REPORT

Baseline Hydrogeological Assessment and Water Balance

Proposed Administration Building, Township of Tiny

Submitted to:

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1 INTRODUCTION

WSP was retained by Unity (Unity or the "Client") to provide a water balance assessment and baseline hydrogeological assessment in support of the proposed Tiny Township Administration Centre (the "Project") to be located at 260 Concession Road 8 East, Tiny (the "Property"; Figure 1 and Figure 2). Development at the Property is anticipated to occur within a 2.74 ha area (the "Site"). The proposed building to be located in the Site will consist of a main floor with an area of approximately 2,800 m^2 and a partial basement with an area of approximately 400 m^2 and have a parking lot with an estimated 200 parking spaces, Based on communication from the Client, it is understood that there is currently no site plan available for the proposed development, however the Project is planned to be constructed on the northern part of the Site.

1.1 Site Description

The Property is currently undeveloped and has an area of approximately 58.5 hectares. The Property is a mix of forested areas and clearings, and there are several walking paths present across the Site. There are two municipal supply wells located on the south side of the Property, Perkinsfield wells 26-4 and 26-5, and a watermain crosses the area from the pumphouse to Concession Road 9 East on the north side of the Property (Figure 2). Based on a review of aerial photographs there are several small structures associated with the groundwater supply wells. No other structures are known to be present on the Property.

1.2 Scope of Work

- Reviewing regional groundwater information, including publicly available drilling and groundwater well records, geological data, topographic mapping, published hydrogeological reports and groundwater taking, and treatment records from nearby municipalities;
- Reviewing available source water protection information, including source protection plans to determine what impact, if any, the Project will have on the municipal water supply wells located near the Property;
- Completing a water balance assessment comparing the pre- and post-development conditions at the Site including potential LID features; and
- Preparing a hydrogeological report documenting the findings of the desktop assessment.

2 SITE CHARACTERIZATION

2.1 Historical Studies

In addition to publicly available information, the following historical studies were reviewed as part of the assessment.

- Dixon Hydrogeology Ltd. (Dixon). 1996. "*Township of Tiny, Lot 10, Concession 8, Hydrogeological Investigation, March 1996*". Dixon was retained by the township of Tiny to conduct a geological and hydrogeological review of the Site. Dixon also conducted several test pits in the north-central part of the property to determine whether the Property could be used to extract aggregate.
- Dixon Hydrogeology Ltd. (Dixon). 1997a. "*Township of Tiny, Lot 10, Concession 8, Testing of TW2/89, Hydrogeological Investigation*". Dixon installed a monitoring well at the Property and carried out a pumping test at a well installed by the previous property owner to determine its ability to act as a municipal supply well. Based on the results of the investigation, the TW2/89 well was put into operation as the Perkinsfield Well 26-4.
- Dixon Hydrogeology Ltd. (Dixon). 1997b. "*Township of Tiny, Construction and Testing, Perkinsfield Well 5 Hydrogeological Investigation*". To further increase the capacity to the Perkinsfield water supply system, Dixon

was retained by the Township of Tiny to install another supply well at the Site (Perkinsfield Well 26-5) and conduct a pumping test on the newly installed well.

- Reid & Associates Ltd. 1989. "*Feasibility Study for Industrial Sub-Surface Sewage Disposal Systems for the Proposed Industrial Subdivision in the Township of Tiny, Lot 10, Concession 8, for Helicon Properties Limited*". To determine the feasibility of a sewage disposal system for a planned industrial development, 18 test pits were excavated and 12 shallow piezometers were installed across the Property at depths ranging from 1.9 mbgs to 2.4 mbgs. The results of the investigation indicated that the surficial overburden at the Property consisted of approximately 0.1 m to 0.3 m of topsoil underlain by sand and gravel deposits, and that the groundwater level at the Property ranged from approximately 0.9 mbgs to 2.3 mbgs.

2.2 Overburden and Bedrock Geology

Based on mapping available from the Ontario Geological Survey (OGS), the overburden in the area of the Property ranges from 60 m to 105 m thick and generally consists of glaciolacustrine silt and sand deposits with deposits of fine-grained till (Figure 3, OGS, 2010) located to the west and north of the Property.

Test pitting at the Site discussed in Reid & Associates Ltd. (1989) confirmed that the shallow overburden at the Property is predominantly sand, with seams of gravel having been noted at several test pits. The presence of a gravel deposit up to 3.5 m thick located in the north-central part of the Property was noted in Dixon (1996), and a figure from the report depicting its location is presented in Appendix B. Bedrock in the vicinity of the Property consists of limestone of the Bobcaygeon formation (OGS, 2007).

2.3 Topography and Drainage

Based on Ontario Base Map (OBM) topographic mapping of the Site (Figure 4), the ground surface is gently sloping, with elevations ranging from approximately 244 masl to 232 masl, generally being highest along a "ridge" present across the Property, extending from the northeast corner of the Property to the south, with the elevation decreasing away from the ridge towards the east and west.

There are three unevaluated wetlands on Property, identified as swamps by the Ontario Ministry of Natural Resources and Forestry (OMNRF) mapping, located in the northeast corner, southeast corner, and southwest corner of the Site, respectively. Additional unevaluated wetlands are present in the surrounding areas, however no evaluated wetlands are noted within 1 km of the Property.

The boundary between the Wye River and South Georgian Bay Shoreline watersheds passes through Property from northeast to south (OMNRF, 2020) generally following the topographic high through the middle of the Property. Drainage over the northern section of the Site is expected to flow to the west towards Georgian Bay while drainage over the southern side of the Property is expected to flow to the east, likely towards an unnamed stream 160 m east of the Site (Figure 4), which in turn discharges to Mud Lake, and eventually Georgian Bay.

2.4 MECP Well Records

A review was conducted of the Ministry of Environment Conservation and Parks (MECP) water well database within the vicinity the Property (Figure 4), and the findings are provided in Appendix C. The MECP database indicates 29 well records are located within approximately 750 m of the Property. Of these, 13 are indicated to have been installed for water supply purposes, with 8 listed as being for domestic supply purposes, 1 for commercial supply, 2 for public water supply (these are the municipal supply wells located on-Site), 1 as water supply for stock, and 1 with no use specified. The depth of the listed supply wells ranges from about 22.3 to 83.8 meters below ground surface (mbgs). There are

15 records listed as observation wells, and 1 well record listed as an abandonment. Other than the two municipal water supply wells, no well records are noted to be present on the Property.

The municipal supply wells present on the Property are the Perkinsfield Well 26-4 and 26-5. Well 26-4 is a 203 mm diameter well, constructed in June 1990 with a 16-slot screen installed within the A3 aquifer between 54.9 mbgs and 57.95 mbgs (Dixon 1997a). Well 26-5 is a 203 mm diameter well, constructed with an 8 slot and 9 slot screen installed within the A3 aquifer between 61.9 mbgs and 71 mbgs (Dixon 1997b).

2.5 Permits to Take Water

A search of the MECP Permit to Take Water (PTTW) mapping indicates the presence of one active PTTW within 2 km of the Property (No.4638-BDXGHH), which applies to the Perkinsfield municipal water supply system. PTTW No. 4638-BDXGHH expires on August 19, 2029. The Perkinsfield well field consists of four supply wells, Well 11-2 Well 22-1, Well 26-4 and Well 26-5 (Figure 3). Wells 11-2 and 22-1 are located in Perkinsfield approximately 2 km to the northwest of the Property and are not relevant to the Project. It is understood that Well 26-4 located in the southwest corner of the Property is not currently in use (Township of Tiny, 2024) and operates as a backup for Well 26-5.

Table 1: Perkinsfield Municipal Supply Wells

Well ID	Max Permitted Water-Taking Rate (L/min)	Permitted Water-Taking Rate (m^3/day)	Number of Water-Taking Days Allowed (days/year)	2023 Maximum Daily Water-Taking Rate (m^3/day)
Well 11-2	136	195.84	365	76.76
Well 22-1	245	352.8	365	106.20
Well 26-4	250	360	365	-
Well 26-5	648	933	365	435.56

2.6 Hydrostratigraphy

The hydrostratigraphy of the area surrounding the Property was described in Dixon Hydrogeology (1997a, 1997b), which characterized the overburden deposits as consisting of five aquifer units, designated A1 through A5 separated by clay layers (aquitards) of varying thickness. Inferred regional hydrostratigraphic profiles, based on well records in the area, are shown on Figure 5 and Figure 6. Figure 7 provides a legend of the hydrogeological symbols and notes used on the hydrostratigraphic profiles. Due to the absence of well records on the Property, the hydrostratigraphic conditions at the Site were generally inferred from information available from boreholes and wells completed at nearby properties.

The A1 aquifer is present at, and in the area of, the Property at elevations from about 225 masl to 240 masl and is on the order of 10 m thick. Based on the records for well completed in this unit on adjacent properties (Figure 4), the depth to groundwater within the A1 aquifer regionally appears to range from approximately 7 m to 12 m, which corresponds to elevations ranging from about 227 masl to 233 masl. At the Site itself, Reid & Associates Ltd. (1989) noted the groundwater table was located on the order of 0.9 mbgs to 2.3 mbgs. The A1 aquifer is generally unconfined, but it was noted in Dixon (1997b) that below approximately 234 masl, discontinuous fine-grained deposits may act as localized confining layers. The wells screened in this unit are observation wells with no recorded pumping rates.

The A2 aquifer is generally described as sand with gravel layers, reportedly separated from the overlying A1 aquifer by a confining layer of sandy clay with a thickness between 2m and 20 m (Dixon, 1997b), however well records to the west of the Property indicate the confining layer may be absent in places. The A2 is present from approximately 200 masl to 214 masl and is about 2 – 20 m thick but does not appear to be present within the Property boundary, only appearing on well records to the west of the Property. Based on the boreholes logs on, and in the immediate vicinity of, the Property it appears that the A2 aquifer deposits are not present at the Property itself. The records indicate groundwater levels in the A2 aquifer ranging from 6 mbgs to 10 mbgs, with elevations ranging from 219 masl to 229 masl. Perkinsfield Wells 11-2 and 22-1 are screened in this unit.

The A3 Aquifer is present regionally at elevations between approximately 155 masl to 180 masl, between approximately 40 mbgs to 80 mbgs. Wells screened across the A3 aquifer reportedly have groundwater levels ranging from 11.9 mbgs to 43.9 mbgs, with corresponds to elevations of about 191 masl to 222 masl. Dixon Hydrogeology (1997b) noted a downward hydraulic gradient between A2 and A3, indicating that the lower A3 is recharged by the overlying A2 aquifer. During a pumping test carried out in A3 (Dixon Hydrogeology, 1997a), no changes were noted in the groundwater level at wells monitored in the overlying A1 and A2 aquifers. The Perkinsfield wells 26-4 and 26-5, located at the Site, are screened within this unit.

Only two well records identify the A4 aquifer and only one well indicated to be screened within the A4 Aquifer in the vicinity of the Site. The groundwater level at the A4 well was reported to be 38.1 mbgs corresponding to an elevation of about 200 masl. A pumping test was completed at the well at a rate of 18 L/min. Regionally, the A4 aquifer appears to be present between approximately 139 masl and 150 masl, at depths ranging from 75 mbgs to 86 mbgs.

The A5 Aquifer was identified at borehole 5718974, located approximately 1 km southeast of the Property (Figure 4). Well record 5918974 notes the A5 aquifer occurring at a depth of approximately 100 mbgs and was noted to have a static water level of approximately 36 mbgs or about 185 masl.

2.6.1 Groundwater Flow

Based on water level data from the test pits and piezometers installed at the Property by Reid (1988) and water level data from surrounding monitoring wells presented in Dixon (1997a, 1997b), groundwater in the shallow A1 aquifer flows to the southeast and southwest, separated by a divide present across the Property, which corresponds with local topography (Figure 8). The inferred groundwater divide is expected to represent the boundary between the Wye River and South Georgian Bay Shoreline watersheds.

Figure 9 shows the inferred groundwater flow patterns in the A2 to A5 aquifer units based on water levels from the MECP well records. Groundwater flow from the deeper confined aquifers is generally to the southwest towards Georgian Bay.

2.7 Hydrogeological Conceptual Model

Based on Dixon (1997a,1997b), Reid (1989) and the available MECP well records in the area, the following conceptual model was established for the Site.

Table 2: Conceptual Model Summary

Aquifer	Type	Material	Thickness (m)	Depth (m)	Elevation (masl)	Groundwater Elevation (masl)	Note
A1	Unconfined	Sand and gravel	<10	<10	225 – 240	226 – 234	-

Aquifer	Type	Material	Thickness (m)	Depth (m)	Elevation (masl)	Groundwater Elevation (masl)	Note
A2	-	-	-	-	-	-	Not present within Site boundary
A3	Confined	Sand	2 - 25	40 - 80	155 – 185	191 - 223	-
A4	Confined	Sand	9 – 11	75 – 86	139 – 150	200	-
A5	-	-	-	-	< 120	185	Not present within Site boundary

Notes: Adapted from Dixon Hydrogeology (1997a, 1997b)

3 SOURCE WATER PROTECTION

The following sections discuss specific policy areas that pertain to groundwater resources and measures taken within the proposed development plan to conform to these policies.

The *Clean Water Act*, 2006 created source protection areas and regions to identify threats to municipal water supplies. Source water protection at the Site is governed under the South Georgian Bay Lake Simcoe Source Protection Plan (SPP; SGBLS Source Protection Committee, 2015), and the Site lies within the Severn Sound Source Protection Area. The SPP provides the policies, rationale, and conditions associated with the source protection program applicable at the Site. The following vulnerable areas are governed by SPP:

- Wellhead Protection Areas (WHPAs)
- Intake Protection Zones (IPZs)
- Highly Vulnerable Aquifers (HVAs)
- Significant Groundwater Recharge Areas (SGRAs)

Policies governing these vulnerable areas are outlined in the SPP along with vulnerability scoring which identifies how easily a drinking water source could be contaminated by nearby activities and is a numerical value from 2 to 10 (MECP, 2021a). IPZs are areas surrounding surface water intakes for municipal supply and are not relevant to the Property as surface water is not used for municipal supply in the area.

3.1 Wellhead Protection Areas

The Perkinsfield Wells 26-4 and 26-5 are located on the southern side of the Property. The Simcoe County GIS online mapping database (https://opengis.simcoe.ca/) indicates that the WHPA-A through WHPA-D associated with wells 26-4 and 26-5 occupy the southern half of the Site (Figure 10). A WHPA is a vulnerable area that surrounds a groundwater well. These areas are classified according to how quickly water moves horizontally through the aquifer, with flow rate measured in years:

- WHPA-A is a 100-metre circle around the well;
- WHPA-B is the 2-year time-of-travel zone;
- WHPA-C is the 5-year time-of-travel zone; and,

- WHPA-D is the 25-year time-of-travel zone.

Whether or not a human activity is or would become a significant drinking water threat depends on:

- where it is located (i.e., within WHPA-A, B, C or D);
- the vulnerability score of that area, which is based on the potential for vertical movement of water; and,
- the type of materials and hazard rating of the activity.

Significant drinking water threats are likely to be in areas closest to the well (100-metre, 2-year and 5-year time-of-travel zones). Based on information provided by the Client it is understood that the planned development activities will be limited to the north half of the Site and should be outside the currently defined WHPA. As such, it is expected that the planned development would not be required to address specific concerns related to source protection from a quality perspective.

In the event that construction or development activities extend into the WHPA, the SPP should be consulted to determine if the activities in question are in compliance with the requirements of the SPP requirements, or if they represent potential threats to the drinking water quality.

Pumping tests completed in 1997 and reported in Dixon Hydrogeology (1997a) and (1997b) indicated that pumping at wells 26-4 and 26-5, screened in the A3 aquifer, resulted in no change in water level in the overlying A1 or A2 aquifers. The proposed construction at the Property may require groundwater control (i.e., dewatering) to permit activities such as utility installation, footing placement, and building construction. Due to the apparent hydraulic separation between the A1 and A3 aquifers, and due to the relatively small, anticipated drawdown likely to be necessary to support construction, it is expected that construction dewatering in the shallow overburden would not represent a threat to the municipal supply wells.

3.2 Highly Vulnerable Aquifers

HVAs are considered susceptible to contamination of groundwater from activities on the surface or shallow subsurface and are automatically assigned a vulnerability score of 6 (MECP, 2021b). There are no HVAs located within the Site. The closest HVA is located approximately 1.1 km to the east of the Site. This is not expected to have any implications for this project, as it will likely be outside the zone of influence of any short-term construction dewatering.

3.3 Significant Groundwater Recharge Areas

Significant groundwater recharges areas (SGRA) are areas characterized by high permeability soils that directly maintain the water level (i.e., recharge) in an aquifer that supplies drinking water (SGBLS Source Protection Committee, 2015). SGRAs are typically assigned vulnerability scores between 2 to 6. The Site is located within a SGRA with a vulnerability score of 2 (Figure 10), which is considered relatively low. Source protection policies may apply to the Project related to the reduction of groundwater recharge and application of deicing salt associated with the planned parking lot and roadways.

4 WATER BALANCE

The Property is currently occupied by densely wooded areas. Based on the information provided by Unity, it is understood that the proposed post-development conditions consist of a main administration building with a parking lot with an estimated 200 parking spaces. In both pre- and post-development conditions, Site is assumed to drain towards Concession Road 8.

In general, the existing pre-development conditions for the Property are dominated by densely wooded areas, while the proposed post-development conditions include a main building with a parking lot and driveway. A water balance assessment was completed to compare pre- and post-development water balance conditions, including estimates of average annual infiltration and runoff volumes from the Site.

The water balance assessment is focused on a total 2.74 ha surface area (“the Site”) including a 0.27 ha building area, 1.10 ha of paved areas and 1.37 ha landscaped area. No additional landscaped areas around the building are being considered at this time, though the larger property would likely remain largely undeveloped. All the assumed areas and land uses were based on the information provided on the “Conceptual Plan” drawings from Unity (Attachment 1) and discussions with Unity, while the soil information was taken from Soil Survey Complex of Ontario GeoHub (gov.on.ca).

4.1 Methodology

The water balance employs Environment Canada water budget procedure (Johnstone & Louie,1983). This method describes water flux in a unit area of soil on an annual basis, based on a balance of precipitation (rainfall and snowmelt), evapotranspiration (ET), soil storage, and surplus. The water budget can be summarized as follows:

Rainfall + Snowmelt – ET – Change in Soil Storage = Surplus

The various water budget components associated with catchment areas are typically presented in millimetres (mm) over their respective sub-catchments and represent the amount of water per unit of watershed area. The water budget model combines accumulated rainfall and snowmelt to estimate total precipitation. Rainfall represents precipitation when daily mean temperatures are greater than 0°C. Snowmelt is initiated when snow is on the ground and daily mean temperatures are greater than 0°C. Hence, snowmelt is based on the depletion of snow storage (accumulated precipitation during periods of sub-zero temperatures).

The potential or maximum ET (PET) is estimated, in this case, by the empirical Thornthwaite equation (using average monthly temperature and hours of daylight) and represents the amount of water that would be evaporated or transpired under saturated soil-water scenarios. The actual ET (AET) is the total evapotranspiration for the period of study based on evapotranspiration demand, available soil-water storage, and the rate at which that soil water is drawn from the ground (as defined by an established drying curve specific to the soil type).

The maximum soil storage is quantified using a Water Holding Capacity (WHC) that is based on guidelines provided in the Stormwater Management Planning and Design Manual (MOE,2003). The WHC represents the total amount of water that can be stored in the soil capillaries and is defined as the water content between the field capacity and wilting point (the practical maximum and minimum soil water content, respectively). WHCs are specific to the soil type and land use, whereby values typically range from approximately 50 mm for shallow rooted crops over sand to 300 mm for mature forest over clay.

For temperate region watersheds, soil storage is relatively stable year-round, remaining at or near field capacity except for the typical mid- to late-summer dry period. As such, the change in soil storage is a minor component in the water budget, particularly at an annual scale. Occasionally, open water areas must also be accounted for in water balances. In the case of water bodies, the WHC is generally assumed to be not applicable, since most years generate a positive surplus in Southern Ontario, and the volume of water available in large bodies generally exceeds the amount that may be withdrawn by evaporation on an annual basis.

Surplus water remains in the system after actual ET has been removed (ET demand is met) and the maximum WHC is exceeded (soil-water storage demand is met). Additionally, for impervious areas (paved roads, roof areas,

and gravel roads), 10% of annual precipitation is assumed lost to evaporation with the remaining 90% of annual precipitation assumed as surplus (LSRCA, 2013).

The Meteorological Service Data Analysis and Archive division of Environment Canada provides monthly water budget summaries for meteorological stations with greater than 20 years of meteorological data. These water budgets include monthly values for all parts of the water budget (rainfall, snowmelt, potential evaporation, etc.) for each of the years in the historic record, as well as average monthly values over the entire record. For the Site, the Environment Canada water budget data (1972-2023) for the Coldwater Warminster station (ID: 6111769) were used in the water budget analysis. The Environment Canada water budget shows an average annual precipitation of 1,062 per year (mm/yr) and an average annual temperature of 6.8 ºC (1972-2023).

Annual surplus estimates are further portioned into runoff and infiltration estimates using an infiltration factor. The infiltration factor represents the proportion of the annual surplus that is expected to infiltrate, with the remainder of the surplus assumed to be runoff. Land slope, soil type, and cover features are used to estimate the respective infiltration factor of the soil; flat, open soils with dense vegetation cover, for instance, would be expected to generate more infiltration (proportional to the total surplus) than a steep tight clay soil with row crops. Total infiltration factor for each land use is, then, estimated as the sum of the cover, soil type, and topography (cover) factors (MOE, 2003). Annual infiltration is estimated as the annual surplus multiplied by the total infiltration factor, and annual runoff is estimated as the difference between surplus and infiltration.

4.2 Pre-Development Conditions

The pre-development conditions for the Site are summarized in Table 3. WHC and infiltration factors based on MOE (2003) for the existing land use were as follows:

- A WHC of 300 mm (Mature Forest in Fine Sandy Loam) and an infiltration factor of 0.8 were used for the densely wooded area, representing flat land with an average slope < 0.6 m/km, open sandy loam (based on Soil Survey Complex of Ontario GeoHub), and trees.

Table 3: Pre-Development Land Use

Land Use	Area (ha)	Soil	Water Holding Capacity (mm)	Infiltration Coefficient			
				Slope Factor	Soil Factor	Vegetation Factor	Total
Densely Wooded Area	2.74	Fine Sandy Loam	300	0.3	0.3	0.2	0.8

4.3 Post-Development (No Mitigation) Conditions

The post-development (no mitigation) conditions for the Site are summarized in Table 4. The proposed post-development conditions contain impervious areas. WHC and infiltration factors based on MOE (2003) for the proposed landscaped and impervious areas were as follows:

- A WHC of 3 mm for impervious areas (rooftop and paved areas), since both paved and roof areas are impervious, it is assumed that all surplus from these areas becomes runoff.

- A WHC of 75 mm (Grass in Fine Sandy Loam) and an infiltration factor of 0.7 were used for the landscaped area, representing flat land with an average slope < 0.6 m/km, open sandy loam (based on Soil Survey Complex of Ontario GeoHub), and short vegetation.

Table 4: Post-Development Land Use

Land Use	Area (ha)	Soil	Water Holding Capacity (mm)	Infiltration Coefficient			
				Slope Factor	Soil Factor	Vegetation Factor	Total
Proposed Roof Area- Impervious Area	0.27	-	3	-	-	-	0
Proposed Parking and Paved roads - Impervious Area	1.10	-	3	-	-	-	0
Landscaped Area	1.37	Fine Sandy Loam	75	0.3	0.3	0.1	0.7

4.4 Post-Development Mitigated Conditions

In order to match pre-development infiltration rates in the post-development condition, two potential low impact development (LID) features have been considered:

- This scenario considers 0.27 ha of the roof area directed towards a series of rain gardens at the downspouts of the building. Rain gardens are typically ground-level vegetated depressions at roof downspouts designed to hold and infiltrate a portion of the roof runoff (see Figure A below from the TRCA LID Manual). The potential runoff reduction of an appropriately designed rain garden in sand soils is 0.5 (based on Table 4.3.1 in the TRCA LID manual), suggesting that rain garden here could potentially capture and infiltrate an average of 294 mm/yr over the 0.27 ha roof area directed to the system.

Figure 4.3.1 Examples of disconnected downspouts draining to a splash pad (left), a rain garden (centre) and an infiltration trench (right)

Source: City of Surrey (left); Riversides (centre); David Elkin (right)

Figure A.: Rain Garden Examples (from TRCA LID Manual)

- This scenario also considers 1.10 ha of the paved areas directed towards a series of vegetated filter strip. Vegetated filter strips are typically gently sloping, densely vegetated areas that treat runoff as sheet flow from adjacent impervious areas (see Figure B below from the TRCA LID Manual). The potential runoff reduction of an appropriately designed vegetated filter strips in sand soils is 0.5 (based on Table 4.6.1 in the TRCA LID manual), suggesting that these could potentially capture and infiltrate an average of 294 mm/yr over the 1.1 ha paved area directed to the system.

Figure 4.6.1 Filter strips along a residential road and as pretreatment to a dry swale

Source: Trinkaus Engineering (left), Seattle Public Utilities (right)

Figure B.: Vegetated Filter Strip Examples (from TRCA LID Manual)

The post-development mitigated conditions for the Site, including the assumed infiltration from the proposed LIDs, are summarised in Table 5.

Table 5: Post Development Mitigated Land Use

Land Use	Area (ha)	Soil	Water Holding Capacity (mm)	Infiltration Coefficient			
				Slope Factor	Soil Factor	Vegetation Factor	Total
Proposed Impervious Roof Area to LID (Rain Gardens)	0.27	Fine Sandy Loam	3	-	-	-	0.5[1]
Proposed Impervious Paved Areas to LID (Vegetated Filter Strip)	1.10	Fine Sandy Loam	3	-	-	-	0.5[1]
Landscaped Area	1.37	Fine Sandy Loam	75	0.3	0.3	0.1	0.7

[1] Runoff reduction for Roof Garden and Vegetated Filter Strip taken from the TRCA Low Impact Development manual (TRCA, 2010)

4.5 Results

Water balance results for the pre- and post-development conditions are presented below.

4.5.1 Pre-Development Conditions

Table 6 presents the results of the water balance for the Site under pre-development conditions. The estimated average annual pre-development surplus is 12,400 m^3/yr, which was divided into 9,900 m^3/yr infiltration and 2,500 m^3/yr runoff.

4.5.2 Post-Development (No Mitigation) Conditions

Table 7 presents the results of the water balance for the Site under post-development (no mitigation) conditions. The estimated average annual post-development surplus is 15,200 m^3/yr (an increase of approximately 23% over pre-development conditions), largely due to decreased evapotranspiration resulting from the additional hard surfaces. The estimated average annual post-development infiltration is 5,000 m^3/yr, as the site is considered to only include the proposed roof, paved areas and landscaped. The estimated annual post-development runoff is 10,200 m^3/yr (an increase of 308% from the pre-development conditions).

4.5.3 Post-Development Mitigated Conditions

Table 8 presents the results of the water balance for the Site under post-development mitigated conditions with LID features. The estimated average annual post-development surplus is the same 15,200 m^3/yr as in the no mitigation condition, however the estimated average annual post-development infiltration is 9,000 m^3/yr (a decrease of 9% over the pre-development conditions), of which the majority (3,200 m^3/yr) is provided by the Vegetated Filter Strip) and a smaller amount (800 m^3/yr) provided by the rain garden. The estimated annual post-development runoff is 6,100 m^3/yr (an increase of 144% from the pre-development conditions).

Table 6: Pre-Development Conditions Water Balance Results

Land Use	Area (ha)	WHC (mm)	Precipitation		Evaporation		Surplus		Infiltration Factor	Infiltration		Runoff	
			(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)		(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)
Densely Wooded Area	2.74	300	1062.0	29,100	608.0	16,700	452.0	12,400	0.80	361.6	9,900	90.4	2,500
Total	**2.74**	-	-	**29,100**	-	**16,700**	-	**12,400**	-	-	**9,900**	-	**2,500**

Table 7: Post-Development Conditions Water Balance Results

Land Use	Area (ha)	WHC (mm)	Precipitation		Evaporation		Surplus		Infiltration Factor	Infiltration		Runoff	
			(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)		(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)
Proposed Impervious Roof Area	0.27	3mm	1062.0	2,900	474.0	1,300	588.0	1,600	0.0	0.0	0	588.0	1,600
Proposed Impervious paved Area	1.1	3mm	1062.0	11,700	474.0	5,200	588.0	6,500	0.0	0.0	0	588.0	6,500
Landscaped	1.37	75mm	1062.0	14,600	542.0	7,400	520.0	7,100	0.7	364.0	5,000	156.0	2,100
Total	**2.74**			**29,200**		**13,900**		**15,200**			**5,000**		**10,200**

Table 8: Post-Development Mitigated Conditions with LID Feature Water Balance Results

Land Use	Area (ha)	WHC (mm)	Precipitation		Evaporation		Surplus		Infiltration Factor	Infiltration		Runoff	
			(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)		(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)
Proposed Impervious Roof Area to LID (Rain Gardens)	0.27	3mm	1062.0	2,900	474.0	1,300	588.0	1,600	0.5	294.0	800	294.0	800
Proposed Impervious Paved Areas to LID (Vegetated Filter Strip)	1.10	3mm	1062.0	11,700	474.0	5,200	588.0	6,500	0.5	294.0	3,200	294.0	3,200
Landscaped	1.37	75mm	1062.0	14,600	542.0	7,400	520.0	7,100	0.7	364.0	5,000	156.0	2,100
Total	**2.74**			**29,200**		**13,900**		**15,200**			**9,000**		**6,100**

[3] Infiltration estimated based on daily rainfall, assumed losses, and capture volume for LID feature

5 CONCLUSIONS

The regional hydrostratigraphy in the area of the Property consists of five overburden aquifer units, A1 to A5. Aquifer A1 generally considered to be unconfined, while the A2 through A5 units are confined. The A1, A3 and A4 aquifers are assumed to be present at the Property, based on the borehole logs from nearby properties. The A2 and A5 aquifers are likely absent.

The A1 aquifer represents the surficial aquifer at the Property. Available borehole data indicates that the A1 aquifer is composed of sand and gravel. The aquifer appears to be present at the Property at elevations between approximately 225 masl to 240 masl, and likely extends to a depth of approximately 10 mbgs. Data from historical piezometer installations at the Property suggest the depth to groundwater is on the order of 1 to 2.3 mbgs.

The A3 aquifer is present at the Property (and surrounding area), at elevations ranging from approximately 155 masl to 190 masl (40 mbgs to 80 mbgs). The Perkinsfield supply wells 26-4 and 26-5 are present on the south side of the Property and are screened in the A3 aquifer.

Data on the A4 aquifer is sparse, as only two well logs in the vicinity of the Property identified this unit. It appears to be present from approximately 139 masl to 150 masl (75 mbgs to 86 mbgs).

Based on communication from the Client, the planned administration centre is to be constructed on the north portion of the Property, with a 2.74 ha sub-section (the “Site”), outside of the WHPA associated with well 26-4 and 26-5. As such, it is anticipated that construction activities should not represent a groundwater quality risk from a source protection perspective. Construction of the building, and associated infrastructure may require short term construction dewatering. Historical pumping tests conducted at wells 26-4 and 26-5 (Dixon, 1997a, 1997b) showed no response in the shallow A1 and A2 aquifer to pumping in the A3 aquifer. As such, it is expected that temporary construction dewatering within the shallow overburden would not affect the supply wells.

The water balance analysis for the pre-development and post-development (without LID feature) conditions for the Site demonstrates that the proposed development (no mitigation) condition will result in a 49% decrease in average annual infiltration and a 308% increase in average annual runoff from the site.

However, the water balance analysis for the post-development mitigated conditions with proposed LID feature for the Site, demonstrates that the inclusion of LID features (including a Rain Garden and Vegetated Filter Strips) to the proposed post-development conditions will result in a 9% decrease in average annual infiltration and a 144% increase in runoff, compared the pre-development condition.

Note that the water balance analysis of the post-development mitigation conditions with LID features presented in Section 4.3 is to demonstrate the impact of LID features on the Site and does not consider any site-specific constraints related to the construction of such features at the Site. An infiltration study should be conducted to determine site-specific opportunities and constraints regarding the types of LID feature that would be most effective at reducing the impacts to infiltration at the Site.

Signature Page

WSP Canada Inc.

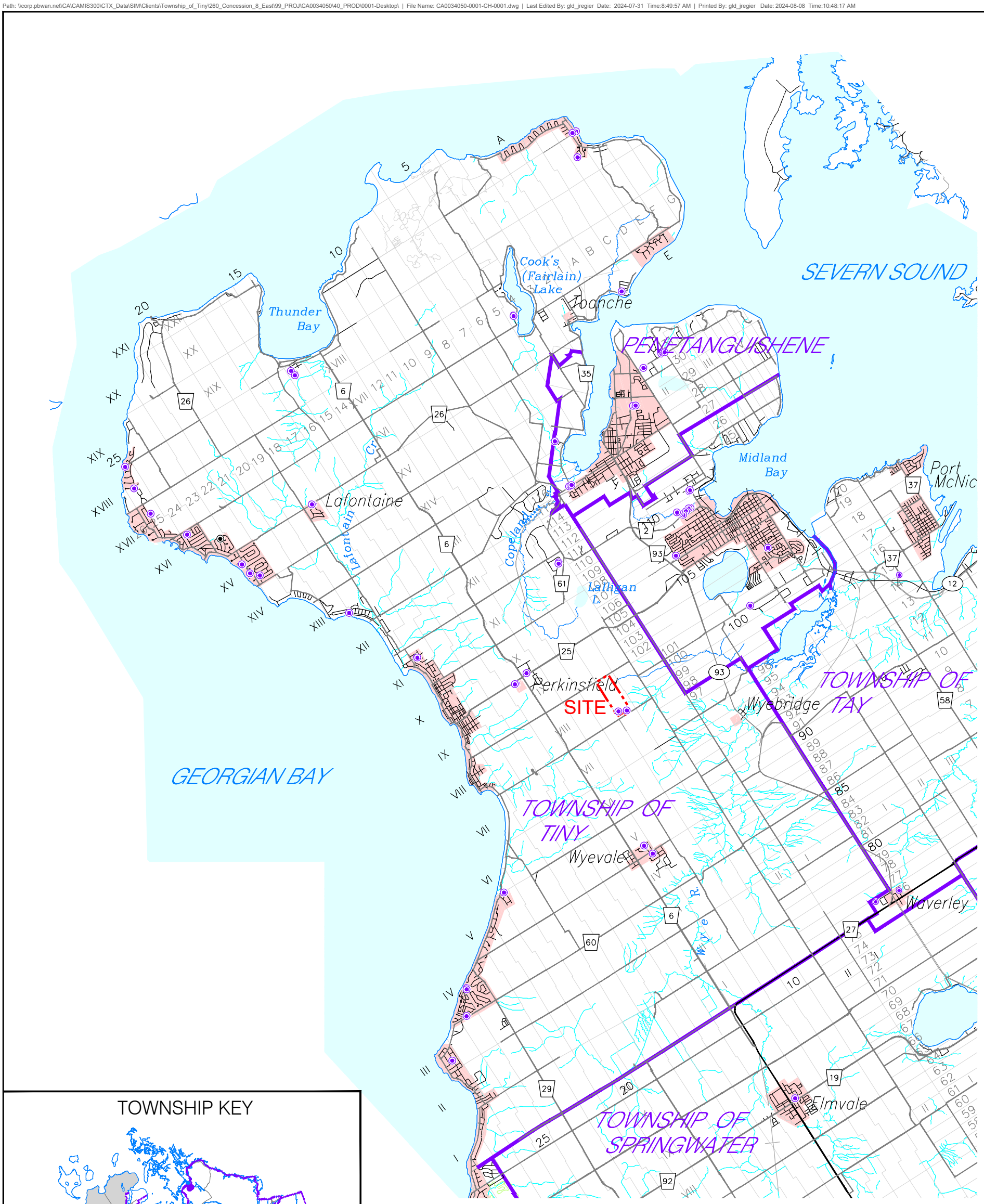
David Dillon, M.Sc., P.G
Senior Hydrogeologist

Chris Davidson, P.Eng
Water Resources Engineer

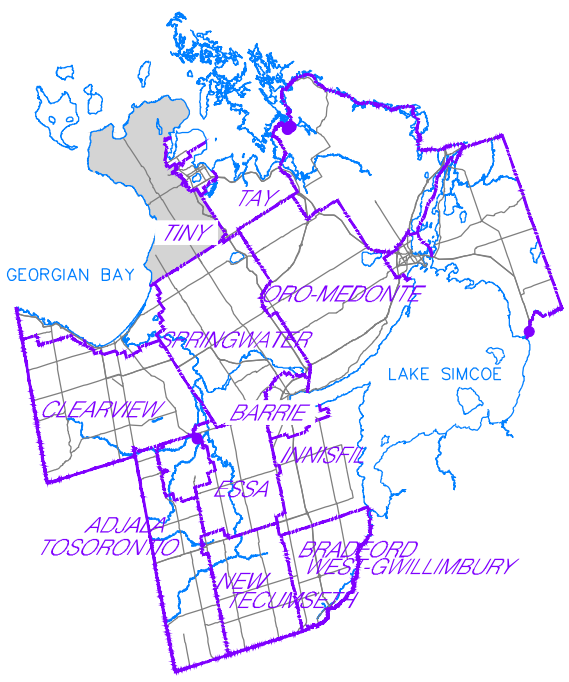
DD/CD/PM/rk

https://wsponline.sharepoint.com/sites/ca-ca00340505435/shared documents/06. deliverables/1.0 water budget and hydrogeological assessment/ca0034050.5435-r-rev1-tiny baseline assessment-30sep24.docx

Figures



TOWNSHIP KEY



CLIENT
UNITY DESIGN STUDIO INC.
TOWNSHIP OF TINY

CONSULTANT
wsp

YYYY-MM-DD	2024-08-08
DESIGNED	
PREPARED	JPR
REVIEWED	PJM
APPROVED	DPD

PROJECT
HYDROGEOLOGICAL AND HYDROLOGICAL ASSESSMENTS
PROPOSED MUNICIPAL ADMINISTRATION BUILDING
260 CONCESSION 8 EAST, TOWNSHIP OF TINY

TITLE
KEY PLAN

PROJECT NO.	CONTROL	REV.	FIGURE
CA0034050	0001	----	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
0 25 mm

SITE PROPERTY LINE

MUNICIPAL WELL
22-5 PUMPHOUSE NUMBER - SYSTEM WELL ID

SITE PLAN SURVEY, PRESTON NICHOLSON HARVEY INC. OLS
FILE: 07-3909A, JANUARY 29, 2009

ORTHOIMAGERY, BING, ESRI 2022

0 100 200
1:4,000 METRES

CLIENT
UNITY DESIGN STUDIO INC.
TOWNSHIP OF TINY

CONSULTANT
wsp

YYYY-MM-DD	2024-08-08
DESIGNED	
PREPARED	JPR
REVIEWED	PJM
APPROVED	DPD

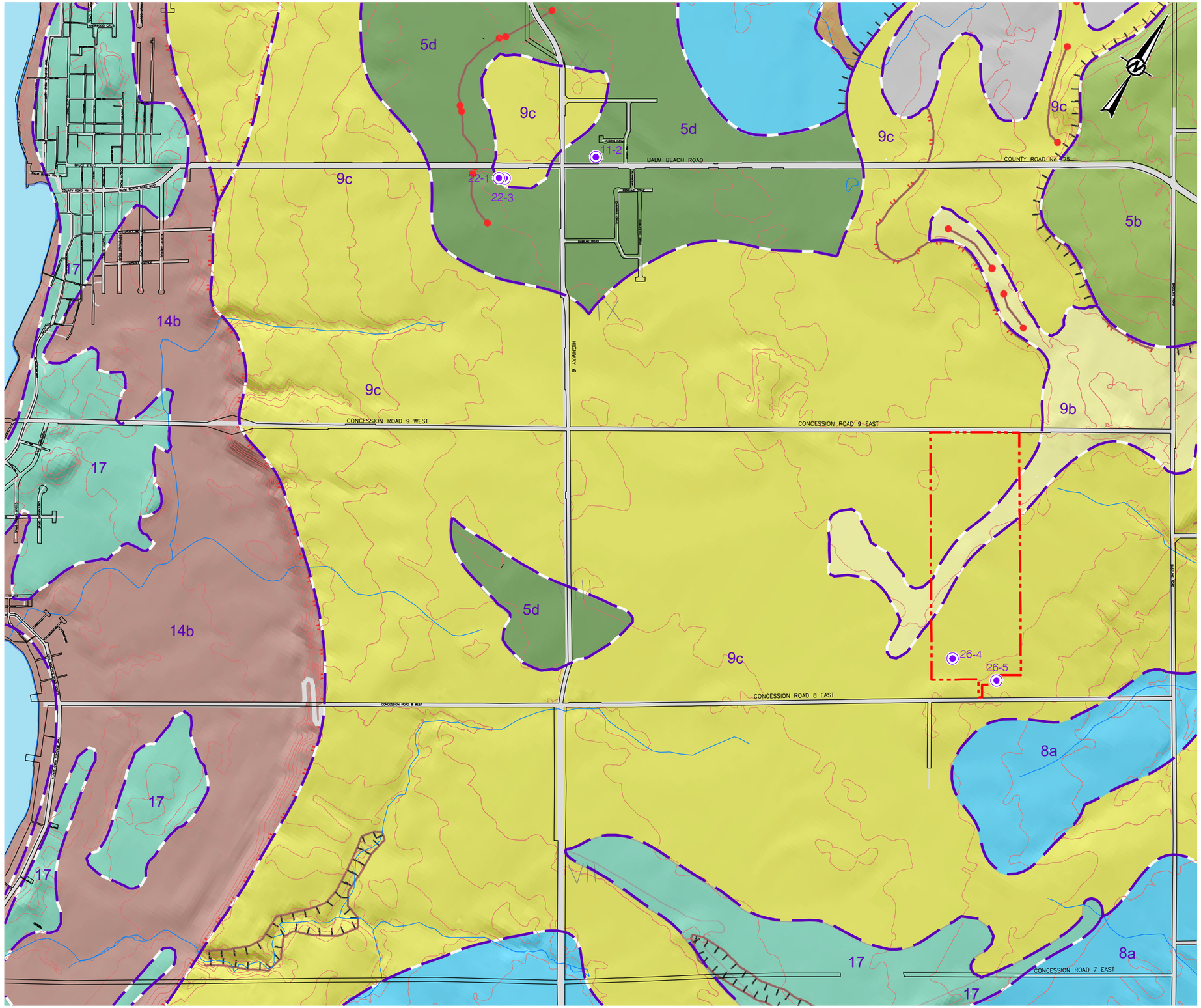
PROJECT
HYDROGEOLOGICAL AND HYDROLOGICAL ASSESSMENTS
PROPOSED MUNICIPAL ADMINISTRATION BUILDING
260 CONCESSION 8 EAST, TOWNSHIP OF TINY

TITLE
SITE PLAN AND SURVEY

PROJECT NO.	CONTROL	REV.	FIGURE
CA0034050	0001	----	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25 mm



SOILS:

	17	EOLIAN SANDS
	14b	MODERN SHORELINE DEPOSITS
	9b	GLACIOLACUSTRINE SAND DEPOSITS
	9c	GLACIOLACUSTRINE SILT & SAND DEPOSITS
	8a	GLACIOLACUSTRINE DEEP WATER DEPOSITS
	5d	FINE GRAINED TILL
	5b	ABLATION TILL

SOURCE: OGS / GSC QUATERNARY SOILS DIGITAL COMPILATION; KING'S PRINTER

LEGEND:

SITE PROPERTY LINE

MUNICIPAL WATER SUPPLY WELL
22-5 PUMPHOUSE NUMBER - SYSTEM WELL ID

0 500 1,000
1:20,000 METRES

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TOWNSHIP OF TINY

PROJECT
HYDROGEOLOGICAL AND HYDROLOGICAL ASSESSMENTS
PROPOSED MUNICIPAL ADMINISTRATION BUILDING
260 CONCESSION 8 EAST, TOWNSHIP OF TINY

TITLE
QUATERNARY SOILS

CONSULTANT

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PREPARED	JPR
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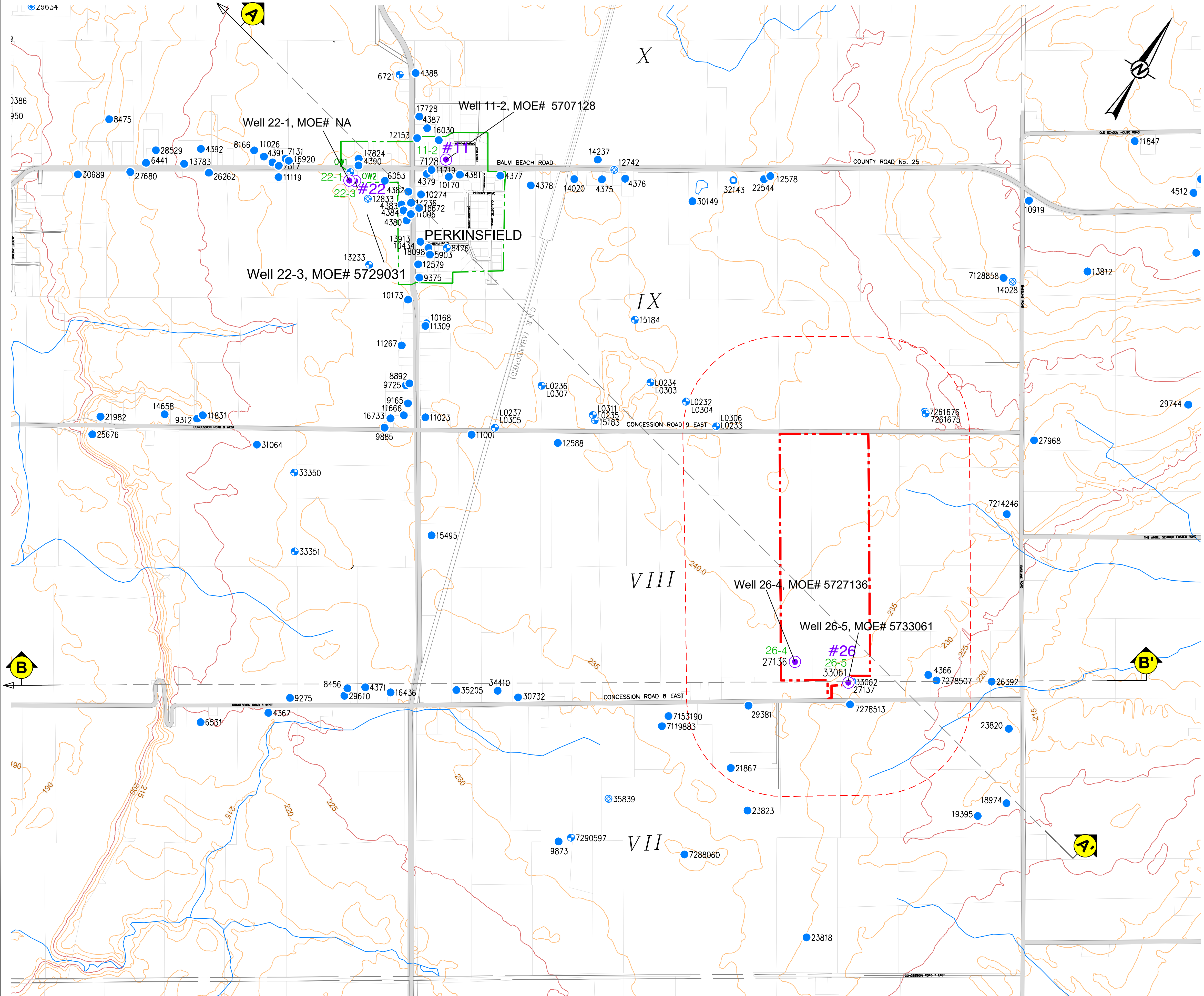
APPROVED	DPD

PROJECT NO.	CONTROL	REV.	FIGURE
CA0034050	0001	----	3



LEGEND:

- SERVICED AREA
- SITE PROPERTY LINE
- PRIVATE WATER WELL
- MUNICIPAL WATER SUPPLY WELL
- DRILLED BEDROCK WELL
- TEST / OBSERVATION WELL
- SHALLOW DUG / BORED WELL
- #11 MUNICIPAL SUPPLY SYSTEM PUMPHOUSE ID
- 26-4 MUNICIPAL WELL ID

REFER TO FIGURE 7 FOR ADDITIONAL LEGEND AND NOTES.

0 500 1,000
1:20,000 METRES

CLIENT
UNITY DESIGN STUDIO INC.
TOWNSHIP OF TINY

PROJECT
HYDROGEOLOGICAL AND HYDROLOGICAL ASSESSMENTS
PROPOSED MUNICIPAL ADMINISTRATION BUILDING
260 CONCESSION 8 EAST, TOWNSHIP OF TINY

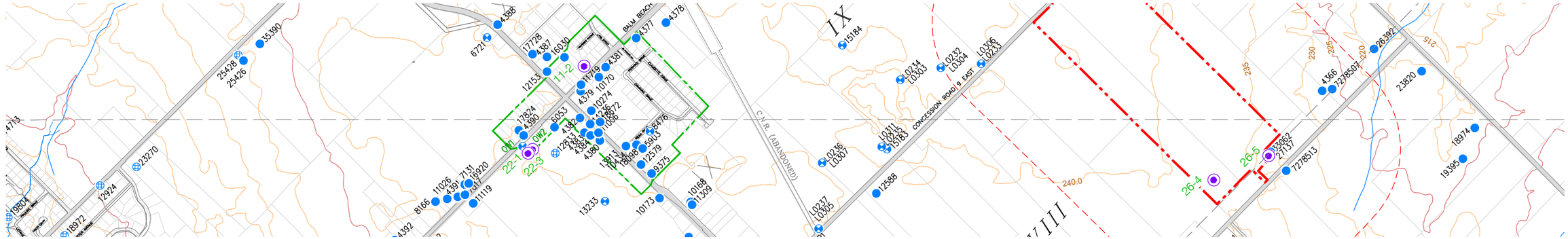
TITLE
MINISTRY REPORTED WELL RECORDS

CONSULTANT: wsp

YYYY-MM-DD	2024-08-08
DESIGNED	
PREPARED	JPR
REVIEWED	PJM
APPROVED	DPD

PROJECT NO.	CONTROL	REV.	FIGURE
CA0034050	0001	----	4

25 mm
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



REFER TO FIGURE 7 FOR LEGEND AND NOTES

CLIENT
UNITY DESIGN STUDIO INC.
TOWNSHIP OF TINY

CONSULTANT
wsp

YYYY-MM-DD	2024-08-08
DESIGNED	
PREPARED	JPR
REVIEWED	PJM
APPROVED	DPD

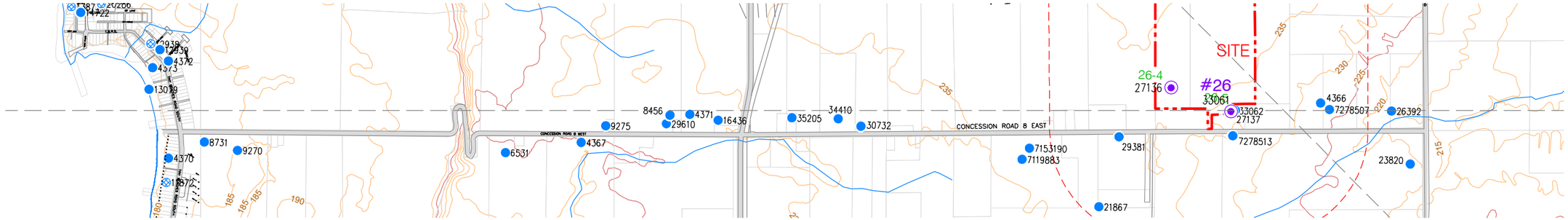
PROJECT
HYDROGEOLOGICAL AND HYDROLOGICAL ASSESSMENTS
PROPOSED MUNICIPAL ADMINISTRATION BUILDING
260 CONCESSION 8 EAST, TOWNSHIP OF TINY

TITLE
SECTION A - A'

PROJECT NO.	CONTROL	REV.	FIGURE
CA0034050	0001	----	5

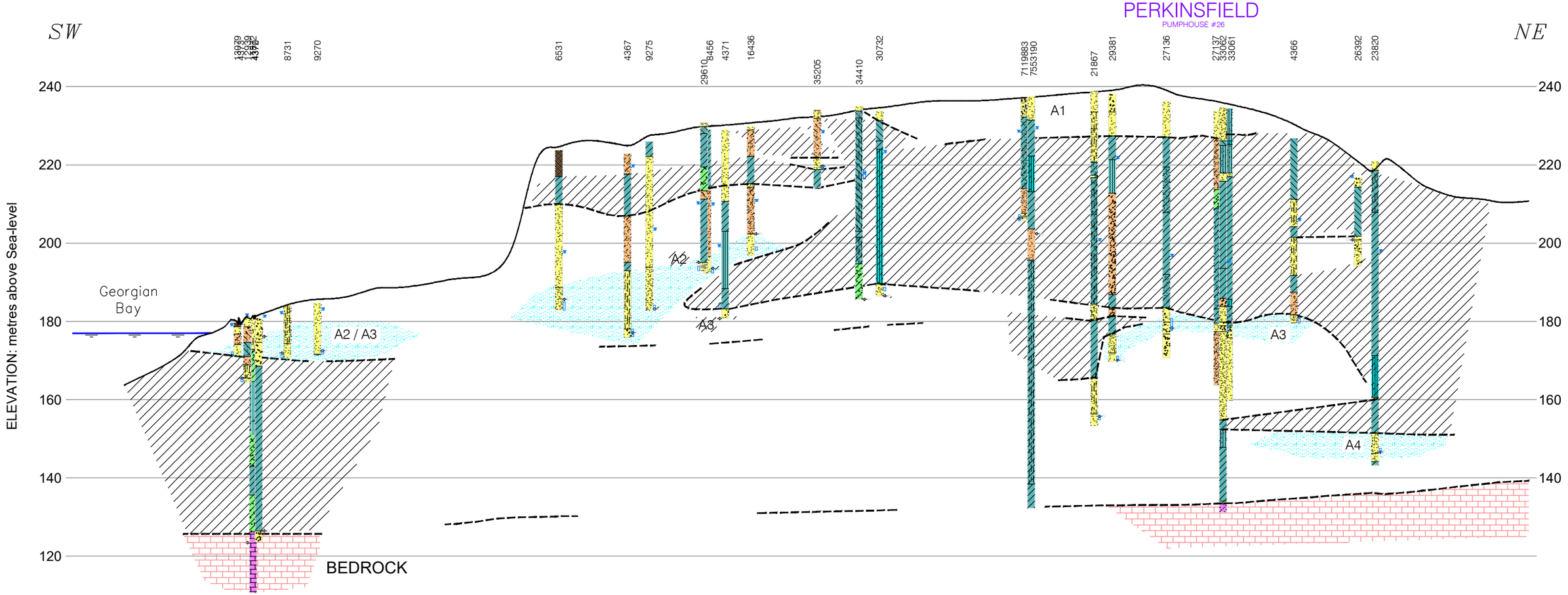
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25 mm



PERKINSFIELD

PUMPHOUSE #26



REFER TO FIGURE 7 FOR LEGEND AND NOTES

0 500 1,000

1:20,000 METRES

CLIENT
UNITY DESIGN STUDIO INC.
TOWNSHIP OF TINY

CONSULTANT
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YYYY-MM-DD	2024-08-08
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PREPARED	JPR
REVIEWED	PJM
APPROVED	DPD

PROJECT
HYDROGEOLOGICAL AND HYDROLOGICAL ASSESSMENTS
PROPOSED MUNICIPAL ADMINISTRATION BUILDING
260 CONCESSION 8 EAST, TOWNSHIP OF TINY

TITLE
SECTION B - B'

PROJECT NO.	CONTROL	REV.	FIGURE
CA0034050	0001	----	6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25 mm

STRATIGRAPHIC PATTERN

- Unoxidized CLAY, Blue, Grey, White, or Undefined CLAY
- Oxidized CLAY, Brown, Red, Yellow
- SILT
- SAND
- GRAVEL
- STONES, Rounded GRAVEL, PEBBLES
- BOULDER
- TILL
- SHALE
- DOLOSTONE
- LIMESTONE
- CRYSTALLINE ROCK

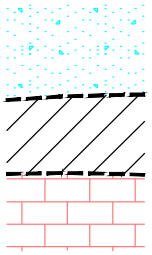
GENERIC MATERIALS

- UNKNOWN OR PREVIOUSLY DUG
- PEAT/LOAM
- AQUIFER
- AQUIFER CLAYEY
- SILT
- SILT CLAYEY
- CLAY
- TILL
- LIMESTONES
- SHALES

	SECONDARY/ SOME	TRACE	MINOR	
Clayey				Clay
Silty				Silt
Sandy				Granular

- Screen
- Recorded Static Water Level
- Water Producing Zone
- Flowing Well
- 23453 MOE Recorded Private Well

STRATIGRAPHY (see Notes)



- AQUIFER
- HYDROSTRATIGRAPHIC CONTACT
- CONFINING MATERIAL
- BEDROCK LIMESTONE OR SHALE

MAP SYMBOLS

- Shallow Dug or Bored <10 m
- Deep Bored Well >10 m
- Drilled Overburden Well
- Test or Observation Well
- Test Pit
- Drilled Bedrock Well
- Sandpoint
- Municipal / Public Supply

NOTES

On all sections, boundaries between soil strata have been determined only at well and test well locations. Between the wells and test wells, boundaries are not proven but are assumed from geological evidence.

Wells are located to MOE Water Well Bulletin Data. Locations and elevations are subject to field verification.

CLIENT
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TOWNSHIP OF TINY

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REVIEWED	PJM
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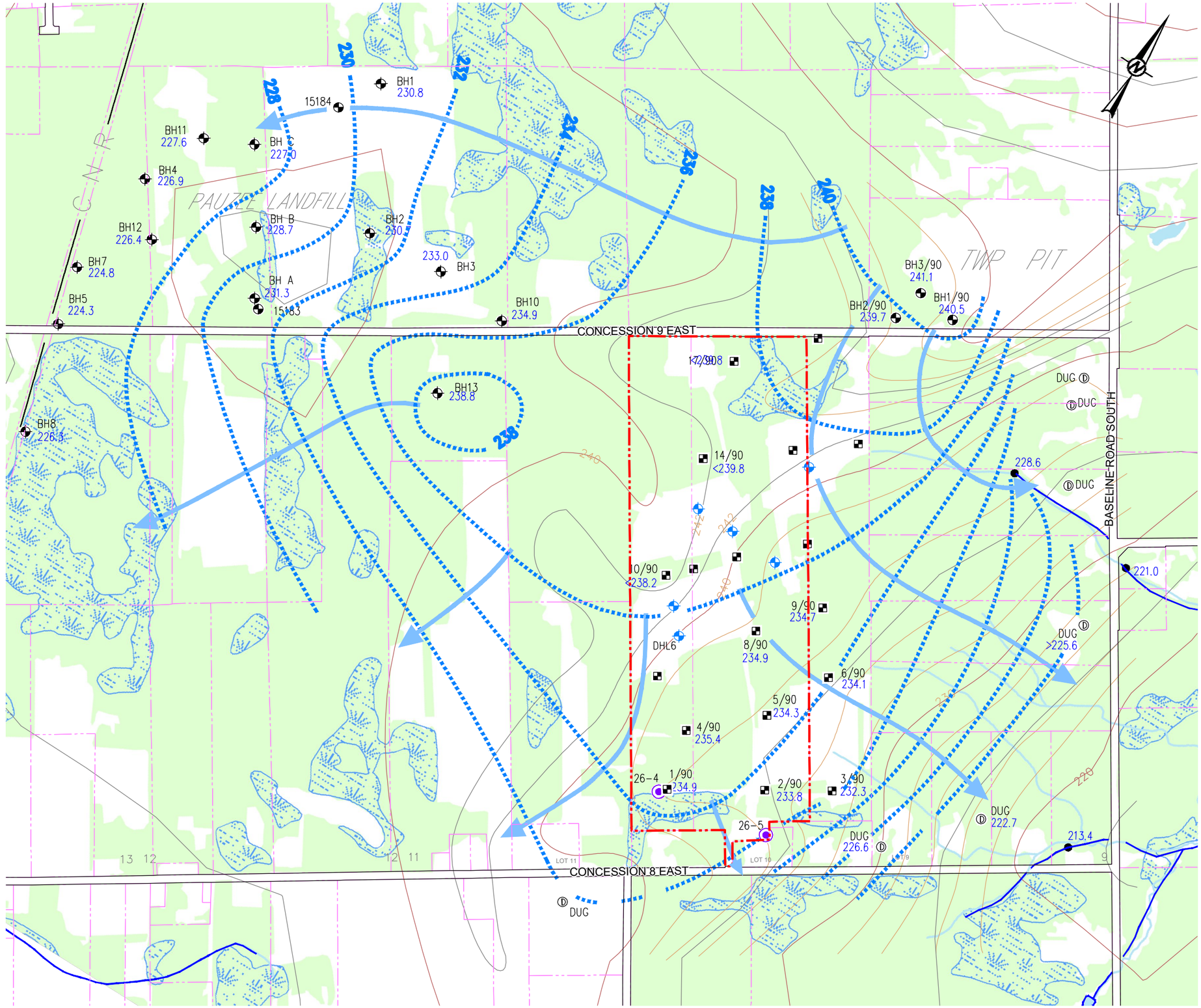
PROJECT
HYDROGEOLOGICAL AND HYDROLOGICAL ASSESSMENTS
PROPOSED MUNICIPAL ADMINISTRATION BUILDING
260 CONCESSION 8 EAST, TOWNSHIP OF TINY

TITLE
HYDROGEOLOGICAL SYMBOLS

PROJECT NO.	CONTROL	REV.	FIGURE
CA0034050	0001	----	7



SITE PROPERTY LINE

FIEILD LOCATED DUG WELL

TEST OR OBSERVATION WELL

MUNICIPAL WELL

TEST PIT

240.5 STATIC WATER ELEVATION

WATER TABLE CONTOUR (MASL)

INFERRED GROUNDWATER FLOW DIRECTION

STATIC WATER LEVELS AT SITE FROM REID AND ASSOCIATES, MAY 1990; WATER LEVELS FROM PAUZE LANDFILL FROM GARTNER LEE, SEPT 1983, UPPER SCREENS

OBM FEATURES, LIO

1:10000 DIGITAL ASSESSMENT MAPPING

0 250 500

1:10,000 METRES

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TOWNSHIP OF TINY

PROJECT
HYDROGEOLOGICAL AND HYDROLOGICAL ASSESSMENTS
PROPOSED MUNICIPAL ADMINISTRATION BUILDING
260 CONCESSION 8 EAST, TOWNSHIP OF TINY

TITLE
SHALLOW GROUNDWATER FLOW WETLANDS

CONSULTANT

YYYY-MM-DD	2024-08-08
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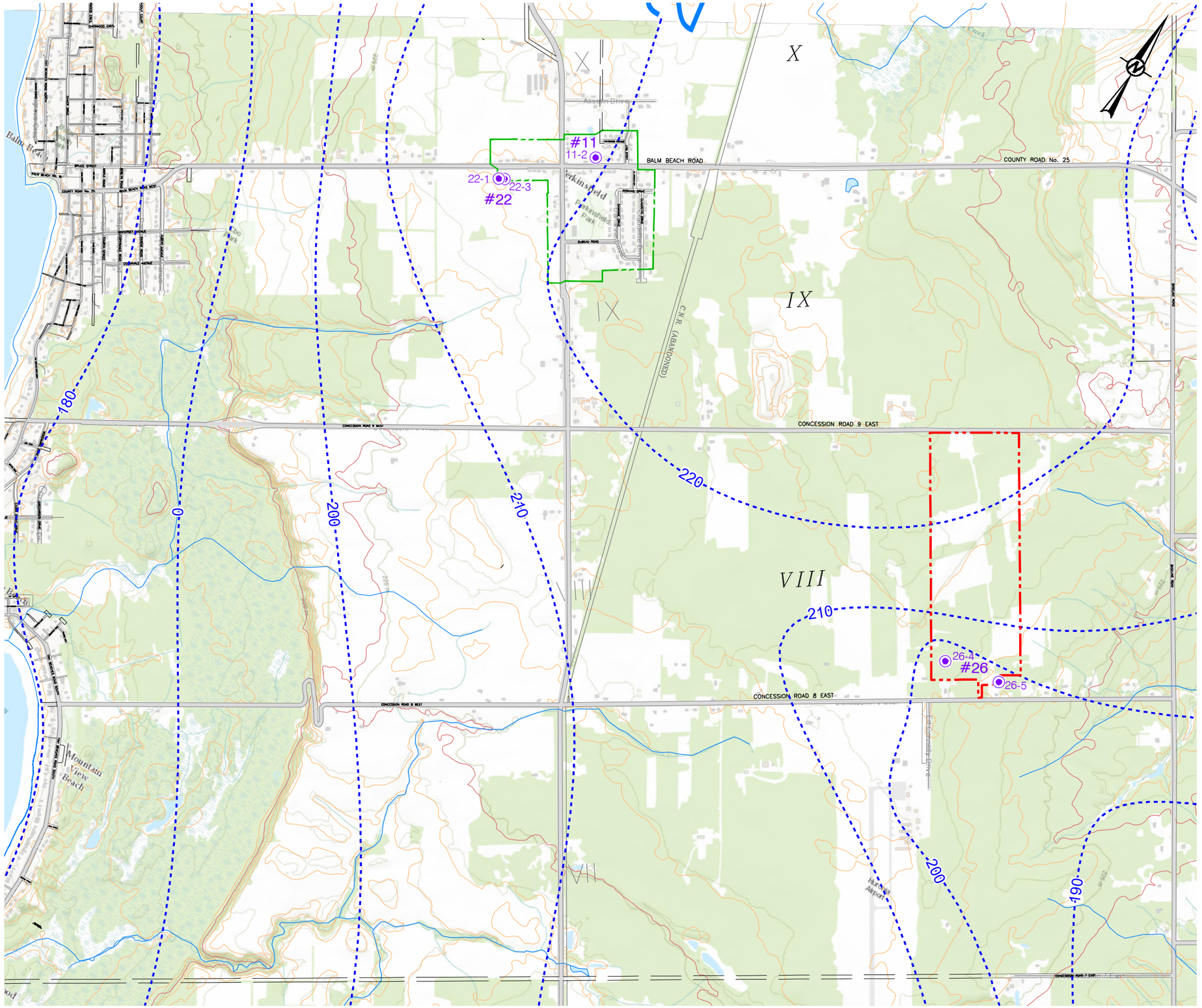
PROJECT NO.	CONTROL	REV.	FIGURE
CA0034050	0001	----	8

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25 mm



LEGEND:

- #22 PUMPHOUSE #
- 22-5 PUMPHOUSE NUMBER - SYSTEM WELL ID
- MUNICIPAL WATER SUPPLY WELL
- SERVICED AREA
- LOWER AQUIFER POTENTIOMETRIC ELEVATION (MASL)

0 500 1,000
1:20,000 METRES

CLIENT
UNITY DESIGN STUDIO INC.
TOWNSHIP OF TINY

PROJECT
HYDROGEOLOGICAL AND HYDROLOGICAL ASSESSMENTS
PROPOSED MUNICIPAL ADMINISTRATION BUILDING
260 CONCESSION 8 EAST, TOWNSHIP OF TINY

TITLE
LOWER AQUIFER GROUNDWATER FLOW

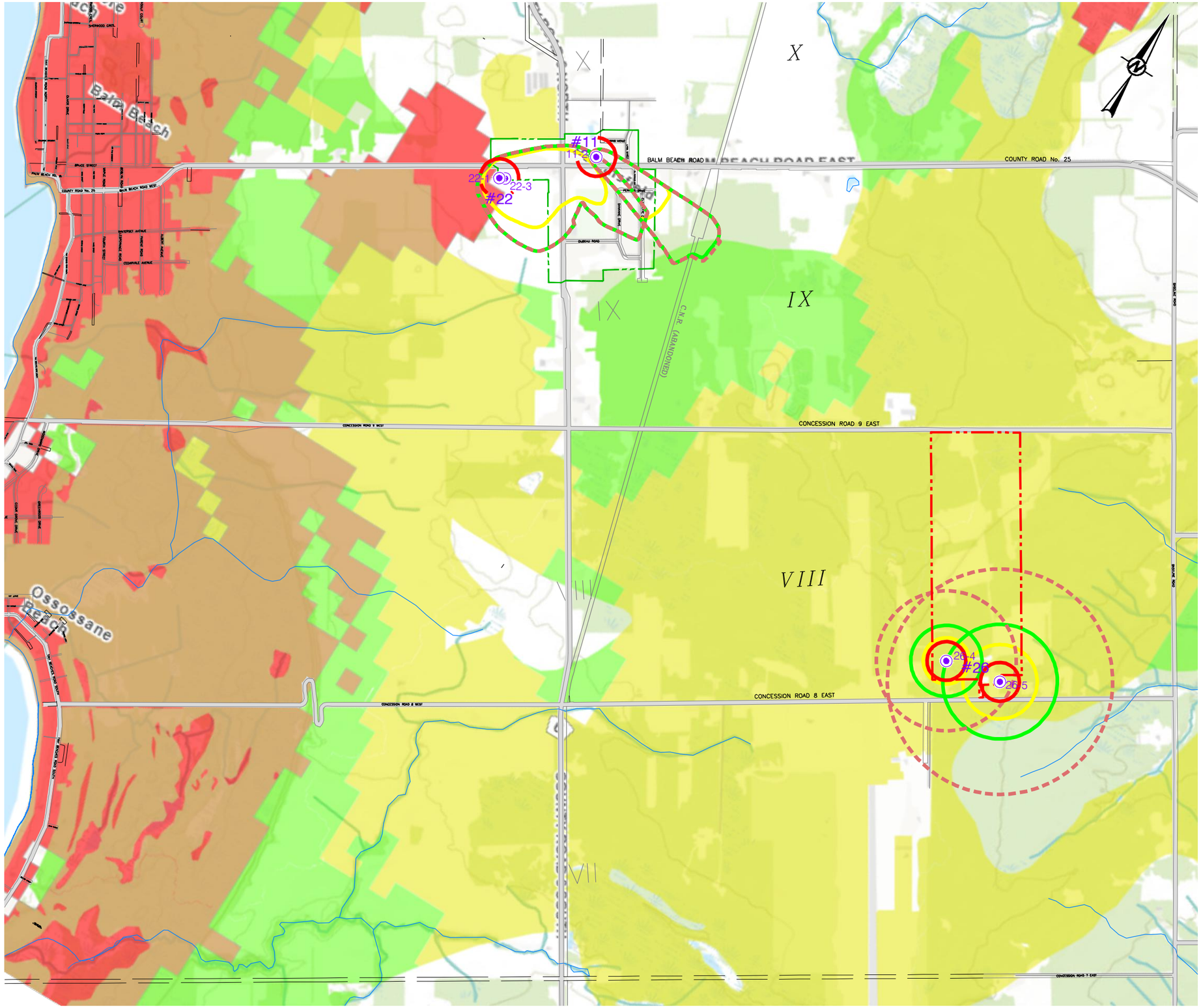
CONSULTANT
wsp

YYYY-MM-DD	2024-08-08
DESIGNED	
PREPARED	JPR
REVIEWED	PJM
APPROVED	DPD

PROJECT NO.	CONTROL	REV.	FIGURE
CA0034050	0001	----	9

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25 mm



LEGEND:

#22 PUMPHOUSE #
22-5 PUMPHOUSE NUMBER - SYSTEM WELL ID
MUNICIPAL WATER SUPPLY WELL
SERVICED AREA

WELL HEAD PROTECTION ZONES

WHPA A
WHPA B
WHPA C
WHPA D

AQUIFER SOURCE WATER VULNERABILITY

HIGHLY VULNERABLE
VULNERABILITY SCORE = 6
VULNERABILITY SCORE = 4
VULNERABILITY SCORE = 2

0 500 1,000
1:20,000 METRES

CLIENT
UNITY DESIGN STUDIO INC.
TOWNSHIP OF TINY

PROJECT
HYDROGEOLOGICAL AND HYDROLOGICAL ASSESSMENTS
PROPOSED MUNICIPAL ADMINISTRATION BUILDING
260 CONCESSION 8 EAST, TOWNSHIP OF TINY

TITLE
SOURCE WATER PROTECTION DETAILS

CONSULTANT
wsp

YYYY-MM-DD	2024-08-08
DESIGNED	
PREPARED	JPR
REVIEWED	PJM
APPROVED	DPD

PROJECT NO. CA0034050 | CONTROL 0001 | REV. ---- | FIGURE 10

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25 mm

Path: \\corp.pbwan.net\CA\CAMIS300\CTX_Data\SM\Clients\Township_of_Tiny\260_Concession_8_East\99_PROJ\CA0034050\40_PRO\0001-Desktop\ | File Name: CA0034050-0001-CH-0009.dwg | Last Edited By: gld_jregier Date: 2024-08-01 Time:12:06:32 PM | Printed By: gld_jregier Date: 2024-08-08 Time:12:00:52 PM

APPENDIX A

Important Information and Limitations of This Report

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: WSP Canada Inc. (WSP) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to WSP by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. WSP cannot be responsible for use of this report, or portions thereof, unless WSP is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without WSP's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, WSP may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to WSP. The report, all plans, data, drawings and other documents as well as all electronic media prepared by WSP are considered its professional work product and shall remain the copyright property of WSP, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of WSP. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of WSP's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to WSP by the Client, communications between WSP and the Client, and to any other reports prepared by WSP for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. WSP can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Ground Water Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, WSP does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that WSP interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

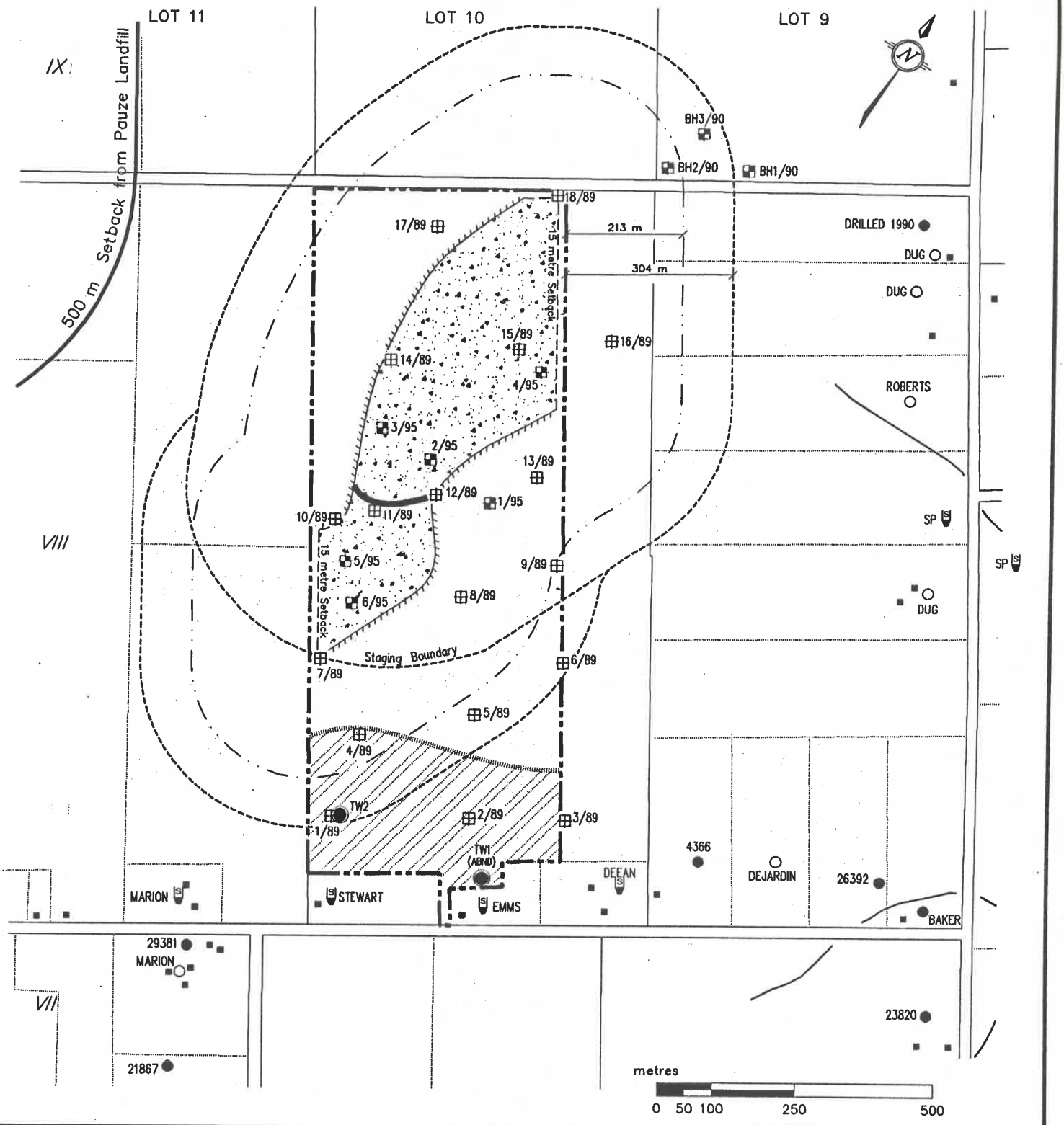
Sample Disposal: WSP will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client’s expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of WSP's report. WSP should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of WSP's report.

During construction, WSP should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of WSP's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in WSP's report. Adequate field review, observation and testing during construction are necessary for WSP to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, WSP's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

APPENDIX B

Gravel Deposit Location Plan



Site Property Line
Gravel Bar site extents
Zoning Bylaw Setback
Area potentially requiring Partly Raised Beds

Reported Wells
● Drilled ○ Dug Ⓢ Sand Point ● Municipal

Test Pits and Bore Holes
⊞ Reid and Associates ⊞ Dixon Hydrogeology

TOWNSHIP OF TINY
PROPOSED DEVELOPMENT : HYDROGEOLOGICAL INVESTIGATION
LOT 10; CONCESSION 8

SITE LOCATION MAP

DIXON HYDROGEOLOGY

FIGURE 2

Drawn J Regier	Job No. T09 E05	Date: 15 Nov 95
Approved	ACAD: T09-SITE	Dwg No. 95291

APPENDIX C

MECP Well Records

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
4366	7 14	Jun-67	585118 4950069	227.4	45.7	Fr	46.0	-1.2	21.0	50	1200	23.8	4816 CT	WS ST	**MOE# 5704366** 0.0 BRWN CLAY 15.5 MSND SILT 22.6 BLUE CLAY 25.3 MSND SILT 35.1 BLUE CLAY 39.3 MSND CLAY 45.1 FSND MSND 47.2
12588	8 12	Nov-75	582861 4950071	237.7	24.7 - 22.9	Fr	22.9	-1.8	9.8	55	30	19.8	3602 CT	WS DO	**MOE# 5712588** 0.0 BRWN SAND DRTY 8.5 GREY CLAY STKY 12.2 GREY CLAY HPAN SNDS 22.9 BRWN SAND WBRG 24.7
15183	9 12	May-78	582961 4950271	242.9			18.0	-0.9	12.2	5	120		4816 RC	OW NU	**MOE# 5715183** 0.0 TPSL 0.6 FSND 2.4 CSND GRVL 7.9 CLAY 8.2 GRVL SAND 13.1 CLAY 14.0 GRVL CLAY 15.2 FSND 19.2 FGVL 21.0 FSND 23.8 CLAY 24.1 SAND GRVL 24.4
15184	9 12	May-78	582861 4950821	239.9			18.0	-0.9	6.7	14			4816 RC	OW NU	**MOE# 5715184** 0.0 TPSL 0.6 FSND 8.8 FSND CLAY GRVL 11.0 MSND GRVL 17.7 CLAY 18.0 MSND GRVL 19.8
21867	7 11	Jun-87	584508 4949120	238.7	82.9	Fr	82.6	-1.2	38.1	18	360	70.4	2652 CT	WS CO	**MOE# 5721867** 0.0 BRWN SAND 5.2 BRWN SAND SILT 9.4 GREY SAND SILT 18.0 GREY CLAY SAND 21.3 GREY SAND GRVL 21.9 GREY HPAN 54.3 GREY SAND GRVL SILT 58.5 GREY CLAY 73.2 GREY SAND SILT 82.3 BRWN SAND 85.3
23823	7 11	Jul-88	584697 4948980	236.2	50.6	Fr	49.7	-0.9	40.5	55	135	48.2	1583 RC	WS DO	**MOE# 5723823** 0.0 BRWN SAND 11.3 BRWN CLAY 12.2 GREY CLAY SILT 25.6 SAND GRVL 29.0 GREY CLAY 42.7 SAND GRVL 46.6 BRWN SAND CSND 53.3 GREY CLAY 54.9
27136	8 10	Jun-90	584498 4949761	236.2	57.9 -		55.5	-3.0	39.6				1583 RC	WS MU	**MOE# 5727136** 0.0 BRWN SAND MSND 9.1 GREY CLAY 16.8 GREY CLAY FSND 28.3 GREY CLAY 44.2 GREY CLAY MSND 52.7 BRWN SAND GRVL MSND 56.4 BRWN SAND STNS MSND 59.4 STNS 65.5
27137	8 10	Jun-90	584804 4949832	234.7					NR				1583 RC	AQ NU	**MOE# 5727137** 0.0 SAND MSND 7.0 SAND CLAY FSND 20.1 CLAY GRVL 25.0 CLAY MSND 50.6 CLAY CSND 54.3 SAND CSND 56.4 SAND CLAY FSND 70.1
29381	7 11	Jul-92	584415 4949442	238.0	68.0	Fr	67.1	-0.9	16.5	23	1		1583 CT	WS DO	**MOE# 5729381** 0.0 GRVL 4.6 SAND 10.7 CLAY 16.8 SILT 25.3 GRVL CLAY 51.2 GREY CLAY 54.6 GRVL CLAY 56.7 GREY CLAY 61.3 SAND FSND 66.1 SAND CMTD 68.3

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
33061	8 10	Sep-97	584789 4949816	234.4	61.9	Fr	61.9	-9.1	11.9	796	4320	16.2	5528 RC	WS MU	**MOE# 5733061** 0.0 BRWN SILT SAND 8.2 BRWN SILT CLAY 9.1 GREY SILT SAND 16.5 GREY SAND GRVL STNS 17.4 GREY CLAY 48.8 GREY SILT CLAY 50.6 GREY CLAY SAND LYRD 55.5 GREY GRVL STNS CMTD 58.5 BRWN SAND 74.7
33062	8 10	Mar-97	584787 4949821	234.7	54.9	Fr	55.8	-1.5	39.6	14	360	51.8	5528 RC	OW MU	**MOE# 5733062** 0.0 BRWN FSND 8.5 BRWN CLAY 9.8 GREY SILT SAND 16.8 GREY SAND CGRD 18.9 GREY CLAY 41.1 GREY CLAY SOFT 48.8 GREY GRVL CLAY 50.9 GREY SAND PGVL 54.9 GREY GRVL 55.8 GREY GRVL 57.3 GREY FSND 79.9 GREY CLAY 82.3 BRWN SILT SAND 86.9 GREY CLAY HARD DNSE 100.6 GREY CLAY GRVL 101.2 GRNT 103.3
35839	7 12	Jan-01	584057 4948651	233.5	115.8	Fr			30.5	36	120	97.5	3602 RC	WS DO	**MOE# 5735839** 0.0 BRWN SAND CLAY 10.7 GREY CLAY STNS 91.4 GREY CLAY SAND GRVL 97.5 GREY CLAY GRVL 100.0 GREY CLAY SAND 112.2 GRNT HARD 115.8
7119883	8 11	Nov-08	584092 4949115	235.0	30.5	Fr	29.6	-1.5	8.5	45		25.6	2514 CT	WS DO	**MOE# 7119883 TAG#A048127** 0.0 BRWN SAND GRVL LOOS 4.6 GREY CLAY FSND SOFT 22.9 GREY FSND DNSE 29.3 GREY GRVL PORS 31.1
7153190		Sep-10	584093 4949177	235.6	35.1	Un			8.2	14	60	21.0	5528 RC	WS DO	**MOE# 7153190 TAG#A068647** 0.0 BRWN SAND 6.1 GREY CLAY 15.2 GREY SILT CLAY 24.4 GREY CLAY 33.8 BRWN SAND 41.8 GREY CLAY SILT LYRD 99.1 GREY CLAY 105.2
7261675	9 9	Jan-16	584391 4951206	248.4			1.5	-3.0	NR				7282 BR	OW MO	**MOE# 7261675 TAG#A167687** 0.0 BRWN SAND 4.6
7261676	9 9	Jan-16	584383 4951212	248.4			4.6	-3.0	NR				7282 BR	OW MO	**MOE# 7261676 TAG#A132036** 0.0 BRWN SAND 7.6
7278507	8 9	Nov-16	585169 4950066	225.2	23.2	Fr	22.3	-0.9	6.4	45	60		2576 OTH	WS -	**MOE# 7278507 TAG#A210843** 0.0 BRWN SAND 8.8 GREY CLAY SILT 14.3 GREY SILT 20.7 BRWN SAND CGRD 23.2
7278513	7	Oct-16	584856 4949725	235.0	23.2	Fr	22.3	-0.9	6.4	45	60		2576 OTH	WS DO	**MOE# 7278513 TAG#A210835** 0.0 TPSL 0.3 BRWN SAND WBRG 6.4 GREY SAND SILT FGRD 20.7 BRWN SAND 23.2
7288060	8 10	Mar-17	584541 4948615	234.7	71.6 71.0 71.0 71.0	Un Un Fr Fr	71.0	-0.9	43.9			61.3	2576 RC	WS DO	**MOE# 7288060 TAG#A218839** 0.0 BRWN SAND 6.4 GREY SILT 13.7 BRWN SAND GRVL 17.7 GREY SAND 23.2 GREY CLAY STNS 57.3 GREY GRVL CLAY CMTD 70.7 GREY SAND MSND 71.9

LABEL	CON	DATE	EASTING	ELEV	WTR	FND	SCR TOP	LEN	SWL	RATE	TIME	PL	DRILLER	TYPE	WELL NAME
	LOT	mmm-yr	NORTHING	masl	mbgl	Qu	mbgl	m	mbgl	L/min	min	mbgl	METHOD	STAT	DESCRIPTION OF MATERIALS
L0232	12	Nov-11	583309	239.6			31.7	-3.0	8.5				9999	OW	**GAL# DHL0232**
	9		4950602				13.1	-1.5					RC	IN	0.0 FSND MSND 13.7 FSND SILT 18.3 SILT CLAY PGVL 19.5 FSND MSND 20.1 SILT CLAY 21.6 FSND 23.2 SILT FSND CLAY 33.2 SILT CLAY SAND 36.6
L0233	12	Nov-11	583509	240.2			27.4	-1.5	7.6				9999	OW	**GAL# DHL0233**
	9		4950578				9.1	-1.5					RC	IN	0.0 FSND 13.7 SILT 21.0 GREY CLAY SILT FSND 26.5 SILT FSND PGVL 29.0
L0234	12	Nov-11	583101	239.0			13.7	-3.0	9.8				9999	OW	**GAL# DHL0234**
	9		4950589				8.5	-3.0					RC	IN	0.0 GRVL CSND 10.4 SILT CLAY PGVL 10.7 FSND MSND 18.3 SILT MSND CLAY 21.3 FSND CSND 24.4 MSND SILT MGVL 24.7 FSND CSND GRVL 37.8 GREY CLAY SILT 38.1
L0235	12	Nov-11	582938	243.5			28.7	-3.0	10.1				9999	OW	**GAL# DHL0235**
	9		4950289				13.7	-3.0					RC	IN	0.0 MSND 10.7 FSND MSND CLAY 25.0 GREY CLAY SILT 25.9 SAND SILT CLAY 27.4 MSND 40.5 SILT SAND GRVL 41.1
L0236	12	Nov-11	582633	235.9			19.8	-1.5	9.1				9999	OW	**GAL# DHL0236**
	9		4950277				10.1	-1.5					RC	IN	0.0 FSND MSND 9.1 FSND SILT 12.2 FSND MSND SILT 13.7 FSND MSND 18.3 MSND CSND 21.9 MSND QSND 32.0 CSND MGVL SILT 44.2 SILT MSND 44.5
L0303	9	Jan-15	583101	239.0			13.7	-3.0	9.8				9999	OW	**GAL# DHL0303**
	12		4950589				8.5	-3.0					RC	PU	0.0 GRVL CSND 10.4 SILT CLAY PGVL 10.7 FSND MSND 18.3 SILT MSND CLAY 21.3 FSND CSND 24.4 MSND SILT MGVL 24.7 FSND CSND GRVL 37.8 GREY CLAY SILT 38.1
L0304	9	Jan-15	583309	239.6			31.7	-3.0	8.5				9999	OW	**GAL# DHL0304**
	12		4950602				13.1	-1.5					RC	PU	0.0 FSND MSND 13.7 FSND SILT 18.3 SILT CLAY PGVL 19.5 FSND MSND 20.1 SILT CLAY 21.6 FSND 23.2 SILT FSND CLAY 33.2 SILT CLAY SAND 36.6
L0306	9	Jan-15	583509	240.2			27.4	-1.5	7.6				9999	OW	**GAL# DHL0306**
	12		4950577				9.1	-1.5					RC	PU	0.0 FSND 13.7 SILT 21.0 GREY CLAY SILT FSND 26.5 SILT FSND PGVL 29.0
L0307	9	Jan-15	582634	234.7			19.8	-1.5	9.1				9999	OW	**GAL# DHL0307**
	12		4950277				10.1	-1.5					RC	PU	0.0 FSND MSND 9.1 FSND SILT 12.2 FSND MSND SILT 13.7 FSND MSND 18.3 MSND CSND 21.9 MSND QSND 32.0 CSND MGVL SILT 44.2 SILT MSND 44.5
L0311	9	Jan-15	582938	240.5			28.7	-3.0	10.1				9999	OW	**GAL# DHL0311**
	12		4950289				13.7	-3.0					RC	PU	0.0 MSND 10.7 FSND MSND CLAY 25.0 GREY CLAY SILT 25.9 SAND SILT CLAY 27.4 MSND 40.5 SILT SAND GRVL 41.1

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS

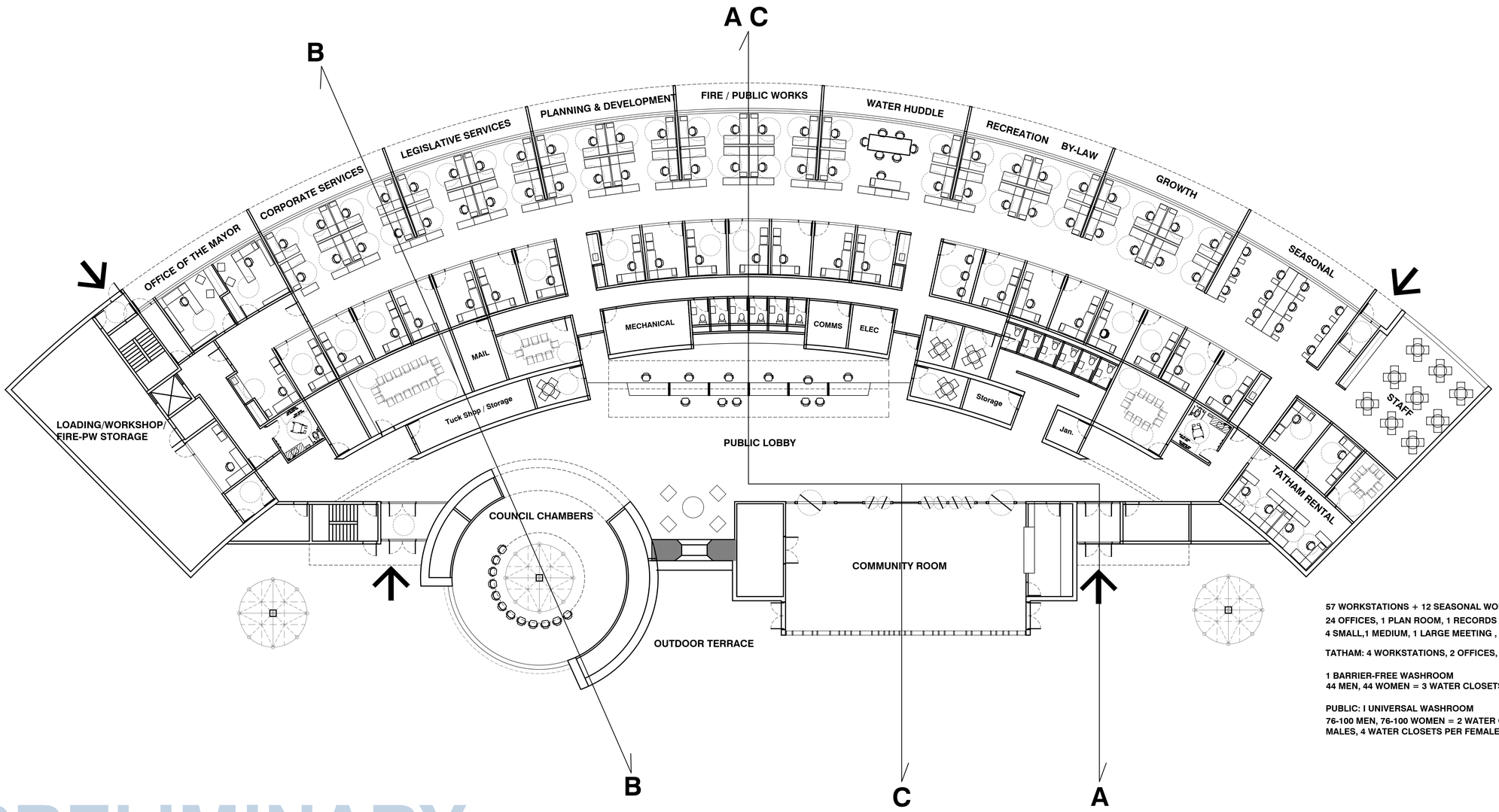
QUALITY:		TYPE:		USE:				METHOD :	
Fr	Fresh	WS	Water Supply	CO	Comercial	NU	Not Used	CT	Cable Tool
Mn	Mineral	AQ	Abandoned Quality	DO	Domestic	IR	Irrigation	JT	Jetting
Sa	Salty	AS	Abandoned Supply	MU	Municipal	AL	Alteration	RC	Rotary Conventional
Su	Sulphur	AB	Abandonment Record	PU	Public	MO	Monitoring	RA	Rotary Air
--	Unrecorded	TH	Test Hole or Observation	ST	Stock	-	Not Recorded	BR	Boring

Easting and Northings UTM NAD 83 Zone 17, Translated from Recorded UTM NAD, subject to Field Verified Location or Improved Location Accuracy.

APPENDIX D

Schematic Plans

18" x 36"



57 WORKSTATIONS + 12 SEASONAL WORKSTATIONS
24 OFFICES, 1 PLAN ROOM, 1 RECORDS ROOM
4 SMALL,1 MEDIUM, 1 LARGE MEETING , 1 BOARD ROOM

TATHAM: 4 WORKSTATIONS, 2 OFFICES, 1 MEETING

1 BARRIER-FREE WASHROOM
44 MEN, 44 WOMEN = 3 WATER CLOSETS PER SEX

PUBLIC: I UNIVERSAL WASHROOM
76-100 MEN, 76-100 WOMEN = 2 WATER CLOSETS PER MALES, 4 WATER CLOSETS PER FEMALES

PRELIMINARY

Unity

Unity Design Studio Inc.

138 Simcoe Street
Peterborough Ontario K9H 2H5

t. 705.743.3311
e. studio@lett.ca

PROJECT PHASE
PRELIMINARY

PROJECT No. 23-135

TINY TOWNSHIP ADMINISTRATION CENTRE

SCHEMATIC OPTION 1

CONCESSION 9 EAST
Perkinsfield, ON

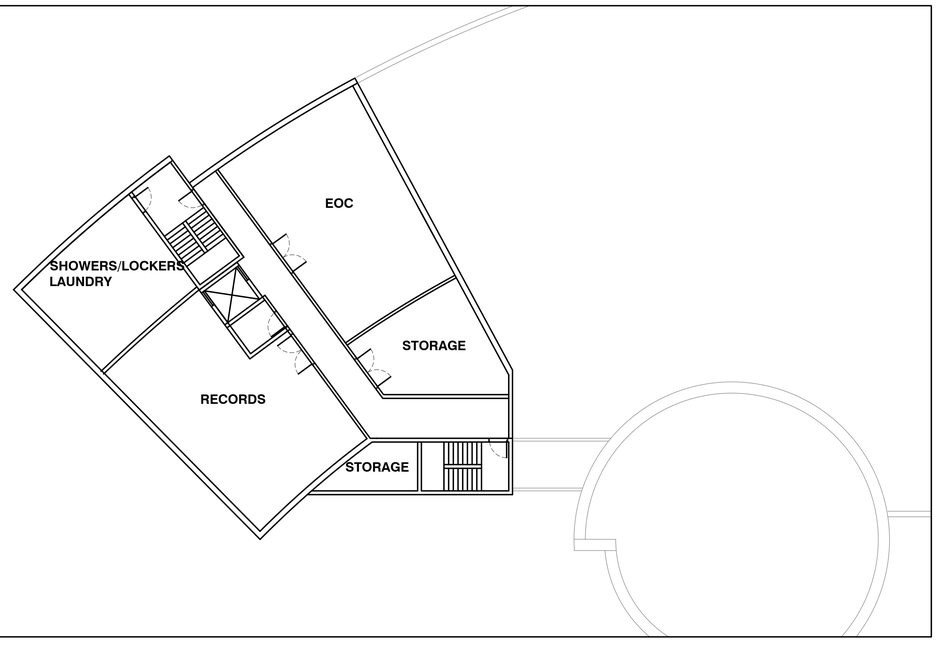
2709 m2
29,160 sq.ft.

FLOOR PLAN

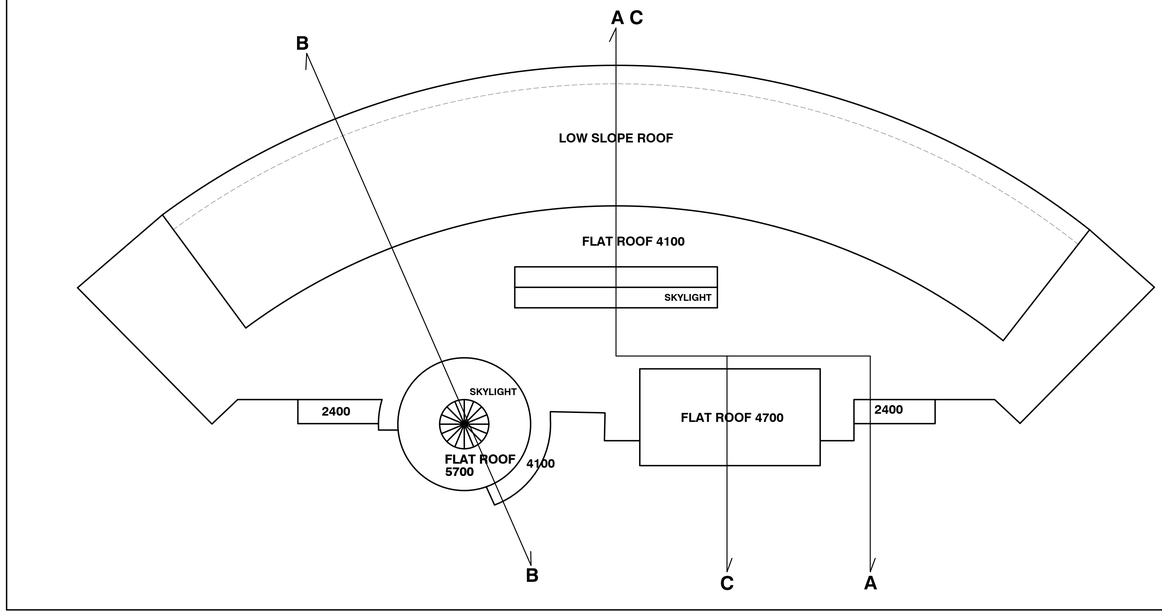
1:150 metric
19 March 2024

A1

18" x 36"



BASEMENT PLAN



ROOF PLAN

PRELIMINARY

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PROJECT PHASE
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PROJECT No. 23-135

TINY TOWNSHIP ADMINISTRATION CENTRE

SCHEMATIC OPTION 1

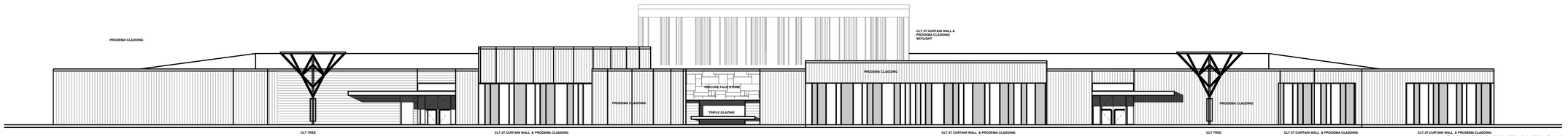
CONCESSION 9 EAST
Perkinsfield, ON

2709 m2
29,160 sq.ft.

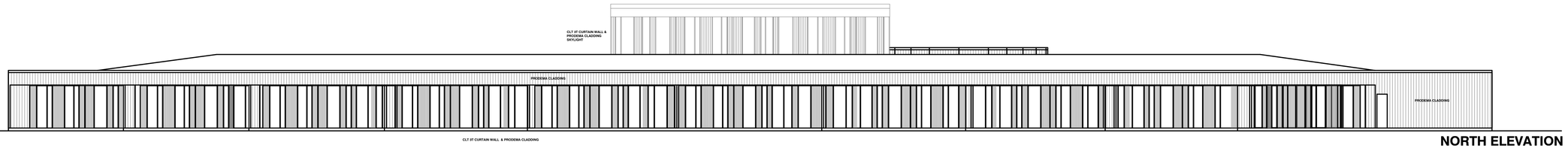
BASEMENT PLAN 1:150
ROOF PLAN: 1:275
As noted metric
19 March 2024

A2

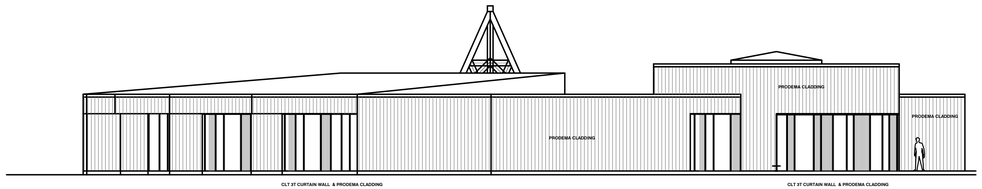
18" x 36"



SOUTH ELEVATION



NORTH ELEVATION



WEST ELEVATION

PRELIMINARY

Unity

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PROJECT PHASE
PRELIMINARY

PROJECT No. 23-135

TINY TOWNSHIP ADMINISTRATION CENTRE

SCHEMATIC OPTION 1

CONCESSION 9 EAST
Perkinsfield, ON

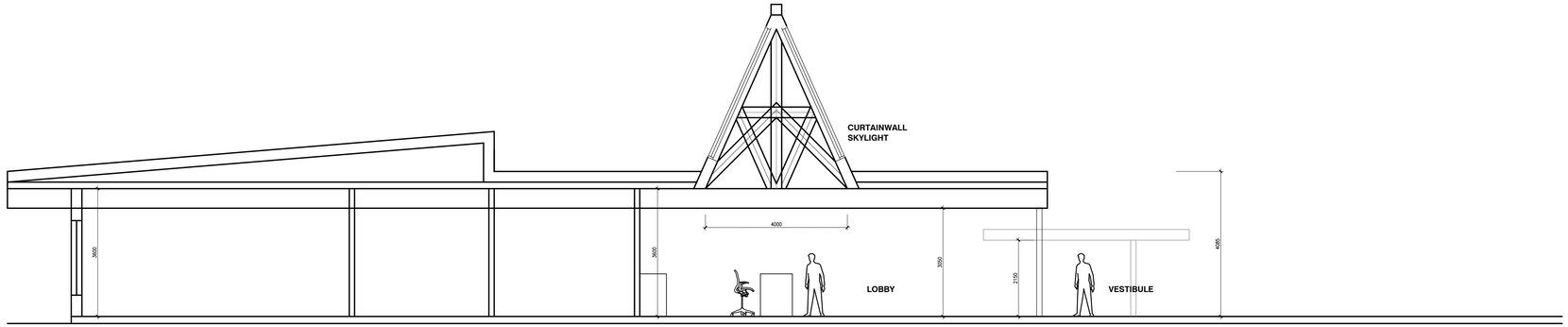
2709 m2
29,160 sq.ft.

ELEVATIONS

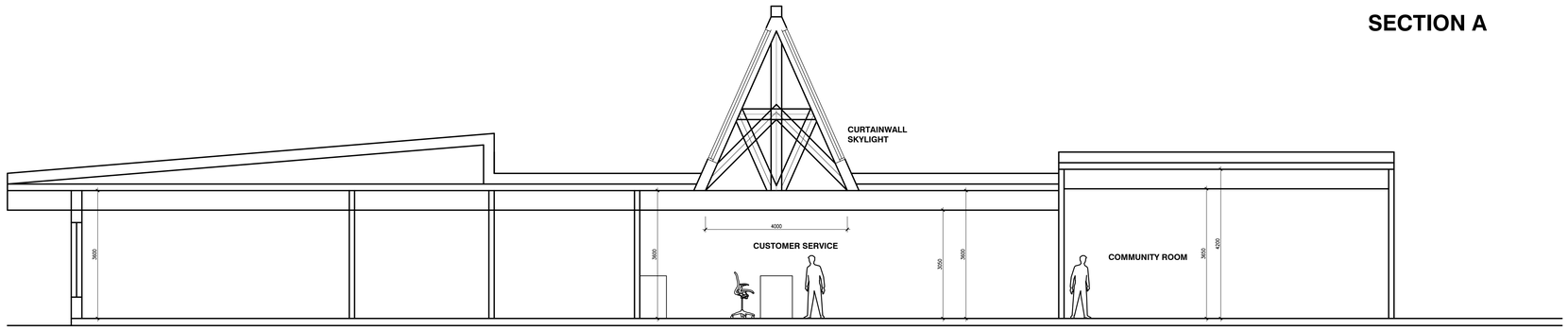
1:150 metric
19 March 2024

A3

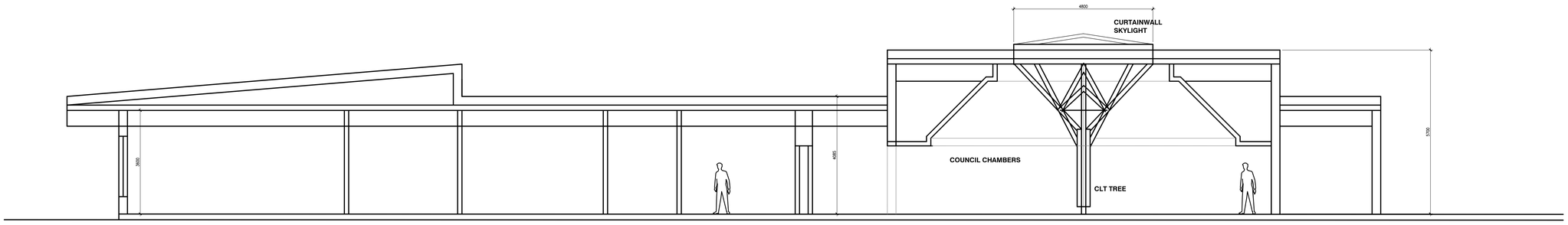
18" x 36"



SECTION A



SECTION C



SECTION B

PRELIMINARY

Unity

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PROJECT PHASE
PRELIMINARY

PROJECT No. 23-135

TINY TOWNSHIP ADMINISTRATION CENTRE

SCHEMATIC OPTION 1

CONCESSION 9 EAST
Perkinsfiled, ON

2709 m2
29,160 sq.ft.

BUILDING SECTIONS
1:75 metric
19 March 2024

A4

wsp.com