Nottawasaga Valley Conservation Authority

Impact assessment of NVCA PGMN groundwater levels to anticipated long-term climatic variation sensitivity

Stephanie McPhie and Ryan Post, NVCA

May 14, 2014

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1.0 Introduction

Climate is inherently variable. According to the Intergovernmental Panel on Climate Change (IPCC), a region's vulnerability to climate change depends on its adaptive capacity, sensitivity, and exposure to changing climatic patterns (Deressa et al., 2008). In addition, an impact assessment can be completed based on current conditions, examining exposure plus sensitivity. It is assumed that areas that are currently exposed and sensitive under current conditions will likely be more impacted under climate change, as defined through an impact assessment which could be prioritized for climate change adaptation.

To date, quantitative climate change analysis completed at the subwatershed scale in the NVCA has been limited to an agricultural-water quantity climate change sensitivity assessment utilizing the following indicators: 1) low water occurrence, 2) irrigated area, 3) surface water stress assessment, and 4) animal water use (Post, 2014). It is noted that the subwatersheds with the largest amount of agricultural activity scored the highest sensitivity to climate change (e.g. Nottawasaga River and Innisfil Creek). Alternatively, the subwatersheds that lack extensive and intensive agriculture scored the lowest sensitivity to climate change – the Mad River, Blue Mountains, and Willow Creek subwatersheds.

The program objective of the Provincial Groundwater Monitoring Network (PGMN) is to monitor water quality and groundwater levels in key Ontario aquifers in order to identify and understand long-term trends in groundwater conditions. With respect to the anticipated long term climate change, groundwater levels in both unconfined and confined aquifer settings are collectively susceptible. There is presently limited understanding how climate change will impact groundwater. The uncertainty over future precipitation distribution, e.g. seasonal distribution, prevents having any certainty with respect to evaluating groundwater impacts due to climate change. Studies in Ontario show groundwater levels increasing in some areas and decreasing in others. The NVCA maintains 16 PGMN wells at 10 locations throughout the 3,300km^2 watershed. Commencing in 2003, the wells are completed in three of the four regional aquifers.To date, no impact assessment completed on this time series data regarding groundwater levels related to climate change.

Advancing the NVCA's understanding of groundwater exposure to climate variability and longer-term change with the focus on water quantity, the objective of this exercise is to determine which subwatershed and aquifers in the NVCA are quantitatively more prone to low groundwater conditions using existing conditions and compare this to the climate change sensitivity ranking from Post (2014).

1.1 NVCA low water declaration summary

Through the Ontario Low Water Response (OLWR) framework, three levels of low water conditions are used to indicate the severity of the watershed conditions; based on the stream flow and precipitation indicators(Ministry of Natural Resources, 2001). The number of Level I and II declarations made by the NVCA Low Water Response Team were summarized on a sub watershed level for the period of 2003-2012, based on internal documentation e.g. media releases). This agricultural-water quantity climate change sensitivity assessment indicator used the following rationale and ranking:

- Low – Score of 1 = Did not declare a level 1 in every dry year

- Medium – Score of 2 = Did not declare a level 1 in every dry year and declared a level 2
- High – Score of 3 = Declared a level 1 in every dry year and declared a level 2

It should be noted that low water declarations (Level I or above) were made somewhere within the NVCA watershed in only six years (Table 1). Further, not every quaternary watershed declared a Level I in each of the six years, and only five quaternary watersheds declared a Level II. A Level III has not been successfully declared in the NVCA. It is noted that the Innisfil Creek and the Boyne River subwatersheds had the highest susceptibility to low water conditions.

Table 1: NVCA Water Response Team low water declaration summary for level 1 ("*1*") and level 2 ("*2*"), 2003-2012.

	2003		**2004**		**2005**		**2006**		**2007**		**2008**		**2009**		**2010**		**2011**		**2012**		**ranking**
	1	***2***	***1***	***2***	***1***	***2***	***1***	***2***	***1***	***2***	***1***	***2***	***1***	***2***	***1***	***2***	***1***	***2***	***1***	***2***	
Innisfil Creek	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	1	0	1	0	3
Mid-Nottawasaga	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	2
Boyne	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	1	0	1	0	3
Pine	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	2
Mad River	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	2
Blue Mountain	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1
Upper Nottawasaga	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	2
Lower Nottawasaga	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	2
Willow	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1

1.2 NVCA Provincial Groundwater Monitoring Network Overview

The NVCA operates 16 PGMN monitoring wells at 10 sites within the watershed (Table 2; Figure 1). The majority of the wells are concentrated in the central-eastern aspect of the watershed with one well (W486-2) located west of the Niagara Escarpment. Physiographically, the wells are overwhelmingly concentrated in the Simcoe Uplands and Simcoe Lowland units. All wells are completed in unconsolidated overburden sediment. Hydrostratgraphically, the wells are screened into three of the four main regional aquifers: no well is completed into the deep regional aquifer 4. Three wells are completed into unconfined aquifer conditions (W281-1, W291-1, and W292-1) and the remainder in confined settings.

Although data collection commenced in 2002 for some wells, the NVCA has varying amounts of GW level data for the 16 PGMN wells since program inception. The limited amount of useable years is reflective of operational issues and the fact that three NVCA PGMN wells are less than five years old (i.e. W479-1, W490-1, and W486-2).

Table 2 - NVCA PGMN well summary.

Well	Subwatershed	Physiographic region	Hydro-Stratigraphic Unit	Confined/ Unconfined	Corrected Time Series		Percent Complete
					Start	Finished	
W223-1	LSRCA	Simcoe Uplands	A3	confined	2-Sep-03	8-May-13	82.67
W224-1	Innisfil	Oak Ridges Moraine	A3	confined	12-Dec-02	4-Nov-13	59.71
W230-1	Pine River	Simcoe Lowlands	A3	confined	25-Mar-03	4-Nov-13	79.36
W231-1	Middle Nott.	Simcoe Lowlands	A3	confined	6-Feb-03	5-Nov-13	63.16
W232-2	Lower Nott.	Simcoe Lowlands	A3	confined	2-Jun-03	4-Nov-13	79.39
W244-2	Willow Creek	Simcoe Uplands	A1	confined	6-Feb-03	4-Nov-13	92.29
W245-2	Willow Creek	Simcoe Uplands	A3	confined	6-Feb-03	24-Jan-14	87.08
W281-1	Middle Nott.	Simcoe Lowlands	A1	unconfined	19-Mar-03	5-Nov-13	68.64
W291-1	Lower Nott.	Simcoe Lowlands	A1	unconfined	19-Mar-03	2-Nov-13	92.21
W292-1	Pine River	Simcoe Lowlands	A1	unconfined	25-Mar-03	4-Nov-13	67.40
W323-2	Innisfil Creek	Simcoe Uplands	A2	confined	21-May-03	4-Nov-13	83.70
W323-3	Innisfil Creek	Simcoe Uplands	A2	confined	21-May-03	4-Nov-13	88.62
W323-4	Innisfil Creek	Simcoe Uplands	A3	confined	21-May-03	4-Nov-13	85.63
W479-1	Middle Nott.	Simcoe Lowlands	A3	confined	11-Dec-08	4-Nov-13	79.96
W480-1	Middle Nott.	Simcoe Uplands	A1	confined	20-Mar-09	4-Nov-13	50.95
W486-2	Upper Nott.	Orangeville Moraine	A1	confined	18-Mar-10	4-Nov-13	89.36

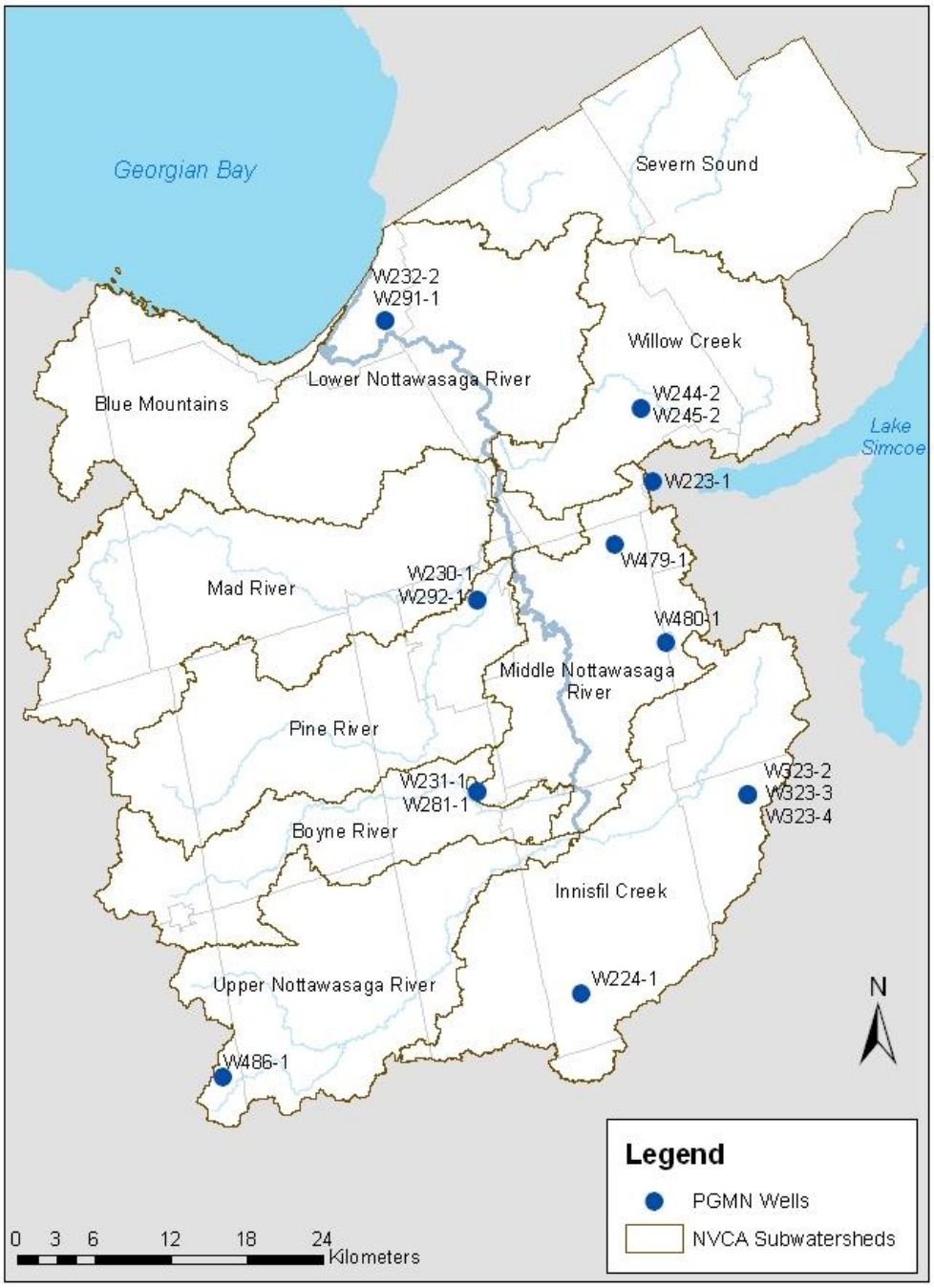

Figure 1 – NVCA subwatershed and NVCA PGMN wells

2.0 Methodology

This exposure analysis occurred in the NVCA subwatersheds where a PGMN well is present and corresponds to: Innisfil Creek, Pine River, Willow Creek, Lower Nottawasaga River, Middle Nottawasaga River, and the Upper Nottawasaga River subwatersheds. Absent subwatersheds include Blue Mountains, Mad River, and Boyne River.

This exercise used the NVCA PGMN data set for the period of 2003-2012.

A complete record is defined as >75% of the annual record, or >6570 hourly reading. It is noted where wells lack the complete annual data set, NA was used.

From McPhie and Post (2014), the following methodology was applied to determine the exposure of groundwater levels to low water conditions. The number of days a well numerically occurred in Level I/II/III on an annual basis from 2003 to 2012 was summed up annually. The scoring consisted of a day at Level I= 1, a day at Level II = 2, and a day at Level III =3. The Level I/II/III were determined via percentiles: Level I equals the 25th percentile, Level II equals the 10th percentile, and Level III equals the 5th percentile. From each well dataset, the respective levels were determined using the 30-day moving average pivot table. Lastly, a declaration table was developed stating the dates when a Level I, II or III occurred. To simplify the data, a low water level was not declared if it occurred for a period of time of 5 consecutive days or less.

To determine the exposure ranking, the data was normalized from 0 to 10 by using the following formula:

$$= x\,(\frac{10}{MAX})$$

X= total score per well
Max = maximum value of the Nottawasaga Watershed (max=700)

The scale 0-10 was subdivided into:

Score 1: Low 0-3, low exposure to low water conditions
Score 2: Medium 4-7, moderate exposure to low water conditions
Score 3: High 8-10, high exposure to low water conditions.

The wells were grouped in order to calculate the scores per subwatershed and aquifer. The scores were added and the same methodology was used to scale the data from 0-10 and to determine the score per subwatershed and aquifer.

3.0 Results

Table 3 scores the individual well exposure ranking on a per year basis. NA indicates that <75% of the data record was available. PGMN well W223-1 was not included since it is not located within the NVCA watershed. The summary of ranking per year per subwatershed is outlined in Table 4. Lastly, an exposure analysis was completed on the individual aquifer system as outlined in Table 5. In addition, Appendix A provides a summary of the low water declaration duration periods for each well and Appendix B outlines the number of days that the Level I/II/III were declared for the 2003-2012 duration. Lastly, Appendix C summarizes the record of completeness per well.

Table 3 - Exposure ranking per well per year.

Year	Innisfil Creek				Pine River		Willow Creek		Lower Nottawasaga		Middle Nottawasaga River				Upp Nott.
	W224-1	W323-2	W323-3	W323-4	W230-1	W292-1	W244-2	W245-2	W232-1	W291-1	W479-1	W480-1	W231-1	W281-1	W486-1
2003	1	NA	NA	NA	1	1	3	2	NA	1	NA	NA	NA	NA	NA
2004	1	1	1	1	1	1	2	2	1	1	NA	NA	NA	NA	NA
2005	1	NA	1	1	NA	2	1	2	2	NA	NA	NA	NA	NA	NA
2006	NA	2	NA	3	NA	NA	1	1	1	2	NA	NA	3	1	NA
2007	NA	1	3	2	1	NA	1	1	2	1	NA	NA	1	2	NA
2008	NA	1	2	1	NA	NA	1	1	NA	1	NA	NA	NA	NA	NA
2009	1	1	1	1	1	1	1	1	1	1	1	NA	1	1	NA
2010	NA	1	1	1	1	1	1	1	1	1	2	2	NA	1	1
2011	1	1	1	1	1	1	1	1	NA	1	1	1	1	NA	2
2012	NA	1	1	1	NA	1	1	1	1	1	1	1	1	1	1

Table 4 - Exposure ranking per subwatershed per year.

Year	**Innisfil Creek**	**Pine River**	**Willow Creek**	**Lower Nott. River**	**Middle Nott. River**	**Upper Nott. River**
2003	1	1	3	1	1	NA
2004	1	1	2	1	1	NA
2005	1	1	2	1	1	NA
2006	2	1	1	2	2	NA
2007	3	1	1	2	1	NA
2008	2	1	1	1	1	NA
2009	1	1	1	1	1	NA
2010	1	1	1	1	2	1
2011	1	1	1	1	1	1
2012	1	1	1	1	1	1

Table 5 - Exposure ranking per aquifer per year.

Year	A1	A2	A3
2003	2	1	2
2004	2	1	2
2005	2	1	2
2006	2	1	3
2007	1	2	3
2008	1	1	1
2009	1	1	1
2010	2	1	1
2011	1	1	1
2012	1	1	1

4.0 Discussion and conclusions

When the data is normalized and summed, Innisfil Creek and Willow Creek are the most susceptible subwatershedsto low water conditions regarding groundwater level where data is available. Excluding the Upper Nottawasaga River subwatershed where the data is limiting, the least impacted subwatershed is the Pine River. Also, the completed impact assessment per aquifer indicates that the regional aquifer A2 (n=2 PGMN wells) is the least susceptible whereas regional aquifer A3 (n=8 PGMN wells) is the most impacted to climate change. It is noted that the A1 aquifer unit contains both PGMN wells completed into unconfined and confined aquifer environments (n=6 PGMN wells). No PGMN wells are completed into the regional aquifer A4. Therefore, the regional aquifer A3 in the Innisfil Creek and the Willow Creek subwatersheds are considered to be the most prone to impact climate change based on the limited PGMN datasets.

The results generated from this study on a subwatershed scale align consistently with the low water declaration level indicator used in the agricultural-water quantity climate change sensitivity assessment completed by Post (2013; Table 6). The exception is the Pine River subwatershed which may be attributed to the other indicators used by Post (2014). It is noted that three other indicators were analyzed for the agriculture sensitivity assessment including surface water stress assessment, irrigated area, and animal water demand. The sensitivity assessment concluded that the watersheds with the largest amount of agricultural activity scored the highest (e.g. Nottawasaga River and Innisfil Creek). This area includes extensive irrigated potato and sod crop lands and noted historical low water conditions. It is also noted that the Nottawasaga River subwatershed is roughly three times the size of any of the other quaternary watersheds and, as a result, the number of animals in this area may be reflective of the area and not necessarily the density of animals.

In short, that the Innisfil Creek has the highest current impact related to the high agricultural sensitivity (Post, 2014) and the results generated from this report to climate change.

Table 6–comparison of the groundwater level exposure ranking (this study) against the low water declaration level climate change sensitivity analysis (Post 2104).

Subwatershed	**Groundwater level exposure ranking**	**Low Water Declaration Level – Climate change sensitivity ranking**
Innisfil Creek	3	3
Pine River	1	2
Willow Creek	2	1
Lower Nott. River	2	2
Middle Nott. River	2	2
Upper Nott. River	1	2

It is noted that this project is limited to the PGMN data set. Therefore, while this desktop analysis is deemed not to be extremely comprehensive, it provides a satisfactory start and could be used as a framework for future groundwater exposure analysis studies in support of climate change work.

From this study, the following recommendations are noted:

- Building on this report, an impact assessment should be also completed using modelled surface water low water levels as defined from the Ontario Low Water Response Protocol.
- Additional groundwater low water exposure analysis should be completed in other (sub) watersheds where the historical groundwater low water declaration periods are known and defined using the 25th, 10th, and 5th percentiles.
- Consideration should be given to develop a detailed provincial climate change impact assessment.
- Consideration should be warranted to undertake a comprehensive groundwater sensitivity assessment at the subwatershed or suitable scale that involve indicators such as but not limited to baseflow index, percentage of shallow water wells, availability of deeper aquifers, percentage of wetland cover, areas where groundwater quality is poor, etc.

7.0 References

Deressa, T.T., Hassan, R.M., and Ringler, C. 2008. Measuring Ethiopian Farmers' Vulnerability to Climate Change Across Regional States. International Food Policy Research Institute. 2 p. http://www.ifpri.org/sites/default/files/publications/rb15_05.pdf

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Appendix A: Declaration tables for groundwater low water levels. It is noted that the declaration is defined for all periods where data is available and is not subject to 75% completeness requirement.

Well 223-1		
Declaration (Level)	**In**	**Out**
1	3-Oct-03	14-Oct-03
1	1-Nov-03	18-Nov-03
1	1-Nov-04	16-Nov-04
1	1-Dec-04	18-Dec-04
1	1-Oct-05	22-Oct-05
1	1-Nov-05	28-Nov-05
2	24-Apr-06	29-Apr-06
1	30-Apr-06	16-May-06
2	17-May-06	31-May-06
1	1-Jun-06	19-Jun-06
2	20-Jun-06	30-Jun-06
1	1-Jul-06	15-Jul-06
2	16-Jul-06	31-Jul-06
3	1-Aug-06	9-Aug-06
2	10-Aug-06	31-Aug-06
3	1-Sep-06	7-Oct-06
2	8-Oct-06	12-Oct-06
1	13-Oct-06	7-Nov-06
2	10-Dec-06	14-Dec-06
1	15-Dec-06	30-Apr-07
1	26-Jun-07	30-Jun-07
1	19-Jul-07	30-Sep-07
3	1-Oct-07	25-Apr-08
2	26-Apr-08	13-May-08
1	14-May-08	31-May-08

Well 224-1		
Declaration (Level)	**In**	**Out**
1	11-Jan-03	31-Jan-03
1	9-Apr-03	30-Apr-03
1	20-May-03	31-May-03
1	24-Jun-03	23-Jul-03
2	24-Jul-03	31-Jul-03
1	1-Aug-03	30-Sep-03
2	1-Oct-03	17-Oct-03
1	18-Oct-03	27-Dec-03
1	1-Apr-04	13-Apr-04
1	22-Jun-05	2-Aug-05
1	17-Aug-06	31-Aug-06
3	1-Sep-06	22-Nov-06
2	23-Nov-06	30-Nov-06
1	1-Dec-06	17-Dec-06
2	18-Dec-06	31-Dec-06
1	1-Jan-07	20-Jan-07
2	21-Jan-07	31-Jan-07
3	1-Feb-07	4-Mar-07
1	5-Mar-07	3-Apr-07
2	4-Apr-07	9-Apr-07
3	10-Apr-07	23-Apr-07
3	18-Nov-08	5-Dec-08
1	6-Dec-08	11-Dec-08

Well 230-1		
Declaration (Level)	**In**	**Out**
1	12-Jul-03	10-Aug-03
2	1-Sep-03	12-Sep-03
3	13-Sep-03	18-Sep-03
2	19-Sep-03	30-Sep-03
3	1-Oct-03	18-Oct-03
1	1-Sep-04	13-Sep-04
3	1-Oct-04	23-Oct-04
2	24-Oct-04	29-Oct-04
1	30-Oct-04	30-Nov-04
3	1-Dec-04	18-Dec-04
2	19-Dec-04	31-Dec-04
1	1-Jan-05	31-Jan-05
2	1-Feb-05	3-Mar-05
1	4-Mar-05	21-Mar-05
2	22-Mar-05	31-Mar-05
1	9-Jun-05	30-Jun-05
1	18-Jul-05	8-Aug-05
2	9-Aug-05	14-Aug-05
1	15-Aug-05	31-Aug-05
3	1-Sep-05	7-Sep-05
3	11-Apr-06	30-Apr-06
1	1-May-06	8-May-06
1	16-May-06	31-May-06
1	20-Jun-06	30-Jun-06
1	1-Mar-07	25-Mar-07
1	4-Aug-07	31-Aug-07
2	2-Sep-07	8-Sep-07
1	9-Sep-07	21-Sep-07
3	1-Oct-07	14-Oct-07
1	15-Oct-07	23-Oct-07
1	10-Nov-07	17-Nov-07
2	18-Nov-07	30-Nov-07
3	1-Dec-07	13-Dec-07
2	14-Dec-07	23-Dec-07
1	1-Feb-08	29-Feb-08
2	1-Mar-08	8-Mar-08
1	9-Mar-08	21-Mar-08
3	10-Dec-08	31-Dec-08
1	1-Mar-09	25-Mar-09
1	16-Feb-11	24-Feb-11

Well 231-1		
Declaration (Level)	**In**	**Out**
3	7-Jan-06	25-Jan-06
2	26-Jan-06	18-Feb-06
1	19-Feb-06	20-Mar-06
2	21-Mar-06	31-Mar-06
3	1-Apr-06	11-Apr-06
2	12-Apr-06	23-Apr-06
3	24-Apr-06	20-Jun-06
2	21-Jun-06	30-Jun-06
3	1-Jul-06	31-Jul-06
1	1-Aug-06	31-Aug-06
3	1-Sep-06	20-Sep-06
2	21-Sep-06	30-Sep-06
3	1-Oct-06	23-Oct-06
2	24-Oct-06	31-Oct-06
1	1-Nov-06	27-Nov-06
1	13-Feb-07	28-Feb-07
1	1-Apr-07	26-Apr-07
1	1-May-07	19-May-07
1	1-Jun-07	13-Jun-07
1	1-Sep-10	17-Sep-10
1	5-Jun-11	20-Jun-11
1	4-Oct-12	28-Oct-12

Well 232-2		
Declaration (Level)	**In**	**Out**
2	3-Sep-03	30-Sep-03
3	1-Oct-03	16-Oct-03
1	17-Oct-03	29-Oct-03
1	2-Nov-03	17-Nov-03
1	1-Mar-04	23-Mar-04
1	1-Sep-04	15-Sep-04
2	1-Oct-04	15-Oct-04
1	16-Oct-04	25-Nov-04
1	1-Dec-04	20-Dec-04
2	1-Jan-05	7-Jan-05
1	8-Jan-05	16-Jan-05
2	1-Apr-05	9-Apr-05
1	10-Apr-05	17-Apr-05
3	30-Sep-05	8-Nov-05
2	9-Nov-05	15-Nov-05
1	16-Nov-05	30-Nov-05
3	1-Dec-05	17-Dec-05
2	18-Dec-05	31-Dec-05
3	1-Jan-06	6-Feb-06
1	7-Feb-06	20-Feb-06
1	24-Jul-06	31-Aug-06
3	1-Sep-06	16-Sep-06
1	17-Sep-06	23-Sep-06
1	3-Oct-06	18-Oct-06
1	1-Nov-06	6-Nov-06
1	1-Dec-06	13-Dec-06
1	1-Jan-07	31-Mar-07
3	1-Apr-07	11-Apr-07
1	12-Apr-07	17-Apr-07
1	21-Jun-07	30-Jun-07
1	7-Jul-07	21-Aug-07
2	22-Aug-07	31-Aug-07
3	1-Sep-07	15-Nov-07
2	16-Nov-07	10-Dec-07
1	11-Sep-08	22-Sep-08
1	5-Oct-08	14-Oct-08
1	6-Mar-10	17-Mar-10
1	25-Apr-10	30-Apr-10

Well 244-2		
Declaration (Level)	**In**	**Out**
2	8-Mar-03	31-Mar-03
3	1-Apr-03	19-Jun-03
2	20-Jun-03	31-Jul-03
1	1-Aug-03	19-Aug-03
2	20-Aug-03	31-Aug-03
1	1-Sep-03	16-Sep-03
2	17-Sep-03	30-Nov-03
3	1-Dec-03	31-Jan-04
2	1-Feb-04	15-Feb-04
1	16-Feb-04	31-Mar-04
2	1-Apr-04	6-Apr-04
1	7-Apr-04	31-May-04
2	1-Jun-04	16-Jun-04
1	17-Jun-04	31-Jul-04
1	8-Aug-04	30-Sep-04
1	20-Oct-04	31-Oct-04
1	15-Nov-04	28-Feb-05
1	19-Mar-05	31-Mar-05
2	1-Apr-05	20-Apr-05
1	21-Apr-05	30-Apr-05
2	1-May-05	10-May-05
1	11-May-05	31-May-05
2	1-Jun-05	16-Jun-05
1	17-Jun-05	30-Jun-05
1	1-Jan-06	30-Jan-06
1	1-Apr-06	8-Apr-06

Well 245-2		
Declaration (Level)	**In**	**Out**
1	8-Mar-03	5-Apr-03
2	6-Apr-03	18-Apr-03
1	19-Apr-03	30-Apr-03
1	22-May-03	31-May-03
1	13-Jul-03	30-Sep-03
3	1-Oct-03	22-Oct-03
2	23-Oct-03	31-Oct-03
3	1-Nov-03	22-Apr-04
1	8-Sep-04	14-Sep-04
3	1-Oct-04	20-Oct-04
1	21-Oct-04	6-Mar-05
1	23-Mar-05	31-Mar-05
2	1-Apr-05	30-Apr-05
1	24-May-05	31-May-05
1	17-Jun-05	30-Jun-05
1	26-Jul-05	31-Aug-05
2	1-Sep-05	30-Sep-05
3	1-Oct-05	20-Oct-05
1	21-Oct-05	14-Nov-05
1	1-Dec-05	22-Dec-05
1	1-Jan-06	24-Jan-06
1	25-Aug-06	1-Sep-06
2	2-Sep-06	10-Sep-06
1	11-Sep-06	19-Sep-06
1	1-Oct-06	7-Oct-06
1	1-Nov-06	8-Nov-06
1	15-Jul-07	24-Jul-07
1	17-Aug-07	24-Aug-07
2	25-Aug-07	5-Sep-07
1	22-Sep-07	30-Sep-07
3	1-Oct-07	14-Oct-07
1	15-Oct-07	25-Nov-07
1	1-Dec-07	28-Dec-07
1	1-Jan-08	17-Jan-08
1	1-Aug-11	13-Aug-11

Well 281-1		
Declaration (Level)	**In**	**Out**
3	18-Apr-03	11-May-03
1	12-May-03	22-May-03
2	23-May-03	31-May-03
1	6-Jun-03	15-Jun-03
1	24-Jun-03	30-Jun-03
1	22-Oct-03	24-Nov-03
1	1-Nov-05	31-Dec-05
3	1-Jan-06	28-Feb-06
1	3-Mar-06	22-Mar-06
1	1-Apr-06	11-Apr-06
3	1-Jan-07	8-Jan-07
1	2-Mar-07	22-Mar-07
1	1-Apr-07	12-Apr-07
1	25-Aug-07	31-Aug-07
1	21-Sep-07	17-Oct-07
2	18-Oct-07	31-Oct-07
3	1-Nov-07	18-Nov-07
2	19-Nov-07	30-Nov-07
3	1-Dec-07	21-Dec-07
2	22-Dec-07	31-Dec-07
3	1-Jan-08	12-Feb-08
1	1-Apr-08	17-Apr-08
3	12-Jan-10	31-Jan-10
1	2-Mar-10	21-Mar-10
1	1-Apr-10	7-Apr-10
3	1-Jan-13	28-Jan-13

Well 291-1		
Declaration (Level)	**In**	**Out**
3	19-Apr-03	30-Apr-03
1	21-May-03	31-May-03
1	8-Sep-03	28-Sep-03
2	29-Sep-03	17-Oct-03
1	18-Oct-03	26-Oct-03
1	1-Nov-03	7-Nov-03
2	8-Nov-03	30-Nov-03
1	1-Mar-04	15-Mar-04
3	1-Apr-04	30-Apr-04
1	1-Nov-04	26-Dec-04
3	11-Oct-05	18-Feb-06
2	19-Feb-06	28-Feb-06
3	1-Mar-06	25-Mar-06
1	26-Mar-06	31-Mar-06
3	3-Apr-06	8-Apr-06
2	9-Apr-06	21-Apr-06
1	22-Apr-06	30-Apr-06
1	13-Aug-06	12-Nov-06
2	13-Nov-06	2-Dec-06
1	1-Mar-07	15-Apr-07
3	16-Apr-07	April 30,07
2	1-Nov-07	30-Nov-07
1	1-Dec-07	15-Dec-07
3	1-Apr-08	30-Apr-08
2	1-Nov-08	30-Nov-08
3	1-Apr-08	April 30 08
2	1-Nov-08	30-Nov-08
3	1-Apr-09	30-Apr-09
2	1-Nov-09	30-Nov-09
1	1-Mar-10	26-Mar-10
1	1-Apr-10	21-May-10
2	1-Nov-10	30-Nov-10
1	1-Mar-11	12-Mar-11
3	1-Apr-11	30-Apr-11
3	8-May-12	31-May-12
1	1-Jun-12	13-Jun-12
2	14-Jun-12	30-Jun-12
1	13-Jul-12	31-Aug-12
2	1-Nov-12	30-Nov-12
1	9-Dec-12	31-Dec-12

Well 292-1		
Declaration (Level)	**In**	**Out**
1	24-Apr-03	30-Apr-03
1	1-Mar-04	18-Mar-04
1	25-Sep-04	30-Nov-04
3	1-Dec-04	15-Dec-04
2	16-Dec-04	21-Dec-04
1	22-Dec-04	31-Dec-04
3	1-Jan-05	19-Jan-05
2	20-Jan-05	25-Jan-05
1	26-Jan-05	31-Jan-05
2	1-Feb-05	31-Mar-05
3	1-Apr-05	21-Apr-05
1	16-Oct-05	31-Oct-05
3	1-Nov-05	20-Jan-06
2	21-Jan-06	11-Feb-06
1	1-Mar-06	14-Mar-06
3	27-Apr-10	18-May-10
1	19-May-10	31-May-10
1	1-Mar-11	13-Mar-11
1	19-Jun-12	30-Jun-12
1	20-Jul-12	3-Aug-12
2	4-Aug-12	21-Aug-12
1	22-Aug-12	31-Aug-12
1	21-Sep-12	4-Oct-12

Well 323-2		
Declaration (Level)	**In**	**Out**
2	20-Jan-03	30-Jun-03
1	1-Jul-03	16-Jul-03
2	17-Jul-03	31-Jul-03
1	1-Aug-03	20-Aug-03
2	21-Aug-03	31-Aug-03
1	1-Sep-03	21-Sep-03
2	22-Sep-03	30-Sep-03
1	1-Oct-03	23-Oct-03
2	24-Oct-03	31-Oct-03
3	1-Nov-03	13-Jan-04
1	14-Jan-04	30-Jan-04
2	4-Feb-04	10-Feb-04
1	11-Feb-04	31-Mar-04
3	1-Apr-04	21-Apr-04
2	22-Apr-04	30-Apr-04
3	1-May-04	16-May-04
2	17-May-04	22-May-04
1	23-May-04	29-May-04
1	1-Jan-06	9-Jan-06
2	10-Jan-06	31-Jan-06
3	1-Feb-06	28-Feb-06
1	1-Mar-06	31-Mar-06
3	1-Apr-06	19-Apr-06
2	20-Apr-06	30-Apr-06
3	1-May-06	20-May-06
1	21-May-06	28-May-06
1	24-Aug-06	31-Aug-06
1	6-Sep-06	30-Sep-06
1	24-Oct-06	31-Oct-06
1	1-Apr-07	23-Apr-07
2	6-May-07	19-May-07
1	20-May-07	30-Jun-07
1	19-Jul-07	31-Jul-07
1	19-Nov-07	31-Dec-07
3	1-Jan-08	20-Jan-08
2	21-Jan-08	31-Jan-08
3	1-Feb-08	16-Feb-08
1	17-Feb-08	26-Feb-08
1	1-Mar-08	31-Mar-08
3	1-Apr-08	17-Apr-08
1	18-Apr-08	24-Apr-08

Well 323-3		
Declaration (Level)	**In**	**Out**
1	20-Jun-03	30-Jun-03
1	2-Oct-03	12-Jan-04
1	1-Jan-06	14-Feb-06
1	25-Jul-06	21-Oct-06
2	22-Oct-06	31-Oct-06
1	1-Nov-06	30-Nov-06
2	1-Dec-06	6-Dec-06
1	7-Dec-06	31-Dec-06
2	1-Jan-07	7-Jan-07
1	8-Jan-07	31-Jan-07
2	1-Feb-07	28-Feb-07
1	1-Mar-07	31-Mar-07
3	1-Apr-07	18-Apr-07
2	19-Apr-07	31-May-07
1	1-Jun-07	9-Jun-07
2	10-Jun-07	30-Jun-07
1	1-Jul-07	20-Jul-07
2	21-Jul-07	31-Jul-07
1	1-Aug-07	21-Aug-07
2	22-Aug-07	31-Aug-07
1	1-Sep-07	9-Sep-07
2	10-Sep-07	3-Oct-07
3	4-Oct-07	31-Oct-07
2	1-Nov-07	30-Nov-07
3	1-Dec-07	25-Apr-08
1	26-Apr-08	31-May-08

Well 323-4		
Declaration (Level)	**In**	**Out**
1	1-Oct-03	19-Oct-03
1	1-Nov-03	17-Nov-03
1	1-Sep-05	30-Sep-05
2	1-Oct-05	13-Oct-05
1	14-Oct-05	31-Dec-05
2	1-Jan-06	31-Jan-06
3	1-Feb-06	7-May-06
2	8-May-06	18-May-06
1	19-May-06	31-May-06
1	18-Jun-06	30-Jun-06
1	24-Jul-06	31-Jul-06
1	21-Aug-06	31-Aug-06
2	1-Sep-06	10-Sep-06
3	11-Sep-06	24-Sep-06
2	25-Sep-06	30-Sep-06
3	1-Oct-06	7-Oct-06
2	8-Oct-06	15-Oct-06
1	16-Oct-06	31-Oct-06
2	3-Nov-06	15-Nov-06
1	16-Nov-06	30-Nov-06
2	1-Dec-06	7-Dec-06
1	8-Dec-06	24-Dec-06
1	1-Jan-07	23-Jan-07
1	1-Feb-07	17-Feb-07
1	1-Mar-07	31-May-07
1	9-Jun-07	30-Jun-07
1	10-Jul-07	31-Jul-07
1	15-Aug-07	31-Aug-07
3	2-Oct-07	14-Jan-08
2	15-Jan-08	20-Jan-08
1	21-Jan-08	31-Jan-08
3	1-Feb-08	7-Feb-08
2	8-Feb-08	14-Feb-08
1	15-Feb-08	27-Mar-08
1	11-Apr-08	30-Apr-08

Well 479-1		
Declaration (Level)	**In**	**Out**
3	10-Jan-09	23-Jan-09
1	24-Jan-09	8-Feb-09
2	4-Mar-10	12-Mar-10
1	13-Mar-10	31-Mar-10
1	15-Apr-10	30-Apr-10
1	6-May-10	31-May-10
1	5-Jun-10	11-Jun-10
2	12-Jun-10	2-Jul-10
1	1-Sep-10	30-Sep-10
2	1-Oct-10	31-Oct-10
3	1-Nov-10	23-Nov-10
1	24-Nov-10	30-Nov-10
1	12-Feb-11	28-Feb-11
2	1-Mar-11	21-Mar-11
1	22-Mar-11	31-Mar-11
1	17-May-11	31-May-11
1	19-Jul-11	31-Jul-11
3	1-Aug-11	28-Aug-11
1	1-Sep-11	7-Sep-11

Well 486-1		
Declaration (Level)	**In**	**Out**
1	23-May-10	31-May-10
1	22-Jun-10	30-Jun-10
1	1-Dec-10	31-Dec-10
3	1-Jan-11	26-Jan-11
1	27-Jan-11	28-Feb-11
3	1-Mar-11	19-Mar-11
1	20-Mar-11	25-Mar-11
1	11-Oct-11	31-Oct-11
3	1-Nov-11	12-Nov-11
1	13-Nov-11	30-Nov-11
3	1-Dec-11	21-Dec-11
1	22-Dec-11	26-Dec-11
1	1-Mar-12	23-Mar-12
1	25-Jul-12	31-Jul-12

Well 480-1		
Declaration (Level)	**In**	**Out**
1	1-Mar-10	9-Apr-10
1	22-Apr-10	30-Apr-10
1	7-May-10	31-May-10
1	19-Jun-10	6-Jul-10
3	1-Oct-10	15-Oct-10
1	16-Oct-10	27-Oct-10
3	1-Nov-10	21-Nov-10
1	22-Nov-10	28-Nov-10
3	1-Dec-10	16-Dec-10
1	17-Dec-10	27-Dec-10
1	1-Mar-11	18-Mar-11

Appendix B: Number of days a Level I/II/III was declared. It is noted that years with over 75% complete record were used. The scoring consisted of a day at Level 1= 1, a day at Level II = 2, and a day at Level III =3.

Innisfil Creek Subwatershed

W224-1							
Year	# of days **Level 1**	Score	# of days **Level 2**	Score	# of days **Level 3**	Score	**Total score**
2003	212	212	15	30	0	0	242
2004	13	13	0	0	0	0	13
2005	41	41	0	0	0	0	41
2006	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2007	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2008	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2009	0	0	0	0	0	0	0
2010	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2011	0	0	0	0	0	0	0
2012	N/A	N/A	N/A	N/A	N/A	N/A	N/A

W323-2							
Year	# of days **Level 1**	Score	# of days **Level 2**	Score	# of days **Level 3**	Score	**Total score**
2003	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2004	74	74	13	26	45	135	235
2005	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2006	89	89	28	56	59	177	322
2007	121	121	14	28	0	0	149
2008	48	48	6	12	44	132	192
2009	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0

W323-3							
Year	# of days **Level 1**	Score	# of days **Level 2**	Score	# of days **Level 3**	Score	**Total score**
2003	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2004	12	12	0	0	0	0	12
2005	0	0	0	0	0	0	0
2006	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2007	114	114	171	342	77	231	687
2008	36	36	0	0	108	324	360
2009	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0

W323-4							
Year	# of days **Level 1**	Score	# of days **Level 2**	Score	# of days **Level 3**	Score	**Total score**
2003	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2004	0	0	0	0	0	0	0
2005	103	103	13	26	0	0	129
2006	93	93	96	192	113	339	624
2007	188	188	0	0	88	264	452
2008	53	53	13	26	21	63	142
2009	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0

Pine River Subwatershed

W230-1							
Year	# of days **Level 1**	Score	# of days **Level 2**	Score	# of days **Level 3**	Score	**Total score**
2003	30	30	19	38	17	51	119
2004	45	45	19	38	41	123	206
2005	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2006	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2007	83	83	24	48	23	69	200
2008	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2009	25	25	0	0	0	0	25
2010	0	0	0	0	0	0	0
2011	9	9	0	0	0	0	9
2012	N/A	N/A	N/A	N/A	N/A	N/A	N/A

W292-1							
Year	# of days **Level 1**	Score	# of days **Level 2**	Score	# of days **Level 3**	Score	**Total score**
2003	7	7	0	0	0	0	7
2004	95	95	6	12	15	45	152
2005	22	22	65	130	85	255	407
2006	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2007	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2008	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2009	0	0	0	0	0	0	0
2010	13	13	0	0	19	57	70
2011	13	13	0	0	0	0	13
2012	49	49	18	36	0	0	85

Willow Creek Subwatershed

W244-2							
Year	# of days **Level 1**	Score	# of days **Level 2**	Score	# of days **Level 3**	Score	**Total score**
2003	35	35	130	260	111	333	628
2004	258	258	37	74	31	93	425
2005	117	117	46	92	0	0	209
2006	38	38	0	0	0	0	38
2007	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0

W245-2							
Year	# of days **Level 1**	Score	# of days **Level 2**	Score	# of days **Level 3**	Score	**Total score**
2003	124	124	22	44	83	249	417
2004	74	74	0	0	118	354	428
2005	187	187	50	100	18	54	341
2006	56	56	9	18	0	0	74
2007	97	97	7	14	10	30	141
2008	17	17	0	0	0	0	17
2009	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0
2011	13	13	0	0	0	0	13
2012	0	0	0	0	0	0	0

Lower Nottawasaga River Subwatershed

W232-1							
Year	# of days **Level 1**	Score	# of days **Level 2**	Score	# of days **Level 3**	Score	**Total score**
2003	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2004	97	97	0	15	0	0	112
2005	32	32	37	74	49	147	253
2006	91	91	0	0	41	123	214
2007	146	146	25	50	70	210	406
2008	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2009	0	0	0	0	0	0	0
2010	18	18	0	0	0	0	18
2011	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2012	0	0	0	0	0	0	0

W291-1							
Year	# of days **Level 1**	Score	# of days **Level 2**	Score	# of days **Level 3**	Score	**Total score**
2003	48	48	42	84	12	36	168
2004	71	71	0	15	30	90	176
2005	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2006	107	107	35	70	79	237	414
2007	55	55	30	60	15	45	160
2008	0	0	30	60	30	90	150
2009	0	0	30	60	30	90	150
2010	71	71	30	60	0	0	131
2011	12	12	0	0	30	90	102
2012	79	79	24	48	12	36	163

Middle Nottawasaga River Subwatershed

W479-1							
Year	# of days **Level 1**	Score	# of days **Level 2**	Score	# of days **Level 3**	Score	**Total score**
2009	16	16	0	0	9	27	43
2010	105	105	57	114	19	57	276
2011	62	62	21	42	24	72	176
2012	0	0	0	0	0	0	0

W480-1							
Year	# of days **Level 1**	Score	# of days **Level 2**	Score	# of days **Level 3**	Score	**Total score**
2009	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2010	108	108	0	0	46	138	246
2011	18	18	0	0	0	0	18
2012	0	0	0	0	0	0	0

W231-1							
Year	# of days **Level 1**	Score	# of days **Level 2**	Score	# of days **Level 3**	Score	**Total score**
2003	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2004	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2005	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2006	83	83	73	146	157	471	700
2007	74	74	0	0	0	0	74
2008	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2009	0	0	0	0	0	0	0
2010	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2011	16	16	0	0	0	0	16
2012	25	25	0	0	0	0	25

W281-1							
Year	# of days **Level 1**	Score	# of days **Level 2**	Score	# of days **Level 3**	Score	**Total score**
2003	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2004	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2005	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2006	31	31	0	0	59	177	208
2007	64	64	35	70	47	141	275
2008	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2009	0	0	0	0	0	0	0
2010	27	27	0	0	20	60	87
2011	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2012	0	0	0	0	0	0	0

Upper Nottawasaga River Subwatershed

W486-1							
Year	# of days **Level 1**	Score	# of days **Level 2**	Score	# of days **Level 3**	Score	**Total score**
2010	46	46	0	0	0	0	46
2011	78	78	0	0	70	210	288
2012	30	30	0	0	0	0	30

Appendix C: Summary of record of completeness, per well. For this study, wells with >75% complete record were used in the groundwater level exposure analysis.

Well	Calendar Year		Number of Records	Percent Complete
	Start	Finished		
W224-1	12-Dec-02	31-Dec-02	466	5.32
	1-Jan-03	31-Dec-03	8761	100.01
	1-Jan-04	31-Dec-04	8784	100.00
	1-Jan-05	7-Sep-05	5516	62.97
	4-Aug-06	31-Dec-06	3589	40.97
	1-Jan-07	23-Apr-07	2700	30.82
	18-Nov-08	31-Dec-08	1037	11.84
	1-Jan-09	31-Dec-09	7931	90.54
	27-Jul-10	31-Dec-10	3777	43.12
	1-Jan-11	31-Dec-11	7189	82.07
	8-May-12	31-Dec-12	5694	65.00
	1-Jan-13	4-Nov-13	7363	84.05

Well	Calendar Year		Number of Records	Percent Complete
	Start	Finished		
W230-1	25-Mar-03	31-Dec-03	6758	77.15
	1-Jan-04	31-Dec-04	8785	100.01
	1-Jan-05	7-Sep-05	5991	68.39
	11-Apr-06	31-Dec-06	6348	72.47
	1-Jan-07	31-Dec-07	8760	100.00
	1-Jan-08	31-Dec-08	5939	67.61
	1-Jan-09	31-Dec-09	8759	99.99
	1-Jan-10	31-Dec-10	8761	100.01
	1-Jan-11	31-Oct-11	7281	83.12
	8-May-12	31-Dec-12	4609	52.47
	1-Jan-13	4-Nov-13	4536	51.78

Well	Calendar Year		Number of Records	Percent Complete
	Start	Finished		
W231-1	6-Feb-03	3-Nov-03	6479	73.96
	2-Nov-05	31-Dec-05	1424	16.26
	1-Jan-06	31-Dec-06	8760	100.00
	1-Jan-07	17-Oct-07	6951	79.35
	10-Dec-08	31-Dec-08	1024	11.66
	1-Jan-09	31-Dec-09	8077	92.20
	15-Jul-10	31-Dec-10	4069	46.45
	1-Jan-11	31-Dec-11	8760	100.00
	1-Jan-12	31-Dec-12	7974	90.78
	1-Jan-13	5-Nov-13	7390	84.36

Well	Calendar Year		Number of Records	Percent Complete
	Start	Finished		
W232-2	2-Jun-03	31-Dec-03	5109	58.32
	1-Jan-04	31-Dec-04	8785	100.01
	1-Jan-05	31-Dec-05	7196	82.15
	1-Jan-06	31-Dec-06	8760	100.00
	1-Jan-07	10-Dec-07	8019	91.54
	8-Aug-08	31-Dec-08	3500	39.85
	1-Jan-09	31-Dec-09	8759	99.99
	1-Jan-10	15-Nov-10	7548	86.16
	9-Sep-11	31-Dec-11	2723	31.08
	1-Jan-12	31-Dec-12	8780	99.95
	1-Jan-13	4-Nov-13	7377	84.21

Well	Calendar Year		Number of Records	Percent Complete
	Start	Finished		
W244-2	6-Feb-03	31-Dec-03	7881	89.97
	1-Jan-04	31-Dec-04	8784	100.00
	1-Jan-05	31-Dec-05	7033	80.29
	1-Jan-06	31-Dec-06	8760	100.00
	1-Jan-07	31-Dec-07	8760	100.00
	1-Jan-08	31-Dec-08	8085	92.04
	1-Jan-09	31-Dec-09	8759	99.99
	1-Jan-10	31-Dec-10	8760	100.00
	1-Jan-11	31-Dec-11	8760	100.00
	1-Jan-12	31-Dec-12	8747	99.58
	1-Jan-13	4-Nov-13	4672	53.33

Well	Calendar Year		Number of Records	Percent Complete
	Start	Finished		
W245-2	6-Feb-03	31-Dec-03	7883	89.99
	1-Jan-04	31-Dec-04	8783	99.99
	1-Jan-05	31-Dec-05	8760	100.00
	1-Jan-06	31-Dec-06	8760	100.00
	1-Jan-07	31-Dec-07	8472	96.71
	1-Jan-08	31-Dec-08	6958	79.21
	1-Jan-09	31-Dec-09	8760	100.00
	1-Jan-10	31-Dec-10	8760	100.00
	1-Jan-11	31-Dec-11	8760	100.00
	1-Jan-12	31-Dec-12	7943	90.43
	1-Jan-13	31-Dec-13	7201	82.20
	1-Jan-14	24-Jan-14	562	6.42

Well	Calendar Year		Number of Records	Percent Complete
	Start	Finished		
W281-1	19-Mar-03	1-Dec-03	6158	70.30
	30-Sep-05	31-Dec-05	2217	25.31
	1-Jan-06	31-Dec-06	8761	100.01
	1-Jan-07	31-Dec-07	8760	100.00
	1-Jan-08	31-Dec-08	5289	60.21
	1-Jan-09	31-Dec-09	8759	99.99
	1-Jan-10	23-Nov-10	7835	89.44
	29-Sep-11	31-Dec-11	2243	25.61
	1-Jan-12	31-Dec-12	8781	99.97
	1-Jan-13	5-Nov-13	7390	84.36

Well	Calendar Year		Number of Records	Percent Complete
	Start	Finished		
W291-1	19-Mar-03	31-Dec-03	6902	78.79
	1-Jan-04	27-Dec-04	8669	98.69
	30-Sep-05	31-Dec-05	2221	25.35
	1-Jan-06	31-Dec-06	8761	100.01
	1-Jan-07	31-Dec-07	8760	100.00
	1-Jan-08	31-Dec-08	7749	88.22
	1-Jan-09	31-Dec-09	8759	99.99
	1-Jan-10	31-Dec-10	8760	100.00
	1-Jan-11	31-Dec-11	8760	100.00
	1-Jan-12	31-Dec-12	8780	99.95
	1-Jan-13	2-Nov-13	7319	83.55

Well	Calendar Year		Number of Records	Percent Complete
	Start	Finished		
W292-1	25-Mar-03	31-Dec-03	6758	77.15
	1-Jan-04	31-Dec-04	8785	100.01
	1-Jan-05	31-Dec-05	7049	80.47
	1-Jan-06	17-Apr-06	2555	29.17
	11-Dec-08	31-Dec-08	485	5.52
	1-Jan-09	31-Dec-09	8759	99.99
	1-Jan-10	31-Dec-10	6672	76.16
	1-Jan-11	31-Dec-11	7779	88.80
	1-Jan-12	31-Dec-12	8780	99.95
	1-Jan-13	4-Nov-13	7370	84.13

Well	Calendar Year		Number of Records	Percent Complete
	Start	Finished		
W323-2	21-May-03	31-Dec-03	5387	61.50
	1-Jan-04	18-Oct-04	6974	79.39
	2-Nov-05	31-Dec-05	1427	16.29
	1-Jan-06	31-Dec-06	8760	100.00
	1-Jan-07	31-Dec-07	6942	79.25
	1-Jan-08	31-Dec-08	8784	100.00
	1-Jan-09	31-Dec-09	8758	99.98
	1-Jan-10	31-Dec-10	8759	99.99
	1-Jan-11	31-Dec-11	8760	100.00
	1-Jan-12	31-Dec-12	8783	99.99
	1-Jan-13	4-Nov-13	7379	84.24

Well	Calendar Year		Number of Records	Percent Complete
	Start	Finished		
W323-3	21-May-03	31-Dec-03	5387	61.50
	1-Jan-04	31-Dec-04	8772	99.86
	1-Jan-05	31-Dec-05	8335	95.15
	1-Jan-06	31-Dec-06	5378	61.39
	1-Jan-07	31-Dec-07	8760	100.00
	1-Jan-08	31-Dec-08	9181	104.52
	1-Jan-09	31-Dec-09	8758	99.98
	1-Jan-10	31-Dec-10	8743	99.81
	1-Jan-11	31-Dec-11	8760	100.00
	1-Jan-12	31-Dec-12	8766	99.80
	1-Jan-13	4-Nov-13	4617	52.71

Well	Calendar Year		Number of Records	Percent Complete
	Start	Finished		
W323-4	11-May-03	31-Dec-03	5387	61.50
	1-Jan-04	31-Dec-04	8772	99.86
	1-Jan-05	31-Dec-05	8191	93.50
	1-Jan-06	31-Dec-06	8433	96.27
	1-Jan-07	31-Dec-07	8089	92.34
	1-Jan-08	31-Dec-08	8784	100.00
	1-Jan-09	31-Dec-09	8746	99.84
	1-Jan-10	31-Dec-10	8759	99.99
	1-Jan-11	31-Dec-11	8760	100.00
	1-Jan-12	21-Nov-12	7813	88.95
	30-Sep-13	4-Nov-13	841	9.60

Well	Calendar Year		Number of Records	Percent Complete
	Start	Finished		
W479-1	11-Dec-08	31-Dec-08	489	5.57
	1-Jan-09	31-Dec-09	8759	99.99
	1-Jan-10	31-Dec-10	8256	94.25
	1-Jan-11	31-Dec-11	8760	100.00
	1-Jan-12	31-Dec-12	8422	95.88
	1-Jan-13	4-Nov-13	7378	84.22

Well	Calendar Year		Number of Records	Percent Complete
	Start	Finished		
W480-1	20-Mar-09	31-Dec-09	6010	68.61
	1-Jan-10	31-Dec-10	8262	94.32
	1-Jan-11	5-Jul-11	4451	50.81
	7-Jun-13	4-Nov-13	3605	41.15

Well	Calendar Year		Number of Records	Percent Complete
	Start	Finished		
W486-1	18-Mar-10	31-Dec-10	6925	79.05
	1-Jan-11	31-Dec-11	8760	100.00
	1-Jan-12	31-Dec-12	8277	94.49
	1-Jan-13	4-Nov-13	7372	84.16

Well	Calendar Year		Number of Records	Percent Complete
	Start	Finished		
W223-1	2-Sep-03	31-Dec-03	2891	33.00
	1-Jan-04	31-Dec-04	8772	99.86
	5-Jan-05	28-Nov-05	6339	72.36
	20-Apr-06	31-Dec-06	6129	69.97
	1-Jan-07	31-Dec-07	8760	100.00
	1-Jan-08	31-Dec-08	8784	100.00
	1-Jan-09	31-Dec-09	8689	99.19
	1-Jan-10	31-Dec-10	8759	99.99
	1-Jan-11	31-Dec-11	8760	100.00
	1-Jan-12	31-Dec-12	8782	*100.25
	1-Jan-13	8-May-13	3058	34.91

*If the annual percentage equals more than 100% it means that more than one reading per hour was done.