A Review of "Proposed Methodological Revisions Regarding Consideration of Structural Alterations for Establishing Category 3 Lake Minimum Levels in the Southwest Florida Water Management District" by D. Leeper, 2006.

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June 23, 2006

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Executive Summary

The major issue the Review Panel has been asked to address is the justification of the District's attempt to provide consistency to the rule making methodology between Category 1 and Category 3 lakes. The Revised Method proposes to accept the highest change standard below the Historic P50 as the Minimum Lake Level (MLL) whenever one or more change standards lie above the Historic P50 in Category 3 lakes. This differs from the Adopted Rule, which currently affords greater protection of water resource values by setting the MLL equal to the Historic P50 whenever one or more change standards lie(s) above the Historic P50 in Category 3 lakes. As many as 10% of the lakes within the District's jurisdiction may be affected by the Revised Method.

The justification for the District staff to propose the Revised Method is to reach a level of consistency in setting MLLs for Category 1 and 3 lakes. For Category 1 lakes, which are structurally unaltered lakes with peripheral cypress wetlands > 0.5 acre in area, the MLL is set at 1.8 feet below the Normal Pool (i.e., Cypress standard, with the stage not less than this for more than 50% of the time). This usually results in a MLL that is less than the Historic P50. If the Revised Method for setting the MLL of structurally unaltered Category 3 lakes was to replace the current Adopted Rule, MLLs for structurally unaltered Category 3 lakes could then be set at a level less than the Historic P50, as is currently done for Category 1 lakes. There is the implied assumption in the Revised Method that potential further diminishment of support for in-lake resource values requiring a higher MLL might therefore be allowed, while still supporting the in-lake resource values with associated MLLs lower than the Historic P50.

We do not concur that allowing further declines in the target water level for Category 3 lakes where one or more of the six resource standards (usually the Dock Use or Basin Connectivity) are at elevations above the Historic P50 is desirable unless it can be demonstrated that no loss of uses or impairment of resources occurs. Wherever a significant change standard results in a target MLL higher than the Historic P50, discarding that standard results in a loss of utility and probable impairment of the associated resource value. Moreover, losses of other resource values, including herbaceous wetland area (HWA), could result. Allowing such losses is counter to the purpose of setting MLLs.

The case has been made that setting the MLL higher than the Historic P50 may not be defensible, but we are not convinced that any parameter that causes the MLL to be set higher than the Historic P50 should be completely discarded. Rather, it seems appropriate to set the MLL equal to the Historic P50 in such cases, maintaining the use or avoiding impairment to the extent possible while not setting an MLL higher than a practically achievable Historic P50. Since the focus of the MLL is to maintain uses and resources, it seems fair to allow a decrease in the MLL below the Historic P50 when no significant change standards are exceeded by that MLL. If, however, any parameter in the multi-parameter approach suggests a MLL higher than the Historic P50, setting the MLL equal to the Historic P50 appears appropriate. This was essentially the conclusion of the original panel review of the MLL-setting approach for Category 3 lakes, and we have not been presented with any convincing arguments to cause us to change our opinion.

Our analysis included examining the accuracy and constancy of the Historic P50, and we concluded that the Historic P50 for many Category 3 lakes may have been determined from data collected during a period of lower-than-normal rainfall due to climatic conditions. The logical interpretation of this situation is that the Historic P50 is likely to have been set lower than it would have been had hydrologic data been taken over a longer period of record, and already allows an extra measure of resource loss at the default value for the MLL.

The Panel recognized the need to consider unique factors in the MLL-setting process to provide protection for sensitive resources not addressed by the applicable change standard, and possibly to reduce protection under extenuating circumstances not considered in the process. However, invoking unique factors in setting MLLs should be the exception rather than the rule because of the undefined nature of the unique factors.

We were able to determine that there was very little difference in the degree of protection for the Dock Use and Basin Connectivity values in Category 1 lakes by applying either the Category 1 or Category 3 MLL methodology. Both methods produced a similarly high percentage of Category 1 lakes that were unprotected for Dock Use. However, a significantly higher percentage of Category 3 lakes had their Dock Use and Basin Connectivity values protected under the Cypress standard than under the currently Adopted Rule methodology for Category 3 lakes. While these comparisons suggest that applying the Cypress standard to Category 3 lakes may be overprotective, the current Category 3 methodology is not sufficiently protective, even under the more conservative Adopted Rule of setting the MLL equal to the Historic P50 for structurally unaltered Category 3 lakes. Lowering the MLL to the highest change standard below the Historic P50 as proposed in the Revised Method would result in an even greater loss of resource values, which cannot be completely quantified under the existing system.

Comparing the water depth lost for the Dock Use and Basin Connectivity standards at the Historic P50 (Adopted Rule) and at the highest change standard below the Historic P50 (Revised Method) for the six Category 3 lakes presented as case studies by Leeper (2006a) convinced us that adoption of the Revised Method would have a negative impact on those two resource values. However, the high frequency in which the Dock Use standard was above the Historic P50 in the Category 3 lakes indicates that the standard setting methodology may be flawed, resulting in overprotection of that resource. We provide reasons of why this may be so, and perhaps the calculation of the change standard for dock use should be adjusted, but completely discarding this change standard when it is higher than the Historic P50 has not been justified.

Besides the reduced utility of dock use and basin connectivity under the Revised Method, we found considerably uncertainty as to the effects that the Revised Method may have on resource values outside of the current six in the Adopted Rule, such as peripheral herbaceous wetlands. No significant change standards have been developed for these resources, and it is not at all certain that the existing standards provide adequate protection for them. Under such uncertainty, further reduction in protection is not justified.

The Panel feels particularly strongly that given its multi-functional role in providing biological, hydrological, and chemical services to a lake, the exclusion of the peripheral herbaceous wetland as one of the multi-parameters used to set MLLs for Category 3 lakes remains a deficiency of the

method. However, we recognize that there are no accepted scientifically-based criteria for defining “significant harm” for herbaceous wetlands. Until “significant harm” can be defined, inclusion of the herbaceous wetland as another resource value in establishing the MLL will be elusive.

In conclusion, our analysis generally supports the current practice in the Adopted Rule of deferring to the Historic P50 when a significant change standard (almost always Dock Use or Basin Connectivity) suggests a higher MLL. Our assessment does not, however, provide much support for setting an even lower MLL, as would be the case if the next lowest change standard below the Historic P50 was accepted (as in the Revised Method).

1.0 Introduction

Chapter 373 of the Florida Statutes directs the Southwest Florida Water Management District (SWFWMD, or the District) to annually update a list of priority water bodies for which minimum flows and levels are to be established and to identify which water bodies for which the District will voluntarily undertake independent scientific peer review. Section 373.042 of the law provides that:

1) A minimum flow is the flow of a watercourse below which further water withdrawals will cause significant harm to the water resources or ecology of the area.
2) A minimum level is the level of water in an aquifer or surface water body at which further water withdrawals will cause significant harm to the water resources of the area.

The law also provides that minimum flows and levels shall be calculated using the best information available, that the Governing Board shall consider and may provide for non-consumptive uses in the establishment of minimum flows and levels, and when appropriate, minimum flows and levels may be calculated to reflect seasonal variation. Revised in 1997, the law currently requires that when establishing minimum flows and levels, changes and structural alterations to watersheds, surface waters and aquifers shall also be considered (Section 373.0421, Florida Statutes). The State Water Resources Implementation Rule (Chapter 62-40, Florida Administrative Code) includes additional guidance for the establishment of minimum flows and levels, providing that "consideration shall be given to the protection of water resources, natural seasonal fluctuations in water flows and levels, and environmental values associated with coastal, estuarine, aquatic, and wetland ecology, including:

(a) Recreation, in and on the water;
(b) Fish and wildlife habitats and the passage of fish;
(c) Estuarine resources;
(d) Transfer of detrital material;
(e) Maintenance of freshwater storage and supply;
(f) Aesthetic and scenic attributes;
(g) Filtration and absorption of nutrients and other pollutants;
(h) Sediment loads;
(i) Water quality; and
(j) Navigation."

In October 1998, the District Governing Board approved a Minimum Flows and Levels Rule (Chapter 40D-8, Florida Administrative Code) that included methods for establishing minimum levels for lakes with lake-fringing cypress swamps greater than one-half acre in size (known as Category 1 or 2 Lakes), and minimum levels for fifteen such lakes in the northern Tampa Bay area. Following adoption of the rule, an independent scientific peer review of the data and methods used to establish the minimum levels was conducted. The panel presented its report in August 1999 and found the methodologies proposed by the District for the establishment of Minimum Levels to be generally sound and reasonable (Bedient et al. 1999).

In October 2003, the District Governing Board approved amendments to the Minimum Flows and Levels Rule (Chapter 40D-8, Florida Administrative Code) that included methods for establishing minimum levels for lakes without fringing cypress swamps greater than one-half acre in size (referred to as Category 3 Lakes), and minimum levels for fourteen such lakes in the northern Tampa Bay area. Prior to adoption of the rule, the District subjected the data and methods used to establish the minimum levels to a voluntary, independent peer-review process. That peer review process (Dierberg and Wagner 2001) noted the fundamental difference between setting water level standards for Category 1 and 2 lakes, where protecting the fringing cypress wetlands is presumed to protect in-lake resource values, and Category 3 lakes, where standards relate directly to those in-lake resource values. The approach taken by the District was found to be a reasonable starting point for Category 3 lakes, but recommendations were made for advancing the science behind the approach. Recommendations advanced by the peer review panel were considered by District staff during revision of the Category 3 lake level methodology that was subsequently adopted by the Governing Board.

Now, after some experience with setting Minimum Lake Levels (MLL) for Category 3 lakes, the District is considering a change to the approach. Currently, the historic 50^{th} percentile for water level (Historic P50) is applied unless the water level targets for supporting designated in-lake resource values are all lower than the historic median water level. The key aspect of the proposed change is the potential lowering of the MLL standard below the Historic P50 for lakes that are not structurally altered, to a point coincident with the next highest level required to meet specified in-lake uses. In other words, if some in-lake resource values are best supported by a water level higher than the Historic P50, the MLL will not be set at the Historic P50 (the highest level that could be reasonably required), but rather will be set at a level that supports the in-lake function with the next highest water level requirement below the Historic P50.

This change would have the effect of lowering the regulatory MLL below the Historic P50 for Category 3 lakes that are not structurally altered. The supporting premise is that if the Historic P50 is lower than the water level desired to support some designated in-lake resource values, it is acceptable to allow some further loss of those resource values and set the regulated MLL in accordance with the in-lake function that has the next highest calculated minimum level requirement below the Historic P50. This is viewed as consistent with the approach applied to Category 1 lakes, which are not structurally altered. MLL is set for Category 1 lakes at a level 1.8 ft below normal pool elevation, which is lower than the Historic P50 for all 19 Category 1 lakes for which data are provided in the May 19, 2006 memorandum from D. Leeper (range of 0.1 to 1.0 ft lower). Using the Cypress "change standard" applied to Category 1 lakes, peripheral cypress wetlands are considered adequately protected with a lowering of the MLL from Historic P50 levels, as long as the minimum level is no less than 1.8 ft below the normal pool elevation for more than 50% of the time. The District's proposal is to allow a lowering of the MLL for structurally unaltered Category 3 lakes to the highest level set by significant change standards for in-lake resource values that is lower than the Historic P50.

2.0 Charge to the Peer Reviewers

The Southwest Florida Water Management District (SWFWMD, or the District) has charged the peer reviewers (Reviewers or Review Panel) with evaluating the draft District document entitled "Proposed Methodological Revisions Regarding Consideration of Structural Alterations for Establishing Category 3 Lake Minimum Levels in the Southwest Florida Water Management District", authored by Doug Leeper of SWFWMD. The reviewers are to review, as appropriate, documents and other materials supporting the concepts and data presented in the draft District document, and render a professional opinion in written form that includes a review of the data, methodologies, analyses, and conclusions outlined in the document, and also includes suggestions, if any, for additional data or approaches that are relevant to the proposed methodological revisions outlined in the report.

Specific tasks include:

Task 1. Determine whether the proposed methodological revisions for establishing minimum levels for lakes that are not contiguous with cypress-dominated wetlands (i.e., Category 3 Lakes) are scientifically reasonable.

(a) Review the data and information that is used to describe or support the proposed methodological revisions to determine whether:
   1. the data and information used was properly collected;
   2. reasonable quality assurance assessments were performed on the data and information;
   3. exclusion of available data from analyses was justified; and
   4. the data used was the best information available.

(b) Review the technical assumptions inherent in the proposed methodological revisions and determine whether:
   1. the assumptions are clearly stated, reasonable and consistent with the best information available;
   2. the assumptions were eliminated to the extent possible, based on available information; and
   3. other analyses that would require fewer assumptions but provide comparable or better results are available.

(c) Review the procedures and analyses used to develop or support the proposed methodological changes to determine whether:
   1. the procedures and analyses were appropriate and reasonable, based on the best information available.
   2. the procedures and analyses incorporate all necessary factors;
   3. the procedures and analyses were correctly applied;
   4. limitations and imprecisions in the information were reasonably handled;
   5. the procedures and analyses are repeatable;
   6. conclusions based on the procedures and analyses are supported by the data.

Task 2. If the proposed methodological changes are not scientifically reasonable, the Reviewers shall:

(a) List and describe scientific deficiencies and, if possible, evaluate the error associated with the deficiencies.

(b) Determine if the identified deficiencies can be remedied.
(c) If the identified deficiencies can be remedied, then describe the necessary remedies and an estimate of time and effort required to develop and implement each remedy.
(d) If the identified deficiencies cannot be remedied, then, if possible, identify one or more alternative methods that are scientifically reasonable. If an alternative method is identified, provide a qualitative assessment of the relative strengths and weaknesses of the alternative method(s) and the effort required to collect data necessary for implementation of the alternative methods.

Task 3. If the proposed methodological changes are scientifically reasonable, but an alternative method is preferable, the reviewer shall:
(a) List and describe the alternative scientifically reasonable method(s), and include a qualitative assessment of the effort required to collect data necessary for implementation of the alternative method(s).

3.0 Results of the Peer Review

3.1 Evaluation of Scientific Reasonableness

3.1.a. Data Collection and Representativeness

The data used by the District in developing the suggested change in the approach for setting MLLs come from actual measurements and calculation of specific change standards for the six itemized in-lake resource values (Dierberg and Wagner 2001) for lakes targeted for standard setting. Additional data for other lakes, including Category 1 and 2 lakes not subject to the Category 3 process, were also supplied by the District.

3.1.a.1. Data Collection

Data appear to have been collected properly and in a manner consistent with all approved processes related to the MLL standard setting approach. The collection of data is not a major issue with regard to the proposed change in application of the standard setting process.

3.1.a.2. Quality Assurance (QA)

All QA processes appear to have been followed. The quality of the applied data is not in question with regard to the proposed change in the standard setting process.

3.1.a.3. Data Exclusion

No data were excluded, although the process allows for exclusion of the significant change standards that result in a MLL higher than the Historic P50. As part of the original authorization of standard setting for Category 3 lakes, it was determined that the Historic P50 would be used as the minimum level when any change standard indicates that a higher water level would be needed for full support of the corresponding in-lake function. The proposed modification of the standard setting process for Category 3 lakes allows exclusion of the Historic P50 value as well, deferring to the highest significant change standard that is lower than the Historic P50.

3.1.a.4. Data Representativeness

Target lakes were not necessarily selected to be representative of the range of possible conditions. The lakes used as examples came from the standard setting process, as they occurred during the normal District operations that result in the setting of MLLs. As such, being representative is not a key criterion. Of greater relevance, however, is how often the issue of using the Historic P50 or the next lowest water level associated with a significant change standard is encountered.

MLLs have been approved or proposed for 48 Category 3 lakes so far, and for 28 of those lakes, that minimum level has been set at the Historic P50. The Historic P50 is applied when one or more levels corresponding to significant change standards for designated in-lake resource values are higher than the Historic P50. The Historic P50 level is the highest level applied, and only lakes where the levels corresponding to all six significant change standards (dock use, recreation, species richness, aesthetics, basin connectivity, and lake mixing) are lower than the Historic P50 can be assigned a lower MLL. This was the case for 20 of the 48 Category 3 lakes for which MLLs have been set.

Of the 28 lakes to which the Historic P50 was applied, 8 are considered to be structurally unaltered. That is, they either have no outlet or a natural outlet maintains the historic level as a control point for lake level. Significant change standards for at least one of the six in-lake resource values designated for support when setting MLLs for Category 3 lakes suggested MLLs higher than the Historic P50 for those 8 lakes. This results in the Historic P50 being designated as the MLL for those lakes.

For the Category 3 lakes addressed to date, 8 of 48 (17%) in total, or 8 of 28 (29%) for which the Historic P50 was applied, would be affected by the proposed change. Note that 48 out of 89 lakes for which MLL have been approved or proposed to date are Category 3 lakes. We do not know if this proportion (54%) is representative of lakes within the District's jurisdiction, but suggests that the lakes potentially affected by the Revised Method would represent slightly less than 10% of all subject lakes.

3.1.b. Assumptions

The assumptions made in developing the proposed change in the approach to setting MLLs for Category 3 lakes are perhaps the most critical aspect of this evaluation. District staff has generally been very careful to lay out assumptions and document and justify all steps in making such assumptions, and are to be commended for the effort. Yet an understanding of those assumptions is not necessarily easily achieved, and is critical to evaluating the efficacy of making any change in the MLL setting process. We note the following assumptions, made explicitly or implicitly, that merit discussion:

1. The Historic P50 is an adequate representation of the median water level of the lake.
2. The Historic P50 is not subject to significant change over the period of record or the near future.
3. For designated resource values, the associated significant change standards are appropriately protective.
4. Failing to meet a water level determined to be appropriate for a given resource value will have a negative effect on that resource value; conversely, meeting the appropriate water level will have a positive effect on the resource value.
5. Resource values for which significant change standards have been developed are adequate to represent the range of in-lake functions for which protection is desired.
6. Unique factors associated with any given lake that may override calculating the MLL from significant change standards can be used to adjust the MLL in a logical and defensible manner.

Assumptions are to be reviewed for Clarity and Validity, Minimization, and Alternative Analyses with Fewer Assumptions, according to the Charge to Reviewers. We believe it will be more useful to perform this analysis for each assumption separately.

3.1.b.1. Adequacy of Historic P50

The assumption of Historic P50 adequacy is clear but not always completely valid. The manner in which it is currently applied minimizes assumptions, but may not account for variation that is real and may affect impacts on resource values. For example, it appears that an implicit assumption is made that climatic conditions will remain relatively stable and similar to what they were at the time that hydrologic data were collected for

establishing the Historic P 50. This is not a safe assumption given the mounting evidence that rainfall in Florida responds to multi-decade cycles in sea surface temperature (Enfield et al. 2001).

The Historic P50 for the lakes in question cover a period of record (POR) dating back to the 1970s through the early 1990s (Leeper 2006a), which was drier than the longer term record available for some other lakes (Kelly 2004). As a consequence of this drier period caused by the Atlantic Multidecadal Oscillation (AMO), Historic P50s have been set lower than what would have been established under a period of more "normal" rainfall or over a longer POR. Since the change standards for in-lake resource values are in part based on historic water level data, this means that the significant change standards for the 6 multi-parameter lake resource values (recreation, aesthetics, dock-use, basin connectivity, mixing depth, and species richness) are set at elevations that represent a lower range of the true long-term hydrologic regime. While this may be the best estimate available for the Historic P50, it does allow for some possible loss of support for resources already, and is almost certainly not overprotective. With the proposed change in the approach for Category 3 lakes, further erosion of protection of lake resource values would occur.

We do not readily see any alternative approaches with lesser or more valid assumptions. However, the limitations of the current assumptions should be incorporated when considering a change in the process for setting MLLs.

3.1.b.2. Constancy of Historic P50

The difference in Historic P50 estimated from more recent vs. longer-term data described above indicates that the Historic P50 is not a constant value, even though it is calculated and used as such. As recent data suggest drier conditions and lower water levels (Kelly 2004), MLLs set from such data will reflect lower Historic P50 values and less resource protection. The exact extent of this loss of protection has not been assessed, but it is assumed to be small enough to warrant application of more recent (since 1970 or so) data without any correction. This has been judged to be reasonable and practical in past reviews, but suggests caution in any action that will further lower the MLL.

As with the assumption of Historic P50 adequacy, the assumption of Historic P50 constancy is clear but may not always be completely valid. Application of the Historic P50 minimizes assumptions, and adjustment of that value in the future with additional data will continue to minimize and validate assumptions. It would be prudent for the District to incorporate climatic variability into a process for periodic reassessment of MLLs, and one option is noted in Section 3.3.

3.1.b.3. Appropriateness of Significant Change Standards

For the six resource values designated in the Category 3 lakes process for setting the MLL, significant change standards have been established to set thresholds for the acceptable maximum limit on change in water level interpreted as impact on the corresponding resource values. As discussed by Dierberg and Wagner (2001), these represent the most defensible standards that could be developed from existing data for

applicable lakes, but refinement may be possible over time with more data, and development of additional change standards is viewed as desirable.

From the available data, the established values appear appropriately protective of the corresponding resource values. This does not mean that they are completely protective or that any loss of protection translates into a complete loss of the resource. Rather, the significant change standards are viewed as reasonable targets for supporting designated resources while allowing other uses of the associated water. At least four out of the six significant change standards are not overprotective; they routinely allow some loss below the Historic P50 before limiting further water level reduction. The exceptions appear to be the Dock Use and Basin Connectivity standards, which are usually higher than the Historic P50 and may have inherent variability in their development that creates a flaw in application. The situation is distinctly more severe for the Dock Use standard than the Basin Connectivity standard.

The percentage of Category 3 lakes whose Dock Use and Basin Connectivity values are not protected increases under the Category 3 lake methodology (equal to Historic P50 if one or more of the change standards lie above the Historic P50) compared to Category 1 and 2 lakes methodology based on the Cypress standard (Table 1). This suggests that protection of both resource values would have been improved had the Category 3 lakes been classified as Category 1 or 2 lakes.

Table 1. The number and percent of Category 1, 2, and 3 lakes whose Dock Use and Basin Connectivity standards are not protected by the Cypress standard (i.e., 1.8 ft below normal pool) applied to Category 1 lakes or the current method in the Adopted Rule for setting the MLL of Category 3 lakes. Source of data: Leeper (2006b).

Lake Category	Resource Value	Total No.	Not Protected by Category 1 Method (Cypress St'd)		Not Protected by Category 3 Method	
			Number	Percent	Number	Percent
1	Dock Use	17	15	88%	13	76%
1	Basin Connectivity	13	3	23%	3	23%
2	Dock Use	6	1	17%	4	67%
2	Basin Connectivity	5	0	0%	0	0%
1 and 2	Dock Use	23	16	70%	17	74%
1 and 2	Basin Connectivity	18	3	17%	3	17%
3	Dock Use	30	4	13%	21	70%
3	Basin Connectivity	33	1	3%	11	33%

Evaluation of the MLL based on the Dock Use standard for a group of Category 1, 2 and 3 lakes indicates that the Dock Use standard is often not met, even under the Category 1 lake MLL-setting process (i.e., Cypress standard or Historic P50 as the options), which is believed to be the most restrictive (Table 1).The Dock Use standard may be set too high, and may warrant further investigation. Currently, the standard is based on the elevation of the lake sediments at the end of existing docks, on top of which two feet of water is

added (for boat mooring) plus the Historic P50 minus Historic P90 or region-specific Reference Lake Water Regime (RLWR) statistic (to make dock use feasible nearly all the time). This may represent an overprotective approach or may be inconsistently protective as a function of several conditions:

1. The terminus of the docks is the location for determining the tenth-percentile sediment elevation. Sedimentation may have occurred at the end of the docks between the time they were built and the when the District measured the tenth-percentile sediment elevations. If so, then a higher Dock Use standard would have been adopted.
2. Docks built during "dry" years would tend to be longer and extend more into the lake than docks built during "wet" years. Docks extending further into the lake would end at lower sediment surface elevations than docks built closer to the shoreline during "wet" years. Consequently docks built in "wet" years would have higher Dock Use standards than docks built in "dry" years.
3. The Historic P50 minus Historic P90 depth that is added to the two feet "mooring" depth may be too generous; a more realistic depth may be the depth corresponding to the Historic P90 at the end of the existing docks.
4. Not all boats need two feet of draft space; many docks would be useable if the water at the end was less than two feet deep.

Additionally, as docks can be altered within local and state constraints, functional utility can be met by actions other than water level control. Docks can be extended or even relocated to take advantage of water depth contours. Dredging may be possible to create access channels in some cases. Boats with shallower draft can be used to minimize the necessary water depth for docking. Most other resource values cannot be recovered by actions other than water level manipulation.

Protection of Basin Connectivity, the other change standard which often results in a higher preferred MLL than the Historic P50 for Category 3 lakes, involves fewer lakes with inadequate protection than for the Dock Use standard (Table 1). The Basin Connectivity standard is calculated with respect to boat and fish passage, which might be facilitated by channel dredging in cases where the MLL is set lower, but the level of complication in supporting this resource value may be much increased over that faced with supporting the Dock Use standard.

This analysis of the assumption of the appropriateness of significant change standards generally supports the current practice of deferring to the Historic P50 when a significant change standard (almost always Dock Use or Basin Connectivity) suggests a higher MLL. It does not, however, provide much support for setting an even lower MLL, as would be the case if the next lowest change standard below the Historic P50 were accepted (as in the Revised Method).

3.1.b.4. Impact of Meeting or Not Meeting Significant Change Standards

While the District staff certainly understands the underpinnings of the targeted resource values and associated significant change standards, the assumption of impacts associated with meeting or not meeting those change standards is largely inherent and not explicitly

discussed in most documents and correspondence. The basic theory behind the proposed change to the Category 3 lake methodology for setting MLLs is that for a structurally unaltered lake, some reduction in water level may be possible while still supporting resource values. This is certainly the case for Category 1 lakes, where a water level that is up to 1.8 ft below normal pool elevation for 50% of the time can support the fringing cypress wetlands, and that level is often lower than the Historic P50. Conversely, setting the MLL at the Historic P50 for a Category 3 lake allows no reduction in water level over the long run and can limit water supply for a developing area. While a specific threshold is set to comply with the normal regulatory process, it is acknowledged that the resource value is not always eliminated if the water level drops below that threshold, and is not necessarily supported to the maximum extent possible at the threshold level. The MLL is a threshold in a regulatory sense, but there may be no true threshold effect in terms of impact.

In this regard, change standards are intended to represent levels of resource support that should be maintained as a minimum. Dropping below the associated water level may not eliminate the resource value immediately, although it will at some point. Dock Use and Basin Connectivity are the two resource values that have change standards that most often result in preferred MLLs higher than the Historic P50. The difference in impact between MLLs set at the Historic P50 vs. the next lowest change standard may provide insight on the level of support lost by such a change.

The Dock Use standard provides for two feet of water plus the difference between the P50 and P90 values; deferring to the Historic P50 may not eliminate all dock use, but at some lower water level all dock use will be eliminated. For the three example lakes that had Dock Use standards established (Leeper 2006a), the water depth available to support docked boats is reduced by 7.1, 2.1 and 3.2 ft when the MLL is based on the Historic P50 instead of the Dock Use standard (Table 2). The loss of an extra 1.3 ft of water depth by deferring to the next lowest change standard for Pasedena/Buddy Lakes may be inconsequential after a decrease of 7.1 ft between the Dock Use standard and the Historic P50; most docks may have been high and dry already. Yet corresponding changes of 2.0 ft after a loss of 2.1 ft at Hancock Lake and 1.2 ft after a loss of 3.2 ft at Miona and Black Lakes may signal further and significant decrease in utility of docks.

For Basin Connectivity, the method provides for one foot of water over the highest elevation in the connecting channel. The six cases provided by Leeper (2006a) suggest a lowering of the water level from the Basin Connectivity standard to the Historic P50 of 0.7 to 9.1 ft (Table 2). For Pasadena/Buddy and Miona/Black, the decline from the Basin Connectivity standard to the Historic P50 will probably leave the channel dry most of the time and virtually eliminate support for Basin Connectivity, as water levels rarely rise to a point that could overcome the difference between the Basin Connectivity standard and the Historic P50 (i.e., compare the water depth lost by setting the MLL at the Historic P50 vs. the difference between the P10 and P50 in Table 2).

The other four lakes have basins that will be connected some of the time if the MLL is set at the Historic P50, as the difference in the P10 and P50 values is great enough to

overcome the lost water depth at least some of the time. However, setting the MLL at the next lowest change standard could be expected to virtually eliminate connectivity, as the additional loss of water depth is too great to be overcome except possibly at rare high water levels. The difference between using the Historic P50 and the next lowest change standard to set the MLL will have a definable impact on four of the six example lake systems in terms of basin connectivity.

Table 2. Comparison of water depth lost in feet by various options for setting the Minimum Lake Level (MLL). NA = not available/not applicable. Source of data: Leeper 2006a.

Lake	**Hist P50 – Highest Change St'd below Hist P50**	**Dock Use Water Depth Losses**		**Basin Connectivity Water Depth Losses**		**P10 - P50 (Water level rise to be expected with some practical frequency)**
		At Hist P50	At Highest Change St'd below Hist P50	At Hist P50	At Highest Change St'd below Hist P50	
Pasadena/Buddy	1.3	7.1	8.4	9.1	10.4	6.4
Neff	1.1	NA	NA	5.8	7.9	7.7
Hancock	2.0	2.1	4.1	0.7	2.7	2.3
Miona/Black	1.2	3.2	4.4	2.6	3.8	1.6
Marion	0.8	NA	NA	4.0	4.8	4.4
Wimauma	2.3	NA	NA	1.9	4.2	3.64

The conclusion of this analysis is that loss of resource values is incremental, and in at least some cases, reducing the MLL from the Historic P50 to the next lowest change standard will have an impact on resource values. It should not be assumed that because a change standard cannot be met at one possible MLL, the corresponding resource value is completely eliminated and would not be affected by setting another, lower MLL.

3.1.b.5. Adequacy of Significant Change Standards

The six significant change standards established for use in Category 3 lakes were the most defensible standards the District could develop. They represent a range of resource values considered applicable to the subject lakes, but are not necessarily adequate to represent all possible resource values. Dierberg and Wagner (2001) discussed the desirability of additional change standards and noted especially the need to examine options for peripheral wetlands. While Category 3 lakes do not have significant cypress wetlands, by definition, they may be bordered by or connected to other wetlands of woody or herbaceous nature. No significant change standard has been developed for peripheral wetlands associated with Category 3 lakes, and it is not at all certain that the existing change standards will provide any protection for such wetlands.

A major criticism of the Revised Method expressed by District staff is that there is no "significant harm" criterion for peripheral non-cypress wetlands for Category 3 lakes. Whereas the cypress community is the only parameter used for establishing change

standards for Category 1 and 2 lakes, there is no reference to the vegetative community whatsoever in the six change standards currently in the Adopted Rule for Category 3 lakes. This is because a scientifically defined significant change standard could be developed for the cypress community (i.e., the Cypress standard whereas if Historic P50 < 1.8 ft below the Normal Pool, then the resource is protected), but not for herbaceous wetlands (Bedient et al. 1999; Dierberg and Wagner 2001). This was thoroughly addressed in the previous peer review by Dierberg and Wagner (2001) for Category 3 lake MLLs (see Sections 3.1.b.1, 3.1.c.3, 3.2.a, and 3.3.g of that report), and can be summarized as follows:

The objective is to identify basin elevations where change in lake stage would result in substantial change in potential wetland area. However, there is a lack of a metric that defines when a "substantial change" occurs which will limit application of a Herbaceous Wetland Area (HWA) standard. Since no guidance can be provided as to what corresponds to a substantial change in potential wetland area, significant change standards cannot be calculated as long as a critical minimum or maximum coverage is not specified. Without a defined significant change standard for the herbaceous wetland, its importance and use in defining MLL can be based on only a subjective interpretation of the data. Of course, the development of a more quantitative significant change standard for the HWA will involve more assumptions and a change in approach.

Of the six case studies presented in the Revised Method report (Leeper 2006a), two of the lakes actually increase their potential wetland area (portions of the basin inundated with up to 4 feet of water) at the High MLL (HMLL) under the Revised Method compared to the Adopted Rule (Table 3). However, the overall aggregated effect is that there is a net loss of potential HWA.

Table 3. Increases or decreases in the potential wetland area at the High Minimum Lake Level (HMLL) of six Category 3 lakes under the Revised Method compared to the wetland areas under the Adopted Rule**.** HMLL is either equal to the MLL + (Historic P10-Historic P50) if historic data are available. If not, then the HMLL is set at an elevation corresponding to the MLL plus the region-specific RLWR50.

Lake	**Potential Wetland Area**	**Lake**	**Potential Wetland Area**
Pasadena/Buddy	20% less	Neff	2% less
Hancock	13% more	Miona/Black	9% less
Marion	10% less	Wimauma	12% more

The inconsistent effect of altering the MLL suggests that the existing change standards do not adequately represent all resource values for a lake in which there would likely be an interest. In contrast to change standards for Category 3 lakes, the Category 1 and 2 lake standards are based on woody peripheral wetlands containing cypress. It was thought by the Review Panel (Bedient et al. 1999) that protecting those cypress wetlands would be adequate to protect in-lake resource values. Examination of the results of applying Category 1 or Category 3 methodology to a set of lakes for which data was provided by Leeper (2006b).

It appears that four of the six resource values (i.e., Recreation/Ski, Species Richness, Aesthetics, and Lake Mixing) are well protected regardless of whether the MLL is established by the Cypress standard or the Category 3 lakes methodology (i.e., defaulted to Historic P50 except when all six change standards are less than the Historic P50, in which case the MLL = highest change standard). However, the Cypress standard (i.e., 1.8 ft below Normal Pool for at least 50% of the time) does not protect the Dock Use and, to a lesser extent, the Basin Connectivity resource values for Category 1 lakes (Table 1) to a substantially greater degree than does the Category 3 methodology.

Applying the Category 3 lakes change standards to Category 1 lakes whose MLL was set as if they were Category 3 lakes produced only a minor improvement in protecting the lakes according to the Dock Use standard (15 lakes unprotected if the MLL = Cypress standard vs 13 lakes unprotected if the MLL follows Category 3 lakes methodology) and no improvement in the number of lakes whose Basin Connectivity standards were above the MLL (Table 1), although the number of lakes where the Basin Connectivity standard was higher than the Cypress standard was lower than for the Dock Use vs. Cypress standard comparison. Thus the Cypress standard is only slightly more protective of Dock Use or Basin Connectivity standards than the current Category 3 methodology applied to Category 1 lakes.

Notwithstanding the low number of lakes represented as Category 2 lakes in Table 1, the Dock Use standard would be met for five of the six lakes if the Cypress standard was used to establish the MLL. This, however, is impractical since the lakes have been structurally altered and their MLLs are typically equal to the Historic P50 by the Adopted Rule. Using the Historic P50 as the MLL results in the Dock Use standard being above the MLL in four of six lakes (Table 1).

The same pattern exists for Category 3 lakes. Considerably more lakes have a Dock Use or Basin Connectivity standard that is not met when the MLL is set by either the Historic P50 or the highest change standard elevation when all six change standard elevations are less than the Historic P50 (i.e., the Category 3 lakes methodology) than when the MLL is equal to the Cypress standard (Table 1). Thus, when MLLs for Category 3 lakes are determined as if they were Category 1 lakes (i.e., MLL = Cypress standard), all six resource values are protected in all but a few cases. This suggests that the MLL may be higher than it needs to be, even for most of the Dock Use and Basin Connectivity standards in Table 1, because the Cypress standard is overprotective of in-lake resource values in most cases.

This analysis calls into question the assumption that Category 1 lake methodology need only address protection of peripheral cypress wetlands, as this approach will be protective of all in-lake resource values. The analysis does suggest, however, that application of Category 1 methodology may be overprotective for Category 3 lakes, and that development of a separate methodology for those lakes without peripheral cypress wetlands is indeed appropriate. Yet it also suggests that the existing methodology is not yet adequate to address all resource values believed to be important. Consequently, any

alteration of the approach that is less protective is to be viewed with skepticism until it can be documented as not causing greater harm than the current approach.

3.1.b.6. Utility of Unique Factors

Unique factors for any given lake are already incorporated into the MLL-setting process, under the assumption that the established change standards may be insufficient to properly select a MLL. The proposed altered Category 3 lake approach suggests that unique factors may be invoked to provide adequate protection for sensitive resources if setting the MLL below the Historic P50 has impacts not addressed by the applicable change standards. The assumption seems reasonable and its use seems to be an appropriate supplementary step in the process, but application of unique factors should be the exception rather than the rule. With a number of resource values already unaddressed by the current method, defaulting to a MLL lower than the Historic P50 may require increasing use of unique factors to provide adequate protection, an approach we do not support.

Although applying unique factors of the lake in lieu of the highest change standard below the Historic P50 can result in setting MLLs that protect the more sensitive resource values of a lake, a unique factor can also be used to argue for lowering the MLL even further. For example, the list of unique factors that would be considered in the Revised Method includes typical uses of lakes (e.g., recreation, aesthetics, navigation, irrigation). Although recreation (Ski standard), aesthetics, and navigation (Basin Connectivity standard) are explicitly addressed in the Adopted Rule, irrigation is not. Thus under the Revised Method, if a case can be argued that irrigation using the lake as the water source for businesses or homeowners qualifies as a unique factor, then conceivably the lake stage could be withdrawn to levels far below the MLL that would have occurred had only the six change standards currently adopted been followed. That risk exists now, but any lowering of the MLL should be from a starting point of the Historic P50, not a lower value.

In the framework of the political process that frequently intersects with resource management, it is likely that unique factors will indeed be an implied de facto consideration. However, we envision increased use under the Revised Method, and this could open the MLL process to undue numbers of challenges; this is probably not the best way to protect the resource and its values. We perceive the Revised Method as an erosion of resource protection linked to potentially increased reliance on unique factors (to raise or lower the MLL) that we do not find appropriate at this time.

3.1.c. Procedures

3.1.c.1. Best Available Information

The proposed Revised Method for Category 1 lakes uses the same information as the Adopted Rule, but changes the chosen MLL endpoint for Category 3 lakes without any structural alteration. The change is from a default MLL coincident with the Historic P50 to the next lowest change standard for the six resource values for which change standards have been developed in association with Category 3 lakes. This is not a function of available information, but rather of assumptions about acceptable loss of resource values.

3.1.c.2. Completeness

The mechanics of the approach are complete, but a detailed review of the associated assumptions was not provided as part of the proposed change document (Leeper 2006a). We have provided such a review as part of this document.

3.1.c.3. Application

The application is correct within the constraints of the altered process, and results in lower MLLs for the six example lakes reviewed by Leeper (2006a).

3.1.c.4. Limitations

The rationale for setting the MLL at the highest change standard below the Historic P50 is two-fold. First, change standards that are higher than the Historic P50 cannot be reasonably met. Second, further harm to those resource values will either not occur or can be tolerated if the MLL is lowered below the Historic P50 to the next lowest change standard. We do not find this rationale to be defensible within the context of ecological theory and practical lake management, although there may indeed be cases where the logic holds true.

Because a change standard is not met does not mean that the resource value is eliminated, merely diminished, although further lowering of the MLL will eventually eliminate the resource value. Furthermore, the six change standards applied to Category 3 lakes are not necessarily adequate to protect all resource values associated with the lake and deserving of protection. Our inability to define change standards that would protect those other resource values, such as peripheral non-cypress wetlands, does not negate their existence, and use of the highest established change standard would be appropriately protective in the absence of a more complete suite of change standards. As this may be impractical where the elevation associated with the highest change standard is greater than the Historic P50 (i.e., the lake would not be expected to achieve the target change standard as a median lake level), defaulting to the Historic P50 level as the MLL is a reasonable management approach. However, lowering the MLL below the Historic P50 may further harm resource values with higher change standards and resource values for which change standards have not yet been established.

3.1.c.5. Repeatability

The Revised Method appears as repeatable as the current, existing approach in the Adopted Rule.

3.1.c.6. Strength of the Conclusions

We are not convinced that the proposed alteration of the Category 3 lakes methodology in the Revised Method is protective of in-lake resource values. Analysis of just the six example lakes provided by Leeper (2006a) suggests that for some of these lakes, no more harm is done to resource values with higher change standards by setting the MLL at the highest change standard that is lower than the MLL, but in some cases more harm is done, and damage to other resource values for which change standards have not yet been developed is distinctly possible. The proposed altered approach in the Revised Method

would allow more consumptive water use for supply purposes, but is not viewed by us as consistent with the thrust of the legislation that calls for water level management (Chapter 40D-8, F.A.C.).

One of the arguments in favor of the proposed alteration of Category 3 lake methodology is that the Revised Method is consistent with the way Category 1 and 2 lakes are handled. Category 2 lakes have been structurally altered, and the Historic P50 becomes the default target value in most cases, as peripheral cypress wetlands are already stressed and a lowering of the MLL would further stress them or eliminate them. Category 1 lakes do not have any structural alteration, and allow for a reduction in the MLL below the Historic P50 as long as the MLL is no lower than 1.8 ft below Normal Pool for at least 50% of the time.

The MLL is based on the Cypress change standard, which is predicated on scientific evidence that cypress wetlands can be maintained at such a water level. By definition, having the MLL set at a water level that occurs at least 50% of the time closely approximates the Historic P50 in many cases. Yet the Historic P50 for Category 1 lakes is likely to be somewhat higher than the Normal Pool – 1.8 ft (a level that can occur more than 50% of the time by the Cypress standard), although usually by only a fraction of a foot (range of 0.1 to 1.0 ft with a median value of 0.3 ft for 19 lakes reviewed by Leeper 2006b).

The Cypress change standard is to some degree linked to the Historic P50; the cypress wetlands formed as a function of lake level over an extended period of time. Local variability in land slopes, soil drainage features, and variability of the lake level can cause the Historic P50 and Cypress change standard to differ slightly, but not by multiple feet. The allowable lowering of the MLL from the Historic P50 to some lower elevation is a function of the science behind the change standard, and an assumption that protecting the fringing cypress wetlands will adequately protect in-lake resource values. This assumption is not always true, but appears to be at least as protective as the current Category 3 methodology (Table 1).

For Category 3 lakes, six in-lake resource values have been identified for which change standards could be developed. More appear needed, but under the current approach the MLL is set at the Historic P50 if any change standard is higher. This protects the resource values to the extent considered feasible in light of the actual hydrologic regime. It may be that the change standards are not as appropriate or adequate as we would like, but this is consistent with the Category 1 lakes methodology. Excluding change standards that are higher than the Historic P50 and defaulting to the highest change standard that is lower than the Historic P50 only appears consistent with the Category 1 methodology because there is only one change standard associated with Category 1 lakes (i.e., the Cypress standard).

3.2 Evaluation of Deficiencies

3.2.a. Identification

The primary deficiency, discussed to considerable extent already, is the potential inadequacy of the proposed approach to protect all in-lake resource values. It has not been justified that a resource value for which a change standard cannot be met can be discarded , and analysis of the available data suggests that the assumption is not upheld in a majority of cases. Assuming that the existing change standards for six identified resource values are adequate to protect the range of in-lake resource values in need of protection is also not justified. Analysis of resulting MLLs if Category 3 lakes were treated as Category 1 lakes results in greater protection (Table 1) through higher MLLs, but may be overprotective in many cases. Still, defaulting to the Historic P50 "gives up" some resource values already. Defaulting to the next highest change standard gives up even more resource values that cannot be completely quantified under the existing system and are not justified by the Revised Method.

3.2.b. Remediation

The simplest remediation is to abandon the Revised Method. A more complicated approach would be to analyze the actual consequences of the Revised Method to the resource values with higher change standards than the Historic P50 for each case where such values exist, and determine whether or not additional harm is done to those resource values if a lower MLL is set. This latter remediation ignores the consequences to resource values that do not yet have workable change standards, but for which such change standards are highly desirable (e.g., peripheral non-cypress wetlands).

3.2.c. Application

Evaluation of the potential impact to resource values with change standards higher than the Historic P50 would focus on how much more impact would be sustained if the MLL was lowered to the next highest change standard below the Historic P50. Elimination of the resource value may occur in the case of the Dock Use and Basin Connectivity standards, which have elevations below which docks and channels between basins are truly unusable. Loss of value between the Historic P50 and the next lower change standard may or may not be linear. For Dock Use, it will be necessary to know the situation for each dock in the lake and estimate the loss of utility for the increment of water depth loss on a cumulative basis. For Basin Connectivity, it will be necessary to calculate the channel depth over the range from perhaps the P10 to the P50 value, minus the difference between the Historic P50 and the next lower change standard, to see how much more frequently the channel will be unusable than if the Historic P50 was applied. It is not certain how other resource value impacts would be assessed, but it may be possible.

Whenever resource values with change standards higher than the Historic P50 occur, the Revised Method proposes to default to the next highest change standard, at least in terms of the six existing change standards. However, there is no convenient way to precisely measure the impact of reductions in resource protection between the current change standard and the point of value elimination, and there is no process in place to set an acceptable level of impact below the change standard as a trade-off for other water uses. The change standard was meant to set that level of acceptability. Further, this process does not consider the

resource values that may be afforded protection by adhering to the currently existing change standards but do not have change standards of their own.

3.2.d. Alternative Methods

No alternative method that applies the proposed alteration of the Category 3 approach is recommended at this time.

3.3 Evaluation of Alternative Methods

3.3.a. Alternative Historic P50 Calculation

Concern has been expressed about the accuracy of the Historic P50 value as a function of the available record and climatological variability. An alternative approach to developing the Historic P50 with potentially more valid assumptions would be to identify two historical benchmark periods, one each during a low-flow and high-flow phase of the AMO, on which to base water levels. MLLs could then be considered based on using the most conservative (i.e., protective) benchmark period, or the average of the two periods. The former approach has been proposed by the District for establishing minimum flows in rivers (Kelly 2004).

3.3.b. Unified MLL Approach (no lake categories)

Some discussion has been devoted toward a unified approach toward MLL setting by combining all the existing change standards into one approach. Where a change standard is inapplicable, such as with the Cypress standard at a lake with no cypress trees, or the Dock Use standard where there are no docks, it would simply be deleted from consideration. Such an approach would provide a more complete picture of protective options for a lake, however, and would facilitate better comparison among lake types. The addition of change standards for important aspects of the in-lake environment that are currently not considered in the analysis would also further a more complete approach.

One of the key resource values excluded from analysis of the change standards by the District is herbaceous wetlands. Peripheral herbaceous wetlands have been demonstrated to carry many functional attributes that are considered critical to the resource. These include providing fish and wildlife habitat and nurseries; filtering of particulates and soluble nutrients and contaminants originating from non-point sources in the watershed; and flood and erosion protection. Unfortunately, identifying the criterion when loss of peripheral wetlands constitutes significant harm remains the cutting edge of wetland science, and little progress has been made since the time of the first Minimum Levels Panel in developing change standards for peripheral wetlands, particularly herbaceous wetlands. The District has given further consideration in determining a significant change standard for HWA (Leeper, pers. commun., June 5, 2006), but given the inherent variability, defining an acceptable level of change in response to lowered water levels remains a challenge. A peer review (Clark et al. 2005) commissioned by the St. Johns River Water Management District on the Minimum Flow and Water Level proposed for Lake Monroe in central Florida cited the inherently qualitative nature of defining “significant harm”, which is difficult to determine without a more quantitative benchmark.

The seminal works in this arena to date conclude that where there are decadal or greater cycles in climate or hydrology, herbaceous wetlands appear to adapt and move up and down

the shoreline gradient, at least where the slope is gentle and the effects of wave action are limited (Wilcox et al. 2002; Keough et al. 1999; Wilcox and Whillans 1999; Kowalski and Wilcox 1999). However, the factors that would affect the area and nature of wetlands in response to changing hydrology are likely to be highly site specific. For example, if the lake's margins are not gently sloping, but instead end in a rather abrupt shelf, then replacement of the size of area once occupied by the wetland under higher MLL will not be the same under the lower MLL. Under these conditions, it is reasonable to assume that a herbaceous wetland community could be completely replaced by a terrestrial upland community. This type of "shelf" hypsographic feature for the southern Lake Miona wetland was a concern expressed by District staff at the May 12, 2006 meeting.

Besides hypsographic discontinuities, a reduction in HWA can also occur in a lake with uniform shallow bathymetry. This is simply a matter of geometry where the width of the herbaceous wetland community can remain the same at two different water levels, but the total HWA would decrease in the case of the lower water level because of a smaller wetted perimeter.

Given that the herbaceous plant community is dynamic and often consisting of annual or short-lived perennial species, it may be that the HWA is not a good indicator of hydrologic change. Only with more intensive studies can a rational determination be made as to the feasibility of including herbaceous wetlands as an indicator of "significant harm" in the MLL-setting process. We would like to offer the following suggestions as ways that the District could evaluate this keynote community for possible inclusion in the MLL-setting process.

1. Examine aerial photos or satellite images of a group of lakes for historical changes in the HWA. Then correlate long-term changes in HWA to hydrologic changes (i.e., changes in water level) documented in the field for the same time period. The purpose is to determine whether long-term changes in water level correlate with changes in the HWA. The technique would also be a valid way to assess variability of the HWA to other factors unrelated to hydrology.
2. Establish vegetation plots along transects to quantify spatial and temporal variability of wetland plant communities. Data collected would indicate how variable these vegetation communities might be in response to seasonal and long-term hydrologic change. The data would also identify the community distribution along the hydrologic gradient to assess whether the lake bathymetry and other conditions allow for gradual downslope migration of desirable wetland communities in response to changes in water level. The vegetation transects could also be used to ground-truth the herbaceous wetland classification derived from aerial photos and satellite images.

In the original Draft Report for Category 3 lakes, Leeper et al. (2001) allude to possibly calculating the significant change standard for herbaceous wetlands relative to the their occupation areas at the Historic P50 elevation. That is, some percentage change of the surface areas occupied by emergent plant communities at the Historic P50 should be determined to represent a pivotal point (i.e., a critical area) above which a significant change would occur in the plant community or related lake features. The elevations corresponding to

this percentage would constitute the significant change standards that would then be compared to the other standards calculated. The elevation corresponding to the critical percentage change in the acreage of HWA from its coverage at the Historic P50 would be equal to the HWA significant change standard. This would be compared to the standards for the other six parameters to add another quantitative measure to the multi-parameter approach to setting MLLs.

The challenge is arriving at scientifically defensible critical minimum areas as the cutoff percentages. These percentages may be determined from a literature review as to what constitutes an "ideal" percentage of herbaceous wetland habitat for lakes, or interviewing lake managers or user groups (fishermen, boaters, lake residents) as to their perceptions of appropriate coverage for herbaceous wetlands within lakes. Another approach would be to adopt a reasonable adverse change in habitat availability as a working threshold for "significant harm". For example, a 5% change in the HWA would probably not constitute "significant harm", although it would constitute a net loss of wetlands. However, changes of 15%-20% of habitat availability are likely to be recognized as representing "significant harm" since that percentage is frequently used as a threshold by water management districts.

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