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MEMORANDUM

To: **Policy Advisory Council**

From: **Trevor Clements and Kimberly Brewer**

Cc: **Technical Advisory Council**

Date: **May 11, 2006**

Subject: **Management Scenario Evaluation**

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1 Introduction

This memorandum provides an update on the work completed to date in refining and evaluating the proposed management scenarios for the Lake Maumelle Watershed, including:

- The revision of the management areas in the watershed,
- Modeling results for the maximum allowable loading to the lake which meet the adopted water quality targets,
- The allocation of allowable loads to nonpoint sources versus wastewater point sources for new development (on a whole watershed basis),
- For each of the three management areas, the annual, per acre loading allocations/performance standards for developable land,
- Initial development options tested for the Non-engineering/Land Conservation Management Scenario (including both large lot and cluster design development requirements) and the Performance Standard/Land Conservations Scenario, and
- Specific requirements needed to achieve the allocations/performance standards for new development.

This memorandum will be the focus of our presentation and discussion at the May 18 meeting. For each section, we have highlighted key policy questions that need to be discussed by the Policy Advisory Council. No votes are required at the meeting. Once we have received your feedback, Tetra Tech will conduct more detailed analysis regarding cost and administrative requirements for the two scenarios. The Team will present that information to you at the June meeting and will work with you on a comprehensive evaluation of how well the two scenarios' requirements meet the watershed plan's overall goals and objectives. A vote on the proposed performance standards and alternative requirements for new development is anticipated for the June meeting.

2 Revised Management Areas

At the March 16 PAC meeting, Tetra Tech presented three proposed management areas: Critical Area A, Critical Area B, and the Upper Watershed Area (see Figure 1).

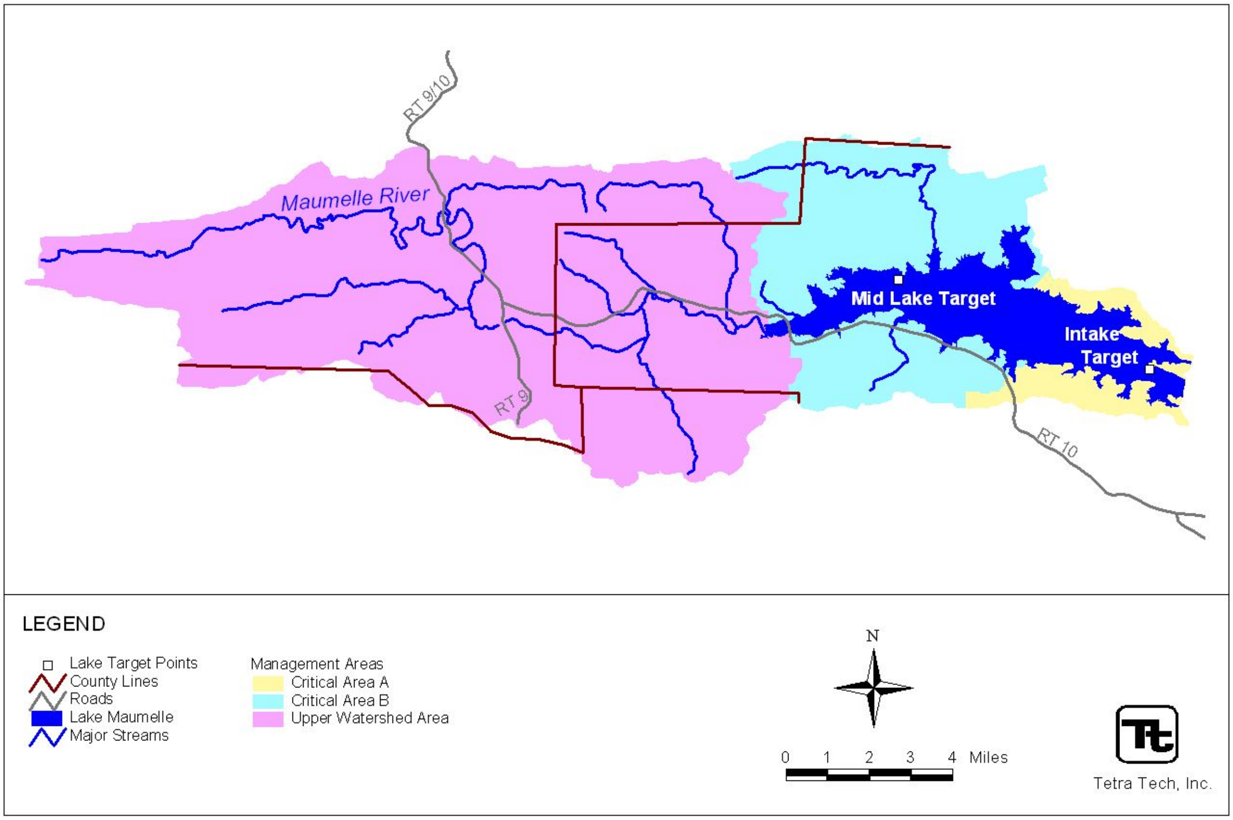


Figure 1. Preliminary Lake Maumelle Management Areas (03-09-06)

Travel time within-lake to the intake area shaped the boundaries for these areas, with Critical Area A having a travel time of less than 5 days, Critical Area B of 20-29 days, and the Upper Watershed a 37-day travel time. Tetra Tech noted that travel time *to* the lake was much shorter, a matter of hours rather than days. One of the PAC members raised a concern about the difference between the eastern and western portions of the Upper Watershed Area in terms of the distance to the lake. The question was raised, "How could we justify or explain having the same requirements for both areas when one is much closer to the lake?" Based on this concern, Tetra Tech reevaluated the management area boundaries based on travel time to the lake and within the lake, as well as on watershed and jurisdictional boundaries. The Revised Management Areas are shown in Figure 2, and include a larger Critical Area B. This area includes land up to Williams Junction along the Highway 10 road corridor, which is close to the Big Maumelle River and likely to develop more quickly than land west of Williams Junction.

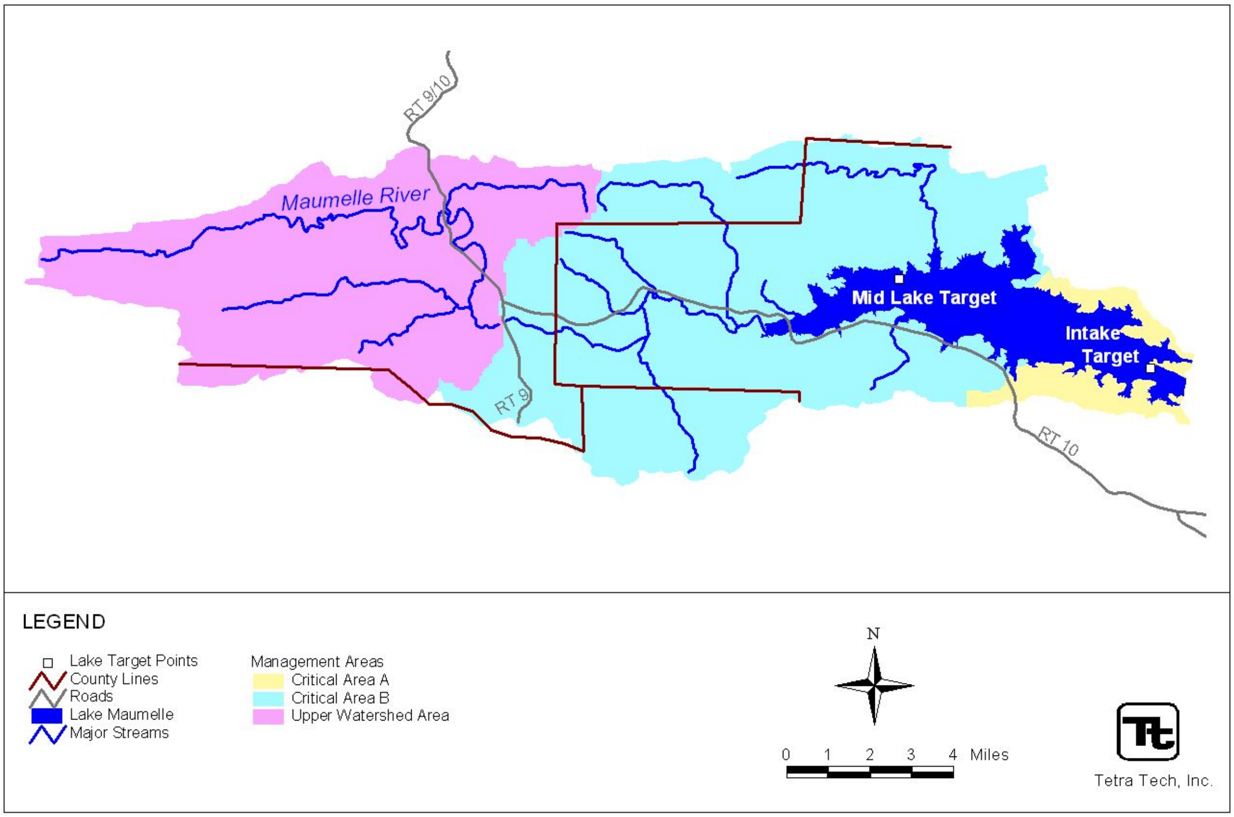


Figure 2. Revised Lake Maumelle Management Areas (05-11-06)

3 Maximum Allowable Loading

3.1 WATERSHED SCALE

In determining the loading allocations, also called performance standards, for each management area, the modeling team first determined the maximum loading that could be allowed and still achieve the adopted water quality targets. As a starting point, Tetra Tech ran the Baseline Large Lot Scenario 1, assuming no direct wastewater discharges (i.e., assuming that wastewater would be pumped out of the watershed or that a subsurface disposal system would be used). The scenario was run using a 7-year hydrologic period (1997-2004), and assuming baseline buildout conditions to determine loads and lake responses.

Iterative modeling runs helped to identify the allocation run, which contains the maximum allowable load (including surface and groundwater) to the lake for the key parameters. Table 1 summarizes the modeling results. The watershed loads from the allocation run performed well in meeting the adopted water quality targets as noted in Table 2.

Table 1. Maximum Allowable Loading to Lake

Indicator	Maximum Allowable Load
Total Phosphorus (TP)	19,250 lb/yr
Total Suspended Solids (TSS)	5,840 t/yr
Total Organic Carbon (TOC)	2,445,000 lb/yr
Fecal Coliform	$2.25 \cdot 10^{15}$ #/yr

Table 2. Predicted Concentration v. Target

Indicator	Predicted Concentration	Target
Chlorophyll *a* (intake)	3.0 µg/L (summer median)	≤ 3.0 µg/L (summer median)
Chorophyll *a* (midlake)	3.4 µg/L (summer median)	≤ 3.5 µg/L (summer median)
TOC	3.1 mg/l	≤ 3.1 mg/l (as close as possible to 2.4)
Tubidity as Secchi	2.6 m	≤ 2.3 m (0.2 m maximum change)
Fecal Coliform	.030 per 100 ml	≤ .065 per 100 ml (factor of 10 increase)

3.2 ALLOCATION OF LOAD TO NEW DEVELOPMENT (NONPOINT SOURCES) V. WASTEWATER

Once allowable loading was established, the Team envisioned allocating a portion of the loading to wastewater and developing onsite performance standards for wastewater. After determining the maximum extent to which we could limit wastewater, which was the major source of nutrients in the baseline analysis, we would then determine loading allocations and performance standards for the new development site (i.e., the nonpoint source loading).

Modeling results from the Baseline Large Lot Scenario without wastewater discharges, coupled with guidance from the PAC, made it clear that this strategy would not meet the water quality targets. First, as shown in Table 2, the Large Lot Baseline Scenario without wastewater discharges was just able to meet the target. However, in that scenario, Tetra Tech assumed most of the land in the watershed was developed with 5- and 10-acre lots, and that 76 percent to 88 percent of the lots would be conserved in undisturbed open space. At the March 16 PAC meeting, members indicated that in defining our management scenario for large lot, we should not consider requiring a minimum lot size greater than five acres, and that requiring undisturbed open space in the development of 60 percent to 90 percent would not be acceptable. Based on this guidance for the Non-engineering/Land Conservation Management Scenario, we tested 5-acre minimum lot sizes with undisturbed open space requirements ranging from 15 percent to 50 percent, depending on slope and management area (except in Critical Area A, which will have stricter requirements). Therefore the Non-engineering/Land Conservation approach—without any wastewater discharge—results in loading from the development that exceeds the targets and would require offsite mitigation of conservation land.

Tetra Tech did discuss with ADEQ the possibility of strict effluent limits on wastewater discharges. ADEQ indicated that a "feasible" limit that it might impose is 1 mg/L of Total Phosphorus, which would be considered a very high level of treatment for a package treatment plant. This limit however, would result in a loading rate of 0.95 lb/yr for a household on a 5-acre lot. As indicated in the following section, Management Area B, which constitutes over half of the land in the watershed, has a Total Phosphorus allocation/performance standard of 0.3 lb/ac/yr or 1.5 lb/yr for a 5-acre lot. The wastewater loading rate would take up 63 percent of the allowable load. However, as discussed above, the loading from the development itself already exceeds the target, exclusive of any wastewater loading. In contrast, properly designed and maintained subsurface discharges of wastewater provide little risk of phosphorus loading, provided adequate setbacks from streams are maintained.

Clearly, to meet the targets, a "no direct discharge" policy would need to be implemented in the watershed, and all of the allowable loading would need to be allocated to nonpoint source runoff from new development. This policy would need to be discussed and adopted by the PAC and by state ADEQ and ADEH agency officials.

Policy Question to Discuss

Would the PAC support a policy of no direct surface discharges in the watershed as part of the management plan? (If not, in order to meet the water quality targets, allowable development in the watershed must be significantly reduced from that shown in Section 5 below.)

What types of wastewater systems would be allowable? In Critical Area A, wastewater would be pumped out of the watershed. In Critical Area B and the Upper Watershed Area, conventional septic systems can be used for individual large lot homes where the soil is suitable. However, since soils are not suitable for conventional systems in the vast majority of the watershed, alternative nondischarge systems will likely be required for most development. Per communication with Arkansas Department of Health (ADH) staff (March 13, 2006), the relatively large lot and open space requirements being considered would be conducive to identifying alternative nondischarge options. ADH staff indicated that for large individual lots, they prefer using a "capped field" alternative. Particularly with lot sizes of 5 acres or more, ADH staff believed that locating suitable sites for a capped field would be likely. For cluster subdivisions, ADH staff indicated that a "drip irrigation" nondischarge system would be a likely alternative. Maintenance is important for these systems, so strong maintenance requirements for subdivision systems will be essential (Personal communication during conference call with Robert Hart, Usman Patel, and Harold Seifert, Arkansas Department of Health, March 13, 2006).

3.3 Site Scale Allocations and Performance Standards

The next task was to translate allowable loading for developable land into site scale allocations for new development. To determine performance standards for development, the allocations are first expressed as an average per-acre rate for surface runoff load from all developable land. This is the average loading rate that must be achieved from developable land to meet the in-lake targets at buildout. These site scale allocations are also called performance standards. The PAC and the public asked that performance standards be increasingly stringent as one moves closer to the lake and intake area.

The purpose of making the Critical Area A load allocations more stringent than the other watershed areas is to ensure maximum implementation of management measures that reduce the risks of loading of all pollutants, including toxic spills, to the portion of the lake adjacent to the water supply intake.

A key policy question arises: how much more stringent should we make the Critical Area A standards compared to other areas in the watershed? And related to that, how does the stringency of the Critical Area A performance standards affect the standards for Critical Area B and the Upper Watershed? Tetra Tech evaluated the sensitivity of the management area allocations by testing three alternatives for performance standards (see Table 3): Alternative one sets the Critical Area A loading allocations at 50 percent of the developable land average standard, while alternatives two and three set Critical Area allocations at 65 percent and 80 percent of the average, respectively. The analysis showed that allocations to Critical Area A (which makes up 2.6 percent of the watershed) have only a small effect on Critical Area B and the Upper Watershed Area allocations. Critical Area B, which makes up approximately 70 percent of the watershed, dominates total loading to the lake. Therefore, selection of more stringent standards for Critical Area A is a policy decision based on reducing risks associated with runoff near the water intake.

Table 3. Sensitivity of Three Alternatives for Management Area Allocations

	Total Phosphorus (lb/ac/yr)	Total Sediment (t/ac/yr)	Total Organic Carbon (lb/ac/yr)
Alternative 1: Critical Area A = 50% of average rate			
Crit Area A	0.154	0.060	18.51
Crit Area B	0.303	0.117	36.43
UWA	0.333	0.129	40.07
Alternative 2: Critical Area A = 65% of average rate			
Crit Area A	0.200	0.080	24.06
Crit Area B	0.302	0.110	36.20
UWA	0.332	0.130	39.82
Alternative 3: Critical Area A = 80% of average rate			
Crit Area A	0.247	0.095	29.61
Crit Area B	0.301	0.116	36.15
UWA	0.331	0.128	39.77

Tetra Tech tested the feasibility of developments meeting the three alternative performance standards. The Team found that setting the Critical Area A allocation at 50 percent of the developable land average standard makes the allocation unachievable to developers. Therefore, Tetra Tech recommends the second alternative which sets the Critical Area A allocation at 65 percent of the average, sets the UWA allocation 10 to 15 percent higher than that in Critical Area B, and adjusts the rate for Critical Area B to ensure meeting the total developable land load allocation for Total Phosphorus and Sediment. A smaller differential was set for Total Organic Carbon due to higher uncertainty and limited data on BMP efficiency for this constituent. The Critical Area A allocations in this alternative yield difficult yet achievable standards. The proposed performance standards for the three management areas are shown in Table 4.

Policy Question to Discuss

Do the recommended management area allocations for new development adequately reflect the PAC guidance, or does the PAC prefer an alternative approach to the three management areas?

Table 4. Proposed Performance Standards for Surface Runoff Loading from Developed Land

	Total Phosphorus (lb/ac/yr)	Total Sediment (t/ac/yr)	Total Organic Carbon (lb/ac/yr)
Critical Area A Allocation for New Development	0.200	0.080	33.30
Critical Area B Allocation for New Development	0.300	0.110	36.30
UWA Allocation for New Development	0.330	0.130	39.00

4 Initial Development Options Tested

Pursuant to guidance from the PAC, the Tetra Tech Team tested various options for meeting these onsite performance standards and allocations. One set of options focused on land conservation without engineered controls. The other included engineered controls designed to meet performance standards. Below is a summary of the initial development options tested that came closest to meeting the targets while still addressing the comments from the PAC regarding feasible large lot and undisturbed open space requirements (e.g., not requiring a minimum lot size greater than 5 acres and not requiring more than 50 percent undisturbed open space on a development tract or parcel).

4.1 Non-Engineering/Land Conservation Scenarios

Critical Area A

(Addressed in the “Land Conservation and Performance Standards Scenario” section.)

Critical Area B and Upper Watershed Area

The Non-engineering/Land Conservation scenarios for Critical Area B and the Upper Watershed Area assume maximum impervious and minimum undisturbed open space requirements. Two scenarios were considered for each management area: 1) Large Lot Development, and 2) Cluster Development. In each scenario, the maximum impervious requirements vary by management area, and the undisturbed open space requirements vary by management area and average slope. “Undisturbed open space” means either undisturbed, forested land *or* land that has previously been disturbed (i.e., logged), yet not graded and reforested. No development would be allowed on land with slopes 25 percent or greater.

Large Lot Development

The Land Conservation Large Lot Scenario limits all residential development to a minimum lot size of 5 acres. A landowner may choose to build on larger lots (e.g., 10 acres, 20, acres, or 100 acres), but the minimum lot size would be 5 acres

For the large lot development, the maximum imperviousness limits are 8 percent in Critical Area B and 9 percent in the Upper Watershed Area. Where land has less than 15 percent average slopes – the “low” slope category – the minimum undisturbed open space requirements are 30 percent in Critical Area B and 15 percent in the Upper Watershed Area. For land with greater than 15 and less than 25 percent average slopes – the “high” slope category – the minimum undisturbed open space requirements are 50 percent in

Critical Area B and 30 percent in the Upper Watershed Area. Land with about 15 percent average slope was divided equally among the two slope categories.

Cluster Development

Under the Land Conservation Cluster Scenario, residential developers can cluster lots that are smaller than 5 acres as long as the overall lot density does not exceed that of a 5-acre lot development. The maximum imperviousness limits are 6 percent in Critical Area B and 7.3 percent in the Upper Watershed Area. For land in the low slope category, the minimum undisturbed open space requirements are 30 percent in Critical Area B and 15 percent in the Upper Watershed Area. For land in the high slope category, the minimum undisturbed open space requirements are 50 percent in Critical Area B and 30 percent in the Upper Watershed Area.

4.1.1 Summary of Non-engineering/Land Conservation Assumptions

Table 5 summarizes the assumptions for the Non-engineering/Land Conservation scenarios. A building footprint of 3,500 square feet was assumed for all developments except for the 3-acre cluster and 5-acre large lot developments in Critical Area B; for these developments, the building footprint was reduced to 3,000 square feet to meet the maximum impervious limits. The remaining impervious surface was assumed to be in driveways, sidewalks, and roads. The 5-acre large lot developments were assumed to have unpaved roads and driveways, and the cluster developments were assumed to have paved roads and driveways. Lawn or managed grassland was assumed to occur on the remaining development area that is not under impervious surfaces or undisturbed open space.

Non-residential land was included as a separate scenario that is exempt from the maximum impervious limits but must comply with the undisturbed open space requirements. A minimum of 5 percent lawn was assumed for non-residential development; therefore, the imperviousness of the non-residential development in Critical Area B was reduced from 70 to 65 percent to accommodate the undisturbed open space requirement of 30 percent and the assumed lawn area. Non-residential land was assumed to occur only under the low slope category.

Table 5. Impervious Surface and Undisturbed Open Space Assumptions for the Land Conservation Scenarios

Scenario	Lot Size (acres)	Slope Category[1]	Percent Impervious	Percent Undisturbed Open Space Required
Critical Area B				
Non-residential	NA	Low	65%	30%
Large Lot	5.0	Low	8%	30%
	5.0	High	8%	50%
Cluster	1.3	Low	5.5%	30%
	1.3	High	5.5%	50%
	3.0	Low	6%	30%
	3.0	High	6%	50%
Upper Watershed Area				
Non-residential	NA	Low	70%	15%
Large Lot	5.0	Low	9%	15%
	5.0	High	9%	30%
Cluster	1.3	Low	5.5%	15%
	1.3	High	5.5%	30%
	3.0	Low	7.3%	15%
	3.0	High	7.3%	30%

[1] The low slope category includes land with average slopes less than 15 percent, and the high slope category includes land with average slopes greater than 15 percent. Land with about 15 percent slope was divided equally among the two slope categories.

4.1.2 Summary of Non-engineering/Land Conservation Evaluation Results

Table 6 summarizes the key features of each management option evaluated for this scenario for Critical Area B and the Upper Watershed Area, and the associated loading for key parameters. Blue indicates that the option meets the standard for a particular parameter, gold indicates that it does not meet the standard. Sediment loading from unpaved roads is the leading cause of these options not meeting the sediment performance standards. In high slope areas, phosphorus and organic carbon associated with the sediment is a major cause of exceeding the phosphorus performance standards.

Some watershed landowners have expressed a desire to maintain the rural nature of the watershed. Existing rural development and uses in the watershed are assumed to be grandfathered in and exempt from proposed requirements in the watershed plan. However, land owners may choose to propose new development. While some may build on rural 5-acre lots, others may build on larger lots, which in turn would decrease the predicted loading to the lake. As an example, Table 6 shows the loading associated with 10-acre lot developments. As you can see, this significantly decreases the loading compared to 5-acre lots, but still exceeds the performance standards.

Table 6. Evaluation of Management Options for Critical Area B and Upper Watershed Area

Scenario	Lot Size (ac)	Slope Category	Percent Impervious	TN (lb/ac/yr)	TP (lb/ac/yr)	TSS (t/ac/yr)	TOC (lb/ac/yr)	FC (#/ac/yr)
Critical Area B								
Non-Residential	NA	Low	65.0%	11.5	1.38	0.46	139.0	2.7E+11
Large Lot	5	Low	8.0%	2.6	0.29	0.33	25.4	3.4E+10
	5	High	8.0%	4.0	0.40	0.35	44.0	3.9E+10
	10	Low	4.3%	2.1	0.20	0.19	22.5	2.3E+10
	10	High	4.3%	3.6	0.31	0.21	42.3	2.5E+10
Cluster	1.3	Low	5.5%	2.5	0.23	0.07	25.6	4.2E+10
	1.3	High	5.5%	4.0	0.34	0.10	45.1	4.7E+10
	3	Low	6.0%	2.5	0.24	0.08	25.6	4.1E+10
	3	High	6.0%	4.0	0.35	0.11	44.8	4.6E+10
Upper Watershed Area								
Non-Residential	NA	Low	70.0%	13.4	1.62	0.60	159.3	3.2E+11
Large Lot	5	Low	9.0%	3.0	0.33	0.43	29.4	3.6E+10
	5	High	9.0%	4.5	0.45	0.46	50.8	3.8E+10
	10	Low	4.3%	2.4	0.22	0.22	25.6	2.4E+10
	10	High	4.3%	4.0	0.34	0.26	48.3	2.5E+10
Cluster	1.3	Low	5.5%	2.8	0.25	0.09	28.9	4.5E+10
	1.3	High	5.5%	4.4	0.37	0.12	51.3	4.6E+10
	3	Low	7.3%	3.0	0.27	0.11	30.3	4.5E+10
	3	High	7.3%	4.6	0.39	0.14	52.2	4.7E+10

Legend: (orange) **Does not meet performance** (cyan) **Does meet performance standards**

4.2 PERFORMANCE STANDARD AND LAND CONSERVATION SCENARIO

Critical Area A

Conservation Design with Best Management Practices

Tetra Tech tested two conservation design options for Critical Area A. The first option used site and landscape conservation design and employed engineered best management practices (BMPs) to help meet water quality onsite performance standards and provide for spill risk mitigation. In evaluating the effectiveness of BMPs for sites in the Lake Maumelle watershed, the Team used national data due to the lack of engineered BMPs in the watershed or on comparable land in the region which could provide more local data. Before engineered BMPs can be employed in Critical Area A, the watershed plan will require that BMP pilot projects be performed on land with comparable topography and soils in areas outside of the watershed (preferably) or, at minimum, outside of Critical Area A. The results of these pilot projects would be used to determine which, if any, BMPs can be used and the degree to which they can be used to meet the onsite performance standards.

Since this area is so close to the intake, in addition to the water quality performance standards, Tetra Tech is recommending that a fixed impervious surface cap (6 percent) be used as well as a fixed minimum undisturbed open space requirement (70 percent of the tract). Tetra Tech tested a net density of 5-acre lots, with an average lot size of 3 acres. The Team used a treatment train connecting bioretention cells throughout the development to extended dry detention ponds. The extended dry detention has a minimum 48-hour draw-down time. In Tetra Tech's example, bioretention is used for treatment and the dry detention is used for flow and spill control only. However, the dry detention could be designed as a water quality and flow/spill control pond. The BMPs and average lot sizes described are for example only. Other BMPs and lots sizes could be used as long as they were shown to meet the performance standards, imperviousness caps, and land conservation requirements. The goal is to meet the performance standards to the extent possible using conservation site design, and to use engineered BMPs to meet only a small fraction of the treatment requirement.

The design resulted in the following performance:

Scenario	TP (lb/ac/yr)	TSS (t/ac/yr)	TOC (lb/ac/yr)
Critical Area A	0.198	0.046	32.8

Large Lot

This second conservation design option evaluated use of large lots only (i.e., using no engineered BMPs). Analysis determined that a 20-acre minimum lot size designed with 92 percent undisturbed open space and a 2.2 percent impervious cap would be required to meet the onsite performance standards without engineered BMPs.

The design resulted in the following performance:

Scenario	TP (lb/ac/yr)	TSS (t/ac/yr)	TOC (lb/ac/yr)
Critical Area A	0.200	0.061	32.6

Critical Area B and Upper Watershed Area

The Performance Standard/Land Conservation scenarios have the same undisturbed area requirements as the Non-engineering/Land Conservation scenarios, but do not have impervious limits or minimum lot size requirements. Instead, the developments can use stormwater BMPs for water quality treatment so long as the net site-scale loading rates meet the performance standards. The conceptual designs highlighted in Table 7 and Table 8 meet all of the applicable performance standards. The example designs in this section begin with the 3-acre lot cluster, 5-acre overall density scenarios discussed under the Non-engineering/Land Conservation scenarios.

Table 7. Upper Watershed Area Performance Standard Designs

Low Sloped Lands

The 3-acre lot cluster, 5-acre overall density design meets the performance standards, so no modifications are needed to the site.

High Sloped Lands

The higher sloped lands have higher pollutant loading rates, so the 3-acre lot cluster, 5-acre overall density design does not meet performance standards. Additional measures are needed to reduce site-scale loading rates. The design had the following elements:

- A development-scale impervious area of 7.3 percent.
- The developed portion of each lot was 1 acre, with a combination of house/driveway impervious surface and maintained lawn. The remainder of each lot had unmanaged native grass cover.
- Forty percent of the site has undisturbed forest area. While this zone (UWA with high slopes) requires 30 percent undisturbed area, it was necessary to leave more of the site in forest cover to meet the performance standards.
- The developed portion of the site (lawns, lot impervious area, and neighborhood roads) was treated by road-side grass swales designed for water quality treatment, all draining to a wet pond providing further pollutant removal.

The design resulted in the following performance:

Scenario	TP (lb/ac/yr)	TSS (t/ac/yr)	TOC (lb/ac/yr)
Upper Watershed Area, high slopes	0.262	0.058	38.3

Table 8. Critical Area B Performance Standard Designs

Low Sloped Lands

The 3-acre lot cluster, 5-acre overall density design meets the performance standards, so no modifications are needed to the site.

High Sloped Lands

The higher sloped lands have higher pollutant loading rates, so the 3-acre lot cluster, 5-acre overall density design does not meet performance standards. Additional measures are needed to reduce site-scale loading rates. The design had the following elements:

- A development-scale impervious area of 7.3 percent.
- The developed portion of each lot was 1 acre, with a combination of house/driveway impervious surface and maintained lawn. The remainder of each lot had unmanaged native grass cover.
- Sixty percent of the site had undisturbed forest area. While this zone (Critical Area B with high slopes) requires 50 percent undisturbed area, it was necessary to leave more of the site in forest cover to meet the performance standards.
- The developed portion of the site (lawns, lot impervious area, and neighborhood roads) was treated by road-side grass swales designed for water quality treatment, all draining to a wet pond providing further pollutant removal.

The design resulted in the following performance:

Scenario	TP (lb/ac/yr)	TSS (t/ac/yr)	TOC (lb/ac/yr)
Critical Area B, high slopes	0.278	0.064	35.3

5 What Is Required to Meet the Performance Standards and Allocations?

The watershed model assumed that existing developed land uses are grandfathered and continue in the future. For new development in the watershed, however, Table 6 shows that the Non-engineering/Land Conservation Scenario's proposed onsite density, imperviousness, and conservation requirements do not meet the performance standards/allocations established for Critical Area B and the Upper Watershed, except for cluster developments on low-sloped areas. Tetra Tech is recommending that cluster developments not be allowed on high sloped areas under the Non-engineering/Land Conservation Scenario. Figure 3 and Figure 4 summarize the onsite requirements being recommended for the Large Lot and Cluster options under the Non-engineering/Land Conservation Scenario, and Figure 5 summarizes the recommended requirements for the Performance Standards and Land Conservation Scenario.

For large lot residential development in this Scenario, onsite and offsite mitigation would be required in the Upper Watershed and in Critical Area B largely due to the excess sediment loading from unpaved roads. Table 9 shows the offsite mitigation requirements in terms of offsite dedicated conservation land needed to meet all of the onsite performance standards. These offsite mitigation needs differ by road surface requirements. It is important to note that in order to meet all the performance standards, all roads, streets, and driveways associated with new development must be paved. Otherwise, from 27,000 to over 34,600 acres of land offsite would need to be permanently dedicated as conservation open space. Table 10 shows the offsite conservation land required in order to meet the TP and TOC performance standards only, again depending on road/driveway surface requirements. If roads/streets/driveways are paved for new development on high-sloped areas, then the TP and TOC requirements can be met, however the TSS standards would be exceeded. If gravel or Best Available Technology (BAT) with BMPs are employed, offsite mitigation would be required to meet the TP and TOC standards; however, TSS would still be exceeded.

Table 9. Offsite Mitigation Acres Needed to Meet All Performance Standards with 5-Acre Lot Development

Scenario	Offsite Mitigation (ac)	Percent of Developable Land in Offsite Mitigation
Gravel with BMPs	34,687	65%
BAT with BMPs	27,174	51%
Paved Roads	0	0%

Table 10. Offsite Mitigation Acres Needed to Meet TP and TOC[1] Performance Standards with 5-Acre Lot Development

Scenario		Offsite Mitigation (ac)	Percent of Developable Land in Offsite Mitigation	Percent Exceeding TSS Standard
Pavement/ BMPs On Low Slopes	Pavement/ BMPs On High Slopes			
No BMPs	Paved	0	0%	89%
Gravel with BMPs	Paved	0	0%	37%
BAT	Paved	0	0%	16%
Gravel with BMPs	Gravel with BMPs	7,366	14%	86%
BAT	BAT	5,111	10%	53%

[1] TOC standard is not met in Upper Watershed Area.

6 Conclusion

Tetra Tech has evaluated the effectiveness of two management scenarios in meeting the Lake's adopted water quality targets and proposed management area load allocations.

The Non-engineering/Land Conservation scenario meets the targets/allocation if:

- Paved roads, streets, and driveways are required for new development, or
- Offsite land conservation is required.

The Performance Standards/Land Conservation Scenario meets the targets/allocations if:

- Onsite engineered BMPs are used. However, engineered BMPs are untested in areas similar to the Lake Maumelle Watershed. Pilot projects must be conducted (outside of Critical Area A) to determine effectiveness.

At the June meeting, the PAC will be asked to vote on which of the two scenarios, or combination of scenarios, best meets the project's overall objectives.

Policy Questions to Discuss

For the large lot option, does the 5-acre minimum lot size meet the right balance between minimizing the burden on the property owner and trying to preserve the rural nature of the watershed?

To meet the per acre TSS allocation for a given large lot development, roads, streets, and driveways associated with the new development would need to be paved or, alternatively, 50 percent to 65 percent of the developable land in the watershed would need to be dedicated as permanent conservation area (see Table 9). Given these requirements, should allocation limits be met for TP, TOC and TSS?

If the PAC believes the TSS performance standard should only be partially met because of the paved roads requirement or the amount of offsite land dedication required, then how much of the TSS allocation should be met? Requiring paved roads/streets/driveways on high sloped areas would meet the TP and TOC requirements, but would exceed the TSS standard by 89 percent. Using only gravel roads with BMPs or the Best Available Technology for road aggregate with BMPs would not meet the TP and TOC requirements—10 percent to 14 percent of the developable land in the watershed would need to be set aside as offsite mitigation to meet these targets; under these road improvements the TSS requirements would still be exceeded by 53 percent (using BAT) and by 86 percent (using gravel) (see Table 10).

If offsite mitigation is required, should the offsite mitigation land be targeted in management areas closest to the lake or be allowed anywhere in the same zone? Should this be required of the developer, CAW, or some combination?

Management Scenario: Non-engineering/ Land Conservation Approach

Large Lot Scenario

<u>Upper Watershed Area</u>

5-acre Minimum Lot Size
Undisturbed Open Space:
- •15% on low slopes
- •30% on high slopes

Maximum Imperviousness: 9%
Road BMP Requirement/ Offsite Mitigation

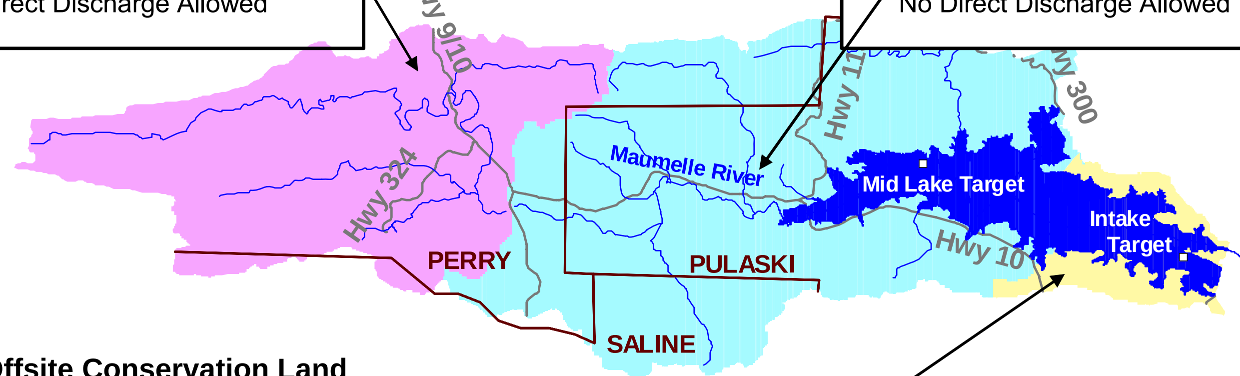
Wastewater Requirements
No Direct Discharge Allowed

<u>Critical Area B</u>

5-acre Minimum Lot Size
Undisturbed Open Space:
- •30% on low slopes
- •50% on high slopes

Maximum Imperviousness: 8%
Road BMP Requirement/ Offsite Mitigation

Wastewater Requirements
No Direct Discharge Allowed



<u>Plus Offsite Conservation Land Mitigation</u>

Paved driveways, streets, and roads:
0 acres

Gravel or BAT with BMPs:
5,111 to 34,687 acres required

<u>Critical Area A</u>

92% Undisturbed Open Space
Minimum Lot Size 20 acres
2.2% Maximum Impervious Limit
Paved Roads

Wastewater Requirements
No Direct Discharge Allowed, Pumped Out of Watershed

Figure 3. **Non-engineering/Land Conservation Scenario: Large Lot Development**

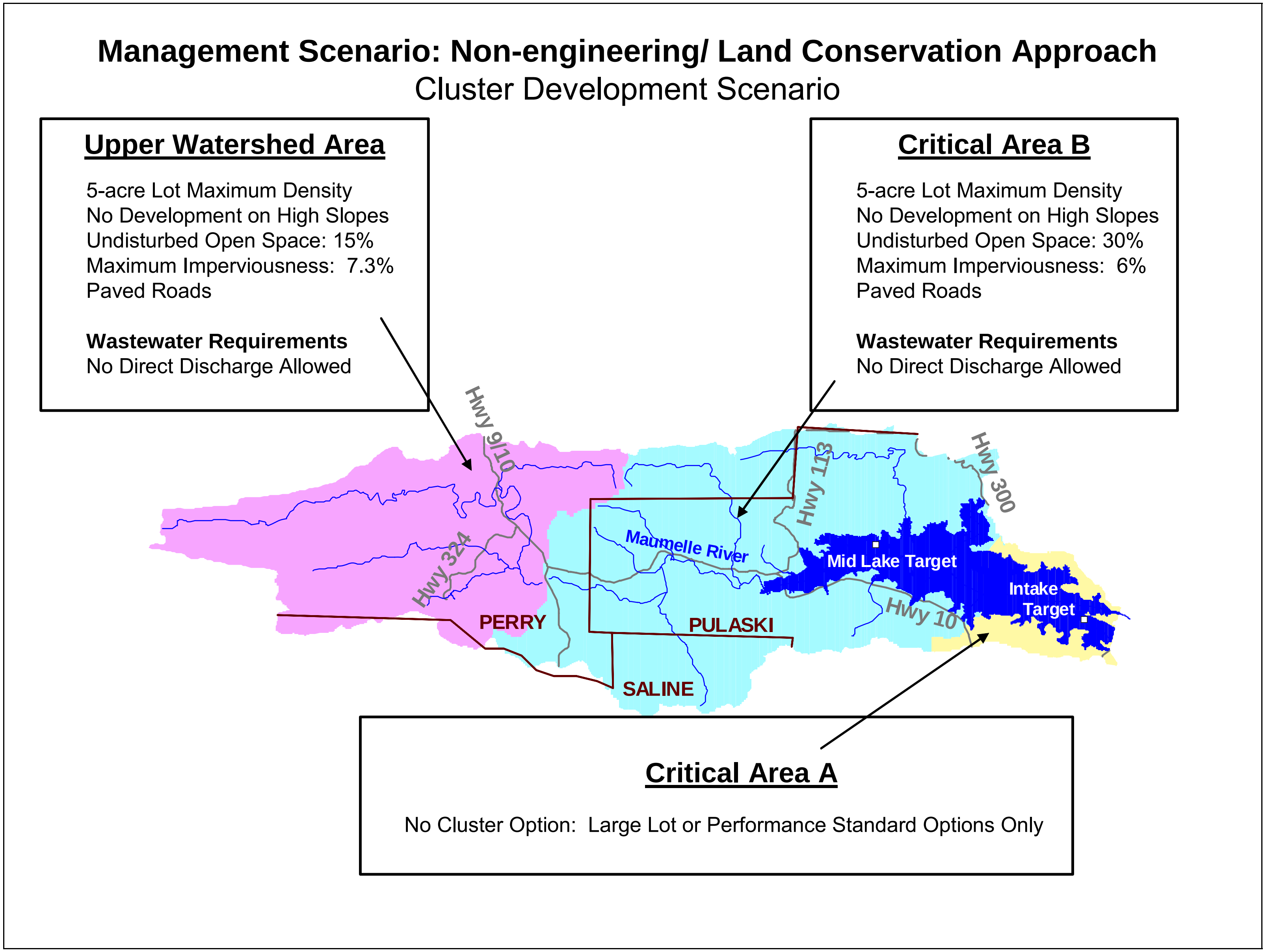


Figure 4. Non-engineering/Land Conservation Scenario: Cluster Development

Scenario 2 – Performance Standards and Land Conservation

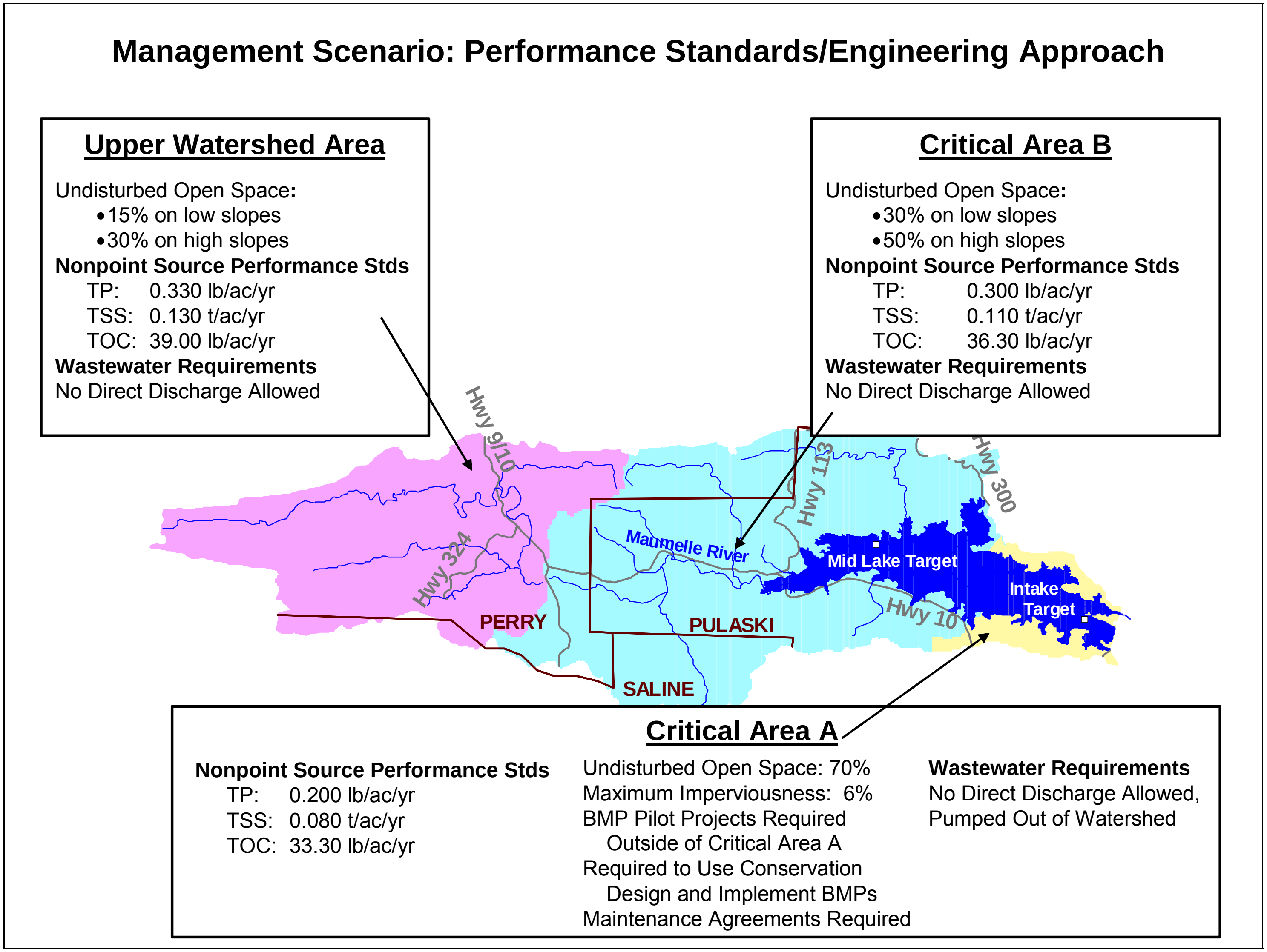


Figure 5. Performance Standards / Engineering Scenario