

## **APPENDIX – P (PEEL)**

### **DILLON CONSULTING LIMITED: WELL HEAD TIME OF TRAVEL CAPTURE ZONE PEER REVIEW EVALUATION RESULTS**

- Dillon Consulting Limited WHPA Peer Review Report Memo
- Wellhead Time of Travel Capture Zone Peer Review Evaluation Results
  - Table 1: Palgrave



July 29, 2010

Lake Simcoe Region Conservation Authority  
120 Bayview Parkway  
Newmarket, Ontario  
L3Y 4X1

Attention: Mr. Don Goodyear, Source Protection Manager

### **WHPA Peer Review Report**

Dear Mr. Goodyear:

Dillon Consulting Limited (Dillon) was retained by the Lake Simcoe Region Conservation Authority (LSRCA) to conduct Peer Reviews of well head protection area (WHPA) mapping for 86 municipal groundwater systems. These systems are located in the South Georgian Bay Lake Simcoe Source Protection Region. External management of the project was conducted by Mr. Dave Ketcheson, P.Eng of Azimuth Environmental Consulting Inc. The results of the peer review are issued in the form of digital spreadsheet files that are attached to this letter. The project scope and peer review methodology is summarized in the letter herein.

### **PROJECT SCOPE**

LSRCA retained Dillon to conduct a 'high level' peer review of the WHPAs that were largely delineated as part of previous WHPA or regional groundwater studies, at a time prior to the finalization of the Director Rules. In general, WHPA delineation was based on an assortment of different model types, including fixed radius, 2-D analytical solutions and numerical 3-D flow modeling. In general, more sophisticated models were applied to those systems where more data was available. The focus of the peer review was on whether the methodologies were consistent with those outlined in the Director Rules, rather than a more traditional technical modeling critique. Evaluations also identified critical issues or deficiencies that would have implications on subsequent steps in the source protection process, so that these may be addressed as part of the Assessment Report. The review also identifies long-term opportunities for improvement in subsequent rounds of the process, recognizing the various levels of effort applied in WHPA delineation across the region (i.e., analytical vs. numerical methods), and the availability of data in the various WHPA settings.

Peer reviewers were Rob Kell, M.A.Sc., P.Eng, P.Geo.; Jeff Hachey, M.Sc. and Darin Burr, M.Sc. P.Geo, all hydrogeologists with Dillon.

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**Dillon Consulting  
Limited**



Evaluation of the WHPAs was performed in a systematic fashion following a “score card” approach. The score card contained both objective and subjective criteria that were evaluated for each system. This template approach enabled reviewers to maintain a level of consistency during the reviews, and was suited to the “high level” nature of the evaluation. The criteria that were evaluated is listed below:

<b>Objective Criteria</b>	<b>Subjective Criteria</b>
Was modeled pumping rate appropriate?	Complexity of geological Setting
Were approved models and methods used?	Appropriateness of Flow Model
	Reasonableness of input parameters
	Adequate incorporation of natural flow field
	Model Calibration
	Incorporation of Uncertainty

For each criterion, a score between 1 and 10 was awarded. In general, a score <5 for any of the criteria would be given if a critical concern was identified that would either significantly affect the reliability of the WHPAs, or is a contravention of the elements of the Directors Rules. An exception for this rule would be the evaluation of the uncertainty criterion. Failure to adequately incorporate uncertainty into the model results was not deemed a requirement of the Director Rules and therefore would not necessarily cause the system to “fail”. Details on conditions that would cause an unacceptable evaluation at the criteria level are presented in the score card sheets.

All systems were given a “pass”, “fail” or “conditional pass” result, depending upon the analysis results. A “pass” ranking was given for those systems where the methodology was generally consistent with the Director Rules, and no critical deficiencies were noted. A “conditional pass” was granted, where the potential for considerable uncertainty in the results existed, but either little data was available to improve the accuracy of the results, or it was the reviewer’s opinion that the uncertainty on the results would not significantly alter the enumeration of land parcels that may contain significant threats.



Following criteria scoring, the individual scores were weighted, and summed to produce an overall system score (between 1 and 10) for the WHPA delineation. Higher the score, the more favorable are the results of the evaluation. Please note that this scoring is a relative ranking between the systems, and is not to be interpreted as any type of marking. For example, a score of 6 does not mean a 60% mark, but rather is a system whose delineated WHPAs are deemed more conservatively robust (in lieu of available data) than a system that receives a score of 5. Theoretically, a system evaluated via fixed radius that is very conservative could receive a higher system score than a detailed numerical model result that is not conservative, as the risk of under-representing the area where significant threats may be lower.

## **RESULTS**

The results of the evaluation are presented on digital Excel™ spreadsheets for each system, and are grouped by township or separated municipality name. Rationale for the individual criteria evaluations, along with the criterion scores, overall system scores and recommendations for future improvement are presented on the individual sheets.

## **LIMITATIONS**

This report was prepared exclusively for the purposes, project and site location(s) outlined in the report. The report is based on information provided to, or obtained by Dillon Consulting Limited ("Dillon") as indicated in the report, and applies solely to site conditions existing at the time of the assessment. Although a reasonable assessment was conducted by Dillon, Dillon's assessment was by no means exhaustive and can not be construed as a certification or acceptance of the reviewed reports. Rather, Dillon's report represents a reasonable review of available information within an agreed work scope, schedule and budget. Further review and updating of the peer review reports will be required as local and site conditions, and the regulatory and planning frameworks, change over time.

This report was prepared by Dillon for the sole benefit of our Client. The material in it reflects Dillon's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. Dillon accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

*Lake Simcoe Region Conservation Authority*  
*Page 4*  
*July 29, 2010*



**CLOSURE**

We appreciate the opportunity to work with LSCRCA on this assignment. If you have any questions about this report, please contact the undersigned.

Yours sincerely,

**DILLON CONSULTING LIMITED**

  
Darin Burr, M.Sc., P.Geo.  
Project Manager

DTB:amb  
Encl.

**Table 1: PALGRAVE - WELL HEAD TIME OF TRAVEL CAPTURE ZONE PEER REVIEW EVALUATION RESULTS**

GENERAL					
<b>System Name:</b>	PALGRAVE WELL SUPPLY				
<b>Reviewed Report:</b>	Wellhead Protection Area Study for Municipal Residential Groundwater Systems Located Within the Toronto and Region Conservation Authority Watersheds Caledon East Wells 2, 3, and 4 and Palgrave Wells 2 and 3, EarthFX, May 2007.				
<b>Terms of Reference:</b>	Ontario Ministry of the Environment and Energy, 2001; Groundwater Studies, 2001/2002, Technical Terms of Reference, November 2001.				
<b>Model Type:</b>	Regional 3-D Modflow				
<b>Score:</b>	6.7				
<b>Pass:</b>	Yes				
<b>Critique Ref:</b>	Sent to Client_Peer Review Score Card Results_052010_2				
System Characteristics					
Hydrogeological Complexity	Deep semi-confined overburden aquifer system				
Spatial variability in Aquifer Vulnerability	Medium				
Known water Quality Issues	None - No human health water quality issues have been reported.				
EVALUATION RESULTS					
Criterion		Awarded Score	General Comments	Comments / Recommendations	
				Critical Deficiencies	Long-term opportunities
Objective Criteria					
1. Were reasonable pumping rates used and documented?		10	Palgrave has four production wells (1, 2, 3 and 4). Pumping rates were assumed to the maximum allowed under their PTTW (Well 1, 1,309 m³/day; Well 2, 2,618 m³/day; Well 3, 5,892 m³/day and Well 4, 2,618 m³/day.	None	The model could be updated if future water supply needs are defined. The rates used were based on maximum permitted rates.
2. Were rule-approved models and methods used?		Pass	3D Numerical flow model is an approved modelling approach	None	Perform continuous updating and verification/validation of the model data.
Subjective Criteria					
3a. Is geological setting complex?	10	6	High complexity. An eight layer model was used as follows: Layer 1, Recent Deposits and Weathered Halton / Kettleby Aquitard; Layer 2, Halton Kettleby Aquitard; Layer 3, ORAC and weathered Newmarket Aquitard; Layer 4, Newmarket Aquitard; Layer 5, Thorncliffe Aquifer Complex; Layer 6, Sunnybrook Aquitard, Layer 7, Scarborough Aquifer Complex and Layer 8, weathered bedrock. Above (west of) the Niagara Escarpment different designations were used but the Palgrave wells are located some distance below (east of) the Escarpment.	None	If planned expansion occurs, further pumping tests and aquifer assessment is required. At that time, the appropriateness of the model to new data should be assessed.
3b. Is Geological Model / Understanding Adequate for assessment method selected?	10	7	Yes the geologic model requires a 3-D numerical modelling approach given the multi-aquifer/aquitard nature of the groundwater system	None	Improve geological model by additional borehole/well construction gathered on a local scale.
4. Is Flow Model Complexity Appropriate?	10	8	Yes - 3D numerical flow model used with significant information regarding the local hydrostratigraphy.	None	Additional monitoring wells positioned upgradient of well field would be beneficial to validate model. Verification of regional model results with results generated on a local scale may also be beneficial.

5. Are model input parameters (recharge, porosity, K) reasonable?	5	6	Porosity values were 0.25 for overburden aquifer material and 0.10 for overburden aquitards and weathered bedrock. Ten recharge zones were used, that ranged from 30 to 420 mm/year. The recharge rates were derived from the calibration of the Core model. Hydraulic conductivity values varies for each model layer and a summary of hydraulic conductivity values that were calibrated were not provided. The report does present figures illustrating two layers (Layer 3 and Layer 5) which shows the distribution of hydraulic conductivity values.	None	Documentation is required. Additional field work would improve estimates, and should be incorporated into the model if information becomes available.
6. Was natural flow field adequately incorporated into model? (Numerical Model)	10	8	Yes - observed head values were used to calibrate the model, however it should be noted that large regional scale models often lead to acceptable calibration residuals without optimizing parameters. A constant head boundary was used to simulate Lake Simcoe and Lake Ontario. A constant head boundary was also used to simulate the main channel of the Credit River. The east perimeter boundary was a no-flow boundary. Stream, rivers and creeks were modelled using both "Drain" boundaries for lower order streams and "river" boundaries for higher order streams. "Drain" boundaries only allow water out of the model but do not allow water from the surface water features to the model - (which "River" boundaries do).	None	An examination of residual values (modelled versus actual water levels) plotted spatially would be beneficial at the local scale.
7. Was natural flow field adequately incorporated into model? (Analytical Model)	10				
8. Was the Model Calibrated?	5	9	The report states " <i>An analysis of variance indicated that the systematic error in the static water level data for wells in or near the study area was around <math>\pm 4</math> m for the ORAC, <math>\pm 5</math> m for the TAC. Trying to match heads to a greater accuracy than these values is not justified; therefore focus was placed on trying to match interpolated heads (which averaged out some of the error), flow patterns, and gradients rather than on matching absolute head measurements at each well. Special care was taken to match water levels and observed flow patterns in the Palgrave and Caledon East vicinity</i> ". The simulated base flow was compared to actual data at four HYDAT stations was also used. Calibration statistics were provided for three different layers and the root mean square error was in the range of 12 m. It is stated that most of the error is associated with well data near the Niagara Escarpment.	None	An examination of residual values (modelled versus actual water levels) plotted spatially would be beneficial at the local scale.
9. Was Uncertainty considered in the analysis?	5	1	Uncertainty analysis consisted of a discussion of the uncertainty. No sensitivity variants were used to define the ToT zones (only the calibrated ToT zones were used).	None	Uncertainty in hydraulic parameters should be completed and the ToT adjusted as appropriate..
10. What is the Uncertainty?		High	Designation not provided in report, but Dillon recommends that it be assessed as high.	None	