FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

SITE PLAN SUBMISSION - OCTOBER 2025

4497 O'Keefe Court, Ottawa, Ontario
Proposed Office and Warehouse Development
KWA PROJECT: 21684
Application #D07-12-25-0085
Plan #19335

Report Prepared for:
O'Keefe Court Properties
c/o The Properties Group Mgmt Ltd.
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1.0 INTRODUCTION

KWA Site Development Consulting Inc. (KWA) has been retained by The Properties Group to prepare a detailed Functional Servicing and Stormwater Management Report along with a corresponding grading and servicing design in support of the Site Plan Application (SPA) for the proposed development. The subject property is located at the northwest corner of O'Keefe Court at municipal address 4497 O'Keefe Court in the City of Ottawa (formerly the Municipality of Nepean). Refer to **Figure 1.1** below.

This report will:

- Provide background information regarding the subject property;
- Summarize the existing site conditions;
- Provide information regarding the proposed development conditions;
- Outline the proposed grading for the development; and
- Outline the existing and proposed municipal servicing.

The recommended servicing has been developed in accordance with the applicable design criteria and requirements of the City of Ottawa (the City).

Figure 1-1: Location Plan

1.1 PROJECT BACKGROUND

The total property is approximately 6.88ha in area at municipal address 4497 O'Keefe Court in the City of Ottawa. The existing site was previously a quarry which has not been active for many years and is now vacant greenfield.

The subject site is bound by O'Keefe Court to the south, Lytle Park to the East, Highway 416 to the west and Vacant greenfield to the north.

The existing topography of the site slopes from north-west to south-east, towards the existing ditches along O'Keefe Court. Existing elevations are 113.0-114.50 in the north-west corner sloping down to the south-east corner with elevations of 102.50-103.00. Site elevation differences of approximately 10-12 m across the length of the site.

1.2 PROPOSED DEVELOPMENT

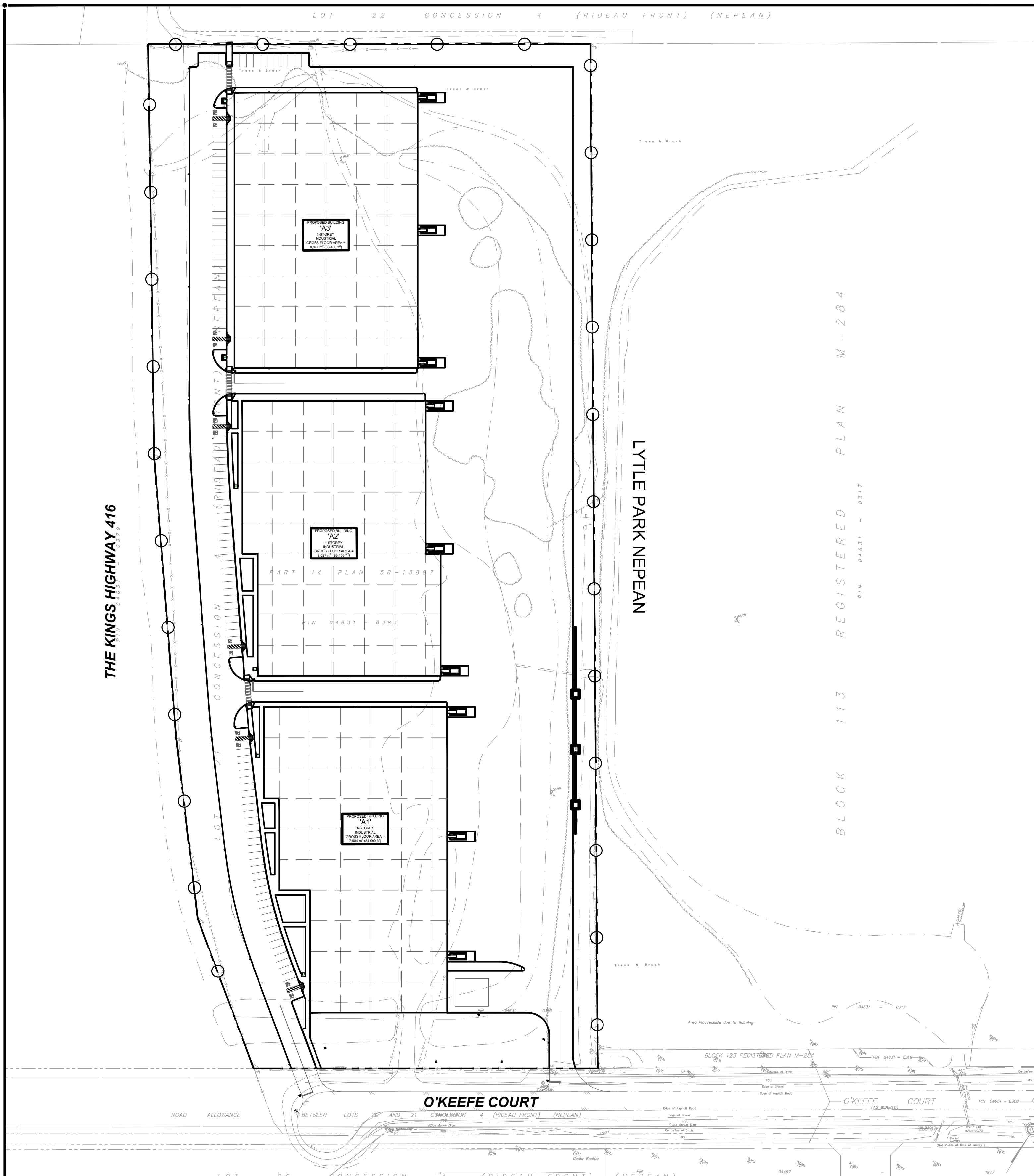
The proposed development of the site includes three (3) industrial warehouse buildings, with a total anticipated floor area of 23,858m^2 (256,800ft^2). The buildings will be surrounded by driveways, parking, and loading docks located on the east side of the buildings, with entrances facing the highway on the west side. Refer to Figure 1-1 for the proposed development plan.

1.3 SITE ACCESS

The site's main vehicular access will be two proposed entrances from O'Keefe Court.

1.4 UTILITIES

As the proposed development is located within a well-developed area of Ottawa, all utilities including telephone, cable, electricity and gas are readily available to service the subject property. Water and sanitary servicing will be further elaborated in the subsequent respective sections in this report.



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REVISION BLOCK

#	DATE	DESCRIPTION
1.	06/09/2025	FIRST SUBMISSION
2.	10/01/2025	SECOND SUBMISSION

PROPOSED DEVELOPMENT PLAN

THE PROPERTIES GROUP
O'KEEFE COURT
NEPEAN, ONTARIO

PROJECT No: | DRAWN BY: | CHECKED BY:

NORTH ARROW

METRIC SCALE

FIG 1-1

2.0 STORMWATER MANAGEMENT

2.1 EXISTING DRAINAGE CONDITIONS

The existing topography of the site slopes from north-west to south-east, towards the existing ditches along O'Keefe Court. Existing elevations are 113.0-114.50 in the north-west corner sloping down to the south-east corner with elevations of 102.50-103.00. Site elevation differences of approximately 10-12 m across the length of the site.

Most of the existing drainage from the site drains towards the east-middle of the site where drainage is conveyed by a 750mm culvert through a landscaped berm along the eastern property limit. This drainage is then conveyed towards a ditch within the neighbouring Lytle Park, where the drainage enters a water feature located on the south side of the Lytle Park property. Flows after this water feature are then conveyed along a swale on the north side of O'Keefe Court, which then crosses to the south side of O'Keefe Court through a culvert. Drainage then continues to flow south-east through conveyance swales and culverts down to Jock River, which finally flows east into the Rideau River flowing north to Ottawa River.

Although existing drainage of the subject site is tributary to the north swale of O'Keefe Court (via Lytle Park), discussions with City staff have determined that the swale along the south side of O'Keefe Court will serve as the most functionally acceptable outfall for the site (i.e. bypassing Lytle Park and the north swale), provided there is sufficient flow capacity. Therefore, the site will be designed based on the allowable outlet determined by City staff instead of existing conditions. Further discussion and analysis can be found in Section 2.7.

The pre-development rates are determined using the Modified Rational Method. The inputs are:

- Drainage area = 6.88ha
- Time of Concentration = 40 minutes (calculated using the Airport Method)
- Runoff Coefficient = 0.30
- Intensity based on the City of Ottawa IDF curves.

Table 1: Pre-development Runoff Peak Flows

Storm Event	Intensity (mm/hr)	Peak Flows (L/s)
2-yr	32.9	189
5-yr	44.2	254
10-yr	51.6	296
25-yr	61.0	350
50-yr	68.0	390
100-yr	75.1	431

Refer to **Figure F2-1** for the proposed drainage plan and **Figure F2-2** for the extent of external drainage route south-east of the site down to Jock River.

2.2 STORMWATER MANAGEMENT DESIGN CRITERIA

The proposed stormwater management design is based on the MOE 2008 Stormwater Management Planning & Design (SWMPD), the City of Ottawa Sewer Guidelines (October 2012), and the City of Ottawa Stormwater Management Design Guidelines (2012).

- **Quantity Control:** Stormwater runoff is to be controlled from pre-development to post-development peak runoff rates for storms up to and including the 100-year event using on-site detention.
    - **Ministry of Transportation (MTO):** It is understood that rooftop controls are typically not permitted for sites within MTO jurisdiction. The drainage outlets for these building rooftops drain easterly away from the Highway 416 corridor and towards the Jock River, therefore the site

- **Quality Control:** Stormwater quality control measures will be provided to achieve at a minimum, Enhanced level of protection (i.e. 80% TSS removal) as described in the MOE SWMPD manual for TSS removal. Thermal mitigation through on-site Best Management Practices (BMP's) is also required.
- **Water Balance:** Based on the Jock River Reach 1 Subwatershed Study (June 2007), future development within this subwatershed should have an objective to maximize infiltration wherever possible using best management practices (BMP). Retention of the first 5mm of all rainfall events will be provided through on-site infiltration as a best efforts approach. Retention of the first 5mm of rainfall is equivalent to a 50% annual runoff reduction.
- **Construction Erosion and Sediment Control:** All applicants must include an Erosion and Sediment Control plan demonstrating that fish habitat and water quality are not affected by sediment from the property during or following site construction.
- **Ponding and Overflows:** Allowable flow depth shall not exceed 300mm in parking lot/private roadway areas. Excess runoff greater than the 100-year storm event must overflow to City ROW (O'Keefe Court).
- **Stormwater Outlet:** Stormwater drainage systems shall discharge to municipal storm sewer system where feasible. In cases where this is not possible, stormwater drainage systems may discharge to natural watercourses.

2.3 Proposed Stormwater Management Design Strategy

The proposed stormwater management system will include the capture and conveyance of the entire proposed development (6.88ha). The primary stormwater management will be achieved by utilization of rooftop storage using control drains. Since the rooftop of the buildings cover a significant portion of the site area, this will provide considerable and effective stormwater management for the site. Surface drainage will be captured by a series of catchbasins spread out across the site. The storm sewers will be sized to capture and convey 5-year storm flows and directed to a series of stormwater management facilities in the southeast corner of the site before outfall.

It is understood that the subject site falls within the jurisdiction of the Ministry of Transportation (MTO), where rooftop controls are typically not permitted. In this case, however, the building rooftops are controlled and ultimately discharge to the roadside ditches on O'Keefe Court, with drainage continuing through the O'Keefe drain, and ultimately to the Jock River, which lies outside MTO jurisdiction. Therefore, given that rooftop drainage is directed away from MTO drainage features, it is assumed that rooftop controls would not be subject to MTO regulation. For a depiction of the ultimate drainage outfall in both existing and proposed conditions, please refer to **Figure 2-2**.

Catchbasin inlets are designed with a 50% blockage factor to capture the 5-year flows, with storm events above the 5-year and up to the 100-year draining overland and being picked up by subsequent catchbasins. In order to ensure overland drainage up to the 100-year storm event does not spill out from the site, the final catchbasin inlet for both the west and east drive aisles have been designed to receive all overland drainage above the 5-year and up to the 100-year storm events for upstream catchments, with only the emergency overland flow route spilling out to O'Keefe Court (i.e. during rainfall events above the 100-year or clogged inlet scenarios). Inlet capacity calculations can be found in **Appendix A**.

The stormwater management facilities include a Cultec storage chamber and dry pond. An orifice and weir is designed at the outlet of the control maintenance hole at the south-east corner prior to release to a culvert that will cross O'Keefe Court and discharge to the south swale. A 170mm orifice plate has been proposed with a 1.50m rectangular weir to match post-development flows to pre-development for all storm events from the 2-year to 100-year storms.

Water balance volumes for infiltration will be achieved with proposed underground infiltration galleries located at building storm outfalls. The infiltration chambers will be sized to provide the water balance infiltration volumes for the building rooftops and drainage captured from the west side of the site. The chambers will be located such that the base of the infiltration gallery is at least 1.0m above existing groundwater and bedrock elevations. Total suspended solids treatment will be achieved primarily using a treatment inlet row (i.e. a Separator Row) located in the first row of the chambers with final treatment by an OGS located at the south-east corner of the property prior to site discharge out to the O'Keefe Court drainage swale.

2.4 STORMWATER QUANTITY CONTROL

The quantity control criteria is to control the post-development peak runoff rates to the pre-development peak runoff rates (as found in Section 2.1) for every storm event up to the 100-year event.

In the post-development condition, the drainage areas and directions will be as follows:

- **Controlled Rooftops:** runoff from **2.39ha** of rooftops is proposed to be controlled to a rate of 42L/s/roof ha by controlled roof drains. Runoff coefficient of 0.90 (used for the purpose of Quality Control sizing).
- **Controlled Landscaped and Pavement areas:** Runoff from **4.00ha** of the landscaped areas, loading docks, and parking lots is collected by catch basins and conveyed to the on-site storm sewers that are sized to accommodate the 5-year design flows. Runoff coefficient of 0.90.
- **Uncontrolled Pavement areas:** Runoff from **0.49ha** of paved and landscape areas (composite runoff coefficient of 0.43) will discharge uncontrolled towards O'Keefe Court
- Total net developable area is **6.88ha.**

For the 100-year storm event, runoff coefficients are increased by a factor of 1.25 for all drainage areas.

Building rooftops (2.39ha) are proposed to be controlled at a rate of 42L/s/ha. Based on the modified rational method, the maximum rooftop storage volume required during the 100-year storm event is **1149.4m^3** across the three building rooftops. Assuming 50% of the rooftops are available for ponding storage and a maximum depth of ponding on rooftops of 0.15m (6"), the total available rooftop storage is estimated to be **1,793m^3**, therefore it is expected that the rooftops will have capacity to provide the rooftop storage required. Further details will be reviewed and refined with the mechanical and structural engineers of the building at a later stage.

A dry pond and underground chamber by Cultec (Recharger 280HD) is proposed to achieve the storage requirements for the remaining controlled site areas (4.00ha), accounting for inflows coming from the upstream controlled rooftops. To optimize attenuation of post-development flows to pre-development levels storm events up to the 100-year storm event, a 170mm orifice plate and 1.5m rectangular weir has been proposed in the control manhole located immediately downstream of the dry pond. Using the modified rational method, a maximum storage volume required during the 100-year storm event was calculated to **1,729m^3.**

The dry pond has been sized to maximize the available landscape area at the south end of the site, while maintaining sufficient freeboard and horizontal clearances from the adjacent building and drive aisles, providing a total pond volume of **644m^3**. The remaining storage deficit will be provided by a Cultec Recharger 280HD that is connected upstream of the dry pond by a transfer pipe and has been sized to provide up to **1,091m^3** of storage volume, providing a total storage of **1,735m^3**. Table 2 below summarizes the stage-storage-discharge relationship of the quantity control measures.

The uncontrolled area of 0.49 ha will discharge uncontrolled in all storm events. Refer to Table 3 below for the total release rates for the site, including the controlled and uncontrolled drainage.

Table 2: Stage-Storage-Discharge

Storm Event	Elevation (m)	Required/Provided Storage (m³)	Post-development Release Rate (L/s)	Target Controlled Release Rate (L/s)
2-yr	104.42	1,190	69	145
5-yr	104.63	1,512	93	193
10-yr	104.66	1,556	120	225
25-yr	104.69	1,594	148	266
50-yr	104.71	1,624	173	296
100-yr	104.80	1,729	324	328

- The required/provided storage corresponds to the available storage in both the pond and chamber at the various elevations for each storm event
- The target controlled release rate is the total allowable release rate less the post-development uncontrolled release rate
- Post-development release rate is based on the acting head on the orifice/weir

Table 3: Comparison of Pre-development and Post-development Peak Flows

Storm Event	Pre-development Release Rates (L/s)	Post-development Release Rates (L/s)			Net Reduction
		Controlled Flows	Uncontrolled Flows	Total	
2-yr	**189**	69	45	**114**	**40%**
5-yr	**254**	93	60	**153**	**40%**
10-yr	**296**	120	71	**191**	**35%**
25-yr	**350**	148	84	**232**	**34%**
50-yr	**390**	173	94	**267**	**32%**
100-yr	**431**	324	104	**428**	**1%**

As shown in Table 3, the proposed quantity controls will have a net reduction in site flows for all storm events in post-development conditions as compared to pre-development conditions, thus achieving the required stormwater quantity criteria.

2.5 STORMWATER WATER QUALITY

2.5.1 TOTAL SUSPENDED SOLIDS

The quality control objective is to provide an enhanced protection level, which corresponds to the removal of minimum 80% TSS.

Runoff on the site will follow a treatment train approach, where rooftop flows (which is generally considered clean), will enter initial treatment through the Separator Rows of the Cultec infiltration systems. Overflows from the infiltration system will be conveyed to secondary treatment from the Oil Grit Separator (OGS), which also treats asphalted surface runoff which are captured by catchbasins on the site. The final treatment occurs at the final Separator Row of the Cultec underground storage chamber, before it is released into the downstream dry pond.

Both the Separator Row and Oil Grit Separator hold Environmental Technology Verification (ETV) and has been sized to achieve 80% TSS removal (granting a 50% TSS removal credit). The OGS unit sized and specified is a Stormceptor EFO12. Using the New Jersey Department of Environmental Protection (NJDEP) formula for TSS Removal rates for BMP's in series, the total TSS removal rate for the site was calculated to **84%**, which meets the minimum 80% TSS removal requirement for the site.

Refer to **Appendix A** for Cultec and OGS design calculations for quality control and the ETV verification statement.

2.5.2 THERMAL MITIGATION

The primary form of thermal reduction on the subject site will be achieved through capturing and conveying stormwater flows to at least one of the four underground detention chambers. Drainage from the west and from rooftops are all directed to an underground infiltration gallery, before merging with runoff from the east side of the site where then flows enter a final underground detention chamber and dry detention pond.

The performance of thermal reduction of stormwater in underground stormwater detention chambers was tested by the department of Civil Engineering at the University of Toronto in collaboration with the TRCA. The results of the analysis determined a maximum temperature reduction of 5 degrees Celsius from inlet to outlet, and outlet temperatures remained within the thermal regime for Coldwater fish habitat throughout the evaluation period (which lasted 6 months). The nominal outlet temperature ranged from 10C in the spring to a high of 13C by the end of the summer. This finding was published in the journal Water, 21 January 2016, an excerpt of the journal article is included in **Appendix A**. Based on these results and the existing high thermal capacity of the subsurface soils, it is expected that the underground chamber would provide a similar order of magnitude thermal benefit to the stormwater for the site.

2.6 WATER BALANCE

The Jock River Reach 1 Subwatershed Study (June 2007) identifies maximizing infiltration through the application of best management practices as a key objective for future developments within the subwatershed. The subcatchment is underlain predominantly by silty clay soils, which provide limited opportunity for groundwater recharge. With the introduction of additional impervious surfaces through development, the potential for infiltration is further reduced, resulting in an estimated infiltration and evapotranspiration deficit of approximately 58 mm/year.

To address water balance requirements for the subject site, a best-efforts approach using a 5 mm rainfall depth has been applied. This value is commonly adopted and represents approximately 50% of annual rainfall, as referenced in the City of Toronto Wet Weather Flow Management Guidelines (November 2016). Based on an average annual precipitation of 944 mm/year within the subwatershed (per Environment Canada Climate Normals), retention and infiltration of the 5 mm event corresponds to approximately 472 mm/year.

Retention and infiltration will be achieved using Cultec chambers installed downstream of the storm stub at each building. The chambers will be constructed as open-bottom systems, with the stone base set a minimum of 1.0 m above the highest observed groundwater elevation identified in the hydrogeological investigation. The chambers are designed to infiltrate all rooftop runoff with an overflow to the downstream storm sewer system, should the chambers be full before the next rainfall event. Although roof water is generally considered clean, each chamber will include a Separator Row to provide pretreatment and remove suspended solids prior to distribution within the infiltration system.

The total 5mm rainfall volume requirement for the subject site is calculated as 344m^3 (6.88ha x 5mm). Based on review of the hydrogeological investigation in relation to the site plan and servicing plan, the following limitations were determined:

- Infiltration is most suitable north of the site, and directly adjacent to building storm outfalls
- Infiltration near the outfall of the site is not feasible due to high groundwater and poor soil infiltration rates
- Connecting storm sewers from the east side of the buildings into the infiltration galleries will be logistically challenging, as the sewers will be sloped against the slope of the surface.

Based on the above limitations, a best-efforts approach for infiltration has been assumed for the subject site, of which only the drainage areas on the west of the site and rooftops will be captured and retained. The total drainage area captured is 3.59ha (2.39ha of rooftop, 1.20ha of impervious), and amounts to a water balance volume of **179.5m^3.** Three infiltration chambers serving each building rooftop have been sized with a total retention volume of **179.5m^3**. The infiltration provided on a site level can be summarized as follows:

- **Drainage area subject to infiltration:** 3.59 ha

    - Through the use of Cultec chambers, infiltration is provided for the 5mm rainfall volume across the drainage area, which is equivalent to 472 mm/year. This drainage area is approximately 52% of the total site area, which results in infiltration of approximately **245 mm/year.**
- **Drainage area not subject to infiltration:** 3.29 ha
    - No infiltration measures are proposed in this drainage area due to the site constraints specified above. As per Table 6.3.9 of the Jock River Reach 1 Subwatershed Study, the site is within the 'O'Keefe' catchment and subject to 112 mm/year of infiltration. This drainage area is approximately 48% of the total site area, which results in infiltration of approximately **54 mm/year**.

In total, infiltration of approximately **299 mm** is provided on the site annually. As per Table 3.7.3 of the Jock River Reach 1 Subwatershed Study, the existing infiltration within the 'O'Keefe' catchment is 181 mm/year. Therefore, with the infiltration measures proposed, the infiltration deficit of 58 mm/year will be met.

A 48-hour drawdown time was selected based on recommendations from the Sustainable Technologies Evaluation Program (STEP) for the 50th percentile interevent time (i.e. 50% probability of the next rainfall event happening in 48 hours) for the Ottawa Region. Drawdown calculations were completed and confirms that retained water can infiltrate within a 48-hour drawdown period. For supporting calculations on infiltration, drawdown, and Cultec sizing, please refer to **Appendix A**. Excerpts of the selection of drawdown time per STEP recommendations can be found in **Appendix E.**

2.7 STORMWATER EMERGENCY OVERLAND FLOW ROUTE

The site has been graded such that drainage up to the 100-year storm event will be contained within the site. All catchbasin inlets have been sized to ensure capture of the 5-year storm event. For storm events above the 5-year and up to the 100-year, flows will drain overland where the final catchbasin has been sized to capture the 100-year (less the 5-year) storm event. The designed grading pattern ensures a maximum 0.30m ponding for each inlet catchment while ensuring a distinctive overland flow route towards the emergency outfall at O'Keefe Court during extreme storm events (beyond the 100-year event), where then drainage will be conveyed through the ditches on O'Keefe Court.

The City of Ottawa stormwater management criteria requires that the overland flow route be designed for the 100-year post development flow from the site + 20% as a safety factor.

The post development uncontrolled 100-yr flow generated from the subject site is 1294L/s, therefore the design flow with 20% addition is **1553L/s.** Further analysis of this flow in relation to the capacity of the O'Keefe swales is discussed in the following section. Refer to **Appendix A** for swale design calculations.

2.8 PROPOSED STORMWATER OUTFALL

It has been determined that the existing swale along the south side of O'Keefe Court will serve as the most functionally acceptable outfall, provided there is sufficient flow capacity. This swale flows easterly along the southern shoulder of O'Keefe Court, where then the drainage continues southerly through conveyance swales and culverts down to the Jock River, which finally flows east into the Rideau River. The drainage route is similar to that in existing conditions, and is represented in **Figure 2-2**.

An analysis of the existing swale was completed to determine flow capacity relative to the anticipated contributing flows. The site outlet will consist of a culvert under O'Keefe Court to direct site flows to the south swale along O'Keefe Court.

Based on the characteristics of the south swale, an analysis was completed using the Manning's equation to estimate a minimum flow capacity of **2275L/s.** This calculation was based on the following characteristics observed from available data on the south swale:

- A top width of approximately **7.0m** (i.e. measured between Top of Slope's from the topographic survey)
- An assumed freeboard of **0.30m,** resulting in a flow depth of **0.87m** for a triangular shaped swale

- A minimum observed slope of **0.30%** between the O'Keefe cul-de-sac bulb to approximately 383m east (where the swale diverts southwards)
- Existing side slopes of **3:1**
- Manning's 'n' coefficient of **0.03**

Based on topographical survey of the existing swale, there appears to be few locations of filled material and reverse slope conditions. It is therefore recommended that remedial improvements to the swale be completed, including regrading the swale to a more consistent slope of 1.0% to provide sufficient flow conveyance. Under these conditions, it is anticipated the minimum flow capacity of the swale would be **4153L/s.**

Based on review of the topographic survey, LIDAR information, existing record drawings (specifically the Storm Drainage Area Plan, drawing 500 for the 416 Lands by IBI Group), and Google imagery, the south swale is assumed to capture drainage from the subject site, Lytle Park, and the O'Keefe ROW (total contributing drainage area of 17.9ha). Based on these contributing drainage areas, the estimated 100-year contributing flow to the O'Keefe south swale is approximately **1356L/s** in post-development conditions, which makes up approximately **33%** of the full flow capacity of the reinstated south swale.

As per Section 2.8, the overland flow route shall be designed such that the 100-year post development flow (with a 20% surcharge) can safely be conveyed from the site. This flow was estimated to be 1553L/s for the subject site, and totals **2477L/s** when accounting for 100-year flows from the remaining contributing drainage areas to the south swale. During emergency overland flow conditions, the south swale is estimated to operate at **60%** of the full flow capacity of the south swale. Therefore, the south swale is sufficiently sized to convey flows in post-development conditions.

The proposed sewer infrastructure is shown on the Servicing Plans and Grading Plans. For detailed calculations on swale capacity and contributing flows, refer to **Appendix A.** For the cross-sections and profiles of the existing south swale, as well as the drainage area plan for this swale, please refer to the figures in **Appendix D**. Grading plans of the proposed swale design can be found in drawing **GSW-1** in **Appendix F**.

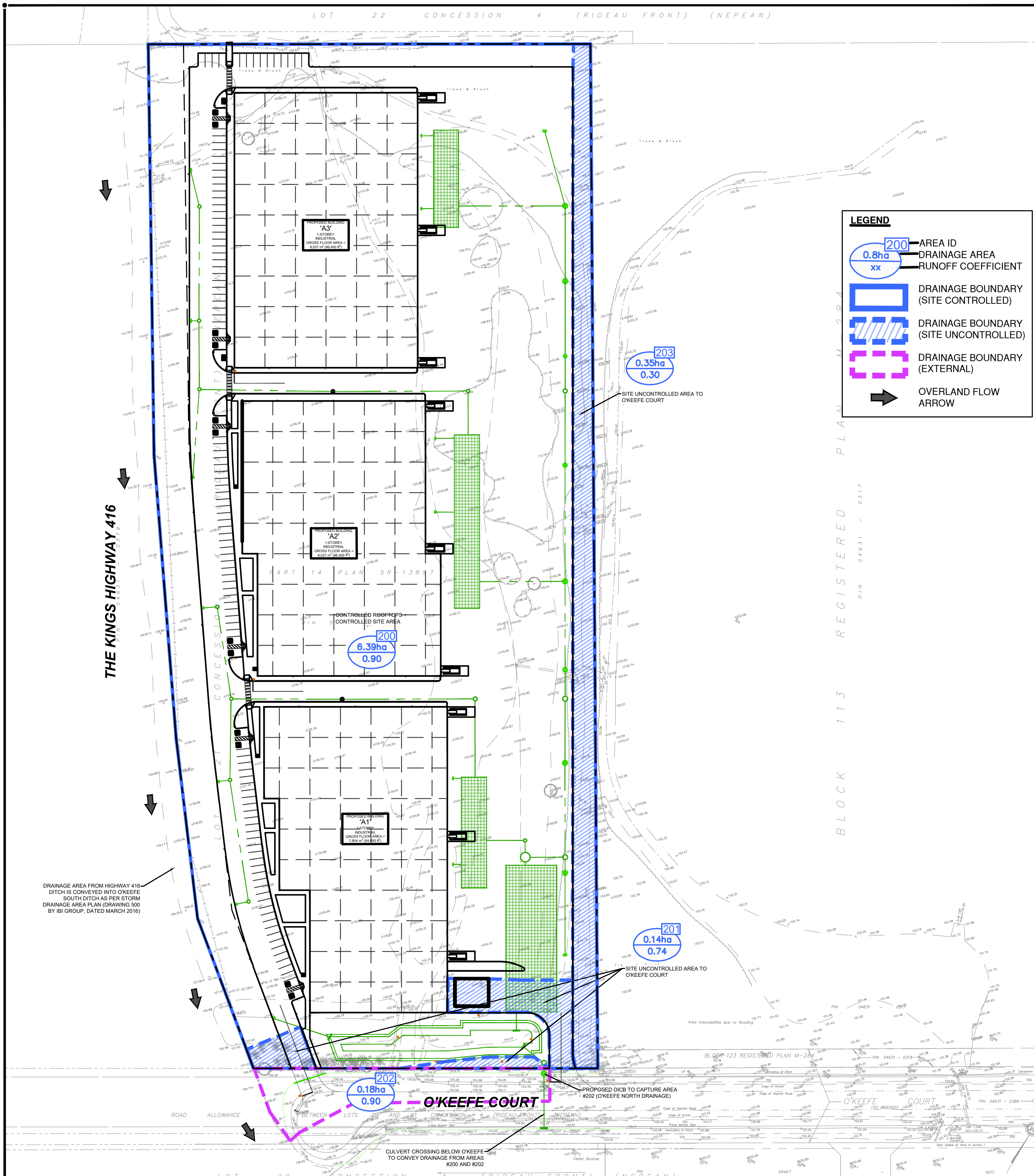
2.9 CONSTRUCTION EROSION AND SEDIMENT CONTROL

Best practices are implemented to control erosion and sedimentation during construction and prior to build-out of stormwater quantity and quality control measures. All measures will be designed in accordance with the Sustainable Technologies Evaluation Program (STEP) "Erosion and Sediment Control Guideline for Urban Construction" dated 2019, and City of Ottawa design criteria. In general, the ESC approach can be outlined as:

- Silt fence to be installed around the site perimeter.
- A construction access (mud mat) is to be provided at the entrance off O'Keefe Court
- Cut-off swales and sediment traps provided on site and prior to discharging to the O'Keefe swales
- Catch basins and catch basin manholes on adjacent streets to have underside of the grate covered with Terrafix 240R non-woven geotextile.

These ESC measures should be regularly inspected and maintained to ensure they are operating as designed.

Refer to **Appendix F** for the **Erosion and Sediment Control Plan**.



KWA SITE DEVELOPMENT CONSULTING INC.
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REVISION BLOCK

#	DATE	DESCRIPTION
1.	06/09/2025	FIRST SUBMISSION
2.	10/01/2025	SECOND SUBMISSION

PROPOSED DRAINAGE PLAN

THE PROPERTIES GROUP
O'KEEFE COURT
NEPEAN, ONTARIO

PROJECT No: | DRAWN BY: | CHECKED BY:

NORTH ARROW

METRIC SCALE

2-1

KWA SITE DEVELOPMENT CONSULTING INC.
2453 Auckland Drive
Burlington, ON L7L 7A9

REVISION BLOCK

#	DATE	DESCRIPTION
1.	02/12/2025	FIRST SUBMISSION

DRAINAGE ROUTE TO ULTIMATE OUTFALL

THE PROPERTIES GROUP
O'KEEFE COURT
NEPEAN, ONTARIO

PROJECT No: | DRAWN BY: | CHECKED BY:

NORTH ARROW

METRIC SCALE

FIG 2-2

3.0 SANITARY SERVICING

3.1 EXISTING SANITARY SERVICING

A development application for the 416 Lands to the south of the subject development indicates there are sanitary sewers proposed and partially constructed as part of this development (City File No. D07-16-13-0013, City Plan No. 17492).

The advancement of the 416 Lands development and availability of the remaining sanitary sewers to be constructed as part of this development is currently not known, and therefore it is assumed that there are no available sanitary sewers in the vicinity of the subject site.

Record drawings for the General Plan of Services for the 416 Lands development can be found in the supporting documentation in **Appendix E**.

3.2 PROPOSED SANITARY SERVICING

Design flows for the proposed development has been calculated using the Ottawa Sewer Design Guidelines (Second Edition – Technical Bulletin ISTB-2018-1 Update March 21, 2018). The internal sanitary sewer drainage system for the subject site is designed to accommodate peak sanitary sewage flows as per the City of Ottawa's design criteria.

The total peak sanitary flow for the proposed development (including the infiltration allowance) has been calculated as **3.24L/s**. Refer to **Appendix B** for details of the calculations.

As there are no gravity sanitary sewer infrastructure available for the site, the proposed design involves an on-site septic system to treat and manage sanitary sewage and is to be completed by others in separate reports and design documents.

Sanitary site servicing for industrial warehouse buildings will consist of a 150 mm diameter connection at a 1.0% slope. These sewers will then be conveyed and discharged to the proposed on-site sanitary sewage treatment facility located at the south-east corner of the property.

The proposed and existing servicing is shown on the **Servicing Drawings**.

4.0 WATER SERVICING

4.1 EXISTING WATER SERVICING

The existing site servicing details obtained from the City of Ottawa engineering plan and profiles and a topographical survey completed of the area, indicate that there is watermain infrastructure in the vicinity of the site. The following watermain infrastructure is adjacent to the subject site;

- A 610mm diameter watermain located along the south side of O'Keefe Court, which extends west from Fallowfield Road to the end of the cul-de-sac in front of the subject site
- A 300mm diameter watermain which was recently constructed extending down Lusk Street to the end of storm water management pond
- A 300mm diameter watermain located in Foxtail Avenue, approximately 750m east of the subject site.

4.2 PROPOSED WATER SERVICING

The proposed water servicing design and calculations are based on the Ottawa Design Guidelines – Water Distribution (July 2010) with all relevant Technical Bulletins issued for the guideline. This includes Technical Bulletin ISTB-2021-03 and ISTB-2010-02. Based on the available record drawings indicated above there is the obvious primary connection made to the existing 610mm watermain located within O'Keefe Court. Through preliminary consultation the city requires that a secondary watermain connection be provided under such conditions in which the existing 610mm watermain were to require shut down for maintenance an alternative water supply be provided to the site. There are two primary considerations for this configuration, which are explained further below.

4.2.1 EXTERNAL WATERMAIN OPTIONS

Previous reports and analyses had contemplated a connection through the future anticipated proposed development to the south. But as discussed previously, there is some uncertainty in the advancement of this development, and should it not proceed, alternative options should be considered such that the site can proceed and be serviced independently of this site.

1. The first option would be to provide a new 300mm waterline along O'Keefe Court, and then connect south to the existing 300mm watermain located in the newly installed and extended watermain in Lusk Street. This watermain would need to remain outside of the private properties so would need to be proposed through the public drainage right-of-way that currently serves for the drainage swale and culvert for the drainage outlet of O'Keefe Court. This watermain would be installed at the very edge of Block 15 such that it does not impact any function or access of the block drainage conveyance infrastructure.
2. The second option would be to extend the watermain further down O'Keefe Court all the way to the 300mm watermain at Lusk Street and O'Keefe Court. This would be the secondary option but would require longer lengths of pipe to be installed and an increased disturbance for the O'Keefe Court right-of-way, but it is possible should the first option not be considered acceptable to the City.

Through discussions with the City, the preferred option is Option 2, and will be the subject of the hydraulic network analysis in the following sections. For the off-site watermain servicing options, please refer to **Figure WAT-E** in **Appendix D**.

4.2.2 FLOW DEMANDS

Domestic water demand was calculated based on the Ottawa Design Guidelines for Water Distribution and Technical Bulletin ISTB-2010-02. An industrial flow rate of 35,000 L/ha/day was used to determine the average water demand for the proposed development. The average day water demand was calculated to be **0.97 L/s**. A maximum day factor of 1.50 (applied to the average day demand) and a peak hour factor of 1.80 (applied to the maximum day demand) were used in determining maximum day and peak hour demands The maximum day and peak hour demands were calculated to be **1.45L/s** and **2.61L/s**, respectively. Calculations are provided in **Appendix C**.

Fire flow calculations we completed based on the Fire Underwriters Survey Water Supply for Public Fire Protection, 2020. Under proposed conditions the development is anticipated to have a fire flow demand of **167L/s** for the worst-case scenario building A3, at the north end of the property, the largest building and furthest distance for the watermain connection. The anticipated maximum day + fire flow demand thus be 168.5L/s.

4.2.3 HYDRAULIC NETWORK ANALYSIS

Model Setup

A hydraulic network analysis was completed for Option 2 to evaluate the serviceability of the proposed development with the planned watermain extension on O'Keefe Court.

A hydrant flow test, carried out by Hydrant Testing Ontario (HTO) on September 18, 2025, was used to calibrate the model boundary conditions. The residual hydrant selected was the first hydrant on Lusk Street, south of O'Keefe Court, closest to the future watermain extension. The test recorded a static pressure of 70.5 psi and a maximum flow of 243 L/s, with an observed pressure variation of 11%.

The hydraulic model was prepared in Bentley WaterCAD (EPANET engine) providing nodes at key locations. Boundary conditions were represented using a reservoir and pump configuration to replicate the flow and pressure response observed in the hydrant test. Ground elevations were assigned using LiDAR survey data.

The hydrant flow test and a schematic of the model setup for Option 2 can be found in **Appendix C**.

Modelling Results

Two flow demand scenarios were analyzed in the model:

1. Peak Hour
2. Maximum Day + Fire

A table summarizing the model inputs for the different scenarios can be found in **Appendix C**.

The proposed watermain on O'Keefe Court was sized to 300mm up to and including the combined fire and domestic water service for the subject development.

Based on the modelling results, all pipe velocities were observed to be within allowable limits (i.e. 2.0m/s for peak hour demands, and 3.0m/s for fire flow demands). In all demand scenarios, all nodes were observed to maintain a residual pressure of above 140kPa (20.3psi) and 275kPa (40psi) during maximum day+fire and peak hour scenarios, respectively. Therefore, it is expected that the proposed watermain through O'Keefe Court will adequately service the subject development.

The water demand calculations, modelling results, and model schematics are shown in **Appendix C** and the proposed and existing watermain infrastructure are shown on the Servicing Drawings. For the preliminary design of watermain Option 2, please refer to the plan & profile drawings for this watermain extension found in **PP1-PP5** in **Appendix F**.

4.3 FIRE HYDRANT COVERAGE

There are four (4) proposed fire hydrants to provide sufficient fire protection coverage, three of which are proposed private within the subject site, and one of which is a future hydrant as part of ongoing off-site works on O'Keefe Court. The coverage radius is shown and indicated by a dashed circle on the servicing plan to show sufficient coverage is provided for fire protection.

5.0 CONCLUSION

The proposed development consists of three industrial buildings across a 6.88ha site area. The proposed development can be serviced utilizing the existing and proposed infrastructure outlined in the Servicing Drawings. Our conclusions and recommendations for servicing of the proposed development is summarized as follows:

Stormwater Management Servicing:

- The proposed development will match post-development flows to pre-development levels for all storm events between the 2-year and 100-year storm events. Quantity controls will be achieved by the use of rooftop controls, Cultec chambers and an on-site dry pond
- Stormwater quality will be achieved by a treatment train approach, primarily through ETV certified technologies including a Separator Row and Oil Grit Separator
- Water balance will be met by infiltrating the initial 5mm rainfall depth of roof runoff and the west drainage area, which achieves approximately 52.2% of the total 5mm volume requirement for the site. This infiltration design provides 299mm/year of infiltration for the site, which surpasses the 58mm/year infiltration deficit noted in the Jock River Reach 1 Subwatershed study.
- Sediment and erosion control measures to be taken during construction have been presented in this report.

Sanitary Servicing:

- The anticipated peak sanitary peak flow for the proposed development is 3.24L/s.
- There are no existing or future planned sanitary sewer infrastructure on O'Keefe Court, therefore the subject site proposes an on-site septic system to manage sanitary sewage. This design is to be completed by others.

Water Servicing:

- The calculated maximum day and peak hour demands were calculated as 1.45L/s and 2.61L/s, respectively.
- The calculated fire flow demand for the proposed development is 167L/s, based on the furthest and largest building (Building A3)
- The proposed development will be serviced by a proposed 300mm watermain primary connection made to the existing 610mm watermain on O'Keefe Court. A secondary connection for the site will be made to a future 300mm local watermain extension on O'Keefe Court.
- Additional confirmation of the fire and domestic branch sizing and fire flow requirements should be provided by the Mechanical Consultant at the Building Permit stage of approval.

5.1 RECOMMENDATIONS:

The following recommendations are presented:

- The contractor shall locate and verify all dimensions, levels, inverts, and datums onsite and report any discrepancies or omissions to the engineer prior to construction.

In summary, the site can be adequately serviced in respect to water supply, sanitary drainage, stormwater drainage, and stormwater management. The stormwater quantity and quality controls can be implemented in accordance to The City of Ottawa Sewer Guidelines (October 2012), and The City of Ottawa Stormwater Management Design Guidelines (2012).

Accordingly, we hereby recommend the adoption of this report as it relates to the provision of servicing works, and for the purposes of site plan application, and building permit application approvals. We trust that this Functional Servicing and Stormwater Management Report is sufficient for your purposes. If you have any questions or comments, please do not hesitate to contact the undersigned.

Yours very truly,

KWA Site Development Consulting Inc.

LICENSED PROFESSIONAL ENGINEER
T. FAIR
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OCT 6, 2025
PROVINCE OF ONTARIO

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APPENDIX A

STORMWATER CALCULATIONS

Prepared By: LP
Reviewed By: TF
Date: 10/2/2025

Pre-development Site Statistics

	Drainage Area #1	Area (ha)	Runoff Coefficient	AxC
1)	Landscape	6.88	0.30	2.06
	Total	6.88		2.06

Composite Runoff Coefficient = 0.30

Time of Concentration - Airport Formula (Runoff Coefficient less than 0.40)

Catchment Area =	6.88	ha
Max. Catchment Elevation =	114.5	
Min. Catchment Elevation =	102.5	
Catchment Length =	440	
Catchment Slope =	2.7	%
Runoff C =	0.30	
Time of Concentration =	39.29	min

Time of Concentration - Bransby William Formula (Runoff Coefficient more than 0.40)

Catchment Area =	6.88	ha
Max. Catchment Elevation =	110.5	
Mni. Catchment Elevation =	102.5	
Catchment Length =	380	
Catchment Slope =	2.1	%
Time of Concentration =	15.39	min

Pre-development Flow Rates

From calculations above, pre-development Time of Concentration = 40 min

Storm Event	Intensity (mm/hr)	Flow Rate (L/s)
2 year	32.9	188.6
5 year	44.2	253.5
10 year	51.6	296.2
25 year	61.0	349.8
50 year	68.0	389.9
100 year	75.1	431.2

Uncontrolled Flow and Allowable Release Rate Calculation

Uncontrolled area (ha) =	0.49
Runoff Coefficient =	0.43
Time of Concentration (min) =	10

Storm Event	Intensity (mm/hr)	Uncontrolled Flow Rate (L/s)	Pre-Development Flow Rate (L/s)	Target Release Rate for Orifice (L/s)
2 year	76.8	44.5	188.6	144.0
5 year	104.2	60.4	253.5	193.1
10 year	122.1	70.8	296.2	225.4
25 year	144.7	83.9	349.8	265.9
50 year	161.5	93.6	389.9	296.3
100 year	178.6	103.5	431.2	327.6

MODIFIED RATIONAL METHOD

2-Year

		Site (Vault)			*Controlled Rooftop*		
		Area	Runoff C		Area	Runoff C	Unit Rate (L/s/ha)
Controlled		4.00	0.90		2.39	0.90	42
Uncontrolled		0.49	0.43				
		4.49					

		Orifice Control Flow (L/s) =	69.47				
Storm Duration t_d (min)	Rainfall Intensity i (mm/h)	Inflow $Q_{in} + Q_{in,roof}$ (L/s)	Controlled Flow $Q_{out,con}$ (L/s)	Storage Required V (m^3)	Storm Runoff $Q_{in,roof}$ (L/s)	Roof Flow $Q_{out,roof}$ (L/s)	Storage Required V (m^3)
10	76.8	869.0	69.47	479.75	459.28	100.38	215.34
15	61.8	718.5	69.47	584.17	369.36	100.38	242.08
20	52.0	621.1	69.47	661.97	311.14	100.38	252.91
25	45.2	552.4	69.47	724.41	270.09	100.38	254.56
30	40.0	501.1	69.47	777.00	239.45	100.38	250.33
40	32.9	429.3	69.47	863.56	196.52	100.38	230.74
60	24.6	346.2	69.47	996.06	146.85	100.38	167.29
70	21.9	319.7	69.47	1050.89	131.03	100.38	128.74
80	19.8	298.8	69.47	1100.96	118.58	100.38	87.35
90	18.1	282.0	69.47	1147.42	108.49	100.38	43.80
100	16.7	267.7	69.47	1189.60	100.14	100.14	0.00
120	14.6	232.8	69.47	1176.08	87.08	87.08	0.00
140	12.9	206.7	69.47	1152.41	77.30	77.30	0.00
160	11.7	186.3	69.47	1121.33	69.67	69.67	0.00
180	10.6	169.9	69.47	1084.60	63.54	63.54	0.00
200	9.8	156.4	69.47	1043.40	58.50	58.50	0.00
240	8.5	135.5	69.47	950.76	50.68	50.68	0.00
280	7.5	119.9	69.47	847.90	44.86	44.86	0.00
320	6.7	107.9	69.47	737.49	40.35	40.35	0.00
360	6.1	98.2	69.47	621.27	36.74	36.74	0.00
			Max Storage (m^3) =	**1189.60**		**Max Roof Storage (m^3) =**	**254.56**
			Total Outflow (L/s) =	**69.47**			
			Target Release Rate (L/s) =	**144.03**			

$V = (Q_{in} - Q_{out,con}) * t_d$

5-Year

		Site (Vault)			*Controlled Rooftop*		
		Area	Runoff C		Area	Runoff C	Unit Rate (L/s/ha)
Controlled		4.00	0.90		2.39	0.90	42
Uncontrolled		0.49	0.43				
		4.49					

		Orifice Control Flow (L/s) =	93.24				
Storm Duration t_d (min)	Rainfall Intensity i (mm/h)	Storm Runoff Q_{in} (L/s)	Controlled Flow $Q_{out,con}$ (L/s)	Storage Required V (m^3)	Storm Runoff Q_{in} (L/s)	Roof Flow $Q_{out,con}$ (L/s)	Storage Required V (m^3)
10	104.2	1143.1	93.24	629.94	623.05	100.38	313.60
15	83.6	936.6	93.24	759.04	499.65	100.38	359.35
20	70.3	803.5	93.24	852.25	420.09	100.38	383.65
25	60.9	709.8	93.24	924.88	364.14	100.38	395.65
30	53.9	640.1	93.24	984.32	322.48	100.38	399.77
40	44.2	542.6	93.24	1078.41	264.21	100.38	393.20
60	32.9	430.1	93.24	1212.61	196.99	100.38	347.81
70	29.4	394.3	93.24	1264.59	175.64	100.38	316.08
80	26.6	366.2	93.24	1310.26	158.84	100.38	280.59
90	24.3	343.5	93.24	1351.16	145.24	100.38	242.24
100	22.4	324.6	93.24	1388.33	133.99	100.38	201.66
120	19.5	295.2	93.24	1454.17	116.41	100.38	115.43
140	17.3	273.2	93.24	1511.65	103.26	100.38	24.20
160	15.6	248.7	93.24	1492.35	93.02	93.02	0.00
180	14.2	226.7	93.24	1441.42	84.79	84.79	0.00
200	13.0	208.6	93.24	1384.61	78.03	78.03	0.00
240	11.3	180.6	93.24	1257.56	67.54	67.54	0.00
280	10.0	159.7	93.24	1117.09	59.74	59.74	0.00
320	9.0	143.6	93.24	966.73	53.71	53.71	0.00
360	8.2	130.7	93.24	808.75	48.88	48.88	0.00
			Max Storage (m^3) =	**1511.65**		**Max Roof Storage (m^3) =**	**399.77**
			Total Outflow (L/s) =	**93.24**			
			Target Release Rate (L/s) =	**193.10**			

$V = (Q_{in} - Q_{out,con}) * t_d$

MODIFIED RATIONAL METHOD

		Site (Vault)			Controlled Rooftop		
10-Year			Area	Runoff C	Area	Runoff C	Unit Rate (L/s/ha)
		Controlled	4.00	0.90	2.39	0.90	42
		Uncontrolled	0.49	0.43			
			4.49				
		Orifice Control Flow (L/s) =	119.91				
Storage Duration	Rainfall Intensity	Storm Runoff	Controlled Flow	Storage Required	Storm Runoff	Roof Flow	Storage Required
t_d (min)	i (mm/h)	Q_{in} (L/s)	$Q_{out,con}$ (L/s)	V (m^3)	Q_{in} (L/s)	$Q_{out,con}$ (L/s)	V (m^3)
10	122.1	1322.8	119.91	721.72	730.38	100.38	378.00
15	97.9	1079.7	119.91	863.79	585.13	100.38	436.28
20	82.2	923.1	119.91	963.88	491.60	100.38	469.46
25	71.2	813.2	119.91	1039.91	425.90	100.38	488.28
30	63.0	731.3	119.91	1100.57	377.00	100.38	497.92
40	51.6	617.0	119.91	1192.99	308.68	100.38	499.91
60	38.5	485.2	119.91	1315.04	229.93	100.38	466.39
70	34.3	443.4	119.91	1358.50	204.93	100.38	439.12
80	31.0	410.5	119.91	1394.63	185.27	100.38	407.49
90	28.3	383.8	119.91	1425.23	169.37	100.38	372.55
100	26.1	361.8	119.91	1451.50	156.22	100.38	335.01
120	22.7	327.4	119.91	1494.20	135.67	100.38	254.08
140	20.1	301.7	119.91	1527.21	120.30	100.38	167.35
160	18.1	281.7	119.91	1553.16	108.34	100.38	76.40
180	16.5	264.0	119.91	1555.96	98.74	98.74	0.00
200	15.2	242.9	119.91	1475.56	90.84	90.84	0.00
240	13.1	210.1	119.91	1299.22	78.60	78.60	0.00
280	11.6	185.8	119.91	1107.39	69.50	69.50	0.00
320	10.4	167.0	119.91	904.13	62.46	62.46	0.00
360	9.5	152.0	119.91	692.08	56.83	56.83	0.00
			Max Storage (m^3) =	**1555.96**		**Max Roof Storage (m^3) =**	**499.91**
V = (Qin - Qout,con) * td			**Total Outflow (L/s) =**	**119.91**			
			Target Release Rate (L/s) =	**225.36**			

		Site (Vault)			Controlled Rooftop		
25-Year			Area	Runoff C	Area	Runoff C	Unit Rate (L/s/ha)
		Controlled	4.00	0.90	2.39	0.90	42
		Uncontrolled	0.49	0.43			
			4.49				
		Orifice Control Flow (L/s) =	147.64				
Storage Duration	Rainfall Intensity	Storm Runoff	Controlled Flow	Storage Required	Storm Runoff	Roof Flow	Storage Required
t_d (min)	i (mm/h)	Q_{in} (L/s)	$Q_{out,con}$ (L/s)	V (m^3)	Q_{in} (L/s)	$Q_{out,con}$ (L/s)	V (m^3)
10	144.7	1548.5	147.64	840.50	865.23	100.38	458.91
15	115.8	1259.6	147.64	1000.77	692.64	100.38	533.03
20	97.3	1073.7	147.64	1111.29	581.56	100.38	577.42
25	84.2	943.2	147.64	1193.35	503.59	100.38	604.81
30	74.5	846.1	147.64	1257.25	445.57	100.38	621.34
40	61.0	710.5	147.64	1350.93	364.56	100.38	634.03
60	45.4	554.4	147.64	1464.31	271.27	100.38	615.21
70	40.4	504.9	147.64	1500.35	241.68	100.38	593.45
80	36.5	465.9	147.64	1527.78	218.41	100.38	566.56
90	33.4	434.4	147.64	1548.73	199.60	100.38	535.79
100	30.8	408.4	147.64	1564.60	184.04	100.38	501.98
120	26.7	367.8	147.64	1584.83	159.75	100.38	427.50
140	23.7	337.4	147.64	1593.72	141.60	100.38	346.23
160	21.3	313.7	147.64	1594.36	127.47	100.38	260.04
180	19.4	294.7	147.64	1588.70	116.13	100.38	170.09
200	17.9	279.1	147.64	1578.10	106.81	100.38	77.18
240	15.4	246.9	147.64	1430.11	92.36	92.36	0.00
280	13.7	218.3	147.64	1186.90	81.64	81.64	0.00
320	12.3	196.1	147.64	930.40	73.34	73.34	0.00
360	11.2	178.4	147.64	663.67	66.71	66.71	0.00
			Max Storage (m^3) =	**1594.36**		**Max Roof Storage (m^3) =**	**634.03**
V = (Qin - Qout,con) * td			**Total Outflow (L/s) =**	**147.64**			
			Target Release Rate (L/s) =	**265.91**			

MODIFIED RATIONAL METHOD

50-Year

	Site (Vault) Area	Site (Vault) Runoff C	Controlled Rooftop Area	Controlled Rooftop Runoff C	Unit Rate (L/s/ha)
Controlled	4.00	0.90	2.39	0.90	42
Uncontrolled	0.49	0.43			
	4.49				

Orifice Control Flow (L/s) = 172.73

Storm Duration t_d (min)	Rainfall Intensity i (mm/h)	Storm Runoff Q_{in} (L/s)	Controlled Flow $Q_{out,con}$ (L/s)	Storage Required V (m^3)	Storm Runoff Q_{in} (L/s)	Roof Flow $Q_{out,con}$ (L/s)	Storage Required V (m^3)
10	161.5	1716.4	172.73	926.19	965.56	100.38	519.11
15	129.2	1393.6	172.73	1098.78	772.70	100.38	605.09
20	108.5	1186.0	172.73	1215.87	648.63	100.38	657.90
25	93.9	1040.2	172.73	1301.23	561.55	100.38	691.76
30	83.1	931.8	172.73	1366.34	496.78	100.38	713.52
40	68.0	780.5	172.73	1458.55	406.35	100.38	734.32
60	50.5	606.2	172.73	1560.62	302.25	100.38	726.73
70	45.0	551.0	172.73	1588.67	269.24	100.38	709.20
80	40.7	507.6	172.73	1607.16	243.29	100.38	685.96
90	37.2	472.4	172.73	1618.44	222.31	100.38	658.41
100	34.3	443.4	172.73	1624.07	204.96	100.38	627.48
120	29.7	398.1	172.73	1622.55	177.88	100.38	557.99
140	26.4	364.2	172.73	1608.43	157.64	100.38	480.98
160	23.7	337.9	172.73	1585.15	141.89	100.38	398.49
180	21.6	316.7	172.73	1554.89	129.25	100.38	311.83
200	19.9	299.3	172.73	1519.13	118.87	100.38	221.88
240	17.2	272.4	172.73	1435.02	102.77	100.38	34.47
280	15.2	242.8	172.73	1177.95	90.83	90.83	0.00
320	13.6	218.1	172.73	871.67	81.59	81.59	0.00
360	12.4	198.4	172.73	554.06	74.20	74.20	0.00

$V = (Q_{in} - Q_{out,con}) * t_d$

Max Storage (m^3) = 1624.07
Total Outflow (L/s) = 172.73
Target Release Rate (L/s) = 296.28
Max Roof Storage (m^3) = 734.32

100-Year

	Site (Vault) Area	Site (Vault) Runoff C	Controlled Rooftop Area	Controlled Rooftop Runoff C	Unit Rate (L/s/ha)
Controlled	4.00	1.13	2.39	1.13	42
Uncontrolled	0.49	0.53			
	4.49				

Orifice Control Flow (L/s) = 324.22

Storm Duration t_d (min)	Rainfall Intensity i (mm/h)	Storm Runoff Q_{in} (L/s)	Controlled Flow $Q_{out,con}$ (L/s)	Storage Required V (m^3)	Storm Runoff Q_{in} (L/s)	Roof Flow $Q_{out,con}$ (L/s)	Storage Required V (m^3)
10	178.6	2344.1	324.22	1211.92	1340.61	100.38	744.14
15	142.9	1895.9	324.22	1414.54	1072.84	100.38	875.22
20	120.0	1607.6	324.22	1540.09	900.58	100.38	960.24
25	103.8	1405.3	324.22	1621.59	779.68	100.38	1018.95
30	91.9	1254.8	324.22	1674.97	689.74	100.38	1060.85
40	75.1	1044.6	324.22	1728.97	564.19	100.38	1113.14
60	55.9	802.7	324.22	1722.63	419.65	100.38	1149.39
70	49.8	726.0	324.22	1687.54	373.82	100.38	1148.44
80	45.0	665.7	324.22	1639.18	337.79	100.38	1139.57
90	41.1	617.0	324.22	1580.81	308.66	100.38	1124.70
100	37.9	576.7	324.22	1514.60	284.57	100.38	1105.16
120	32.9	513.7	324.22	1364.42	246.97	100.38	1055.47
140	29.2	466.7	324.22	1196.76	218.87	100.38	995.33
160	26.2	430.1	324.22	1016.37	197.00	100.38	927.59
180	23.9	400.7	324.22	826.29	179.46	100.38	854.05
200	22.0	376.6	324.22	628.58	165.04	100.38	775.96
240	19.0	339.2	324.22	215.67	142.69	100.38	609.32
280	16.8	311.4	324.22	0.00	126.11	100.38	432.29
320	15.1	290.0	324.22	0.00	113.28	100.38	247.61
360	13.7	272.8	324.22	0.00	103.02	100.38	57.04

$V = (Q_{in} - Q_{out,con}) * t_d$

Max Storage (m^3) = 1728.97
Total Outflow (L/s) = 324.22
Target Release Rate (L/s) = 327.63
Max Roof Storage (m^3) = 1149.39

ORIFICE SIZING

Orifice Equation: $Q = C \times A \times \sqrt{2gh}$

Weir Equation: $Q = (C)(L)(H)^{\frac{3}{2}}$

Orifice Details

Orifice 1		Weir	
Orifice Location =	Chamber Outlet	Orifice Location =	Chamber Outlet
Orifice Type =	Plate		
Discharge Coefficient =	0.63	Discharge Coefficient =	1.81
Orifice Diameter =	170	Weir Width =	1.50
Orifice Area =	0.02		
Orifice Invert =	103.13	Weir Invert =	104.60

Storm Event	Volume Required	Headwater Elevation	Total Head	Orifice Release Rate, a		Orifice Release Rate, b		Target Release Rate	Difference [Target - Flow] (L/s)	Proportion [Flow/ Target] (%)
	(m^3)	(m)	(m)	(L/s)		(L/s)				
2-Year	1190	104.42	1.20	69		69		145	75.53	48%
5-Year	1512	104.63	1.42	93		93		193	99.86	48%
10-Year	1556	104.66	1.45	120		120		225	105.45	53%
25-Year	1594	104.69	1.47	148		148		266	118.27	56%
50-Year	1624	104.71	1.49	173		173		296	123.54	58%
100-Year	1729	104.80	1.58	324		324		328	3.41	99%

STAGE STORAGE DISCHARGE

Orifice 1		Weir	
$Q = (C)(A)\sqrt{2g\Delta h}$		$Q = (C)(A)\sqrt{2g\Delta h}$	
Invert	103.13	Invert	104.6
Size (mm)	170	Width	1.50
Area (m2)	0.0227		
Type	Plate		
Cd	0.63	Cd	1.81

Elevation (m)	Total Storage (cu.m)	Pond	Cultec	Stage (m)	Orifice 1 Discharge	Weir Discharge	TOTAL DISCHARGE
104.82	1735.41	644.05	1091.36	1.02	80.24	280.16	360.40
104.78	1735.41	644.05	1091.36	0.98	79.15	201.32	280.47
104.75	1713.57	640.00	1073.57	0.95	78.50	159.47	237.97
104.73	1655.04	599.25	1055.79	0.93	77.85	121.00	198.85
104.70	1478.00	440.00	1038.00	0.90	77.19	86.24	163.44
104.67	1576.03	555.81	1020.22	0.88	76.53	55.65	132.18
104.65	1532.82	530.39	1002.43	0.85	75.86	29.90	105.76
104.62	1498.35	513.71	984.64	0.83	75.19	10.16	85.35
104.60	1455.95	489.09	966.86	0.80	74.51	0.00	74.51
104.57	1422.01	472.94	949.07	0.77	73.82	0.00	73.82
104.55	1380.40	449.11	931.29	0.75	73.13	0.00	73.13
104.52	1346.99	433.49	913.50	0.72	72.43	0.00	72.43
104.50	1306.17	410.46	895.71	0.70	71.72	0.00	71.72
104.47	1280.81	402.88	877.93	0.67	71.01	0.00	71.01
104.46	1249.51	380.48	869.03	0.66	70.65	0.00	70.65
104.43	1215.85	365.81	850.04	0.64	69.92	0.00	69.92
104.41	1173.29	344.18	829.11	0.61	69.19	0.00	69.19
104.38	1134.67	330.03	804.64	0.58	68.45	0.00	68.45
104.36	1087.09	309.19	777.90	0.56	67.70	0.00	67.70
104.33	1045.04	295.55	749.49	0.53	66.94	0.00	66.94
104.31	995.22	275.48	719.74	0.51	66.18	0.00	66.18
104.28	951.28	262.36	688.92	0.48	65.40	0.00	65.40
104.26	900.22	243.06	657.16	0.46	64.62	0.00	64.62
104.23	855.06	230.45	624.61	0.43	63.83	0.00	63.83
104.21	803.22	211.91	591.31	0.41	63.02	0.00	63.02
104.18	751.26	193.84	557.42	0.38	62.21	0.00	62.21
104.15	705.03	182.04	522.99	0.36	61.38	0.00	61.38
104.13	652.34	164.71	487.63	0.33	60.55	0.00	60.55
104.10	605.41	153.42	451.99	0.30	59.70	0.00	59.70
104.08	552.94	136.85	416.09	0.28	58.84	0.00	58.84
104.05	505.97	126.05	379.92	0.25	57.97	0.00	57.97
104.03	453.69	110.23	343.46	0.23	57.08	0.00	57.08
104.00	406.40	99.93	306.47	0.20	56.18	0.00	56.18
103.98	354.01	84.86	269.15	0.18	55.27	0.00	55.27
103.95	306.73	75.05	231.68	0.15	54.34	0.00	54.34
103.93	254.19	60.71	193.48	0.13	53.39	0.00	53.39
103.90	202.03	46.81	155.22	0.10	52.43	0.00	52.43
103.87	154.60	37.79	116.81	0.08	51.45	0.00	51.45
103.85	102.90	24.62	78.28	0.05	50.45	0.00	50.45
103.82	55.70	16.09	39.61	0.03	49.43	0.00	49.43
103.80	3.65	3.65	0.00	0.00	48.39	0.00	48.39

CULTEC Stormwater Design Calculator

Date:	October 02, 2025

Project Information:

Calculations Performed By:

RECHARGER 280HD

Recharger 280HD Chamber Specifications		
Height	**673**	mm
Width	**1194**	mm
Length	**2.44**	meters
Installed Length	**2.13**	meters
Bare Chamber Volume	**1.20**	cu. meters
Installed Chamber Volume	**2.19**	cu. meters

Breakdown of Storage Provided by Recharger 280HD Stormwater System		
Stone Porosity	**40.0**	%
Within Chambers	**677.19**	cu. meters
Within Stone	**573.95**	cu. meters
Total Storage Provided	**1,251.1**	**cu. meters**
Total Storage Required	1227.96	cu. meters

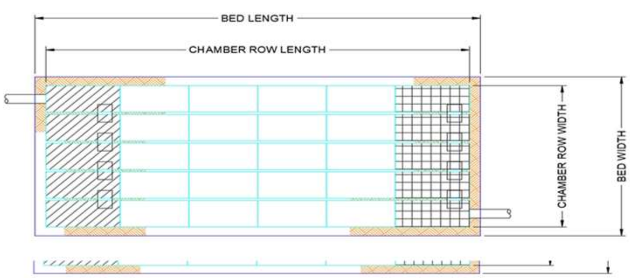
Materials List

Recharger 280HD		
Total Number of Chambers Required	**560**	**pieces**
Separator Row Chambers	**40**	pieces
Starter Chambers		pieces
Intermediate Chambers	**532**	pieces
End Chambers	**14**	pieces
HVLV FC-24 Feed Connectors	**26**	pieces
CULTEC No. 410 Non-Woven Geotextile	**4698**	sq. meters
CULTEC AFAB-HPF Woven Geotextile	**131**	meters
Stone	**1435**	cu. meters

Separator Row Qty Included in Total

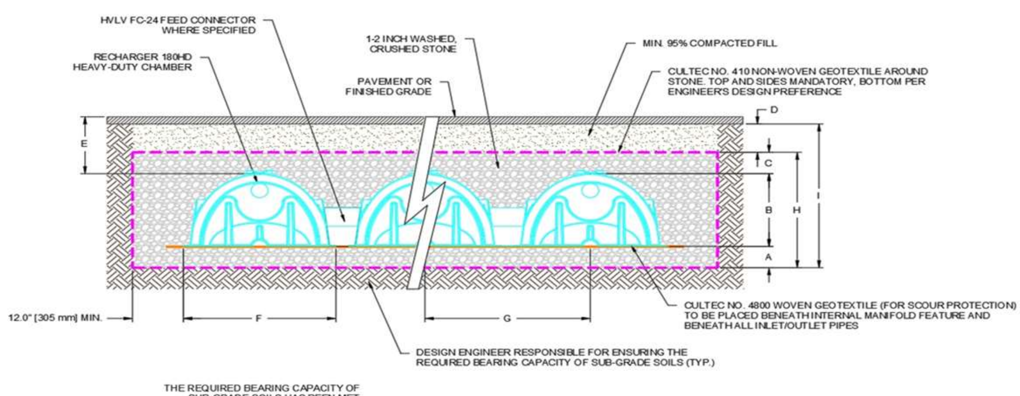
Based on 2 Internal Manifolds

Bed Detail



Bed Layout Information		
Number of Rows Wide	**14**	pieces
Number of Chambers Long	**40**	pieces
Chamber Row Width	**19.69**	meters
Chamber Row Length	**85.65**	meters
Bed Width	**20.29**	meters
Bed Length	**86.26**	meters
Bed Area Required	**1750.58**	sq. meters
Length of Separator Row	**85.65**	meters

Bed detail for reference only. Not project specific. Not to scale.



Conceptual graphic only. Not job specific.

Cross Section Table Reference			
A	Depth of Stone Base	**229**	mm
B	Chamber Height	**673**	mm
C	Depth of Stone Above Units	**305**	mm
D	Depth of 95% Compacted Fill	**254**	mm
E	Max. Depth Allowed Above the Chamber	**3.66**	meters
F	Chamber Width	**1194**	mm
G	Center to Center Spacing	**1.42**	meters
H	Effective Depth	**1.21**	meters
I	Bed Depth	**1.46**	meters

CULTEC Stage-Storage Calculations

CULTEC

Date:	October 2, 2025

Project Information:

Project Number:
0

Chamber Model -	Recharger 280HD	
Number of Rows-	14	units
Total Number of Chambers -	560	units
Stone Void -	40	%
Stone Base -	229	mm
Stone Above Units -	305	mm
Area -	1750.58	m2
Base of Stone Elevation -	103.57	

Recharger 280HD Incremental Storage Volumes

Height of System		Chamber Volume		HVLV Feed Connector Volume		Stone Volume		Cumulative Storage Volume		Total Cumulative Storage Volume		Stage / Area		Elevation		
in	mm	ft^3	m^3	ft3	m3	ft^3	m^3	ft^3	m^3	ft^3	m^3	ft^2	m^2	ft	m	
47.5	1207	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	44193.96	1251.43	7537.23	700.21	107.53	104.78	Top of Stone Elevation
46.5	1181	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	43565.86	1233.65	7537.23	700.21	107.45	104.75	
45.5	1156	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	42937.75	1215.86	7537.23	700.21	107.36	104.73	
44.5	1130	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	42309.65	1198.07	7537.23	700.21	107.28	104.70	
43.5	1105	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	41681.55	1180.29	7537.23	700.21	107.20	104.67	
42.5	1080	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	41053.45	1162.50	7537.23	700.21	107.11	104.65	
41.5	1054	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	40425.34	1144.72	7537.23	700.21	107.03	104.62	
40.5	1029	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	39797.24	1126.93	7537.23	700.21	106.95	104.60	
39.5	1003	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	39169.14	1109.14	7537.23	700.21	106.86	104.57	
38.5	978	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	38541.03	1091.36	7537.23	700.21	106.78	104.55	
37.5	953	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	37912.93	1073.57	7537.23	700.21	106.70	104.52	
36.5	927	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	37284.83	1055.79	7537.23	700.21	106.61	104.50	
35.5	902	0.4	0.0	0.0	0.0	313.9	8.9	314.287	8.9	36656.73	1038.00	3771.45	350.37	106.53	104.47	Top of Chamber Elevation
35.0	889	70.8	2.0	0.0	0.0	599.8	17.0	670.590	19.0	36342.44	1029.10	8047.08	747.57	106.49	104.46	
34.0	864	184.9	5.2	0.0	0.0	554.1	15.7	739.042	20.9	35671.85	1010.11	8868.50	823.88	106.40	104.43	
33.0	838	393.4	11.1	0.0	0.0	470.7	13.3	864.143	24.5	34932.81	989.19	10369.71	963.35	106.32	104.41	
32.0	813	527.2	14.9	0.0	0.0	417.2	11.8	944.396	26.7	34068.66	964.72	11332.76	1052.81	106.24	104.38	
31.0	787	625.5	17.7	0.0	0.0	377.9	10.7	1,003.406	28.4	33124.27	937.97	12040.88	1118.60	106.15	104.36	
30.0	762	704.2	19.9	0.0	0.0	346.4	9.8	1,050.614	29.8	32120.86	909.56	12607.37	1171.22	106.07	104.33	
29.0	737	767.1	21.7	0.0	0.0	321.3	9.1	1,088.381	30.8	31070.25	879.81	13060.57	1213.33	105.99	104.31	
28.0	711	822.2	23.3	0.0	0.0	299.2	8.5	1,121.426	31.8	29981.87	848.99	13457.12	1250.17	105.90	104.28	
27.0	686	869.4	24.6	0.0	0.0	280.3	7.9	1,149.751	32.6	28860.44	817.24	13797.01	1281.74	105.82	104.26	
26.0	660	912.7	25.8	0.0	0.0	263.0	7.4	1,175.716	33.3	27710.69	784.68	14108.59	1310.69	105.74	104.23	
25.0	635	948.1	26.8	0.0	0.0	248.9	7.0	1,196.959	33.9	26534.97	751.39	14363.51	1334.37	105.65	104.21	
24.0	610	979.6	27.7	0.0	0.0	236.3	6.7	1,215.842	34.4	25338.01	717.49	14590.11	1355.42	105.57	104.18	
23.0	584	1,034.6	29.3	0.0	0.0	214.2	6.1	1,248.888	35.4	24122.17	683.06	14986.66	1392.26	105.49	104.15	
22.0	559	1,050.4	29.7	0.0	0.0	208.0	5.9	1,258.330	35.6	22873.28	647.70	15099.95	1402.79	105.40	104.13	
21.0	533	1,066.1	30.2	0.0	0.0	201.7	5.7	1,267.815	35.9	21614.95	612.07	15213.78	1413.36	105.32	104.10	
20.0	508	1,081.9	30.6	0.3	0.0	195.4	5.5	1,277.551	36.2	20347.14	576.17	15330.62	1424.21	105.24	104.08	
19.0	483	1,097.6	31.1	0.7	0.0	189.1	5.4	1,287.310	36.5	19069.59	539.99	15447.71	1435.09	105.15	104.05	
18.0	457	1,129.1	32.0	0.8	0.0	176.5	5.0	1,306.335	37.0	17782.28	503.54	15676.02	1456.30	105.07	104.03	
17.0	432	1,148.7	32.5	0.9	0.0	168.6	4.8	1,318.224	37.3	16475.94	466.55	15818.69	1469.56	104.99	104.00	
16.0	406	1,156.6	32.8	0.9	0.0	165.5	4.7	1,322.989	37.5	15157.72	429.22	15875.86	1474.87	104.90	103.98	
15.0	381	1,199.9	34.0	1.0	0.0	148.2	4.2	1,348.997	38.2	13834.73	391.76	16187.96	1503.86	104.82	103.95	
14.0	356	1,203.8	34.1	1.0	0.0	146.6	4.2	1,351.401	38.3	12485.73	353.56	16216.81	1506.54	104.74	103.93	
13.0	330	1,211.7	34.3	1.0	0.0	143.4	4.1	1,356.143	38.4	11134.33	315.29	16273.72	1511.83	104.65	103.90	
12.0	305	1,219.5	34.5	1.1	0.0	140.3	4.0	1,360.886	38.5	9778.19	276.89	16330.63	1517.12	104.57	103.87	
11.0	279	1,227.4	34.8	1.1	0.0	137.1	3.9	1,365.629	38.7	8417.30	238.35	16387.54	1522.40	104.49	103.85	
10.0	254	1,282.5	36.3	1.2	0.0	115.1	3.3	1,398.751	39.6	7051.68	199.68	16785.01	1559.33	104.40	103.82	
9.0	229	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	5652.93	160.07	7537.23	700.21	104.32	103.80	Bottom of Chamber Elevation
8.0	203	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	5024.82	142.29	7537.23	700.21	104.24	103.77	
7.0	178	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	4396.72	124.50	7537.23	700.21	104.15	103.75	
6.0	152	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	3768.62	106.72	7537.23	700.21	104.07	103.72	
5.0	127	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	3140.51	88.93	7537.23	700.21	103.99	103.70	
4.0	102	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	2512.41	71.14	7537.23	700.21	103.90	103.67	
3.0	76	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	1884.31	53.36	7537.23	700.21	103.82	103.65	
2.0	51	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	1256.21	35.57	7537.23	700.21	103.74	103.62	
1.0	25	0.0	0.0	0.0	0.0	628.1	17.8	628.103	17.8	628.10	17.79	7537.23	700.21	103.65	103.60	
0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.00	0.00	103.57	103.57	Bottom of Stone Elevation
-1.0																
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CULTEC, Inc.
P.O. Box 280
Brookfield, CT 06804 USA

Phone: 203-775-4416
www.cultec.com
tech@cultec.com

Quality Control Calculations

	Device	TSS Removal Efficiency
BMP1	Separator Row-1	50%
BMP2	OGS	50%
BMP3	Separator Row-2	50%

NJDEP Calculation for TSS removal rates for BMP in Series:
R = A + B - [(AxB)/100]
A = TSS Removal rate from First (Upstream BMP)
B = TSS Removal rate from Second (Downstream BMP)

Land Type	Area (m^2)	Starting TSS Removal (A)	TSS Removal (B_1)	TSS Removal (B_2)	TSS Removal (B_3)	Notes
Roof	23,900	90%	95%	98%	99%	*Roof is treated by all three BMPs*
Landscape	1,400	90%	90%	95%	98%	*Landscape does not get treated by BMP1*
Impervious	43,500	0%	0%	50%	75%	*Impervious does not get treated by BMP1*
TOTAL	68,800	**33%**	**35%**	**67%**	**84%**	

Stormceptor

Rinker

Stormceptor EF Sizing Report

Imbrium® Systems
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

02/16/2025

Province:	Ontario
City:	Ottawa
Nearest Rainfall Station:	OTTAWA CDA RCS
Climate Station Id:	6105978
Years of Rainfall Data:	20

Project Name:	O'Keefe Court
Project Number:	21684
Designer Name:	Luan Phan
Designer Company:	KWA
Designer Email:	luan.phan@kwasitedev.com
Designer Phone:	437-453-3130
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Site Name:	O'Keefe Court

Drainage Area (ha):	6.88
Runoff Coefficient 'c':	0.90

Particle Size Distribution:	Fine
Target TSS Removal (%):	80.0
Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	199.85
Oil / Fuel Spill Risk Site?	No
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	7583
Estimated Average Annual Sediment Volume (L/yr):	6165

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EF4	43
EF5	52
EF6	59
EF8	69
EF10	76
EF12	81

Recommended Stormceptor EF Model:	**EF12**
Estimated Net Annual Sediment (TSS) Load Reduction (%):	**81**
Water Quality Runoff Volume Capture (%):	**> 90**

imbrium

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

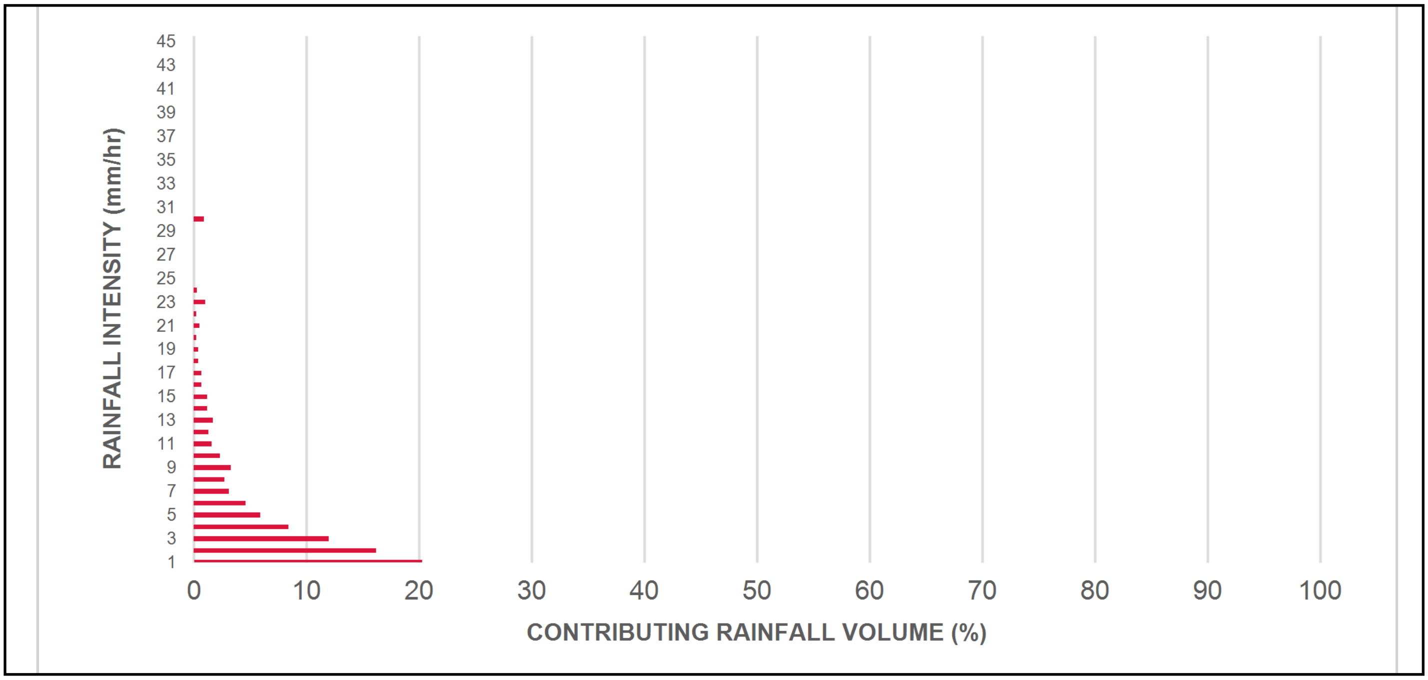
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (μm)	Percent Less Than	Particle Size Fraction (μm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

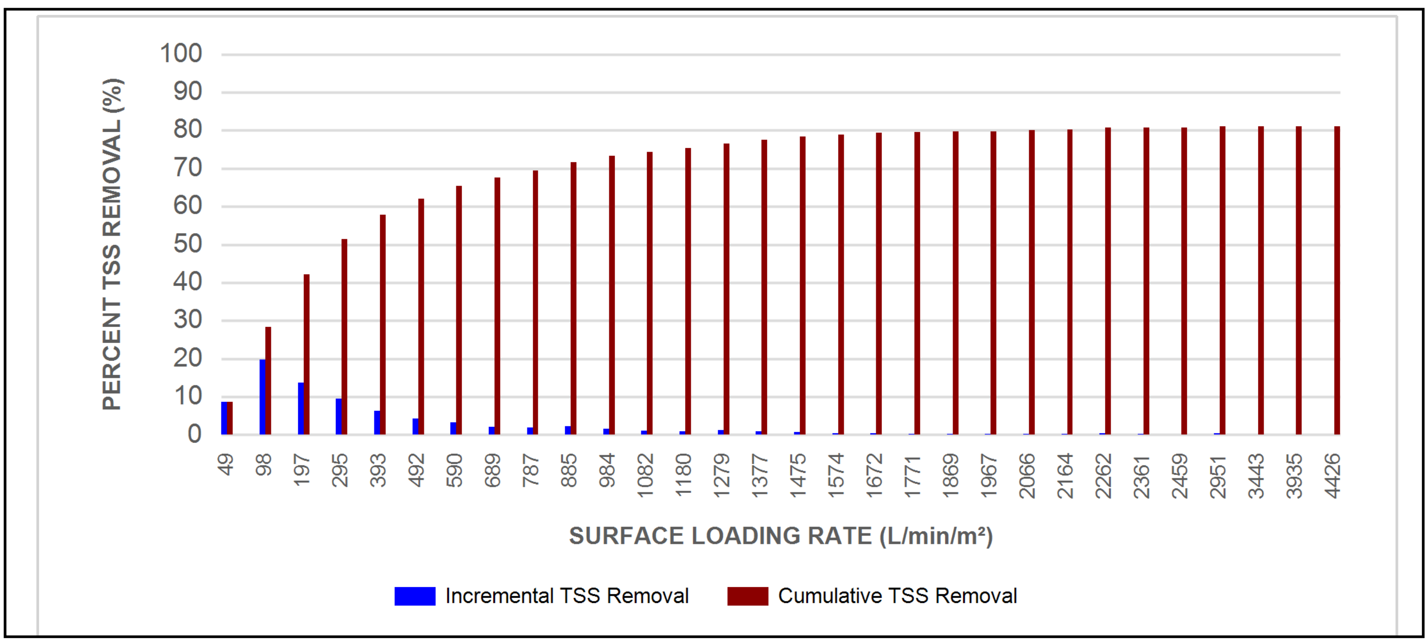
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.6	8.6	8.61	516.0	49.0	100	8.6	8.6
1.00	20.3	29.0	17.21	1033.0	98.0	97	19.8	28.4
2.00	16.2	45.2	34.43	2066.0	197.0	84	13.7	42.1
3.00	12.0	57.2	51.64	3098.0	295.0	79	9.5	51.5
4.00	8.4	65.6	68.86	4131.0	393.0	74	6.3	57.8
5.00	5.9	71.6	86.07	5164.0	492.0	72	4.3	62.1
6.00	4.6	76.2	103.28	6197.0	590.0	71	3.3	65.4
7.00	3.1	79.3	120.50	7230.0	689.0	70	2.1	67.6
8.00	2.7	82.0	137.71	8263.0	787.0	69	1.9	69.5
9.00	3.3	85.3	154.92	9295.0	885.0	69	2.3	71.7
10.00	2.3	87.6	172.14	10328.0	984.0	68	1.6	73.3
11.00	1.6	89.2	189.35	11361.0	1082.0	69	1.1	74.4
12.00	1.3	90.5	206.57	12394.0	1180.0	71	0.9	75.3
13.00	1.7	92.2	223.78	13427.0	1279.0	73	1.3	76.6
14.00	1.2	93.5	240.99	14460.0	1377.0	75	0.9	77.5
15.00	1.2	94.6	258.21	15492.0	1475.0	72	0.8	78.3
16.00	0.7	95.3	275.42	16525.0	1574.0	67	0.5	78.8
17.00	0.7	96.1	292.63	17558.0	1672.0	63	0.5	79.3
18.00	0.4	96.5	309.85	18591.0	1771.0	60	0.2	79.5
19.00	0.4	96.9	327.06	19624.0	1869.0	57	0.2	79.7
20.00	0.2	97.1	344.28	20657.0	1967.0	54	0.1	79.8
21.00	0.5	97.5	361.49	21689.0	2066.0	51	0.2	80.1
22.00	0.2	97.8	378.70	22722.0	2164.0	49	0.1	80.2
23.00	1.0	98.8	395.92	23755.0	2262.0	47	0.5	80.7
24.00	0.3	99.1	413.13	24788.0	2361.0	45	0.1	80.8
25.00	0.0	99.1	430.34	25821.0	2459.0	43	0.0	80.8
30.00	0.9	100.0	516.41	30985.0	2951.0	36	0.3	81.1
35.00	0.0	100.0	602.48	36149.0	3443.0	31	0.0	81.1
40.00	0.0	100.0	688.55	41313.0	3935.0	27	0.0	81.1
45.00	0.0	100.0	774.62	46477.0	4426.0	24	0.0	81.1
Estimated Net Annual Sediment (TSS) Load Reduction =								**81 %**

Climate Station ID: 6105978 *Years of Rainfall Data*: 20

RAINFALL DATA FROM OTTAWA CDA RCS RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF5 / EFO5	1.5	5	90	762	30	762	30	710	25
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

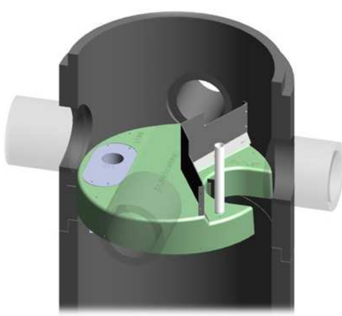
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

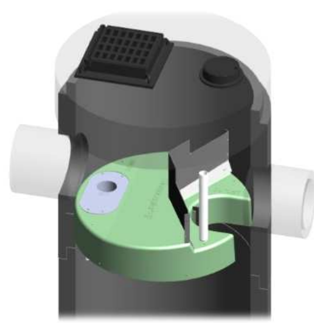
DESIGN FLEXIBILITY

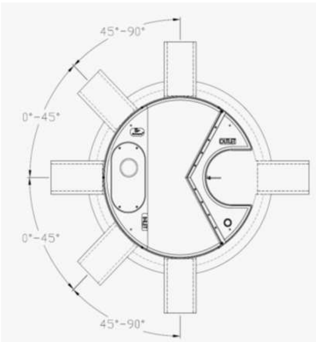
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft^3)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF5 / EFO5	1.5	5	1.62	5.3	420	111	305	10	2124	75	2612	5758
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREAMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The **minimum** sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	5 ft (1524 mm) Diameter OGS Units:	1.95 m^3 sediment / 420L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

water

Article

Performance of an Underground Stormwater Detention Chamber and Comparison with Stormwater Management Ponds

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Academic Editors: Kelly T. Morgan and Monica Ozores-Hampton
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Abstract: The transportation of pollutants from impervious surfaces during runoff events to receiving water bodies is a serious environmental problem. Summer runoff is also heated by impervious surfaces, causing thermal enrichment in receiving water body systems and degradation of coldwater aquatic ecosystems. End-of-pipe stormwater management facilities that are open to the environment can result in further elevated temperatures due to exposure to solar radiation. Receiving water systems that provide coldwater habitat require cool water temperatures to sustain healthy conditions for cold water flora and fauna (e.g., trout, dace). Underground Stormwater Detention Chambers (USDC) are a technology for the detention and treatment of stormwater runoff that can potentially solve the thermal issues associated with sun-exposed detention facilities while still providing an equivalent level of treatment services for stormwater pollutants. A field study of an USDC located in Southern Ontario was undertaken to characterize its treatment performance and effect on water temperature. The results were: the USDC was found to provide similar levels of stormwater treatment as wet detention ponds. On average, outlet maximum temperatures were 5 °C cooler than inlet maximum temperatures, and outlet water temperatures remained within the thermal regime for coldwater fish habitat throughout the evaluation period. There was little to no stratification of temperature, nor dissolved solids, but stratification of dissolved oxygen was observed mid-winter and into the spring.

Keywords: stormwater detention; end-of-pipe; underground detention chambers; ponds; water quality; temperature

1. Introduction

Stormwater management is a key issue in the design of urban infrastructure. Sustained increases in urbanization have resulted in large-scale replacement of pervious land by impervious surfaces, which reduces infiltration rates and available surface storage [1]. Due to these changes, a larger proportion of urban precipitation becomes runoff. Runoff from urban areas causes non-point source pollution by transporting pollutants-which are deposited on impervious surfaces through human activities and atmospheric deposition-to receiving water bodies [2,3].

Stormwater management (SWM) ponds have been the most widely employed management practice in urban drainage for over 40 years [4]. SWM ponds have been widely documented to improve stormwater quality reducing concentrations of suspended sediments [5], metals [5], nutrients [5,6] and bacteria [7]. Ponds are often assumed to provide high removal efficiency for total suspended solids

Mannings Equation - Trapezoidal Channel

Project Name: O'Keefe Court
Project Number: 21684
Location: Nepean, Ontario
Date: 2/19/2025
Prepared By: LP

EXISTING SWALE

Parameter	Value		Units	
Flow depth	0.87		m	
Freeboard	0.3			*assumed*
Side slope Ratio	3	:1	H:V	*existing side slopes approx. 3:1*
Bed width	0		m	*assume triangular - per cross sections*
Top width	7		m	*existing top width is >7m*
Area	2.253		m^2	
Wetted Perimeter	5.481		m	
Slope	0.3		%	*MINIMUM SLOPE ALONG SOUTH SWALE*
Mannings 'n'	0.03			*BETWEEN CUL-DE-SAC AND POINT OF*
Channel Capacity	2.275		m^3/s	*DIRECTIONAL SWITCH*
Channel Capacity	**2275**		**L/s**	*FLOW CAPACITY OF DITCH AT WORST*
Channel Capacity	1.009		m/s	*CASE SCENARIO*

REINSTATED SWALE

Parameter	Value		Units	
Flow depth	0.87		m	
Freeboard	0.3			*assumed*
Side slope Ratio	3	:1	H:V	*existing side slopes approx. 3:1*
Bed width	0		m	*assume triangular - per cross sections*
Top width	7		m	*existing top width is >7m*
Area	2.253		m^2	
Wetted Perimeter	5.481		m	
Slope	1		%	*APPROXIMATE SLOPE FROM AVERAGING*
Mannings 'n'	0.03			*OUT SLOPE BETWEEN CUL-DE-SAC AND*
Channel Capacity	4.153		m^3/s	*POINT OF DIRECTIONAL SWITCH*
Channel Capacity	**4153**		**L/s**	
Channel Capacity	1.843		m/s	

Total Site - Uncontrolled Flow

Uncontrolled area (ha) =	6.88
Runoff Coefficient =	0.9
Time of Concentration (min) =	40

Storm Event	Intensity (mm/hr)	Uncontrolled Flow Rate (L/s)
2 year	32.9	565.7
5 year	44.2	760.6
10 year	51.6	888.6
25 year	61.0	1049.4
50 year	68.0	1169.7
100 year	75.1	1293.5

100-year Flow + 20% Surcharge = 1552.2

Calculation of Contributing Flow to O'Keefe South Swale (Up to Block 15 Inlet)

					Rainfall Intensity (mm/hr)		Rational Flow (L/s)	
*Drainage ID	Description	Area (ha)	**ToC (min)	Runoff C	2 year	100 year	2 year	100 year
200	Subject Site - Controlled Flow	6.74	***Flow is predetermined - Refer to SWM Calcs***				166.5	379.8
201	Subject Site - Uncontrolled Flow	0.14	***Flow is predetermined - Refer to SWM Calcs***				22.1	51.4
202a	O'Keefe ROW - North	0.57	15	0.90	61.8	142.9	88.1	203.8
202b	O'Keefe ROW - South	0.66	20	0.90	52.0	120.0	85.9	198.1
203	Lytle Park	9.8	50	0.30	28.0	64.0	229.2	522.7
		17.91						
						Total Flow (L/s)	**591.8**	**1355.8**

IDF curve equations (Intensity in mm/hr)

100 year Intensity $= 1735.688 / (\text{Time in min} + 6.014)^{0.820}$
50 year Intensity $= 1569.580 / (\text{Time in min} + 6.014)^{0.820}$
25 year Intensity $= 1402.884 / (\text{Time in min} + 6.018)^{0.819}$
10 year Intensity $= 1174.184 / (\text{Time in min} + 6.014)^{0.816}$
5 year Intensity $= 998.071 / (\text{Time in min} + 6.053)^{0.814}$
2 year Intensity $= 732.951 / (\text{Time in min} + 6.199)^{0.810}$

Ditch Capacity =	**4153**	L/s
Total Tributary Flow (2-year) =	**591.8**	L/s
Total Tributary Flow (100-year) =	**1355.8**	L/s
***Site Overland Flow Conditions =	**2476.8**	L/s

Operating Capacities

2-year	**14%**
100-year	**33%**
Overland Flow	**60%**

*Refer to Figure PDP-A in Appendix E

**time of concentration calculated using Airport Formula (RC<0.4) and Bransby William Formula (RC>0.4)

***site overland flow conditions based on uncontrolled flow of total site (with 20% surcharge) + 100-year flows from areas 202a, 202b, 203

Culvert Sizing

Pipe Size =	600	mm
Pipe Grade % =	2	
Full Wetted Area =	0.28	m2
Full Wetted Perimeter =	1.88	m
Mannings Coefficient	0.024	
Full Flow Velocity =	**1.66**	**m/s**
Full Flow Capacity =	**470.4**	**L/s**

	Area (m^2)	**Runoff C**	**ToC (min)**	
Area #202	1828	0.75	10	*O'Keefe north ROW drainage*

Pre-Development Flow (L/s)

	2 year	**5 year**	**10 year**	**25 year**	**50 year**	**100 year**
Area 202	29.27	39.71	46.55	55.15	61.54	68.06
Site (Area 200)	151.00	166.41	202.35	266.16	317.97	378.29
% of FFC	38%	44%	53%	68%	81%	95%

Project:	**O'Keefe Court**
Project #:	21684
Designed By:	L.P.
Checked By:	T.F
Date:	2-Oct-2025

Site Total - Infiltration Rate & Drawdown Time

Infiltration Storage Required

Rainfall Retention Depth =	**5.00**	mm
Site Area =	**6.88**	ha
Total Water Balance Volume Required =	**344.00**	m^3
Combined Rooftop Area =	**2.39**	ha
West Drainage Area =	**1.20**	ha
Total Target Water Balance Volume =	**179.50**	m^3
Total Water Balance Volume Provided =	**179.50**	m^3
% of total volume requirement =	52.2%	

Project:	**O'Keefe Court**
Project #:	21684
Designed By:	T.G
Checked By:	T.F
Date:	2-Oct-2025

Infiltration Gallery - 1 (Cultec 100HD Stormwater System) - Infiltration Rate & Drawdown Time

Infiltration Rate

Infiltration Rate =	25.8	mm/hr	*as per Hydrogeological Investigation (Gemtech) dated 09/04/24*
Safety Correction Factor =	2.5		
Total Target Water Balance Volume Pr	10.32	mm/hr	

Infiltration Storage Required

Rainfall Retention Depth =	**5.00**	mm
Building A3 Area =	**0.80**	ha
Total Target Water Balance Volume	**40.00**	m^3

Cultec 100HD Stormwater System Dimensions

Footprint	**384.97**	m2
Volume	**40.00**	m3

	Vol of Infiltration (m^3)	**Infiltration Rate (m/hr)**	**Area of Infiltration (m^2)**	**Infiltration Vol. Rate (m^3/hr)**	**Drawdown Time (hrs)***
Infiltration	40.00	0.0103	384.97	4.0	10.1
Total	**40.00**				

*Max allowable drawdown time = 48 hours (2 days)

**effective depth of water from Cultec stage-storage sheet multiplied by 0.40 (water volume/bulk volume ratio)

Project:	**O'Keefe Court**
Project #:	21684
Designed By:	T.G
Checked By:	T.F
Date:	2-Oct-2025

Infiltration Gallery - 2 (Cultec 100HD Stormwater System) - Infiltration Rate & Drawdown Time

Infiltration Rate

Infiltration Rate =	4.3	mm/hr	*as per Hydrogeological Investigation (Gemtech) dated 09/04/24*
Safety Correction Factor =	2.5		
Total Target Water Balance Volume Pr	1.72	mm/hr	

Infiltration Storage Required

Rainfall Retention Depth =	**5.00**	mm
Building A2 + West Parking Lot Area =	**1.40**	ha
Total Target Water Balance Volume	**70.00**	m^3

Cultec 100HD Stormwater System Dimensions

Footprint	**960.62**	m2
Volume	**70.00**	m3

	Vol of Infiltration (m^3)	**Infiltration Rate (m/hr)**	**Area of Infiltration (m^2)**	**Infiltration Vol. Rate (m^3/hr)**	**Drawdown Time (hrs)***
Infiltration	70.00	0.0017	960.62	1.7	42.4
Total	**70.00**				

*Max allowable drawdown time = 48 hours (2 days)

**effective depth of water from Cultec stage-storage sheet multiplied by 0.40 (water volume/bulk volume ratio)

Project:	**O'Keefe Court**
Project #:	21684
Designed By:	T.G
Checked By:	T.F
Date:	2-Oct-2025

Infiltration Gallery - 3 (Cultec 100HD Stormwater System) - Infiltration Rate & Drawdown Time

Infiltration Rate			
Infiltration Rate =	13.2	mm/hr	*as per Hydrogeological Investigation (Gemtech) dated 09/04/24*
Safety Correction Factor =	2.5		
Total Target Water Balance Volume Pr	5.28	mm/hr	
Infiltration Storage Required			
Rainfall Retention Depth =	**5.00**	mm	
Building A1 + West Parking Lot Area =	**1.39**	ha	
Total Target Water Balance Volume	**69.50**	m^3	
Cultec 100HD Stormwater System Dimensions			
Footprint	**444.54**	m2	
Volume	**69.50**	m3	

	Vol of Infiltration (m^3)	**Infiltration Rate (m/hr)**	**Area of Infiltration (m^2)**	**Infiltration Vol. Rate (m^3/hr)**	**Drawdown Time (hrs)***
Infiltration	69.50	0.0053	444.54	2.3	29.6
Total	**69.50**				

*Max allowable drawdown time = 48 hours (2 days)
**effective depth of water from Cultec stage-storage sheet multiplied by 0.40 (water volume/bulk volume ratio)

CULTEC Stormwater Design Calculator

Date:	October 02, 2025

Project Information:
Building A1 - Chamber

Calculations Performed By:

CONTACTOR 100HD

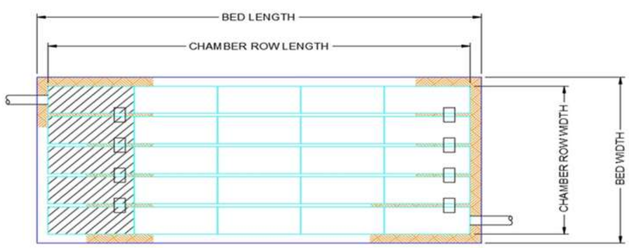
Contactor 100HD Chamber Specifications		
Height	**318**	mm
Width	**914**	mm
Length	**2.44**	meters
Installed Length	**2.29**	meters
Bare Chamber Volume	**0.40**	cu. meters
Installed Chamber Volume	**0.97**	cu. meters

Breakdown of Storage Provided by Contactor 100HD Stormwater System		
Stone Porosity	**40.0**	%
Within Chambers	**68.55**	cu. meters
Within Stone	**105.82**	cu. meters
Total Storage Provided	**174.4**	**cu. meters**
Total Storage Required	170.00	cu. meters

Materials List

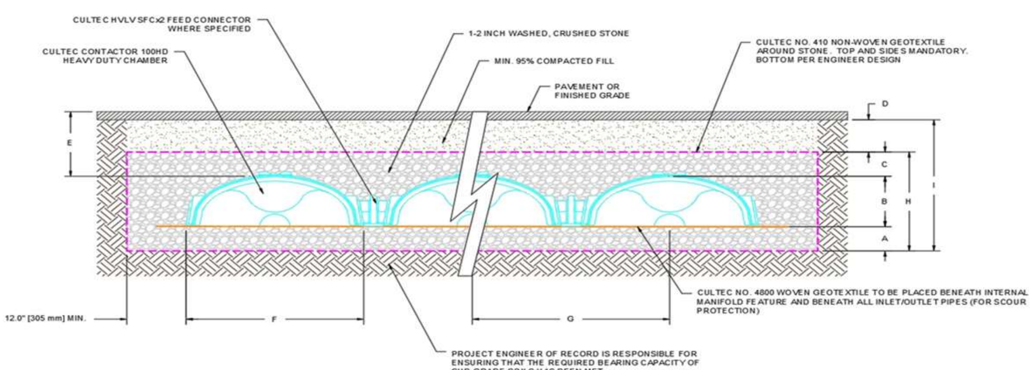
Contactor 100HD			
Total Number of Chambers Required	**171**	**pieces**	
Separator Row Chambers	**19**	pieces	Separator Row Qty Included in Total
Starter Chambers	**9**	pieces	
End Chambers	**162**	pieces	
HVLV SFCx2 Feed Connectors	**16**	pieces	*Based on 2 Internal Manifolds*
CULTEC No. 410 Non-Woven Geotextile	**1213**	sq. meters	
CULTEC AFAB-HPF Woven Geotextile	**66**	meters	
Stone	**265**	cu. meters	

Bed Detail



Bed Layout Information		
Number of Rows Wide	**9**	pieces
Number of Chambers Long	**19**	pieces
Chamber Row Width	**9.45**	meters
Chamber Row Length	**43.59**	meters
Bed Width	**10.06**	meters
Bed Length	**44.20**	meters
Bed Area Required	**444.54**	sq. meters
Length of Separator Row	**43.59**	meters

Bed detail for reference only. Not project specific. Not to scale.



Conceptual graphic only. Not job specific.

Cross Section Table Reference			
A	Depth of Stone Base	**280**	mm
B	Chamber Height	**318**	mm
C	Depth of Stone Above Units	**152**	mm
D	Depth of 95% Compacted Fill	**203**	mm
E	Max. Depth Allowed Above the Chamber	**3.66**	meters
F	Chamber Width	**914**	mm
G	Center to Center Spacing	**1.07**	meters
H	Effective Depth	**0.75**	meters
I	Bed Depth	**0.95**	meters

CULTEC

CULTEC Stage-Storage Calculations

Date:	October 2, 2025

Project Information:
Building A1 - Chamber

Project Number:
0

Chamber Model -	**Contactor 100HD**	
Number of Rows-	9	units
Total Number of Chambers -	171	units
Stone Void -	40	%
Stone Base -	280	mm
Stone Above Units -	152	mm
Area -	444.54	m2
Base of Stone Elevation -	104.90	

Contactor 100HD Incremental Storage Volumes

Height of System		Chamber Volume		HVLV Feed Connector Volume		Stone Volume		Cumulative Storage Volume		Total Cumulative Storage Volume		Stage / Area		Elevation		
in	mm	ft^3	m^3	ft3	m3	ft^3	m^3	ft^3	m^3	ft^3	m^3	ft^2	m^2	ft	m	
29.5	749	0.0	0.0	0.0	0.0	159.5	4.5	159.500	4.5	6159.41	174.41	1914.00	177.81	107.36	105.65	Top of Stone Elevation
28.5	724	0.0	0.0	0.0	0.0	159.5	4.5	159.500	4.5	5999.91	169.90	1914.00	177.81	107.28	105.62	
27.5	699	0.0	0.0	0.0	0.0	159.5	4.5	159.500	4.5	5840.41	165.38	1914.00	177.81	107.19	105.60	
26.5	673	0.0	0.0	0.0	0.0	159.5	4.5	159.500	4.5	5680.91	160.87	1914.00	177.81	107.11	105.57	
25.5	648	0.0	0.0	0.0	0.0	159.5	4.5	159.500	4.5	5521.41	156.35	1914.00	177.81	107.03	105.55	
24.5	622	0.0	0.0	0.0	0.0	159.5	4.5	159.500	4.5	5361.91	151.83	1914.00	177.81	106.94	105.52	
23.5	597	0.1	0.0	0.0	0.0	79.7	2.3	79.827	2.3	5202.41	147.32	957.93	88.99	106.86	105.50	Top of Chamber Elevation
23.0	584	30.9	0.9	0.0	0.0	147.1	4.2	178.033	5.0	5122.58	145.06	2136.39	198.47	106.82	105.48	
22.0	559	86.2	2.4	0.0	0.0	125.0	3.5	211.237	6.0	4944.55	140.01	2534.85	235.49	106.73	105.46	
21.0	533	141.6	4.0	0.0	0.0	102.9	2.9	244.442	6.9	4733.31	134.03	2933.30	272.50	106.65	105.43	
20.0	508	178.9	5.1	0.0	0.0	87.9	2.5	266.836	7.6	4488.87	127.11	3202.03	297.47	106.57	105.41	
19.0	483	204.6	5.8	0.0	0.0	77.6	2.2	282.287	8.0	4222.03	119.55	3387.44	314.69	106.48	105.38	
18.0	457	223.9	6.3	0.0	0.0	69.9	2.0	293.908	8.3	3939.74	111.56	3526.90	327.65	106.40	105.36	
17.0	432	236.8	6.7	0.2	0.0	64.8	1.8	301.749	8.5	3645.84	103.24	3620.98	336.39	106.32	105.33	
16.0	406	247.1	7.0	0.2	0.0	60.7	1.7	307.981	8.7	3344.09	94.69	3695.77	343.34	106.23	105.31	
15.0	381	261.3	7.4	0.2	0.0	55.0	1.6	316.497	9.0	3036.11	85.97	3797.97	352.83	106.15	105.28	
14.0	356	261.3	7.4	0.3	0.0	55.0	1.6	316.510	9.0	2719.61	77.01	3798.12	352.85	106.07	105.26	
13.0	330	261.3	7.4	0.3	0.0	55.0	1.6	316.523	9.0	2403.10	68.05	3798.28	352.86	105.98	105.23	
12.0	305	287.0	8.1	0.4	0.0	44.7	1.3	332.075	9.4	2086.58	59.09	3984.90	370.20	105.90	105.20	
11.0	279	0.0	0.0	0.0	0.0	159.5	4.5	159.500	4.5	1754.50	49.68	1914.00	177.81	105.82	105.18	Bottom of Chamber Elevation
10.0	254	0.0	0.0	0.0	0.0	159.5	4.5	159.500	4.5	1595.00	45.17	1914.00	177.81	105.73	105.15	
9.0	229	0.0	0.0	0.0	0.0	159.5	4.5	159.500	4.5	1435.50	40.65	1914.00	177.81	105.65	105.13	
8.0	203	0.0	0.0	0.0	0.0	159.5	4.5	159.500	4.5	1276.00	36.13	1914.00	177.81	105.57	105.10	
7.0	178	0.0	0.0	0.0	0.0	159.5	4.5	159.500	4.5	1116.50	31.62	1914.00	177.81	105.48	105.08	
6.0	152	0.0	0.0	0.0	0.0	159.5	4.5	159.500	4.5	957.00	27.10	1914.00	177.81	105.40	105.05	
5.0	127	0.0	0.0	0.0	0.0	159.5	4.5	159.500	4.5	797.50	22.58	1914.00	177.81	105.32	105.03	
4.0	102	0.0	0.0	0.0	0.0	159.5	4.5	159.500	4.5	638.00	18.07	1914.00	177.81	105.23	105.00	
3.0	76	0.0	0.0	0.0	0.0	159.5	4.5	159.500	4.5	478.50	13.55	1914.00	177.81	105.15	104.98	
2.0	51	0.0	0.0	0.0	0.0	159.5	4.5	159.500	4.5	319.00	9.03	1914.00	177.81	105.07	104.95	
1.0	25	0.0	0.0	0.0	0.0	159.5	4.5	159.500	4.5	159.50	4.52	1914.00	177.81	104.98	104.93	
0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.00	0.00	104.90	104.90	Bottom of Stone Elevation
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Brookfield, CT 06804 USA

Phone: 203-775-4416
www.cultec.com
tech@cultec.com

CULTEC Stormwater Design Calculator

Date:	October 02, 2025

Project Information:
Building A2 - Chamber

Calculations Performed By:

CONTACTOR 100HD

Contactor 100HD Chamber Specifications		
Height	**318**	mm
Width	**914**	mm
Length	**2.44**	meters
Installed Length	**2.29**	meters
Bare Chamber Volume	**0.40**	cu. meters
Installed Chamber Volume	**0.92**	cu. meters

Breakdown of Storage Provided by Contactor 100HD Stormwater System		
Stone Porosity	**40.0**	%
Within Chambers	**150.95**	cu. meters
Within Stone	**208.02**	cu. meters
Total Storage Provided	**359.0**	**cu. meters**
Total Storage Required	350.00	cu. meters

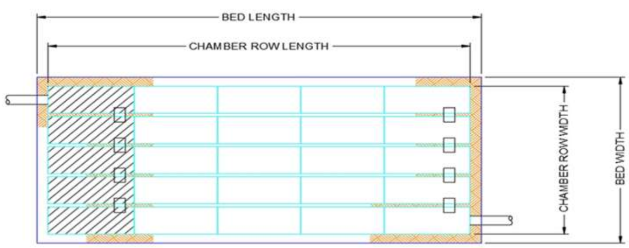
Materials List

Contactor 100HD		
Total Number of Chambers Required	**377**	**pieces**
Separator Row Chambers	**29**	pieces
Starter Chambers	**13**	pieces
End Chambers	**364**	pieces
HVLV SFCx2 Feed Connectors	**24**	pieces
CULTEC No. 410 Non-Woven Geotextile	**2544**	sq. meters
CULTEC AFAB-HPF Woven Geotextile	**98**	meters
Stone	**520**	cu. meters

Separator Row Qty Included in Total

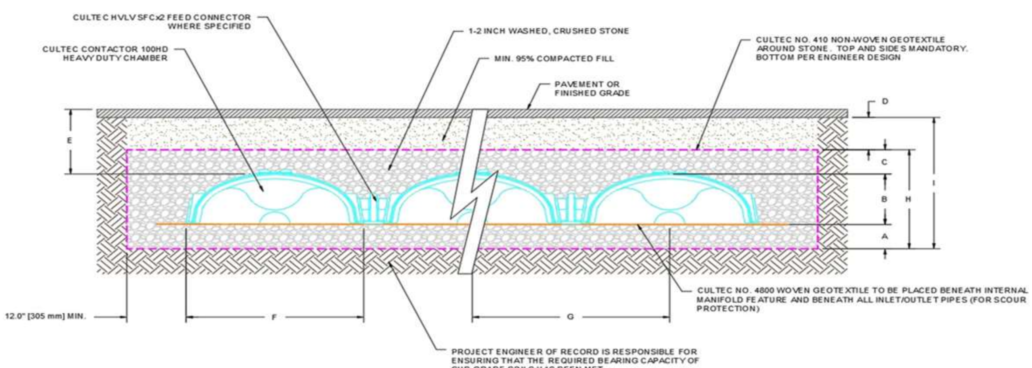
Based on 2 Internal Manifolds

Bed Detail



Bed Layout Information		
Number of Rows Wide	**13**	pieces
Number of Chambers Long	**29**	pieces
Chamber Row Width	**13.72**	meters
Chamber Row Length	**66.45**	meters
Bed Width	**14.33**	meters
Bed Length	**67.06**	meters
Bed Area Required	**960.62**	sq. meters
Length of Separator Row	**66.45**	meters

Bed detail for reference only. Not project specific. Not to scale.



Conceptual graphic only. Not job specific.

Cross Section Table Reference			
A	Depth of Stone Base	**230**	mm
B	Chamber Height	**318**	mm
C	Depth of Stone Above Units	**152**	mm
D	Depth of 95% Compacted Fill	**203**	mm
E	Max. Depth Allowed Above the Chamber	**3.66**	meters
F	Chamber Width	**914**	mm
G	Center to Center Spacing	**1.07**	meters
H	Effective Depth	**0.70**	meters
I	Bed Depth	**0.90**	meters

CULTEC

CULTEC Stage-Storage Calculations

Date:	October 2, 2025

Project Information:
Building A2 - Chamber

Project Number:
0

Chamber Model -	**Contactor 100HD**	
Number of Rows-	13	units
Total Number of Chambers -	377	units
Stone Void -	40	%
Stone Base -	230	mm
Stone Above Units -	152	mm
Area -	960.62	m2
Base of Stone Elevation -	104.80	

Contactor 100HD Incremental Storage Volumes

Height of System		Chamber Volume		HVLV Feed Connector Volume		Stone Volume		Cumulative Storage Volume		Total Cumulative Storage Volume		Stage / Area		Elevation		
in	mm	ft³	m³	ft3	m3	ft³	m³	ft³	m³	ft³	m³	ft²	m²	ft	m	
27.5	699	0.0	0.0	0.0	0.0	344.7	9.8	344.667	9.8	12679.31	359.04	4136.00	384.23	107.09	105.50	Top of Stone Elevation
26.5	673	0.0	0.0	0.0	0.0	344.7	9.8	344.667	9.8	12334.64	349.28	4136.00	384.23	107.01	105.47	
25.5	648	0.0	0.0	0.0	0.0	344.7	9.8	344.667	9.8	11989.98	339.52	4136.00	384.23	106.93	105.45	
24.5	622	0.0	0.0	0.0	0.0	344.7	9.8	344.667	9.8	11645.31	329.76	4136.00	384.23	106.84	105.42	
23.5	597	0.0	0.0	0.0	0.0	344.7	9.8	344.667	9.8	11300.64	320.00	4136.00	384.23	106.76	105.40	
22.5	572	0.0	0.0	0.0	0.0	344.7	9.8	344.667	9.8	10955.98	310.24	4136.00	384.23	106.68	105.37	
21.5	546	0.3	0.0	0.0	0.0	172.2	4.9	172.503	4.9	10611.31	300.48	2070.04	192.31	106.59	105.35	Top of Chamber Elevation
21.0	533	68.0	1.9	0.0	0.0	317.5	9.0	385.476	10.9	10438.81	295.59	4625.72	429.73	106.55	105.33	
20.0	508	189.9	5.4	0.0	0.0	268.7	7.6	458.593	13.0	10053.33	284.68	5503.12	511.24	106.47	105.31	
19.0	483	311.7	8.8	0.0	0.0	220.0	6.2	531.711	15.1	9594.74	271.69	6380.53	592.75	106.38	105.28	
18.0	457	393.9	11.2	0.0	0.0	187.1	5.3	581.022	16.5	9063.03	256.64	6972.27	647.72	106.30	105.26	
17.0	432	450.6	12.8	0.0	0.0	164.4	4.7	615.041	17.4	8482.00	240.18	7380.49	685.65	106.22	105.23	
16.0	406	493.1	14.0	0.1	0.0	147.4	4.2	640.604	18.1	7866.96	222.77	7687.25	714.15	106.13	105.21	
15.0	381	521.5	14.8	0.2	0.0	136.1	3.9	657.786	18.6	7226.36	204.63	7893.43	733.30	106.05	105.18	
14.0	356	544.1	15.4	0.3	0.0	127.0	3.6	671.472	19.0	6568.57	186.00	8057.66	748.56	105.97	105.16	
13.0	330	575.3	16.3	0.4	0.0	114.5	3.2	690.209	19.5	5897.10	166.99	8282.51	769.44	105.88	105.13	
12.0	305	575.3	16.3	0.4	0.0	114.5	3.2	690.228	19.5	5206.89	147.44	8282.74	769.47	105.80	105.10	
11.0	279	575.3	16.3	0.4	0.0	114.5	3.2	690.247	19.5	4516.67	127.90	8282.97	769.49	105.72	105.08	
10.0	254	632.0	17.9	0.6	0.0	91.9	2.6	724.418	20.5	3826.42	108.35	8693.01	807.58	105.63	105.05	
9.0	229	0.0	0.0	0.0	0.0	344.7	9.8	344.667	9.8	3102.00	87.84	4136.00	384.23	105.55	105.03	Bottom of Chamber Elevation
8.0	203	0.0	0.0	0.0	0.0	344.7	9.8	344.667	9.8	2757.33	78.08	4136.00	384.23	105.47	105.00	
7.0	178	0.0	0.0	0.0	0.0	344.7	9.8	344.667	9.8	2412.67	68.32	4136.00	384.23	105.38	104.98	
6.0	152	0.0	0.0	0.0	0.0	344.7	9.8	344.667	9.8	2068.00	58.56	4136.00	384.23	105.30	104.95	
5.0	127	0.0	0.0	0.0	0.0	344.7	9.8	344.667	9.8	1723.33	48.80	4136.00	384.23	105.22	104.93	
4.0	102	0.0	0.0	0.0	0.0	344.7	9.8	344.667	9.8	1378.67	39.04	4136.00	384.23	105.13	104.90	
3.0	76	0.0	0.0	0.0	0.0	344.7	9.8	344.667	9.8	1034.00	29.28	4136.00	384.23	105.05	104.88	
2.0	51	0.0	0.0	0.0	0.0	344.7	9.8	344.667	9.8	689.33	19.52	4136.00	384.23	104.97	104.85	
1.0	25	0.0	0.0	0.0	0.0	344.7	9.8	344.667	9.8	344.67	9.76	4136.00	384.23	104.88	104.83	
0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.00	0.00	104.80	104.80	Bottom of Stone Elevation
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CULTEC Stormwater Design Calculator

Date:	October 02, 2025

Project Information:
Building A3 - Chamber

Calculations Performed By:

CONTACTOR 100HD

Contactor 100HD Chamber Specifications		
Height	**318**	mm
Width	**914**	mm
Length	**2.44**	meters
Installed Length	**2.29**	meters
Bare Chamber Volume	**0.40**	cu. meters
Installed Chamber Volume	**0.85**	cu. meters

Breakdown of Storage Provided by Contactor 100HD Stormwater System		
Stone Porosity	**40.0**	%
Within Chambers	**58.48**	cu. meters
Within Stone	**72.43**	cu. meters
Total Storage Provided	**130.9**	**cu. meters**
Total Storage Required	120.00	cu. meters

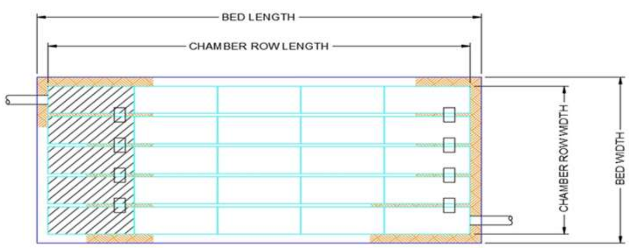
Materials List

Contactor 100HD		
Total Number of Chambers Required	**144**	**pieces**
Separator Row Chambers	**4**	pieces
Starter Chambers	**36**	pieces
End Chambers	**108**	pieces
HVLV SFCx2 Feed Connectors	**70**	pieces
CULTEC No. 410 Non-Woven Geotextile	**1038**	sq. meters
CULTEC AFAB-HPF Woven Geotextile	**88**	meters
Stone	**181**	cu. meters

Separator Row Qty Included in Total

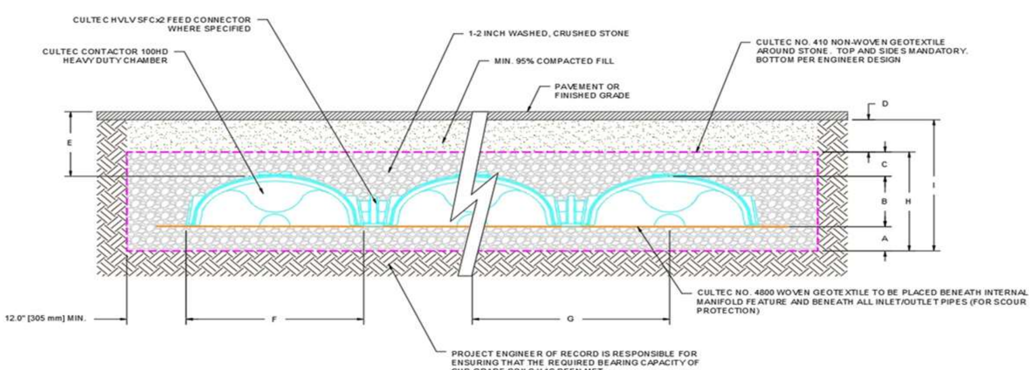
Based on 2 Internal Manifolds

Bed Detail



Bed Layout Information		
Number of Rows Wide	**36**	pieces
Number of Chambers Long	**4**	pieces
Chamber Row Width	**38.25**	meters
Chamber Row Length	**9.30**	meters
Bed Width	**38.86**	meters
Bed Length	**9.91**	meters
Bed Area Required	**384.97**	sq. meters
Length of Separator Row	**9.30**	meters

Bed detail for reference only. Not project specific. Not to scale.



Conceptual graphic only. Not job specific.

Cross Section Table Reference			
A	Depth of Stone Base	**152**	mm
B	Chamber Height	**318**	mm
C	Depth of Stone Above Units	**152**	mm
D	Depth of 95% Compacted Fill	**203**	mm
E	Max. Depth Allowed Above the Chamber	**3.66**	meters
F	Chamber Width	**914**	mm
G	Center to Center Spacing	**1.07**	meters
H	Effective Depth	**0.62**	meters
I	Bed Depth	**0.83**	meters

CULTEC Stage-Storage Calculations

CULTEC

Date:	October 2, 2025

Project Information:
Building A3 - Chamber

Project Number:
0

Chamber Model -	**Contactor 100HD**	
Number of Rows-	36	units
Total Number of Chambers -	144	units
Stone Void -	40	%
Stone Base -	152	mm
Stone Above Units -	152	mm
Area -	384.97	m2
Base of Stone Elevation -	106.20	

Contactor 100HD Incremental Storage Volumes

Height of System		Chamber Volume		HVLV Feed Connector Volume		Stone Volume		Cumulative Storage Volume		Total Cumulative Storage Volume		Stage / Area		Elevation		
in	mm	ft³	m³	ft3	m3	ft³	m³	ft³	m³	ft³	m³	ft²	m²	ft	m	
24.5	622	0.0	0.0	0.0	0.0	138.1	3.9	138.125	3.9	4630.20	131.11	1657.50	153.98	108.24	106.82	Top of Stone Elevation
23.5	597	0.0	0.0	0.0	0.0	138.1	3.9	138.125	3.9	4492.08	127.20	1657.50	153.98	108.16	106.80	
22.5	572	0.0	0.0	0.0	0.0	138.1	3.9	138.125	3.9	4353.95	123.29	1657.50	153.98	108.08	106.77	
21.5	546	0.0	0.0	0.0	0.0	138.1	3.9	138.125	3.9	4215.83	119.38	1657.50	153.98	107.99	106.75	
20.5	521	0.0	0.0	0.0	0.0	138.1	3.9	138.125	3.9	4077.70	115.47	1657.50	153.98	107.91	106.72	
19.5	495	0.0	0.0	0.0	0.0	138.1	3.9	138.125	3.9	3939.58	111.56	1657.50	153.98	107.83	106.70	
18.5	470	0.1	0.0	0.0	0.0	69.0	2.0	69.128	2.0	3801.45	107.64	829.54	77.06	107.74	106.67	Top of Chamber Elevation
18.0	457	26.4	0.7	0.0	0.0	127.6	3.6	153.936	4.4	3732.32	105.69	1847.23	171.61	107.70	106.66	
17.0	432	73.6	2.1	0.0	0.0	108.7	3.1	182.265	5.2	3578.39	101.33	2187.18	203.19	107.62	106.63	
16.0	406	120.8	3.4	0.0	0.0	89.8	2.5	210.593	6.0	3396.12	96.17	2527.12	234.77	107.53	106.61	
15.0	381	152.6	4.3	0.0	0.0	77.1	2.2	229.698	6.5	3185.53	90.20	2756.38	256.07	107.45	106.58	
14.0	356	174.6	4.9	0.0	0.0	68.3	1.9	242.906	6.9	2955.83	83.70	2914.87	270.79	107.37	106.56	
13.0	330	191.1	5.4	0.2	0.0	61.7	1.7	252.954	7.2	2712.92	76.82	3035.44	281.99	107.28	106.53	
12.0	305	202.0	5.7	0.7	0.0	57.3	1.6	260.061	7.4	2459.97	69.66	3120.74	289.92	107.20	106.50	
11.0	279	210.8	6.0	1.0	0.0	53.8	1.5	265.571	7.5	2199.91	62.29	3186.86	296.06	107.12	106.48	
10.0	254	222.9	6.3	1.1	0.0	49.0	1.4	272.915	7.7	1934.34	54.77	3274.97	304.25	107.03	106.45	
9.0	229	222.9	6.3	1.1	0.0	49.0	1.4	272.971	7.7	1661.42	47.05	3275.65	304.31	106.95	106.43	
8.0	203	222.9	6.3	1.2	0.0	49.0	1.4	273.027	7.7	1388.45	39.32	3276.32	304.37	106.87	106.40	
7.0	178	244.9	6.9	1.6	0.0	40.2	1.1	286.676	8.1	1115.43	31.59	3440.11	319.59	106.78	106.38	
6.0	152	0.0	0.0	0.0	0.0	138.1	3.9	138.125	3.9	828.75	23.47	1657.50	153.98	106.70	106.35	Bottom of Chamber Elevation
5.0	127	0.0	0.0	0.0	0.0	138.1	3.9	138.125	3.9	690.63	19.56	1657.50	153.98	106.62	106.33	
4.0	102	0.0	0.0	0.0	0.0	138.1	3.9	138.125	3.9	552.50	15.65	1657.50	153.98	106.53	106.30	
3.0	76	0.0	0.0	0.0	0.0	138.1	3.9	138.125	3.9	414.38	11.73	1657.50	153.98	106.45	106.28	
2.0	51	0.0	0.0	0.0	0.0	138.1	3.9	138.125	3.9	276.25	7.82	1657.50	153.98	106.37	106.25	
1.0	25	0.0	0.0	0.0	0.0	138.1	3.9	138.125	3.9	138.13	3.91	1657.50	153.98	106.28	106.23	
0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.00	0.00	106.20	106.20	Bottom of Stone Elevation
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Phone: 203-775-4416
www.cultec.com
tech@cultec.com

Project Name: O'KEEFE COURT
Project #: 21684
Date: 3/4/2025

Prepared by: TG
Checked by: TF,LP

LOCATION: OTTAWA
STORM SEWER DESIGN SHEET
STORM EVENT (yr) 5

a = 998.071
b = 6.053
c = 0.814

$i = a[(T+b)/60]^{-c}$, where i (mm/h) ; T (min)
Q = A(i)C/3600 + C. FLOW x (42), where A (m^2) ; i (mm/h)
AC = AREA x RUNOFF COEFFICIENT
C. FLOW = CONTROLLED FLOW

STREET		UPSTREAM STRUCTURE	DOWNSTREAM STRUCTURE	AREA (m^2) C=0.90	AC (m^2)	CUMULATIVE AC (m^2)	ToC (min)	C. FLOW @42L/s/ha (m^2)	CUMULATIVE C. FLOW (m^2)	i (mm/h)	Q (L/s)	PIPE SIZE (mm)	GRADE (%)	CAPACITY (L/s)	VELOCITY (m/s)	LENGTH (m)	% CAPACITY
	0	STUB - BLDG A3-1	INFIL GALLERY 1	0	0	0	10.00	4000	4000	104.19	16.8	250	1.00	59.5	1.2	5.0	28%
	1	STUB - BLDG A3-2	INFIL GALLERY 1	0	0	0	10.00	4000	4000	104.19	16.8	250	1.00	59.5	1.2	5.1	28%
	2	INFIL GALLERY 1	STM CBMH8	0	0	0	10.07		8000	103.83	33.6	250	1.00	59.5	1.2	42.5	57%
	3	STM CB10	STM CBMH8	4900	4410	4410	10.00		0	104.19	127.6	525	0.30	235.6	1.1	31.0	54%
	4	STM CBMH8	STM CBMH7	1700	1530	5940	10.65		8000	100.86	200.0	600	0.30	336.3	1.2	30.1	59%
	5	STM CBMH7	STM CBMH6	1800	1620	7560	11.08		8000	98.83	241.2	600	0.30	336.3	1.2	29.9	72%
	6	STM CBMH6	STM MH12	1600	1440	9000	11.50		8000	96.91	275.9	600	0.30	336.3	1.2	13.9	82%
	7	STM CB8	STM MH16	2500	2250	2250	10.00		0	104.19	65.1	375	0.70	146.7	1.3	14.9	44%
	8	STM MH16	STM MH15	0	0	2250	10.19		0	103.21	64.5	375	0.70	146.7	1.3	45.6	44%
	9	STM CB7	STM MH15	1600	1440	1440	10.00		0	104.19	41.7	250	1.10	62.4	1.3	3.4	67%
	10	STM MH15	STM MH14	0	0	3690	10.76		0	100.35	102.9	375	0.70	146.7	1.3	27.4	70%
	11	STM CB6	STM MH14	2100	1890	1890	10.00		0	104.19	54.7	300	0.80	86.5	1.2	35.2	63%
	12	STM MH14	STM CBMH12	0	0	5580	11.10		0	98.71	153.0	450	0.70	238.5	1.5	53.4	64%
	13	STM CBMH12	STM MH12	1000	900	6480	11.70		0	96.02	172.8	525	0.46	291.7	1.3	92.7	59%
	14	STM MH12	STM CBMH9	0	0	15480	12.84		8000	91.25	426.0	750	0.30	609.8	1.4	29.6	70%
	15	STM CBMH9	STM CBMH5	3400	3060	18540	13.20		8000	89.87	496.4	750	0.30	609.8	1.4	46.4	81%
	16	STUB - BLDG A2-1	INFIL GALLERY 2	0	0	0	10.00	4500	4500	104.19	18.9	250	1.00	59.5	1.2	7.7	32%
	17	STUB - BLDG A2-2	INFIL GALLERY 2	0	0	0	10.00	3600	3600	104.19	15.1	250	1.00	59.5	1.2	7.8	25%
	18	INFIL GALLERY 2	STM MH20	0	0	0	10.11		8100	103.63	34.0	250	1.00	59.5	1.2	10.9	57%
	19	STM MH20	STM CBMH5	0	0	0	10.26		8100	102.85	34.0	250	0.96	58.3	1.2	35.6	58%
	20	STM CBMH5	STM CBMH4	2700	2430	20970	13.76		16100	87.79	579.0	825	0.30	786.2	1.5	35.2	74%
	21	STM CBMH4	STM CBMH3	1300	1170	22140	14.16		16100	86.38	598.8	825	0.30	786.2	1.5	11.7	76%
	22	STM CB5	STM MH10	1800	1620	1620	10.00		0	104.19	46.9	250	2.00	84.1	1.7	6.2	56%
	23	STM MH10	STM MH6	0	0	1620	10.06		0	103.88	46.7	250	2.00	84.1	1.7	37.1	56%
	24	STM HONEYCOMB CB1	STM MH9	800	720	720	10.00		0	104.19	20.8	250	0.40	37.6	0.8	15.9	55%
	25	STM MH9	STM MH8	0	0	720	10.35		0	102.40	20.5	250	0.40	37.6	0.8	31.9	54%
	26	STM CB3	STM MH8	2100	1890	1890	10.00		0	104.19	54.7	300	1.00	96.7	1.4	5.5	57%
	27	STM MH8	STM MH7	0	0	2610	11.04		0	99.00	71.8	375	0.40	110.9	1.0	49.1	65%
	27.5	STM CB4	STM MH7	1900	1710	1710	10.00		0	104.19	49.5	300	1.00	96.7	1.4	5.1	51%
	28	STM MH7	STM MH6	0	0	4320	11.85		0	95.32	114.4	450	0.40	180.3	1.1	32.4	63%
	29	STM MH6	STM CBMH11	0	0	5940	12.33		0	93.31	154.0	525	0.30	235.6	1.1	44.3	65%
	30	STM CBMH11	STM CBMH3	700	630	6570	13.01		0	90.59	165.3	525	0.30	235.6	1.1	89.0	70%
	31	STM CBMH3	STM CBMH10	0	0	28710	14.37		16100	85.64	750.6	900	0.30	991.6	1.6	25.6	76%
	32	STM CBMH10	STM MH19	3100	2790	31500	14.65		16100	84.72	808.9	900	0.30	991.6	1.6	37.6	82%
	33	STM HONEYCOMB CB2	STM CBMH2	2000	1800	1800	10.00		0	104.19	52.1	375	0.30	96.0	0.9	32.7	54%
	34	STM CBMH2	STM MH19	0	0	1800	10.63		0	100.99	50.5	375	0.30	96.0	0.9	6.3	53%
	35	STM MH19	OGS EF12	1200	1080	34380	15.05		16100	83.40	864.1	900	0.30	991.6	1.6	15.9	87%
	36	STUB - BLDG A1-1	INFIL GALLERY 3	0	0	0	10.00	4400	4400	104.19	18.5	250	1.03	60.4	1.2	3.3	31%
	37	STUB - BLDG A1-2	INFIL GALLERY 3	0	0	0	10.00	3400	3400	104.19	14.3	250	1.00	59.5	1.2	3.3	24%
	38	INFIL GALLERY 3	STM MH2	0	0	0	10.05		7800	103.96	32.8	250	0.83	54.2	1.1	18.7	60%
	39	STM MH2	OGS EF12	0	0	0	10.33		7800	102.50	32.8	250	1.98	83.7	1.7	6.7	39%
	40	OGS EF12	CULTEC	0	0	34380	15.22		23900	82.86	891.7	900	1.00	1810.3	2.8	3.2	49%
	41	CULTEC	HW1 (OPSD 804.030)	0	0	34380	15.24		23900	82.80	891.1	900	0.55	1342.6	2.1	7.5	66%

Inlet Capcity Analysis

Project Name: O'Keefe Court
Project Number: 21684
Location: Nepean, Ottawa
Date: 3/4/2025

Prepared By: T.G
Checked By: T.F

Rainfall Data		
Location:	Nepean, Ottawa	
Event	5 year	100 year
a	998.071	1735.688
b	6.053	6.014
c	0.814	0.820

Drain ID	Structure Name	Overland Outlet	Drain Catchment Area (m^2)	Runoff Coefficient	Tc (min)	Intensity (mm/hr)	Flow (m^3/s)	Drain Type	Depth of Ponding (m)	Inlet Capacity (m^3/s)	Inlet Capacity with 50% Blockage (m^3/s)	OK with 50% Blockage?
1	STM CB8	West	2500	0.90	10.00	104.2	0.065	Single CB	0.30	0.220	0.110	OK
2	STM CB10	East	4900	0.90	10.00	104.2	0.128	Twin CB	0.30	0.405	0.203	OK
3	STM CBMH8	East	1700	0.90	10.00	104.2	0.044	Single CB	0.20	0.155	0.078	OK
4	STM CBMH7	East	1800	0.90	10.00	104.2	0.047	Single CB	0.20	0.155	0.078	OK
5	STM CB7	West	1600	0.90	10.00	104.2	0.042	Single CB	0.20	0.155	0.078	OK
6	STM CBMH9	East	3400	0.90	10.00	104.2	0.089	Single CB	0.30	0.220	0.110	OK
7	STM CBMH5	East	2700	0.90	10.00	104.2	0.070	Single CB	0.25	0.180	0.090	OK
8	STM CBMH4	East	1300	0.90	10.00	104.2	0.034	Single CB	0.15	0.120	0.060	OK
9	STM CBMH10	East	3100	0.90	10.00	104.2	0.081	Single CB	0.25	0.180	0.090	OK
10	STM CBMH2	East	2000	0.90	10.00	104.2	0.052	Single CB	0.20	0.155	0.078	OK
11	**STM HONEYCOMB CB2**	**East - Final Catchment***	**1200**	**0.90**	**10.00**	**178.6**	**0.504**	**Twin Honeycomb CB**	**0.20**	**1.202**	**0.601**	OK
12	STM CBMH11	East	700	0.90	10.00	104.2	0.018	Single CB	0.10	0.060	0.030	OK
13	**STM HONEYCOMB CB1**	**West - Final Catchment***	**800**	**0.90**	**10.00**	**178.6**	**0.259**	**Honeycomb CB**	**0.25**	**0.672**	**0.336**	OK
14	STM CB3	West	2100	0.90	10.00	104.2	0.055	Single CB	0.30	0.220	0.110	OK
15	STM CB4	West	1900	0.90	10.00	104.2	0.050	Single CB	0.30	0.220	0.110	OK
16	STM CB5	West	1800	0.90	10.00	104.2	0.047	Single CB	0.30	0.220	0.110	OK
17	STM CB6	West	2100	0.90	10.00	104.2	0.055	Single CB	0.30	0.220	0.110	OK
18	STM CBMH6	East	1600	0.90	10.00	104.2	0.042	Single CB	0.30	0.220	0.110	OK
19	STM CBMH12	East	1000	0.90	10.00	104.2	0.026	Single CB	0.12	0.085	0.043	OK

Overland Flow Route Design (East Outlet)

Return Period	ToC (min)	i (mm/hr)	Runoff Coefficient	Area (m2)	Flow (m3/s)
5-year	10	104.19	0.9	24200	0.631
100-year	10	178.56			1.081
				Flow Difference (m3/s) =	**0.450**

<- Flow added to 100-yr Flow of Drain #11

*Flow calculated for the final catchments in each overland outlet is based on the 100-year storm flow for that catchment plus the flow difference (100-year minus 5-year) for all upstream catchments

Overland Flow Route Design (West Outlet)

Return Period	ToC (min)	i (mm/hr)	Runoff Coefficient	Area (m2)	Flow (m3/s)
5-year	10	104.19	0.9	12000	0.313
100-year	10	178.56			0.536
				Flow Difference (m3/s) =	**0.223**

<- Flow added to 100-yr Flow of Drain #13

APPENDIX B

SANITARY CALCULATIONS

KWA	Project Name : **4497 O'Keefe Court, Ottawa** Project # : **21684** ***Sanitary Servicing Analysis***	Prepared by: TF Checked by: TF Date: February 20, 2025

Standards = Ottawa

Formulas

Peaking Factor (Harmon) = $1+14/[4+(P/1000)^{1/2}]$

Peak Flow = p(q)M(unit conversion) + infiltration

Existing Sanitary Design Flow

Land Type	Area (m^2)	# of Units /Floor Area	Density	Population (p)	Average Flow (q)	Peaking Factor (M)	Peak Flow (Q) (L/s)
Infiltration Allowance	68836				0.33 L/ha/d		2.27
Total	**68836**						**2.27**

Proposed Sanitary Design Flow

Land Type	Area (m^2)	Floor Area (Ha)	Density	Population (p)	Average Flow (q)	Peaking Factor (M)	Peak Flow (Q) (L/s)
Infiltration Allowance	68836				0.33 L/ha/d		2.27
BUILDING A1	7804	0.7804			35000 L/day/ha of floor	1.00	0.32
BUILDING A2	8027	0.8027			35000 L/day/ha of floor	1.00	0.33
BUILDING A3	8027	0.8027			35000 L/day/ha of floor	1.00	0.33
Total	**68836**						**3.24**

Summary

Existing Sanitary Design Flow =	2.27 L/s
Proposed Sanitary Design Flow =	3.24 L/s
Increased Flow =	0.97 L/s

Service Connection	Diameter (m)	Slope (%)	Velocity (m/s)	Full Flow Capacity (L/s)	Spare Capacity (L/s)	Usage Increased (%)	Total Usage (%)
Residential	150	1.0	0.86	15.23	11.99	-	21.3%
San. Main	250	0.5	0.86	42.05	38.81	2.3%	7.7%

Notes

1. The proposed development would be an increase of 0.97 L/s of peak sanitary flow to the downstream sanitary sewer system.
2. This increase is equal to 2.3% of the total pipe capacity of the 250mm municipal sanitary sewer.
3. This flow is equal to 21.3% of the total pipe capacity of a 150mm diameter service connection.

APPENDIX C

WATER CALCULATIONS

4497 O'Keefe Court, Ottawa Prepared by: **LP**

Project Number 21684 Checked by: **TF**

Required Fire Flow - BLDG A3 Date: **September 22, 2025**

as per Fire Underwriters Survey Water Supply for Public Fire Protection, 2020

1. Initial Required Fire Flow (Step A, B, C)

Construction Type = Type II Noncombustible Construction

Construction Coefficient, C = 0.8

Total Effective Area, A* = 8027 m^2 *largest/furthest building*

Required Fire Flow, RFF = 15768.46 LPM

RFF, rounded = 16000 LPM

2. Occupancy and Contents Adjustment Factor (Step D)

Contents = Combustible contents

Adjustment Factor = 0%

RFF = 16000 LPM

3. Automatic Sprinkler Protection (Step E)

Sprinkler Design	Designed	Building Coverage	Credit
Automatic sprinkler protection designed and installed in accordance with NFPA 13	Yes	100%	30%
Water supply is standard for both the system and Fire Department hose lines	Yes	100%	10%
Fully supervised system	Yes	100%	10%
	Total Sprinkler Credit =		50%

Reduction = 8000 LPM

4. Exposure Adjustment Charge (Step F)

Direction	Distance	Charge
North	Greater than 30	0%
South	10.1m to 20m	15%
East	Greater than 30	0%
West	Greater than 30	0%

Total Charge = 15%

Charge = 2400 LPM

5. Final Required Fire Flow (Step G)

RFF = 16000 LPM

Reduction = 8000 LPM

Charge = 2400 LPM

RFF = 10400 LPM

Final RFF, rounded = 10000 LPM

2642 GPM

167 L/s

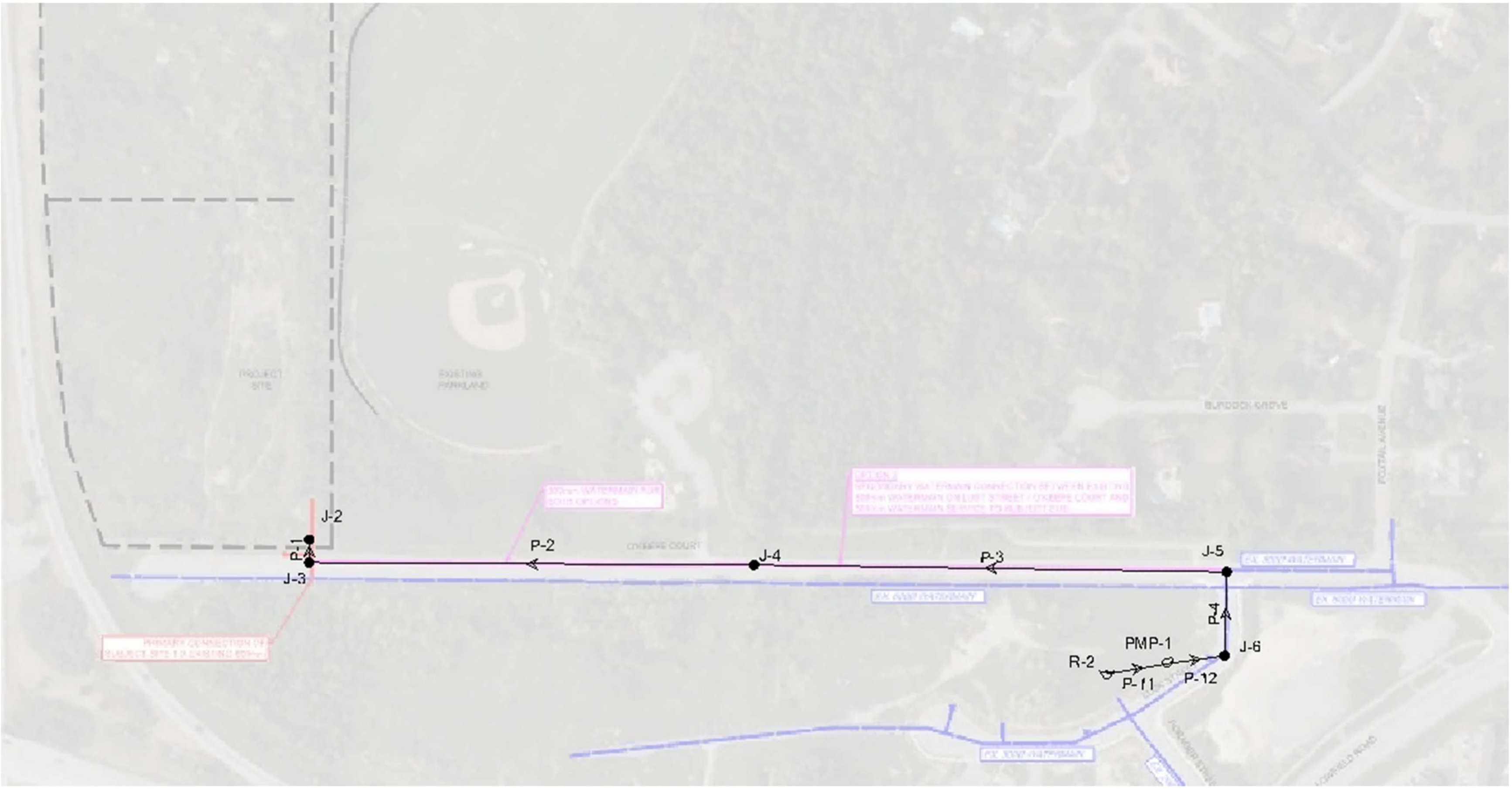
as per CITY OF OTTAWA DESIGN GUIDELINES

TOTAL BUILDING AREA =	2.39	ha
FLOW =	35000	L/ha/day
Average Daily Demand =	83503	L/day
	0.97	L/s

	Average Day	Maximum Day	Peak Hour*	
Peaking Factor	n/a	1.50	1.80	
Demand	**0.97**	**1.45**	**2.61**	**L/s**
	15.32	22.98	41.36	GPM

*Peak Hour Factor applies to the maximum day demand as per Technical Bulletin ISTB 2010-02

Model Setup – Node & Pipe ID's



Hydrant Testing Ontario

Tel: 289-354-1942
Info@HTOntario.ca

REPORT
N°. 2692

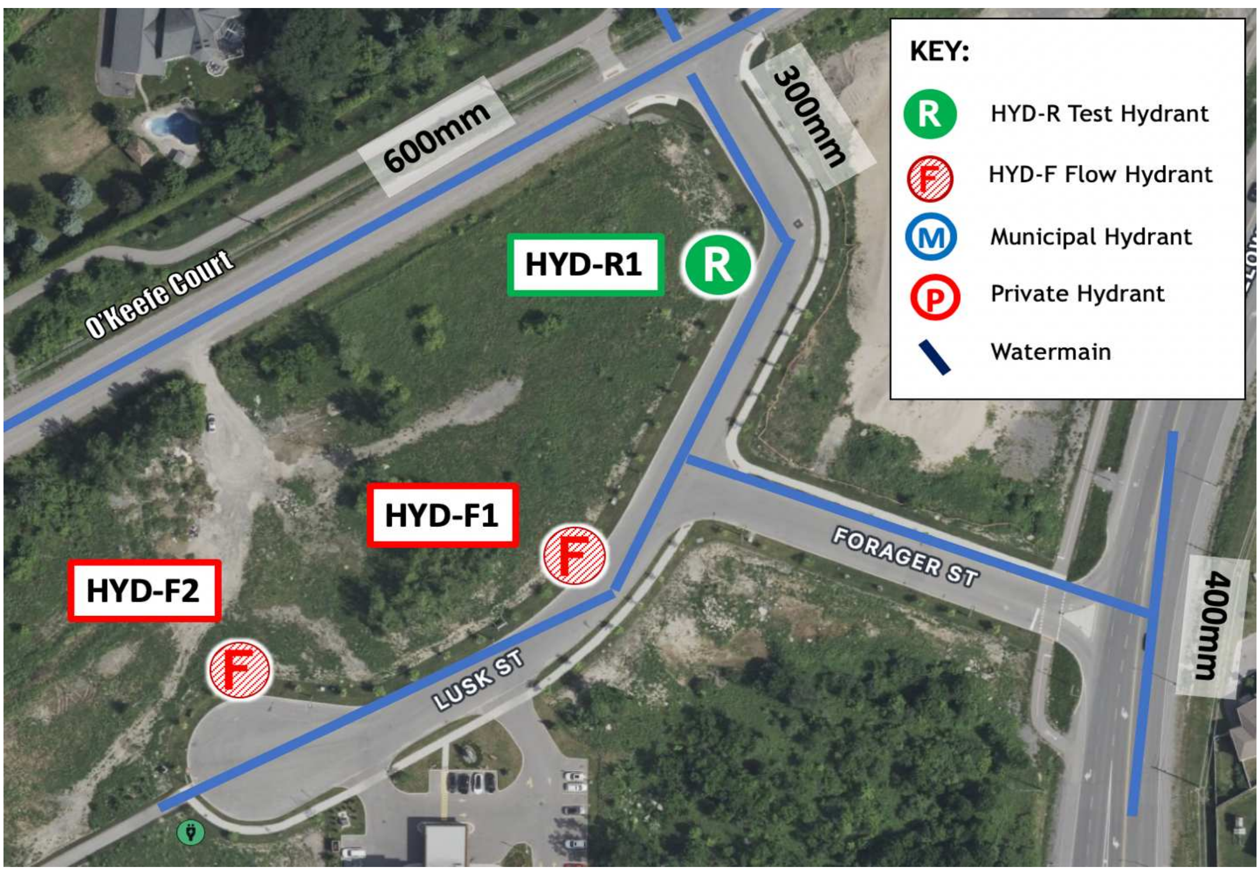
September 18, 2025

To: Ted Fair, P. Eng.
KWA Site Development Consulting Inc.
ted.fair@kwasitedev.com
2453 Auckland Dr,
Burlington, ON L7L 7A9

RE: Hydrant Flow Test – 4497 O'Keefe Court, Ottawa

Please find the Report for the following works

Scope: Conducted Hydrant Flow Test as per NFPA291 Recommended Practices for Water Flow Testing and Marking of Hydrants.



HYDRANT FLOW TEST

OTTAWA

TEST 1

DATE: September 18, 2025 TIME: 11:00 AM

R -TEST HYDRANT LUSK ST/O'KEEFE CRT - 300mr HYDRANT No. HYD-R1

HYDRANT MODEL: AVK COLOUR: BLUE

STATIC PRESSURE psi (hr-20^0.54): **70.5** VARIANCE: 6%

Q - FLOW HYDRANT 125 LUSK ST/FORAGER ST HYDRANT No. HYD-F1

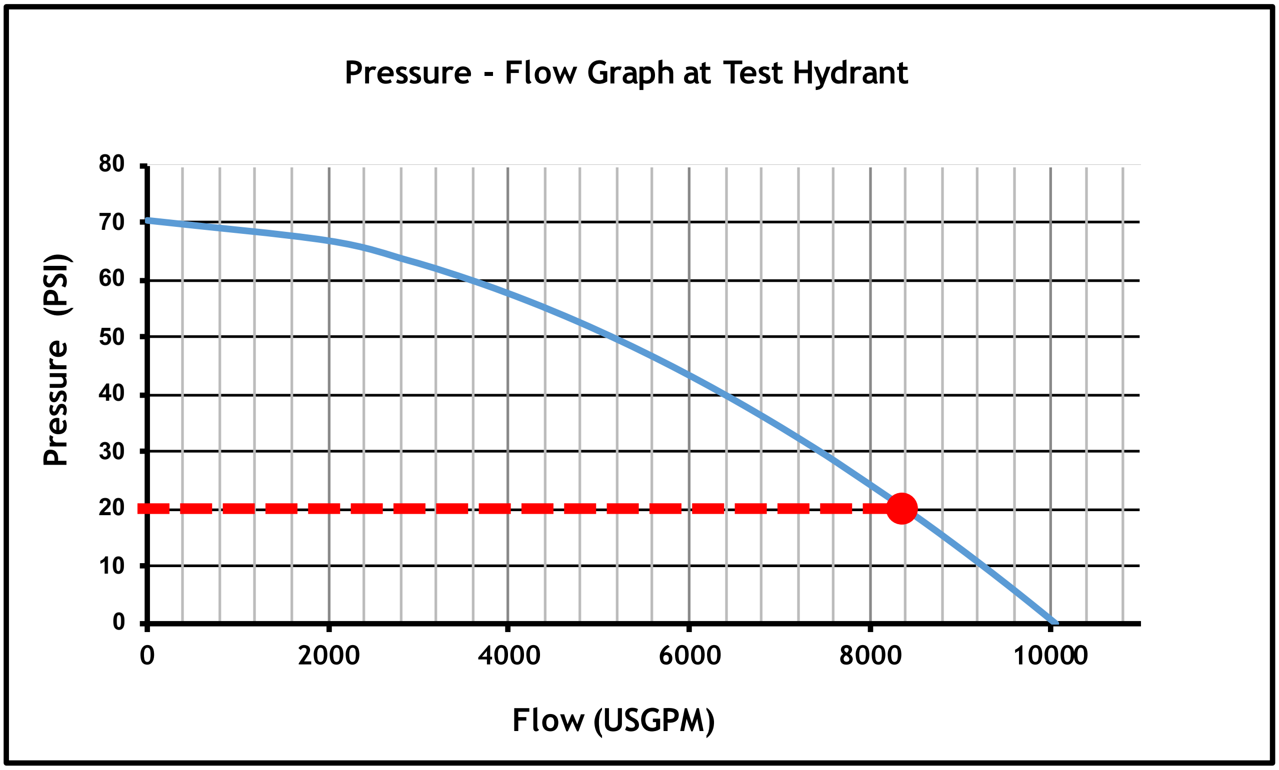
HYDRANT MODEL: AVK COLOUR: BLUE

No. Outlets	Residual Pressure (hf-R^0.54)	Orifice Dia Dia. (in.) (d^2)	Coefficient	Nozzle PSI $(\sqrt{psi})$	Q = Flow (USGPM) $Q = 29.83\ (c)\ (d2)\ (\sqrt{psi})$
1	68.5	2.5	0.9	52	1210
2	66	2.5	0.9	46	1138
			Q_F = Total Flow (USGPM)		**2276**

Q_R = flow predicted @ 20 psi — 8399 USGPM

$Q_R = Q_F * (H_r - 20^{0.54}) / (H_f - R^{0.54})$ — 530 L/s

NFPA Rating: **CLASS AA - BLUE**



HYDRANT FLOW TEST

OTTAWA

TEST 2

DATE: September 18, 2025 TIME: 11:00 AM

R -TEST HYDRANT LUSK ST/O'KEEFE CRT - 300mr HYDRANT No. HYD-R1

HYDRANT MODEL: AVK COLOUR: BLUE

STATIC PRESSURE psi (hr-20^0.54): **70.5** VARIANCE: 11%

Q - FLOW HYDRANT 125 LUSK STREET HYDRANT No. HYD-F1/2

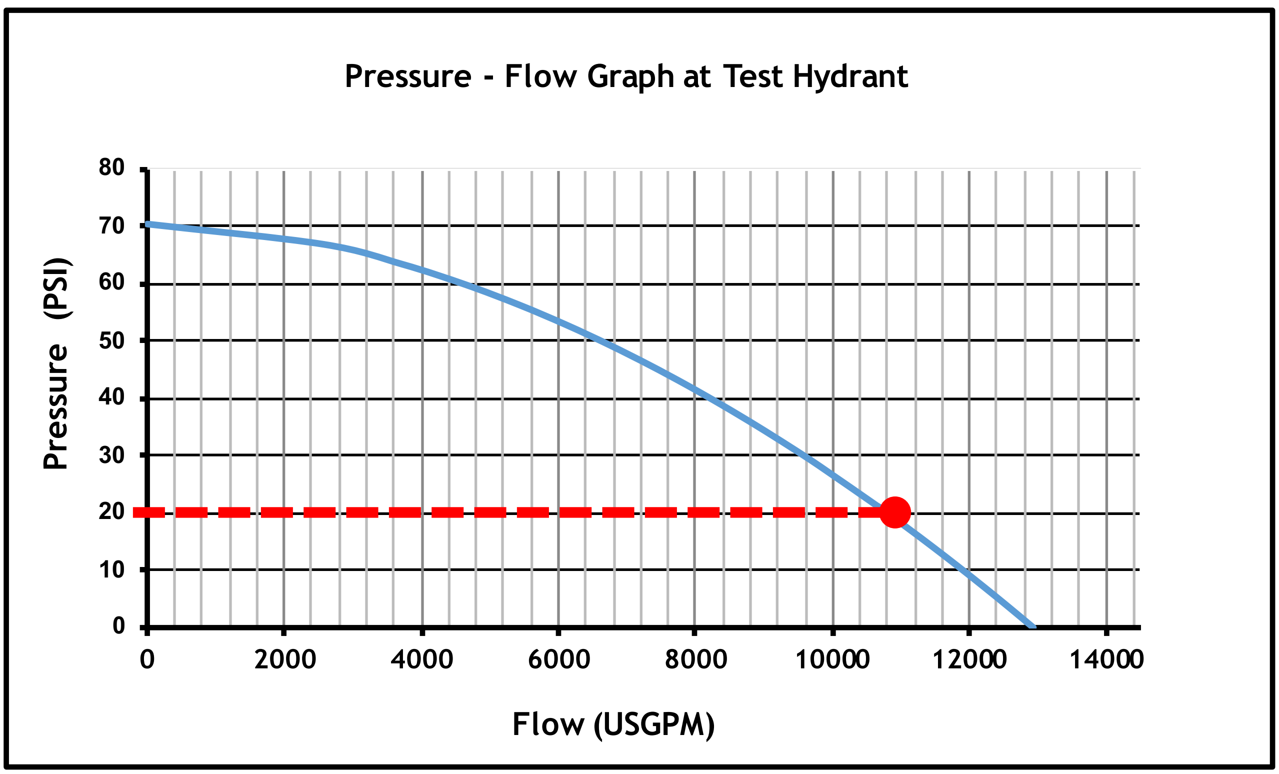
HYDRANT MODEL: AVK COLOUR: BLUE

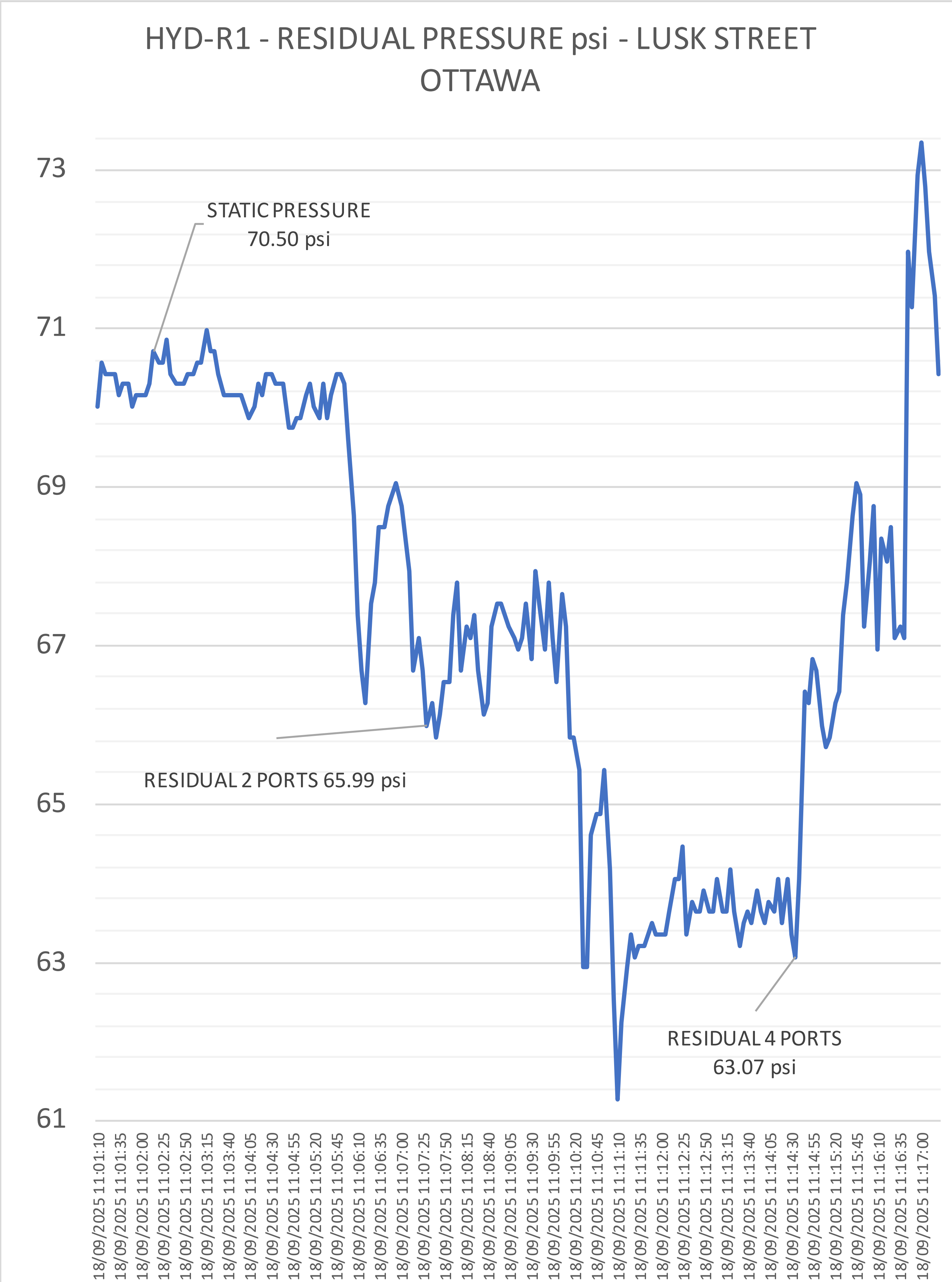
No. Outlets	Residual Pressure (hf-R^0.54)	Orifice Dia Dia. (in.) (d^2)	Coefficient	Nozzle PSI $(\sqrt{psi})$	Q = Flow (USGPM) $Q = 29.83\ (c)\ (d2)\ (\sqrt{psi})$
3	65.5	2.5	0.9	40	1061
4	63	2.5	0.9	33	964
			Q_F = Total Flow (USGPM)		**3856**

Q_R = flow predicted @ 20 psi — 10798 USGPM — 681 L/s

$Q_R = Q_F * (H_r - 20^{0.54}) / (H_f - R^{0.54})$

NFPA Rating: **CLASS AA - BLUE**




HYD-R1 - RESIDUAL PRESSURE psi - LUSK STREET
OTTAWA
STATIC PRESSURE
70.50 psi
RESIDUAL 2 PORTS 65.99 psi
RESIDUAL 4 PORTS
63.07 psi
73
71
69
67
65
63
61
18/09/2025 11:01:10
18/09/2025 11:01:35
18/09/2025 11:02:00
18/09/2025 11:02:25
18/09/2025 11:02:50
18/09/2025 11:03:15
18/09/2025 11:03:40
18/09/2025 11:04:05
18/09/2025 11:04:30
18/09/2025 11:04:55
18/09/2025 11:05:20
18/09/2025 11:05:45
18/09/2025 11:06:10
18/09/2025 11:06:35
18/09/2025 11:07:00
18/09/2025 11:07:25
18/09/2025 11:07:50
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18/09/2025 11:08:40
18/09/2025 11:09:05
18/09/2025 11:09:30
18/09/2025 11:09:55
18/09/2025 11:10:20
18/09/2025 11:10:45
18/09/2025 11:11:10
18/09/2025 11:11:35
18/09/2025 11:12:00
18/09/2025 11:12:25
18/09/2025 11:12:50
18/09/2025 11:13:15
18/09/2025 11:13:40
18/09/2025 11:14:05
18/09/2025 11:14:30
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18/09/2025 11:15:20
18/09/2025 11:15:45
18/09/2025 11:16:10
18/09/2025 11:16:35
18/09/2025 11:17:00

Test Conclusion

The system at the time of testing produced a theorectical projected flow rate of:

LOCATION	Total USGPM	USGPM at 20 psi	lps at 20 psi	Test #
LUSK STREET	3856	10798	681	2

Hydrants are classified in accordance with their rated capacities as per NFPA291.

COLOUR	CLASS	Available Flow @ 20psi
BLUE	AA	1500 GPM or more
GREEN	A	1000 – 1499 GPM
ORANGE	B	500 – 999 GPM
RED	C	Below 500 GPM

We strongly feel that all attempts have been made to ensure that the required data as stipulated was captured, stored and presented in an accurate, efficient and timely manner for the required period.

We look forward to working with you in the future.

Please feel free to contact the undersigned should you require any further information.

Best Regards

Rob Gamache E.P
Manager of Operations
Hydrant Testing Ontario
Info@HTOntario.ca

Modelling Results
O'Keefe Court

Ottawa, Ontario

Peak Hour

Node Table

Node ID	Node Description	Elevation	Demand	Head	HGL	Pressure
		m	L/s	m	m	psi
J-2	Subject site	103.56	2.61	46.92	150.48	66.7
J-3		103.4	0.00	47.07	150.47	66.9
J-4	O'Keefe & easement	101.07	0.00	49.41	150.48	70.3
J-5	Lusk & O'Keefe	102.62	0.00	47.86	150.48	68.1
J-6	Residual hydrant	101.39	0.00	49.09	150.48	69.8
				MIN	**150.47**	**66.7**
				MAX	**150.48**	**70.3**

Pipe Table

Link ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity	Headloss
			m	mm		L/s	m/s	(m)
P-1	J-2	J-3	10	300	120	2.61	0.04	0.0001
P-2	J-3	J-4	260	300	120	2.61	0.04	0.0023
P-3	J-4	J-5	300	300	120	2.61	0.04	0.0026
P-4	J-5	J-6	60	300	120	2.61	0.04	0.0005
						MAX	**0.04**	

*Elevations are approximate, based on LiDAR information

Modelling Results
O'Keefe Court
Ottawa, Ontario

Maximum Day + Fire

Node Table

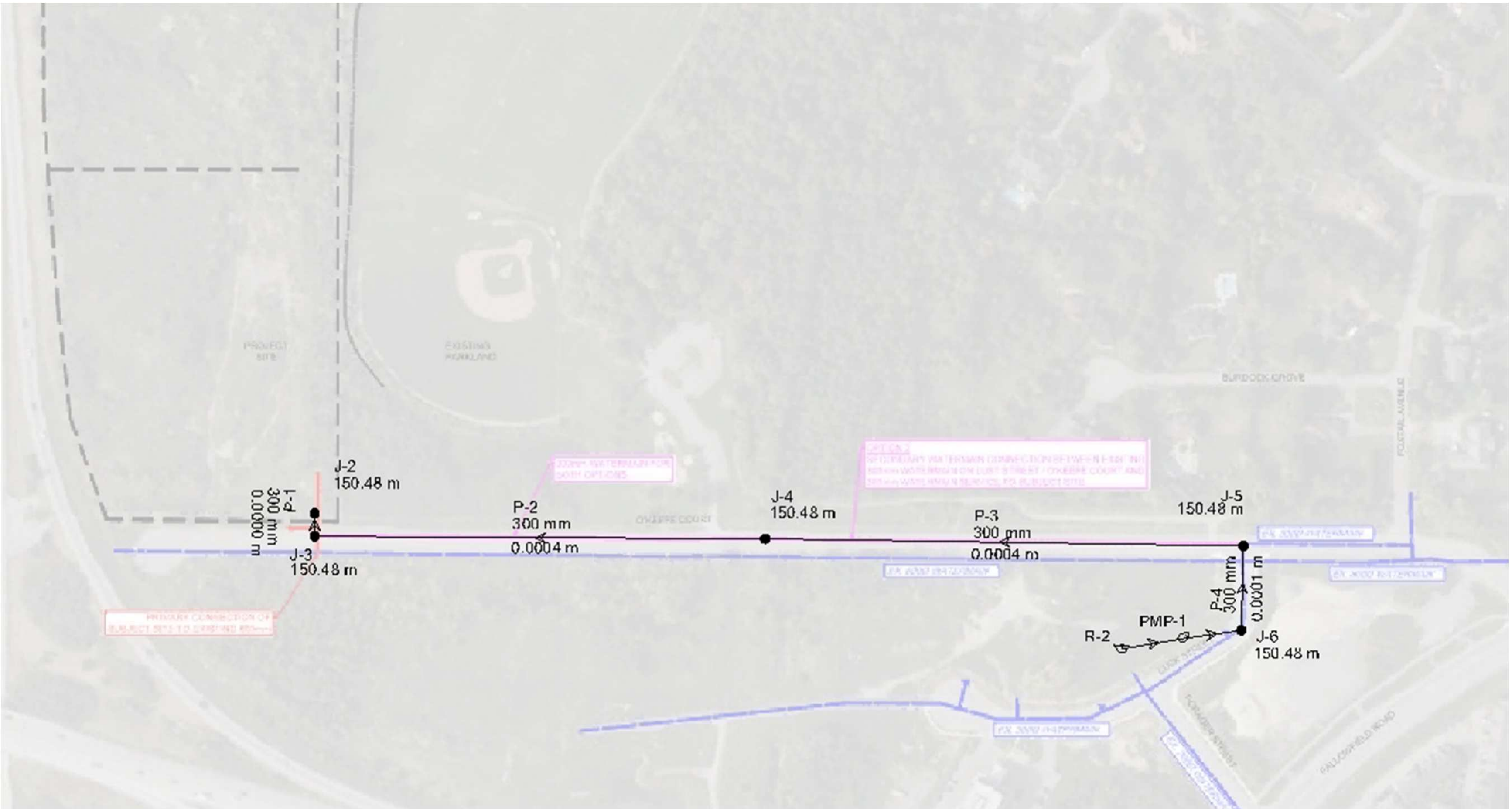
Node ID	Node Description	Elevation	Demand	Head	HGL	Pressure
		m	L/s	m	m	psi
J-2	Subject site	103.56	168.45	32.08	135.64	45.6
J-3		103.4	0.00	32.43	135.83	46.1
J-4	O'Keefe & easement	101.07	0.00	39.86	140.93	56.7
J-5	Lusk & O'Keefe	102.62	0.00	44.18	146.8	62.8
J-6	Residual hydrant	101.39	0.00	46.59	147.98	66.2
				MIN	**135.64**	**45.6**
				MAX	**147.98**	**66.2**

Pipe Table

Link ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity	Headloss
			m	mm		L/s	m/s	(m)
P-1	J-2	J-3	10	300	120	168.45	2.38	0.1958
P-2	J-3	J-4	260	300	120	168.45	2.38	5.0902
P-3	J-4	J-5	300	300	120	168.45	2.38	5.8733
P-4	J-5	J-6	60	300	120	168.45	2.38	1.1747
						MAX	**2.38**	

*Elevations are approximate, based on LiDAR information

Modeling Results (Average Day)



Legend

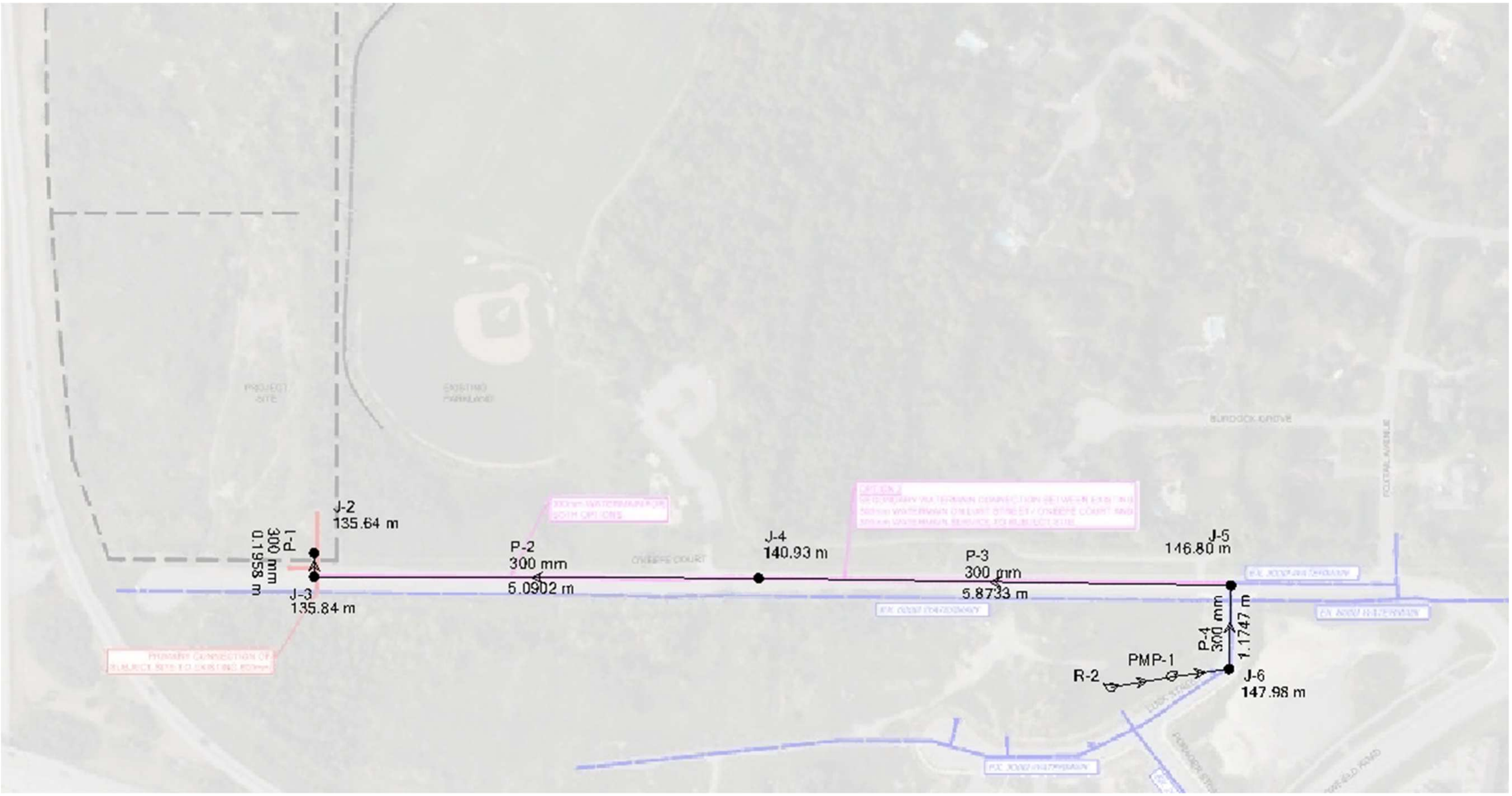
Nodes	Pipes
Junction ID HGL	Pipe ID Pipe Size Headloss

Modeling Results (Peak Hour)

Legend

Nodes	Pipes
Junction ID	Pipe ID
HGL	Pipe Size
	Headloss

Modeling Results (Max Day + Fire)



Legend

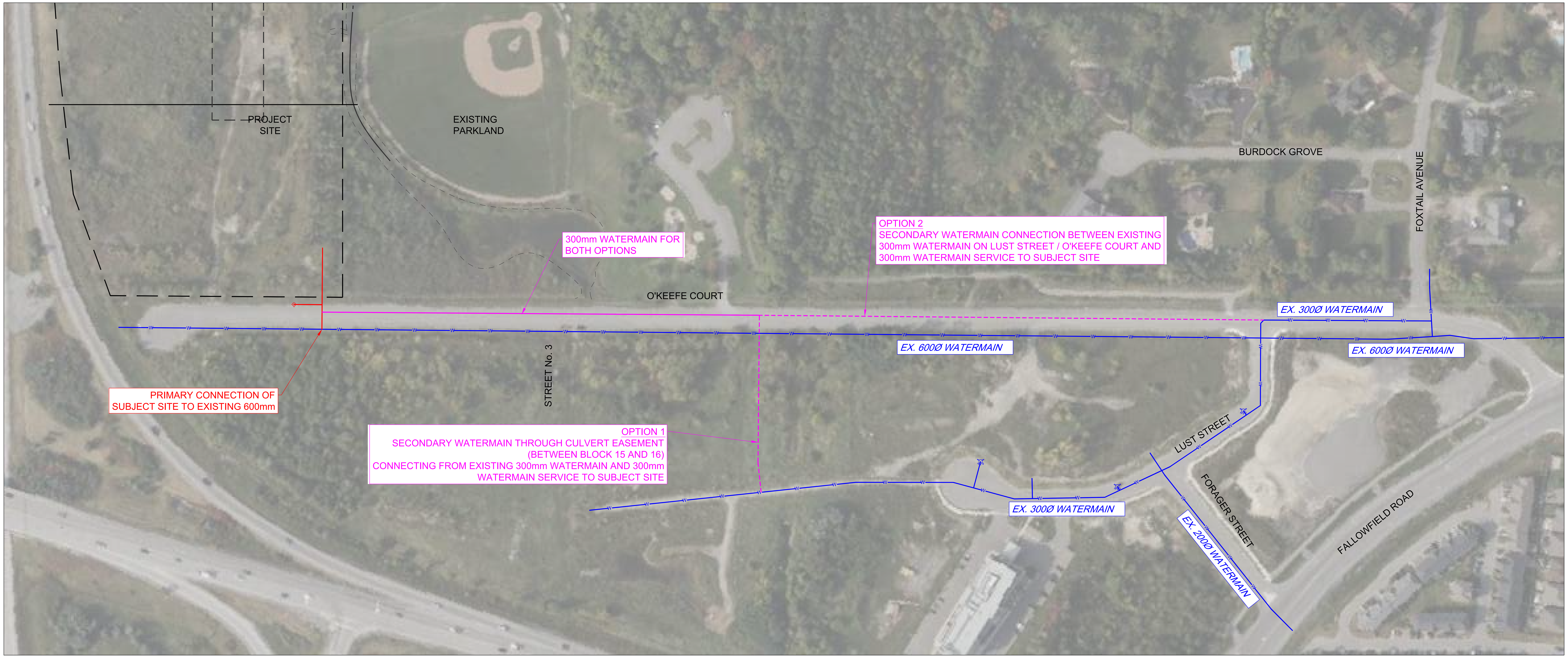
Nodes	Pipes
Junction ID	Pipe ID
HGL	Pipe Size
	Headloss

APPENDIX D

OFFSITE WORKS EXHIBITS

REVISION BLOCK

#	DATE	DESCRIPTION



LEGEND

- EXISTING WATERMAIN
- EXISTING HYDRANT
- PROPOSED WATERMAIN (KWA)
- PROPOSED HYDRANT (KWA)
- FUTURE WATERMAIN (BY OTHERS)
- FUTURE HYDRANT (BY OTHERS)

KWA SITE DEVELOPMENT CONSULTING INC.
2453 Auckland Drive
Burlington, ON L7L 7A9

NORTH ARROW

METRIC SCALE

N.T.S

WATERMAIN SERVICING EXHIBIT

THE PROPERTIES GROUP

PROPOSED OFFICE & WAREHOUSE DEVELOPMENT

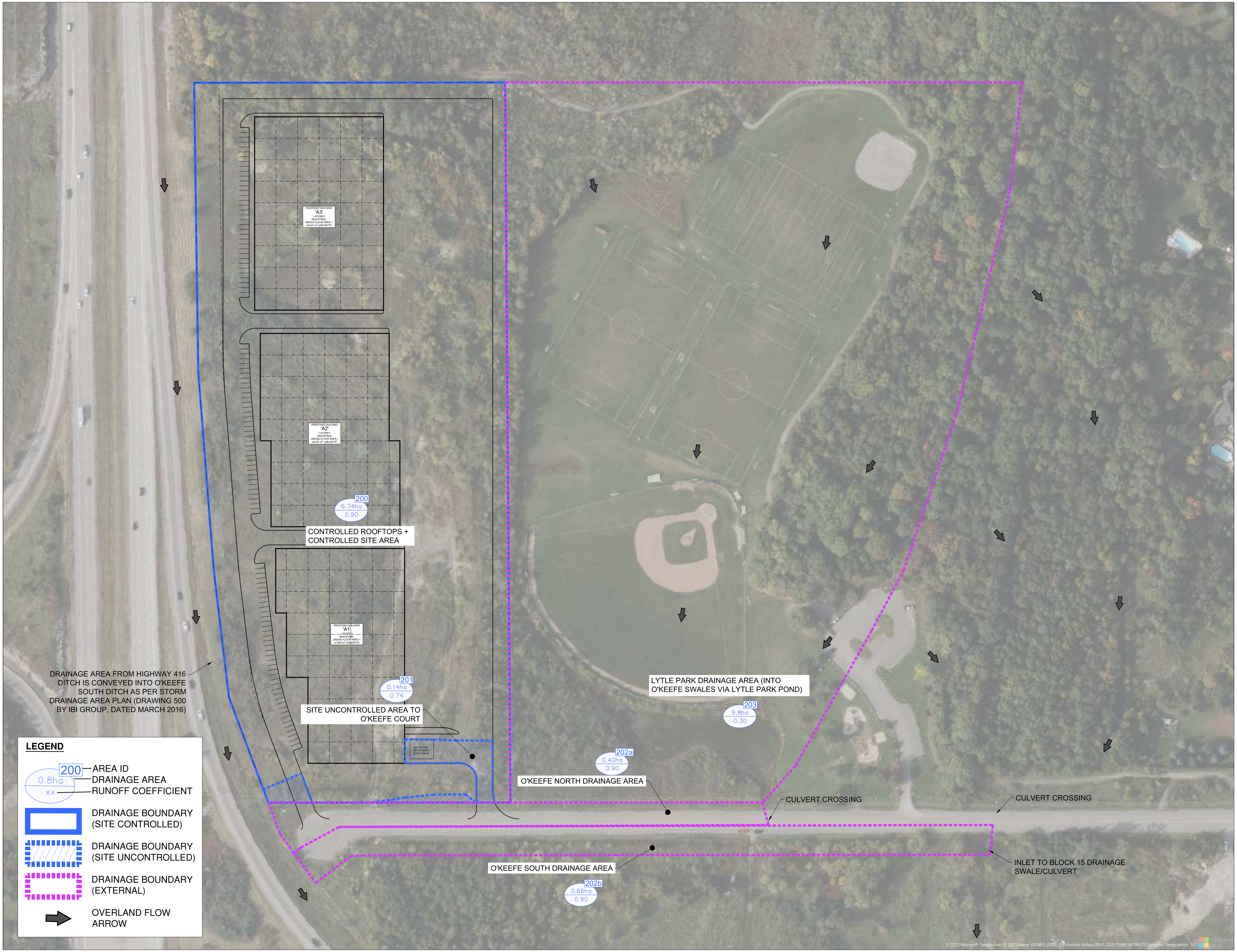
NEPEAN, ONTARIO

PROJECT No:21684

DRAWN BY:ARV

CHECKED BY:CDB

WAT-E



REVISION BLOCK

#	DATE	DESCRIPTION
1.	MM/DD/YY	DESCRIPTION

KWA SITE DEVELOPMENT CONSULTING INC.
2453 Auckland Drive
Burlington, ON L7L 7A9

NORTH ARROW

METRIC SCALE
1:750

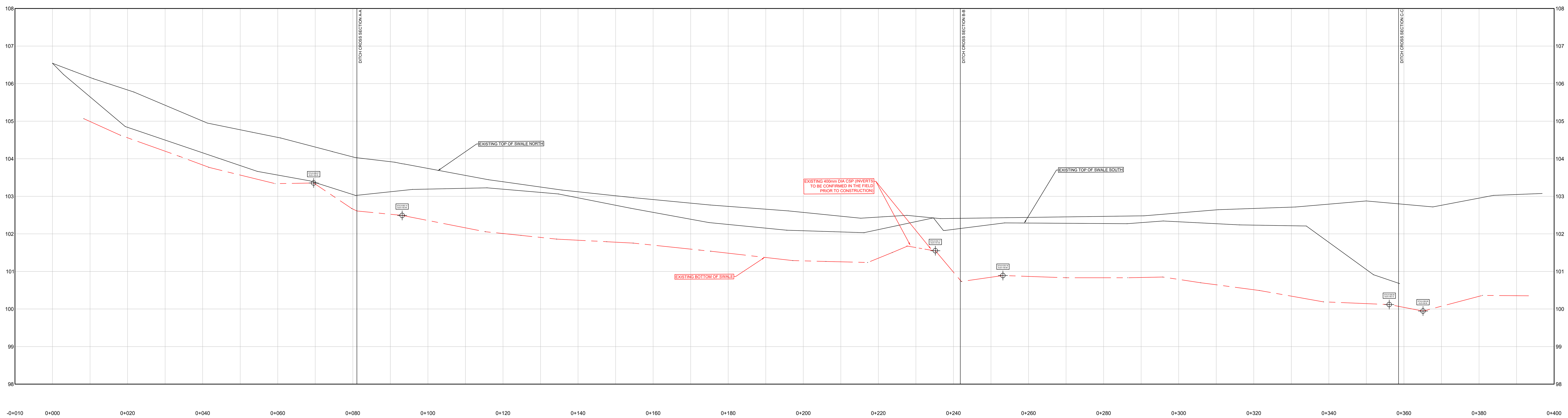
DRAINAGE PLAN (FOR SOUTH SWALE)

THE PROPERTIES GROUP
O'KEEFE COURT (NEPEAN)
NEPEAN, ONTARIO

PROJECT No:21684
DRAWN BY:LP
CHECKED BY:TF

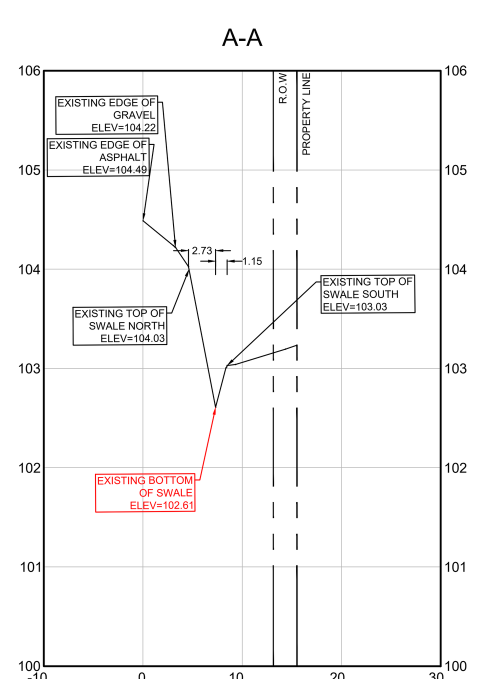
PDP-A

O'KEEFE COURT MODEL VIEW
SCALE = 1:500



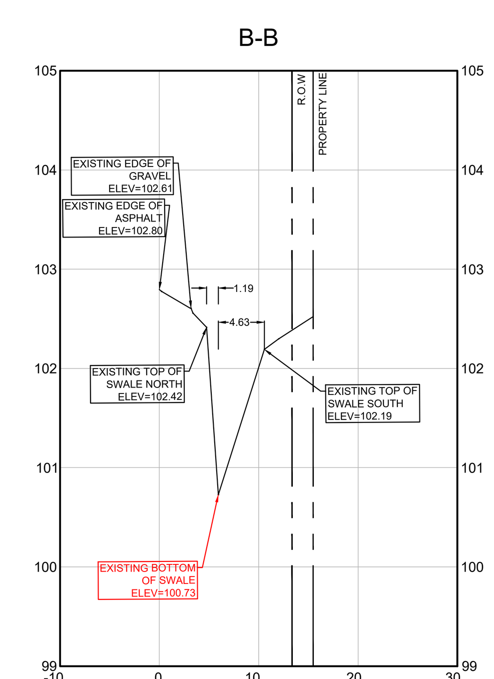
EXISTING DITCH AND TOP OF SLOPE PROFILE

HORIZONTAL SCALE = 1:500
VERTICAL SCALE = 1:50



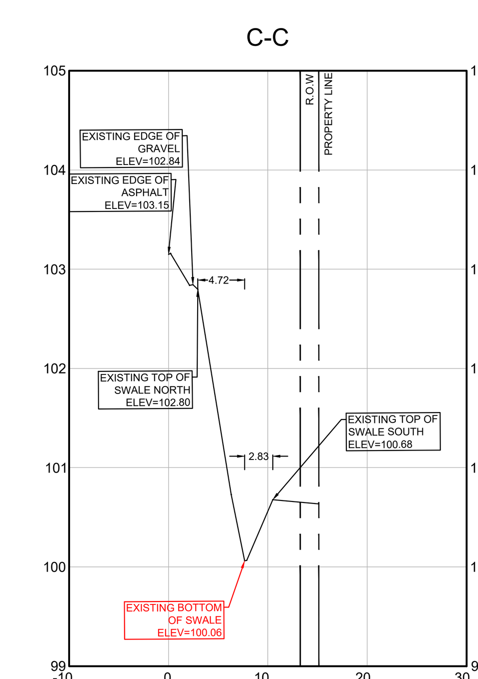
EXISTING DITCH CROSS SECTION A-A

HORIZONTAL SCALE = 1:500
VERTICAL SCALE = 1:50



EXISTING DITCH CROSS SECTION B-B

HORIZONTAL SCALE = 1:500
VERTICAL SCALE = 1:50



EXISTING DITCH CROSS SECTION C-C

HORIZONTAL SCALE = 1:500
VERTICAL SCALE = 1:50

REVISION BLOCK

#	DATE	DESCRIPTION
1.	MM/DD/YY	DESCRIPTION

KWA SITE DEVELOPMENT CONSULTING INC.
2453 Auckland Drive
Burlington, ON L7L 7A9

NORTH ARROW

METRIC SCALE
AS NOTED

EXISTING DITCH CROSS SECTION

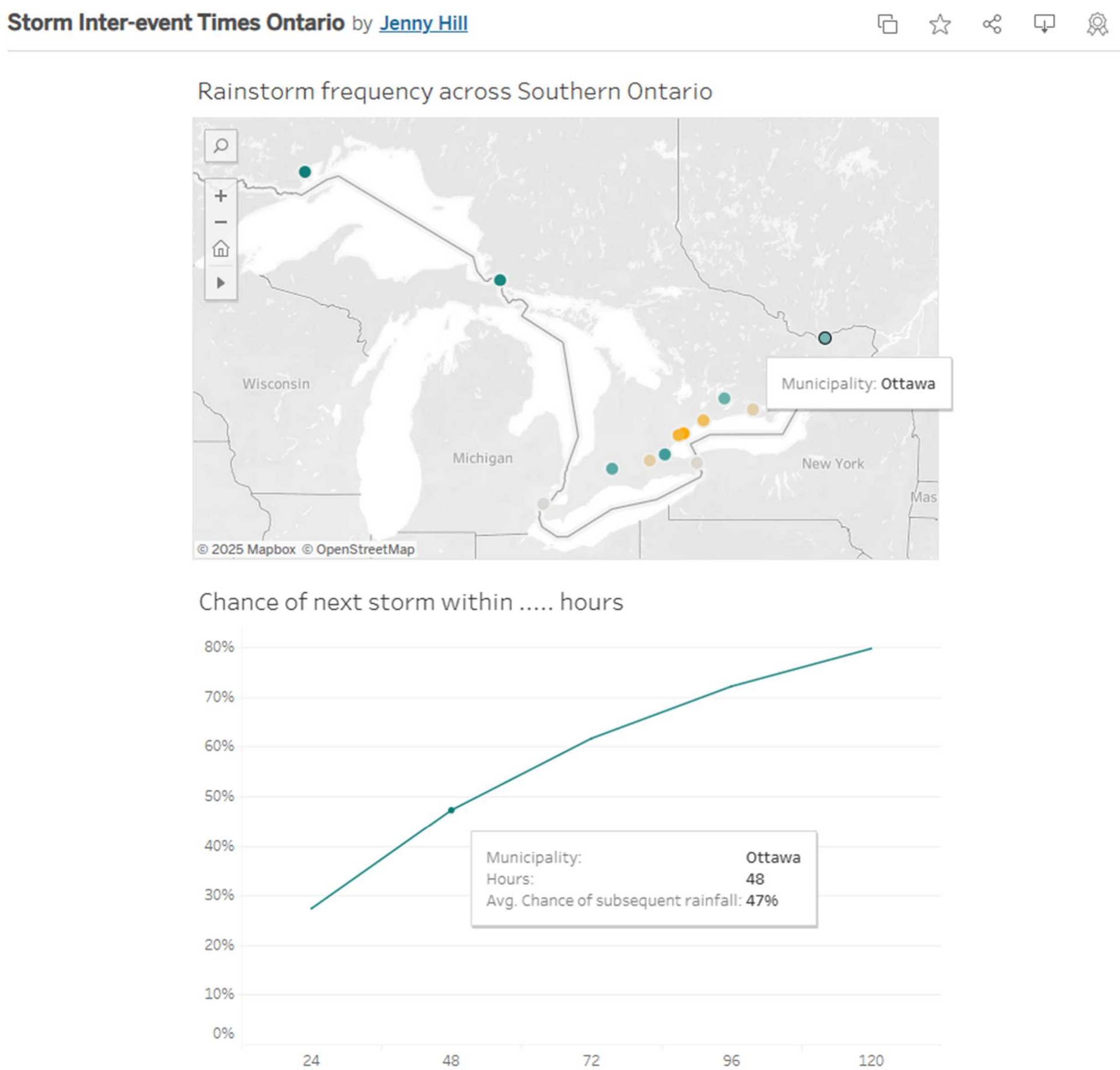
THE PROPERTIES GROUP
O'KEEFE COURT (NEPEAN)
NEPEAN, ONTARIO

PROJECT No:21684
DRAWN BY:BC
CHECKED BY:RA

X-SEC

APPENDIX E

SUPPORTING DOCUMENTATION



Source:

https://wiki.sustainabletechnologies.ca/wiki/Drainage_time
https://public.tableau.com/app/profile/jenny.hill/viz/StormIntereventTimesOntario/Dashboard1

project-specific basis and are not considered in the Conceptual Fisheries Compensation Plan completed for the Barrhaven South community.

3.7 WATER BALANCE

Cursory water balance calculations were conducted for a portion of Reach 1 as part of the master drainage planning for the South Nepean growth area. The study identified the following water budget conditions for existing and estimated proposed future conditions, summarized in **Table 3.7.1**:

Table 3.7.1 South Nepean Master Drainage Plan Water Balance Results (CG&S, 1997)

Component	Existing	Urbanized to 40% Imperviousness
Precipitation	Rainfall: 663 mm Snowfall (as liquid water): 217 mm Total: 880 mm	880 mm
Evapotranspiration	550 mm – 600 mm	370 mm – 410 mm
Water Yield (Surface runoff plus contribution to groundwater)	300 mm – 350 mm	470 mm – 510 mm
Surface Runoff	100 mm – 150 mm	350 mm – 400 mm
Net Contribution to Water Table	200 mm	70 mm – 160 mm

As part of this Subwatershed study, a more detailed water budget analysis was prepared. Hydrogeotechnical input on the water holding capacities of the existing soils was used in conjunction with Meteorological Service of Canada (Environment Canada) modeling data and Ministry of the Environment (MOE) surplus water (i.e. infiltration factor) data to generate water budget results.

Marine clay is the predominant soil in the study area. The South Nepean Master Servicing Study (1998) included correspondence from Jaques Whitford Limited (JWL) estimating the permeability for each of the identified soil units and assessing their suitability for stormwater management infiltration practices (based on MOE SWM guidelines). The permeability estimates are summarized in **Table 3.7.2** (refer to **Figure 3.4.1** for soil units). Based on the suggested permeability, it is shown that only a minor fraction (14%) of the proposed Barrhaven South Community will be suitable for infiltration practices due to the limited areas with sandy soil.

Table 3.7.2 Permeability Estimate and Infiltration Suitability for Surficial Materials (from Jacques Whitford, 1994 & 1995)

Soil Unit	Soil Description	Permeability (m/s)	Suitable for Infiltration?
1	Glacial Till (silty sand/dense sand)	$1 \times 10^{-5} – 1 \times 10^{-4}$	No
2	Fluvioglacial Deposits (stratified sand and gravel)	$1 \times 10^{-1} – 1 \times 10^{-4}$	Yes
3	Champlain Sea Silty Clay (silty 'Leda' clay)	$1 \times 10^{-5} – 1 \times 10^{-8}$	No
4	Beach Deposits (coarse sand containing gravel/cobbles)	$1 \times 10^{-1} – 1 \times 10^{-4}$	Yes
5	Marine Sand (uniform, fine-grained sand)	$1 \times 10^{-3} – 1 \times 10^{-6}$	Yes
8	Abandoned River Channel Deposits (silt to silty clay & sand)	$1 \times 10^{-7} – 1 \times 10^{-4}$	Marginal
10	Organic Deposits (peat, poorly-drained)	$<< 1 \times 10^{-7}$	No

3.7.1 Methodology

Environment Canada uses the Thornthwaite & Mather methodology and Ottawa International Airport mean long-term (1939-2004) monthly precipitation data to generate annual potential and actual evapotranspiration and surplus water estimates. This information is based on type of soil (holding capacity), precipitation input (rain and snow), variations in soil storage throughout the year, and solar input (latitude). MOE infiltration factors are then used to determine the fraction of water surplus that is infiltration and runoff, based on soil type, cover, and topography. In addition, an assumption for urban impervious surfaces is applied to reallocate the infiltration and evapotranspiration components from these surfaces directly to runoff (conservative simplification).

Due to the variations in soil distribution and land cover, and in the interest of understanding the water contribution to the existing tributaries of the Jock River, the water balance was subdivided into several subcatchments corresponding with the hydrologic modeling areas (See **Drawing PRE-1**).

3.7.2 Results

Results of the annual water budget analysis are presented in **Table 3.7.3**. Detailed calculations are provided in **Appendix F**.

Table 3.7.3 Existing Condition Annual Water Balance Results

Catchment	Area (ha)	Total Evapotranspiration		Total Infiltration		Total Runoff	
		(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)
OKEEFE	531	2,896,695	546	958,980	181	1,156,965	218
FOSTER	335	1,232,320	368	394,156	118	1,535,924	458
FRASER	90	532,945	592	167,299	186	149,356	166
KEN_BU	281	1,044,908	372	334,921	119	1,272,812	453
W_CLAR	65	382,166	588	134,858	207	96,576	149
E_CLAR	85	496,745	584	170,592	201	135,063	159
TODD	201	1,180,605	587	368,817	183	348,018	173
CORRIG	75	420,836	561	145,674	194	141,491	189
MILLS	139	765,280	551	239,367	172	307,514	221
JOCKVA	226	1,337,355	592	417,945	185	378,140	167
S_1	349	2,009,745	576	724,166	207	560,649	161
S_2	112	634,255	566	201,658	180	221,367	198
DESIRE	24	106,464	444	33,653	140	86,443	360
Total	2,513	13,040,318	519	4,292,084	171	6,390,318	254

The overall results indicate general concurrence with the previous master drainage plan water budget assessment, with differences attributed to the degree of development considered ‘existing’ as shown in **Drawing PRE-1**. Evapotranspiration (519 mm) accounts for a significant fraction of total rainfall (944 mm). Of the 425 mm of available rainfall, 171 mm infiltrates and 254 mm is converted into surface runoff.

Subcatchments with development exhibit reduced evapotranspiration and infiltration rates, with a corresponding increase in runoff. The O’Keefe drain in the northwest corner of Reach 1 exhibits reduced infiltration from the drains south of the river due to the prevalence of silty clay over the majority of the subcatchment and the presence of urban development north of Fallowfield Road. Areas that show presence of sand and woodlots such as the east and west Clarke drains, Mills, S_1 and SW_1, have higher infiltration rates and consequently lower runoff. The Heart’s Desire community, although estate-type development, has limited vegetative cover and therefore produces very low evapotranspiration and infiltration rates.

Overall, the majority of the Reach is within tight-natured soils thereby limiting the recharge potential. A component not directly reflected is the presence of tile drainage in the northern agricultural portion of the reach, which reduces the potential for infiltration/recharge as water is diverted to the many municipal and non-municipal drains.

classified as poor. The observation that the water quality in the upstream reaches of the Jock River is consistent with the water quality of this reach implies that a holistic approach to water quality improvement should be taken at a watershed level. However, the proposed developments in Reach 1 have an opportunity to improve water quality by providing enhanced level treatment to urban runoff. Hence all the proposed developments should make sufficient efforts in improving water quality of the Jock River and the SWM facilities must be designed to meet water quality criteria established in this study.

> The combination of urbanization and stormwater treatment will reduce net loading of phosphorus to the Jock River.
>
> Stormwater management facilities in Reach 1 are required to provide Enhanced Level treatment of urban runoff corresponding to 80% TSS removal (*MOE, March 2003*).
>
> An integrated watershed based approach is required to improve the water quality of the Jock River.

6.3.5 Water Balance

The increase in surface imperviousness due to urbanization of lands has two major impacts in water balance – decreased infiltration and evaporation and increased runoff volume and peak flows. In the areas of critical hydrogeological function, reduction in infiltration becomes a serious concern as it has the potential to deplete the groundwater levels over a longer period. Therefore it is important to identify net changes in infiltration due to development. A subwatershed scale post development water balance analysis was completed to assess the potential change in infiltration using the MOE method as described in **Section 3.7**. Impervious areas were considered to have no infiltration capacity. The summary of the post development water balance for the subwatershed is presented in **Table 6.3.9**. The results show that as a result of urbanization of the subwatershed, there will be a net reduction in infiltration by approximately 58mm if no infiltration BMPs are implemented. The details are included in **Appendix F**.

Table 6.3.9 Post Development Annual Water Balance

Catchment	Area (ha)	Total Evapotranspiration		Total Infiltration		Total Runoff	
		(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)
OKEEFE	448	1,422,280	317	500,764	112	2,306,076	515
FOSTER	373	931,560	250	294,462	79	2,295,098	615
FRASER	90	376,148	418	120,007	133	353,445	393
KEN_BU	281	701,165	250	221,635	79	1,729,840	616

		Total Evapotranspiration		Total Infiltration		Total Runoff	
W_CLAR	243	761,221	313	361,456	149	1,171,243	482
TODD	195	608,305	312	200,405	103	1,032,090	529
CORRIG	149	451,200	303	149,668	100	805,692	541
MILLS	139	476,015	342	150,948	109	685,197	493
JOCKVA	252	698,670	277	220,847	88	1,459,364	579
S_1	245	1,358,525	555	429,424	175	524,851	214
S_2	102	574,155	563	182,812	179	205,913	202
DESIRE	24	99,810	416	31,550	131	95,201	397
Total	2,541	8,459,054	333	2,863,977	113	12,664,009	498

The majority of surficial soils of the subwatershed have very low permeability, with only about 14% of the surface soils within the CDP area being suitable for infiltration measures. Low existing permeability and the reduction in pervious surface area due to development are expected to further reduce the total infiltration within the subwatershed.

> To maximize infiltration, non-structural infiltration BMPs should be implemented throughout the subwatershed.
>
> In the areas where suitable soils for infiltration are present, structural BMPs should be implemented to maintain the existing rate of recharge.
>
> Any future development of the quarry area should ensure that the existing rate of recharge, at a minimum, is maintained.

Hydrogeological investigations suggest that the groundwater derived from the deeper bedrock formations is likely recharged in the upstream areas near the Village of Richmond. Some recharge of overburden groundwater is expected from the existing gravel quarry area as the area has higher infiltration rate, however expected recharge of deeper formation is likely minimal due to underlying impermeable soils. The existing quarry area lies to the south-east corner of the subwatershed. Although currently outside the urban area, it may have potential for future development should the land use designation change. Even though this area in not likely to recharge the deeper ground water, higher infiltration in the area contributes to the baseflow through interflow. Therefore any future developments should ensure that at least the existing rate of recharge is maintained. Further analysis will be required to quantify the amount of existing recharge from this area.

For the rest of the subwatershed, structural Best Management Practices (BMPs) such as soakaway pits or infiltration trenches may not be effective, due to low permeability of thick layer

APPENDIX F

DRAWINGS