Terra-Dynamics Consulting Inc.
404 Queenston Street, St. Catharines, ON L2P 2Y2

August 21, 2014

David Pitblado
Property Manager
Penta Properties Inc.
4480 Paletta Court
Burlington, ON L7L 5R2

Re: 1200 King Road, Hydrogeological and Hydrological Assessment, Burlington, ON

Dear Mr. Pitblado,

1.0 Introduction and Background Information

Penta Properties Inc. retained Terra-Dynamics Consulting Inc. in June, 2013 to complete a hydrogeological and hydrological assessment of the 1200 King Road property in Burlington (Aldershot), Ontario (Figures 1 and 2). The property is approximately 50.3 hectares (124.3 acres) in area and commercial type development is planned.

The work entailed a hydrogeological assessment, streamflow monitoring and surface water quality monitoring of the subject lands. The work was completed per the *Terms of Reference, Environmental Impact Assessment/Stormwater Management Study for 1200 King Road, Burlington* with specific reference to *Section 2.2.1 Hydrogeology and Geology*, *Section 2.2.7 Water Quality* and *Section 3.3 Impact Assessment and Management Strategies – Hydrogeology* along with additional information on these tasks provided in *Appendices A and B* from the *Terms of Reference.*

The *Terms of Reference* outline the study requirements for assessing the groundwater to surface water interactions at the site for three subwatersheds that are present and cross the property from west to east, namely:

1. a tributary of Grindstone Creek;
2. Falcon Creek; and
3. Indian Creek.

This report describes the various tasks associated with completing the Hydrogeological and Hydrological Assessment and the results of this assessment.

2.0 Purpose

The purpose of the hydrogeology and hydrology assessment was to:
1. assess pre-development hydrogeologic conditions of the site and the inter-relationship of the site's groundwater flow regime relative to the creeks that flow through the property;
2. assess pre- and post-development groundwater recharge conditions;

3. monitor the surface water quality from the creeks that flow through the property for baseline conditions for both high flow and low flow conditions;
4. evaluate post-development conditions with respect to identifying any constraints to development regarding a Groundwater Protection Plan.

3.0 Methodologies

3.1 Site Mapping

The site was visited in July and August, 2013 to observe on-site conditions and the stream flow in a tributary of Grindstone Creek, Falcon Creek and Indian Creek. Aerial photographs of the site were evaluated in addition to Ontario Geological Survey and Hamilton-Halton Source Protection maps of the Waterdown area. Aerial orthophotographs for 1999, 2002, 2005, 2007 and 2010 for the area were reviewed utilizing the City of Hamilton iMapper website.

3.2 Installation of Groundwater Monitoring Wells

Monitoring wells were installed in August, 2013 after underground utilities were cleared. The wells were installed at the following locations relative to the location of Falcon and Indian Creeks. Access to the Grindstone Creek tributary was not possible with a drilling rig due to the presence of the Falcon Creek ravine and forested lands that comprise the western half of the property. Locations described below are in the context of the accessible sections of the property east of Falcon Creek and west of King Road:

- MW-1: This shallow monitoring well was installed between King Road and Indian Creek in the northeast corner of the site;
- MW-2: This shallow monitoring well was installed between King Road and Indian Creek in the southeast corner of the site;
- MW-3: This shallow monitoring well was installed west of Indian Creek in the southern section of the site.
- MW-4: This shallow monitoring well was installed in the central portion of the site at the base of the slope associated with the ancestral glacial Lake Iroquois shoreline;
- MW-5: This shallow monitoring well was installed east of Falcon Creek in the southwest corner of the accessible section of the site;
- MW-6-Shallow (S): This shallow monitoring well was installed east of Falcon's Creek in the northwest corner of the accessible section of the site;
- MW-6-Deep (D): The installation of this deeper monitoring well or piezometer allowed for an evaluation of the vertical groundwater hydraulic gradient next to Falcon Creek to assess whether the upper section of the ancestral glacial Lake Iroquois shoreline is recharging the bedrock or is a groundwater discharge zone associated with the Niagara Escarpment to the north;
- MW-7: This shallow monitoring well was installed in the central portion of the site at the top of the slope of the ancestral shoreline;
- MW-8-Shallow (S): This shallow monitoring well was installed west of Indian Creek in the at the top of the slope of the ancestral shoreline;

- MW-8-Deep (D): The installation of this deeper monitoring well or piezometer allowed for an evaluation of the vertical groundwater hydraulic gradient next to the western channel of Indian Creek to assess whether the upper section of the ancestral glacial Lake Iroquois shoreline is recharging the bedrock or is a groundwater discharge zone associated with the Niagara Escarpment to the north.

The drilling was completed with a track-mounted CME 55 drilling rig with hollow-stem augers. The wells are constructed of 5 cm (2 inch) flush-threaded PVC tubing and pre-cleaned and pre-wrapped PVC 10-slot well screen. Borehole logs are presented in Appendix 1.

3.3 Staff Gauges

Stainless steel drive point wells, with appropriate extensions, were manually installed at the following locations to serve as staff gauges and correlate creek levels with groundwater levels:

- Indian Creek Inflow East (IC-I-E): this staff gauge was used to measure flows and levels in the eastern inflow channel of Indian Creek;
- Indian Creek Inflow West (IC-I-W): this staff gauge was used to measure flows and levels in the western inflow channel of Indian Creek;
- Indian Creek Outflow (IC-O): this staff gauge was used to measure flows and levels at the outflow of Indian Creek;
- Falcon Creek Inflow (FC-I): this staff gauge was used to measure flows and levels at the inflow of Falcon Creek;
- Falcon Creek Outflow (FC-O): this staff gauge was used to measure flows and levels at the outflow of Falcon Creek;
- Tributary of Grindstone Creek Inflow (GC-I): this staff gauge was used to measure flows and levels at the inflow of the tributary of Grindstone Creek;
- Tributary of Grindstone Creek Pond: this man-made pond was instrumented with a staff gauge to assess fluctuations in pond levels; and
- Tributary of Grindstone Creek Outflow: this staff gauge was used to measure flows and levels from the aforementioned pond.

3.4 Hydrological Measurements

Flows in the three watercourses were measured at each of the seven staff gauges. The flow method utilized the “velocity x area” method, using a Marsh McBirney FloMate electromagnetic flow meter to measure streamflow velocities and a tape measure to measure stream width and section depths. Rating curves were developed for each of the seven creek staff gauges to correlate between creek water height or stage and creek flow discharge.

3.5 Geodetic Survey

All monitoring wells and staff gauges were surveyed for elevation and UTM coordinates by Metropolitan Consulting Inc.

3.6 Water Level Recorders

Monitoring wells MW-3, MW-4, MW-5 and Monitoring Well Nests MW-6-Shallow and Deep and MW-8-Shallow and Deep were all instrumented with Solinst level loggers for the purpose of generating continuous-type hydrographs of the water table at monitoring wells. The inflow and outflow locations of Indian Creek, Falcon Creek, and the tributary of Grindstone Creek were also instrumented as staff gauges as described in Section 3.3. Data were acquired on a 15 minute frequency. A barometric pressure recorder was also installed at the site in order to compensate level logger data from barometric pressure effects.

3.7 *In Situ* Hydraulic Conductivity (Permeability) Tests

The monitoring wells were subject to bailer withdrawal hydraulic conductivity (permeability) tests in September, 2013. Solinst level loggers were placed in each of the monitoring wells installed by Terra-Dynamics and a volume of water was removed from the well with a disposable plastic bailer. Groundwater recovery was recorded with the level loggers for the purpose of performing hydraulic conductivity analysis with the Hvorslev method. Aquifer-Test software from Schlumberger Inc. was used to create a database of the digitally-acquired data and assess hydraulic conductivity values at monitoring well locations. The test at MW-1 was unsuccessful but the remaining monitoring well data analysis and plots are provided in Appendix 2 and summarized on Table 1.

4.0 Physical Setting and Geologic Conditions

4.1 Physical Setting

The subject property is located in the Aldershot area of Burlington, Ontario. The site is bounded by King Road to the east, Highway 403 to the north, the Aldershot GO Station to the west and property associated with the Canadian National Railway to the south. Silty clay and silty clay with stones (Halton Till) overlie the Queenston Shale across the property. A prominent feature that traverses the site from the southwest central area to northeast corner is an approximate 7 m high ridge associated with the ancestral Glacial Lake Iroquois shoreline (Karrow, 1963).

Three watercourses flow across the property from north to south as are shown on Figure 2:

1. Indian Creek in the eastern section of the property;
2. Falcon Creek through the middle section of the property; and
3. A tributary of Grindstone Creek in the western section of the property that also contains a rectangular man-made pond.

The three creeks have eroded down through the silty clay and glacial till and bottom-out or are based in these fine-grained overburden sediments. All three creeks discharge into Hamilton Harbour.

4.2 Overburden Geology

The site is situated on a 7 to 11 m layer consisting of a mixture of low permeability silty clay and clayey glacial till (Halton Till). Discontinuous lenses of silt and sandy silt were encountered within the Glacial Lake Iroquois ridge. The site is shown in geologic cross-section in Figure 3 with reference to Figure 2. Borehole logs are presented in Appendix 1.

4.3 Bedrock Geology

Armstrong and Carter (2010) document that the Paleozoic rocks beneath the site are composed of red shale from the Queenston Formation from the Upper Ordovician Era. It is laterally extensive across Southern Ontario, New York State and the State of Michigan. Beneath the site it is greater than 120 m and forms an extensive low permeability aquitard (Armstrong and Sergerie, 2002).

Beneath the ridge associated with the Glacial Lake Iroquois Shoreline, the Queenston Shale was encountered at depths of 10.1 m (MW-8-D) and 10.7 m (MW-6-D). Below the ridge, it was encountered at depths of 7.3 m (MW-1) and 8.8 m (BH-5, Soil Mat Engineers and Consultants (2011)). A southerly regional dip in the bedrock surface is present towards Hamilton Harbour.

5.0 Hydrogeologic Conditions and Groundwater Flow

Hydraulic conductivity test results are presented in Appendix 2 and summarized below in Table 1.

Table 1. Summary of *In-situ* Hydraulic Conductivity Tests

Well I.D.	Geologic Formation	Hydraulic Conductivity (m/sec)
MW-2	Silty Clay Till	1.00×10^{-8}
MW-3	Silty Clay Till and Silty Clay	2.23×10^{-8}
MW-4	Silty Clay Till and Silty Clay	4.26×10^{-10}
MW-5	Silty Clay and Silty Clay Till	8.07×10^{-10}
MW-6-S	Silty Clay Till and Silty Clay	6.53×10^{-8}
MW-6-D	Silty Clay	1.78×10^{-9}
MW-7	Silty Clay with Thin Sand Lens	2.25×10^{-6}
MW-8-S	Silty Clay with Lenses of Sand and Silt	7.94×10^{-9}
MW-8-D	Silty Clay and Queenston Shale	3.24×10^{-9}

The silty clay and silty clay till exhibit a very low hydraulic conductivity with a geometric mean of the nine tests referenced in Table 1 of 9.29×10^{-9} m/sec, indicating that the clay-based overburden within the accessible sections of the subject site is an aquitard. As is shown in Figure 3 at Monitoring Wells MW-6-Shallow and Deep, the groundwater in the clay-based aquitard is slowly recharging the shale bedrock aquitard during the spring season and after storm events as is further explained in Section 6.0. Groundwater velocity calculations are provided in Appendix 3. During groundwater recharge conditions from the overburden aquitard to the shale bedrock aquitard, the average linear groundwater flow velocity through the clay aquitard to the shale bedrock aquitard is approximately 1.7 cm/year.

Figure 4 shows the groundwater flow direction in the silty clay and clayey glacial till overburden is generally southward towards Hamilton Harbour and in a small radial pattern towards both Falcon and Indian Creeks in the vicinity of the creeks. Manual groundwater level and staff gauge level measurements are tabulated in Table 2. The horizontal average linear groundwater flow velocity calculation is presented in Appendix 3 which is approximately 4 cm/year southerly towards Hamilton Harbour and locally, towards the creeks.

No groundwater monitoring wells were cored into the shale bedrock aquitard but on a regional scale, groundwater flow in the shale bedrock is likely in a southerly direction towards Hamilton Harbour.

6.0 Hyetographs and Hydrographs

Figures 5 and 6 are hyetographs from September 27, 2013 to July 17, 2014 of (i) daily precipitation, (ii) the shallow water table in the clay-based aquitard, (iii) the potentiometric surface of the groundwater elevation at the base of the clay-based aquifer, and (iv) the water level in the two creeks that flow across the property. Precipitation data are from Environment Canada's nearby Royal Botanical Gardens Weather Station. Figure 5 pertains to Monitoring Wells MW-6-Shallow and Deep and the inflow staff gauge at Falcon Creek (see Figure 2). Figure 6 pertains to Monitoring Wells MW-8-Shallow and Deep and the inflow staff gauge at Indian Creek (see Figure 2). The following are some observations that pertain to precipitation events, surface water and groundwater levels/elevations data:

<u>Figure 5, Falcon Creek Area Hyetograph (northwest corner of the proposed development):</u>

1. The linear spikes in the water level of Falcon Creek and shallow groundwater (water table) level elevation data at Monitoring Well MW-6-Shallow uniformly correspond with storm events where precipitation was generally greater than 10 mm/day and snow melt events in January and March, 2014.

2. The shallow groundwater will slowly flow towards Falcon Creek at very low rates of approximately 4 cm/year as there is an approximate 3 to 4 m hydraulic head difference between the water table at MW-6-Shallow and Falcon Creek.

3. Based on the data collected over 10 months, the potentiometric pressure from the interface of the clay-based aquitard and the underlying shale aquitard is greater than the water table elevation approximately 50% of the time. This vertically upward groundwater pressure is evident in (a) the drier late-spring and summer season, and (b) the dry winter season of 2013/2014. The source of the upward vertical hydraulic gradients is likely where the Queenston Shale is exposed near surface up-slope of the site near the base of the Niagara Escarpment as is documented by Karrow (1963). During the wetter seasons and after significant storm events, the water table has a higher elevation than the potentiometric surface at depth and the water table is slowly recharging the underlying clay-based aquitard and shale aquitard at very slow rates at velocities of approximately 2 cm/year.

4. There is little to no base flow from the shale bedrock to Falcon Creek during the drier seasons when vertically upward hydraulic gradients are present as is referenced above because an

approximate 5 m-thick layer of tight clay-based soils is present beneath Falcon Creek (see the cross-section of Figure 3).

5. The potentiometric surface of the interface of the clay-based aquitard and the underlying shale aquitard at MW-6-Deep is not synchronized or "in-step" with the storm events described above indicating confining groundwater conditions at depth.

Figure 6, Indian Creek Area Hyetograph (near the northeast corner of the proposed development):

1. The linear spikes in the water level of Indian Creek and shallow groundwater (water table) level elevation data at Monitoring Well MW-8-Shallow uniformly correspond with storm events where precipitation was generally greater than 10 mm/day and snow melt events in January and March, 2014.

2. The shallow groundwater will slowly flow towards Indian Creek at very low rates of approximately 4 cm/year as there is an approximate 2 m hydraulic head difference between the water table at MW-8-Shallow and Indian Creek.

3. Based on the data collected over 10 months, the potentiometric pressure from the interface of the clay-based aquitard and the underlying shale aquitard is continuously less than the water table elevation indicating vertically downward groundwater pressure or very slow groundwater recharge conditions to the underlying shale bedrock at velocities of approximately 2 cm/year.

4. There is no base flow from the shale bedrock to Indian Creek as vertically downward hydraulic gradients are present as is referenced above and because an approximate 6 m-thick layer of tight clay-based soils is present beneath Indian Creek (see the cross-section of Figure 3 and Borehole Logs 1, 2 and 3 in Appendix 1).

5. The potentiometric surface of the interface of the clay-based aquitard and the underlying shale aquitard at MW-8-Deep is not synchronized or "in-step" with the storm events described above indicating confining groundwater conditions at depth.

6. The very slow upward trend in the potentiometric surface observed at MW-6-Deep from September 27, 2013 to approximately November 27, 2014 represents both a regional-based increase in the groundwater potentiometric surface, and the full recovery of a bailer withdrawal test completed on September 17, 2013 when approximately 0.6 m of groundwater was vacated from the monitoring well for the hydraulic conductivity test (see test results for MW-8-D in Appendix 2). The hydraulic conductivity test results at MW-8-Deep were 3.24×10^{-9} m/sec as is presented in Table 1. The interface of the clay-based aquitard and the underlying shale aquitard exhibits very low permeability conditions based on these observations and data.

Remaining Hyetographs and Staff Gauge Rating Curves

Hyetographs are presented in Appendix 4 for Monitoring Wells MW-3, MW-4 and MW-5. It should be noted that the water table at MW-4, which is located at the base of the Ancestral Glacial Lake Iroquois Shoreline, is basically at surface for most of the year.

Hyetographs and staff gauge flow rating curves for the three creek inflow and outflow locations and the hyetograph for the pond located on the tributary of Grindstone Creek are presented in Appendix 5. The rating curves generated in Appendix 5 are observed to have high R^2 values ranging between 0.85 and 0.98, indicating a strong relationship between the creek flow measurements and water level elevations measured at the staff gauges. R^2 (the coefficient of determination) is an indicator of the strength (i.e. goodness of fit) of the linear equation that predicts the value of one variable as a function of one or more variables.

7.0 Surface Water Quality

Per the *Terms of Reference* for the study, the inflow and outflow locations for the three creeks were sampled for a variety of water quality parameters including herbicides and pesticides. Surface water quality was sampled during high flow conditions on April 10, 2014 and during low flow conditions on July 17, 2014. Results are presented on Table 3 and laboratory Certificates of Analysis are presented in Appendix 6.

Results indicate elevated concentrations of chloride from the application of road salt for deicing. Low concentrations of the pesticide atrazine were detected at the inflow and outflow points of the three creeks for the July, 2014 sampling event. Total phosphorus and iron concentrations were elevated throughout the three watersheds. A number of naturally occurring metals were detected that likely originate from the Halton Till on-site or the Queenston Shale as described by Armstrong (2001) upstream of the site where the creek comes in contact with the shale and where the creek flows over the lower sections of the Niagara Escarpment.

8.0 Water Balance, Pre-Development and Post-Development Conditions

The principles of a water balance assessment are presented in the Hamilton-Halton Source Protection report (2010). In summary, a water balance consists of various inputs of water into the system, various outputs of water from the system and changes in storage. The water balance or budget components can be represented as follows:

INPUTS = OUTPUTS +/- CHANGE IN STORAGE

According to the above equation, water inputs into the subwatershed or subwatersheds will be balanced by the outputs and the changes in storage within the subwatershed or subwatersheds. It is reasonable to assume the changes in storage will be negligible over a long period of time. In addition, there are no groundwater users in the study area as the surrounding subdivisions are on municipally-supplied water, hence there is no man-made cause to affect or withdraw groundwater out of storage. Therefore, the water balance equation can be simplified to:

INPUTS = OUTPUTS *Equation 1*

In hydrologic terms, this equation can be written as

P – AET + R + RO *Equation 2*

where:

> P = Total Precipitation (millimetres (mm));
> AET = Actual Evapotranspiration (mm);
> R = Recharge (mm); and
> RO = Total Runoff (mm).

or:

$$RO = P - (AET + R)$$ *Equation 3*

Water balance parameters were available for this area of Burlington from Hamilton-Halton Source Protection (HHSP) (2010). Data are provided in Appendix 7 along with a storm water management map from Metropolitan Consulting Inc. which shows the primary drainage direction will be to Indian Creek. Table 2.2 of the Source Protection report for the Indian Creek watershed provided precipitation (P) and actual evapotranspiration (AET) rates of 907 and 533 mm/year, respectively based on an evaluation of precipitation and AET from 1989 to 1997. This 2010 Source Protection report also presented a range in groundwater recharge values for the subdivision area of Waterdown of approximately 120 and 160 mm/year from Figure 2.12 of the Source Protection report. The lower end value of 120 mm/year for recharge was selected based on the results of the on-site drilling program and *in situ* hydraulic conductivity test results which indicate very low permeability overburden deposits. Runoff was calculated as the difference between precipitation less actual evapotranspiration less recharge (see Equation 3).

The development consisting of 33.44 hectares was subject to the water balance assessment that is presented in Appendix 7. An assessment of pre- and post-development scenarios comparing percent pervious and percent imperviousness for the above referenced water balance factors was completed. Metropolitan Consulting Inc. has prepared a stormwater management report pertaining to percent impervious and percent previous for the development. An engineering drawing pertaining to the development is also presented in Appendix 7. Percent imperviousness calculations, as a function of area, are presented in Table 1 of Appendix 7. The above referenced water balance factors are presented in Table 2 of Appendix 7.

Table 3 of Appendix 7 compares pre- and post-development water balance calculations for the 33.44 hectare area. The loss of recharge from the development was calculated to be approximately 20,064 m^3/year which equates to the loss of approximately 0.64 Litres/sec of recharge to the Queenston Shale aquitard. This loss of recharge value would be considered a negligible amount in an aquitard setting that discharges to Hamilton Harbour/Lake Ontario.

9.0 Conclusions and Recommendations

8.1 Conclusions

The following conclusions are provided:

1. The Penta Properties Inc. development is underlain by 7 to 11 m of very low permeability silty clay and clay-based glacial till (Halton Till) deposits with isolated and discontinuous lenses or pockets of silt and silty sand. The topographically higher areas of the northern section of the property are associated with a ridge of the ancestral Glacial Lake Iroquois shoreline.

2. The silty clay and clay-based till deposits form an aquitard resulting in “flashy” surface water runoff conditions. The overburden deposits overlie a shale bedrock (Queenston Shale Formation) which is both laterally extensive and thick. On the eastern sections of the proposed development, the overburden deposits slowly recharge the bedrock with an average linear groundwater velocity that is less than 2.0 cm/year. On the western sections of the proposed development, the overburden deposits slowly recharge the bedrock as noted above for approximately 50% of the year whereas during the drier seasons, a vertically upward hydraulic gradient is present which restricts the downward movement of groundwater from the overburden deposits to the shale bedrock, which is also considered a regional aquitard. The upper elevation of the shale aquitard dips to the south towards Hamilton Harbour, which is also the likely prominent flow direction of groundwater in the bedrock.

3. Indian and Falcon Creeks and a tributary of Grindstone Creek flow from north to south across the subject lands but the developable section of the property is almost entirely within the Indian Creek watershed. Indian Creek was historically altered into a straight channel to optimize past land use for agricultural purposes.

4. Flow in the creeks respond quickly to precipitation events and hydrographs and rating curves are presented in appendices herein. Flow in the creeks has little to no influence from groundwater sources within the proposed development area of the site. A total of 4 to 5 m of low permeability clay-based deposits are located beneath Indian and Falcon Creeks which are in turn underlain by approximately 120 m of low permeability shale of the Queenston Formation.

5. Groundwater flow in the clay-based overburden deposits is generally southward towards Hamilton Harbour and localized groundwater flow at very slow velocities of approximately 4 cm/year occurs towards both Indian and Falcon Creeks.

6. Baseline surface water quality results from both high and low flow conditions indicate the presence of elevated concentrations of chloride from the application of road salt for deicing on Highway 403. Total phosphorus and iron concentrations were elevated throughout the three watersheds. A number of naturally occurring metals were detected that likely originate from the Halton Till on-site or the Queenston Shale upstream of the site.

7. A comparison of pre- and post-development water balance calculations show that the impervious surfaces of the development within the footprint of the proposed development should have a negligible impact on the function of the Indian Creek and Falcon Creek. Approximately 20,000 m^3/year of groundwater recharge will be diverted as runoff to a stormwater retention pond that will act as a recharge zone to the underlying bedrock aquifer. On a regional scale, the diversion of 20,000 m^3/year of groundwater recharge could result in a decrease of approximately 0.64 Litres/sec of recharge to the shale bedrock aquitard and subsequently Hamilton Harbour and Lake Ontario. This loss of recharge value would be considered a negligible amount on a regional scale.

9.2 Recommendations

The following recommendations are provided for your consideration.

1. The use of low-impact development (LID) techniques to enhance groundwater recharge will likely be ineffective at the proposed development owing to the presence of the very low permeability silty clay and clay-based till overburden aquitard and are not recommended as they will create ponding and pooling with limited ability for infiltration.

2. Groundwater protection should include the standard methods of primary and secondary containment for the storage of petroleum products and other chemicals that would be found within a commercial development.

3. Groundwater monitoring wells MW-1 through MW-8 are within the construction area of the proposed development. They should be decommissioned by a Ministry of the Environment-licensed water well contractor per Regulation 903 of the Ontario Water Resources Act.

We trust this information is sufficient to satisfy your present needs. If you have any questions, please do not hesitate to contact me at 905-646-7931 or via email at dslaine@terra-dynamics.com.

Yours truly,

TERRA-DYNAMICS CONSULTING INC.

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<u>Attachments</u>
Table 2. Groundwater and Surface Water Level/Elevation Measurements
Table 3. Water Quality Monitoring Results for Indian Creek, Falcon Creek and a Tributary of Grindstone Creek

Figure 1. Location of Subject Lands
Figure 2. Base Map
Figure 3. Geologic Section
Figure 4. Groundwater Flow Map
Figure 5. Hyetograph – Comparison of Water Level Elevations at MW-6-D, MW-6-S and Falcon Creek and Precipitation Values
Figure 6. Hyetograph – Comparison of Water Level Elevations at MW-8-D, MW-8-S and Indian Creek and Precipitation Values

Appendix 1. Borehole Logs
Appendix 2. Hydraulic Conductivity Tests Analyses
Appendix 3. Groundwater Velocity Calculations
Appendix 4. Hyetographs Monitoring Wells MW-3, MW-4 and MW-5
Appendix 5. Hyetographs for Creek Inflow and Outflow Staff Gauge Locations and Associated Rating Curves
Appendix 6. Water Quality Certificates of Analysis
Appendix 7. Water Balance

10.0 References

Armstrong, D.K. 2001. A regional evaluation of the shale resource potential of the Upper Ordovician Queenston Formation, Southern Ontario. Ontario Geological Survey, Open File Report 6058, 148 p.

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Hamilton-Halton Source Protection. 2010, August 27. Report on Tier 1 Water Budget and Water Quantity Stress Assessment for Hamilton-Halton Source Protection and Report on Tier 2 Water Budget and Quantity Stress Assessments for the Upper Branch of Sixteen Mile Creek and Middle Spencer Creek Subwatersheds.

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Soil Mat Engineers and Consultants. 2011. Preliminary Geotechnical Investigation, Proposed Stadium/Commercial Development, King Road and Highway 403, Burlington (Aldershot), Ontario. Prepared for Paletta International Corporation, January 24, 2011.

Table 2. Groundwater and Surface Water Level and Elevation Measurements

Well I.D	Ground Elevation (masl)	Stick-up (m)	TOC Elevation (masl)	Northing	Easting	Sept 17/13		Dec 4/13		Jan 12/14	
						Depth TOC (m)	Elevation (masl)	Depth TOC (m)	Elevation (masl)	Depth TOC (m)	Elevation (masl)
MW 1	104.99	0.89	105.88	4797733	593906	1.41	104.47	0.97	104.91	FRZ	---
MW 2	104.13	0.88	105.01	4797658	594070	2.09	102.92	1.37	103.64	1.29	103.72
MW 3	103.85	0.88	104.73	4797485	593946	1.45	103.28	0.97	103.76	FRZ	---
MW 4	106.01	0.85	106.86	4797367	593688	2.23	104.63	1.03	105.83	FRZ	---
MW 5	104.66	1.01	105.67	4797133	593650	5.53	100.14	2.71	102.96	2.31	103.36
MW 6 S	112.67	0.86	113.53	4797241	593464	3.65	109.88	2.76	110.77	2.08	111.45
MW 6 D	112.67	0.60	113.27	4797246	593462	3.89	109.38	2.20	111.07	1.84	111.43
MW 7	112.60	0.91	113.51	4797419	593593	2.71	110.8	2.12	111.39	1.87	111.64
MW 8 S	111.61	0.92	112.53	4797588	593684	3.92	108.61	3.53	109.00	3.55	108.98
MW 8 D	111.45	0.95	112.40	4797586	593686	6.68	105.72	3.99	108.41	3.86	108.54

Well I.D	Ground Elevation (masl)	Stick-up (m)	TOC Elevation (masl)	Northing	Easting	Apr 9/14		July 17/14	
						Depth TOC (m)	Elevation (masl)	Depth TOC (m)	Elevation (masl)
MW 1	104.99	0.89	105.88	4797733	593906	0.99	104.89	1.26	104.62
MW 2	104.13	0.88	105.01	4797658	594070	1.02	103.99	1.72	103.29
MW 3	103.85	0.88	104.73	4797485	593946	0.96	103.77	1.41	103.32
MW 4	106.01	0.85	106.86	4797367	593688	1.13	105.73	1.28	105.58
MW 5	104.66	1.01	105.67	4797133	593650	1.89	103.78	2.96	102.71
MW 6 S	112.67	0.86	113.53	4797241	593464	1.82	111.71	3.33	110.20
MW 6 D	112.67	0.60	113.27	4797246	593462	1.78	111.49	2.57	110.70
MW 7	112.60	0.91	113.51	4797419	593593	1.59	111.92	2.53	110.98
MW 8 S	111.61	0.92	112.53	4797588	593684	3.96	108.57	3.78	108.75
MW 8 D	111.45	0.95	112.40	4797586	593686	4.19	108.21	4.14	108.26

Notes: TOC = Top of Casing; m = metres; masl = metres above sea level

Table 2. Groundwater and Surface Water Level and Elevation Measurements

Drive Point I.D	TOC Elevation (masl)	Northing	Easting	Sept 20/13		Nov 1/13		Dec 4/13	
				Depth TOC (m)	Elevation (masl)	Depth TOC (m)	Elevation (masl)	Depth TOC (m)	Elevation (masl)
Indian Creek Inflow- East	107.56	4797706	593779	0.54*	107.02	0.47	107.09	0.51	107.05
Indian Creek Inflow- West	106.95	4797644	593751	0.31	106.64	0.22	106.73	0.16	106.79
Indian Creek Outflow	103.37	4797525	593975	0.28	103.09	0.21	103.16	0.26	103.11
Falcon Creek Inflow	107.66	4797096	593392	0.42	107.24	0.36	107.3	0.37	107.29
Falcon Creek Outflow	103.37	4797022	593633	0.73*	Dry	0.36	103.01	0.42	102.95
Grindstone Creek Inflow	111.37	4796771	592986	0.24	111.13	0.23	111.14	0.23	111.14
Grindstone Creek Outflow	109.20	4796651	593164	0.52*	Dry	0.43	108.77	0.49	108.71
Grindstone Creek Pond	110.63	4796709	593144	0.41*	Dry	0.27	110.36	0.35	110.28

Drive Point I.D	TOC Elevation (masl)	Northing	Easting	Jan 12/14		Apr 9/14		July 17/14	
				Depth TOC (m)	Elevation (masl)	Depth TOC (m)	Elevation (masl)	Depth TOC (m)	Elevation (masl)
Indian Creek Inflow- East	107.56	4797706	593779	0.49	107.07	0.51	107.05	Dry	Dry
Indian Creek Inflow- West	106.95	4797644	593751	-0.04	106.99	0.16	106.79	0.14	106.81
Indian Creek Outflow	103.37	4797525	593975	0.04	103.33	0.04	103.33	0.06	103.31
Falcon Creek Inflow	107.66	4797096	593392	0.06	107.60	0.31	107.35	0.42	107.24
Falcon Creek Outflow	103.37	4797022	593633	-0.10	103.47	0.35	103.02	0.48	102.89
Grindstone Creek Inflow	111.37	4796771	592986	0.19	111.18	0.28	111.09	0.25	111.12
Grindstone Creek Outflow	109.20	4796651	593164	0.30	108.90	0.43	108.77	Dry	Dry
Grindstone Creek Pond	110.63	4796709	593144	0.25	110.38	0.28	110.35	Dry	Dry

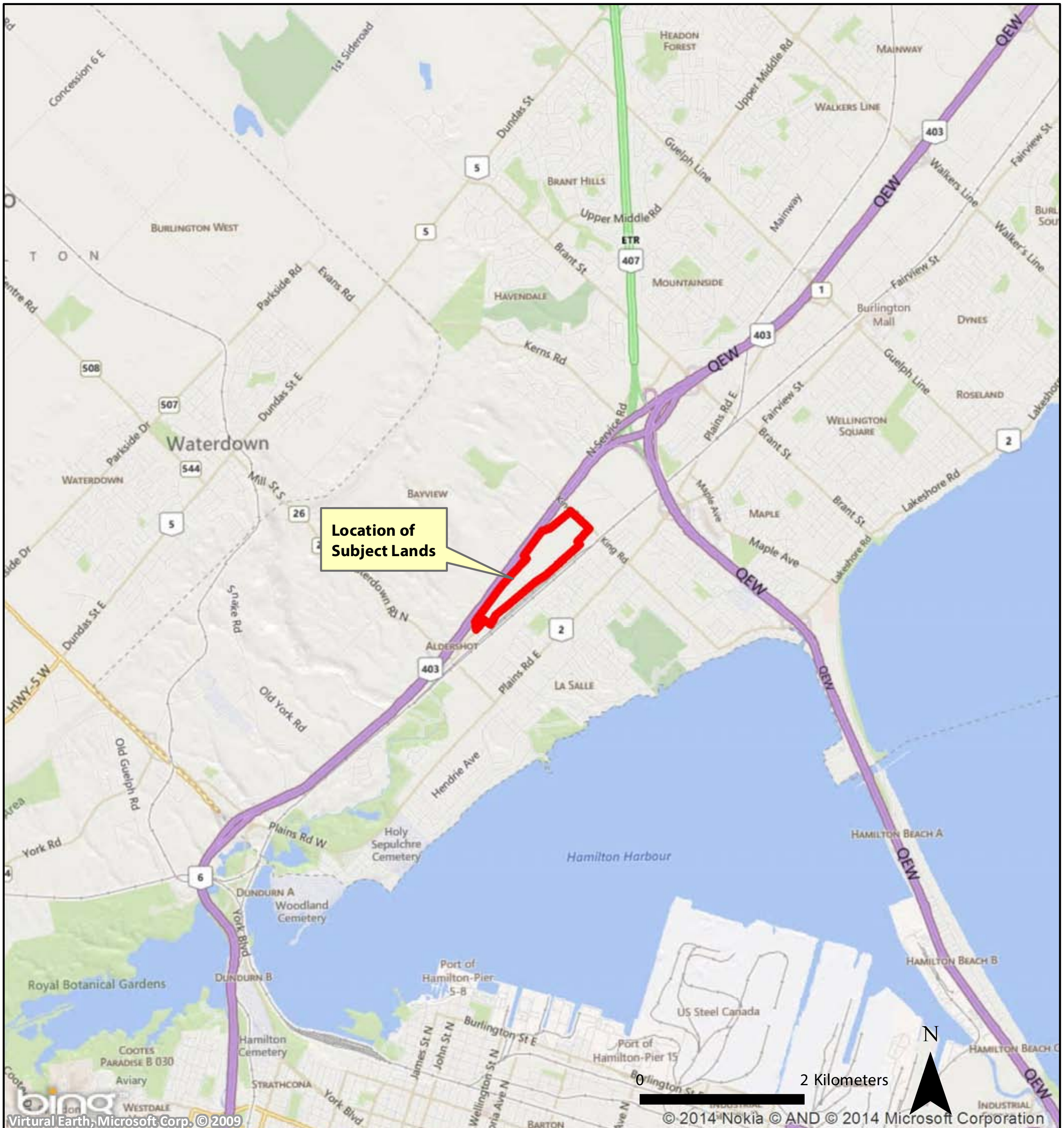
Notes: *= Dry, No flowing water present at SG
TOC= Top of Casing

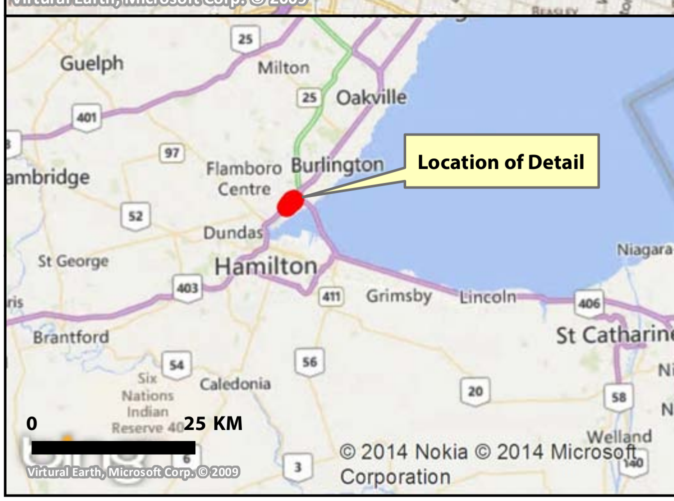
Table 3. Surface Water Quality of the Inflow and Outflow Locations of Indian Creek, Falcon Creek and the Tributary of Grindstone Creek

Parameter	Units	PWQO	Indian Creek Inflow West		Indian Creek Inflow East		Indian Creek Outflow		Falcon Creek Inflow		Falcon Creek Outflow		Grindstone Creek Inflow		Grindstone Creek Outflow	
Sample Date			2014-04-10	2014-07-17	2014-04-10	2014-07-17	2014-04-10	2014-07-17	2014-04-10	2014-07-17	2014-04-10	2014-07-17	2014-04-10	2014-07-17	2014-04-10	2014-07-17
Temperature	°C		9.3	21.6	8.4	DRY	9.1	21	11.1	18	10.5	19	9.4	18.5	13.4	21.8
Dissolved Oxygen	mg/L		10.8	7.05	10.6	DRY	10.3	7.58	11.1	9.75	11.1	10.89	10.5	6.97	9.8	8.06
pH	units	6.5-8.5	8.14	8.05	8.32	DRY	8.15	8.05	8.29	8.39	8.30	8.41	8.09	8.22	8.03	8.18
Conductivity	us/cm		1141	1415	1775	DRY	1237	1335	557	1361	772	1219	7400	1000	2065	1256
Total Suspended Solids	mg/L		149	15	13	DRY	72	18	53	8	39	12	23	55	9	6
NH3+NH4	as N mg/L		0.4	0.2	0.1	DRY	< 0.1	< 0.1	< 0.1	0.2	< 0.1	< 0.1	0.1	0.2	< 0.1	0.2
TKN	as N mg/L		< 0.5	< 0.5	< 0.5	DRY	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.5
Chloride	mg/L	120 (640)*	190	170	390	DRY	200	160	110	230	120	210	450	160	630	340
Sulphate	mg/L		190	420	71	DRY	190	410	48	120	47	110	37	70	32	39
Nitrite	as N mg/L		< 0.03	< 0.03	< 0.03	DRY	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.03	< 0.03	< 0.03
Nitrate	as N mg/L	3.0*	0.95	0.76	0.19	DRY	0.90	0.70	0.20	< 0.06	0.21	0.10	0.29	0.56	< 0.06	0.11
NO2+NO3	as N mg/L		0.95	0.76	0.19	DRY	0.90	0.70	0.20	< 0.06	0.21	0.10	0.29	0.59	< 0.06	0.11
Hardness	mg/L CaCO3		361	511	453	DRY	365	497	277	417	271	420	295	366	311	162
Silver	mg/L	0.0001	< 0.000002	< 0.000002	0.000007	DRY	< 0.000002	< 0.000002	0.000003	< 0.000002	0.000005	< 0.000002	0.000005	< 0.000002	0.000005	< 0.000002
Aluminum (total)	mg/L	0.075	6.68	0.55	0.39	DRY	4.78	0.62	1.69	0.27	1.70	0.41	2.26	2.57	0.54	0.11
Arsenic (total)	mg/L	0.005	0.0030	0.0020	0.0009	DRY	0.0016	0.0019	0.0010	0.0013	0.0008	0.0015	0.0012	0.0026	0.0006	0.0021
Barium (total)	mg/L		0.0932	0.0941	0.106	DRY	0.0829	0.0921	0.0548	0.0809	0.0503	0.0810	0.0712	0.0823	0.0660	0.0358
Beryllium (total)	mg/L	1.1	0.000317	0.000021	0.000014	DRY	0.000169	0.000022	0.000070	0.000007	0.000054	0.000013	0.000054	0.000087	0.000021	< 0.000007
Boron (total)	mg/L	0.2	0.330	0.725	0.167	DRY	0.308	0.688	0.0569	0.238	0.0544	0.232	0.0394	0.114	0.0302	0.0632
Bismuth (total)	mg/L		0.000022	< 0.000007	< 0.000007	DRY	< 0.000007	< 0.000007	0.000008	< 0.000007	< 0.000007	< 0.000007	0.000009	< 0.000007	0.000010	< 0.000007
Calcium (total)	mg/L		108	157	127	DRY	109	153	72.6	103	70.4	106	81.9	88.0	87.9	38.6
Cadmium (total)	mg/L	0.0002	0.000083	< 0.000003	0.000018	DRY	0.000044	< 0.000003	0.000004	0.000007	0.000004	0.000006	< 0.000004	0.000063	< 0.000004	0.000012
Cobalt (total)	mg/L	0.0009	0.00393	0.000407	0.000371	DRY	0.00176	0.000416	0.000920	0.000325	0.000691	0.000391	0.000585	0.00156	0.000279	0.000393
Chromium (total)	mg/L	0.0089	0.00689	0.00081	0.00087	DRY	0.00433	0.00096	0.00157	0.00074	0.00146	0.00070	0.00278	0.00425	0.00187	0.00291
Copper (total)	mg/L	0.005	0.0167	0.00192	0.00264	DRY	0.00591	0.00164	0.00254	0.00343	0.00185	0.00296	0.00371	0.00777	0.00690	0.00451
Iron (total)	mg/L	0.3	5.15	0.485	0.398	DRY	3.43	0.535	1.60	0.242	1.40	0.348	1.38	2.69	0.473	0.188
Potassium (total)	mg/L		14.0	20.0	11.5	DRY	13.2	19.3	4.86	11.4	4.87	10.3	6.51	11.8	6.53	9.12
Lithium (total)	mg/L		0.0526	0.106	0.0143	DRY	0.0458	0.0994	0.00768	0.0282	0.00717	0.0251	0.00988	0.0429	0.00625	0.0136
Magnesium (total)	mg/L		22.4	28.7	33.0	DRY	22.9	28.1	23.4	38.7	23.1	37.8	22.1	35.6	22.2	15.9
Manganese (total)	mg/L		0.111	0.0317	0.0195	DRY	0.0712	0.0282	0.0854	0.0677	0.0470	0.0248	0.0611	0.206	0.0560	0.0397
Molybdenum (total)	mg/L	0.04	0.00677	0.0171	0.00113	DRY	0.00581	0.0162	0.00042	0.00237	0.00044	0.00245	0.00253	0.00488	0.00201	0.00369
Sodium (total)	mg/L		112	109	209	DRY	113	101	68.5	124	69.6	113	206	70.0	312	173
Nickel (total)	mg/L	0.025	0.0109	0.0025	0.0028	DRY	0.0063	0.0025	0.0030	0.0025	0.0026	0.0024	0.0032	0.0049	0.0029	0.0045
Phosphorus (total)	mg/L	0.03	0.125	0.035	0.052	DRY	0.105	0.032	0.090	0.027	0.068	0.054	0.146	0.243	0.093	0.072
Lead (total)	mg/L	0.025	0.00231	0.00066	0.00046	DRY	0.00153	0.00034	0.00096	0.00080	0.00048	0.00028	0.00178	0.00460	0.00079	0.00092
Antimony (total)	mg/L	0.02	< 0.0002	0.0003	0.0002	DRY	< 0.0002	0.0004	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0002	< 0.0002	0.0002	< 0.0002
Selenium (total)	mg/L	0.1	0.005	0.001	< 0.001	DRY	0.009	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001	< 0.001	0.001	< 0.001
Silicon (totall)	mg/L		16.6	2.81	3.79	DRY	12.7	3.06	5.81	2.73	5.99	3.16	7.57	10.1	3.17	0.70
Tin (total)	mg/L		0.00022	0.00021	0.00015	DRY	0.00021	0.00023	0.00010	0.00043	0.00016	0.00026	0.00039	0.00048	0.00010	0.00045
Strontium (total)	mg/L		1.69	2.41	1.23	DRY	1.67	2.35	0.376	1.73	0.373	1.39	1.05	1.37	0.810	0.562
Titanium (total)	mg/L		0.146	0.0100	0.00810	DRY	0.0958	0.0118	0.0245	0.00545	0.0281	0.00718	0.0465	0.0619	0.0120	0.00205
Thallium (total)	mg/L	0.0003	0.000097	0.000279	0.000011	DRY	0.000051	0.000238	0.000014	< 0.000005	0.000012	0.000005	0.000022	0.000026	0.000005	< 0.000005
Uranium (total)	mg/L	0.005	0.00661	0.00777	0.00686	DRY	0.00604	0.00699	0.00159	0.00462	0.00156	0.00450	0.00148	0.00294	0.000808	0.000647
Vanadium (total)	mg/L	0.006	0.0111	0.00217	0.00097	DRY	0.00731	0.00210	0.00270	0.00092	0.00254	0.00132	0.00315	0.00661	0.00103	0.00097
Zinc (total)	mg/L	0.02	0.035	0.008	0.032	DRY	0.030	0.007	0.008	0.017	0.010	0.009	0.041	0.042	0.037	0.027
Total Coliform	cfu/100mL		2000	1180	680	DRY	1300	2700	460	2300	420	1740	43	56000	560	1480
e coli	cfu/100mL	100	1	78	15	DRY	2	113	3	308	4	480	3	2780	4	41

Table 3. Surface Water Quality of the Inflow and Outflow Locations of Indian Creek, Falcon Creek and the Tributary of Grindstone Creek

Parameter	Units	PWQO	Indian Creek Inflow West		Indian Creek Inflow East		Indian Creek Outflow		Falcon Creek Inflow		Falcon Creek Outflow		Grindstone Creek Inflow		Grindstone Creek Outflow	
Sample Date			2014-04-10	2014-07-17	2014-04-10	2014-07-17	2014-04-10	2014-07-17	2014-04-10	2014-07-17	2014-04-10	2014-07-17	2014-04-10	2014-07-17	2014-04-10	2014-07-17
Alachlor	µg/L		< 0.02	< 0.04	< 0.02	DRY	< 0.02	< 0.04	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Aldicarb	µg/L	1.0*	< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aldrin + Dieldrin	µg/L	0.001	< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aldrin	µg/L		< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dieldrin	µg/L		< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Atrazine + N-dealkyl	µg/L	1.8*	< 0.01	0.07	< 0.01	DRY	< 0.01	0.06	< 0.01	0.01	< 0.01	0.01	< 0.05	0.04	< 0.01	0.05
Atrazine	µg/L		< 0.01	0.05	< 0.01	DRY	< 0.01	0.03	< 0.01	0.01	< 0.01	0.01	< 0.01	0.02	< 0.01	0.03
Desethyl atrazine	µg/L		< 0.01	0.02	< 0.01	DRY	< 0.01	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.05	0.02	< 0.01	0.02
Azinphos-methyl	µg/L		< 0.02	< 0.04	< 0.02	DRY	< 0.02	< 0.04	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Bendiocarb	µg/L		< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Carbaryl	µg/L	0.2	< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Carbofuran	µg/L	1.8*	< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chlordane (total)	µg/L	0.06	< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
a-chlordane	µg/L		< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
g-chlordane	µg/L		< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Oxychlordane	µg/L		< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chlorpyrifos	µg/L	0.001	< 0.02	< 0.04	< 0.02	DRY	< 0.02	< 0.04	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Cyanazine	µg/L	2.0*	< 0.03	< 0.06	< 0.03	DRY	< 0.03	< 0.06	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Diazinon	µg/L	0.08	< 0.02	< 0.04	< 0.02	DRY	< 0.02	< 0.04	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
(DDT) + Metabolites	µg/L	0.003	< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
op-DDT	µg/L		< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
pp-DDD	µg/L		< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
pp-DDE	µg/L		< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
pp-DDT	µg/L		< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dimethoate	µg/L	6.2*	< 0.03	< 0.06	< 0.03	DRY	< 0.03	< 0.06	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Diuron	µg/L	1.6	< 0.03	< 0.06	< 0.03	DRY	< 0.03	< 0.06	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Heptachlor + Heptach	µg/L		< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Heptachlor	µg/L	0.001	< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Heptachlor epoxide	µg/L	0.001	< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Lindane	µg/L	0.01	< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Malathion	µg/L	0.1	< 0.02	< 0.04	< 0.02	DRY	< 0.02	< 0.04	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Methoxychlor	µg/L	0.04	< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Metolachlor	µg/L	3	< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Metribuzin	µg/L		< 0.02	< 0.04	< 0.02	DRY	< 0.02	< 0.04	< 0.02	< 0.02	< 0.02	< 0.02	< 0.05	< 0.02	< 0.02	< 0.02
Parathion	µg/L	0.008	< 0.02	< 0.04	< 0.02	DRY	< 0.02	< 0.04	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Phorate	µg/L		< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Prometryne	µg/L		< 0.03	< 0.06	< 0.03	DRY	< 0.03	< 0.06	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Simazine	µg/L	10	< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Temephos	µg/L		< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Terbufos	µg/L		< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Triallate	µg/L	0.24*	< 0.01	< 0.02	< 0.01	DRY	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Trifluralin	µg/L	0.2*	< 0.02	< 0.04	< 0.02	DRY	< 0.02	< 0.04	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
2,4-dichlorophenoxya	µg/L	4	< 0.19	< 0.38	< 0.19	DRY	< 0.19	< 0.38	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.48
2,4,5-T	µg/L		< 0.22	< 0.44	< 0.22	DRY	< 0.22	< 0.44	< 0.22	< 0.22	< 0.22	< 0.22	< 0.22	< 0.22	< 0.22	< 0.22
Bromoxynil	µg/L	5.0*	< 0.33	< 0.66	< 0.33	DRY	< 0.33	< 0.66	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33
Dicamba	µg/L	200	< 0.20	< 0.40	< 0.20	DRY	< 0.20	< 0.40	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Diclofop-methyl	µg/L	6.1*	< 0.40	< 0.80	< 0.40	DRY	< 0.40	< 0.80	< 0.40	< 0.40	< 0.40	< 0.40	< 0.40	< 0.40	< 0.40	< 0.40
Dinoseb	µg/L	0.05*	< 0.36	< 0.72	< 0.36	DRY	< 0.36	< 0.72	< 0.36	< 0.36	< 0.36	< 0.36	< 0.36	< 0.36	< 0.36	< 0.36
Picloram	µg/L	29*	< 1	< 2	< 1	DRY	< 1	< 2	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1





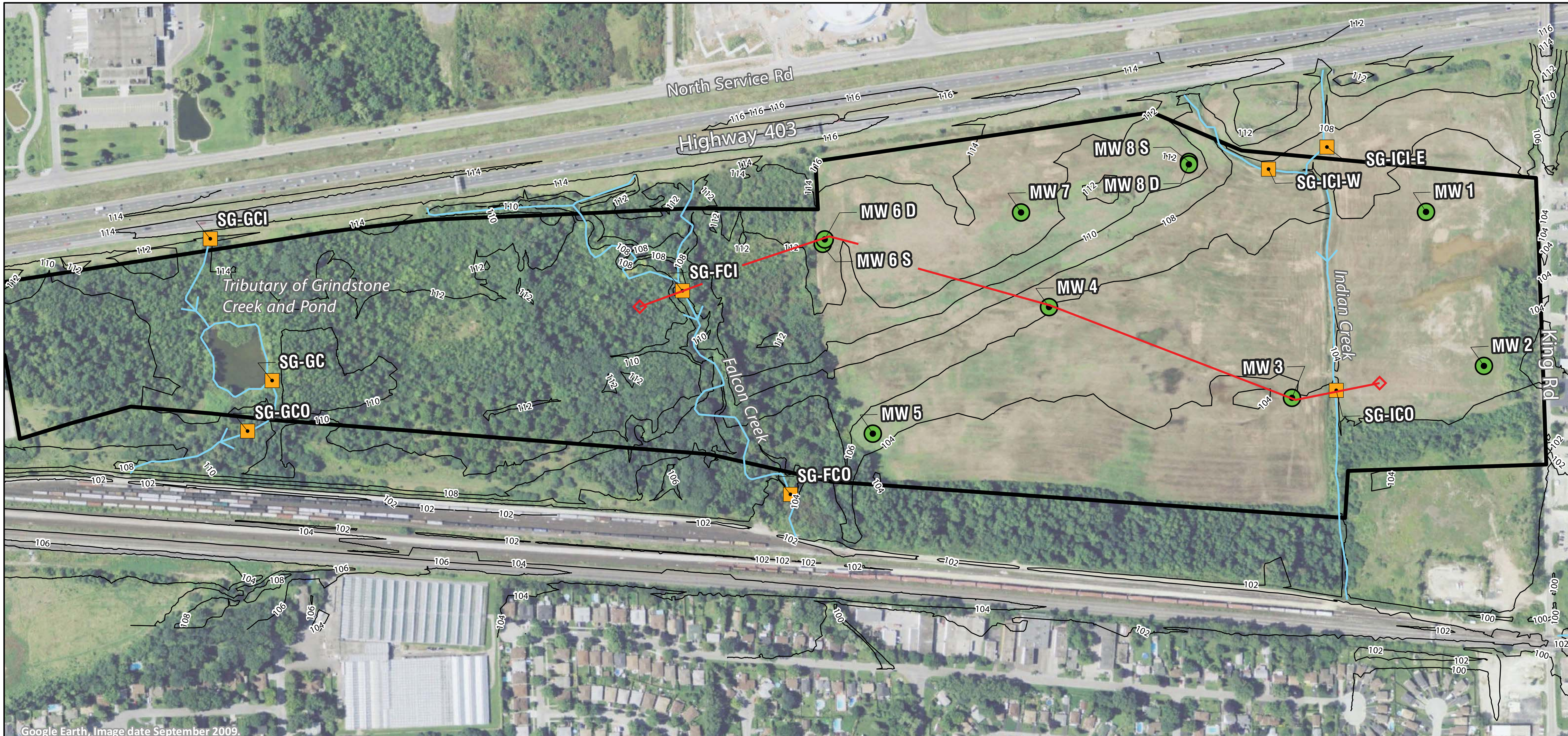
Location of Subject Lands

1200 King Road, Aldershot

Terra-Dynamics Consulting Inc.

Project No. 261	Figure 1

Path: H:\TERRA_DYNAMICS\8755 - Terra-Dynamics 261 1200 King Road Aldershot\gis\mxd\Figure 1 Location of Subject Lands.mxd   Revised: Wednesday, August 20, 2014



Property Boundary

Watercourse

MW6D Monitoring Well

SG-GCI Staff Gauge

Line of Geologic Cross-section

0 100 Meters

1:4,250

N

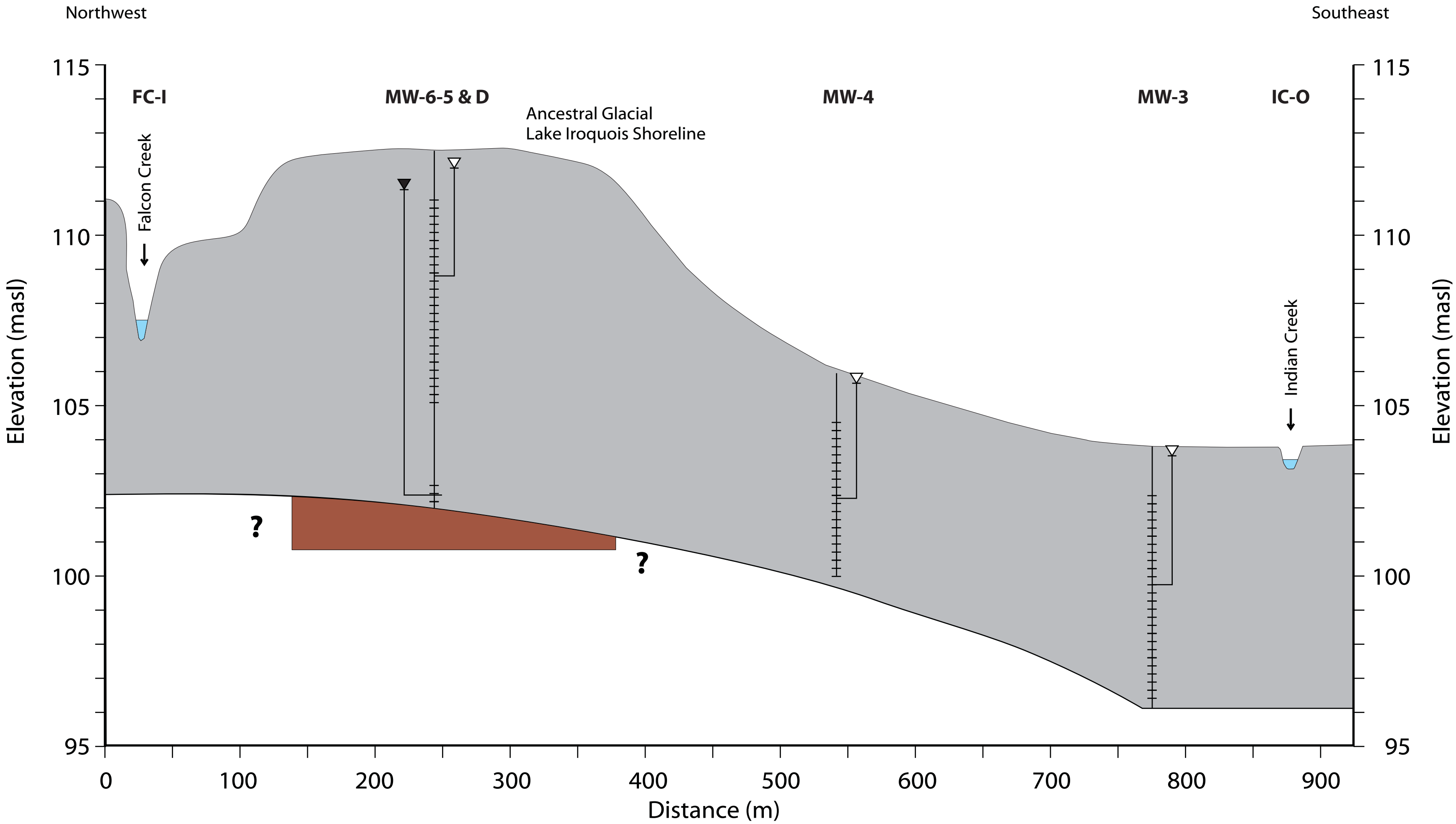
Base Map

1200 King Road, Aldershot

TDC Terra-Dynamics Consulting Inc.

Project No. 261	Figure 2

Path: H:\TERRA_DYNAMICS\8755 - Terra-Dynamics --- 1200 King Road Aldershot\gis\mxd\Base Map.mxd Date Saved: 2014-08-18 11:26:45 AM



Water Table

Potentiometric Groundwater Elevation (masl)

Well Screen

MW Monitoring Well

Glacial Clayey Silt Till, or Clayey Silt, or Silty Clay

Bedrock, Queenston Shale Formation

Groundwater and surface water elevations from April 9, 2014.

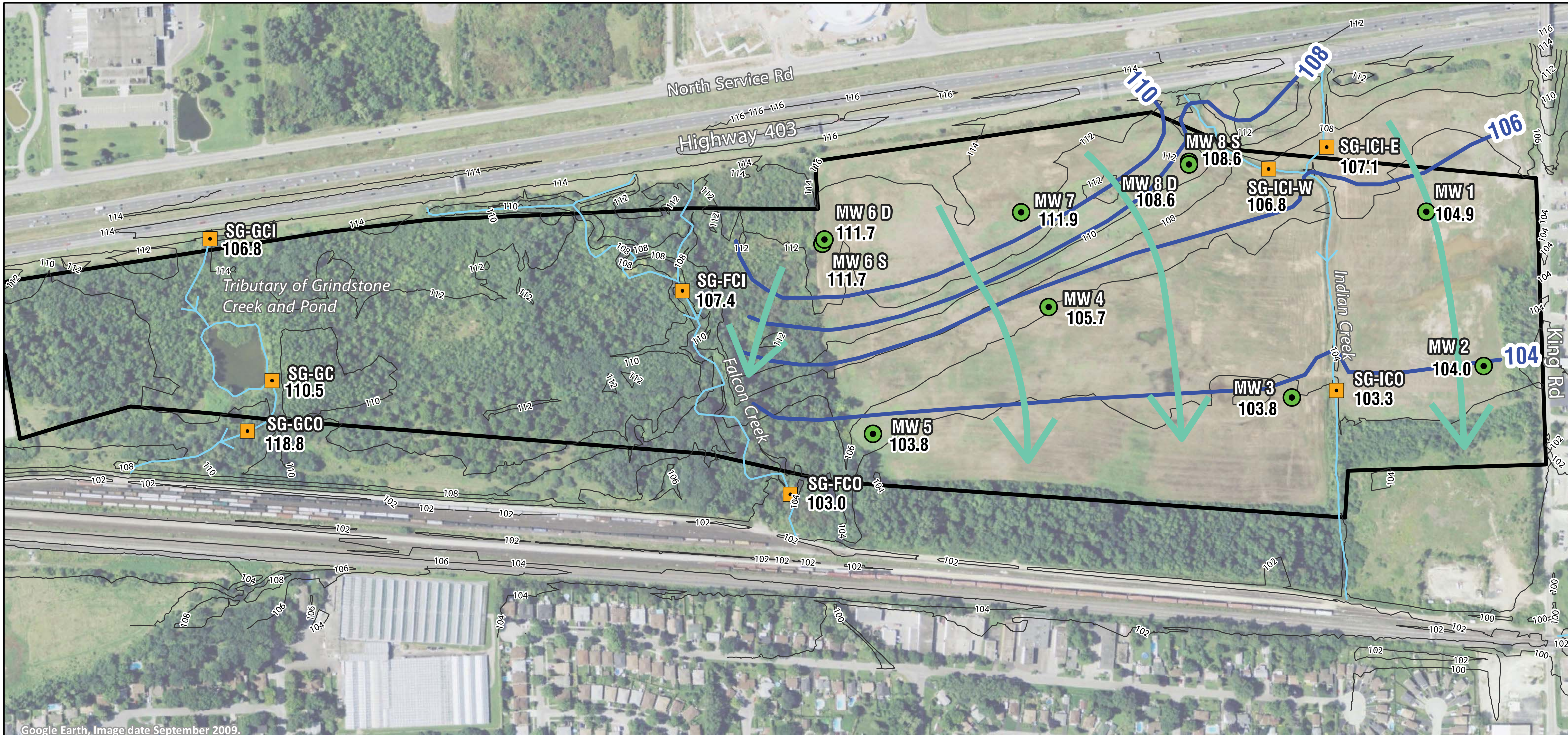
Geologic Cross-section

1200 King Road, Aldershot

TDC Terra-Dynamics Consulting Inc.

Project No.	Figure
261	3

Revised January 13, 2014 File:H:\TERRA_DYNAMICS\8686 - Terra-Dynamics 257 Losani Homes\corel\Figure 3 Geologic Cross-sections A-A'.cdr



Property Boundary

Watercourse

Water Table or Creek Elevation (masl) — MW6S 111.7 — Monitoring Well

SG-GCI 106.8 — Staff Gauge

Water Table Elevation Contour (masl)

Shallow Groundwater Flow Direction

Groundwater and staff gauge elevation data are from April 9, 2014.

N

0 — 100 M

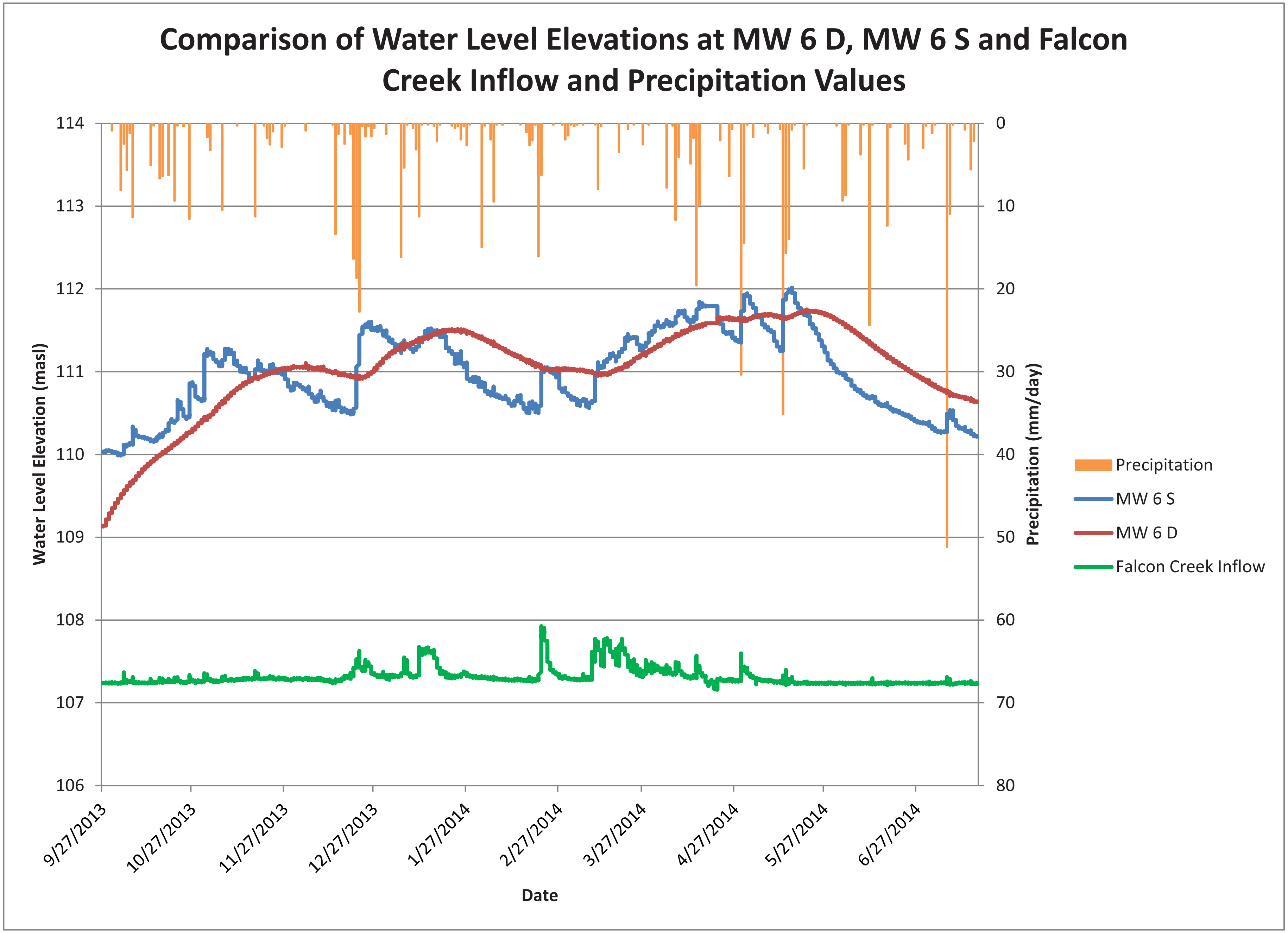
1:4,250

Groundwater Flow Directions Map

1200 King Road, Aldershot

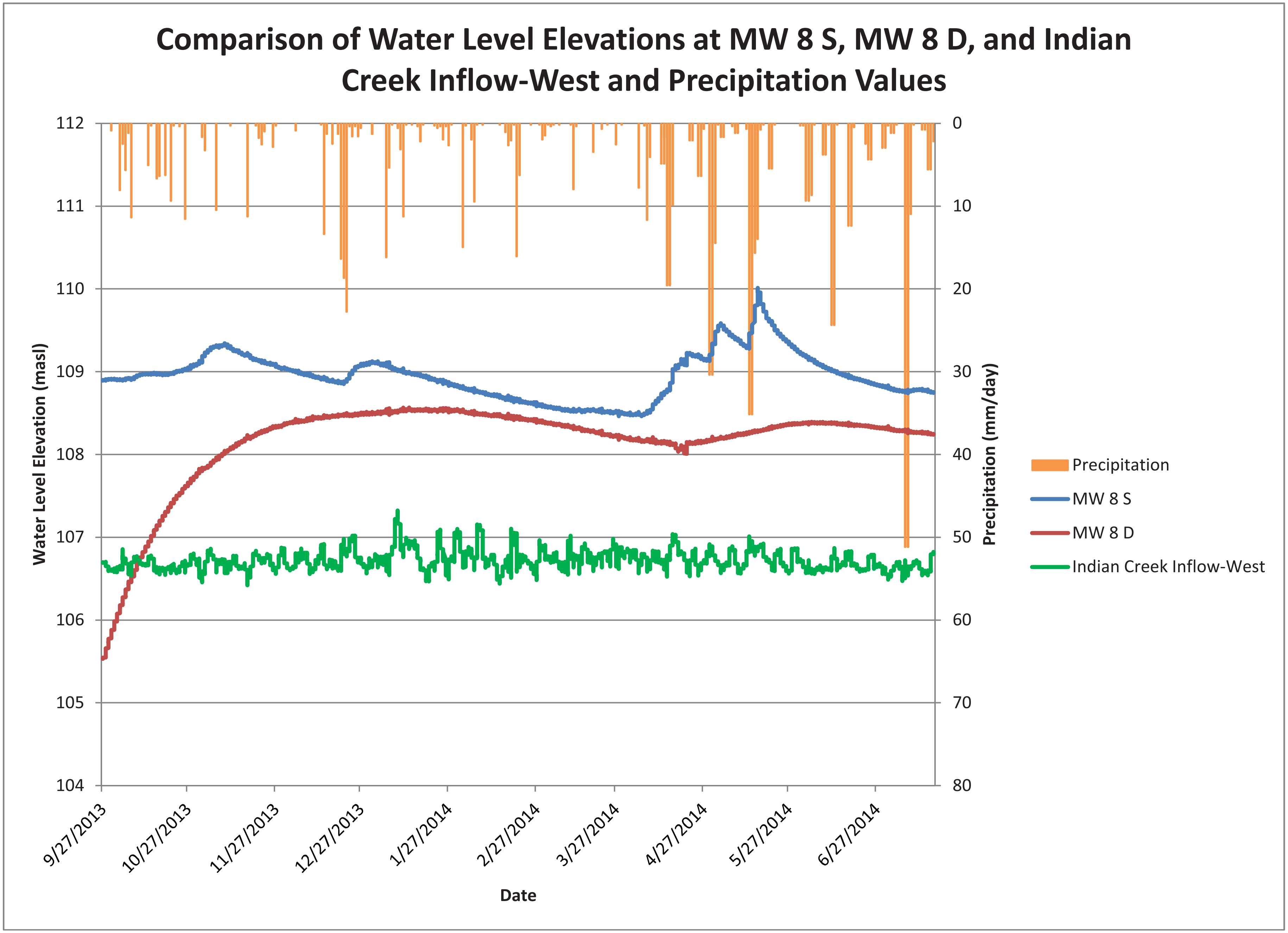
TDC Terra-Dynamics Consulting Inc.

Project No. 261	Figure 4



Terra-Dynamics Consulting Inc.

Figure 5



Terra-Dynamics Consulting Inc.

Figure 6

Appendix 1.

Borehole Logs and Monitoring Well Construction Details

TDC
Terra-Dynamics Consulting Inc
404 Queenston St.
St. Catharines, ON L2P 2Y2
905-646-7931

Log of Borehole: MW-1

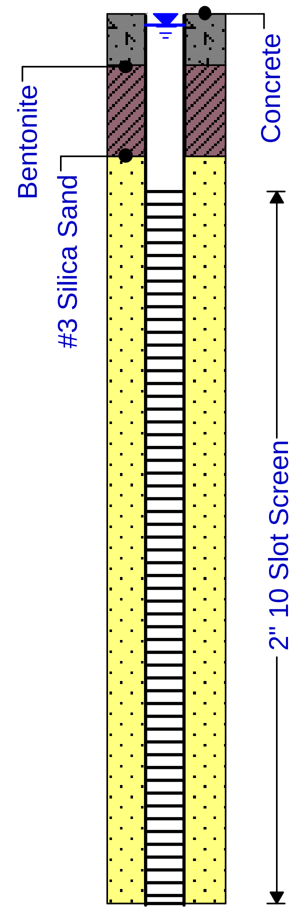
Project No.: 261

Project: 1200 King Road Hydrogeological Assessment

Client: Penta Properties Inc.

Location: Aldershot, ON ***Geologist:*** K. Slaine/D. Slaine

SUBSURFACE PROFILE				SAMPLE				
Depth (m)	Symbol	Description	Elev. (masl)	Number	Type	Recovery	Blows/Ft	Well Completion Details
		Ground Surface	104.99					
0.0		TOPSOIL - silty clay based	0.00	1		50	13	
1.0		SILTY CLAY - reddish brown turning wet at approximately 1.52 m, turning grey at approximately 3.05 m. There are a few small lenses of medium sand between 3.05 and 6.10 m. Very stiff to hard.		2		100	36	
3.0			101.94 3.05	3		100	29	
5.0				4		83	44	
6.0		SANDY SILT - brown, wet, hard	98.89 6.10	5		75	55	
7.0		SHALE - Queenston Formation, red, weathered .	97.67 7.32					
8.0								
9.0								
10.0								



Groundwater Level Apr 9/14

UTM Coordinates: 593906E, 4797733N ***Hole Size:*** 20.3 cm

Drill Method: Hollow Stem Augers ***Datum:*** 104.99 masl

Drill Date: August 14, 2013 ***Sheet:*** 1 of 1

Terra-Dynamics Consulting Inc
404 Queenston St.
St. Catharines, ON L2P 2Y2
905-646-7931

Log of Borehole: MW-2

Project No.: 261

Project: 1200 King Road Hydrogeological Assessment

Client: Penta Properties Inc.

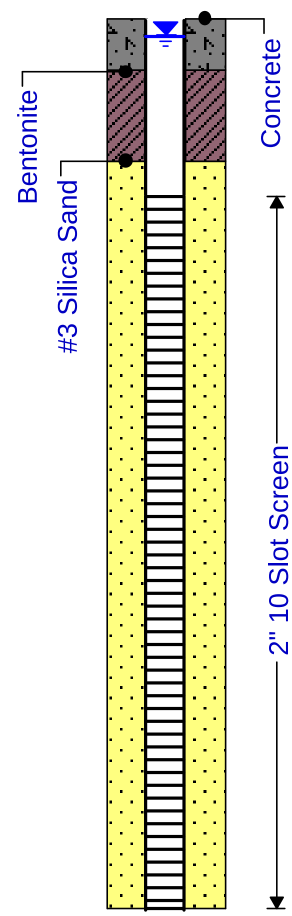
Location: Aldershot, ON

Geologist: K. Slaine/D. Slaine

Depth (m)	Description (Subsurface Profile)	Elev. (masl)	Sample Number	Type	Recovery	Blows/Ft
	Ground Surface	104.13				
0.00	TOPSOIL - silty clay based	104.13	1	‖	29	7
	SILTY CLAY TILL - Halton Till, reddish brown with trace of gravel, turning grey at approximately 2.13 m. Trace of gravel persists to bottom of borehole. Very stiff to hard.		2	‖	96	46
2.13		102.00	3	‖	100	21
			4	‖	63	20
			5	‖	100	40
7.62		96.51				

Depth scale (m): 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Well Completion Details



Groundwater Level Apr 9/14

UTM Coordinates: 594070E, 4797658N

Drill Method: Hollow Stem Augers

Drill Date: August 14, 2013

Hole Size: 20.3 cm

Datum: 104.13 masl

Sheet: 1 of 1

TDC
Terra-Dynamics Consulting Inc
404 Queenston St.
St. Catharines, ON L2P 2Y2
905-646-7931

Log of Borehole: MW-3

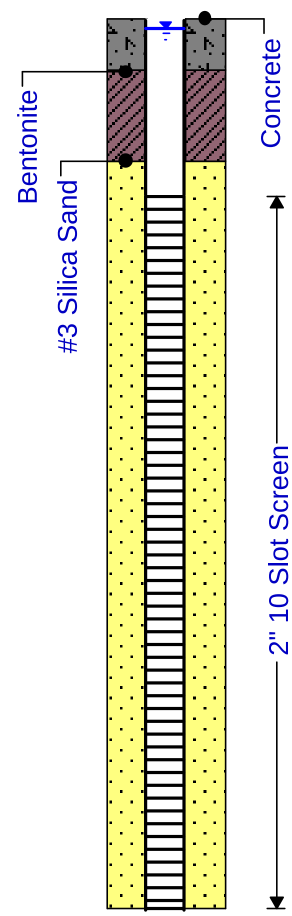
Project No.: 261

Project: 1200 King Road Hydrogeological Assessment

Client: Penta Properties Inc.

Location: Aldershot, ON ***Geologist:*** K. Slaine/D. Slaine

SUBSURFACE PROFILE				SAMPLE				Well Completion Details
Depth (m)	Symbol	Description	Elev. (masl)	Number	Type	Recovery	Blows/Ft	
		Ground Surface	103.85					
0.0		TOPSOIL - silty clay based	0.00	1		54	7	
1.0		SILTY CLAY TILL - Halton Till, reddish brown with trace of gravel, turning grey at approximately 3.05 m , medium to very stiff.						
2.0				2		100	34	
3.0		SILTY CLAY - grey, wet, medium to very stiff.	100.80 3.05	3		100	12	
4.0								
5.0				4		29	10	
6.0				5		100	21	
7.0								
8.0			96.23 7.62					
9.0								
10.0								



Groundwater Level Apr 9/14

UTM Coordinates: 593946E, 4797485N

Drill Method: Hollow Stem Augers

Drill Date: August 14, 2013

Hole Size: 20.3 cm

Datum: 103.85 masl

Sheet: 1 of 1

Terra-Dynamics Consulting Inc
404 Queenston St.
St. Catharines, ON L2P 2Y2
905-646-7931

Log of Borehole: MW-4

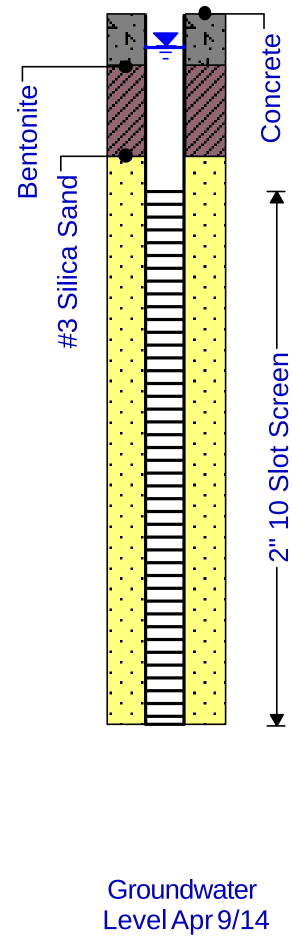
Project No.: 261

Project: 1200 King Road Hydrogeological Assessment

Client: Penta Properties Inc.

Location: Aldershot, ON ***Geologist:*** K. Slaine/D. Slaine

SUBSURFACE PROFILE				SAMPLE				
Depth (m)	Symbol	Description	Elev. (masl)	Number	Type	Recovery	Blows/Ft	Well Completion Details
		Ground Surface	106.01					
0.0		TOPSOIL - silty clay based , some gravel	0.00	1		42	7	
1.0		SILTY CLAY TILL - Halton Till, reddish brown and grey with trace of gravel and silt, medium to very stiff.						
2.0				2		83	37	
3.0		SILTY CLAY - grey, wet, stiff to very soft.	102.96 3.05	3		100	12	
4.0								
5.0				4		100	1	
6.0			99.91 6.10					
7.0								
8.0								
9.0								
10.0								



UTM Coordinates: 593688E, 4797367N ***Hole Size:*** 20.3 cm

Drill Method: Hollow Stem Augers ***Datum:*** 106.01

Drill Date: August 14, 2013 ***Sheet:*** 1 of 1

Terra-Dynamics Consulting Inc
404 Queenston St.
St. Catharines, ON L2P 2Y2
905-646-7931

Log of Borehole: MW-5

Project No.: 261

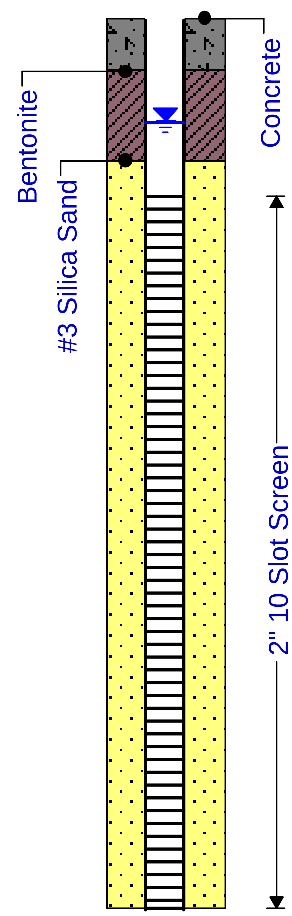
Project: 1200 King Road Hydrogeological Assessment

Client: Penta Properties Inc.

Location: Aldershot, ON ***Geologist:*** K. Slaine/D. Slaine

SUBSURFACE PROFILE			SAMPLE				Well Completion Details
Depth (m)	Description	Elev. (masl)	Number	Type	Recovery	Blows/Ft	
	Ground Surface	104.66					
0.0	TOPSOIL - sandy	0.00	1	▌▌	67	3	
	SILTY SAND - brown with traces of gravel, very loose .	103.14					
1.52	SILTY CLAY - brown with a 28 cm thick segment of sandy gravel at 1.28 m, wet, very stiff.	101.61	2	▌▌	88	18	
3.05	SILTY CLAY TILL - grey, with traces of gravel, grey, very stiff.	100.09	3	▌▌	100	21	
4.57	SILTY CLAY - brownish grey, stiff.	98.56	4	▌▌	100	9	
6.10	SILTY CLAY TILL - grey, with traces of red shale, very stiff.	97.04	5	▌▌	100	18	
7.62							

Depth scale (m): 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0



UTM Coordinates: 593650E, 4797133N

Drill Method: Hollow Stem Augers

Drill Date: August 15, 2013

Hole Size: 20.3 cm

Datum: 104.66 masl

Sheet: 1 of 1

Terra-Dynamics Consulting Inc
404 Queenston St.
St. Catharines, ON L2P 2Y2
905-646-7931

Log of Borehole: MW-6-S

Project No.: 261

Project: 1200 King Road Hydrogeological Assessment

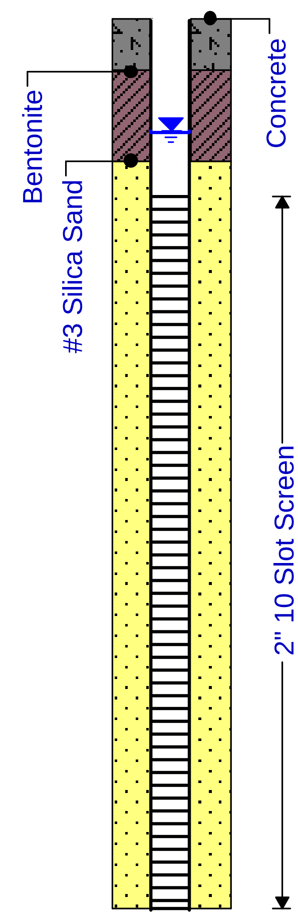
Client: Penta Properties Inc.

Location: Aldershot, ON ***Geologist:*** K. Slaine/D. Slaine

Depth (m)	Description	Elev. (masl) / Depth	Sample Number	Type	Recovery	Blows/Ft
	Ground Surface	112.67				
0.0	TOPSOIL - clay based.	0.00	1	▮▮	63	15
	SILTY CLAY TILL - brown with traces of gravel, medium to stiff.		2	▮▮	100	9
			3	▮▮	92	7
	SILTY CLAY TILL - grey with traces of gravel, hard.	108.10 / 4.57	4	▮▮	92	35
	SILTY CLAY - grey, stiff to very stiff. MW-6-S was drilled straight to a depth of 7.62 m using the geologic log from MW-6-D and then inst rumented witht the monitoring well.	106.57 / 6.10	5	▮▮	100	20
		105.05 / 7.62				

Depth scale (m): 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Well Completion Details



Groundwater Level Apr 9/14

UTM Coordinates: 593464E, 4797241N

Hole Size: 20.3 cm

Drill Method: Hollow Stem Augers

Datum: 112.67 masl

Drill Date: August 16, 2013

Sheet: 1 of 1

Terra-Dynamics Consulting Inc
404 Queenston St.
St. Catharines, ON L2P 2Y2
905-646-7931

Log of Borehole: MW-6-D

Project No.: 261

Project: 1200 King Road Hydrogeological Assessment

Client: Penta Properties Inc.

Location: Aldershot, ON

Geologist: K. Slaine/D. Slaine

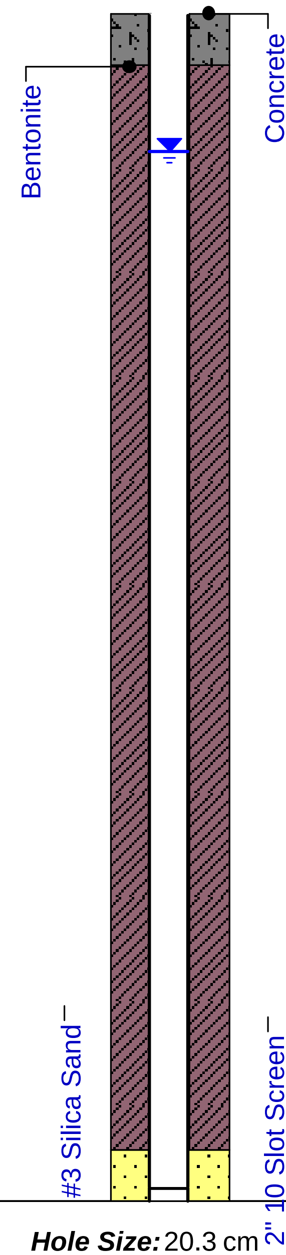
SUBSURFACE PROFILE / SAMPLE

Depth (m)	Description	Elev. (masl)
	Ground Surface	112.67
0.0	TOPSOIL - clay based.	0.00
	SILTY CLAY TILL - brown with traces of gravel, medium to stiff.	
4.57	SILTY CLAY TILL - grey with traces of gravel, hard.	108.10 / 4.57
6.10	SILTY CLAY - grey with red shale fragments from approximately 9.14 m, stiff to very stiff.	106.57 / 6.10
10.67	Borehole terminated at 10.67 m on assumed Queenston Shale	

Number	Type	Recovery	Blows/Ft
1		63	15
2		100	9
3		92	7
4		92	35
5		100	20
6		100	12
7		100	17

Depth scale (m): 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Well Completion Details



UTM Coordinates: 593462E, 4797246N

Hole Size: 20.3 cm

Drill Method: Hollow Stem Augers

Datum: 112.67 masl

Drill Date: August 16, 2013

Sheet: 1 of 2

Terra-Dynamics Consulting Inc
404 Queenston St.
St. Catharines, ON L2P 2Y2
905-646-7931

Log of Borehole: MW-6-D

Project No.: 261

Project: 1200 King Road Hydrogeological Assessment

Client: Penta Properties Inc.

Location: Aldershot, ON

Geologist: K. Slaine/D. Slaine

SUBSURFACE PROFILE				SAMPLE				
Depth (m)	Symbol	Description	Elev. (masl)	Number	Type	Recovery	Blows/Ft	Well Completion Details
			102.00 10.67					
11.0								
12.0								Groundwater Level Apr 9/14
13.0								
14.0								
15.0								
16.0								
17.0								
18.0								
19.0								
20.0								

UTM Coordinates: 593462E, 4797246N

Drill Method: Hollow Stem Augers

Drill Date: August 16, 2013

Hole Size: 20.3 cm

Datum: 112.67 masl

Sheet: 2 of 2

Terra-Dynamics Consulting Inc
404 Queenston St.
St. Catharines, ON L2P 2Y2
905-646-7931

Log of Borehole: MW-7

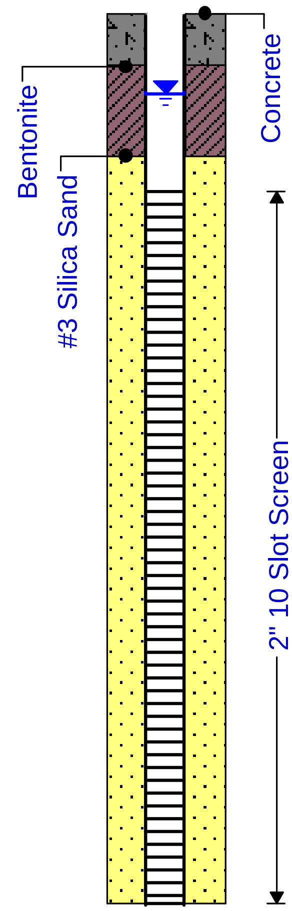
Project No.: 261

Project: 1200 King Road Hydrogeological Assessment

Client: Penta Properties Inc.

Location: Aldershot, ON ***Geologist:*** K. Slaine/D. Slaine

SUBSURFACE PROFILE				SAMPLE				
Depth (m)	Symbol	Description	Elev. (masl)	Number	Type	Recovery	Blows/Ft	Well Completion Details
		Ground Surface	112.60					
0.0		TOPSOIL - clay based.	0.00	1		29	11	
		SILTY CLAY - reddish brown, stiff.	111.08					
1.0		SILTY SAND.	1.52	2		75	21	
2.0		SILTY CLAY - reddish brown, turning to a brownish grey at 3.05 m with a 5 cm thick sandy gravel lens at 3.35 m. Silty clay is stiff to very stiff.						
3.0				3		88	9	
4.0				4		75	25	
5.0			106.50					
6.0		SILTY CLAY - grey, wet, stiff to very stiff.	6.10	5		71	15	
7.0			104.98					
8.0			7.62					
9.0								
10.0								



Groundwater Level Apr 9/14

UTM Coordinates: 5935593E, 4797419N ***Hole Size:*** 20.3 cm

Drill Method: Hollow Stem Augers ***Datum:*** 112.60 masl

Drill Date: August 16, 2013 ***Sheet:*** 1 of 1

Terra-Dynamics Consulting Inc
404 Queenston St.
St. Catharines, ON L2P 2Y2
905-646-7931

Log of Borehole: MW-8-S

Project No.: 261

Project: 1200 King Road Hydrogeological Assessment

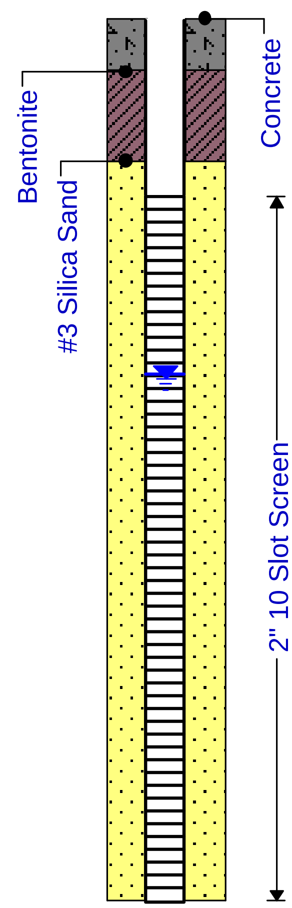
Client: Penta Properties Inc.

Location: Aldershot, ON ***Geologist:*** K. Slaine/D. Slaine

SUBSURFACE PROFILE / SAMPLE

Depth (m)	Description	Elev. (masl)	Number	Type	Recovery	Blows/Ft
	Ground Surface	111.61				
0.0	TOPSOIL - silt based.	0.00	1		50	22
	SANDY SILT - brown, traces of gravel, very stiff .					
1.0						
	SAND - brown, medium grained, loose.	110.09 1.52	2		75	23
2.0	SILTY CLAY - brown, very stiff.					
3.0	SANDY SILT - brown, wet, stiff.	108.41 3.20	3		75	15
	SILTY CLAY - grey, wet, very stiff. MW-8-S was drilled straight to a depth of 7.62 m using the geologic log from MW-8-D and then inst rumented with the monitoring well.					
4.0						
5.0			4		83	29
6.0						
			5		88	27
7.0						
		104.05 7.56				
8.0						
9.0						
10.0						

Well Completion Details



Groundwater Level Apr 9/14

UTM Coordinates: 593684E, 4797588N

Drill Method: Hollow Stem Augers

Drill Date: August 20, 2013

Hole Size: 20.3 cm

Datum: 111.61 masl

Sheet: 1 of 1

Terra-Dynamics Consulting Inc
404 Queenston St.
St. Catharines, ON L2P 2Y2
905-646-7931

Log of Borehole: MW-8-D

Project No.: 261

Project: 1200 King Road Hydrogeological Assessment

Client: Penta Properties Inc.

Location: Aldershot, ON ***Geologist:*** K. Slaine/D. Slaine

SUBSURFACE PROFILE

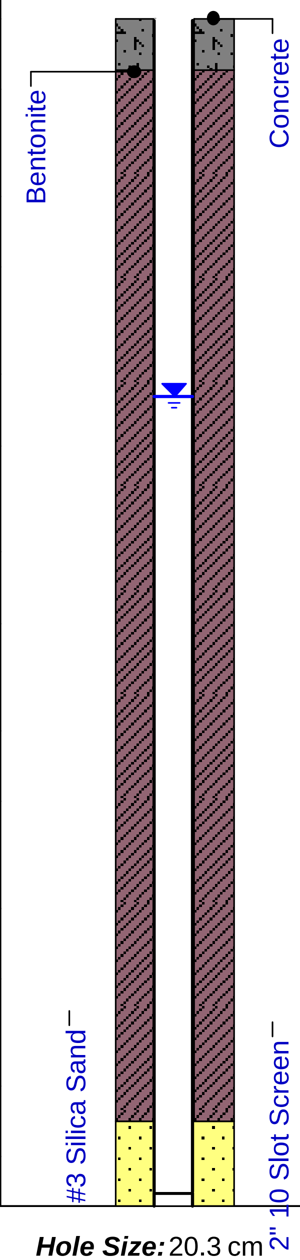
Depth (m)	Description	Elev. (masl)
	Ground Surface	111.45
0.00	TOPSOIL - silt based.	
	SANDY SILT - brown, traces of gravel, very stiff .	
1.52	SAND - brown, medium grained, loose.	109.93
	SILTY CLAY - brown, very stiff.	
3.20	SANDY SILT - brown, wet, stiff.	108.25
	SILTY CLAY - grey, wet, very stiff.	
7.77	SAND - brown, medium grained.	103.68
	SILTY CLAY - grey, wet, very stiff.	
10.06		101.39

Depth (m): 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

SAMPLE

Number	Type	Recovery	Blows/Ft
1		50	22
2		75	23
3		75	15
4		83	29
5		88	27
6		100	20
7		100	30

Well Completion Details



UTM Coordinates: 593686E, 4797586N

Drill Method: Hollow Stem Augers

Drill Date: August 20, 2013

Hole Size: 20.3 cm

Datum: 111.45 masl

Sheet: 1 of 2

Terra-Dynamics Consulting Inc
404 Queenston St.
St. Catharines, ON L2P 2Y2
905-646-7931

Log of Borehole: MW-8-D

Project No.: 261

Project: 1200 King Road Hydrogeological Assessment

Client: Penta Properties Inc.

Location: Aldershot, ON

Geologist: K. Slaine/D. Slaine

SUBSURFACE PROFILE				SAMPLE				Well Completion Details
Depth (m)	Symbol	Description	Elev. (masl)	Number	Type	Recovery	Blows/Ft	
		SHALE - Queenston Formation, red, weathered.	100.78 10.67					
11.0								
12.0								Groundwater Level Apr 9/14
13.0								
14.0								
15.0								
16.0								
17.0								
18.0								
19.0								
20.0								

UTM Coordinates: 593686E, 4797586N

Drill Method: Hollow Stem Augers

Drill Date: August 20, 2013

Hole Size: 20.3 cm

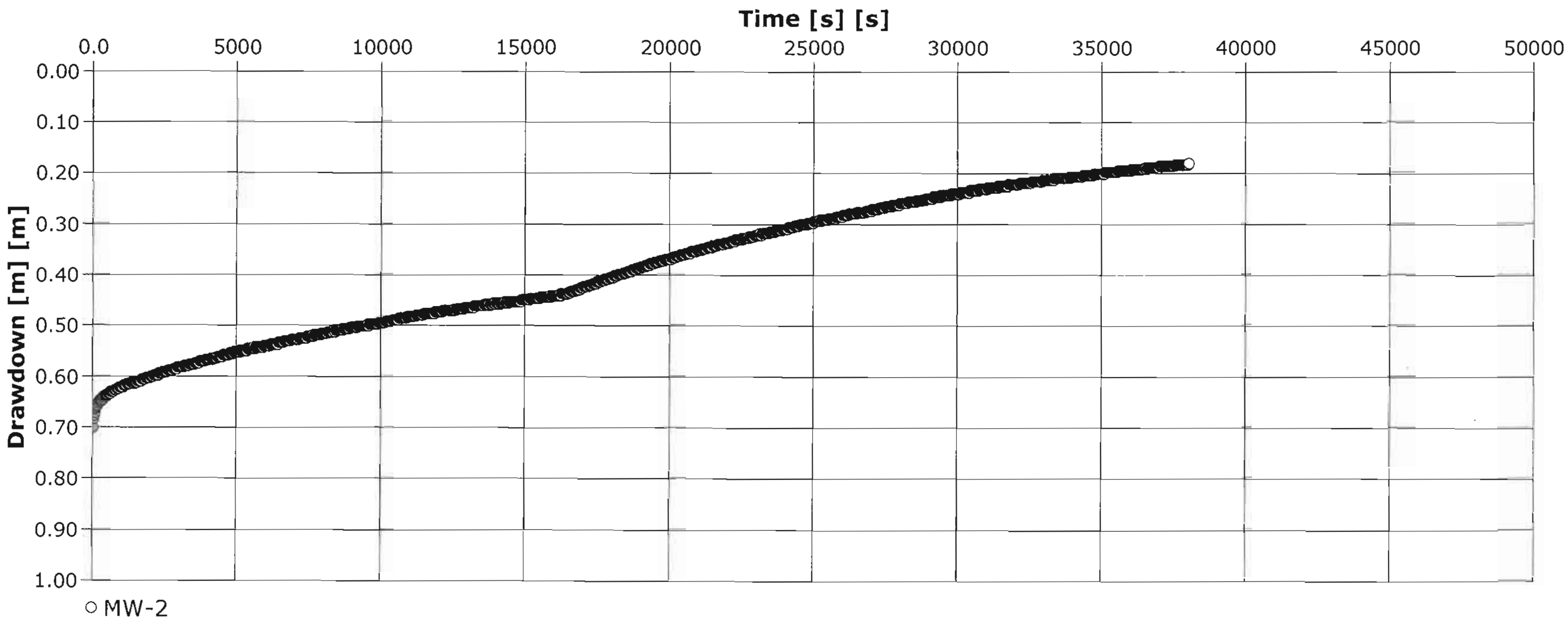
Datum: 111.45 masl

Appendix 2.

Hydraulic Conductivity Tests Analyses

Terra-Dynamics Consulting
404 Queenston Street
St. Catharines, ON L2P 2Y2
www.terra-dynamics.com

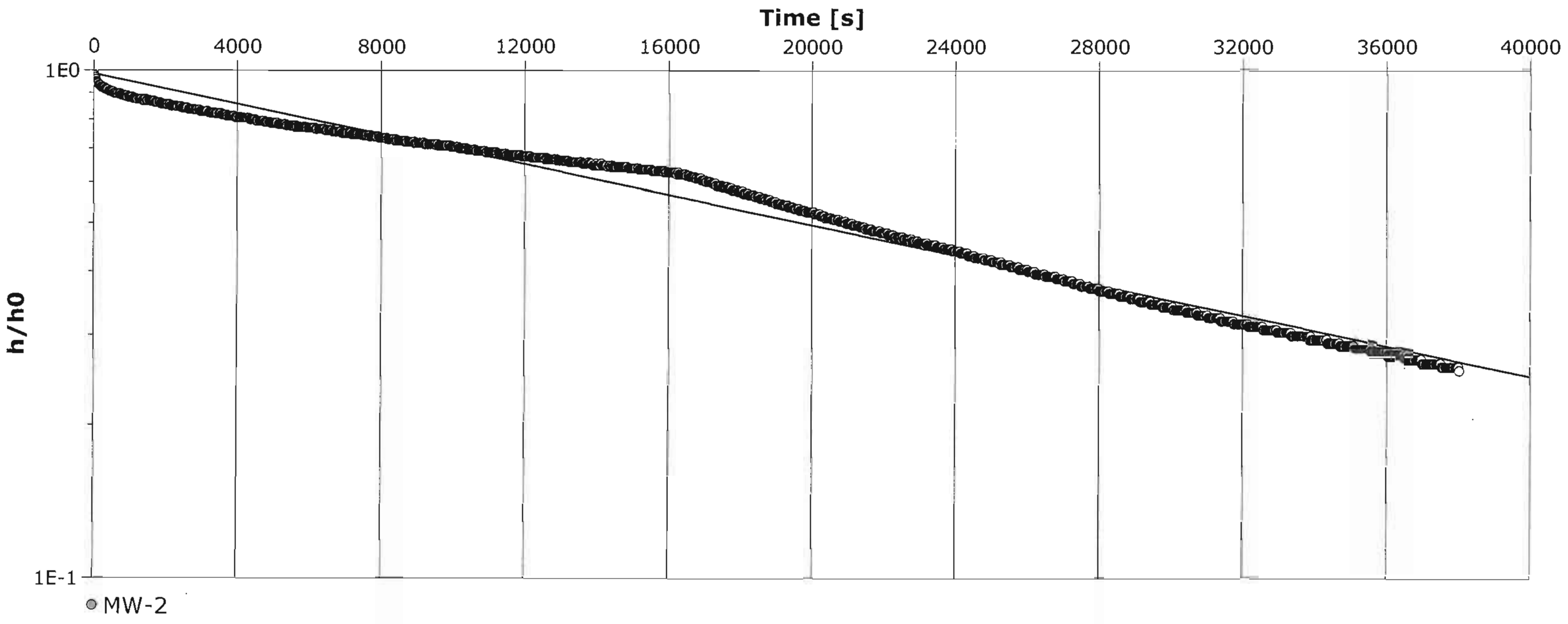
Slug Test Analysis Report		
Project: 1200 King Road		
Number: 261		
Client: Penta Properties Inc.		
Location: Burlington, ON	Slug Test: MW-2 Withdrawal	Test Well: MW-2
Test conducted by: Kevin Slaine		Test date: 17/09/2013
Analysis performed by: David Slaine	Time vs. Change in Water Level	Date: 20/11/2013
Aquifer Thickness: 7.00 m		



Terra-Dynamics Consulting
404 Queenston Street
St. Catharines, ON L2P 2Y2
www.terra-dynamics.com

Slug Test Analysis Report

Project: 1200 King Road		
Number: 261		
Client: Penta Properties Inc.		
Location: Burlington, ON	Slug Test: MW-2 Withdrawal	Test Well: MW-2
Test conducted by: Kevin Slaine		Test date: 17/09/2013
Analysis performed by: David Slaine	Hvorslev	Date: 20/11/2013
Aquifer Thickness: 7.00 m		

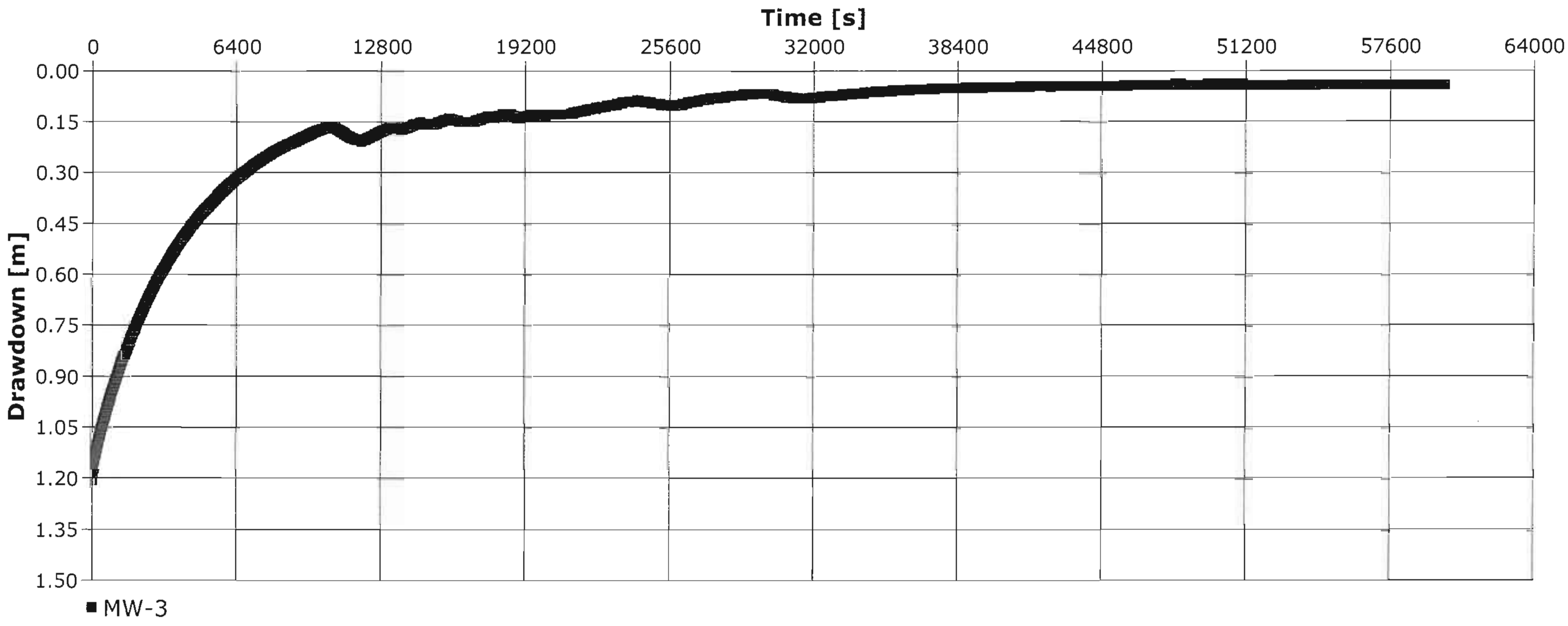


Calculation after Hvorslev

Observation well	K [m/s]	
MW-2	1.00×10^{-8}	

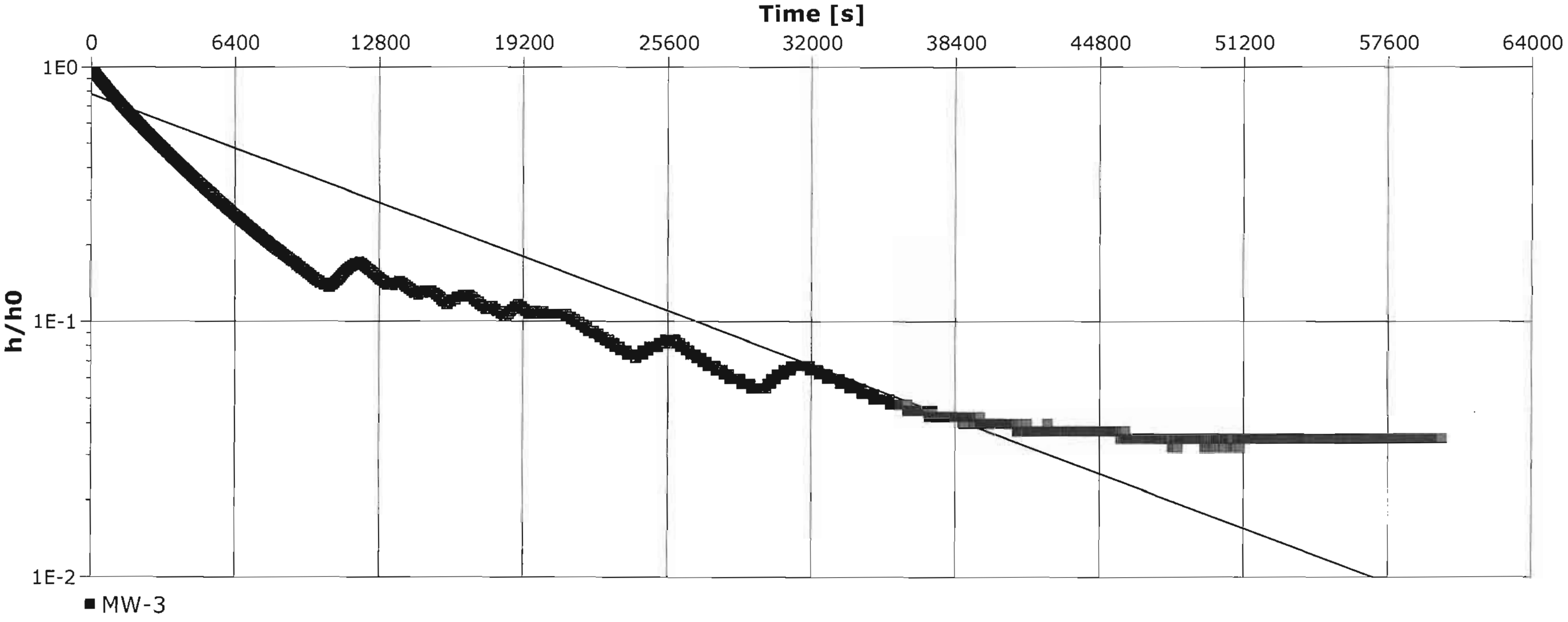
Terra-Dynamics Consulting **404 Queenston Street** **St. Catharines, ON L2P 2Y2** **www.terra-dynamics.com**	**Slug Test Analysis Report** Project: 1200 King Road Number: 261 Client: Penta Properties Inc.

Location: Burlington, ON	Slug Test: MW-3 Withdrawal	Test Well: MW-3
Test conducted by: Kevin Slaine		Test date: 17/09/2013
Analysis performed by: David Slaine	Time vs. Change in Water Level	Date: 20/11/2013
Aquifer Thickness: 7.00 m		



Terra-Dynamics Consulting **404 Queenston Street** **St. Catharines, ON L2P 2Y2** **www.terra-dynamics.com**	**Slug Test Analysis Report** Project: 1200 King Road Number: 261 Client: Penta Properties Inc.

Location: Burlington, ON	Slug Test: MW-3 Withdrawal	Test Well: MW-3
Test conducted by: Kevin Slaine		Test date: 17/09/2013
Analysis performed by: David Slaine	Hvorslev	Date: 20/11/2013
Aquifer Thickness: 7.00 m		

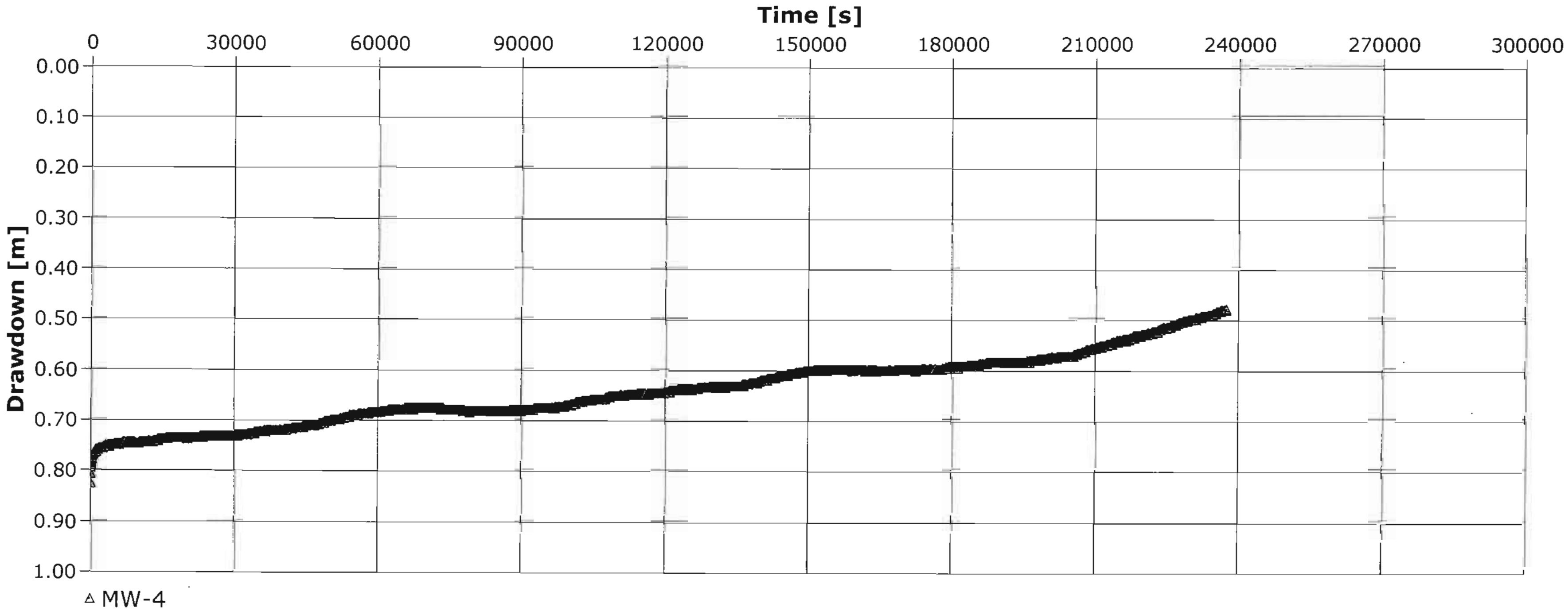


Calculation after Hvorslev

Observation well	K [m/s]	
MW-3	2.23×10^{-8}	

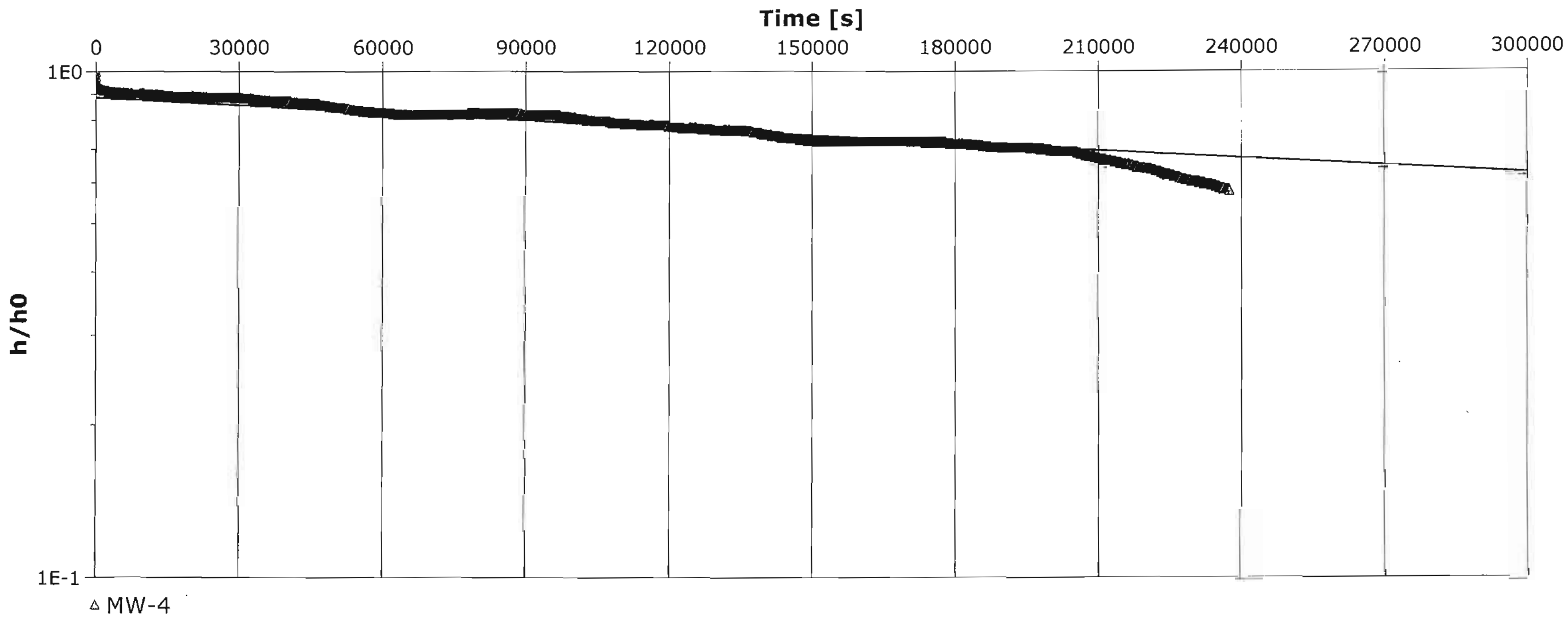
Terra-Dynamics Consulting **404 Queenston Street** **St. Catharines, ON L2P 2Y2** **www.terra-dynamics.com**	**Slug Test Analysis Report** Project: 1200 King Road Number: 261 Client: Penta Properties Inc.

Location: Burlington, ON	Slug Test: MW-4 Withdrawal	Test Well: MW-4
Test conducted by: Kevin Slaine		Test date: 17/09/2013
Analysis performed by: David Slaine	Time vs. Change in Water Level	Date: 20/11/2013
Aquifer Thickness: 4.50 m		



Terra-Dynamics Consulting 404 Queenston Street St. Catharines, ON L2P 2Y2 www.terra-dynamics.com	Slug Test Analysis Report Project: 1200 King Road Number: 261 Client: Penta Properties Inc.

Location: Burlington, ON	Slug Test: MW-4 Withdrawal	Test Well: MW-4
Test conducted by: Kevin Slaine		Test date: 17/09/2013
Analysis performed by: David Slaine	Hvorslev	Date: 20/11/2013
Aquifer Thickness: 4.50 m		

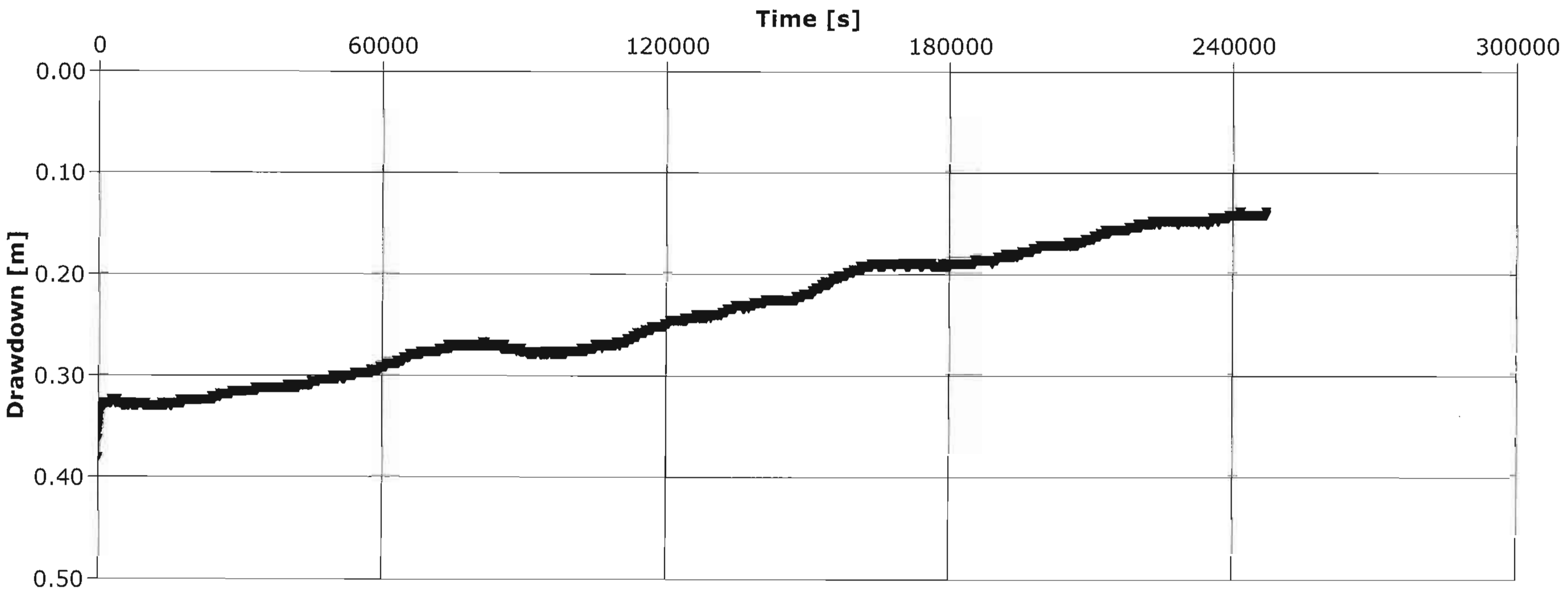


Calculation after Hvorslev

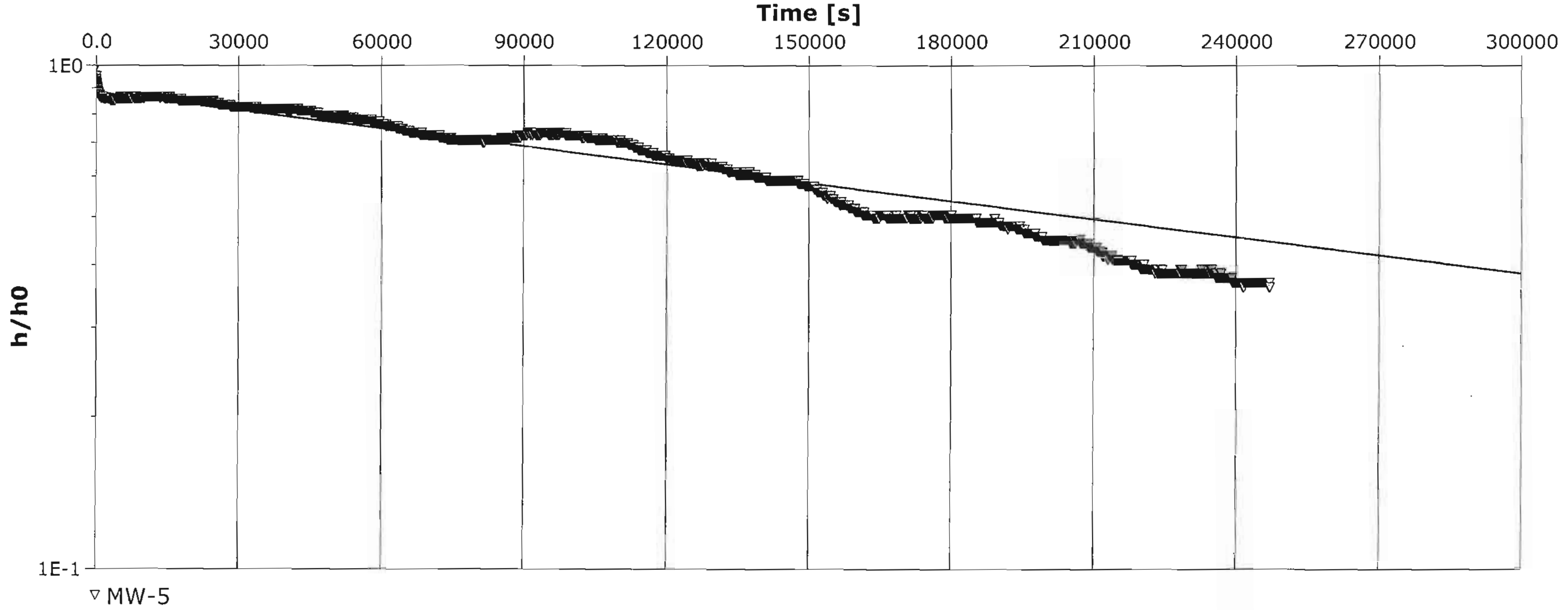
Observation well	K [m/s]
MW-4	4.26×10^{-10}

Terra-Dynamics Consulting
404 Queenston Street
St. Catharines, ON L2P 2Y2
www.terra-dynamics.com

Slug Test Analysis Report		
Project: 1200 King Road		
Number: 261		
Client: Penta Properties Inc.		
Location: Burlington, ON	Slug Test: MW-5 Withdrawal	Test Well: MW-5
Test conducted by: Kevin Slaine		Test date: 17/09/2013
Analysis performed by: David Slaine	Time vs. Change in Water Level	Date: 20/11/2013
Aquifer Thickness: 7.00 m		



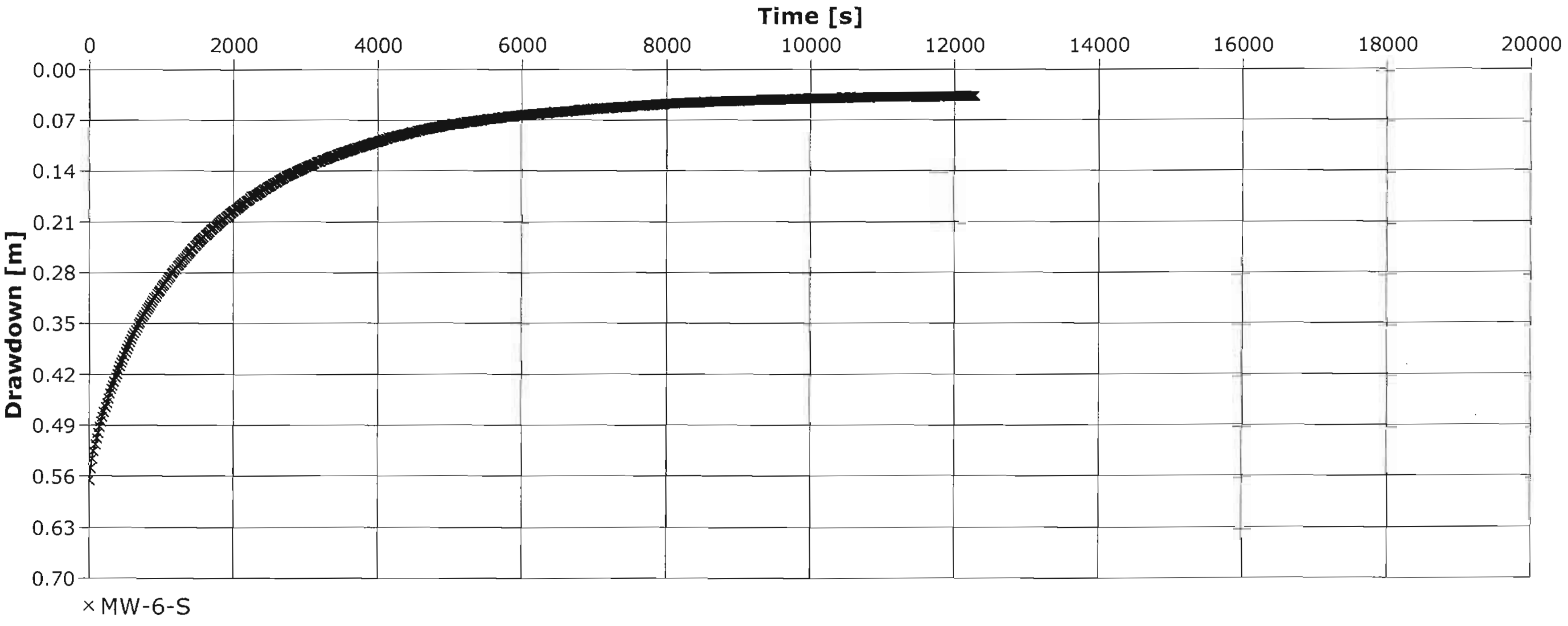
Terra-Dynamics Consulting 404 Queenston Street St. Catharines, ON L2P 2Y2 www.terra-dynamics.com	**Slug Test Analysis Report** Project: 1200 King Road Number: 261 Client: Penta Properties Inc.	
Location: Burlington, ON	Slug Test: MW-5 Withdrawal	Test Well: MW-5
Test conducted by: Kevin Slaine		Test date: 17/09/2013
Analysis performed by: David Slaine	Hvorslev	Date: 20/11/2013
Aquifer Thickness: 7.00 m		



Calculation after Hvorslev

Observation well	K [m/s]
MW-5	8.07×10^{-10}

Terra-Dynamics Consulting 404 Queenston Street St. Catharines, ON L2P 2Y2 www.terra-dynamics.com		Slug Test Analysis Report Project: 1200 King Road Number: 261 Client: Penta Properties Inc.
Location: Burlington, ON	Slug Test: MW-6-S Withdrawal	Test Well: MW-6-S
Test conducted by: Kevin Slaine		Test date: 17/09/2013
Analysis performed by: David Slaine	Time vs. Change in Water Level	Date: 20/11/2013
Aquifer Thickness: 7.00 m		



Terra-Dynamics Consulting
404 Queenston Street
St. Catharines, ON L2P 2Y2
www.terra-dynamics.com

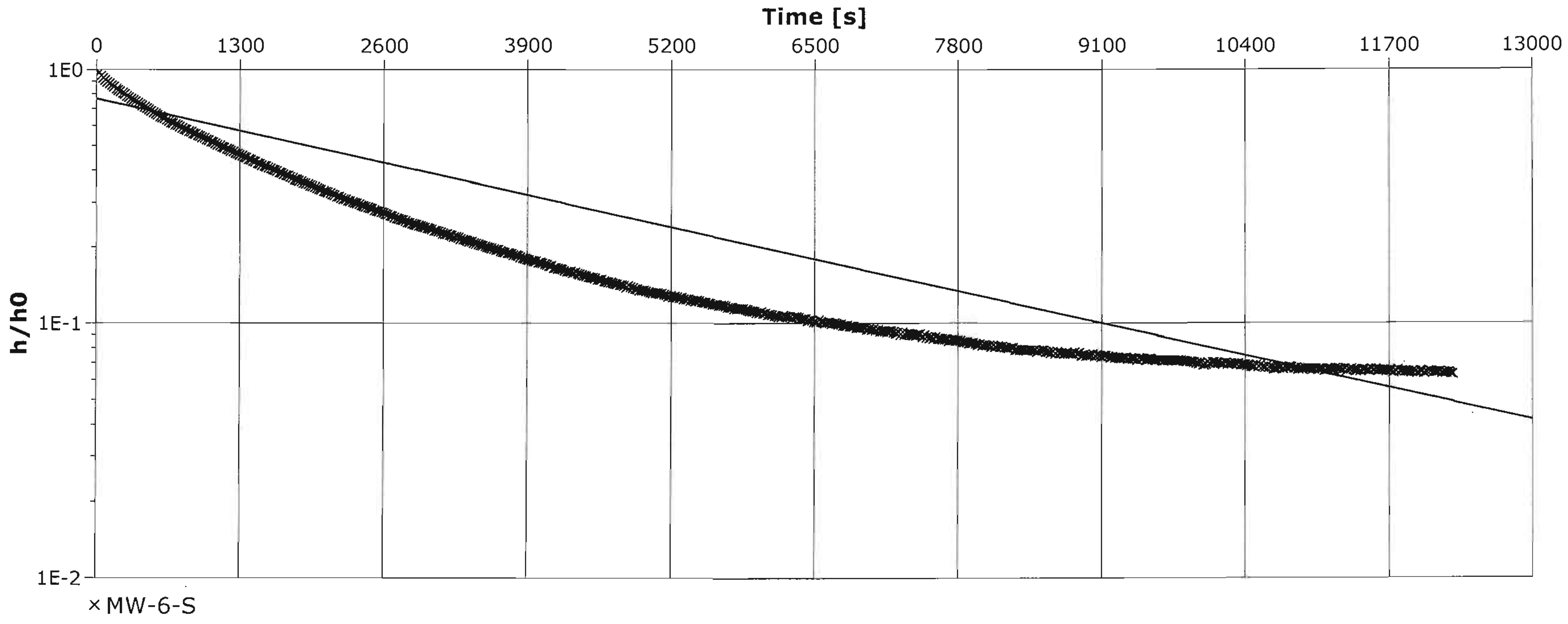
Slug Test Analysis Report

Project: 1200 King Road

Number: 261

Client: Penta Properties Inc.

Location: Burlington, ON	Slug Test: MW-6-S Withdrawal	Test Well: MW-6-S
Test conducted by: Kevin Slaine		Test date: 17/09/2013
Analysis performed by: David Slaine	Hvorslev	Date: 20/11/2013
Aquifer Thickness: 7.00 m		



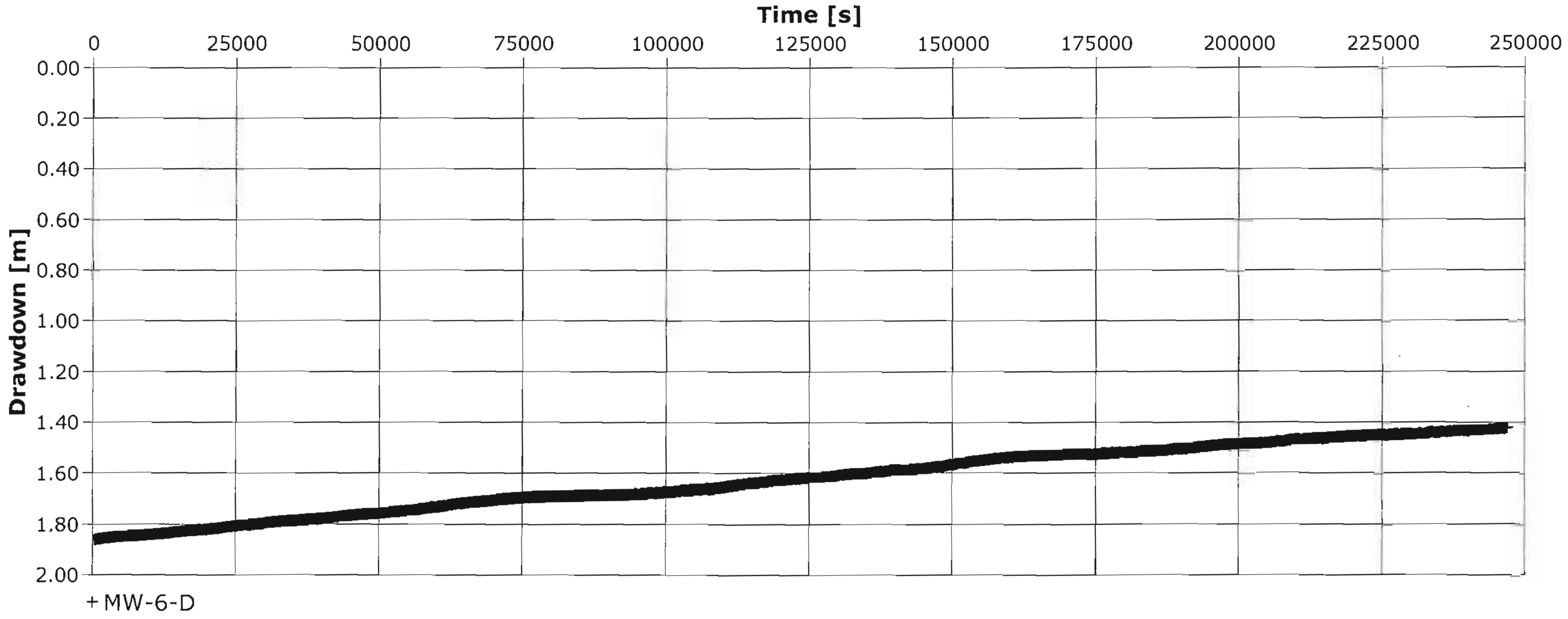
Calculation after Hvorslev

Observation well	K [m/s]
MW-6-S	6.53×10^{-8}

Terra-Dynamics Consulting
404 Queenston Street
St. Catharines, ON L2P 2Y2
www.terra-dynamics.com

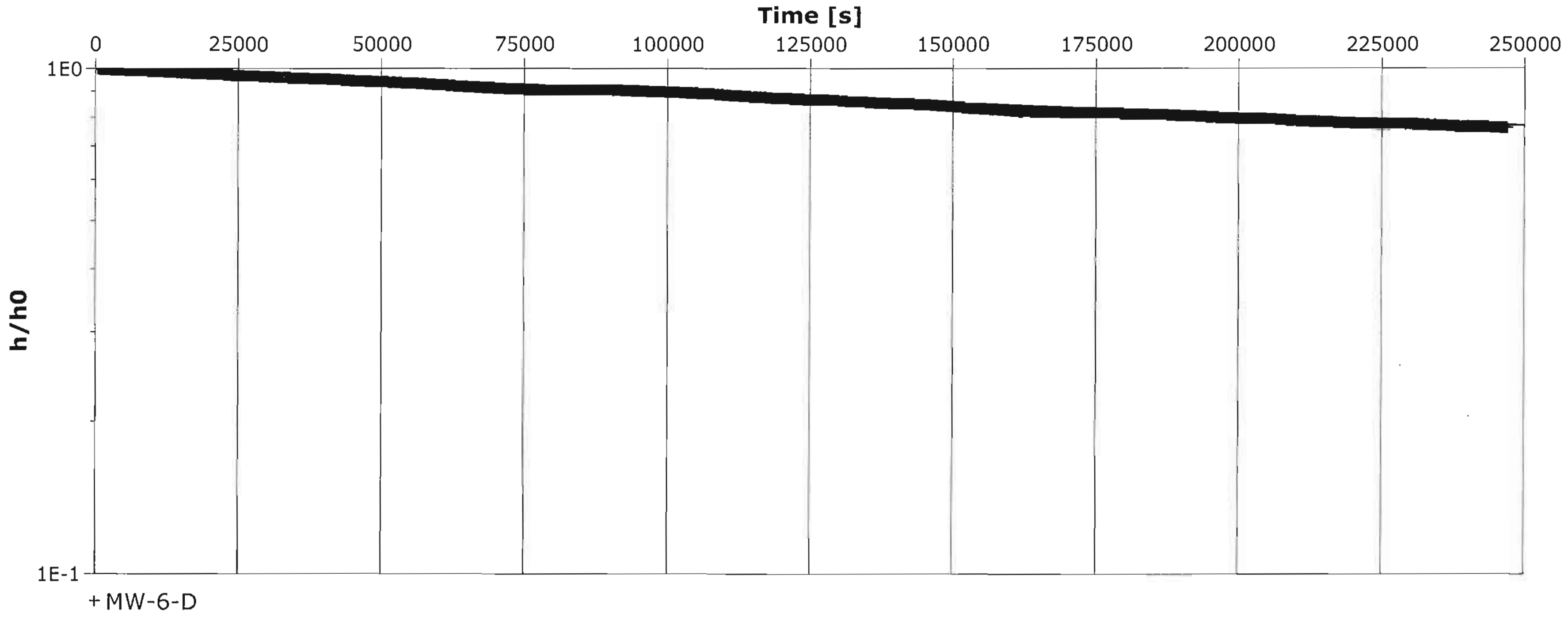
Slug Test Analysis Report	
Project: 1200 King Road	
Number: 261	
Client: Penta Properties Inc.	

Location: Burlington, ON	Slug Test: MW-6-D Withdrawal	Test Well: MW-6-D
Test conducted by: Kevin Slaine		Test date: 17/09/2013
Analysis performed by: David Slaine	Time vs. Change in Water Level	Date: 20/11/2013
Aquifer Thickness: 1.00 m		



Terra-Dynamics Consulting **404 Queenston Street** **St. Catharines, ON L2P 2Y2** **www.terra-dynamics.com**	**Slug Test Analysis Report** Project: 1200 King Road Number: 261 Client: Penta Properties Inc.

Location: Burlington, ON	Slug Test: MW-6-D Withdrawal	Test Well: MW-6-D
Test conducted by: Kevin Slaine		Test date: 17/09/2013
Analysis performed by: David Slaine	Hvorslev	Date: 20/11/2013
Aquifer Thickness: 1.00 m		

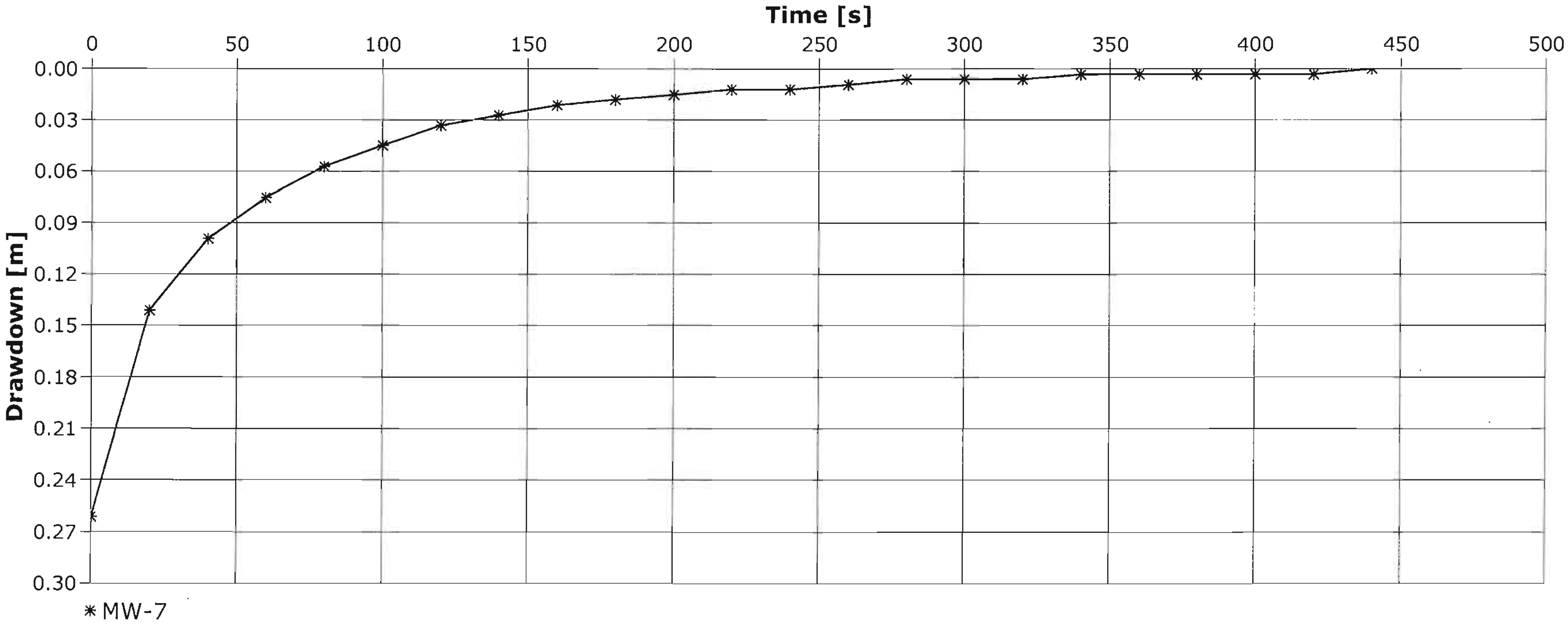


Calculation after Hvorslev

Observation well	K [m/s]	
MW-6-D	1.78×10^{-9}	

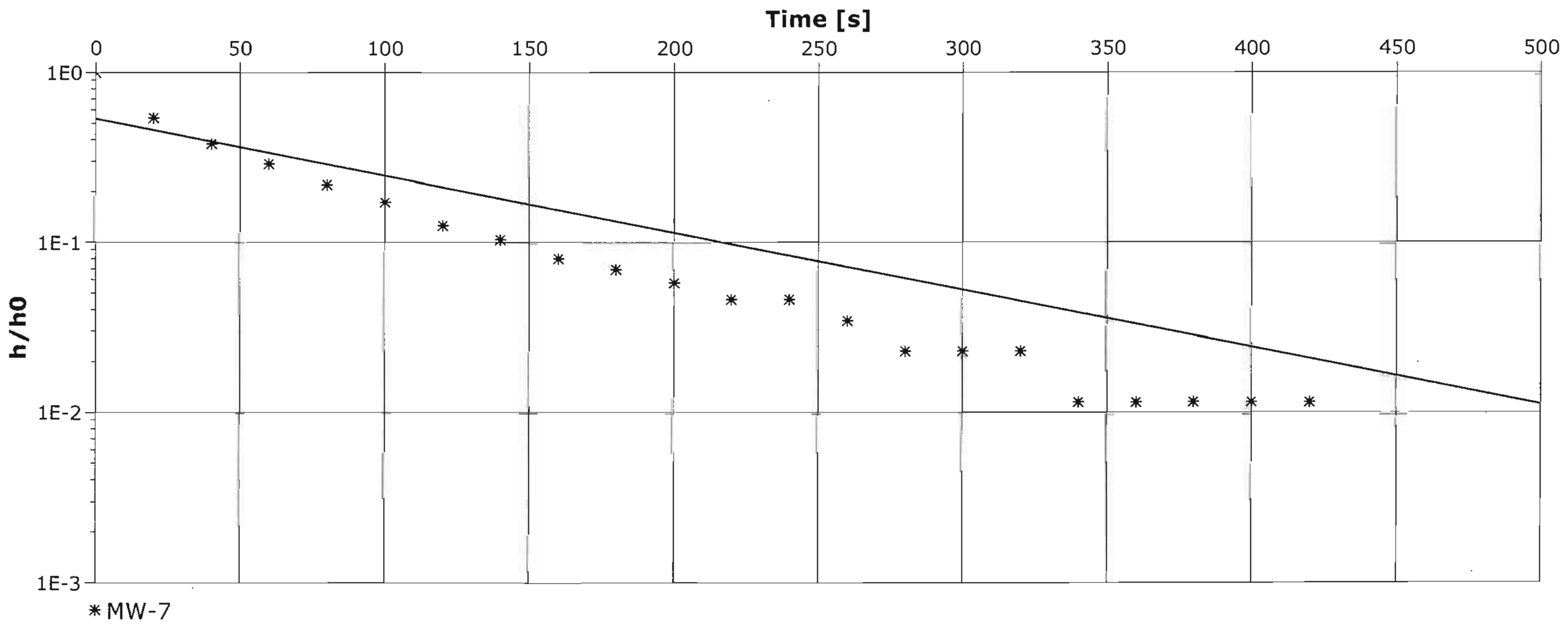
Terra-Dynamics Consulting **404 Queenston Street** **St. Catharines, ON L2P 2Y2** **www.terra-dynamics.com**	**Slug Test Analysis Report** Project: 1200 King Road Number: 261 Client: Penta Properties Inc.

Location: Burlington, ON	Slug Test: MW-7 Withdrawal	Test Well: MW-7
Test conducted by: Kevin Slaine		Test date: 17/09/2013
Analysis performed by: David Slaine	Time vs. Change in Water Level	Date: 20/11/2013
Aquifer Thickness: 7.00 m		



Terra-Dynamics Consulting **404 Queenston Street** **St. Catharines, ON L2P 2Y2** **www.terra-dynamics.com**	**Slug Test Analysis Report** Project: 1200 King Road Number: 261 Client: Penta Properties Inc.

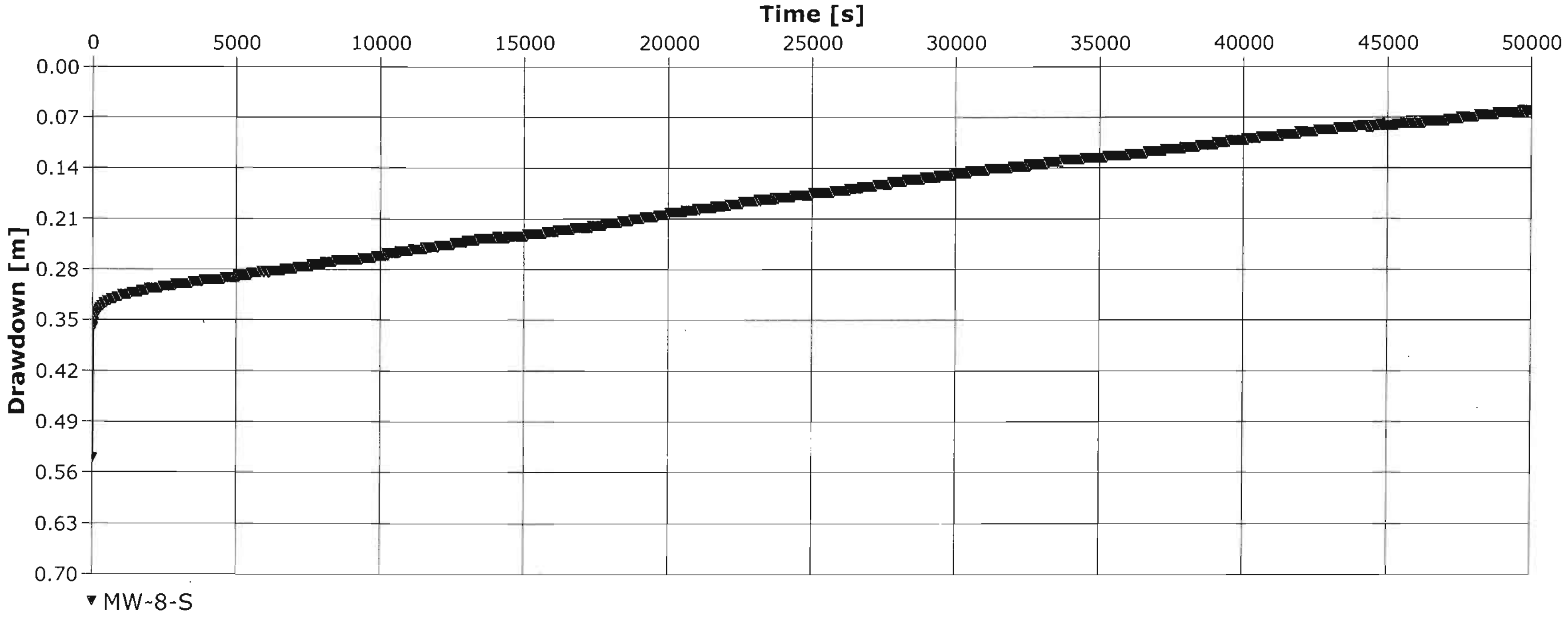
Location: Burlington, ON	Slug Test: MW-7 Withdrawal	Test Well: MW-7
Test conducted by: Kevin Slaine		Test date: 17/09/2013
Analysis performed by: David Slaine	Hvorslev	Date: 20/11/2013
Aquifer Thickness: 7.00 m		



Calculation after Hvorslev

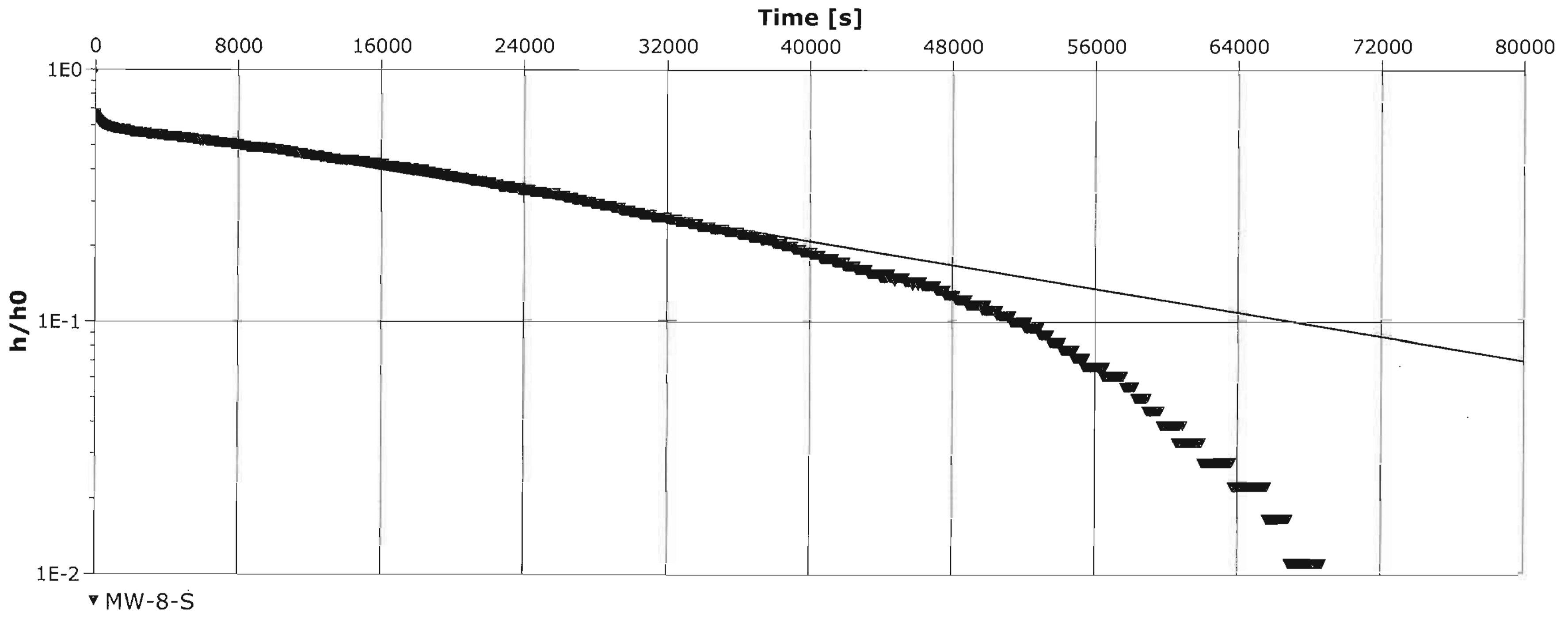
Observation well	K [m/s]
MW-7	2.25×10^{-6}

Terra-Dynamics Consulting **404 Queenston Street** **St. Catharines, ON L2P 2Y2** **www.terra-dynamics.com**	**Slug Test Analysis Report** Project: 1200 King Road Number: 261 Client: Penta Properties Inc.	
Location: Burlington, ON	Slug Test: MW-8-S Withdrawal	Test Well: MW-8-S
Test conducted by: Kevin Slaine		Test date: 20/11/2013
Analysis performed by: David Slaine	Time vs. Change in Water Level	Date: 20/11/2013
Aquifer Thickness: 7.00 m		



Terra-Dynamics Consulting **404 Queenston Street** **St. Catharines, ON L2P 2Y2** **www.terra-dynamics.com**	**Slug Test Analysis Report** Project: 1200 King Road Number: 261 Client: Penta Properties Inc.

Location: Burlington, ON	Slug Test: MW-8-S Withdrawal	Test Well: MW-8-S
Test conducted by: Kevin Slaine		Test date: 20/11/2013
Analysis performed by: David Slaine	Hvorslev	Date: 20/11/2013
Aquifer Thickness: 7.00 m		

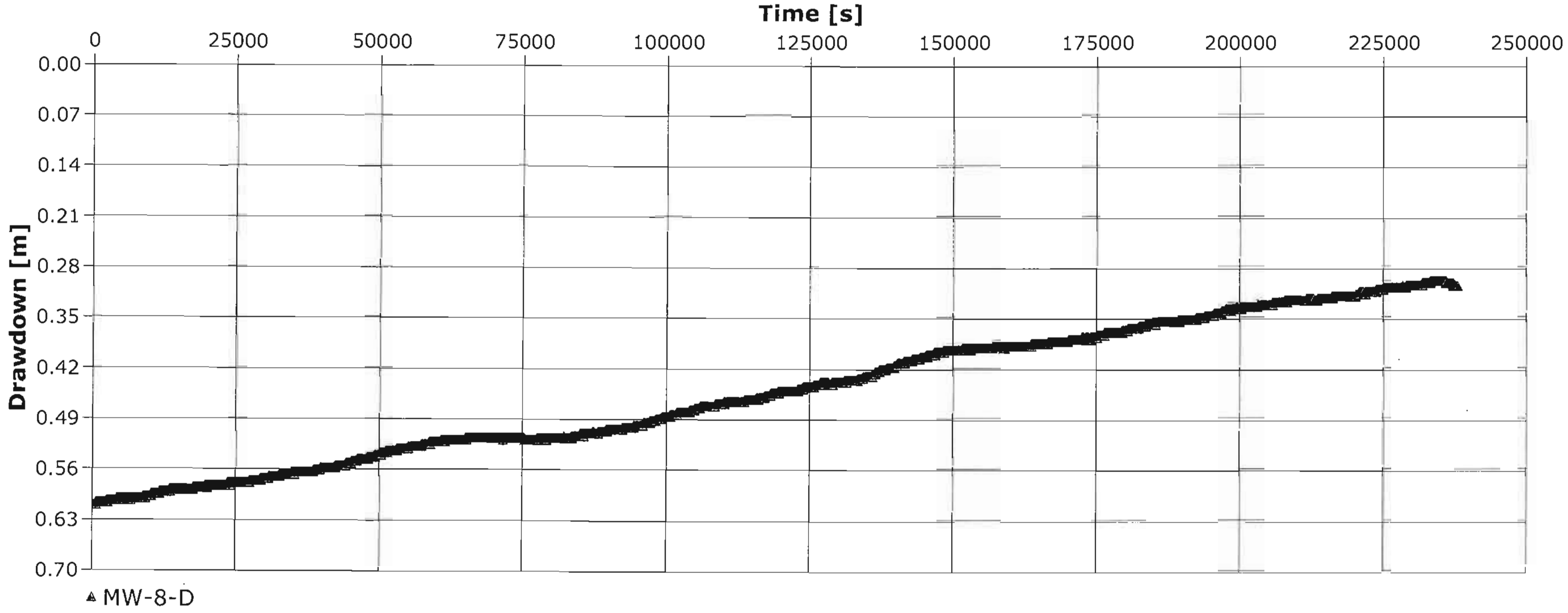


Calculation after Hvorslev

Observation well	K [m/s]
MW-8-S	7.94×10^{-9}

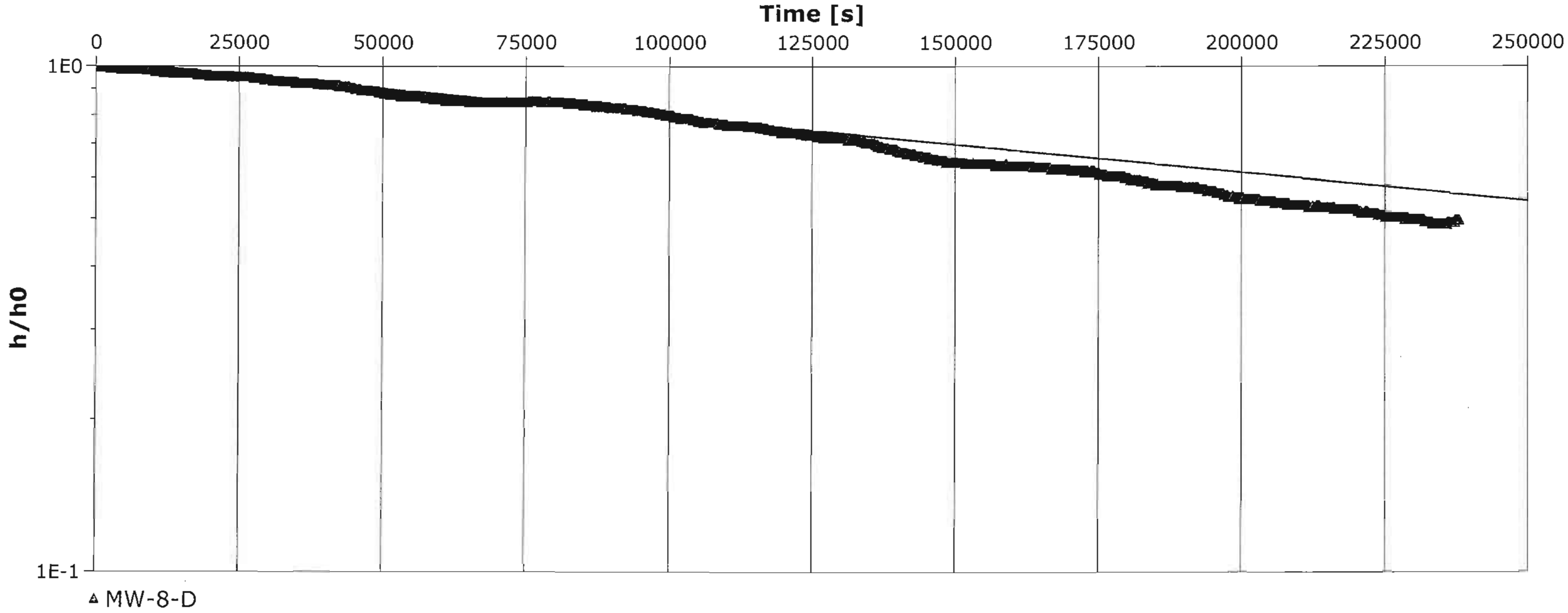
Terra-Dynamics Consulting **404 Queenston Street** **St. Catharines, ON L2P 2Y2** **www.terra-dynamics.com**	**Slug Test Analysis Report** Project: 1200 King Road Number: 261 Client: Penta Properties Inc.

Location: Burlington, ON	Slug Test: MW-8-D Withdrawal	Test Well: MW-8-D
Test conducted by: Kevin Slaine		Test date: 17/09/2013
Analysis performed by: David Slaine	Time vs. Change in Water Level	Date: 20/11/2013
Aquifer Thickness: 1.30 m		



Terra-Dynamics Consulting 404 Queenston Street St. Catharines, ON L2P 2Y2 www.terra-dynamics.com	Slug Test Analysis Report Project: 1200 King Road Number: 261 Client: Penta Properties Inc.

Location: Burlington, ON	Slug Test: MW-8-D Withdrawal	Test Well: MW-8-D
Test conducted by: Kevin Slaine		Test date: 17/09/2013
Analysis performed by: David Slaine	Hvorslev	Date: 20/11/2013
Aquifer Thickness: 1.30 m		



Calculation after Hvorslev

Observation well	K [m/s]
MW-8-D	3.24×10^{-9}

Appendix 3.

Groundwater Velocity Calculations

Appendix 3. Groundwater Calculations

Appendix 3.1 Evaluation of Horizontal Groundwater Velocity in the Silty Clay and Clay Till Aquitard Southerly Towards Hamilton Harbour

The horizontal average linear groundwater velocity (v) in the silty clay and clay till-based aquitard between approximately Highway 403 southerly towards the Candian National Railway tracks (see Figures 2 and 3) can be evaluated by the following equation as per Freeze and Cherry (1979):

$$v = -Ki_H/n$$

where K is the hydraulic conductivity of the overburden. The geometric mean of nine hydraulic conductivity tests in the clay aquitard was calculated to be 9.29 x 10^{-9} m/sec. The horizontal hydraulic gradient (i_H) was measured between MW-6-Shallow near Highway 403 and MW-5 near the CNR tracks as the change in hydraulic head over the change in distance of dh/dl. For the April 9, 2014 groundwater measurements, this equals a head decrease of 111.71 – 103.78 metres above sea level (masl) (see Table 2) over an approximate distance of 165 m or a horizontal hydraulic gradient of 0.048. The porosity (n) was determined from literature (Freeze and Cherry, 1979) for clay-based soils at 0.40 or 40%.

Therefore, the average linear horizontal velocity can be determined as follows:

$$v = (9.29 \times 10^{-9} \text{ m/sec}) \times (0.048) / 0.40$$
$$= 1.11 \times 10^{-9} \text{ m/sec}$$
$$= 0.04 \text{ m/year}$$

Appendix 3.2 Evaluation of Vertical Groundwater Velocity Through the Clay-based Aquitard to the Queenston Shale Bedrock

The vertical average linear groundwater velocity (v) in through the silty clay and clay-based till aquitard to the Queenston Shale can be evaluated at Monitoring Well MW-6 Shallow and Deep by using the following equation as per Freeze and Cherry (1979):

$$v = -Ki_v/n$$

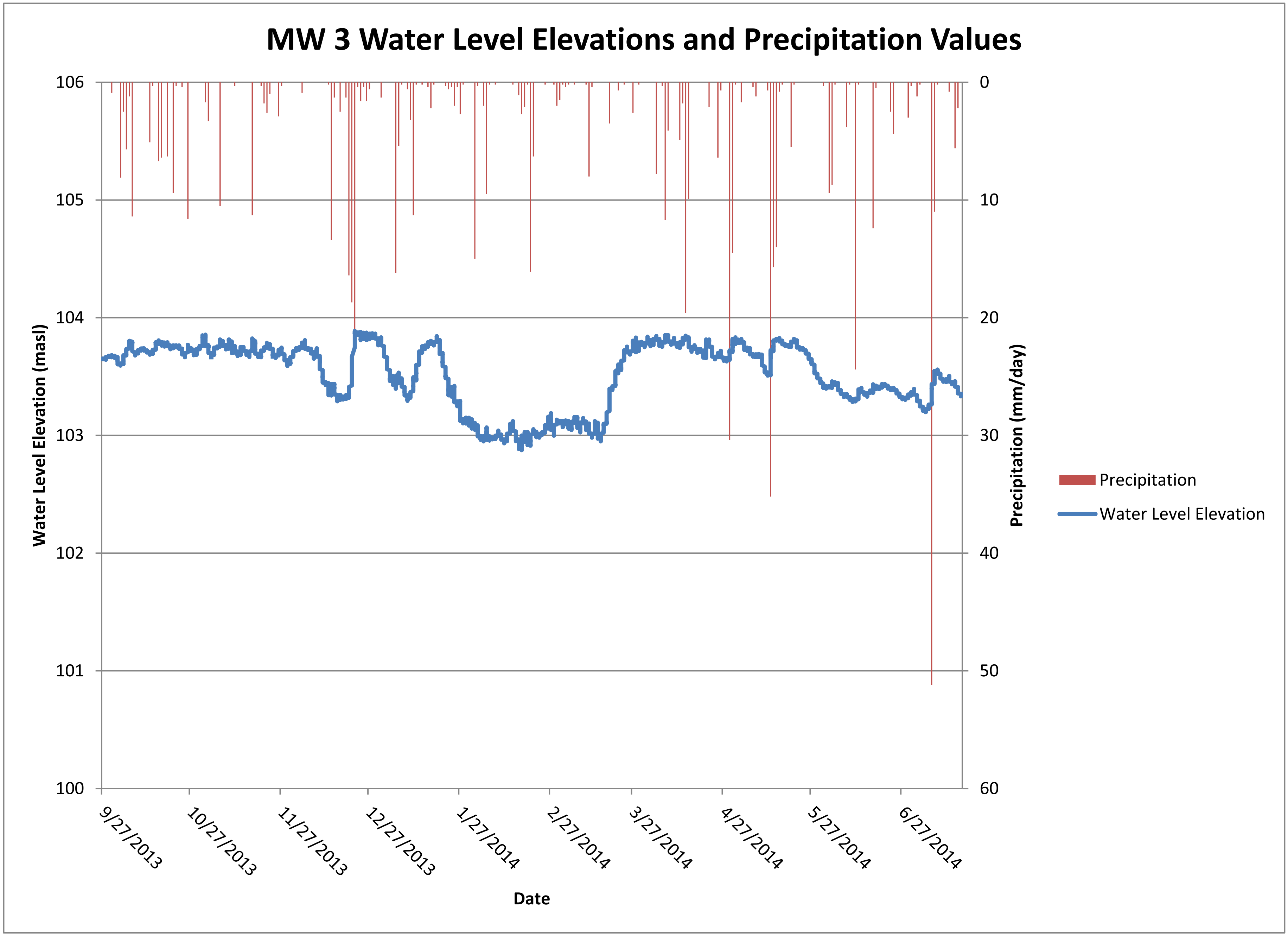
where K is the geometric mean of the nine clay aquitard hydraulic conductivity tests or 9.29 x 10^{-9} m/sec. The vertical hydraulic gradient (i_v) as measured between MW-6-S and MW-6-D as the vertical change in hydraulic head over the change in vertical distance of dh/dl. For the April 9, 2014 groundwater measurements (see Table 2), this equals a downward decrease in hydraulic head of 111.71 – 111.49 masl = over an approximate distance of 10.34 m – 0.96 m = 9.38 m (see Borehole Logs for MW-6-S&D) or a vertical hydraulic gradient of 0.023. The porosity (n) was determined from literature (Freeze and Cherry, 1979) for the cay-based soils at 0.40 or 40%.

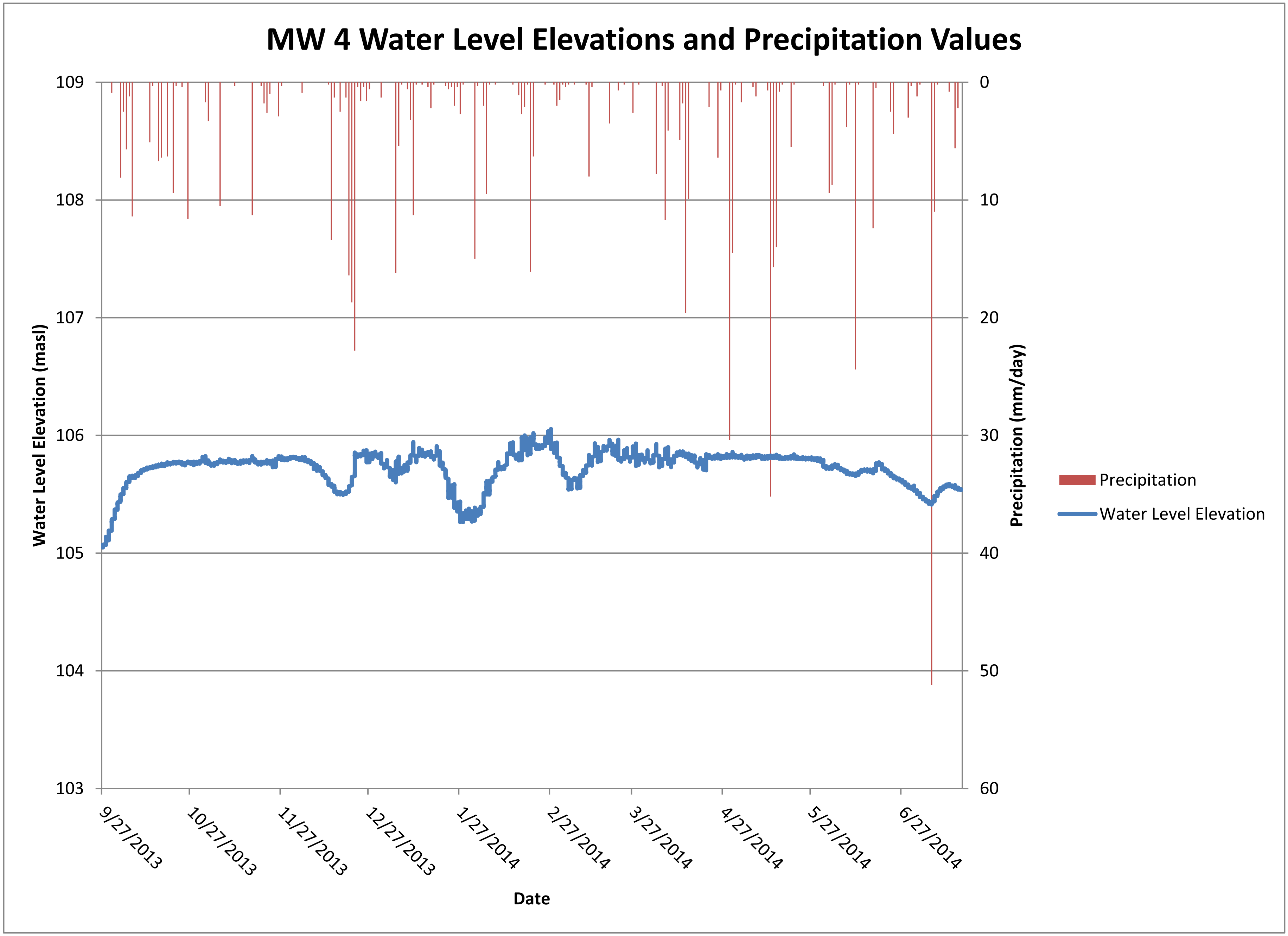
Therefore, the average linear vertical velocity can be determined as follows:

$$v = (9.29 \times 10^{-9} \text{ m/sec}) \times (0.023) / 0.40$$
$$= 5.34 \times 10^{-10} \text{ m/sec}$$
$$= 0.017 \text{ m/year}$$

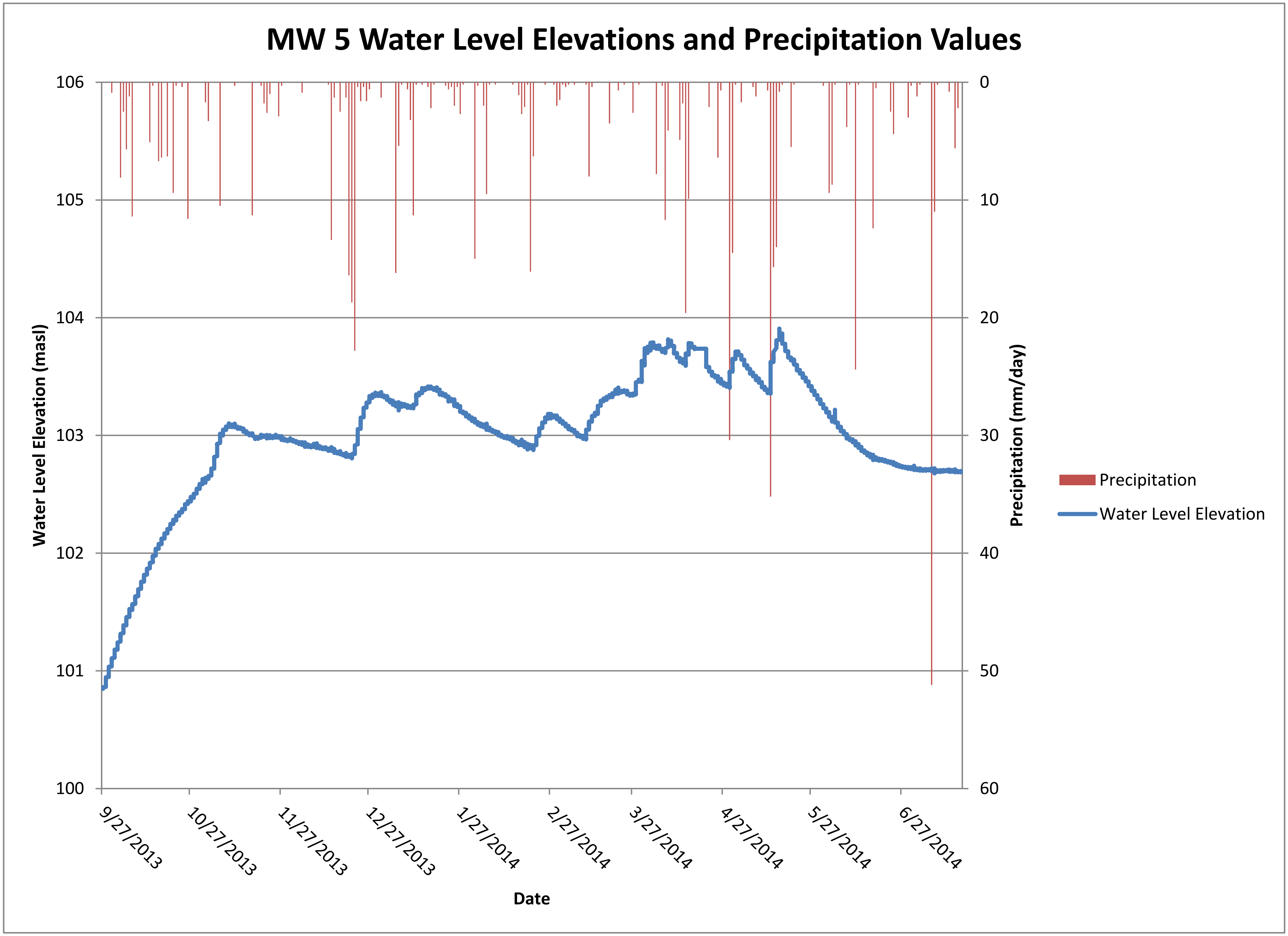
Appendix 4.

Hyetographs Monitoring Wells MW-3, MW-4 and MW-5


MW 3 Water Level Elevations and Precipitation Values
Water Level Elevation (masl)
106
105
104
103
102
101
100
Precipitation (mm/day)
0
10
20
30
40
50
60
9/27/2013
10/27/2013
11/27/2013
12/27/2013
1/27/2014
2/27/2014
3/27/2014
4/27/2014
5/27/2014
6/27/2014
Date
Precipitation
Water Level Elevation



MW 4 Water Level Elevations and Precipitation Values
Water Level Elevation (masl)
Precipitation (mm/day)
109
108
107
106
105
104
103
0
10
20
30
40
50
60
9/27/2013
10/27/2013
11/27/2013
12/27/2013
1/27/2014
2/27/2014
3/27/2014
4/27/2014
5/27/2014
6/27/2014
Date
Precipitation
Water Level Elevation


MW 5 Water Level Elevations and Precipitation Values
Water Level Elevation (masl)
106
105
104
103
102
101
100
Precipitation (mm/day)
0
10
20
30
40
50
60
9/27/2013
10/27/2013
11/27/2013
12/27/2013
1/27/2014
2/27/2014
3/27/2014
4/27/2014
5/27/2014
6/27/2014
Date
Precipitation
Water Level Elevation

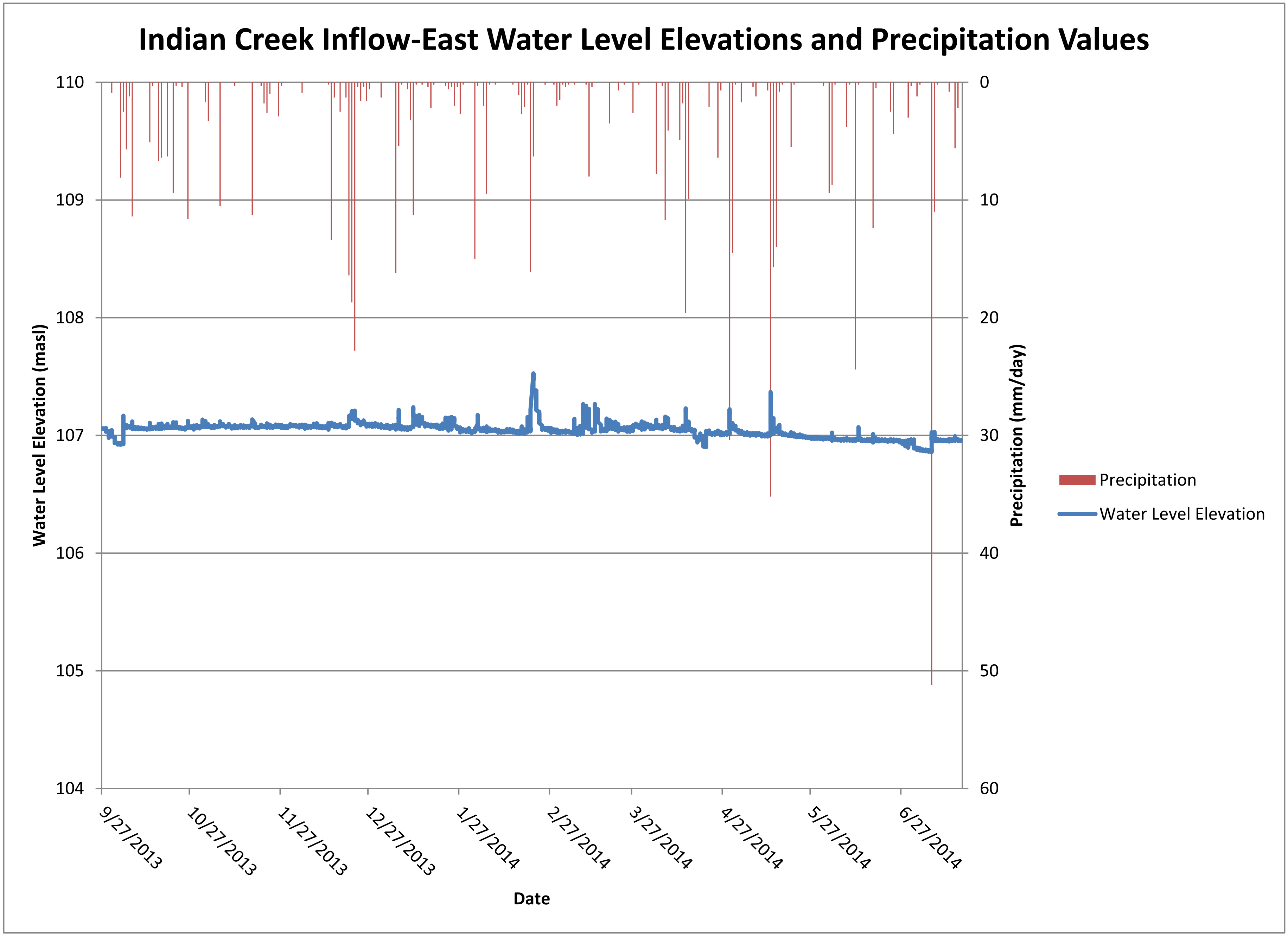
Appendix 5.

Hyetographs for Creek Inflow and Outflow Staff Gauge Locations and Associated Rating Curves

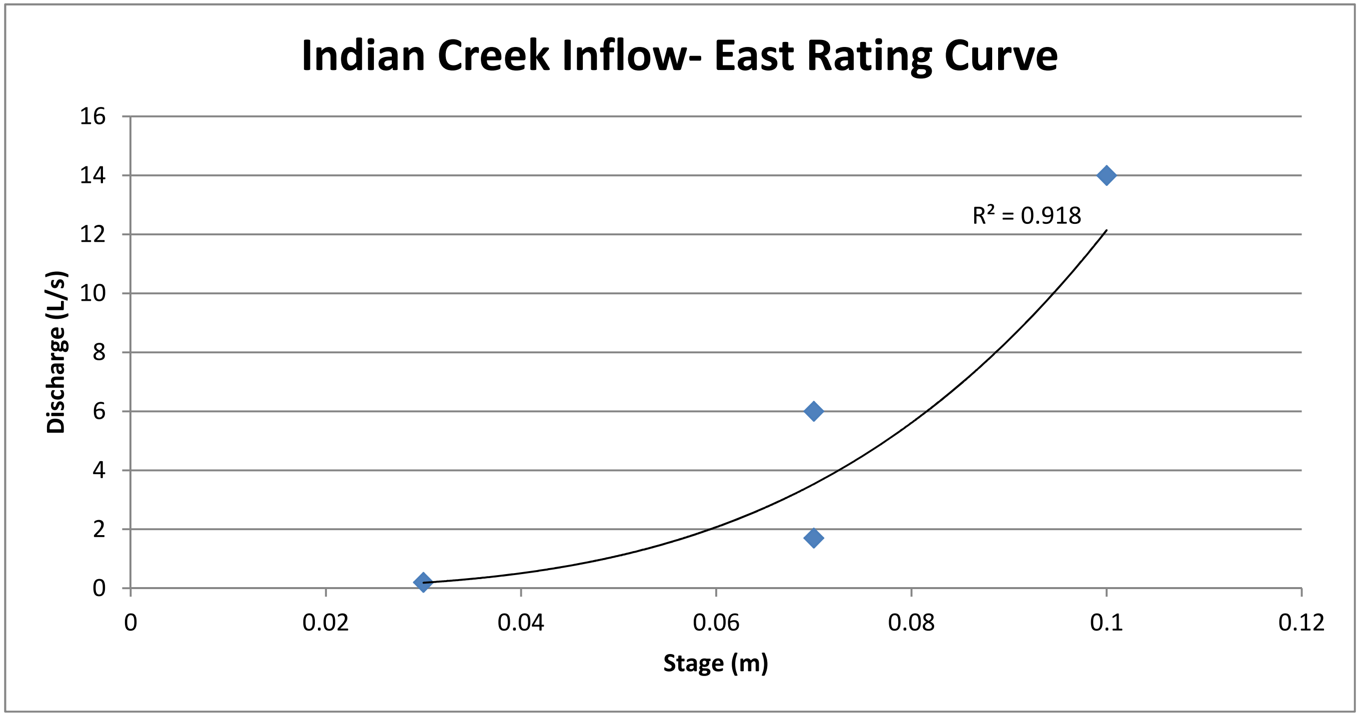
Table 5-1. Stage and Flow Measurements, Indian Creek, Falcon Creek and Grindstone Creek Tributary

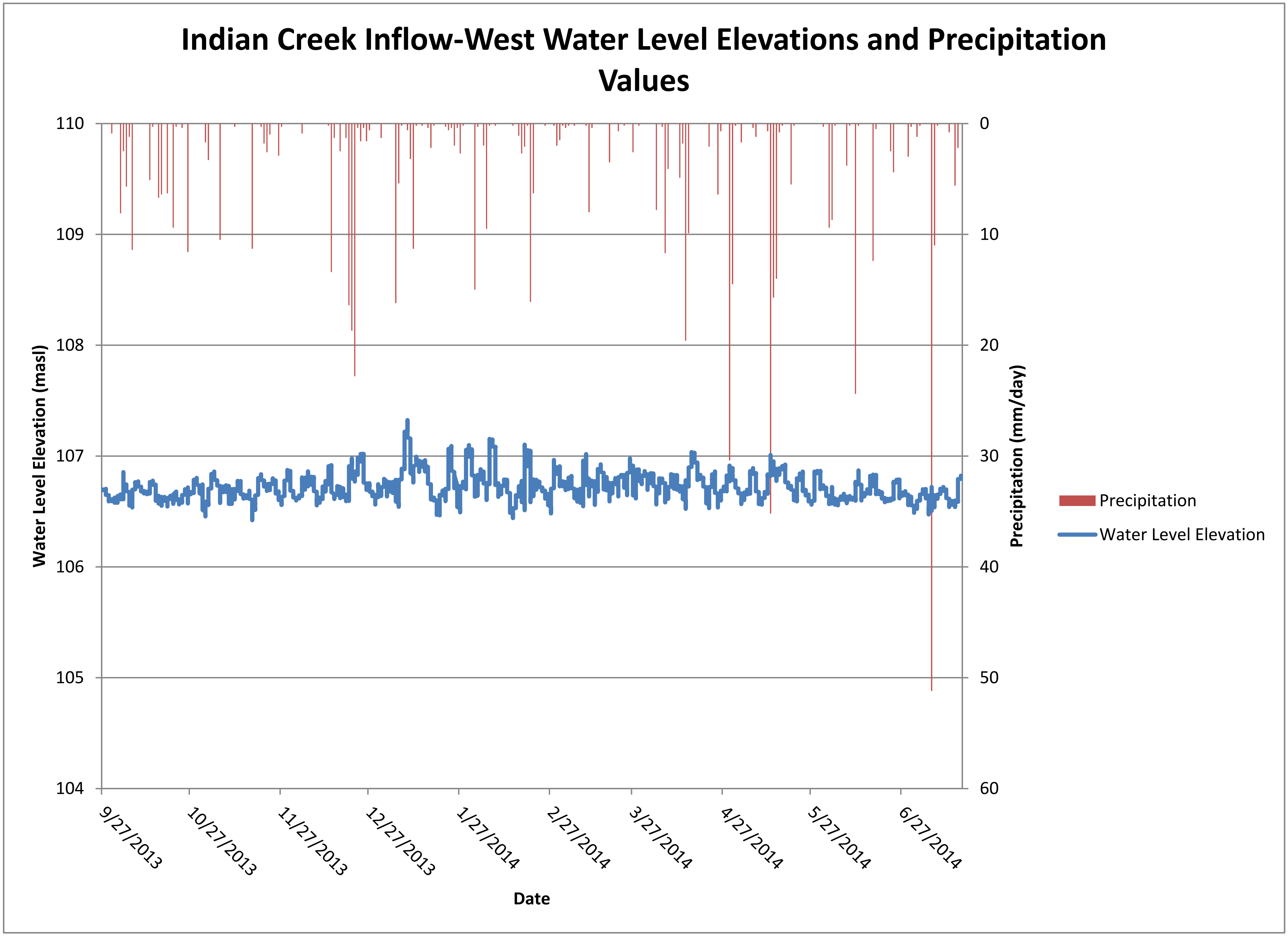
	Sept. 20/13		Nov. 1/13		Dec. 4/13		Jan. 13/14		April 9/14	
Location	Stage (m)	Flow (L/s)	Stage (m)	Flow (L/s)	Stage (m)	Flow (L/s)	Stage (m)	Flow (L/s)	Stage (m)	Flow (L/s)
Indian Creek Inflow-East	0	0	0.07	1.7	0.03	0.2	0.11	3.1	0.07	6.0
Indian Creek Inflow-West	0.06	4.2	0.18	16.9	0.24	28.7	0.44	37.7	0.24	24.1
Indian Creek Outflow	0.10	3.5	0.18	13.2	0.13	5.5	0.37	43.2	0.24	14.6
Falcon Creek Inflow	0.09	0.5	0.15	23.6	0.14	2.4	0.58	67.0	0.18	88.7
Falcon Creek Outflow	0	0	0.37	24.0	0.33	1.7	0.87	85.0	0.38	74.7
Grindstone Creek Trib Inflow	0.07	0.2	0.11	2.0	0.08	0.3	0.19	14.5	0.09	2.1
Grindstone Creek Trib Outflow	0	0	0.08	3.2	0.04	0.2	0.12	7.8	0.07	5.7

	April 30/14	
Location	Stage (m)	Flow (L/s)
Indian Creek Inflow-East	0.10	14.0
Indian Creek Inflow-West	0.28	48.9
Indian Creek Outflow	0.29	43.9
Falcon Creek Inflow	0.26	134.5
Falcon Creek Outflow	0.38	165.4
Grindstone Creek Trib Inflow	0.13	15.0
Grindstone Creek Trib Outflow	0.10	17.0

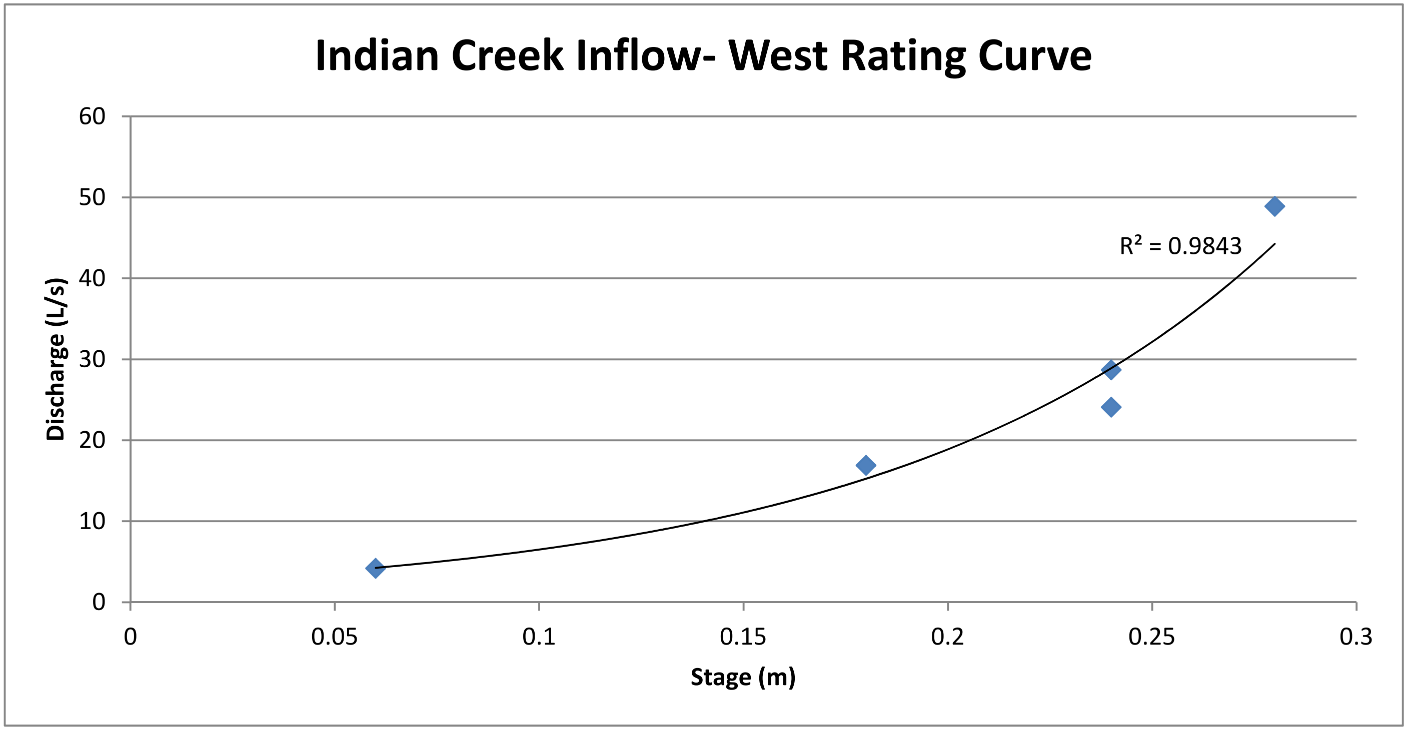


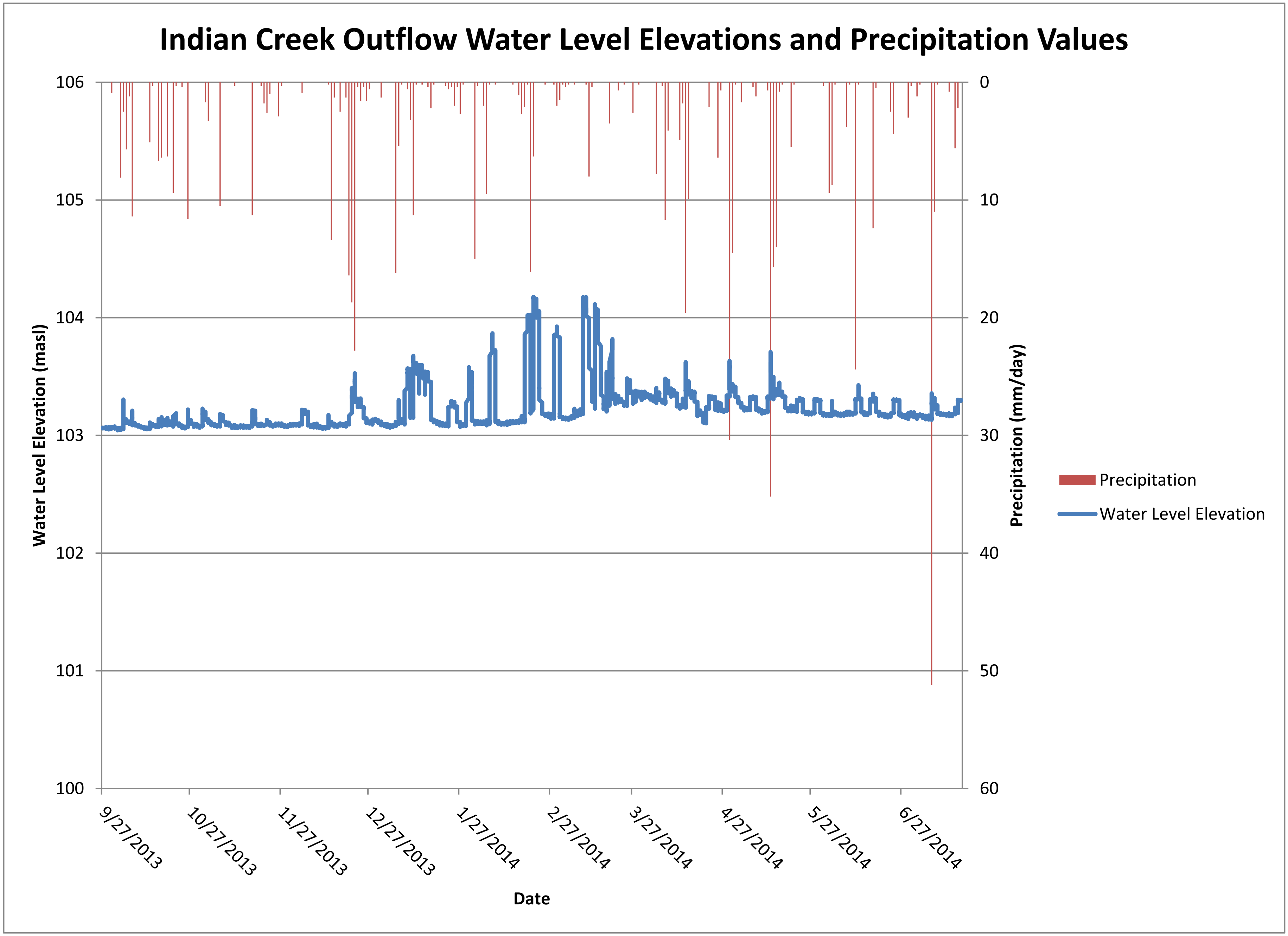
Indian Creek Inflow-East Water Level Elevations and Precipitation Values
Water Level Elevation (masl)
Precipitation (mm/day)
110
109
108
107
106
105
104
0
10
20
30
40
50
60
9/27/2013
10/27/2013
11/27/2013
12/27/2013
1/27/2014
2/27/2014
3/27/2014
4/27/2014
5/27/2014
6/27/2014
Date
Precipitation
Water Level Elevation

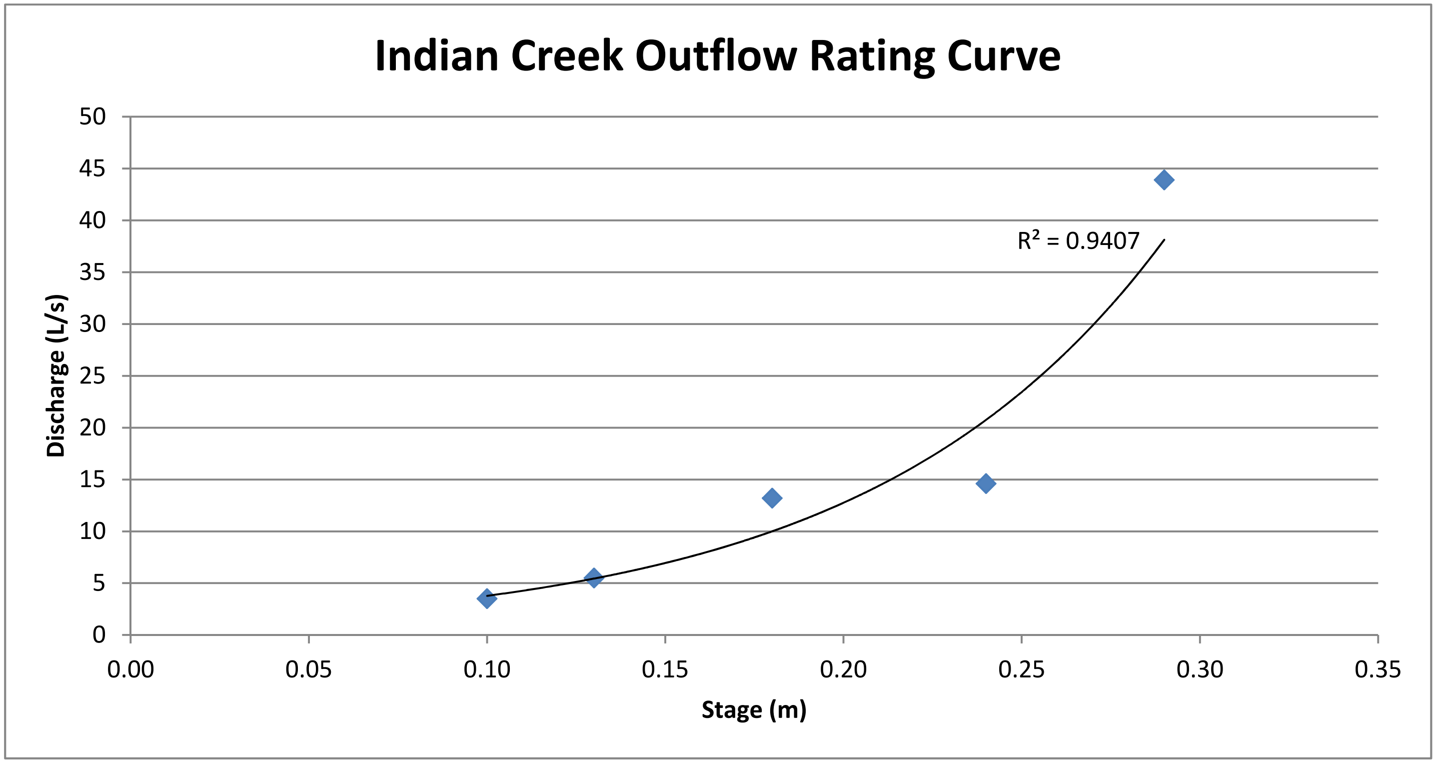

Indian Creek Inflow- East Rating Curve
16
14
12
10
8
6
4
2
0
Discharge (L/s)
R^2 = 0.918
0
0.02
0.04
0.06
0.08
0.1
0.12
Stage (m)

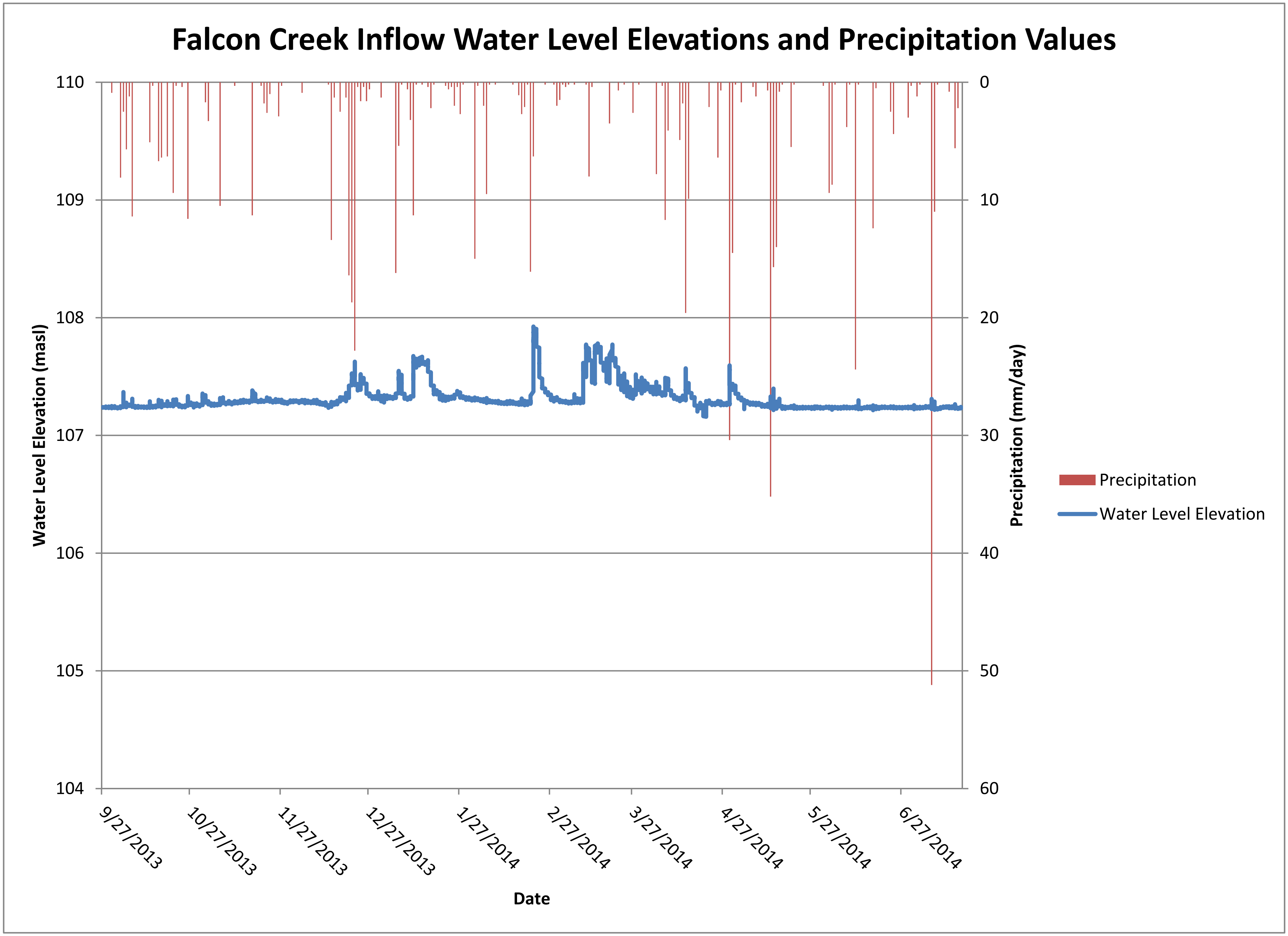


Indian Creek Inflow-West Water Level Elevations and Precipitation Values
Water Level Elevation (masl)
110
109
108
107
106
105
104
Precipitation (mm/day)
0
10
20
30
40
50
60
9/27/2013
10/27/2013
11/27/2013
12/27/2013
1/27/2014
2/27/2014
3/27/2014
4/27/2014
5/27/2014
6/27/2014
Date
Precipitation
Water Level Elevation

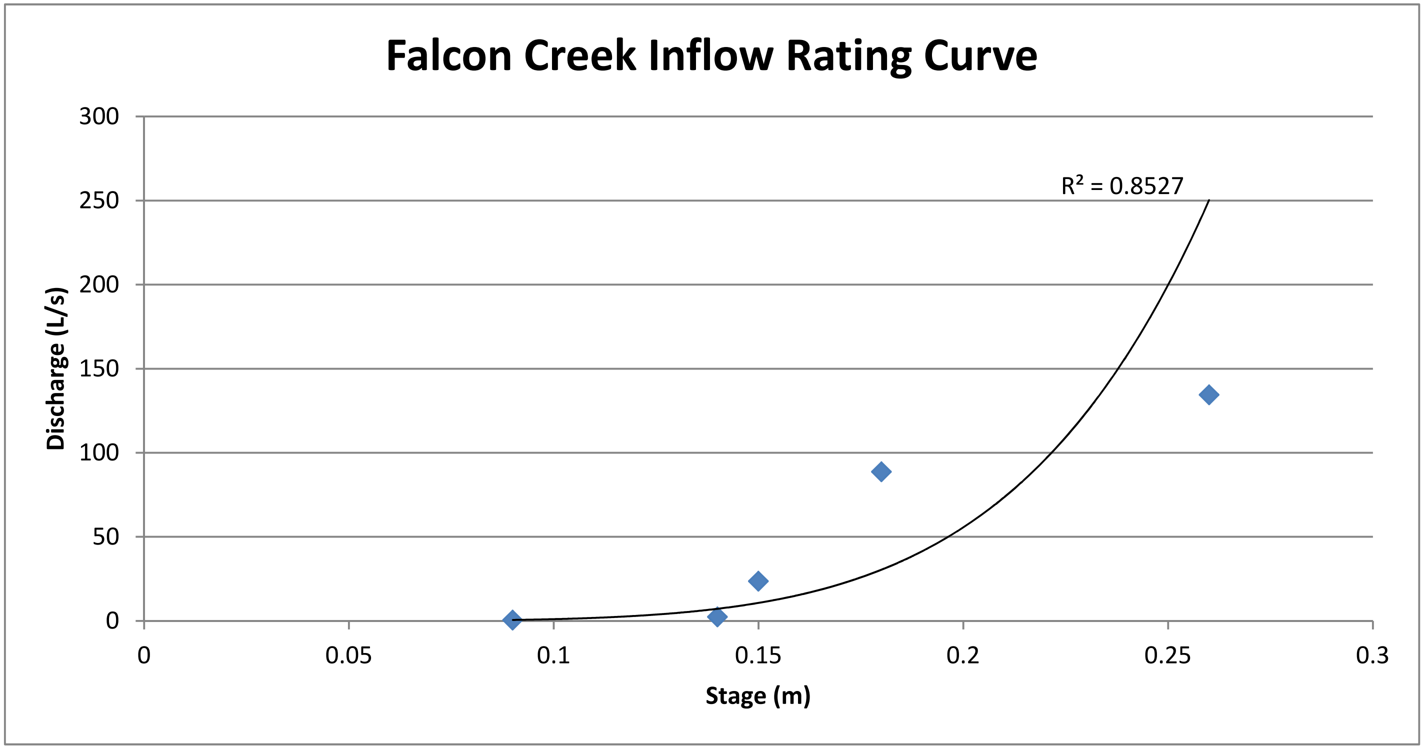

Indian Creek Inflow- West Rating Curve
60
50
40
30
20
10
0
Discharge (L/s)
R² = 0.9843
0
0.05
0.1
0.15
0.2
0.25
0.3
Stage (m)


Indian Creek Outflow Water Level Elevations and Precipitation Values
Water Level Elevation (masl)
106
105
104
103
102
101
100
Precipitation (mm/day)
0
10
20
30
40
50
60
Precipitation
Water Level Elevation
9/27/2013
10/27/2013
11/27/2013
12/27/2013
1/27/2014
2/27/2014
3/27/2014
4/27/2014
5/27/2014
6/27/2014
Date

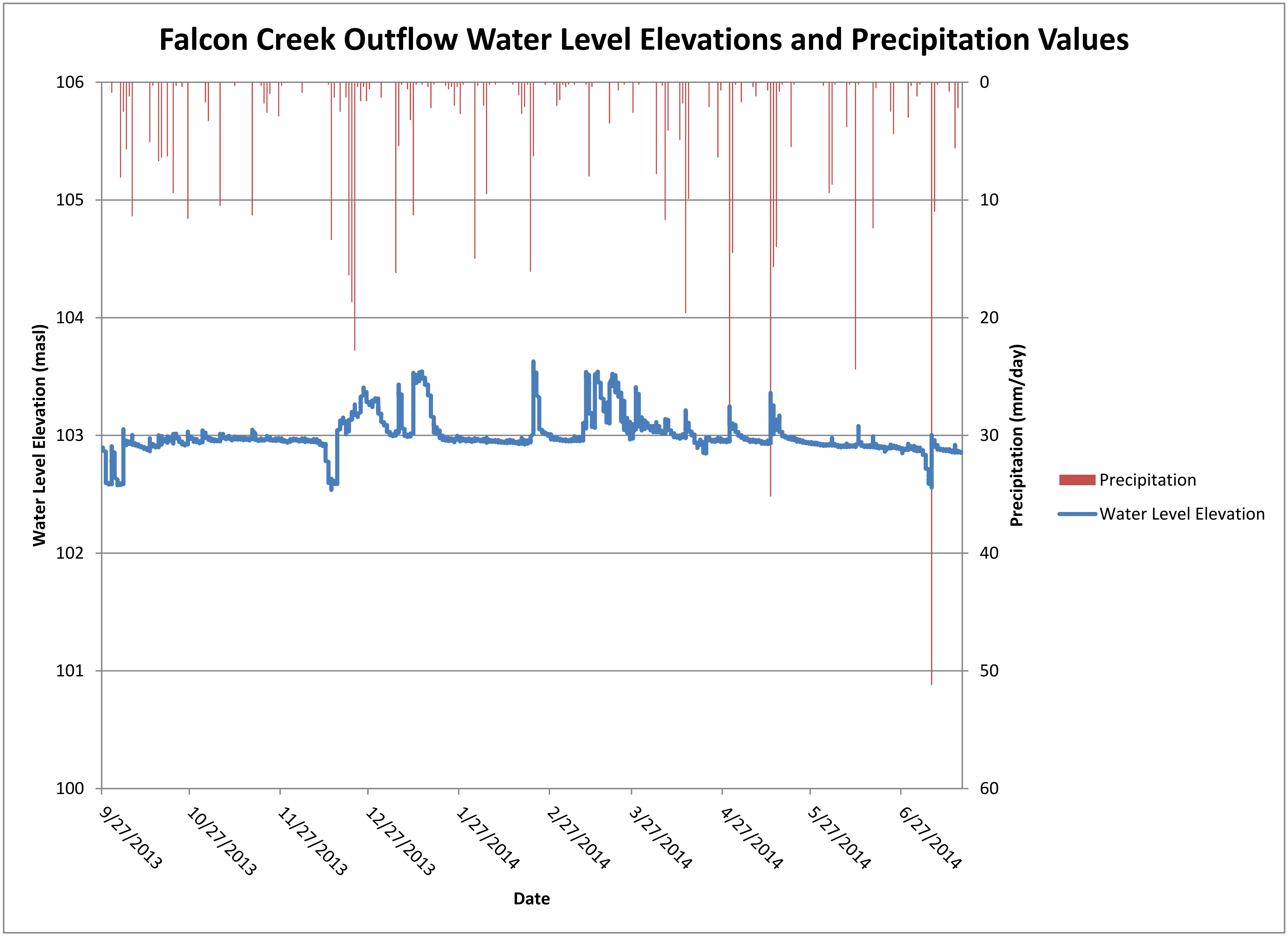

Indian Creek Outflow Rating Curve
50
45
40
35
30
25
20
15
10
5
0
Discharge (L/s)
R² = 0.9407
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Stage (m)



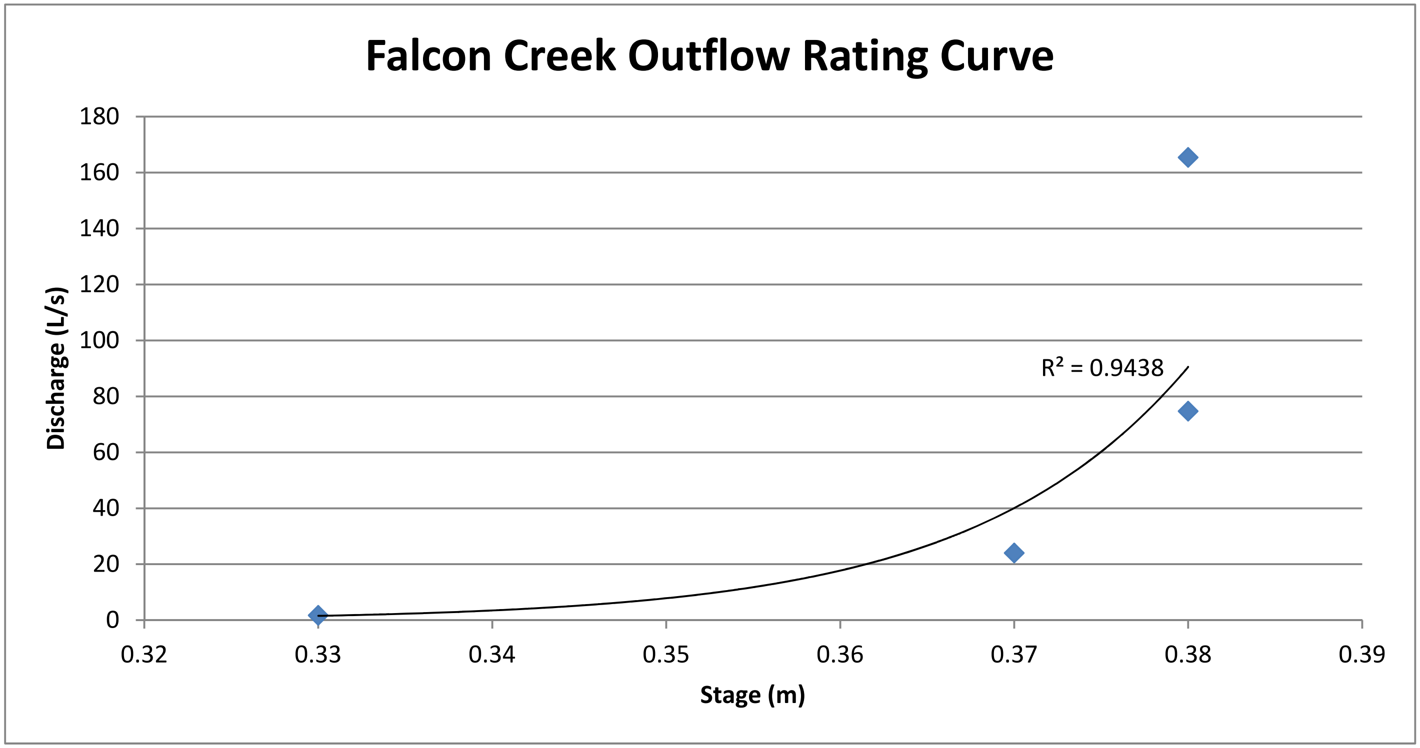
Falcon Creek Inflow Water Level Elevations and Precipitation Values
Water Level Elevation (masl)
110
109
108
107
106
105
104
Precipitation (mm/day)
0
10
20
30
40
50
60
9/27/2013
10/27/2013
11/27/2013
12/27/2013
1/27/2014
2/27/2014
3/27/2014
4/27/2014
5/27/2014
6/27/2014
Date
Precipitation
Water Level Elevation

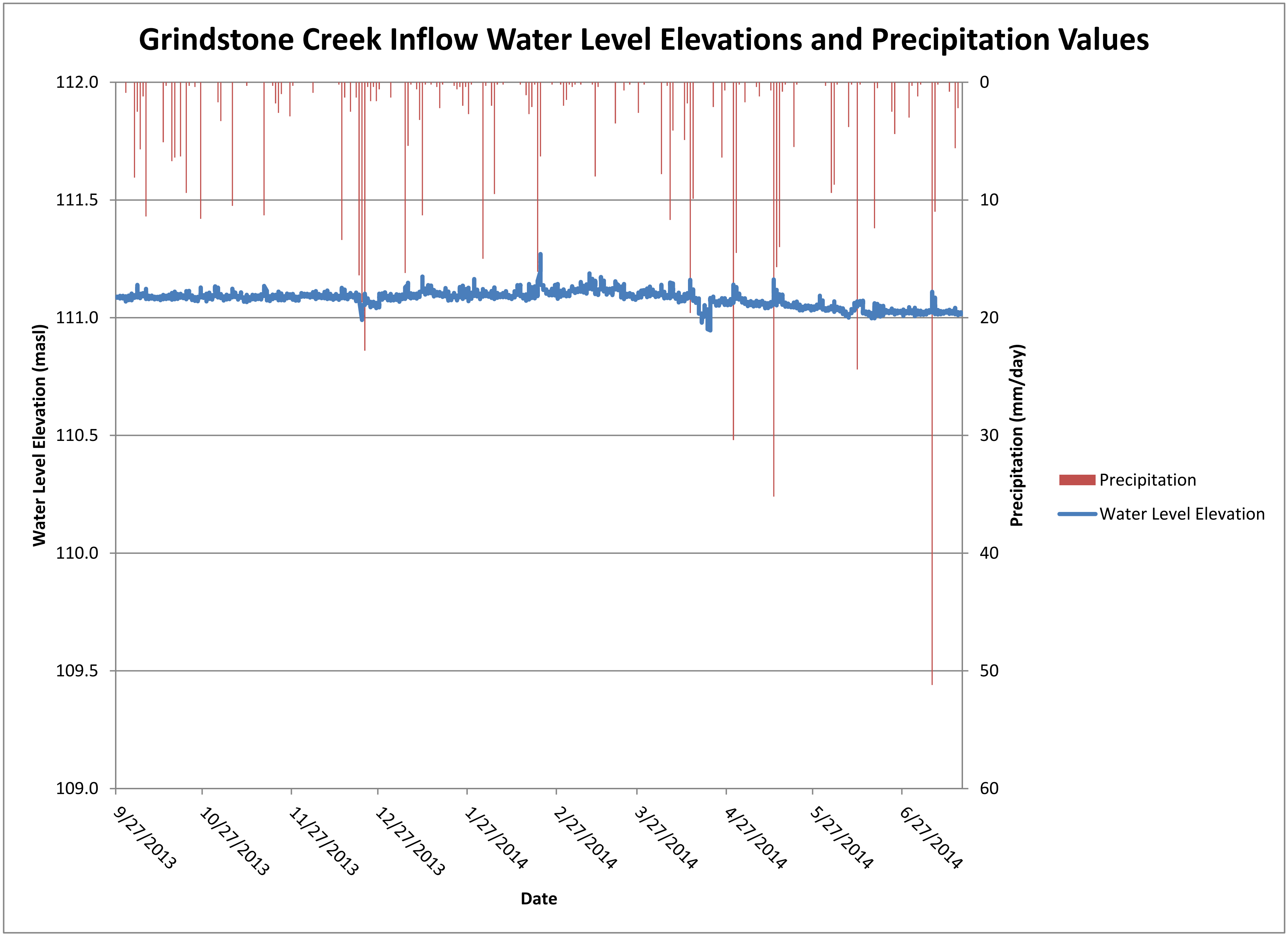


Falcon Creek Inflow Rating Curve
Discharge (L/s)
300
250
200
150
100
50
0
R² = 0.8527
0
0.05
0.1
0.15
0.2
0.25
0.3
Stage (m)

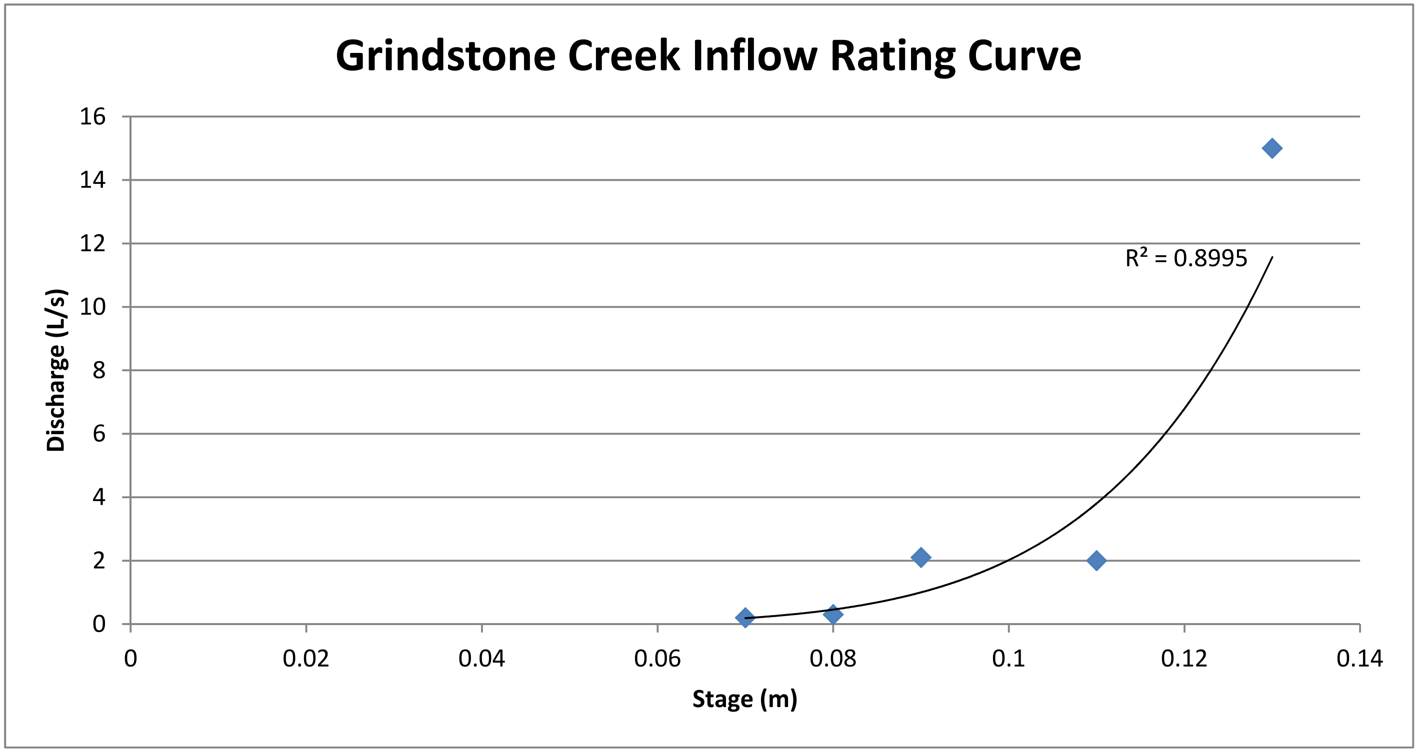


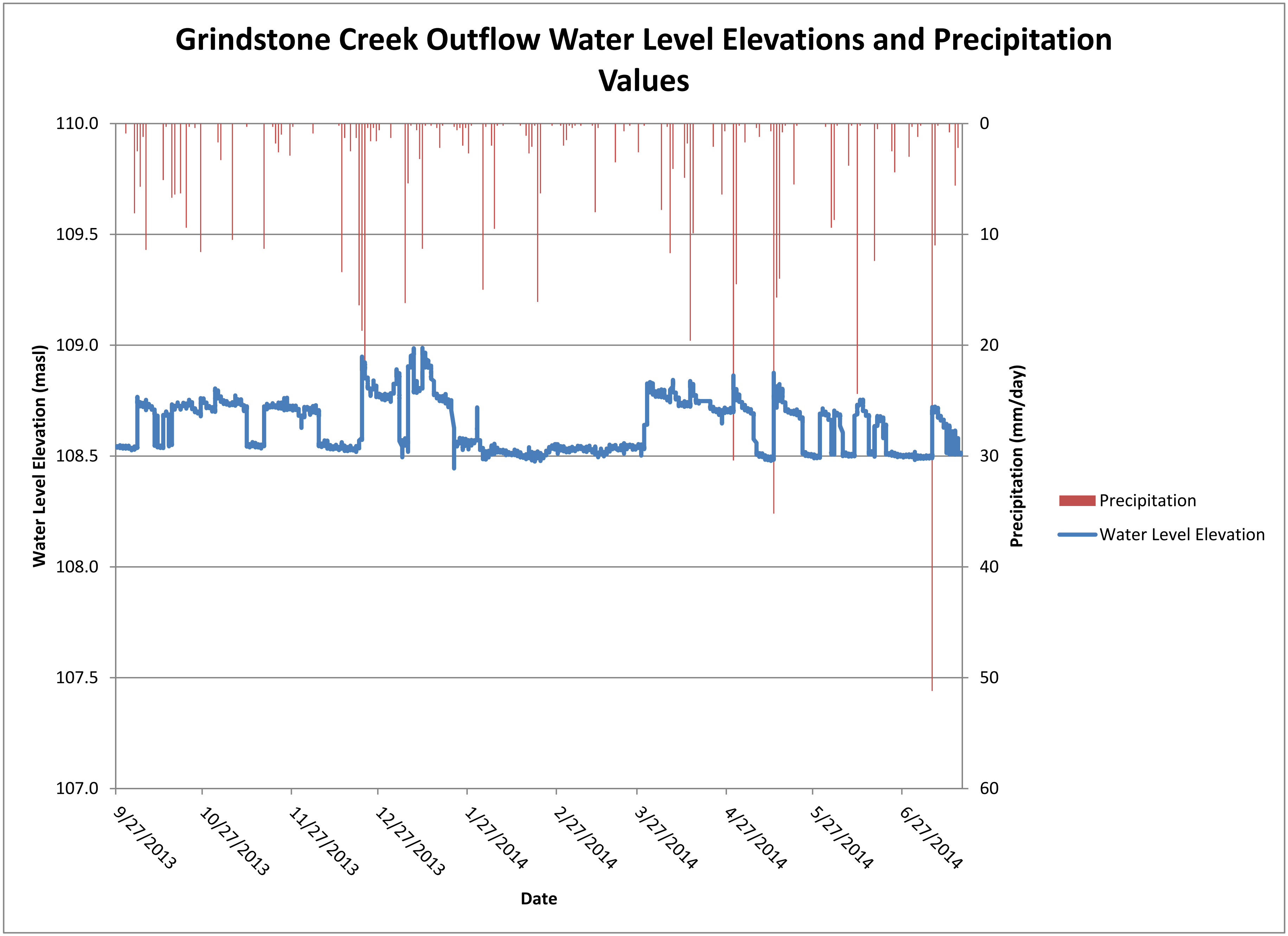
Falcon Creek Outflow Water Level Elevations and Precipitation Values
Water Level Elevation (masl)
Precipitation (mm/day)
106
105
104
103
102
101
100
0
10
20
30
40
50
60
9/27/2013
10/27/2013
11/27/2013
12/27/2013
1/27/2014
2/27/2014
3/27/2014
4/27/2014
5/27/2014
6/27/2014
Date
Precipitation
Water Level Elevation


Falcon Creek Outflow Rating Curve
180
160
140
120
100
80
60
40
20
0
Discharge (L/s)
R² = 0.9438
0.32
0.33
0.34
0.35
0.36
0.37
0.38
0.39
Stage (m)

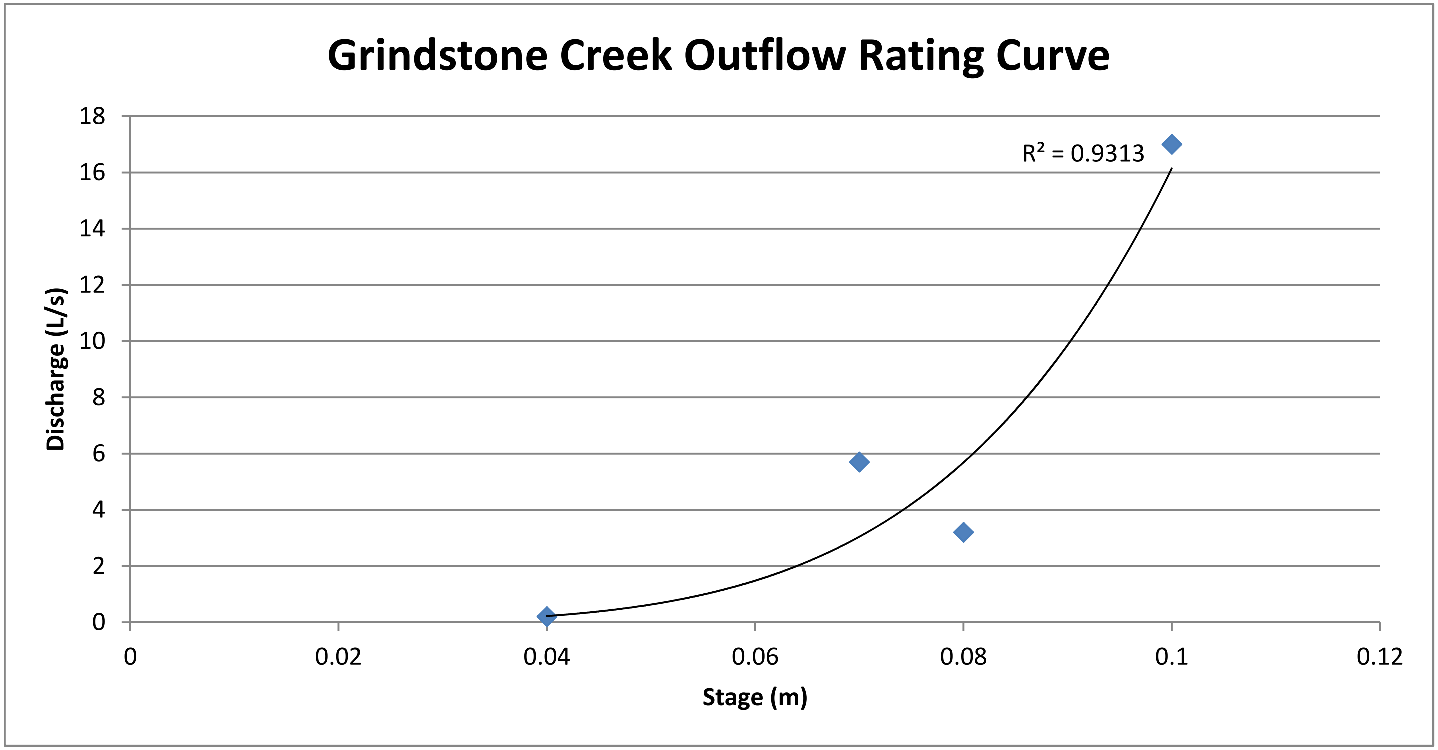


Grindstone Creek Inflow Water Level Elevations and Precipitation Values
Water Level Elevation (masl)
112.0
111.5
111.0
110.5
110.0
109.5
109.0
Precipitation (mm/day)
0
10
20
30
40
50
60
9/27/2013
10/27/2013
11/27/2013
12/27/2013
1/27/2014
2/27/2014
3/27/2014
4/27/2014
5/27/2014
6/27/2014
Date
Precipitation
Water Level Elevation

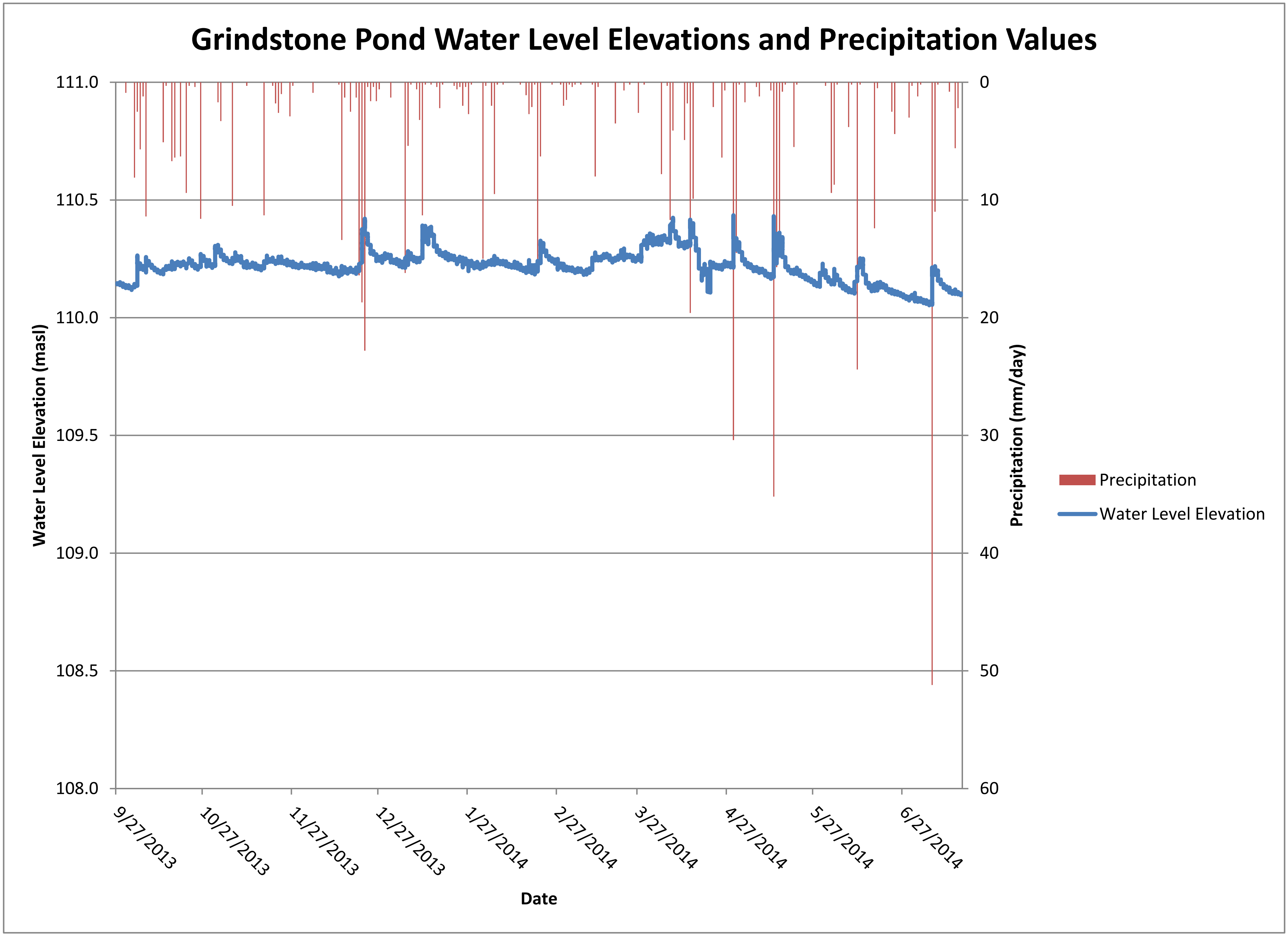

Grindstone Creek Inflow Rating Curve
16
14
12
10
8
6
4
2
0
Discharge (L/s)
R² = 0.8995
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
Stage (m)



Grindstone Creek Outflow Water Level Elevations and Precipitation Values
Water Level Elevation (masl)
110.0
109.5
109.0
108.5
108.0
107.5
107.0
Precipitation (mm/day)
0
10
20
30
40
50
60
9/27/2013
10/27/2013
11/27/2013
12/27/2013
1/27/2014
2/27/2014
3/27/2014
4/27/2014
5/27/2014
6/27/2014
Date
Precipitation
Water Level Elevation



Grindstone Creek Outflow Rating Curve
R² = 0.9313
Discharge (L/s)
18
16
14
12
10
8
6
4
2
0
0
0.02
0.04
0.06
0.08
0.1
0.12
Stage (m)


Grindstone Pond Water Level Elevations and Precipitation Values
Water Level Elevation (masl)
111.0
110.5
110.0
109.5
109.0
108.5
108.0
Precipitation (mm/day)
0
10
20
30
40
50
60
9/27/2013
10/27/2013
11/27/2013
12/27/2013
1/27/2014
2/27/2014
3/27/2014
4/27/2014
5/27/2014
6/27/2014
Date
Precipitation
Water Level Elevation

Appendix 6.

Water Quality Laboratory Certificates of Analysis

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

23-April-2014

Terra-Dynamics Consulting Inc.
Attn : David Slaine

404 Queenston Street, St. Catharines
, L2P 2Y2
Phone: 905-646-7931, Fax:

Date Rec. : 11 April 2014
LR Report: **CA15178-APR14**
Reference: Aldershot

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: Indian Creek Inflow East	6: Indian Creek Inflow West	7: Indian Creek Outflow	8: Falcon Creek Outflow	9: Falcon Creek Inflow	10: GS Creek Outflow	11: GS Creek Inflow
Sample Date & Time			10-Apr-14 12:15	10-Apr-14 12:30	10-Apr-14 12:45	10-Apr-14 13:30	10-Apr-14 13:50	10-Apr-14 14:15	10-Apr-14 14:40
Temperature Upon Receipt [°C]	---	---	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Alachlor [ug/L]	22-Apr-14	14:49	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Aldicarb [ug/L]	22-Apr-14	14:49	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aldrin + Dieldrin [ug/L]	22-Apr-14	14:49	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aldrin [ug/L]	22-Apr-14	14:49	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dieldrin [ug/L]	22-Apr-14	14:49	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Atrazine + N-dealkylated metabolites [ug/L]	22-Apr-14	14:49	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.05
Atrazine [ug/L]	22-Apr-14	14:49	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Desethyl atrazine [ug/L]	22-Apr-14	14:50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.05
Azinphos-methyl [ug/L]	22-Apr-14	14:50	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Bendiocarb [ug/L]	22-Apr-14	14:50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Carbaryl [ug/L]	22-Apr-14	14:50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Carbofuran [ug/L]	22-Apr-14	14:50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chlordane (total) [ug/L]	22-Apr-14	14:50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
a-chlordane [ug/L]	22-Apr-14	14:50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
g-chlordane [ug/L]	22-Apr-14	14:50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Oxychlordane [ug/L]	22-Apr-14	14:50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chlorpyrifos [ug/L]	22-Apr-14	14:50	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Cyanazine [ug/L]	22-Apr-14	14:50	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Diazinon [ug/L]	22-Apr-14	14:50	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02

SGS Canada Inc.
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LR Report : **CA15178-APR14**

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: Indian Creek Inflow East	6: Indian Creek Inflow West	7: Indian Creek Outflow	8: Falcon Creek Outflow	9: Falcon Creek Inflow	10: GS Creek Outflow	11: GS Creek Inflow
(DDT) + Metabolites [ug/L]	22-Apr-14	14:50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
op-DDT [ug/L]	22-Apr-14	14:50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
pp-DDD [ug/L]	22-Apr-14	14:50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
pp-DDE [ug/L]	22-Apr-14	14:50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
pp-DDT [ug/L]	22-Apr-14	14:50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dimethoate [ug/L]	22-Apr-14	14:50	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Diuron [ug/L]	22-Apr-14	14:50	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Heptachlor + Heptachlor Epoxide [ug/L]	22-Apr-14	14:50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Heptachlor [ug/L]	22-Apr-14	14:50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Heptachlor epoxide [ug/L]	22-Apr-14	14:50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Lindane [ug/L]	22-Apr-14	16:01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Malathion [ug/L]	22-Apr-14	16:01	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Methoxychlor [ug/L]	22-Apr-14	16:01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Metolachlor [ug/L]	22-Apr-14	16:01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Metribuzin [ug/L]	22-Apr-14	16:01	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.05
Parathion [ug/L]	22-Apr-14	16:01	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Phorate [ug/L]	22-Apr-14	16:01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Prometryne [ug/L]	22-Apr-14	16:01	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Simazine [ug/L]	22-Apr-14	16:01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Temephos [ug/L]	22-Apr-14	16:01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Terbufos [ug/L]	22-Apr-14	16:01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Triallate [ug/L]	22-Apr-14	16:01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Trifluralin [ug/L]	22-Apr-14	16:01	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
2,4-dichlorophenoxyacetic acid (2,4-D) [ug/L]	17-Apr-14	12:11	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
2,4,5-trichlorophenoxyacetic acid (2,4,5-T) [ug/L]	17-Apr-14	12:11	< 0.22	< 0.22	< 0.22	< 0.22	< 0.22	< 0.22	< 0.22
Bromoxynil [ug/L]	17-Apr-14	12:11	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33
Dicamba [ug/L]	17-Apr-14	12:11	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Diclofop-methyl [ug/L]	17-Apr-14	12:11	< 0.40	< 0.40	< 0.40	< 0.40	< 0.40	< 0.40	< 0.40
Dinoseb [ug/L]	17-Apr-14	12:11	< 0.36	< 0.36	< 0.36	< 0.36	< 0.36	< 0.36	< 0.36
Picloram [ug/L]	17-Apr-14	12:11	< 1	< 1	< 1	< 1	< 1	< 1	< 1

SGS Canada Inc.
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Brian Graham B.Sc.
Project Specialist
Environmental Services, Analytical

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23-April-2014

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Attn : David Slaine

404 Queenston Street, St. Catharines
, L2P 2Y2
Phone: 905-646-7931, Fax:

Date Rec. : 11 April 2014
LR Report: **CA15170-APR14**
Reference: Aldershot

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: Indian Creek Inflow East	6: Indian Creek Inflow West	7: Indian Creek Outflow	8: Falcon Creek Outflow	9: Falcon Creek Inflow	10: GS Creek Outflow	11: GS Creek Inflow
Sample Date & Time			10-Apr-14 12:15	10-Apr-14 12:30	10-Apr-14 12:45	10-Apr-14 13:30	10-Apr-14 13:50	10-Apr-14 14:15	10-Apr-14 14:40
Temperature Upon Receipt [°C]	---	---	14.0	14.0	14.0	14.0	14.0	14.0	14.0
Dissolved Oxygen [mg/L]	15-Apr-14	12:05	10.6	10.8	10.3	11.1	11.1	9.8	10.5
pH [no unit]	15-Apr-14	15:01	8.32	8.14	8.15	8.30	8.29	8.03	8.09
Total Suspended Solids [mg/L]	16-Apr-14	15:07	13	149	72	39	53	9	23
Ammonia+Ammonium (N) [mg/L]	16-Apr-14	15:12	0.1	0.4	< 0.1	< 0.1	< 0.1	< 0.1	0.1
Total Kjeldahl Nitrogen [as N mg/L]	15-Apr-14	19:23	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chloride [mg/L]	16-Apr-14	16:38	390	190	200	120	110	630	450
Sulphate [mg/L]	15-Apr-14	20:31	71	190	190	47	48	32	37
Nitrite (as N) [mg/L]	15-Apr-14	16:46	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Nitrate (as N) [mg/L]	15-Apr-14	16:46	0.19	0.95	0.90	0.21	0.20	< 0.06	0.29
Nitrate + Nitrite (as N) [mg/L]	15-Apr-14	16:46	0.19	0.95	0.90	0.21	0.20	< 0.06	0.29
Hardness [mg/L as CaCO3]	16-Apr-14	09:02	453	361	365	271	277	311	295
Silver (total) [mg/L]	15-Apr-14	15:31	0.000007	< 0.000002	< 0.000002	0.000005	0.000003	0.000005	0.000005
Aluminum (total) [mg/L]	16-Apr-14	09:02	0.39	6.68	4.78	1.70	1.69	0.54	2.26
Arsenic (total) [mg/L]	15-Apr-14	15:31	0.0009	0.0030	0.0016	0.0008	0.0010	0.0006	0.0012
Barium (total) [mg/L]	15-Apr-14	15:31	0.106	0.0932	0.0829	0.0503	0.0548	0.0660	0.0712
Beryllium (total) [mg/L]	15-Apr-14	15:31	0.000014	0.000317	0.000169	0.000054	0.000070	0.000021	0.000054
Boron (total) [mg/L]	15-Apr-14	15:31	0.167	0.330	0.308	0.0544	0.0569	0.0302	0.0394
Bismuth (total) [mg/L]	15-Apr-14	15:31	< 0.000007	0.000022	< 0.000007	< 0.000007	0.000008	0.000010	0.000009
Calcium (total) [mg/L]	16-Apr-14	09:02	127	108	109	70.4	72.6	87.9	81.9

OnLine LIMS

000014807

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

LR Report : CA15170-APR14

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: Indian Creek Inflow East	6: Indian Creek Inflow West	7: Indian Creek Outflow	8: Falcon Creek Outflow	9: Falcon Creek Inflow	10: GS Creek Outflow	11: GS Creek Inflow
Cadmium (total) [mg/L]	15-Apr-14	15:31	0.000018	0.000083	0.000044	0.000004	0.000004	< 0.000004	< 0.000004
Cobalt (total) [mg/L]	15-Apr-14	15:31	0.000371	0.00393	0.00176	0.000691	0.000920	0.000279	0.000585
Chromium (total) [mg/L]	15-Apr-14	15:31	0.00087	0.00689	0.00433	0.00146	0.00157	0.00187	0.00278
Copper (total) [mg/L]	15-Apr-14	15:31	0.00264	0.0167	0.00591	0.00185	0.00254	0.00690	0.00371
Iron (total) [mg/L]	16-Apr-14	09:02	0.398	5.15	3.43	1.40	1.60	0.473	1.38
Potassium (total) [mg/L]	16-Apr-14	09:02	11.5	14.0	13.2	4.87	4.86	6.53	6.51
Lithium (total) [mg/L]	15-Apr-14	15:31	0.0143	0.0526	0.0458	0.00717	0.00768	0.00625	0.00988
Magnesium (total) [mg/L]	16-Apr-14	09:02	33.0	22.4	22.9	23.1	23.4	22.2	22.1
Manganese (total) [mg/L]	15-Apr-14	15:31	0.0195	0.111	0.0712	0.0470	0.0854	0.0560	0.0611
Molybdenum (total) [mg/L]	15-Apr-14	15:31	0.00113	0.00677	0.00581	0.00044	0.00042	0.00201	0.00253
Sodium (total) [mg/L]	21-Apr-14	09:54	209	112	113	69.6	68.5	312	206
Nickel (total) [mg/L]	15-Apr-14	15:31	0.0028	0.0109	0.0063	0.0026	0.0030	0.0029	0.0032
Phosphorus (total) [mg/L]	16-Apr-14	09:02	0.052	0.125	0.105	0.068	0.090	0.093	0.146
Lead (total) [mg/L]	15-Apr-14	15:32	0.00046	0.00231	0.00153	0.00048	0.00096	0.00079	0.00178
Antimony (total) [mg/L]	15-Apr-14	15:32	0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0002	0.0002
Selenium (total) [mg/L]	15-Apr-14	15:32	< 0.001	0.005	0.009	< 0.001	< 0.001	0.001	0.001
Silicon (total) [mg/L]	16-Apr-14	09:02	3.79	16.6	12.7	5.99	5.81	3.17	7.57
Tin (total) [mg/L]	15-Apr-14	15:32	0.00015	0.00022	0.00021	0.00016	0.00010	0.00010	0.00039
Strontium (total) [mg/L]	16-Apr-14	09:02	1.23	1.69	1.67	0.373	0.376	0.810	1.05
Titanium (total) [mg/L]	15-Apr-14	15:32	0.00810	0.146	0.0958	0.0281	0.0245	0.0120	0.0465
Thallium (total) [mg/L]	15-Apr-14	15:32	0.000011	0.000097	0.000051	0.000012	0.000014	0.000005	0.000022
Uranium (total) [mg/L]	15-Apr-14	15:32	0.00686	0.00661	0.00604	0.00156	0.00159	0.000808	0.00148
Vanadium (total) [mg/L]	15-Apr-14	15:32	0.00097	0.0111	0.00731	0.00254	0.00270	0.00103	0.00315
Zinc (total) [mg/L]	16-Apr-14	09:02	0.032	0.035	0.030	0.010	0.008	0.037	0.041
Total Coliform [cfu/100mL]	14-Apr-14	11:17	680	2000	1300	420	460	560	43
E. Coli [cfu/100mL]	14-Apr-14	11:17	15	1	2	4	3	4	3

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25-July-2014

Terra-Dynamics Consulting Inc.
Attn : David Slaine

404 Queenston Street, St. Catharines
, L2P 2Y2
Phone: 905-646-7931, Fax:

Date Rec. : 18 July 2014
LR Report: **CA15250-JUL14**
Reference: Aldershot

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: Indian Creek Inflow West	6: Indian Creek Outflow	7: Falcon Creek Outflow	8: Falcon Creek Inflow	9: Grindstone Creek Outflow	10: Grindstone Creek Inflow
Sample Date & Time			17-Jul-14 12:35	17-Jul-14 13:15	17-Jul-14 15:00	17-Jul-14 15:30	17-Jul-14 16:10	17-Jul-14 17:10
Temperature Upon Receipt [°C]	---	---	22.0	22.0	22.0	22.0	22.0	22.0
pH [no unit]	22-Jul-14	12:39	8.05	8.05	8.41	8.39	8.18	8.22
Total Suspended Solids [mg/L]	22-Jul-14	15:38	15	18	12	8	6	55
Ammonia+Ammonium (N) [mg/L]	22-Jul-14	12:17	0.2	< 0.1	< 0.1	0.2	0.2	0.2
Total Kjeldahl Nitrogen [as N mg/L]	23-Jul-14	10:11	< 0.5	< 0.5	< 0.5	< 0.5	0.5	< 0.5
Chloride [mg/L]	23-Jul-14	11:14	170	160	210	230	340	160
Sulphate [mg/L]	23-Jul-14	11:14	420	410	110	120	39	70
Nitrite (as N) [mg/L]	22-Jul-14	12:22	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.03
Nitrate (as N) [mg/L]	22-Jul-14	12:22	0.76	0.70	0.10	< 0.06	0.11	0.56
Nitrate + Nitrite (as N) [mg/L]	22-Jul-14	12:22	0.76	0.70	0.10	< 0.06	0.11	0.59
Hardness [mg/L as CaCO3]	23-Jul-14	12:14	511	497	420	417	162	366
Silver (total) [mg/L]	23-Jul-14	11:30	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002
Aluminum (total) [mg/L]	23-Jul-14	12:14	0.55	0.62	0.41	0.27	0.11	2.57
Arsenic (total) [mg/L]	23-Jul-14	11:30	0.0020	0.0019	0.0015	0.0013	0.0021	0.0026
Barium (total) [mg/L]	23-Jul-14	11:30	0.0941	0.0921	0.0810	0.0809	0.0358	0.0823
Beryllium (total) [mg/L]	23-Jul-14	11:30	0.000021	0.000022	0.000013	0.000007	< 0.000007	0.000087
Boron (total) [mg/L]	23-Jul-14	11:30	0.725	0.688	0.232	0.238	0.0632	0.114

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Bismuth (total) [mg/L]	23-Jul-14	11:30	< 0.000007	< 0.000007	< 0.000007	< 0.000007	< 0.000007	< 0.000007
Calcium (total) [mg/L]	23-Jul-14	12:14	157	153	106	103	38.6	88.0
Cadmium (total) [mg/L]	23-Jul-14	11:31	< 0.000003	< 0.000003	0.000006	0.000007	0.000012	0.000063
Cobalt (total) [mg/L]	23-Jul-14	11:31	0.000407	0.000416	0.000391	0.000325	0.000393	0.00156
Chromium (total) [mg/L]	23-Jul-14	11:31	0.00081	0.00096	0.00070	0.00074	0.00291	0.00425
Copper (total) [mg/L]	23-Jul-14	11:31	0.00192	0.00164	0.00296	0.00343	0.00451	0.00777
Iron (total) [mg/L]	23-Jul-14	12:14	0.485	0.535	0.348	0.242	0.188	2.69
Potassium (total) [mg/L]	23-Jul-14	12:14	20.0	19.3	10.3	11.4	9.12	11.8
Lithium (total) [mg/L]	23-Jul-14	11:31	0.106	0.0994	0.0251	0.0282	0.0136	0.0429
Magnesium (total) [mg/L]	23-Jul-14	12:14	28.7	28.1	37.8	38.7	15.9	35.6
Manganese (total) [mg/L]	23-Jul-14	11:31	0.0317	0.0282	0.0248	0.0677	0.0397	0.206
Molybdenum (total) [mg/L]	23-Jul-14	11:31	0.0171	0.0162	0.00245	0.00237	0.00369	0.00488
Sodium (total) [mg/L]	24-Jul-14	13:39	109	101	113	124	173	70.0
Nickel (total) [mg/L]	23-Jul-14	11:31	0.0025	0.0025	0.0024	0.0025	0.0045	0.0049
Phosphorus (total) [mg/L]	23-Jul-14	12:14	0.035	0.032	0.054	0.027	0.072	0.243
Lead (total) [mg/L]	23-Jul-14	11:31	0.00066	0.00034	0.00028	0.00080	0.00092	0.00460
Antimony (total) [mg/L]	23-Jul-14	11:31	0.0003	0.0004	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Selenium (total) [mg/L]	23-Jul-14	11:31	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Silicon (total) [mg/L]	23-Jul-14	12:14	2.81	3.06	3.16	2.73	0.70	10.1
Tin (total) [mg/L]	23-Jul-14	11:31	0.00021	0.00023	0.00026	0.00043	0.00045	0.00048
Strontium (total) [mg/L]	23-Jul-14	12:14	2.41	2.35	1.39	1.73	0.562	1.37
Titanium (total) [mg/L]	23-Jul-14	11:31	0.0100	0.0118	0.00718	0.00545	0.00205	0.0619
Thallium (total) [mg/L]	23-Jul-14	11:31	0.000279	0.000238	0.000005	< 0.000005	< 0.000005	0.000026
Uranium (total) [mg/L]	23-Jul-14	11:31	0.00777	0.00699	0.00450	0.00462	0.000647	0.00294
Vanadium (total) [mg/L]	23-Jul-14	11:31	0.00217	0.00210	0.00132	0.00092	0.00097	0.00661
Zinc (total) [mg/L]	23-Jul-14	12:14	0.008	0.007	0.009	0.017	0.027	0.042
Total Coliform [cfu/100mL]	21-Jul-14	08:51	1180	2700	1740	2300	1480	56000
E. Coli [cfu/100mL]	21-Jul-14	08:51	78	113	480	308	41	2780
Alachlor [ug/L]	24-Jul-14	15:57	< 0.04	< 0.04	< 0.02	< 0.02	< 0.02	< 0.02
Aldicarb [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Aldrin + Dieldrin [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Aldrin [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01

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Dieldrin [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Atrazine + N-dealkylated metabolites [ug/L]	24-Jul-14	15:57	0.07	0.06	0.01	0.01	0.05	0.04
Atrazine [ug/L]	24-Jul-14	15:57	0.05	0.03	0.01	0.01	0.03	0.02
Desethyl atrazine [ug/L]	24-Jul-14	15:57	0.02	0.02	< 0.01	< 0.01	0.02	0.02
Azinphos-methyl [ug/L]	24-Jul-14	15:57	< 0.04	< 0.04	< 0.02	< 0.02	< 0.02	< 0.02
Bendiocarb [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Carbaryl [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Carbofuran [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Chlordane (total) [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
a-chlordane [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
g-chlordane [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Oxychlordane [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Chlorpyrifos [ug/L]	24-Jul-14	15:57	< 0.04	< 0.04	< 0.02	< 0.02	< 0.02	< 0.02
Cyanazine [ug/L]	24-Jul-14	15:57	< 0.06	< 0.06	< 0.03	< 0.03	< 0.03	< 0.03
Diazinon [ug/L]	24-Jul-14	15:57	< 0.04	< 0.04	< 0.02	< 0.02	< 0.02	< 0.02
(DDT) + Metabolites [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
op-DDT [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
pp-DDD [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
pp-DDE [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
pp-DDT [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Dimethoate [ug/L]	24-Jul-14	15:57	< 0.06	< 0.06	< 0.03	< 0.03	< 0.03	< 0.03
Diuron [ug/L]	24-Jul-14	15:57	< 0.06	< 0.06	< 0.03	< 0.03	< 0.03	< 0.03
Heptachlor + Heptachlor Epoxide [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Heptachlor [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Heptachlor epoxide [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Lindane [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Malathion [ug/L]	24-Jul-14	15:57	< 0.04	< 0.04	< 0.02	< 0.02	< 0.02	< 0.02
Methoxychlor [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Metolachlor [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Metribuzin [ug/L]	24-Jul-14	15:57	< 0.04	< 0.04	< 0.02	< 0.02	< 0.02	< 0.02
Parathion [ug/L]	24-Jul-14	15:57	< 0.04	< 0.04	< 0.02	< 0.02	< 0.02	< 0.02
Phorate [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01

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Prometryne [ug/L]	24-Jul-14	15:57	< 0.06	< 0.06	< 0.03	< 0.03	< 0.03	< 0.03
Simazine [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Temephos [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Terbufos [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Triallate [ug/L]	24-Jul-14	15:57	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Trifluralin [ug/L]	24-Jul-14	15:57	< 0.04	< 0.04	< 0.02	< 0.02	< 0.02	< 0.02
2,4-dichlorophenoxyacetic acid (2,4-D) [ug/L]	24-Jul-14	10:06	< 0.38	< 0.38	< 0.19	< 0.19	0.48	< 0.19
2,4,5-trichlorophenoxyacetic acid (2,4,5-T) [ug/L]	24-Jul-14	10:06	< 0.44	< 0.44	< 0.22	< 0.22	< 0.22	< 0.22
Bromoxynil [ug/L]	24-Jul-14	10:06	< 0.66	< 0.66	< 0.33	< 0.33	< 0.33	< 0.33
Dicamba [ug/L]	24-Jul-14	10:06	< 0.40	< 0.40	< 0.20	< 0.20	< 0.20	< 0.20
Diclofop-methyl [ug/L]	24-Jul-14	10:06	< 0.80	< 0.80	< 0.40	< 0.40	< 0.40	< 0.40
Dinoseb [ug/L]	24-Jul-14	10:06	< 0.72	< 0.72	< 0.36	< 0.36	< 0.36	< 0.36
Picloram [ug/L]	24-Jul-14	10:06	< 2	< 2	< 1	< 1	< 1	< 1

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Appendix 7.

Water Balance Calculations

Appendix 7a: Water Balance Calculations for Existing Conditions at 1200 King Road

Table 1: Existing percent impervious for total area at 1200 King Road

Area ID	Area (ha)	Area (m^2)	% Impervious	Impervious area (m^2)		
1	5.00	50000	0.30	15000		
2	1.60	16000	0.30	4800		
3	21.10	211000	0.30	63300		
4	2.30	23000	0.30	6900		
EXT1	2.05	20500	0.30	6150		
EXT3	0.60	6000	0.30	1800		
EXT4	0.10	1000	0.30	300		
EXT5	0.02	200	0.30	60		
EXT6	0.67	6700	0.30	2010		
Total area =	**33.44**	**334400**		**100320**	**% Impervious =**	**0.30**

Table 2: Indian Creek Subwatershed Annual Water Budget Components (from HHSP, 2010)*

	Subwatershed Area (km^2)	Precipitation (mm/yr)	Actual ET (mm/yr)	Recharge (mm/yr)**	Runoff (mm/yr)
Indian Creek	6.07	907	533	120	254
		0.907	0.533	0.120	0.254

**Indian Creek subwatershed annual water budget components selected for water balance calculations since it contains over 90% of the proposed development area*

***Recharge number based on Figure 2.12 from HHSP (2010) and results of on-site borehole drilling which indicate a high clay content*

Table 3: Water balance calculations for existing conditions for 33.44 ha property at 1200 King Road

	Precip (m^3/yr)	Actual ET (m^3/yr)	Recharge (m^3/yr)	Runoff (m^3/yr)
Pre-dev	303300.8	178235.2	28089.6	96976.0

Appendix 7b: Water Balance Calculations for Proposed Development at 1200 King Road

Table 1: Post-development percent impervious for total area at 1200 King Road

Area ID	Area (ha)	Area (m^2)	% Impervious	Impervious area (m^2)		
C1	4.60	46000	0.90	41400		
C2	0.99	9900	0.90	8910		
C3	18.30	183000	0.90	164700		
C4	1.03	10300	0.90	9270		
C5	0.70	7000	0.30	2100		
EXT1	2.05	20500	0.30	6150		
EXT2	0.05	500	0.30	150		
EXT4	0.12	1200	0.30	360		
EXT5	0.02	200	0.30	60		
EXT6	0.67	6700	0.30	2010		
SWMP1	0.90	9000	0.95	8550		
SWMP2	2.07	20700	0.95	19665		
Additional	1.94	19400	0.30	5820		
Total area =	**33.44**	**334400**		**269145**	**% Impervious =**	**0.80**

Table 2: Indian Creek Subwatershed Annual Water Budget Components (from HHSP, 2010)*

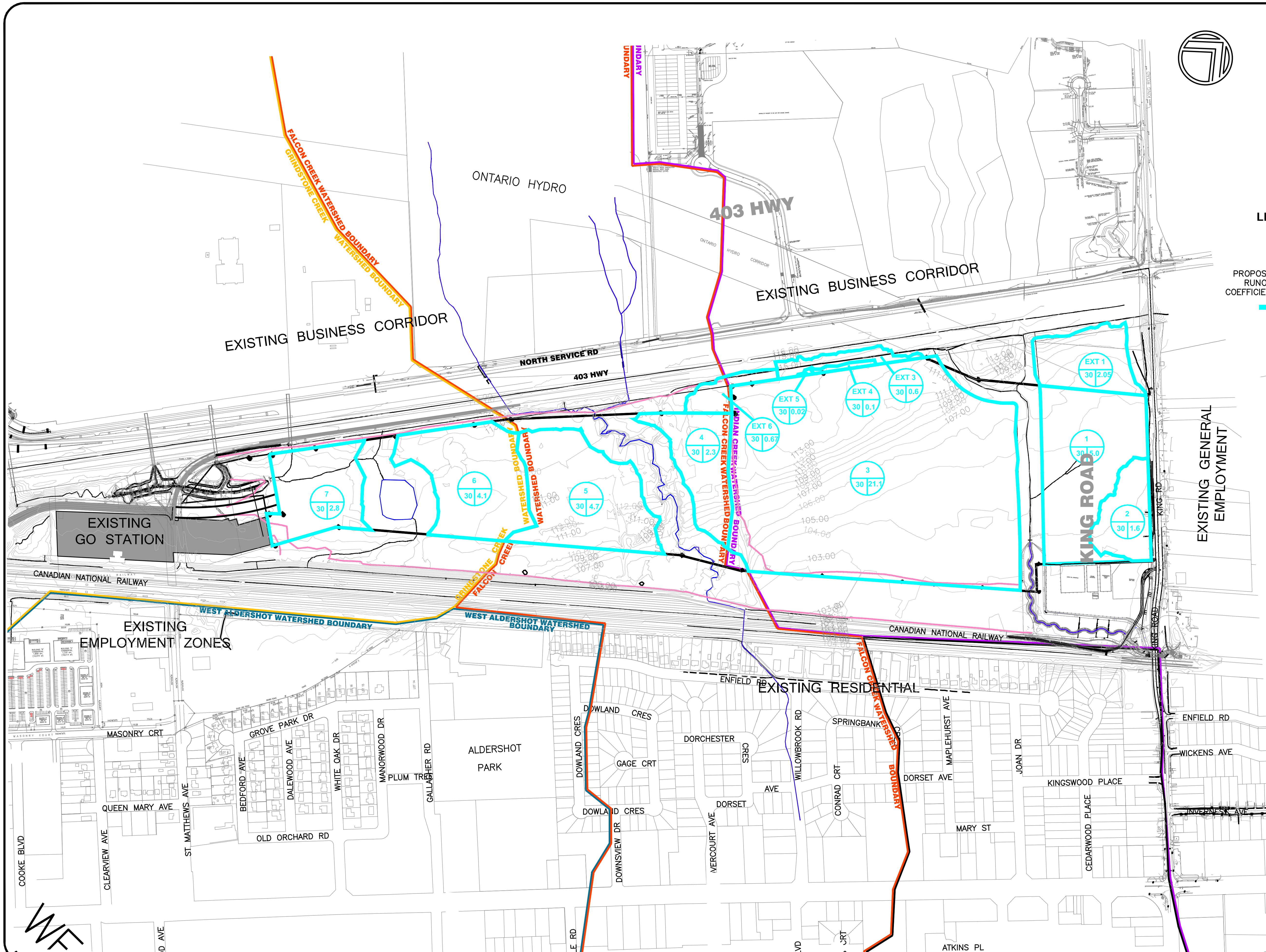
	Subwatershed Area (km^2)	Precipitation (mm/yr)	Actual ET (mm/yr)	Recharge (mm/yr)**	Runoff (mm/yr)
Indian Creek	6.07	907	533	120	254
		0.907	0.533	0.120	0.254

**Indian Creek subwatershed annual water budget components selected for water balance calculations since it contains over 90% of the proposed development area*

***Recharge number based on Figure 2.12 from HHSP (2010) and results of on-site borehole drilling which indicate a high clay content*

Table 3: Water balance calculations for existing conditions for 33.44 ha property at 1200 King Road

	Precip (m^3/yr)	Actual ET (m^3/yr)	Recharge (m^3/yr)	Runoff (m^3/yr)
Pre-dev	303300.8	178235.2	28089.6	96976.0
Post-dev	303300.8	178235.2	8025.6	117040.0
		Difference =	20064.0	20064.0
			loss of recharge	*increase in runoff*
			Equivalent to 0.64 L/s	



LEGEND :

- 2 — EXISTING DRAINAGE AREA No.
- 30 — PROPOSED RUNOFF COEFFICIENT
- 1.6 — EXISTING AREA (Ha)
- EXISTING STORM DRAINAGE AREA BOUNDARY
- 105.00 — EXISTING CONTOUR MAJOR
- 105.50 — EXISTING CONTOUR MINOR

P:\Paletta\P10003 King Road\dwg\Engineering\Fig 8 – Existing Storm Drainage Areas.dwg

CLIENT:

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4480 Paletta Court
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2290 QUEENSWAY DRIVE
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EMAIL: ENGINEERING@METROCON.CA

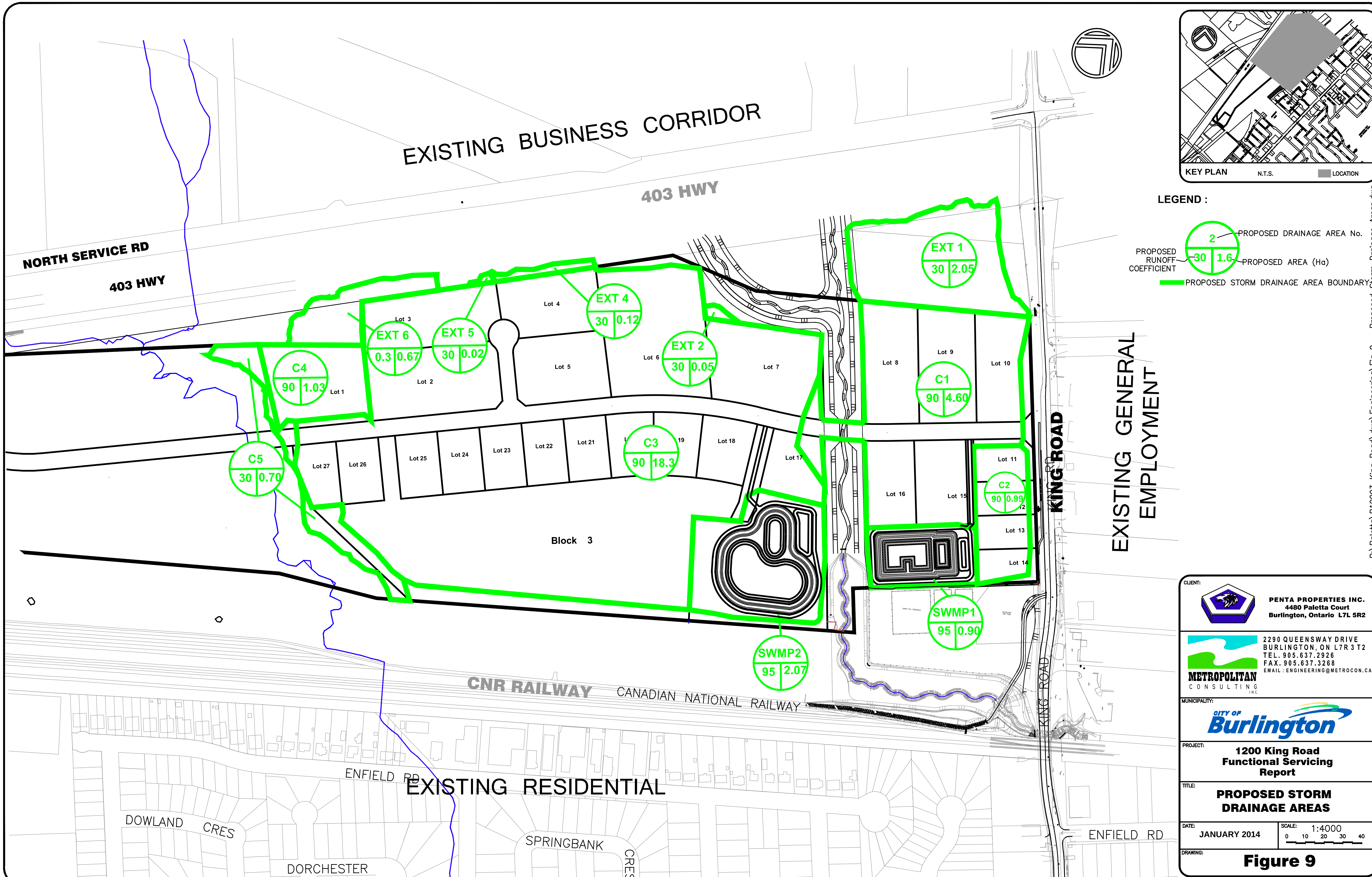
MUNICIPALITY: City of Burlington

PROJECT: **1200 King Road**

TITLE: **EXISTING STORM DRAINAGE**

DATE:	SCALE:
JANUARY 2014	1:7000

DRAWING:


EXISTING BUSINESS CORRIDOR
403 HWY
NORTH SERVICE RD
403 HWY
EXT 1
30 2.05
EXT 2
30 0.05
EXT 4
30 0.12
EXT 5
30 0.02
EXT 6
0.3 0.67
C1
90 4.60
C2
90 0.99
C3
90 18.3
C4
90 1.03
C5
30 0.70
SWMP1
95 0.90
SWMP2
95 2.07
Lot 1
Lot 2
Lot 3
Lot 4
Lot 5
Lot 6
Lot 7
Lot 8
Lot 9
Lot 10
Lot 11
Lot 13
Lot 14
Lot 15
Lot 16
Lot 17
Lot 18
Lot 21
Lot 22
Lot 23
Lot 24
Lot 25
Lot 26
Lot 27
Block 3
KING ROAD
EXISTING GENERAL EMPLOYMENT
CNR RAILWAY
CANADIAN NATIONAL RAILWAY
ENFIELD RD
EXISTING RESIDENTIAL
DOWLAND CRES
DORCHESTER
SPRINGBANK CRES
ENFIELD RD
KEY PLAN
N.T.S.
LOCATION
LEGEND :
2
PROPOSED DRAINAGE AREA No.
PROPOSED RUNOFF COEFFICIENT
30
1.6
PROPOSED AREA (Ha)
PROPOSED STORM DRAINAGE AREA BOUNDARY
P:\Paletta\P10003 King Road\dwg\Engineering\Fig 9 – Proposed Storm Drainage Areas.dwg
CLIENT:
PENTA PROPERTIES INC.
4480 Paletta Court
Burlington, Ontario L7L 5R2
2290 QUEENSWAY DRIVE
BURLINGTON, ON L7R 3T2
TEL. 905.637.2926
FAX. 905.637.3268
EMAIL: ENGINEERING@METROCON.CA
METROPOLITAN CONSULTING INC.
MUNICIPALITY:
CITY OF Burlington
PROJECT:
1200 King Road Functional Servicing Report
TITLE:
PROPOSED STORM DRAINAGE AREAS
DATE:
JANUARY 2014
SCALE:
1:4000
0 10 20 30 40
DRAWING:
Figure 9