management actions (2005-2015) and development completed prior to 2005, which is unaffected by any of the management measures simulated.
**Management measure is included in the multiple measure scenario (7).

The sewer line extension impacted development only in the Calhoun-Mission Branch area, where it increases development density. Estimated TN loads from developed areas in this sub-watershed increased by about one quarter, with smaller increases for other pollutants (Table 3.3).

Table 3.3 Calhoun-Mission Branch Load Changes with Sewer Line Extension

Pollutant	% Increase in Load with Sewer Extension	
	Total Load	Load from Residential Areas
Total Suspended Solids	<1%	10%
Total Phosphorus	2%	10%
Total Nitrogen	3%	26%