

Guidelines for Hydrogeologic Studies

The purpose of these Guidelines is to set out the conceptual approach and recommended information requirements for the preparation of hydrogeological reports in support of development proposals. The following guidelines provide general direction for studies including areas where only a minimal understanding of the hydrogeologic characterization exists. The level of understanding in the existing watershed and subwatershed studies may be sufficient to provide a preliminary understanding of the site specific setting within the more regional groundwater setting. It is important to recognize that future groundwater studies and information will become available from consultants and local and provincial agencies which will provide technical input in refining the groundwater characterisation.

The hydrogeological reports should establish:

- (1) that the development will not cause unacceptable groundwater quality impacts (i.e. through storm water management facilities) which may effect either the potability of the groundwater resource or subsequently cause unacceptable surface water impacts where the groundwater discharges to a surface water body;
- (2) that the development will not reduce the quantity of groundwater or lower groundwater levels (i.e. reduced infiltration or water table dewatering) such that unacceptable impacts on the local water table, groundwater availability in existing wells, where applicable, or that unacceptable reduction in groundwater baseflow to surface water bodies occurs.
- (3) that soil conditions are suitable for stormwater BMP's.

It is recognized, from a hydrogeological perspective, that developments may impact (1) the groundwater resources and (2) surface water resources where groundwater has a significant discharge component to the surface water body. This potential may become real if the development is allowed to proceed without an assessment of potential impacts, and appropriate mitigation of these impacts, if necessary.

The level of hydrogeological assessment and subsequent reporting will be dependent on:

- (1) The sensitivity of the groundwater and surface water resources and resulting potential impact due to land use changes (i.e. wetlands, coldwater streams and shallow water table aquifers are generally more sensitive than warm water streams or deeper aquifers confined by a low permeability layer) and the existing impacts at and adjacent to the proposed development.
- (2) the overall size and density of the development;
- (3) storm water management design relative to the sensitivity of the setting (e.g. storm water infiltration into a shallow unprotected aquifer used for water supply); and
- (4) the complexity of the hydrogeological setting.

Proponents will be required to submit reports which address the issues outlined above. These reports will be prepared by a qualified hydrogeologist and where necessary, a professional consultant with experience in stormwater management design.

The aim is to try to provide a cost effective approach to balance the level of effort with potential impact concerns which may arise at early stages of investigation. In this way all parties will be aware as early as possible in the planning stages what these concerns may be, how they may affect the size or engineering requirement of the development or the type of studies required to determine appropriate designs to mitigate certain impacts.

As a result of the cost intensiveness of detailed on-site hydrogeological studies, it is recommended that the information requirements be presented in two stages.

Stage 1 will provide preliminary information on the suitability of the site for development. The Stage 1 assessment will indicate whether or not the site will likely be suitable for the proposed development. If the review by the City and other appropriate regulatory authorities were favourable then it would be recommended to proceed to the Stage 2 Detailed Hydrogeological Investigation of the site.

These guidelines should be applied concurrently with the Guidelines, Policies and Regulations of other agencies.

The Stage 1 investigation will involve:

- a review of existing available geologic and hydrogeologic information;
- a door-to-door well survey;
- excavation of test pits or drilling of boreholes;
- measurement of water levels;
- an estimation of the percolation time of the native soil, in order to determine the hydrogeologic setting, the hydrogeologic connection to any surface water, the potential impacts of the development on the groundwater quantity and groundwater quality and the suitability of the site for stormwater management facilities.

The report will provide preliminary recommendations on the potential of the site for development.

The report should also provide as clearly and concisely as possible various options being pursued for the development related to storm water management to better assess potential impacts and potential mitigation of impacts related to development options/controls.

The information requirements at Stage 1 are as follows;

Data Review

A review of all available geologic and hydrogeologic information shall be conducted prior to conducting the preliminary field program. The data review would normally include but not necessarily be limited to the following:

- topographic maps (1:10,000)
- soil and aggregate reports
- quaternary geology maps and reports
- bedrock geology maps
- hydrogeologic or septic suitability reports for adjacent subdivision developments
- Ministry of the Environment and Energy water well records
- watershed and subwatershed studies
- water supply reports for existing nearby developments
- groundwater quality data
- MOEE hydrogeologic files (including confirmed groundwater quality and quantity problems), and
- hydrogeologic maps

The information obtained from the existing data review should include:

Site Setting

- site topography including surface relief, water courses, ponds ESA's, wetland classifications, fisheries classification, if applicable, etc.

Physiographic Region

- as described by Chapman and Putnam (1984)

Regional Geology

- overburden thickness and soil types, e.g. glaciofluvial, outwash etc.,

Regional Groundwater System

- overburden and aquifers, general identifiable units, general characteristics, flow direction, previous exploitation, communal well locations, permitted well locations and existing well yields,
- preliminary assessment of the development setting in relation to the regional flow system (i.e. local / regional recharge area, local / regional discharge area.)
- significant or sensitive recharge and discharge areas
- existing impacts

Information and assessment included within this current document is based to a large extent, on the information described above, and as such could be utilised in the site specific studies.

Stage 1 Field Program

Based on the results of the review of available information, a suitable preliminary field program will be designed and implemented to undertake a preliminary determination of site specific soil and groundwater conditions. The purpose of the Stage 1 Field Programme is to conduct a preliminary assessment of impacts related to reduced infiltration and storm water management facilities.

Where applicable, a door-to-door inventory of water supply wells within 500m of the proposed development will be conducted prior to implementing the field program. The survey will be conducted to determine the condition and details of local wells, including the method of construction, water level, pump intake and well depths, water use, general water quality and suitability of the well for future monitoring, if required. The results of this survey will also determine the number of wells located 500m downgradient of the site, and thus the wells which could be potentially impacted by the proposed development. In addition, the survey provides a baseline of data for future groundwater interference resolution if a complaint arises.

An on-site investigation comprised of excavation of test pits with a backhoe, or shallow boreholes, will be conducted to determine surficial geologic and hydrogeologic conditions.

Preliminary Water Quality Impact Assessment

A preliminary water quality impact assessment must be carried out to determine the potential impacts on the groundwater quality from the infiltration of water from storm water management facilities. Due consideration should also be given to potential phosphorous loading, in particular, to surface water bodies.

Stage 1 Environmental Evaluation Report Requirements

On completion of evaluation of all existing data and test results, a report will be submitted to the Town/City and to other appropriate regulatory authorities for review. The primary purpose of the study is to enable a

preliminary determination as to the potential suitability of the site for development.

In addition to the information requirements presented above, the preliminary environmental evaluation will address, but not be limited to the following:

- assessment of the suitability of the site for development
- proposed stormwater management controls, in particular infiltration techniques.
- preliminary assessment of existing groundwater quantity and quality
- options for phased development based on the hydrogeological assessment of the site
- assessment of impact on existing developments and possible future downgradient developments
- a preliminary assessment on quality and quantity impacts on surface water resources

The Stage 2 evaluation will only be undertaken if the Stage 1 report is accepted by the City and will build on the preliminary information provided in the Stage 1 report. The Stage 2 report will be a complete stand alone document providing more detailed geotechnical and hydrogeological information and analysis based on a site investigation. Preparation of the Stage 2 report will generally require an on-site hydrogeological investigation. The extent of this investigation and the subsequent assessment will depend on the level of detail of existing information and the level of confidence in understanding the hydrogeologic setting. The Stage 2 report will include all information contained in the Stage 1 report, and the following:

- Site geology.
- Identification of aquifers and aquitards including depth, thickness, extent, continuity, and hydraulic conductivity. The information will be presented in geologic/hydrogeologic cross-sections.
- Description of groundwater flow of shallow systems and deep systems, where appropriate including a contour plan showing flow direction, the average horizontal gradient, and determination of vertical gradients between hydrogeological units.
- The extent of hydraulic connection between the on-site groundwater flow system and any local or regional surface water body.
- A discussion of the site hydrogeology relative to the regional groundwater flow system and the relationship of the site to regional / local recharge areas and/or regional / local discharge areas.
- A general water balance appraisal including approximate annual precipitation, pre-development and post-development recharge, and groundwater flux.

Consideration must be given for the specific location and depths of wells, where appropriate, with respect to the existing and potential contaminant sources.

The water quality of the upper shallow aquifer or surficial aquifer, if applicable, must be determined in order to assess the existing conditions in the shallow flow system in relation to adjacent sensitive areas such as wetlands and water courses, if present. In this way the potential impact, positive or negative, of the proposed development can be better assessed.

Assessment of Potential Impact

The intent of this assessment is for the proponent to demonstrate a degree of understanding by conducting an evaluation of site conditions such that the potential impact of the proposed development can be shown. There are two main impacts which must be addressed i) effects due to a reduction in groundwater recharge and ii) contamination caused by stormwater infiltration facilities.

Groundwater and Surface Water Resources

The proponent should address the following minimum requirements, if applicable to the property or site:

- address potential for well interference
- identify nearby wells and corresponding aquifer(s),
- assess long term source contributions of groundwater to wells and the effect on groundwater quality and identify area over which infiltration replenishes the local water supply well.
- identify potential impacts related to sensitive surface water features such as wetlands, baseflow to surface water courses etc.
- assess potential quantity related impacts due to alteration of on site infiltration by storm water management techniques.

Where development is being undertaken in phases, the developer may be required to demonstrate that the impact of previous phases is acceptable prior to approval of future phases. This may involve monitoring of groundwater and/or surface water quality and quantity. Wells may be required downgradient of the development for on-going groundwater quality monitoring or in other strategic locations to address potential reductions in recharge. The proposed monitoring program should address:

- rationale for location of the proposed monitoring well for example, direction of groundwater flow, contaminant sources, etc.;
- zone(s) to be monitored (i.e. depth of well, aquifer receiving effluent, sensitive wetland or stream).
- chemical and other parameters to be monitored
- extent of development and the sensitivity of the groundwater or surface water resource.
- frequency of water levels, baseflow measurements, quality sampling program
- parameters to be monitored

The site specific monitoring program may be discontinued after a period of time where the results indicate that predicted impacts are acceptable. All or part of the site specific monitoring program may be incorporated into a more regional monitoring program.

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