

## Review Comments on “Permit to Take Water Monitoring Program . . MOE Ref #4635-7GFNDT”

This **Permit to Take Water Monitoring Program (PTTWMP)** is reviewed on the basis that it is an amendment to the on-going monitoring program behind which was the intention to provide data and information to assure the protection of the PSW. There are numerous aspects of this PTTWMP which are woefully inadequate as a basis for the long-term protection and rehabilitation of the PSW. Previous reviews of PsTTW have documented that on-going groundwater monitoring data were not analyzed adequately to ensure the protection of the PSW. In addition the decline of groundwater levels well below trigger levels was not interpreted by the Permit Holder to require any action. The serious decline levels below trigger was attributed to weather without satisfactory substantiation. This PTTWMP is reviewed to ascertain if these inadequacies have been eliminated here. As these inadequacies remain, the most serious have been selected and discussed in specific comments.

### COMMENTS:

1. P. 2, last paragraph; *“During servicing construction periods when there is temporary water taking, the frequency will be increased to two-week intervals.”* This statement and subsequent explanations of data downloading and interpretation are written in the interest of protecting the contractor and not for the protection of the PSW. If the monitoring were truly aimed at the protection of the wetland integrity and function, any time there is an approach of the groundwater levels toward the trigger levels it would invoke action leading to protective measures.
2. P.3, 3<sup>rd</sup> paragraph; *“During 2007, and to a lesser degree in 2008, it was observed that the natural fluctuation of groundwater elevations during periods of low precipitation, when no temporary water takings occurred, fell below the previously established trigger elevations.”* This statement is, at best, an anecdotal impression presented and distributed by Golder in previous PTTW submissions. This statement is not factual because there are at least two unsubstantiated assumptions underlying or implied in it. Firstly, there is an implied correlation between precipitation and groundwater elevations which has never been demonstrated to exist for this wetland, especially in its state of having been impacted by nearby construction. Secondly, the rigidity or level of uncertainty in the correlation has not been quantified. Thirdly, in the statement there is the phrase *“during periods of low precipitation”* in which additional values are accepted without validation and give rise to the following quantitative questions. What are the durations of how many periods? How is “low precipitation” quantified and has the confidence level of this value been validated?

3. P. 3, 3<sup>rd</sup> paragraph; “*Although this factual information demonstrates that seasonal and annual precipitation can cause groundwater levels in the areas of the PSW to naturally decline to as much as 0.8 m below the established triggers, it is proposed that the trigger elevations to be used . . .*” The unsubstantiated statement of comment 2 above has now become “*factual information*”. Unsubstantiated assumptions are never transformed to factual information until and only if they are validated by adequate statistical confirmation based on valid analyses of data and processes governing the assumptions.
4. P. 3-4, Table 1; the comments rationalizing the removal of monitors 03-10A and 03-10B from the array of trigger levels are inadequate. If the trigger levels are for the protection of the PSW then these monitors provide a convenient and appropriate early warning if dangerously low monitor elevations are occurring at this boundary. Contrary to the claim in Table 1, this bedrock/overburden pair situated on the northeast boundary would be very useful as this region of the wetland has already been damaged by inappropriate attempts at earlier remedial measures which led to flood damage inside the PSW and well beyond the boundary.
5. P. 4, 1<sup>st</sup> paragraph following Table 1; this four line paragraph implies a number of assumptions and none have been validated. “*An assessment of the reason for the decline based on the activities ongoing at the time will be made.*” The assumption here is that “*the activities ongoing*” will be the reason for the decline whereas in the statement in Comment 2 above, ongoing activity was excluded and the cause suggested in 2007 was low precipitation. The assumptions of what causes groundwater decline are too limited and changing for each situation under the author’s discussion and these assumptions were not validated as they should be. In the last sentence, the implied assumption is that temporary pumping for construction is the only reason the contractor will be required to implement mitigation measures. How will such a restrictive requirement for initiating mitigation measures protect the PSW?
6. P. 4, 2<sup>nd</sup> paragraph; “*data would be reviewed and if there is a decline to below the trigger level and it is assessed to be due to temporary pumping, those responsible for the data monitoring would advise the contractor later that day or the following morning.*” This statement leaves too many possible questions unanswered, such as, who is doing the assessment and using what criteria? When the contractor is advised what is the contractor to do? If the assessment concludes the decline is not due to temporary pumping is no action to be taken?

7. P. 4, 3<sup>rd</sup> paragraph, *“Based on previous site-specific experience, the primary mitigation measure would be for the contractor to suspend pumping, at which point the ground water level is expected to recover very quickly.”* There has been no quantitative confirmation that *“previous site-specific experience”* did not result in collateral wetland damage in the form of generally lower groundwater levels on a long term observation period than has been used. For example, the impact of short-term pumping has not been analyzed in relation to the other factors which affect the groundwater levels in a wetland setting. Thus observation of the initial rapid rise of groundwater levels on cessation of pumping may be an indicator of damage caused by decreasing the natural buffering of groundwater levels in native wetlands. The Leitrim wetland is no longer unaffected because of the construction in its buffer region. A detailed investigation would be required to substantiate the basis for using such a simple observational criterion.
8. P. 4, 3<sup>rd</sup> paragraph; *“If a decline occurs due to natural causes, and continued pumping is not inhibiting water level recovery, then no mitigative action by the Permit Holder would be required.”* The assumption that natural causes for groundwater level decline can be separated from the effects of pumping and other wetland processes has not been documented or substantiated by appropriate data and analyses. How will it be determined that *“continued pumping is not inhibiting water level recovery”*?
9. P. 5, 1<sup>st</sup> paragraph, *“if groundwater monitoring indicates that ground water levels are naturally declining towards the trigger elevations due to seasonal lack of precipitation, the Control Structure could be used to restrict surface water discharge with the objective to maintain or induce a rise in the groundwater level within the PSW.”* This sentence depends on being able to identify and separate quantitatively the numerous causes for the decline in groundwater levels. The complexity of the hydrogeological setting and the associated changes arising from construction would make separation of causes impossible unless a hydrogeological model had been developed and calibrated for the original wetland setting and was modified and up-dated to include effects of construction. Further, the use of the Control Structure to maintain or induce groundwater level change had been tried with disastrous flooding and devastation being the results. Where is the evidence that the use of this method of groundwater control will work now or in the future? Again a hydrogeology model would be needed to identify the effectiveness and the limits of such a procedure.
10. P. 7, 3<sup>rd</sup> paragraph; this paragraph mentions geo-referencing but there is neither mention of precision in any dimension and there is no mention of z-referencing or the precision or accuracy if available for the z-dimension to provide the surface height.

11. P. 7, 4<sup>th</sup> paragraph; measurement of water content using a TDR device. Although my colleagues and I were responsible for introducing TDR to the plant and earth sciences and for conducting a major component of the research demonstrating the excellence of TDR for water content determination, there are limitations for its use. These limitations are not indicated in the PTTWMP. If one does not operate a TDR within the limits governing its appropriate use the recorded data will have no value. In peat soil two factors constrain use of TDR for water content measurement. Firstly, water in peat soil is chemically bound by organic molecules which alter the electrical properties of the water as detected by TDR. Specific calibration overcomes this factor. Secondly, a major portion of water content change in organic soils, such as peat, occurs by volume changes, i.e. shrinkage, of the organic matrix. TDR does not detect the difference between water content change by water removal or by shrinkage. Thus TDR measurements at depths of 12 and 20 cm would most likely indicate constant apparent water content, even if the water content was changing.
12. P. 8, 1<sup>st</sup> paragraph; “*This data, together with water level and precipitation information, will allow a correlation . . .*” It is unclear to what purpose(s) this correlation would be directed if one exists. Finding a correlation coefficient never provides useful or useable information unless it is related to a hypothesis. There is no evidence that a hypothesis has been proposed or is available to be tested using these data and the expected correlation coefficient.
13. P. 8, 2<sup>nd</sup> paragraph; the first sentence as summary conditions under which to grant a PTTW guarantees extremely inadequate protection of the PSW. The past record of this Permit Holder in regard to data assessment in previous PsTTW and in the lack of quantified data assessment in this PTTWMP are strong indications that the Permit Holder will not undertake adequate data analysis to demonstrate the need for remedial action. Further, this PTTWMP contains no basis for defining what would be the appropriate action.

In conclusion, this PTTWMP fails to recognize and account for the complex interaction among the various hydrologic factors and processes which operate to produce the hydrologic state of the PSW. The separation of temporary short-term groundwater adjustment as a single factor to be considered when determining the remedial action for PSW protection assures no protection at all.

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