MONTGOMERY COUNTY PLANNING DEPARTMENT
THE MARYLAND-NATIONAL CAPITAL PARK AND PLANNING COMMISSION

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Worksession: Clarksburg Limited Master Plan for the Ten Mile Creek Watershed - Presentation and Discussion of Scenario Analysis

Valdis Lazdins, Chief, Area 1, valdis.lazdins@montgomeryplanning.org, 301-495-4506
Mary Dolan, Chief, Functional Planning & Policy, mary.dolan@montgomeryplanning.org 301-495-4552
Frederick Vernon Boyd, Planner/Coordinator, Area 3, fred.boyd@montgomeryplanning.org 301-495-4654

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Description

The County Council has asked the Planning Board to prepare an amendment to the 1994 Clarksburg Master Plan by October 2013. This second worksession with the Planning Board is to discuss the land use and transportation considerations for the amendment and review some additional environmental analysis to help determine the appropriate alternative scenarios to test. Staff seeks feedback from the Planning Board on additional analysis and the range of scenarios to test, given the resources and time available. Several background reports are attached to this memo that provide further documentation to the presentation given to the Planning Board on March 14, 2013 as well as inform this worksession. Given the time constraints of the project schedule, some materials are in draft form and final copies will be posted on the Planning Board's website.

Summary

The staff recommends that the Planning Board review the existing conditions and findings of the analysis of the 1994 Clarksburg Master Plan buildout for the Ten Mile Creek watershed and direct the staff to explore a scenario or scenarios that will further inform the development of recommendations for the Clarksburg Limited Master Plan for Ten Mile Creek Watershed.

The Planning Board reviewed a considerable amount of information at the March 14, 2013 worksession and raised several questions about the work that had been done to characterize the watershed conditions and to predict the results of buildout of the 1994 Clarksburg Master Plan within the Ten Mile Creek watershed. In addition, questions were received from the property owners and environmental groups that have required additional analysis. Work has continued as well on a parallel effort to more clearly understand and describe Ten Mile Creek in the context of the range of stream quality for streams in Montgomery County using a nationally-recognized standard, the Biological Condition Gradient.

This staff report summarizes the answers to the following questions:

- What is the land use and transportation context for the master plan at this time?
- What is the quality of Ten Mile Creek in relation to other creeks in Montgomery County?

- How would different assumptions about stormwater management and the protection of interior forest play out in the model results for the 1994 Plan buildout?
- Can we determine the potential effect of the buildout on the biology of the stream and stream quality?
- What principles should guide the development of other scenarios that might be more protective of stream quality?
- What further scenarios should we test in order to provide the best information for decision makers?

Land Use Context

The Clarksburg Master Plan manages Clarksburg's evolution from a rural crossroads to a vibrant town surrounded by open space. A number of Plan policies currently guide that process. Perhaps first among these is Policy 1, *Town Scale of Development*, which proposes that Clarksburg develop at "a larger scale than proposed in the 1968 Clarksburg Master Plan but smaller than a corridor city such as Germantown." (p. 16) The Plan implements this policy by:

- including the Clarksburg Historic District as an important component of the Town Center;
- making land use recommendations that balance the need to protect sensitive environmental resources with the desirability of somewhat higher densities that can support transit service;
- keeping intact the concept of a technology corridor centered on I 270, while reducing its scale;
- organizing future development into defined neighborhoods that include broad mixes of housing types.

From these four major components, the Plan derives other important guiding policies. The *Town Center* (Policy 6) is a mixed-use, transit-oriented central area that concentrates Clarksburg's civic resources to define it clearly as the focus of public life in Clarksburg and creates a "Main Street" using MD 355 through the historic district.

Plan recommendations recognize the importance of environmental protection in Clarksburg (Policy 2, *Natural Environment*) by:

- recognizing the Countywide environmental significance of the Ten Mile Creek watershed;
- recommending public acquisition of stream valleys that in turn can support a *Greenway Network* (Policy 3); and
- offering development guidelines for stream systems likely to experience substantial impacts, including a water quality review process to occur prior to development in Ten Mile Creek.

At the same time, Plan recommendations are premised on a comprehensive *Transit System* (Policy 4) that reduces dependence on the car and targets higher densities to areas nearer the transit line. In the

Town Center, these recommendations include high technology *Employment* centers (Policy 8) at the interstate interchange and higher residential densities near transit stations.

The Plan proposes creation of seven neighborhoods in Clarksburg that would be oriented towards *pedestrians* and would maintain *connections to the transit network* (Policy 7). These neighborhoods would contain a mix of uses and a diversity of housing types. They would also incorporate a *Hierarchy of Roads and Streets* (Policy 5) that would allow through traffic to bypass the developed areas in the Town Center's historic district, connect streets within neighborhoods for improved local movements and include pedestrian friendly design for streets that link neighborhoods to through routes.

The thrust of these policies is the creation of a clearly defined community that includes land uses ranging from agriculture, which would contribute to *Farmland Preservation* (Policy 9) in the western parts of Clarksburg, to employment along the proposed Corridor Cities Transitway. Civic activities in the Town Center would draw residents from the neighborhoods, whose retail nodes would include grocery shopping and other routine retail needs. Community building would be managed by a *Staging Plan* (Policy 10) that would balance the provision of needed civic infrastructure with the pace of development. The focus is on early development of the Town Center and the need to undertake significant environmental monitoring to determine if standards in effect and actions taken by property owners are sufficient to protect the stream before allowing development in the Ten Mile Creek watershed.

Clarksburg's evolution is underway and it is ongoing. In 1994, when the County Council approved the Master Plan, there were about 600 dwelling units and about 660,000 square feet of non-residential space in Clarksburg. In January 2013, according to the Department's Center for Research and Information Systems, there were nearly 5,800 residential units and more than 1.25 million square feet of non-residential space. Another 4,700 dwelling units and 2.75 million square feet of non-residential space are approved but as yet, unbuilt.

The Master Plan includes recommended mixes of housing types for Clarksburg's five largest neighborhoods: the Town Center, Transit Corridor, Newcut Road, Cabin Branch and Ten Mile Creek East, as shown in the following table:

Neighborhood	Detached	Attached	Multi-family
Town Center	10 percent to 20 percent	30 percent to 50 percent	25 percent to 45 percent
Transit Corridor (Transitway)	5 percent to 10 percent	40 percent to 60 percent	30 percent to 50 percent
Transit Corridor (MD 355 Area)	50 percent to 60 percent	30 percent to 40 percent	5 percent to 10 percent
Newcut Road	45 percent to 55 percent	35 percent to 45 percent	10 percent to 20 percent
Cabin Branch	45 percent to 55 percent	35 percent to 45 percent	10 percent to 20 percent
Ten Mile Creek East	70 percent to 100 percent	0 percent to 30 percent	0 percent

The following table, drawn from the Research center's development pipeline data, shows that approved development in Clarksburg is largely meeting master plan benchmarks.

Neighborhood	SFD	SFA	MF	Total	SFD %	SFA %	MF %
Town Center	469	839	359	1,667	0.28	0.50	0.22
Transit Corridor	276	658	194	1,128	0.24	0.58	0.17
Newcut Road	1,905	1,294	1,234	4,433	0.43	0.29	0.28
Cabin Branch	1,036	654	939	2,629	0.39	0.25	0.36
Ten Mile Creek	0	0	0	0	0	0	0

While slightly more than 600,000 square feet of non-residential space has been built in Clarksburg since plan approval, almost all of that space is in office or warehouse uses; just 31,500 square feet of retail space in the Transit Corridor district is open and available, and another 14,300 square feet of mixed retail and office space is located in the Town Center. There are approvals for nearly 195,000 square feet of neighborhood retail space in the Town Center and 109,000 square feet of neighborhood retail space in the Newcut Road neighborhood, but these spaces have not been built.

The slow pace of retail development in Clarksburg may reflect market realities; the 5,800 dwelling units built in Clarksburg since 1994 may not be sufficient to support neighborhood retail at this time. There are about 4,700 approved, but unbuilt units now in the pipeline. This would give Clarksburg a total population of about 23,100 on their completion, a number that could support neighborhood retail uses. Whether that number is sufficient to sustain several million square feet of office space, as recommended in the master plan, is questionable. With significant amounts of space in Germantown and the Life Sciences Center proposed for research, development, biotechnology and other activities, there may be more appropriate near- and medium-term uses for land in Clarksburg now recommended for employment activities.

Transportation Context

Areawide analysis using the Transportation Policy Area Review (TPAR) method for the Clarksburg Policy Area indicates that the area operates at an average of "C" level of service with most major roads operating at "A" or "B." MD 27 Ridge Road operates at a "D" level, bringing down the average for the Policy Area. The majority of roads in the study area are currently underutilized and provide a high level of service. There a number of missing roadway links that are awaiting completion as part of development projects and the County Capital Improvement Program.

All of the intersections function at adequate levels of service under the existing conditions. Although the intersection of Clarksburg Road (MD 121) and Frederick Road (MD 355) has the lowest level of service, LOS "C" in both the morning and evening peak hours, the traffic volumes there are similar to the volumes at Stringtown Road and Frederick Road (MD 355). Stringtown Road has more lanes resulting in greater capacity at the intersection. The following are overall observations about current transportation:

- Transit service is limited to two routes. The Clarksburg Policy Area does not yet have adequate transit service in terms of the factors of Coverage and Peak Headway although it is just adequate in terms of the factor of Span of Service.
- Most of the travel in the area is north-south with the east-west movements generally providing access to the north-south travel.
- I-270 is highly utilized and the directional split (i.e., percent of traffic going northbound or southbound) in the peak hours reflects this with typically 60 percent in the peak direction and 40 percent in non-peak direction.
- The peak to daily ratio on I-270 is around seven percent, showing the high demand throughout the day for travel on I-270. (A default peak to daily ratio would be 10 percent.)
- MD 355 had a much higher peak to daily traffic ratio showing the commuter nature of trips in the morning and the combination of commuter and local activity in the evening peak hour.
- The directional split on MD 355 north of MD 121 reflects commuter travel in the peak hours with an 80:20 split.
- The directional split on MD 355 south of Stringtown Road reflects greater activity and land use along the corridor. South of Stringtown Road the directional split is approximately 70:30.
- The east-west peak hours typically show 70:30 directional split of traffic.

Summary CLV Table

Intersection	Existing			
	AM		PM	
MD 121 & I-270 Western Intersection	A	365	A	250
I-270 & MD 121 Eastern Intersection	A	609	A	480
MD 355 & MD 121	C	1225	C	1150
MD 355 & Shawnee Lane	A	750	A	875
MD 355 & Stringtown Road	A	914	B	1068
Gateway Center Dr. & Stringtown Road	A	667	A	846

Environmental Context

Existing environmental conditions in the Ten Mile Creek watershed were evaluated by reviewing GIS data, water quality monitoring data and numerous reports and studies of the watershed. A detailed report was attached to the March 14, 2013 worksession staff report and key watershed characteristics are described below:

- Ten Mile Creek feeds into Little Seneca Lake, which serves as a reservoir providing additional flow to the Potomac River, a public raw water supply, during drought periods (Montgomery County Department of Park and Planning, 1994). The aquifer in the study area is designated as a Sole Source Aquifer per the United States Environmental Protection Agency's (U.S. EPA) Sole Source Aquifer Program (Greenhorne & O'Mara, Inc., 1992).
- Base flows are low in the summer months and the creek is susceptible to low flows from lack of rain. However, even in the driest years tributaries have continued to flow and provide cool, clean water as refuge for the stream biotic community. Montgomery County DEP located seeps and springs throughout the Ten Mile Creek study area and the majority of springs are in headwaters of tributaries to Ten Mile Creek. Both are necessary to maintain base flows in headwater streams (Montgomery County Department of Environmental Protection, 2013).
- Wetlands are concentrated along Ten Mile Creek mainstem. These are predominantly palustrine forested wetlands and are fed by groundwater.
- Beaver have developed a series of dams in the upper reaches of Ten Mile Creek. These provide pools that act as refuges for fish, amphibians and reptiles during the drier summer months and habitat for wintering waterfowl and wildlife in the winter months (Montgomery County Planning Department, 2009). In addition, "bird surveys in 2009 observed or heard 12 migratory nesting forest interior bird species in Stage 4 forest interior areas of Ten Mile Creek" (Montgomery County Planning Department, 2009).
- Development in the overall watershed is low and roughly half of the study area is forested. Imperviousness in the total watershed is approximately 4%, and the remaining land cover is predominantly a mix of non-forested pervious area, including pasture, cropland, and turf. Ten Mile Creek subwatersheds labeled LSTM206 and LSTM201 have the highest impervious cover and urban land uses. Current imperviousness in the LSTM206 is 16.2%.
- Subwatersheds LSTM202 and LSTM201 as well as subwatersheds along the mainstem have the highest forested land cover. The forested cover along the mainstem and through LSTM202 and LSTM201 is a major contiguous hub link with hubs in Black Hill and Little Bennett Regional Parks. MDNR (2003) defines hubs as areas that consist of large contiguous tracts of forest land that are integral to the ecological health of the state, and corridors as linear remnants of these vital habitats that form important linkages among the hubs. The largest gap in forest cover occurs in northeast LSTM201, north of I-270, which bisects the corridor to Little Bennett Regional Park. Forested areas within the study area are characterized as upland or bottomland hardwood forest. Upland hardwood forest is particularly prevalent in the western portion of study area. Bottomland hardwood forests are located along stream, floodplains and wetland areas within the watershed.

- Soils within the study area were formed from weathered phyllite, a metamorphic rock, and are generally rocky with a shallow to moderate depth to bedrock and steep slopes. Based on soil survey mapping, 45 percent slopes are the steepest slopes found along the upland stream valley. The upland summits range from 3 to 8 percent slopes (Soil Survey Staff, 2013). Erodible soils were prevalent in subwatersheds LSTM203, LSTM204, LSTM202, and LSTM112. The shallow bedrock, slopes, and erodible soils could pose general siting restrictions for foundations, septic systems, roads, basements, etc., as well as a challenge for erosion and sediment control during construction activities, and post-construction stormwater management. In addition, disturbance to the shallow soils that result from grading associated with development could also create negative impacts to local stream habitat and biology.
- Long-term and spatially comprehensive geomorphic monitoring data are not available for Ten Mile Creek. The limited available datasets and field observations suggest that the streams are very dynamic (i.e. streams frequently move and deposit material and adjust their shape). Evidence of widespread and significant channel degradation (i.e. chronic lowering of the channel bed with time), which is often observed in highly disturbed watersheds, is not evident in the Ten Mile Creek watershed. Flood flows along many reaches of Ten Mile Creek still access the floodplain, sustaining important geomorphic and ecological processes. Streams in the region have been subjected to an extended history of changes in sediment supply and hydrology due to land use changes. Like many streams in the region, Ten Mile Creek has adjusted in response to these historic changes, and continues to adjust to existing inputs of water and sediment.
- Long-term monitoring of the stream habitat within the Ten Mile Creek watershed by DEP, including measurement of the physical habitat and sampling of biological communities (fish, benthic macroinvertebrates, and herptofauna), indicates that the overall biological condition is in the good range (63-87) with an average score for all stations of 77. Two subwatersheds (LSTM110 and LSTM110) scored in the excellent range (>87) and two subwatersheds (LSTM112 and LSTM206) scored in the fair range (41-63).
- In-stream physical habitat conditions (such as stream bed and bank conditions) show signs of decline since 2007. While the change is subtle over time, these conditions are indicative of a watershed that is sensitive and is responding to various stressors. Evidence of declining habitat conditions include increased embeddedness (the degree to which coarse bed material is choked by fine sediments), sedimentation, and decreased streambank vegetation. However a proportional response in the overall biological condition has not been observed. Long-term monitoring data collected by DEP does generally indicate that the proportion of sensitive taxa, both fish and benthic macroinvertebrate, present within the watershed are declining while the pollution-tolerant individuals are increasing in both number and richness.

Biological Condition Gradient

Montgomery County uses Indices of Biotic Integrity (IBI), as the best measure of overall stream health, since the organisms must experience all the conditions that affect the stream throughout the year. The County's IBIs use aggregated data based on all of the stream species that are sampled at each site. Since the early 1990's, the county has collected this data and it has been used to inform studies of Ten Mile Creek. Recently, a new way of analyzing this data has been developed by the Environmental Protection Agency (EPA), which provides additional information and a way to more accurately rank the quality of streams across the County.

The Biological Condition Gradient (BCG) was developed to provide a common scale of biological conditions to support comparisons between streams given varying amounts and types of biological information. Further detail on the methodology and results is provided in Attachment 1.

What Is the BCG? (adapted from EPA's "A Primer on Using Biological Assessments to Support Water Quality Management")

The BCG is a conceptual, narrative model that describes how biological attributes of aquatic ecosystems change along a gradient of increasing anthropogenic stress (stress caused by human activity). It provides a framework for understanding current conditions in a water body relative to natural, undisturbed conditions.

EPA worked with biologists from across the United States to develop the BCG conceptual model (Davies and Jackson 2006.) The BCG shows an ecologically based relationship between the stressors affecting a waterbody (the physical, chemical, biological impacts) and the response of the aquatic community, manifested as the biological condition. The model is consistent with ecological theory and can be adapted, or calibrated, to reflect specific geographic regions and waterbody types (e.g., streams, rivers, wetlands, estuaries, lakes).

The BCG is divided into six levels of biological conditions along the stressor-response curve, ranging from observable biological conditions found at no or low levels of stress (level 1) to those found at high levels of stress (level 6) (see Figure).

Level 1. Native structural, functional, and taxonomic integrity is preserved; ecosystem function is preserved within range of natural variability. Level 1 describes waterbodies that are pristine, or biologically indistinguishable from pristine condition.

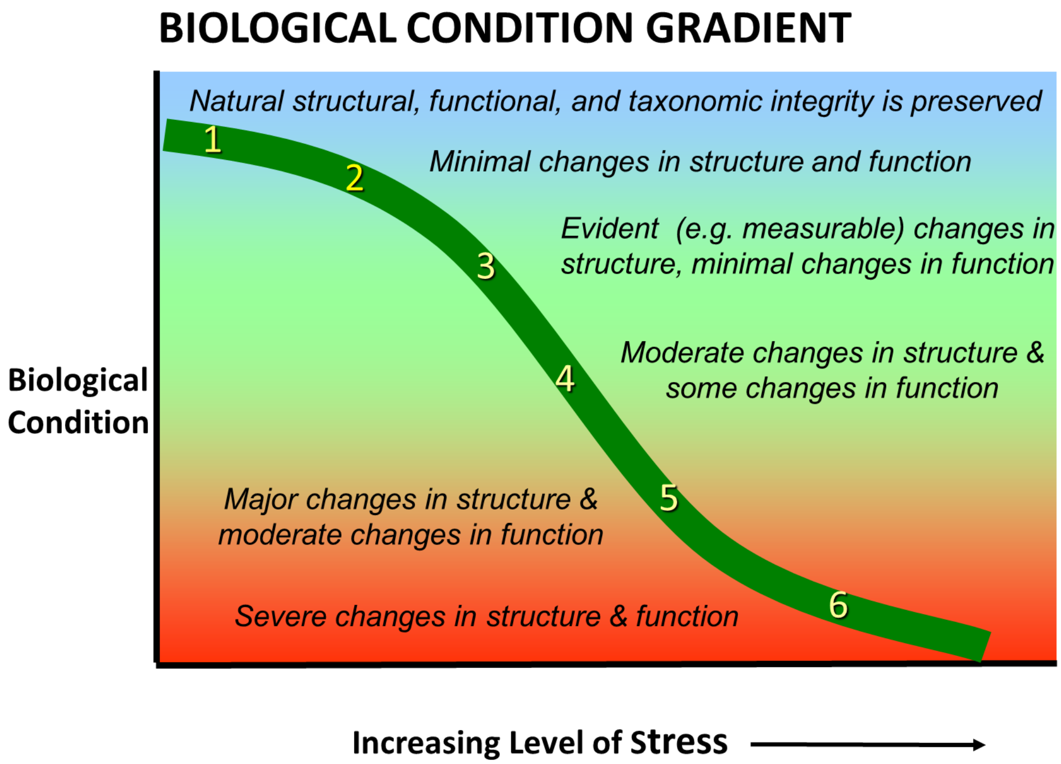
Level 2. Virtually all native taxa are maintained with some changes in biomass and/or abundance; ecosystem functions are fully maintained within the range of natural variability.

Level 3. Some changes in structure due to loss of some highly sensitive native taxa; shifts in relative abundance of taxa but sensitive–ubiquitous taxa are common and abundant; ecosystem functions are fully maintained through redundant attributes of the system, but may differ quantitatively.

Level 4. Moderate changes in structure due to replacement of sensitive–ubiquitous taxa by more tolerant taxa, but reproducing populations of some sensitive taxa are maintained; overall balanced distribution of all expected major groups; ecosystem functions largely maintained through redundant attributes.

Level 5. Sensitive taxa are markedly diminished; conspicuously unbalanced distribution of major groups from that expected; organism condition shows signs of physiological stress; system function shows reduced complexity and redundancy; increased buildup or export of unused organic materials.

Level 6. Extreme changes in structure; wholesale changes in taxonomic composition; extreme alterations from normal densities and distributions; organism condition is often poor (e.g. diseased individuals may be prevalent); ecosystem functions are severely altered.



Source: Modified from Davies and Jackson 2006.

Note: The BCG was developed to serve as a scientific framework to synthesize expert knowledge with empirical observations and develop testable hypotheses on the response of aquatic biota to increasing levels of stress. It is intended to help support more consistent interpretations of the response of aquatic biota to stressors and to clearly communicate this information to the public, and it is being evaluated and piloted in several regions and states.

The BCG model provides a framework to help water quality managers:

- Decide what environmental conditions are desired (goal-setting) — the BCG can provide a framework for organizing data and information and for setting achievable goals for waterbodies relative to "natural" conditions (e.g., condition comparable or close to undisturbed or minimally disturbed condition).

- Interpret the environmental conditions that exist (monitoring and assessment) — practitioners can get a more accurate picture of current waterbody conditions.

- Plan for how to achieve the desired conditions and measure effectiveness of restoration— the BCG framework offers water program managers a way to help evaluate the effects of stressors on a waterbody, select management measures by which to alleviate those stresses, and measure the effectiveness of management actions.

- Communicate with stakeholders — when biological and stress information is presented in this framework, it is easier for the public to understand the status of the aquatic resources relative to what high-quality places exist and what might have been lost.

Development of a BCG in Montgomery County

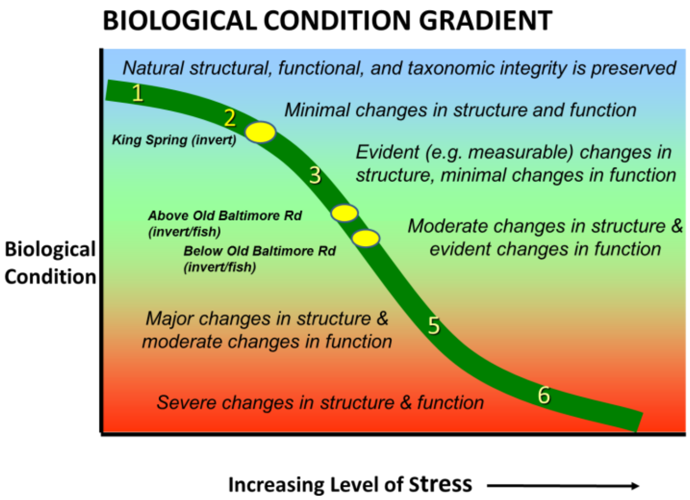
Recently, M-NCPPC Planning Department and Department of Environmental Protection staff have been working with biological experts in the EPA, State, academia, and the private sector to begin developing a BCG for Montgomery County. As a first step, a preliminary BCG for County headwater streams (less than 5 square miles) was undertaken. A sample of 20 headwater streams, ranging from the best to the lowest in stream health, was evaluated and ranked by the experts. Three of the streams chosen are in the Ten Mile Creek watershed, which allowed an assessment to be made of Ten Mile Creek and how it fits into a preliminary BCG for the County.

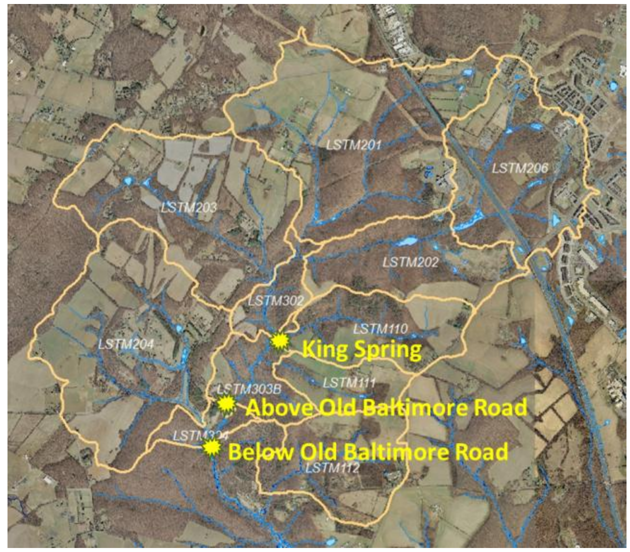
BCG results

The expert judgments of the biological condition of the Ten Mile Creek sites ranged between high to fair quality (BCG levels 2- to level 4). The highest quality Ten Mile Creek site was the King Spring Tributary (LSTM 110) where the primary headwater stream supported cold and cool water sensitive, native benthic macroinvertebrate taxa. The experts identified these sites as excellent candidates for protection. (See following graphics)

The highest quality site in the dataset (rated 2- by BCG) for benthic invertebrates was Ten Mile Creek tributary LSTM110 (King Spring), despite that the B-IBI scored 32. The experts rated lower Ten Mile Creek sites (LSTM 303B and LSTM 304 toward the gage station) as 3- indicating portions of the stream that may be considered at risk of impairment. A stream assigned to a BCG level 3 is considered a good quality stream. The 3- indicates that the stream is still in good condition but there changes in the assemblage that are indicative of degradation.

Analysis of the fish community rated Ten Mile Creek 3- to 4- indicating that the fish community could be at risk of degradation. The main stressor to Ten Mile Creek fish sites is the influence of novel, non-native invaders from the downstream reservoir. However, the panelists thought that a stream like Ten Mile was a potential candidate for Brook Trout re-introduction due to presence of some cold-water benthic indicator taxa, critical fish habitat and extensive, undisturbed riparian zone. Further restoration activities to re-introduce Brook Trout would likely move the stream up to Level 2 or higher.





It appears that the BCG evaluation detected detailed and important changes in the community that were not detected in the B-IBI score. Thus, information from the BCG evaluation can be used to add detail and insight to the results of B-IBI assessments such as detecting significant changes earlier, particularly high quality waters, or tracking incremental improvements in degraded waters. For example, more detailed IBI metrics may be found to be more useful in documenting declines in stream health than the currently used aggregated IBIs.

Important aquatic species in Maryland's Piedmont headwater streams. Salamanders (Long-tailed, Dusky, and Red); fishes (Potomac Sculpin, Rosyside Dace, American Eel); Insects (Sweltsa, *Paraleptophlebia*, *Ephemerella*).

Further development of the BCG in Montgomery County will produce a more useful tool that will cover all of the County streams, and will allow future assessments of the BCG level of a stream based on its biological community data.

Principles for Protecting Ten Mile Creek

The quality of Ten Mile Creek is highly dependent on retaining as much of the current environmental infrastructure intact as possible. The stream has adapted to the long-term agricultural uses on about 40% of the watershed area, and to some extent, replacing these uses with a limited amount of new development would have less impact on the stream than development on forested land. Based on our analysis of information provided by the consultant team, County agencies, state and federal environmental agencies, the following principles will greatly reduce the risk of significant degradation of Ten Mile Creek due to new development:

- Protecting natural resources. This includes both those that directly affect Ten Mile Creek's stream quality by filtering and ameliorating stormwater flows, but also those that indirectly serve the natural cycles that maintain a healthy ecosystem.
- Minimizing the footprint of development within the watershed. The damage done by grading, filling and compaction of the soil, combined with the loss of forest cover and alteration of the natural drainage to springs and seeps would be minimized if the total disturbed area is reduced.
- Protecting the immediate drainage area around the heads of streams beyond the area protected by the stream buffer.
- Reforesting farm fields outside of the development footprint to native plant communities. Forest will absorb more water and nutrients than fallow farm fields, but will also reverse the current impact of farming on the stream.
- Reducing the extent of disturbance to stream buffers and existing forest due to utility and roads crossings of streams to serve the new development. To the extent possible, these impacts should be avoided or minimized.
- Limiting the total imperviousness in the watershed through either a cap on new imperviousness or a combination of density, land use and development guidance.
- Incorporating higher standards than current regulations for stormwater management.
- Retrofitting impervious surfaces that do not currently have stormwater management control.

Some Lessons Learned from the Clarksburg Monitoring So Far

- Best Management Practice (BMP) Performance
    - In general, the data show that BMPs don't perform as well as they are rated

        - There is a need to add performance adjustment factors to the estimates

    - Construction-phase activities are more destructive than we thought

        - Sensitive species generally drop out and the degree to which they recover is uncertain. MCDEP staff noted that some sensitive species return, but nowhere near the same numbers. There is a need to oversize BMPs to begin with to help compensate for reduced performance.

        - There is a need to monitor BMPs as development proceeds. This will provide data to help make adjustments to future development, based on monitoring results: the Adaptive Management approach (For example, it might be possible to factor-in a SWM reserve area for extra BMPs if future monitoring shows bad results (instead of staging development).

        - Perpetual maintenance is essential, e.g. if there is a drought, there may be a need to water vegetation and back flush grassed swales.

Process and Analytical Method for Understanding Potential Impacts of Development

At the March 14, 2013, worksession the Planning Board reviewed the consultants' buildout analysis of the potential impacts of the 1994 Master Plan. Several questions were raised after that presentation that suggested some follow-up analysis. The detailed findings of the original analysis are attached (Attachments 2-8), as well as additional detail on the information summarized below.

Consultant Analysis of Ten Mile Creek

Biohabitats, Brown and Caldwell, and the Center for Watershed Protection conducted extensive analysis of potential impacts of the 1994 Master Plan buildout. The results of each analyses were reviewed by the Consultant Team and the relative change, or impact within each subwatershed was assigned a narrative rating, as summarized in the Table 2, below.

Table 2. Summary of 1994 Master Plan Scenario Analysis

Subwatershed	Watershed Health Indicator				
	Hydrology	Geomorphology (inferred from H&H Analysis)	Pollutant Loading	Natural Resource Disturbance (per Spatial Analysis)	OVERALL
LSTM110	Significant	Significant	Low	Moderate	Significant
LSTM111	Significant	Significant	N/A	Low to Moderate	Significant to Moderate
LSTM112	Low to Moderate	Low to Moderate	N/A	Low	Low to Moderate
LSTM201	Low to Moderate	Low to Moderate	Low	Low to Moderate	Low to Moderate
LSTM202	Moderate	Moderate	N/A	Low to Moderate	Moderate
LSTM203	N/A	N/A	N/A	N/A	N/A
LSTM204	N/A	N/A	N/A	N/A	N/A
LSTM206	Low to Moderate	Low to Moderate	Significant	Significant	Moderate
LSTM302	Moderate	Low to Moderate	Moderate to Significant	Low	Moderate
LSTM303B	Moderate	Low to Moderate	Low to Moderate	Low	Moderate
LSTM304	Moderate	Moderate	N/A	N/A	Low to Moderate

Key findings include:

- The projected limits of disturbance associated with the 1994 Master Plan are approximately 407 acres, or 13% of the Ten Mile Creek study area (Table 3). Most development would occur in Subwatershed 206, followed by Subwatershed 110, 202, 111 and 201. However, the extent of development is greatest across Subwatersheds 111 and 110. No new development would occur in Subwatersheds 203, 204, and 304.
- Natural resources impacts associated with development regulated by the County (e.g., SPA buffer requirements) were limited to forest, slope and soil impacts whereas other features, such as streams, wetlands, springs, seeps, and floodplains, are protected. However, public infrastructure in support of development, including the proposed 355 Bypass and the sanitary sewer extension, will

result in impacts to a variety of natural resources. The most significant impacts occur in Subwatershed 206, and are largely associated with the proposed 355 Bypass. Development within Subwatershed 110 will result in loss of forested areas, including interior forest.

- Watershed-wide pollutant loads for nutrients (Nitrogen and Phosphorus) increase during construction and decrease to slightly above pre-developed rates in the post-developed condition. Sediment loads decrease uniformly after construction, except in undisturbed watersheds. This is because sediment loads from urban lands are much lower than those from most pre-developed land uses, with the exception of forest.
- Sediment loads are much higher during construction, with the sediment load increasing on average about 2% during the construction period. Some subwatersheds experience an increase during construction but a decrease after construction. For example, subwatershed LSTM 206 has a 76% increase during construction, but a 35% decrease after construction. This occurs because sediment loads from construction are much higher than any rural land, while loads from developed land are much lower. Consequently, subwatersheds with a large area of disturbance will experience an increase during construction, followed by a much lower post-construction load.
- The results of the H&H model indicated that ESD practices can help control the elevated peak stream flows caused by development. However, the post-development H&H model hydrographs do not replicate the pre-development hydrographs, which was consistent with some of the evidence documented in the literature reviewed for this study. In general, the H&H modeling results indicate that the development proposed for the Ten Mile Creek study area may increase total streamflow volumes in the majority of subwatersheds and the increased runoff volumes may be conveyed to the stream at low to moderate velocities during the latter part of the storm hydrographs.
- The change in post-development hydrology response was not uniform across the subwatersheds, and significant increases in post-development peak flows were predicted in two subwatersheds.
- Although modeling for Ten Mile Creek predicts changes to flows, it does not provided information about changes to sediment supply, which are a necessary part of predicting channel response. A clear threshold for geomorphic change is uncertain; however, if it were possible to hold other factors constant (e.g., bed slope and substrate), changes to the stream channel would be expected to be relative to the magnitude of change in flows. For the locations included in the modeling, this perspective would suggest that the channel at LSTM111 would be the most vulnerable to geomorphic changes (e.g, enlargement). In contrast, the channels at LSTM112, LSTM201, LSTM202, and LSTM206 would be predicted to undergo relatively less geomorphic change, and the channel at LSTM110 would be predicted to undergo an intermediate response.
- The hydrologic modeling for Ten Mile Creek also does not provide information about changes to stream biological health in response to potential development.
- In summary, the H&H modeling predicted that although ESD may help mitigate increased in peak streamflows in some locations, development will result in changes to stream hydrology which, when combined with other changes to watershed characteristics, may contribute to changes in overall stream condition.

Cumulative Stream Impact Analysis

In addition to the consultants' analyses, the Planning Staff also prepared an analysis of the potential change to impervious surface coverage that might result from the 1994 Master Plan buildout. For many years, Planning Staff has used imperviousness and the well-established correlation between imperviousness and stream quality (see Attachment 9 for the literature review) as a guide for planning appropriate density depending on the quality and sensitivity of streams. Whenever possible, zones were chosen that generally result in imperviousness that is protective of the current stream conditions. Where densities chosen were potentially threatening to a stream's quality, the watersheds have been established as Special Protection Areas and often an environmental overlay zone was established to limit imperviousness of development proposals. ESD has been demonstrated to have favorable results over previous stormwater control requirements on a site basis, however, there is a benefit in understanding how we have evaluated the potential for impact to stream quality in the past as a way to understand the risk to stream quality and the high expectations we are placing on ESD to achieve better results.

CSPS Score Change Estimate (CSCE) Model

A statistical model was developed for the Upper Rock Creek Master Plan to estimate the potential effect of development on stream health, as measured by the County's Indices of Biotic Integrity (IBIs). IBIs measure the biological health of a stream using invertebrate (mostly insect) and/or vertebrate (fish) diversity and abundance. The model uses potential changes in impervious cover area as the predictor variable for estimating potential changes in IBI scores. Other watershed variables were also analyzed for potential use as predictor variables, but were found to be too highly correlated with impervious cover to be useful in a statistically-based model. As a result, in the CSCE model, impervious cover functions as an integrator of all of the stream health-related impacts of development, not just the effects of impervious cover itself. The CSCE model was subsequently used to estimate potential IBI score changes in other master plans including Olney, Damascus, Germantown, and Great Seneca Science Corridor.

The CSCE model was developed using countywide IBI data collected by the Montgomery County Department of Environmental Protection, and the M-NCPPC Parks Department. Because of the variability in the data, the initial statistical regression model was found to be too inaccurate to usefully estimate potential changes in individual IBI scores. But when used to predict potential IBI score changes, rather than individual IBI scores, the model estimates have substantially improved confidence intervals. This is because there is more error involved in estimating an individual IBI score than an estimated change in an IBI score.

The score changes estimated by the CSCE model are then used in conjunction with actual monitored IBI scores to produce estimates for changes in those scores in response to different development scenarios. Used this way, the predicted IBI score change from development in a given watershed is subtracted from the monitored pre-development score to provide an estimate of the resulting post-development IBI score.

The CSCE model was developed using data that reflects pre-ESD development standards, and therefore cannot be used to predict potential changes in IBIs that might result from development that uses ESD. Until enough data exists to update the CSCE model to predict the benefits of ESD, however, the model can be used to estimate the potential stream health impact under the old regulations. This estimated impact can in turn be used as an estimate of the lower endpoint for the range of potential improvement that might result from using ESD.

Additional Analysis of Impact of 1994 Plan under Current Development Regulations

Some additional questions were raised by various parties regarding the analysis of the impact of the 1994 Master Plan and additional analysis was conducted to provide answers to those questions. They included:

- What would be the result if less conservative assumptions were made about the stormwater management?
- Shouldn't the spatial analysis be focused mainly on those factors that affect stream quality and consider impacts to forest interior separately?
- How might imperviousness projections affect the stream quality?

Hydrologic Model with Less Conservative Assumptions

The initial modeling results presented to the Planning Board on March 14, 2013, conservatively assumed that at the time of the projected storm the ESD stormwater bio-infiltration facilities would be saturated. However, the design criteria used by the Department of Permitting Services assumes such facilities to be dry. For master planning purposes, we felt that a more conservative assumption gave a factor of safety that seemed reasonable given that we were not modeling a fully designed development. Given concerns raised by the development community, we decided to model an assumption that is between the two. (See Attachments 3 and 4 for details on the assumptions)

Table 1 provides a comparison summary of the total streamflow volume for the outlets of the primary subbasins for the 1-yr storm event and 2-yr storm event. As also shown in Technical Memorandum No. 1 and below, total streamflow volume is generally expected to increase after development, and the revised ESD assumptions modeled in this additional analysis had minimal impacts on the total streamflow volume as compared with the ESD assumptions originally modeled for the Master Plan scenario[1].

[1] The small differences in streamflow volume between these two analyses are more likely attributable to model response to the changes in the ESD parameters and modeling method, rather than being indicators of changes in stream response.

Table 1 Summary of Total Streamflow Volume

		1-yr 24-hr storm Volume (ac-ft)			2-yr 24-hr storm Volume (ac-ft)		
Model Link #	Corresponding Watershed #	Existing Conditions	1994 Master Plan*	**Master Plan* with ESD, additional storage**	Existing Conditions	1994 Master Plan*	**Master Plan* with ESD, additional storage**
LN 071	LSTM 110	8.7	15.0	15.9	13.6	21.7	22.6
LN 061	LSTM 111	4.3	7.9	8.4	6.8	11.4	11.9
LN 101	LSTM 202	39.5	44.1	46.0	56.7	62.1	64.0
LN 102	LSTM 206	27.9	29.6	30.7	38.7	40.6	41.7
LN 030	Outlet	126.2	141.5	145.3	193.4	212.3	216.3

*** Plan scenarios assumed treatment with ESD, and soil compaction from construction activities**

Table 2 provides a summary of the model results for the peak streamflow for the same subbasins for the 1-yr and 2-yr storm event. It is interesting to note that the revised ESD modeling scenario remained relatively unchanged for subwatersheds LSTM 206 and LSTM 202. However, when comparing the revised ESD scenario with the original modeled Master Plan ESD scenario for subwatersheds LSTM 110, LSTM 111, and the model outlet, the model predicted a decrease in peak flow rate.

Table 2 Summary of Peak Stream Flow

		1-yr 24-hr storm Peak Stream Flow (cfs)			2-yr 24-hr storm Peak Stream Flow (cfs)		
Model Link #	**Corresponding Watershed #**	**Existing Conditions**	**1994 Master Plan***	**Master Plan* with ESD, additional storage**	**Existing Conditions**	**1994 Master Plan***	**Master Plan* with ESD, additional storage**
LN 071	LSTM 110	16.2	29.2	15.3	33.2	52.0	26.2
LN 061	LSTM 111	5.0	24.0	12.9	8.2	43.2	22.6
LN 101	LSTM 202	175.7	134.5	134.5	246.9	198.2	195.5
LN 102	LSTM 206	158.8	128.3	128.6	219.4	182.9	182.7
LN 030	Outlet	213.7	219.2	197.0	384.4	399.4	341.0

*** Plan scenarios assumed treatment with ESD, and soil compaction from construction activities**

Table 3 provides a comparison summary of the peak stream velocity between the Existing Conditions scenario, the Master Plan scenario modeled with original ESD assumptions, and the Master Plan scenario modeled with revised ESD assumptions. The model predicted that the peak stream velocity remained relatively unchanged between the three scenarios when analyzing subwatersheds LSTM 202, LSTM 206, and the outlet. For the reaches draining subwatersheds LSTM 110 and LSTM 111, the model predicted that under the revised ESD scenario, the peak stream velocities would remain close to those of the existing conditions. It is important to remember that for this planning-level model, the result of interest is the difference in the parameters between the modeling scenarios rather than the absolute value of the parameters for any one scenario.

Table 3 Summary of Peak Stream Velocity

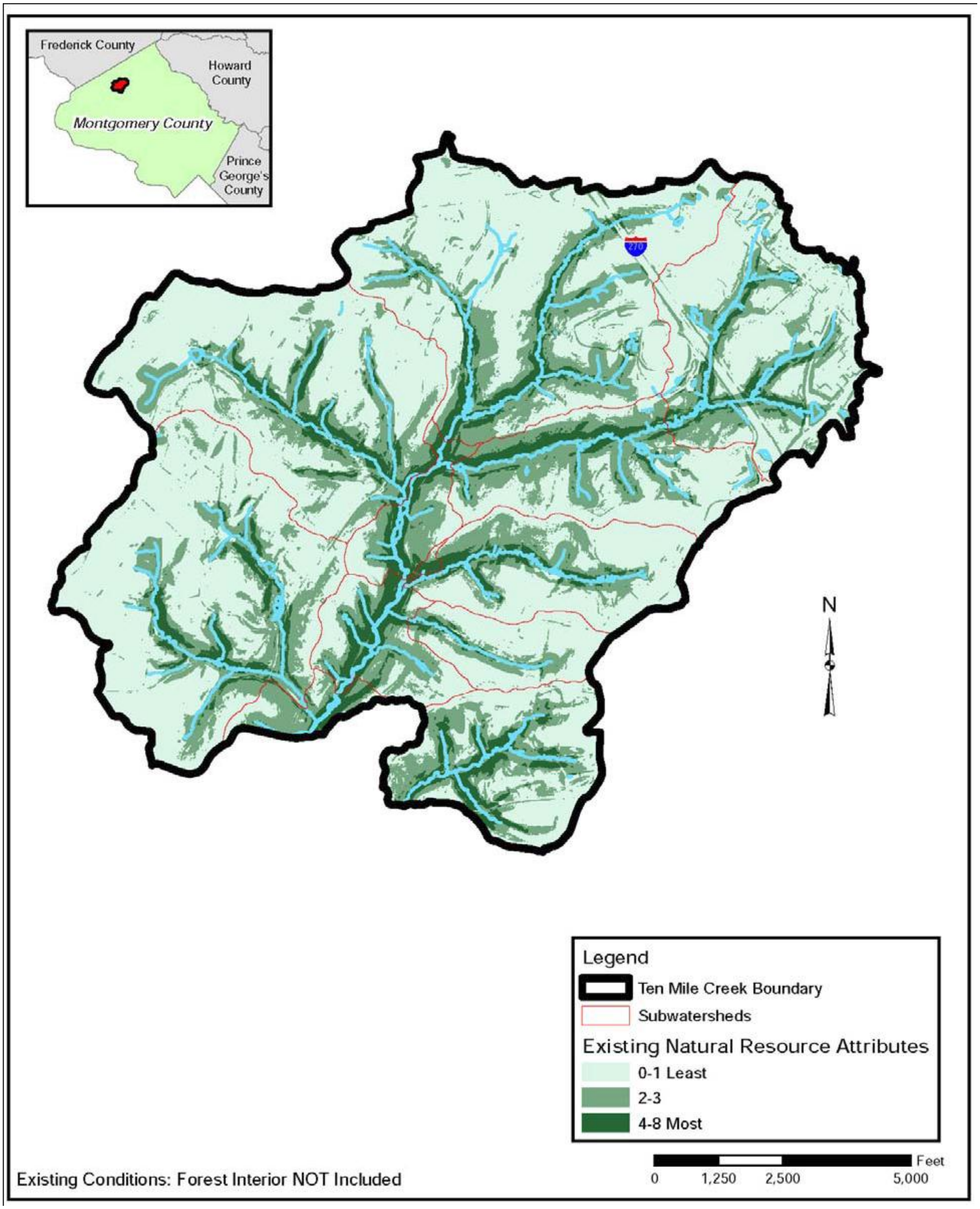
		1-yr 24-hr storm Peak Stream Flow (cfs)			2-yr 24-hr storm Peak Stream Flow (cfs)		
Model Link #	Corresponding Watershed #	Existing Conditions	1994 Master Plan*	Master Plan* with ESD, additional storage	Existing Conditions	1994 Master Plan*	Master Plan* with ESD, additional storage
LN 071	LSTM 110	1.8	2.2	1.8	2.3	2.5	2.1
LN 061	LSTM 111	1.3	2.3	1.9	1.6	2.8	2.2
LN 101	LSTM 202	2.9	2.7	2.8	3.3	3.0	3.0
LN 102	LSTM 206	2.8	2.7	2.6	3.2	2.9	2.9
LN 030	Outlet	2.7	2.7	2.7	3.2	3.3	3.1

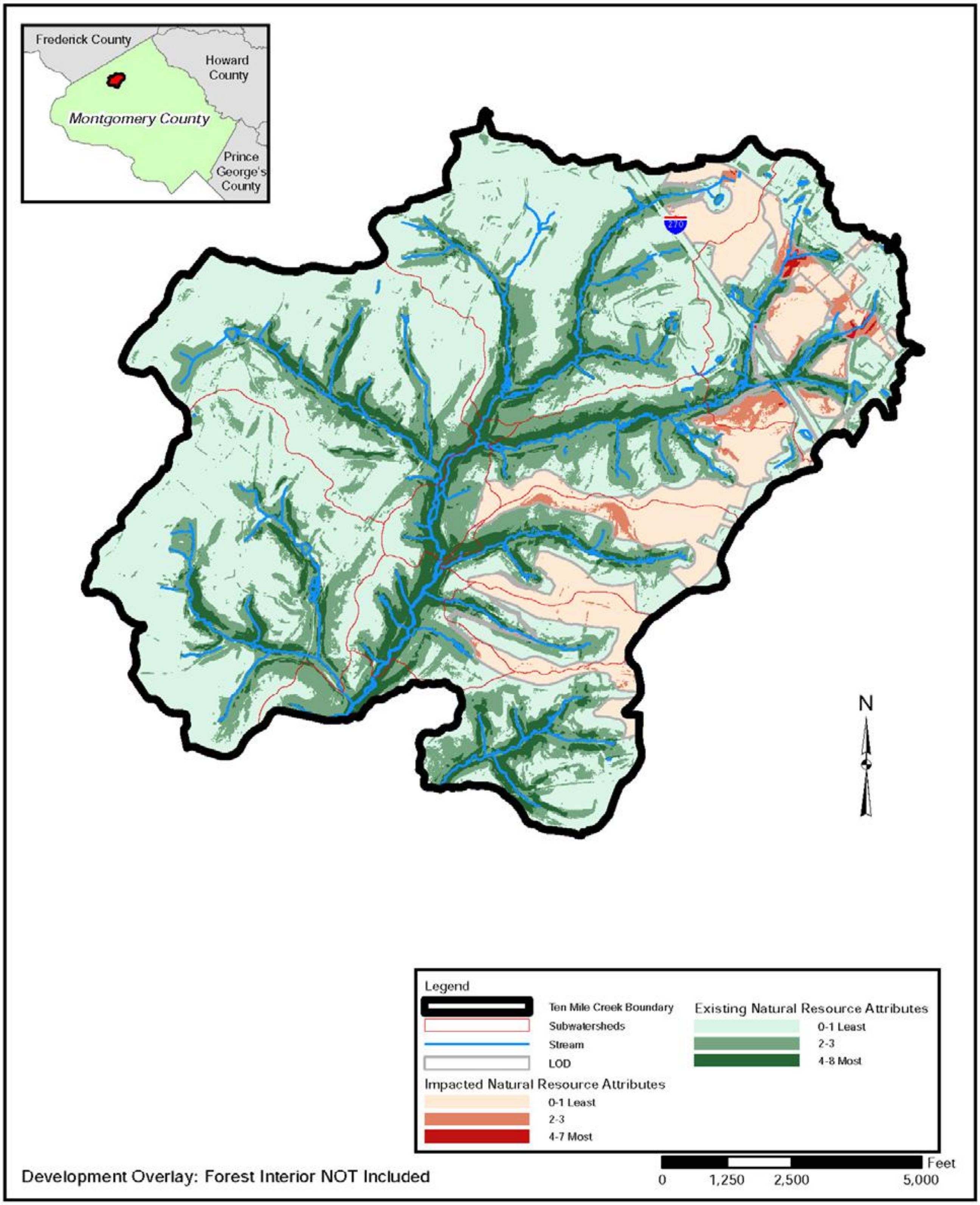
*** Plan scenarios assumed treatment with ESD, and soil compaction from construction activities**

In conclusion, when comparing the revised ESD model scenario with the previous Master Plan scenario the results indicate that for subwatersheds LSTM 202, LSTM 206, and the model outlet the metrics of total streamflow volume, peak stream flow, and peak stream velocity remain relatively unchanged. The greatest response from the revised ESD model scenario was observed in subwatersheds LSTM 110 and LSTM 111. The model predicted a decrease in peak stream flow when compared to the original Master Plan model scenario outlined in Technical Memorandum No. 1; however, an increase in peak stream flow over the existing conditions model scenario is predicted. When comparing the metrics of total streamflow volume the model predicted little difference between the original master plan scenario to that of the revised ESD scenario. A slight decrease was observed in subwatersheds LSTM 110 and LSTM 111 when analyzing the metric of peak stream velocity for the revised ESD scenario compared to the original master plan model.

Spatial analysis with adjusted factors

After further consideration of the results of the spatial modeling, an alternative analysis was conducted using the same methodology as before with the forest interior layer removed. The reasoning behind this alternative analysis was to more directly evaluate stream quality as opposed to overall watershed health. The following graphics depict the results of the analysis. The darker areas corresponding to higher attribute values are concentrated near the streams, reflecting both the importance of streams and their buffer areas to watershed health and to the abundance of stream related GIS data used in the analyses relative to the other non-stream attribute data.




Frederick County
Howard County
Montgomery County
Prince George's County
270
N
Legend
Ten Mile Creek Boundary
Subwatersheds
Stream
LOD
Impacted Natural Resource Attributes
0-1 Least
2-3
4-7 Most
Existing Natural Resource Attributes
0-1 Least
2-3
4-8 Most
Feet
0
1,250
2,500
5,000
Development Overlay: Forest Interior NOT Included

Removing interior forest from the analysis shifts approximately 2% of the land area from Categories 2-3 into Category 1. Over 80% of the total land area in the watershed is located in areas designated as Category 0 (37%), 1 (28%) or 2 (16%). Almost twenty percent of the total area of the watershed is located in areas designated as Category 3 (10%), Category 4 (6%) or Category 5 (3%).
Less than 1% of the watershed is located in areas designated as Category 6-7. More than half the land area is located in Categories 0-1 and more than 80% is located in Categories 0-2.

Application of the CSCE Model in Ten Mile Creek

Since it was created, Little Seneca Lake has had a negative effect on the fish community in the upstream portion of Ten Mile Creek, which comprises the study area for the Clarksburg plan amendment. The presence of the lake blocks fish passage between the upper and lower reaches of Ten Mile Creek, and provides a source of lake fish to the stream above the Lake, which disrupts natural stream fish communities. Because of this, the decision was made in conjunction with DEP and Parks staff, to use the benthic macroinvertebrate IBI scores (which are not affected by the Lake) as the best indicator of the biological health of Ten Mile Creek.

The CSCE model was applied to the Ten Mile Creek and its subwatersheds to estimate the potential impacts to benthic stream biology resulting from development under the 1994 Clarksburg master plan, and assuming pre-ESD stormwater management. Because of this limitation, the modeled results do not reflect the changes in stream biology that would result from development in Ten Mile Creek using ESD, as is now required by law. The results do, however, provide an idea of the degree of stream biological impact that would result under the previous stormwater management standards, and provide a lower endpoint for the range of potential improvements that could result from the same development using ESD. Because of the lack of biological response data from watersheds developed using ESD, there is currently no way to estimate how much better ESD will perform over the earlier standards to protect the stream biology of Ten Mile Creek. In addition, the extra sensitivity of Ten Mile Creek, due to its high number of cool water spring seeps, thin rocky soils, and shallow depth to bedrock, makes such estimates even more problematical.

Subwater-shed ID	1994_2012_BIBI	1994_2012_BIBI_Nar	Estimated Master Plan BIBI Score	Estimated Master Plan BIBI Narrative Ranking	Estimated Master Plan BIBI 95% Confidence Upper Value	95% Confidence Upper Value Narrative Ranking	Estimated Master Plan BIBI 95% Confidence Lower Value	95% Confidence Lower Value Narrative Ranking
LSTM 201	31	**Good**	29	**Good**	29	**Good**	28	**Low Good**
LSTM 111	30	**Good**	20	**Fair**	24	**High Fair**	16	**Poor**
LSTM 112	30	**Good**	28	**Good**	29	**Good**	27	**Low Good**
LSTM 206	21	**Fair**	10	**Poor**	13	**Poor**	7	**Poor**
LSTM 202	30	**Good**	20	**Low Fair**	23	**Fair**	18	**Low Fair**
LSTM 302	35	**High Good**	31	**Good**	32	**Good**	30	**Good**
LSTM 110	35	**High Good**	25	**High Fair**	29	**Good**	20	**Fair**
LSTM 303B	36	**Low Excellent**	32	**Good**	33	**High Good**	31	**Good**
LSTM 304	34	**High Good**	30	**Low Good**	31	**Good**	29	**Good**
LSTM 203	32	**Good**	**32**	**Good**	**32**	**Good**	**32**	**Good**
LSTM 204	32	**Good**	**32**	**Good**	**32**	**Good**	**32**	**Good**

Although impacts to biological impacts to Ten Mile Creek are still expected from development using ESD, the use of ESD is also expected to cause less of an impact to stream biology than the previous stormwater management regulations. How much less, however, cannot be determined until statistical data is collected from monitoring over several years. Similarly, if current ESD standards are exceeded, for example, by using additional measures such as soil decompaction and amendments with organic matter, or by increasing the retention capacity of ESD BMPs, then the potential impacts to stream biology will be even further reduced.

Transportation Impacts

In support of this Plan, a Countywide Transportation Policy Area Transportation Review (TPAR) analysis was conducted assuming a land use/transportation scenario reflecting the following key elements:

- **Regional Background Conditions:** The year 2040 Round 8.1 Cooperative Forecast for the region in conjunction with a transportation network generally reflecting the Constrained Long Range Plan. Regional transportation network assumptions also include the extension of HOV lanes on I-270 between MD 121 and MD 15 in Frederick.

- **Clarksburg Area Conditions:** The proposed “alternative master plan” land use development scenario within the Ten Mile Creek Area in combination with year 2040 Round 8.1 Cooperative Forecast land use in the remainder of the Clarksburg policy area. This development scenario is assumed in combination with the adopted Clarksburg Master Plan transportation network.

The results of this analysis are depicted in the graphic shown as Figure 1. The following notes should be used in support of interpreting the results provided in this figure:

- The vertical "blue-hatched" bars show the **range** of the average of roadway speeds by direction of travel in relation to the "free flow speed", or LOS, for each Policy Area in the PM peak period.

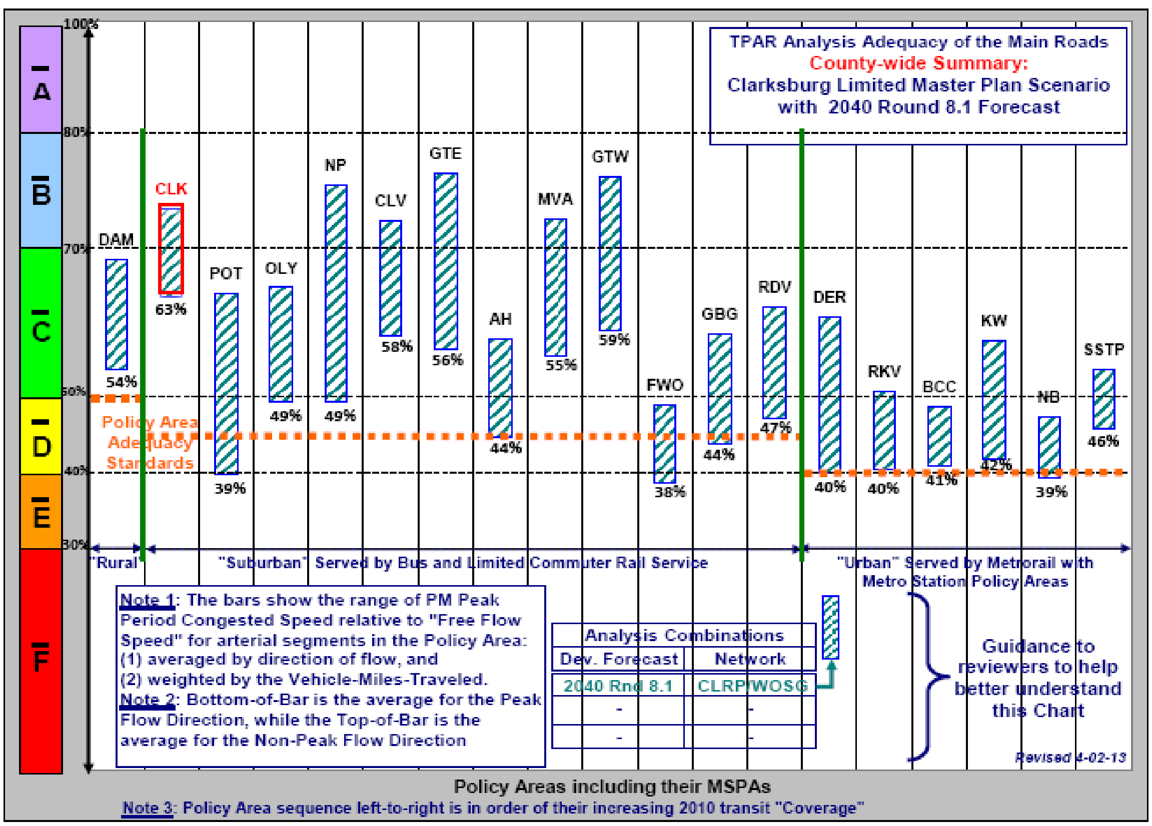
- The bottom of the bar shows the average LOS in the peak direction of travel. The top of the bar shows the average speed (LOS) in the non-peak direction.

- The measurement scale weighted average LOS is shown on the left side of the chart.

- Horizontal dotted orange lines are shown to depict the adequacy standards (LOS) for the Rural, Suburban and Urban (with Metrorail) Policy Areas, from left to right, corresponds to the Standards of Roadway Adequacy as defined the context of TPAR.

The TPAR results depicted in the figure shows that the bottom of the blue-hatched bar for Clarksburg (as noted by the red abbreviation "CLK" and highlighted in the figure below) is projected to achieve a 63% ratio of congested relative to uncongested roadway travel speed. This ratio is well above the 45% policy area standard for suburban policy areas the County as determined by the Subdivision Staging Policy. This result shows that the Clarksburg policy area is forecasted to achieve adequate roadway travel conditions by the year 2040 planning horizon with the proposed alternative master Plan development scenario in the Ten Mile Creek Area.

Figure 1: Year 2040 County-wide TPAR Adequacy Analysis of the Main Roads with the Clarksburg Limited Master Plan Scenario



For comparison purposes, the summary TPAR results derived from the year 2040 Countywide roadway adequacy analysis performed in support of the 2012- 2016 Subdivision Staging Policy are also provided. These results are depicted in Figure 2 and reflect the build-out of the adopted Clarksburg Master Plan by the year 2040.

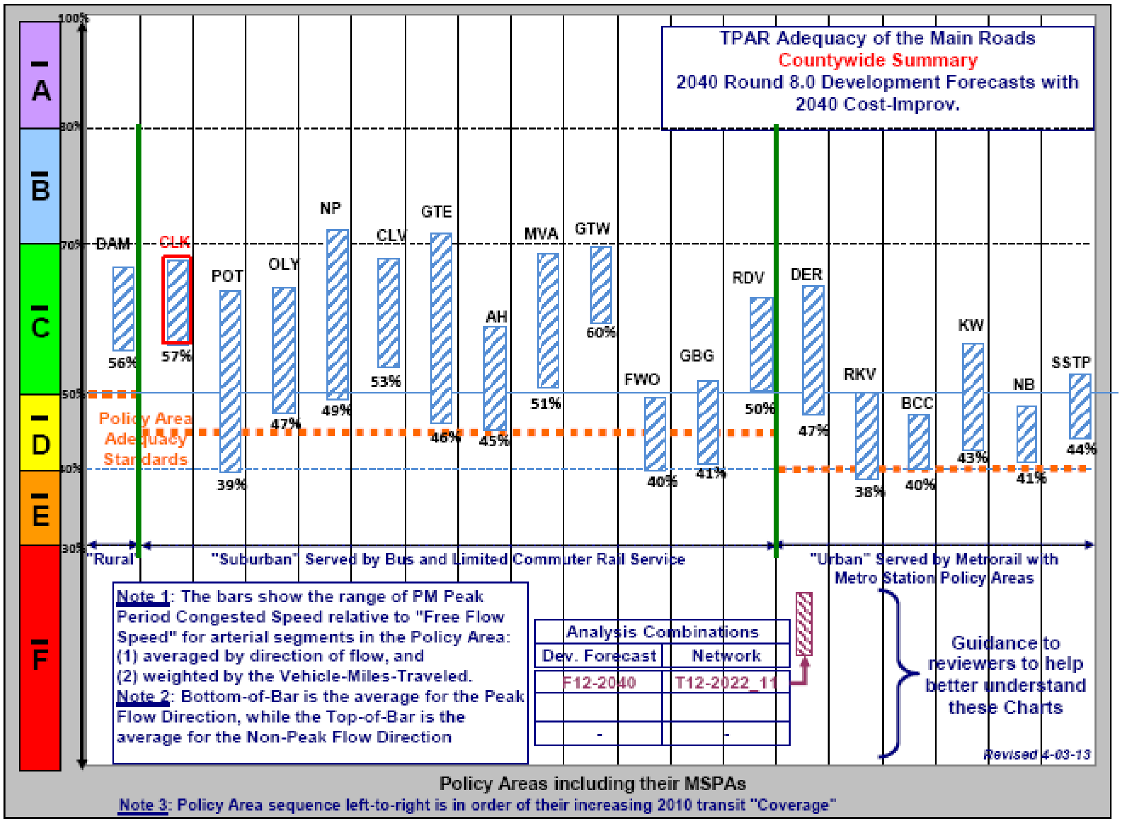
As can be observed, the highlighted results for Clarksburg show that the policy area is projected to achieve a 57% ratio of congested relative to uncongested roadway travel speed. This ratio is well above the 45% policy area standard for suburban policy areas the County as determined by the Subdivision Staging Policy. This result shows that the Clarksburg policy area is forecasted to achieve adequate roadway travel conditions by the year 2040 planning horizon with the land use assumed in the adopted Clarksburg Master Plan.

While the land/use transportation assumptions reflected in Figure 2 are generally comparable to those reflected in Figure 1, there are key differences which particularly impact the TPAR results for Clarksburg, as well as Germantown East. These differences are described below.

- **Demographic Differences:** Figure 1 reflects the year 2040 **Round 8.1** Cooperative Forecast while Figure 2 reflects year 2040 **Round 8.0** Cooperative Forecast. The year 2040 employment forecast for Frederick is roughly 35% lower in Round 8.1 relative to Round 8. This difference influences the forecast of trip distribution patterns between Frederick and Montgomery Counties.

- **Network Differences:** Figure 1 generally reflects the regional Constrained Long Range Plan network, including the full length of Midcounty Highway through Germantown East. Figure 2 reflects those projects needed to achieve TPAR roadway adequacy by 2040 as determined by the TPAR costing analysis performed in support of the 2012-2016 Subdivision Staging Policy. This analysis did not reflect the segment Midcounty Highway between Middlebrook Road and Montgomery Village Avenue.

Figure 2: Year 2040 County-wide TPAR Adequacy Analysis of the Main Roads with the Adopted Clarksburg Master Plan



The Local Area Analysis focused on seven intersections that represent gateways into the study area, as well as key internal junctions. The intersections include:

- Interchange ramp terminals for I-270 and Clarksburg Road (MD 121) for both the eastern and western side of the interchange;
- Clarksburg Road (MD 121) & Frederick Road (MD 355);
- Shawnee Lane & Frederick Road (MD 355);
- Stringtown Road (MD 121A) & Frederick Road (MD 355);
- Gateway Center Drive & Clarksburg Road (MD 121);
- New By-pass Road & Stringtown Road (MD 121A).

The consultant was asked to determine if the proposed 355 by-pass were removed from the plan, what the impact might be on intersection congestion. The year 2040 forecasts were developed using the County's TRAVEL/3 travel demand forecast model and land use supplied by the County for both the master planned land use and a high land use scenario that included the shift from residential and employment on the Miles/Coppola property to retail, hotel and residential denoted as "HI" on the chart. A no-build and build alternatives were run with both land use scenarios. The following table gives the results:

Summary CLV Table

Intersection	Existing				2040 No-Build				2040 Build				2040 HI No-Build				2040 HI Build			
	AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
MD 121 & I-270 Western Intersection	A	365	A	250	B	1125	A	675	B	1125	A	675	B	1125	A	675	B	1125	A	700
I-270 & MD 121 Eastern Intersection	A	609	A	480	C	1213	D	1325	C	1200	D	1325	D	1306	D	1325	D	1306	D	1350
MD 355 & MD 121	C	1225	C	1150	D	1425	**F**	**1850**	A	875	**F**	**1800**	E	1525	**F**	**1850**	A	950	**F**	**1800**
MD 355 & Shawnee Lane	A	750	A	875	B	1083	B	1117	B	1096	B	1142	C	1183	B	1100	C	1196	C	1225
MD 355 & Stringtown Road	A	914	B	1068	**F**	**1719**	**F**	**2431**	B	1073	E	1522	**F**	**1970**	**F**	**2431**	C	1210	**F**	**1657**
Gateway Center Dr. & Stringtown Road	A	667	A	846	D	1397	D	1325	E	1540	E	1468	**F**	**1721**	D	1325	**F**	**1802**	**F**	**1870**
New Road & Stringtown Road									D	1386	**F**	**1616**					D	1445	**F**	**1801**

Summary of findings:

- With the added development by the year 2040 there will be a need for added capacity for travel north and south in the Clarksburg area.
- Frederick Road (MD 355) with a two lane cross section provides limited capacity for trips traveling north and south.
- The additional by-pass facility provides added capacity for north and south travel along the corridor.
- Even with the new facility there is a need for additional capacity improvements. These could include improved intersection geometrics, added lanes on the by-pass and MD 355, new facilities to the east of MD 355. The following table provides a summary of the critical lane volume analysis. The critical lane volume worksheets are attached.

Scenario Analysis

The challenge in developing alternative scenarios for the Clarksburg Planning Area will be to balance the plan's clearly articulated policies with the principles for protecting Ten Mile Creek that are supported by the underlying environmental analysis. Two scenarios, one for the Town Center east of I 270 and one for the Ten Mile Creek neighborhood, should therefore be considered for further analysis.

East of I 270, the Plan's community building policies for the Town Center rely heavily on protecting and enhancing the historic district and on creating an identity for the area by locating important civic activities there. Further, national as well as regional changes in employment and related land use patterns that have occurred, especially over the last ten years, raise the question about devoting significant areas along I 270 within the Clarksburg Planning Area to employment uses. This is an especially vexing question in light of ongoing planning and development activities to the south, in support of employment uses along I 270 in Germantown and Shady Grove. In addition, long term desires for more shopping, entertainment and business opportunities, as expressed by the public during community workshops, raise questions about the population, market, and development scale necessary to support such activities within the three planned neighborhood retail areas. It further begs the question about considering changes in land use in support of such community building goals. Consequently, the plan scenario should:

- Retain the proposed bypass of the historic district (Observation Drive), but evaluate an alignment and cross section with the least environmental impact.

- Keep the fire station in the Town Center district, but consider relocating it to an already developed site, which would allow the existing forest stand in the headwaters of the Ten Mile Creek to be preserved.

- Retain residential development in the western part of this area, as currently proposed in the Plan.

- Consider mixed land uses to include residential, specialty retail and entertainment uses in areas now designated for employment. Such uses are currently allowed in the MXPD Zone recommended for the area, and the development plan process could accommodate analysis of densities reflecting additional environmental protection.

West of I 270, closer scrutiny of environmental impacts would reflect Plan policies recognizing the importance of the Ten Mile Creek watershed. A scenario for analysis should:

- Evaluate a smaller development footprint east of Ten Mile Creek and west of MD 121 that would add to the amount of undeveloped and forested land and create places where forest could be added.

- Keep recommended residential densities but adjust the mix of units.

- Explore possible incentives for property owners west of Ten Mile Creek to increase forested areas, including a program similar to the transfer development rights.

VL/MD am
Attachments:

Attachment 1: Biological Condition Gradient: A headwater Stream Catchment in the Northern Piedmont Region, Montgomery County, Maryland Technical Expert Workshop Preliminary Report (first draft review), April 3, 2013

Attachment 2: Summary of the 1994 Master Plan Scenario Analysis

Attachment 3: Draft Technical Memorandum No. 1: Preliminary Results of the Hydrology and Hydraulics Analysis

Attachment 4: Draft Amendment A to Technical Memorandum No. 1: Revised Environmental Site Design Modeling Scenario

Attachment 5: Spatial Watershed Analysis

Attachment 6: Pollutant Load Modeling Assumptions

Attachment 7: Pollutant Load Modeling Results

Attachment 8: Trend Analysis of Little Seneca Benthic and Habitat Assessment Data

Attachment 9: Environmental Site Design Literature Review