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

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Work session: Clarksburg Limited Master Plan for the Ten Mile Creek Watershed - Discussion of Assumptions and Scenario Analysis

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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 work session is to respond to questions raised at the April 17, 2013 Planning Board meeting and to help refine the alternative scenarios to test. In addition to the consultant team, staff from state and county agencies have been invited to respond to the appropriateness of the modeling assumptions and background on the state regulations for Environment Site Design.

Summary

The staff recommends that the Planning Board review the assumptions of the modeling effort, reconfirm the scenarios to be tested, and determine whether a fourth scenario will further inform the development of recommendations for the Clarksburg Limited Master Plan for Ten Mile Creek Watershed.

The Planning Board, on April 17, 2013, took the opportunity to hear from interested parties who questioned various aspects of the environmental work being done in support of the plan. Staff believes that the approach being taken is sound, and the work that the consultant has provided is accurate based on the inputs and assumptions agreed to by staff and agency partners. Given the concerns raised, however, some minor adjustments have been incorporated into the assumptions and are reported below.

Is the Base Data Accurate?

The information used for this analysis is the most accurate ever used for a master plan. Typically, the GIS layers interpreted from aerial photos are spot field-checked to determine if significant stretches of smaller streams or wetlands are missing from the data base. In this case, the Montgomery County Department of Environmental Protection (DEP) undertook an extensive field survey to locate as many of the small streams, seeps and springs throughout the watershed where they were able to obtain access to private property. Only a small portion of the properties in the agricultural reserve were not surveyed. This was a prodigious effort that the Executive contributed to the study, providing data consistent with their methodology used countywide (see Attachment 1 for methodology). This allowed us not only to have substantially more detailed information than is normally available for a master plan, but also gave us valuable information in validating the Natural Resources Inventories submitted for two of the key development parcels. DEP staff will present information on the specific locations noted by the Peterson Company at the worksession. Stormwater discharges on all properties are documented separately and were also available to the consultant. DEP staff is investigating the alleged "illicit discharges" cited by the consultants for the Peterson Company. Again, this level of detail is generally not addressed in master plans.

Quality of LSTM 206 versus the Larger Watershed

LSTM206 currently is considered in Fair condition and has the highest imperviousness of all the subwatersheds in the larger watershed. Portions of individual streams within the subwatershed may have a variety of conditions, but our assessment is based on the condition of the stream at the most downstream point of the subwatershed (falling west of I-270), which effectively averages out the upstream conditions. Currently, approximately 40 acres of imperviousness is untreated in LSTM206, having been built before stormwater management regulations. This is approximately 11% of 370-acre subwatershed. This untreated area includes I-270, MD 355, Clarksburg Road and various private properties along MD 355. The following table reflects the existing stormwater treatment in LSTM206.

Existing Stormwater Management Features in the Ten Mile Creek study area

Subwatershed	Structure Type	Approval Date	Drainage Area (acres)	Land Use
LSTM206	Flow Splitter to Sand Filter	1979	3.2	Little Bennett Regional Park Parking
LSTM206	Bioretention	2007	1.1	Woodcrest Phase 5 Medium-Density Residential
LSTM206	Infiltration Trench	1995	6.1	Clarksburg Nursery (Commercial)
LSTM206	Bioretention	2003	0.9	Clarksburg Ridge High-Density Residential
LSTM206	Sand Filter	2003	0.6	Clarksburg Ridge High-Density Residential
LSTM206	Wet Pond w/ Extended Detention	1989	34.5	Gateway 270 Corporate Park
LSTM206	Oil/grit Separator to Underground Detention	1992	3.8	Clarksburg Elementary School
LSTM206	Underground Infiltration trench	1974	0.3	Clarksburg Elementary School
LSTM206	Erosion & Sediment Control Pond, to be converted to a Wet Pond[2]	2012	12.9	Stringtown Road Extension & Gateway Commons

Source: DEP Urban Stormwater BMP Database, except for
1 Montgomery County Department of Environmental Protection, 2003
2 Montgomery County Department of Environmental Protection, 2012

Modeling

The models used in this assessment are more generalized tools appropriate for a planning-level assessment that compare the results of different scenarios against some basic parameters, not for precise predictions of future health of Ten Mile Creek. Significantly, there are still no models that can determine the impacts of proposed Environmental Site Design (ESD) on the biological and ecosystem health of a receiving stream. In addition, questions were raised about modeling the potential impacts to groundwater and to springs and seeps fed by groundwater. At this point, the models cannot predict these impacts. Greater infiltration of stormwater can help recharge the groundwater, but the degree to which pollutants will be filtered, how groundwater quality will be affected and whether individual springs and seeps will continue to flow cannot be predicted.

Is imperviousness a relevant measure for potential impact?

Because of modeling limitations, staff has also relied on scientific research regarding the impacts of urbanization on receiving ecosystems and the results of ESD modeling and monitoring studies. This literature review and the opinions of environmental agency experts support the following:

- Natural areas provide many interdependent environmental functions and ecosystem services supporting stream health.

- ESD and imperviousness limits achieve different goals, and work together in complementary ways to maximize environmental protection of high-quality or sensitive watersheds.

- The relationship between impervious cover and stream health has been well documented. Environmental impacts begin at the lowest levels of land disturbance and impervious cover, with high-quality streams being the most vulnerable to those impacts. While there are some high quality streams with higher levels of imperviousness, Ten Mile Creek is considered highly sensitive and fragile. This relationship has been established given stormwater management practices that have been in place for some time and does not reflect widespread use of ESD. However, despite past improvements to stormwater management, the relationship has remained the same.

- ESD and Best Management Practices (BMPs), such as porous pavement, are intended to mimic the infiltration capacity of wooded areas, but not the other environmental functions and benefits of natural areas.

- Limiting impervious cover reduces development-related impacts to the full range of environmental functions and benefits provided by natural areas, undisturbed topography and soils, of which infiltration is but one. This type of approach is well supported by scientific literature.

- There is very little data available to prove that ESD alone can protect a sensitive watershed.

Are the H and H model assumptions appropriate?

We have been meeting with the Department of Permitting Services and the Department of the Environment to determine how to best make the assumptions consistent with their requirements and a margin of safety to account for the variability in the performance of ESD practices over time. Some minor adjustments are being made to the assumptions based on the comments from the April 17, 2013 worksession with the Planning Board (see below).

The revised ESD model assumptions included 8" of storage above the soil media, with a decaying infiltration rate and modeling the available storage within the soil media as if it were initially dry with a constant infiltration rate. The Horton method was utilized in XP-SWMM to represent both the decaying infiltration of the ponded area and the constant infiltration from the soil media. A maximum infiltration rate of 2 in/hour and a minimum infiltration rate of 0.25 in/hour with a decaying rate of 0.0015/sec were utilized in the model to represent the decaying infiltration rate. A constant infiltration rate of 0.025 in/hour was used to represent the infiltration from the soil media.

The available storage within the soil media was computed by assuming that the soil media cross section would be 3 feet deep with a 40% void ratio. This depth of storage was combined with the assumed 3-inch thick stone reservoir, also with a 40% void ratio, to arrive at the total storage available within the conceptualized micro-bioretention cross section.

Comparison of model results to peak discharges recorded

Questions were raised by the Audubon Naturalist Society about the lack of correspondence between the recorded peak discharges from various storms and the predictions of the model. The H&H model employed in our analysis utilizes the U.S. Department of Agriculture Soil Conservation Service (SCS) type II synthetic rainfall distribution to analyze the affect increased runoff from the proposed development will have on the Ten Mile Creek watershed. The SCS design storms are widely accepted, are referenced in the MD stormwater design manual, and have been used nationwide for stormwater modeling for 20+ years and tend to be inherently conservative. Statistically speaking the SCS type II hyetograph contains the most intense 5-minute expected rainfall nested inside the most intense 10 minute expected rainfall, nested inside the most intense 20 minute expected rainfall, and so forth.

It is important to note that the model estimates discharge from each of the subwatershed areas to the model nodes. We are interested in the difference between the existing conditions scenario and the modeled master plan scenarios in order to evaluate potential impact of development, rather than the absolute value of the parameters in each scenario, which would require a much more detailed modeling approach than used for this planning level analysis. Individual storms similar to the one listed below can be modeled and historical storm data recorded at gauge stations can certainly be used to calibrate an H&H model, but that level of effort is more time consuming than the scope and schedule defined for this project. We are using a planning level model that hasn't been calibrated to the gauge. This is an accepted methodology that is used to compare scenarios, rather than provide results that produce identical patterns with actual storms. The consultant is examining the data provided to determine if it can be used in any way to further inform our work.

Impervious caps vs Watershed limits

There were questions and concerns about applying a single imperviousness limit to all properties and how that relates to an overall watershed goal. Recommendations will be based on the potential impact of different imperviousness assumptions based on land use and density on each subwatershed as well as the watershed as a whole (to the USGS gauge station). Impervious caps on new development (if they are recommended) will have different effects depending on the underlying conditions in each subwatershed. There is a desire to maintain a low overall imperviousness in the watershed, but also to protect particularly sensitive watersheds. The effect of different densities and land uses will be tested to determine the resulting imperviousness resulting at both the watershed and subwatershed level, and imperviousness caps, if any, will be set to limit the potential impact of added imperviousness.

Would the Use of Stormwater Treatment Trains Improve the Effectiveness of ESD?

Treatment trains are not required with ESD. Treatment trains were required in under the old SPA stormwater requirements in case a water quality structure failed/ needed to be maintained, and then a downstream structure would catch and treat that area. Those standards typically had a 3 acre drainage area limit on surface sand filters and a one acre drainage area limit on structural filters which concentrated a large volume of runoff to fewer locations. With ESD the drainage areas are so small (20,000 square feet max, less than a half-acre) that if one of these need to be maintained there should still be several others functioning and the need for redundancy is significantly reduced.

Will development of the Miles/Coppola and Egan properties improve conditions in LSTM206?

The hydrologic and pollutant load analyses do not distinguish the impacts or effects of individual parcels on the stream; they identify the cumulative impacts or effects. In the previous analysis of the 1994 Master Plan, hydrologic indicators in LSTM206 (e.g., volume, flow, velocity) showed slight improvements or remained unchanged. The pollutant load analysis showed an increase in Total Phosphorus and Total Nitrogen annual loads after construction, and a decrease in Sediment annual loads after construction. The spatial watershed analysis does show a high level of impacts to natural resources (e.g., forest cover, springs and seeps) in LSTM206 compared to other subwatersheds.

Can we require mitigation of impacts from existing development as part of approvals?

Yes, but up to a point - there must be a correlation between potential development impacts and the impacts that are being mitigated. Consequently, we do not believe a property owner can be required to mitigate, for example, stormwater run-off associated with I-270; especially since the County has no jurisdiction over that facility and, therefore, could not compel an agency to make the improvements. However, we believe a property owner could be required to participate, as part of the development review process, in the restoration of Ten Mile Creek and its tributary subwatersheds.

What was the basis for the ESD performance standard set by the State, and what was it intended to achieve?

State staff has been invited to attend the worksession to speak to this issue. According to The Maryland Stormwater Design Manual, Section 5.0.1, "The primary goal of Maryland's stormwater management program is to maintain after development, as nearly as possible, the predevelopment runoff characteristics."

Title 4, Subtitle 201.1(B) of the Stormwater Management Act of 2007 that requires ESD, defines it as "…using small-scale stormwater management practices, nonstructural techniques, and better site planning to mimic natural hydrologic runoff characteristics and minimize the impact of land development on water resources." The Maryland Stormwater Manual states that "Under this definition, ESD includes:

- Optimizing conservation of natural features (e.g. drainage patterns, soil, vegetation).
- Minimizing impervious surfaces (e.g. pavement, concrete channels, roofs).
- Slowing down runoff to maintain discharge timing and to increase infiltration and evapotranspiration.
- Using other nonstructural practices or innovative technologies approved by MDE."

The Act requires ESD to be implemented to the Maximum Extent Practicable (MEP).

According to the Maryland Stormwater Manual, "The Act presents an opportunity to improve Maryland's stormwater management program." The ESD hydrologic performance standard in the Manual is for post-development hydrology to mimic the hydrology of "woods in good condition" to the Maximum Extent Practicable (MEP). The General Performance Standards (Section 1.2) in the Manual address hydrology-related standards for development under ESD (see response below), but the Manual does not specify performance standards for the many other environmental functions that "woods in good condition" provide that may be impacted by development. The Manual also does not include performance standards for the ecological or biological health of receiving watersheds and streams.

If ESD to the MEP is applied to development, will that ensure that there will be no impacts to the biological health of receiving ecosystems and streams, and hence no need to limit the extent of development or impervious cover?

The General Performance Standards for Stormwater management in Maryland (Section 1.2 of the Maryland Stormwater Design Manual) lists 14 standards. These standards address stormwater runoff, stormwater treatment, maintenance of predevelopment groundwater recharge, water quality control for suspended sediment and phosphorus, maintenance of the pre-development discharge rates, managing runoff to protect stream channels, potential need for additional performance criteria to protect sensitive resources, and other technical stormwater management standards. The General Performance Standards do not include any standards related to the biological health and response of receiving ecosystems or streams. But Standard No. 8 does state that "Stormwater discharges to critical areas with sensitive resources [e.g., cold water fisheries, shellfish beds, swimming beaches, recharge areas, water supply reservoirs, Chesapeake Bay Critical Area (see Appendix D.)] may be subject to additional performance criteria or may need to utilize or restrict certain BMPs."

Section 5.0.3 of the Maryland Stormwater Design Manual cites scientific studies that "indicate that stream biodiversity decreases as impervious cover increases. There is no simple formula, rule, or threshold for determining how much impervious cover may be sustained in a given watershed. These studies establish a fundamental connection between impervious cover and watershed impairment." There is nothing in the Manual indicating that ESD was intended to or can mitigate all of the environmental impacts that can result from development.

Discussions with MDE staff confirmed that local jurisdictions wishing to provide additional protection for high-quality or sensitive watersheds and streams may choose to add requirements beyond ESD, which could include land use-based environmental protection measures that limit the extent of development and associated impervious cover, and maximize retention or restoration of natural areas.

If measures that go beyond ESD are applied to development, could that further reduce impacts to stream health to a significant or otherwise acceptable degree?

As mentioned above, General Performance Standard No. 8 in the Manual indicates that sensitive watersheds or natural resources may require additional performance criteria to provide enhanced environmental protection. Standard No. 8 also says that in such cases, certain BMPs may be needed. What these BMPs might be is not specified, but given the linkage between impervious cover and stream health that is recognized in the Manual, this could involve land use management measures that limit development and imperviousness (as was confirmed in discussion with MDE staff). It could also conceivably involve other ESD BMPs. But with the existing requirement to maintain annual groundwater recharge rates and mimic the hydrology of woods in good condition, it is not clear how much additional benefit infiltration in excess of natural levels would provide, or what the effects on stream biology might be if extra infiltration changes the existing hydrologic regime.

Scenario Assumptions

Since many questions were raised about the assumptions used in the modeling, additional meetings have been held with the Department of Permitting Services and the Department of Environmental Protection to assure that the assumptions used in the modeling reasonably approximate the requirements with a margin of safety appropriate for a planning-level analysis. The assumptions below highlight the changes that will be applied to all the new model runs. Most of these reflect changes to refine the inputs, examine the potential for improvement associated with re-vegetation of agricultural land on the developable properties. The modeling that will be carried through each scenario will assume:

- Existing land use/land cover and stormwater treatment on parcels that will not be developed or redeveloped.
- Application of County requirements on parcels that will be developed or redeveloped
    - Stream buffer planted in forest where not currently forested (previously assumed to remain in existing land cover)
    - Upland vegetation between stream buffer and Limit of Disturbance – assume meadow in good condition (previously assumed remain in existing land cover)
    - Soil decompaction per County requirements (see attachment 2 for details)
    - ESD with micro-bioretention
        - 8" ponding – change to 9"
        - Soil Media Depth = 3' – change to 3.5'
        - Maximum infiltration rate = 2"/hr
        - Minimum infiltration rate = 0.25"/hr
        - Constant infiltration rate into underlying soils = 0.025"/hr
        - Underdrains placed above stone reservoir with overflow to surface waters
        - Gravel bedding – 3" required
    - Conventional stormwater management for I270 widening, for additional pavement only

Scenario Discussion

Staff will be presenting an analysis of potential scenarios to the Planning Board for discussion. Given budgetary and schedule constraints, two scenarios (Scenario 2 and 3) are being modeled with the results to be presented at a later planning Board meeting, most likely June 6, 2013. These scenarios are generally described in the table below, which identifies each and lists the modeled amount of impervious acres for the most of the potential development, as well as the approximate resulting imperviousness percentage for the entire watershed. Watershed imperviousness has been identified, and historically applied, as a guide for water quality.

Among the scenarios is a revised 1994 Plan, Scenario 2, which adjusts the assumptions used in the previous model run. These adjustments include added impervious cover to account for such elements as the future expansion of I-270, revised stream buffers and the development of rural lots. These changes will be discussed by Staff at the worksession. The other scenarios include a reduced area of disturbance associated with the Pulte property (but retaining recommended 1994 densities – Scenario 3) and the County property south of the Detention Center. Scenario 4 reduces the area of disturbance and also reduces development density on the Pulte property. Again, the details of each scenario will be further described by Staff at the worksession.

The key observation for all scenarios is the challenge in reducing overall watershed imperviousness. As you may recall, at one of the previous Planning Board sessions there was a desire to model an overall 7%

watershed imperviousness and the Audubon Naturalist Society recommended examining a 6% level. As can be seen in the chart, neither one of these can be achieved without substantial reductions in impervious area with potential effects on density. In our opinion, this level of reduction substantially affects the other measure for this planning effort – community building. These issues and conflicts will be reviewed and discussed with the Board in greater detail, but ultimately, the Board will have to decide whether to test such scenarios.

Approximate Imperviousness of Proposed Scenarios

Scenario	Description	Pulte	County	Fire Station	Miles/Coppola	Egan	355 Bypass	I270	Rural	Resulting Watershed Imperviousness
		Impervious Acres Associated with Development								
1	1994 Plan (as previously modeled)	67.2	19.0	1.5	25.5	30.8	11.7	Existing	Existing	8.8%
2	1994 Plan Revised (with added development)	67.2	19.0	1.5	25.5	28.5	11.7	3.6	13.30	9.3%
3	Reduced Footprint at 1994 density	47.6	10.2	1.5	29.4	30.8	7.8	3.6	13.30	8.5%
4	Reduced Footprint at Reduced Density	39.3	10.2	1.5	29.4	30.8	7.8	3.6	13.30	8.3%

Attachment 1

DEP Field Methodology

Prior to field verification, locations of potential new features (reference points) were identified using ArcGIS. LiDAR data (2008) and orthophoto imagery were used in combination to visually identify low points and drainage patterns most likely to exhibit stream or wetland features outside of existing buffer zones. Numbered reference points were generated for locations that appeared to show hydrologic low points or drainage paths. Maps displaying these reference points, existing features and buffers, aerial photography, roads, table of reference point coordinates, and other important features, were provided to field crews to ground-truth.

Using the maps of reference points, field crews generated GPS coordinates of previously unmapped stream/wetland features. When a feature was found:

If a seasonal pool or wetland >10ft^2, collect at least 1 GPS point, as well as max length and max width. If a spring/seep/headcut, walk length of it, taking a GPS reading at multiple intervals (enough so a line may be mapped showing the general shape and length)

For each feature found, assign a number (Site #), record GPS unit in use, and GPS accuracy if available. Record feature type as either: perennial, intermittent, ephemeral stream, spring, seep, or wetland. Record lat/long coordinates in decimal degrees. Sketch feature and label points with direction/bearing and lines with lengths. Take digital photograph(s) of feature and record description, picture#, and time picture taken. Note any flora, fauna, habitat, pool activity, etc. under observations.

*The GPS coordinates are mapped as a point coverage, with attribute data such as the direction and bearing of spring heads or the direction and bearing to the existing stream channel, type of feature, date field located, crew, etc. Photos (**Figure 1**) and sketches were also taken of each feature.*

Figure 1 – Example of Newly Mapped Environmentally Sensitive Feature in Ten Mile Creek

Attachment 2
Curve Number (CN) Assumptions for ESD Development

The XP-SWMM hydrologic model uses a standard Curve Number (CN) method as part of its calculation of runoff during storm events. Curve numbers correspond to runoff characteristics of different hydrologic soil groups and land cover types, with higher curve numbers corresponding to soil groups and land cover types that are less permeable and contribute more stormwater runoff. During development, heavy equipment used to grade land and for construction compacts soils within the limits of disturbance, which increases the runoff from these areas along with the associated curve number. The typical degree of compaction from development ranges from the next less permeable hydrologic soil group to somewhat less permeable than that. As a result, a moderate assumption that is typically made in models that use curve numbers, to account for the soil compaction that occurs during development, is to assume that a compacted soil moves from its original hydrologic soil group to the next less permeable soil group.

In addition to State ESD requirements, Montgomery County requires a decompaction procedure for soils in grassed and landscaped (pervious) areas with the limits of disturbance. This procedure involves tillage to a depth from 8 to 10 inches, with 4 inches of topsoil added. A more rigorous procedure that involves a deeper tillage of 2ft., with organic material mixed in to amend the soil typically is sufficient to bring the soil approximately back to its original curve number. Because the County's requirements involve tillage to almost half the depth of the more rigorous procedure, and includes topsoil, which doesn't enhance permeability as well as organic material, a moderate assumption for the effect of the County's soil decompaction method is a final curve number halfway between the original soil curve number and the compacted soil curve number. This was the assumption made to represent the County's soil decompaction requirements in the XP-SWMM hydrologic model