McCamus Ida Subdivision
Part of Lot 12, Concession XI (Cavan)
1910 County Road 10
Township of Cavan Monaghan

Hamlet of Ida
County of Peterborough
Project No. 22-D-5981

STORMWATER MANAGEMENT QUALITY AND QUANTITY CONTROL REPORT

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1.0 INTRODUCTION

The proposed McCamus Ida Subdivision is located on Part of Lot 12, Concession XI in the geographic Township of Cavan, now in the Township of Cavan Monaghan, in the County of Peterborough. The property is known municipally as 1910 County Road 10. Tamara and Barry McCamus, the owners of the property, are proposing to develop a 1.433 hectare portion of the property north of Sharpe Line and west of County Road 10, herein referred to as the subject site. M.J. Davenport & Associates Ltd. has been retained to complete a Stormwater Management Report in support of a 5-lot single family rural residential draft plan of subdivision.

The subject site is located in the hamlet of Ida, approximately ten kilometres southwest of the City of Peterborough, north of Highway No. 7A. The subject site is bordered by agricultural farmland to the north, hamlet residential lands and agricultural farmland to the east, hamlet residential lands across Sharpe Line to the south and hamlet residential lands and agricultural farmland to the west. The subject lands are designated hamlet settlement area in the Township of Cavan Monaghan Official Plan and zoned Agriculture in the Comprehensive Zoning Bylaw. The site is well vegetated and comprised of cultivated agricultural farmland. Property boundary fence rows exist along the south and west site borders. The land is mildly sloped to the east with approximately 5 metres of relief from the northwest corner of the site to the southeast corner.

A stormwater management plan must address the potential impact of increased surface water runoff from the project site taking into consideration the quantity and quality of that runoff plus implement erosion controls. The project site will have a relatively low imperviousness typical of a rural residential subdivision. Mild slopes on the site make utilizing source and conveyance controls a viable option. Therefore, each lot will utilize source and conveyance control techniques and contain one lot level LID control practice to provide quantity and quality control for the development.

The location plan on Figure 1 on page 2 provides an overview of the location of the proposed McCamus Ida Subdivision. The layout of the proposed 5 lots within the 1.433 hectare parcel of land that is the subject of this report is identified on the Lot Grading Plan, Drawing No. 6213-03 prepared by M.J. Davenport & Associates and is included in Appendix I.

Figure 1: Location Plan

2.0 PRE-DEVELOPMENT CONDITIONS

The pre-development site has variable topography with good vegetation cover over the majority of the site. The site topography varies from moderately sloping (2.0%) to steep (8.0%), with much of the site being in the range of 2.0% - 3.0%.

The Ontario Ministry of Agriculture and Food soil mapping for Peterborough County shows Otonabee Loam as the sole surficial soil present within the subject site and on the adjacent land directing runoff through the site. Otonabee Loam is considered a well drained loam soil. The Soil Conservation Service (SCS) hydrologic soil grouping classifies Otonabee Loam as a Type 'B' soil.

The subject site is considered two subwatershed areas under pre-development conditions based on the natural topography of the land determined from contour data

taken from Ontario base maps, a topographical survey and a visual field inspection completed by M.J. Davenport & Associates Ltd.

Published County of Peterborough base mapping of the area shows a watercourse crossing the northern extent of the subject site. However, during multiple field visits, an active watercourse was not observed. The watercourse shown on the base mapping likely represents a low area in the active farm field that directs runoff easterly toward County Road 10. An area of agricultural farmland to the north of the subject site directs stormwater runoff into the low area and through the site. In the post development condition this depression will be redirected into the rear yard swales of the lots and continue to drain to County Road 10.

Base mapping contour information suggests that the agricultural land west of the site directs runoff easterly through the subject site. However, our field visit revealed an earth and stone fence along the westerly property line of the site. The fence re-directs stormwater runoff southerly into the Sharpe Line roadside ditch. The pre-development subwatershed areas are illustrated on Pre-Development Subwatershed Areas Drawing No. 6213-SW1.

The pre-development subwatershed areas include:

Subwatershed Area PRE. 1

Subwatershed Area PRE. 1 (0.911 hectares) represents the area of the subject site that directs stormwater runoff into the Sharpe Line roadside ditch. Under pre-development conditions, this subwatershed area directs runoff as sheet flow south-easterly into the Sharpe Line roadside ditch, ultimately outletting into a watercourse located east of the subject site. This subwatershed area is comprised entirely of cultivated row crop area and does not contain any area external to the development. The calculated percentage of total impervious area of this subwatershed is 0.0%.

Subwatershed Area PRE. 2

Subwatershed Area PRE. 2 (0.522 hectares) consists of the remaining area of the subject site and directs stormwater runoff easterly to the County Road 10 roadside ditch. Under pre-development conditions, this subwatershed area directs runoff as sheet flow easterly into an existing swale within the drainage easement across 914 and 916 Sharpe Line that exists to the benefit of the proposed subdivision. The swale within the drainage easement outlets directly into the County Road 10 roadside ditch, with runoff eventually entering the watercourse that is located east of the subject site in the Hamlet area.

This subwatershed area is comprised entirely of cultivated row crop area. In the pre-development condition, external drainage area to the north of the subject site drains into a low area and through subwatershed PRE.2 to the drainage easement. However, in the post development condition, the external drainage area will be redirected into the swale along the rear of the proposed lots. Runoff generated by the external drainage area will bypass the subdivision lands and enter the drainage easement as it does in the pre-development scenario. Therefore, the flows from the external drainage area are not accounted for subwatershed area PRE.2. The calculated percentage of total impervious area of this subwatershed is 0.0%.

The parameters used in the pre-development Rational Method peak flow calculations are presented below in **Error! Reference source not found.**.

Table 1: Pre-Development Subwatershed Area Parameters

Sub-watershed Area	Area (ha)	Landuse	Slope (%)	Length (m)	Weighted Runoff 'C'	Time of Concentration (min.)
PRE.1	0.911	Agricultural/Row Crop	2.6	200	0.35	22.4
PRE.2	0.522	Agricultural/Row Crop	2.5	205	0.35	22.9

The weighted runoff coefficient, 'C' is based upon "Design Chart 1.07: Runoff Coefficients" of the MTO Drainage Management Manual (MTO, 1997). The 'C' value considers the land use and topography plus the hydrologic soil classification or soil texture then is used to calculate "Time of Concentration." In accordance with the MTO Drainage Management Manual, we have increased the 25-year, 50-year, and 100-year runoff coefficient (C) by 10%, 20% and 25%, respectively.

The pre-development time of concentration T_c was calculated using the Airport Method. If the time of concentration was calculated to be less than 15 minutes, a T_c value of 15 minutes was used in accordance with normal municipal stormwater management design criteria as the minimum inlet time when using IDF curve data with the rational method. Figure 1 in Appendix I "Supporting Information" includes the calculation of the weighted runoff coefficient, 'C' and the "time of concentration" for each subwatershed area.

The rational method has been used to calculate the selected return period peak discharges for the pre-development condition. Intensity-Duration-Frequency (IDF) curves developed from the 1971 to 2006 Peterborough Airport data were used in the stormwater calculations. Peak flows for varying return periods were computed for the entirety of the subject site (Subwatershed Areas PRE.1 and PRE.2 combined). The

results are shown below in Table 3. The detailed rational method calculations are provided in Figure 2 in Appendix I.

3.0 POST DEVELOPMENT CONDITIONS

The development will create 5 rural estate residential lots each fronting onto Sharpe Line. No new streets will be constructed to provide access to this subdivision.

The proposed rural subdivision configuration and lot grading will have a minor impact on the existing division of post development subwatershed areas compared to the pre-development condition. Lot grading and swale construction will be required to prevent stormwater runoff from entering adjacent properties and to divert external subwatershed area runoff from entering the subdivision lands.

Each proposed rural estate residential lot is assumed to contain the same amount of impervious area for stormwater management design purposes. The estimated total impervious area per lot is 492 square metres. This total impervious area consists of an estimated 250.0 square metre single detached family house and a 242.0 square metre (6.10 metre wide by 39.67 metre long) paved driveway. Based on the proposed grading plan, the entirety of the proposed driveway area and front yard area will drain toward the Sharpe Line roadside ditch. The majority of the rooftop area will also be directed to the roadside ditch. A portion of rooftop runoff and the rear yards of the lots will generally drain to the north, into the rear yard swale and through the existing drainage easement to the County Road 10 roadside ditch.

A lot-level Low Impact Development rain garden feature is proposed on the southeast corner of each of the five lots. Each rain garden infiltration feature is sized to fully capture the 25mm quality storm event generated by the area of the proposed driveway that can be feasibly directed to the feature. In addition, the combined storage capacity provided in the five rain gardens is sized to provide quantity control for the development.

The proposed development consists of two (2) subwatershed areas based on the proposed subdivision grading plan and natural topography of the land. The subwatershed areas are divided according to the area directing stormwater runoff into the Sharpe Line roadside ditch (Subwatershed Area PR. 1) and the remaining site area directing runoff easterly through the drainage easement across the two adjacent properties and into the County Road No. 10 roadside ditch (Subwatershed Area PR. 2). The proposed catchment areas are illustrated on Post Development Subwatershed Areas Drawing No. 6213-SW2.

The post-development subwatershed areas include:

Subwatershed Area PR. 1

Subwatershed Area PR. 1 (0.966 hectares) represents the area of the developed site that directs stormwater runoff into the Sharpe Line roadside ditch. This subwatershed area is comprised of building area, asphalt driveway and maintained grass yard area. In the post development condition, the majority of stormwater runoff from this subwatershed area is directed into a series of swales and outlets into the roadside ditch. Quality treatment and quantity control for the stormwater runoff from most of the asphalt driveway, grass front yard area and a portion of the rooftop area will be provided by the proposed LID rain gardens located on each lot adjacent to the roadside ditch. Flows greater than the capacity of the rain gardens will overflow directly into the Sharpe Line roadside ditch. The calculated percentage of total impervious area of this subwatershed is 23.5%.

Subwatershed Area PR. 2

Subwatershed Area PR. 2 (0.467 hectares) consists of the remaining area of the subject site and directs stormwater runoff easterly to the County Road 10 roadside ditch. This subwatershed area is comprised primarily of maintained grass yard area with a small portion of rooftop area. All surface water runoff from this subwatershed area is considered clean and does not require quality treatment. Therefore, in the post development scenario, this subwatershed area has no proposed stormwater controls and directs runoff easterly into an existing swale within the drainage easement across 914 and 916 Sharpe Line and into the County Road No. 10 roadside ditch.

The grading design presented in the Lot Grading Plan Drawing No. 6213-03 specifies that the runoff directed toward the site from the external drainage area to the north be redirected into the rear yard swale of the proposed lots. The runoff from the external drainage area will then bypass the subdivision lands and enter the drainage easement as it does in the pre-development scenario. The calculated percentage of total impervious area of this subwatershed is 4.1%.

All parameters used to model the post-development subwatershed areas in the Visual Otthymo computer simulation are shown in Table 2 below.

Table 2: Post Development Subwatershed Area Parameters

Sub-watershed Area	Area (ha)	Landuse	Slope (%)	Length (m)	Weighted Runoff 'C'	Time of Concentration (min.)
PR.1	0.966	Estate Residential	1.8	82	0.36	15.8
PR.2	0.467	Estate Residential	2.8	180	0.23	22.9*

*Time of concentration for Subwatershed Area PR.2 was calculated as 25.5 minutes, however, as per typical municipal standards, the time of concentration was reduced to 22.9 minutes to not exceed the pre-development subwatershed area PRE.2 time of concentration.

4.0 PEAK RUNOFF CALCULATIONS

The development of the site into a rural residential subdivision will result in an overall increase in total impervious area over the pre-development site. The increase in impervious area is anticipated to result in an increase in post development peak flows leaving the subject site if left uncontrolled.

Peak flows listed in this report were calculated using the Rational Method applying the subwatershed area parameters provided in Table 1 and Table 2. Peak flows were calculated for each of the 2, 5, 10, 25, 50 and 100-year return periods. The pre-development and post-development uncontrolled peak flows generated for the entire subject site using the Rational Method calculation is provided in Table 3. The spreadsheets detailing the Rational Method calculations are included in Appendix I. Rainfall data for the site was taken from the Peterborough Airport gauging station and is included in Appendix I.

Table 3: Pre-Development and Post Development Uncontrolled Peak Flow Rates Discharging Offsite

Design Storm (yr)	Peak Flows (m^3/s)					
	PRE.1	PRE.2	Total Pre-Dev.	PR.1	PR.2	Total Post Dev.
2	0.041	0.023	**0.064**	0.054	0.014	**0.068**
5	0.054	0.031	**0.085**	0.071	0.018	**0.089**
10	0.063	0.035	**0.098**	0.082	0.021	**0.103**
25	0.081	0.046	**0.127**	0.105	0.027	**0.132**
50	0.098	0.055	**0.153**	0.127	0.032	**0.160**
100	0.112	0.063	**0.175**	0.145	0.037	**0.182**

Table 3 indicates that off site peak flows will increase under post development conditions. Stormwater management controls are required to reduce peak flows to be equal to or less than the calculated pre-development peak flow rates for all storm events listed.

5.0 STORMWATER MANAGEMENT CONTROLS

5.1 Low Impact Development (LID) Controls

Several different low impact development techniques were considered for the site to promote infiltration and achieve a pre/post development water balance. It is important to note that the low impact development stormwater management planning and design guide accepts the fact that low impact development techniques can work in any soil type, despite low measured groundwater infiltration rates.

Oakridge Environmental Ltd. determined the hydraulic conductivity (K) of the native soils on site is on the order of 9.0×10^{-5} cm/sec. Using Appendix C of the LIDSWMPPD to convert the measured hydraulic conductivity (K) to an infiltration rate yields a rate range of approximately 12 mm/hr and 30 mm/hr. The design of low impact development practices for the project site considers the measured infiltration rate of the soils on the site.

It was determined that a lot-level rain garden constructed on each proposed lot in the development was the best solution to meet quality and quantity control objectives for the subdivision without requiring a dedicated stormwater management block. Due to grading constraints, the proposed LID rain gardens will capture and infiltrate runoff from Subwatershed Area PR. 1 only.

Each of the proposed LID rain gardens are sized to capture at a minimum the volume of runoff generated by the 25mm quality storm event from the 230 square metres of asphalt driveway area directed to each individual facility. Typical stormwater management guidelines specify that for of estate residential lots, rooftop and grass yard runoff is considered clean and does not require treatment. In this case, the runoff from the asphalt driveway is the only area that requires on-site quality control.

The combined stormwater storage capacity provided in the surface ponding area above the rain garden and the amended soil storage layer within the rain garden is sized to provide the required quantity control volume to reduce peak flows to be equal to or less than pre-development conditions. Runoff generated by storm events larger that the capacity of the rain gardens will overflow the rain garden berm and enter the Sharpe Line roadside ditch.

The proposed LID rain gardens have dimensions of 4.27 metres by 4.27 metres with a surface ponding depth of 0.25 metres and an amended soil storage layer depth of 0.60 metres. The storage layer is composed of native soils amended with a high sand content (60%) and low volume of organic materials such as compost (3-5%). A 50-75mm thick layer of hardwood mulch shall be placed on the top of the rain garden for weed suppression and to provide pre-treatment of the stormwater entering the facility. Each rain garden as designed provides a total volume of 8.92 cubic metres of storage, after adjusting for void ratio of 0.40 in the amended soil storage layer. A proposed 0.20m high berm constructed across the front of the lots will direct surface runoff into the rain gardens. The detailed calculation of the storage volume provided in each LID rain garden is included in Appendix I.

For infiltration practices, a minimum separation of 1.0 m is recommended from the bottom of practice to the seasonally high groundwater level. The Oakridge Environmental report measured the average groundwater depth on site to be approximately 1.1 metres below existing ground.

As the groundwater level across the site is generally shallow, best practices have been used to provide maximum separation from the bottom of the rain garden storage layer to the level of the groundwater. A minimum 0.50 metre vertical separation from the measured groundwater level to the rain garden storage layer has been provided.

Several factors after development of the subdivision will affect the groundwater level in the proximity of the subdivision. The finished grade across the entire site will be raised compared to existing to provide adequate drainage for the proposed lots. The swale proposed across the rear of the lots will direct external surface water away from the subject site, removing a potential surficial source affecting the groundwater level.

Furthermore, the installation of subdrains around the houses will also work to lower the groundwater level in the immediate area of the development. As a result, the 0.50 metres of separation provided from the base of the rain gardens to the measured groundwater level provided in the Oakridge Report is a conservative assumption.

In addition to the LID rain garden facilities proposed, driveway areas and downspouts will be directed to pervious surfaces where possible to passively treat runoff during conveyance and increase infiltration. The lot grading has been reduced to a minimum of target of 2.0% to promote filtration and infiltration of runoff during conveyance.

5.2 Quality Control

Developing the subject site with the proposed asphalt driveways and houses will increase the impervious area on site compared with the pre-development condition and can cause additional pollutants to be conveyed offsite if left uncontrolled. The proposed asphalt driveways on the site require "Enhanced" level protection (80% T.S.S. removal) as described in the Ontario Ministry of the Environment's "Stormwater Management Practices Planning and Design Manual, 2003". The remainder of the areas on site are not subject to stormwater controls as runoff from rooftop and landscaped areas is considered clean.

Primary stormwater quality control for the proposed impervious areas will be achieved for this site using infiltration within the proposed LID rain gardens. Quality control for the majority of the proposed asphalt driveways will be accomplished by directing driveway runoff first across the grass landscaped front lawn and into the proposed lot level rain garden for primary treatment and minimum 80% T.S.S. removal.

The combined storage volume provided in the surface ponding area (4.55 m^3) and soil storage layer (4.37 m^3) for each rain garden meets or exceeds the MOE quality storage guidelines for an enhanced level of protection (80% T.S.S. removal) prescribed in Table 3.2 of the Ontario Ministry of the Environment's "Stormwater Management Practices Planning and Design Manual, 2003." Extrapolating from Table 3.2 for Enhanced, 80% long-term T.S.S. removal at 100% impervious level, the required storage volume is 45 m^3/ha. The driveway area directed to each rain garden is 0.023 ha, which results in a total required infiltration storage volume of 1.04 m^3. The provided combined rain garden storage volume of 8.92 m^3 greatly exceeds the required storage volume to provide an Enhanced level of treatment for each driveway area.

Another criteria typically used the Peterborough region to evaluate if adequate quality control is provided is to ensure that the proposed stormwater management facility can completely capture the 25mm quality storm event volume. The total stormwater runoff volume generated by the 25mm storm event from the asphalt driveway area on

each lot directed to the proposed rain garden is approximately 5.18 cubic metres. The provided rain garden volume of 8.92 cubic metres exceeds the required 25mm storm volume. The detailed calculation of the 25mm storm event volume is included in Appendix I.

Therefore, a minimum of 80% T.S.S. removal will be accomplished for the impervious areas requiring treatment in the development.

5.3 Quantity Control

The proposed post development condition of the site results in an overall increase in total impervious area over the pre-development site. The increase in impervious area would result in an increase in post development peak flows offsite if left uncontrolled. Stormwater management facilities must maintain post development at pre-development levels to ensure the proposed development does not increase downstream flooding potential.

The modified Rational Method has been used to calculate the required on-site storage volumes to reduce post development peak flows to be equal or less than pre-development peak flows.

Table 4 summarizes the cumulative required stormwater quantity storage volume for the 2, 5, 10, 25, 50 and 100-year return periods.

Table 4: Modified Rational Method Storage Volume Requirement

Design Storm (yr)	Modified Rational Method Storage Volume Requirement		
	Allowable Peak Flow (m^3/s)	Required Peak Flow Storage (m^3/s)	Required Storage Volume (m^3)
2	0.0644	0.0538	**16.14**
5	0.0847	0.0707	**21.22**
10	0.0982	0.0820	**24.59**
25	0.1266	0.1057	**31.71**
50	0.1533	0.1278	**38.33**
100	0.1753	0.1461	**43.84**

From the modified Rational Method, the total required on-site storage volume is 43.84 cubic metres for the 100-year storm event. The detailed calculations of the modified Rational Method for all storm events are included on Figure 5 in Appendix I.

The proposed storage volume in each LID rain garden is 8.92 m^3. An equally sized rain garden is proposed on each of the five lots. The five rain gardens provide a total

combined storage volume of 44.60 cubic metres, which exceeds the required storage volume to reduce post development peak flows to be equal or below pre-development peak flow rates.

6.0 EROSION AND SEDIMENTATION CONTROL

Erosion and sedimentation control measures will be installed prior to the commencement of any on-site construction activity. These measures will be maintained throughout the construction period until the site has been stabilized with vegetation to prevent construction sediment from affecting lands external to the development.

During all phases of construction, vehicle refueling and maintenance operations shall occur a minimum distance of 15 metres away from any natural water feature, storm drain or temporary sediment control pond.

Prior to commencement of any on-site construction activity, clearing and grubbing operations shall take place along the south property boundary adjacent to Sharpe Line to provide access to the site.

Once clearing and grubbing is complete, light duty silt fence will be installed according to OPSD 219.110 in locations as specified on Drawing No. 6213-EC1 prepared by M.J. Davenport & Associates Ltd. Silt fence will be installed completely along the South boundary of the development as shown on the drawing. Since the site will be developed on a lot-by-lot basis, opportunities for erosion control practices are limited. Sediment control practices are the primary method of downstream protection for this development.

The front, side and rear lot grades of the development are designed to generally match the existing ground contours. Therefore, rough grading of the building lots will not be necessary until such time as a home builder begins home construction. With no significant earth moving operations proposed, a mud mat construction entrance is not warranted for this development. Once constructed, the gravel driveway entrances will provide access to the site. The contractor/home builders shall be responsible for cleaning Sharpe Line as required until construction is complete.

The re-grading of the north roadside ditch of Sharpe Line and construction of the five entrance driveways for each building lot shall now commence. Prior to commencement, two strawbale flow checks shall be installed according to OPSD 219.180 within the existing roadside ditch downstream (east) of the proposed works. The ditch area disturbed during construction shall be seeded immediately upon

completion of grading operations. Once vegetation is established and the area is stabilized, the temporary strawbale flow check dams can be removed.

During construction of new homes, the home builder shall erect, on a lot-by-lot basis, light duty silt fence on the down gradient side of all disturbed areas on their construction site sufficient to contain silt prior to that surface water runoff entering watercourses and ditches. Staked straw bales shall be installed in the swales at the front of the lots, if front draining, and both the front and rear of the lots if split drainage is proposed. A typical individual lot erosion control detail is provided on Drawing No. 6213-EC1. Lot level LID rain gardens shall be constructed on a lot-by-lot basis after home construction is completed and the lot area draining to the rain garden is stabilized with vegetation.

All areas disturbed that are to remain exposed for more than 30 days and are not subject to active construction will be seeded or otherwise stabilized to protect against erosion during the remaining phases of construction. Any dewatering operations required during the construction process shall follow the dewatering detail shown on Drawing No. 6213-EC1.

All erosion and sediment control practices including perimeter silt fence shall be inspected weekly and after every significant storm event (defined as greater than 15mm of rain over a 24-hour period or an event with rainfall intensity greater than or equal to 5mm/hr with a total rainfall amount of 10mm or greater). For the facilities to continue to function as intended, maintenance of all temporary sediment control measures will be the responsibility of the on-site contractor and developer. Sediment deposits shall be removed when the deposit reaches one-third the height of the fence. The accumulated construction sediment must be removed carefully so as not to damage the silt fence fabric or undermine the structural base support. Maintenance shall be carried out within 24 hours on any part of the facilities requiring repair.

Once home building is complete, final site stabilization and decommissioning of erosion and sediment control features can commence. During this phase, the staged removal of the erosion and sediment control features will begin once the remaining disturbed soil areas are stabilized. All accumulated construction sediment shall be removed from the ESC features. Finally, all remaining erosion and sediment controls such as silt fence, flow check dams etc. shall be removed and disposed of offsite.

7.0 CONCLUSIONS

The development of a five-lot rural residential subdivision on vacant land on Part of Lot 12, Concession XI in the Township of Cavan Monaghan has the potential to increase pollutants in the stormwater runoff and increase the peak runoff rates when compared to the pre-development condition. The stormwater management design presented in this report addresses the potential to affect downstream receivers.

In our professional opinion, stormwater quality control for the subdivision will be provided by the lot level Low Impact Development rain gardens that provide a stormwater storage volume that exceeds the required volume prescribed in Table 3.2 of the Ontario Ministry of the Environment Stormwater Management Practices Planning & Design Manual, 2003 to provide an enhanced level of protection. In addition, the rain gardens are sized to fully capture the 25mm quality storm event from the impervious drainage area directed to each practice. These features combined will provide a minimum of "Enhanced" level of treatment (80% T.S.S. removal) for the impervious areas on site requiring treatment.

In our professional opinion, the increase in post development surface water runoff created by the increased impervious areas proposed on the subject site will be adequately controlled at equal to or below pre-development peak flow runoff rates by the lot level Low Impact Development rain gardens all storm events up to and including the 100-year storm event.

Erosion and sediment control measures have been designed to limit the potential for construction sediment from affecting surrounding lands during the construction period. If the proposed erosion and sediment control measures are placed in accordance with the design, installed correctly and maintained during construction, the risk of transport of construction sediment to downstream lands is minimal.

If the stormwater management design is implemented as designed, the rural residential subdivision can be constructed without negative impacts to adjacent or downstream landowners.

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October 15, 2024

APPENDIX I

STORMWATER MANAGEMENT SUPPORTING CALCULATIONS

APPENDIX II

ENGINEERING DESIGN DRAWINGS