District of
North Saanich

STAFF REPORT

To: Rob Buchan
Chief Administrative Officer

Date: October 12, 2017

From: Eymond Toupin
Director of Infrastructure Services

Re: McDonald Park Road Drain and Sandown Drainage

RECOMMENDATION(S):

That Council:

1. Approve District funding of $65,000 from the General Infrastructure Reserve for the Glamorgan crossing upgrade to a 900x1800mm box culvert to be constructed by the developer of the Sandown site, and;
2. Approve District funding of $569,000 from the General Infrastructure Reserve for the proposed stormwater management concept on the Sandown site to address the capacity constraint on the McDonald Park Road Drain to be constructed by the developer of the Sandown property.

STRATEGIC PLAN IMPLICATIONS:

This matter relates to the following Council strategic priorities:

Protect and Enhance Rural, Agricultural, Heritage, Marine and Environmental Resources

Maintain a Safe and Healthy Community

Encourage Compatible Commercial and Local Business Development

Maintain a Strong Sense of Community

Ensure Strong Leadership, Fiscal Responsibility and Transparent Government

INTRODUCTION/BACKGROUND:

The Sandown property straddles two drainage catchments in North Saanich, the McDonald Park Road Drain, which outlets to into Tsehum Harbour near the end of Blue Heron Road and Wsikem Creek which outlets into Patricia Bay. The commercial development portion of the property, which fronts on McDonald Park Road, is connected to and will be serviced by the McDonald Park Road Drain. The agricultural portion of the site, as will be described in more detail below, connects both drainage catchments.

These drainage catchments have been studied independently of each other, the McDonald Park Road Drain in 2000 and Wsikem Creek (Tseycum Creek) in 2007. The McDonald Park Road Drain has the most direct impact and interaction with proposed development, both on the commercial and reclaimed agricultural portions of the site and will be discussed in the following section.

McDonald Park Road Drain

In 1999, the District commissioned Reid Crowther to complete the McDonald Park Road Drainage Study and Pre-Design Report in response to capacity issues in the existing storm drain and ditch system with flooding occurring at locations along the route even during minor storm events. The catchment area is shown in Figure 1.

The study included the following scope of work:

- Survey of channel and pipes to establish profile and cross-sections for hydraulic modelling;
- Hydraulic analysis to determine hydraulic grade lines (flood profiles) for existing and anticipated future improved conditions;
- Identification of upgrade requirements and estimated costs.

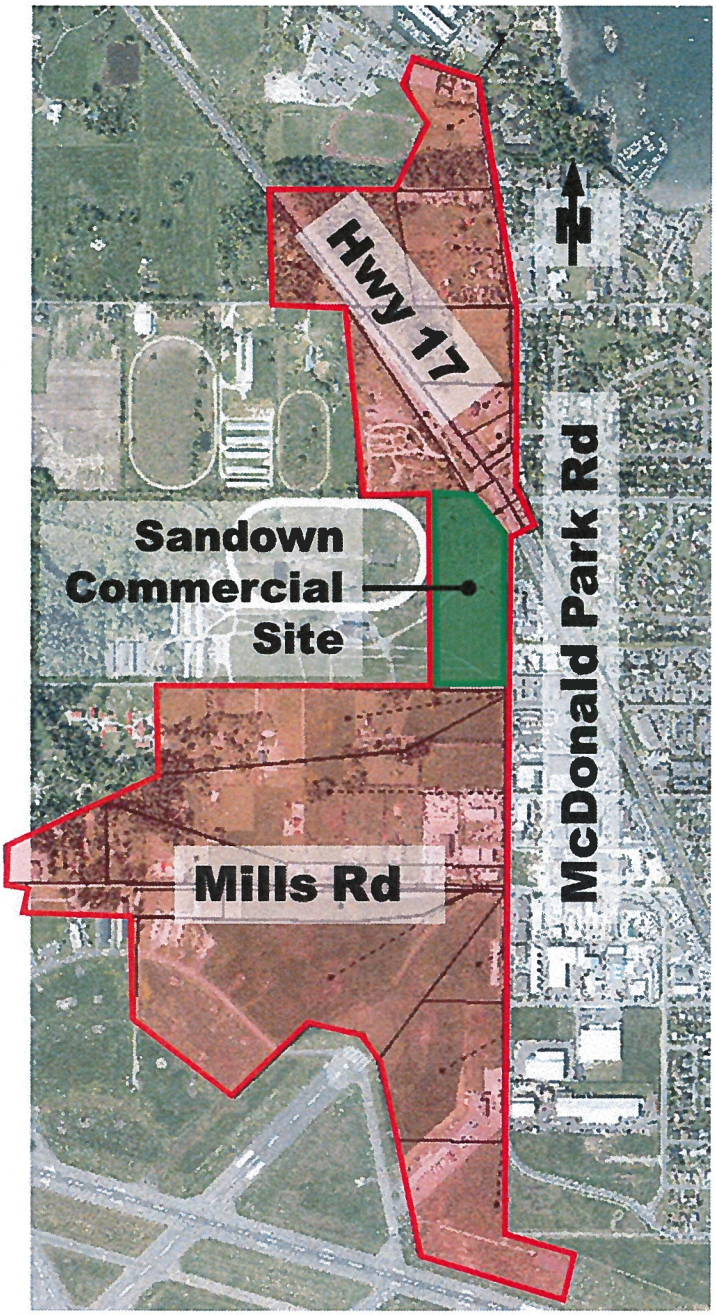


Figure 1: McDonald Park Drain Catchment Area in 2000 Study

The study identified upgrades and estimated project costs for the McDonald Park Drain and five phases of construction:

Table 1: McDonald Park Road Drain Upgrade – 2000 Project Cost Estimates

Phase	Extents	Approximate Length and Size of Upgrade	Estimated Project Cost (in 2000)
1	Outlet (Blue Heron Road) to Resthaven Avenue	600 m of 1,350 mm diameter piping	$546,000
2	Resthaven to Pat Bay Highway	300 m of 1,350 mm diameter piping	$263,000
3	Pat Bay Highway Crossing	100 m of 1,350 mm diameter piping	$209,000
4	Pat Bay Highway to Glamorgan Road	500 m of 1,350 mm diameter piping	$332,000
5	Glamorgan Road to Mills Road	400 m of 1,200 mm diameter piping	$310,000
		Total	$1,660,000

The first phase of the recommended upgrades (Outlet to Resthaven Avenue) was completed in 2009 at an approximate cost of $1,300,000 (more than twice the estimated cost from the study completed in 2000). This phase of construction was funded from a number of District sources including reserves and operating budgets. Detailed designs for the remaining phases were never advanced, presumably because flooding had not yet impacted critical infrastructure or property. The most significant constraints remaining in this drainage system would be addressed by completing Phases 2 to 4. Completion of Phase 5 would likely provide fewer benefits and could be re-evaluated in the future.

As part of their work for the Platform Properties, Kerr Wood Leidal (KWL) generated an estimate of the costs to complete the upgrade to the McDonald Park Road Drain from the northeast corner of the proposed Sandown commercial development to the intersection of Resthaven Avenue and McDonald Park Road where Phase 1 terminated in 2009 (Table 2 of Attachment B). These works would represent all of the work identified in Phases 2 and 3 of the 2000 study and approximately 100 m from Phase 4. The current total estimated cost for these works based on the installation of 1,350mm diameter piping is $2.3 million (roughly four times the estimated project cost from the study).

As shown in Figure 1, the proposed Sandown commercial development is located on McDonald Park Road immediately upstream of the existing undersized drain crossing of the Pat Bay Highway. The commercial development would therefore be immediately impacted by the level of service the McDonald Park Road Drain currently provides (estimated to be a 1 to 2 year level of service).

Although this was not examined as part of the original drainage study completed in 2000, because of its depressed elevation relative to the roadway, the Sandown property functions as an overflow or relief for the McDonald Park Drain during large storm events which compensates for lack of downstream conveyance capacity. In other words, during large events, when the downstream storm system is overwhelmed, the water level in the municipal drain rises and eventually spills onto (i.e. floods) the eastern half of the Sandown property (i.e. up to the western extremity of the former race track), which then effectively functions as a stormwater detention facility.

Stormwater Management Plan for Sandown Site

The analysis completed by KWL as part of the development of the stormwater management and site servicing plans for the Sandown property is provided in Attachment A. Taking into consideration the existing servicing and flooding constraints, KWL developed a stormwater management concept involving storage on the Sandown site to compensate for the lack of downstream system capacity, thereby formalizing and enhancing the storage conditions which already existed. These works are also identified in the agricultural reclamation and drainage plan which will be presented to Council in a separate report.

It is worthy of note that the study of the McDonald Park Road Drain completed by the District in 2000 had evaluated stormwater detention on the racetrack property as part of drainage system upgrades. However at the time it was determined that, when taking into account land costs for detention facilities, there were no cost savings versus a conveyance upgrade (i.e. pipe-only solution). However, given the current understanding of the system conditions and that, under the terms of the current agreement, the agricultural portion of Sandown would be under the control of the District, detention storage on these lands was determined to be a practical and cost-effective solution which could defer and reduce the costs of downstream conveyance upgrades.

The concept involves the following elements:

- constructing and formalizing a diversion conduit from the McDonald Park Road Drain through the commercial site to the agricultural lands to the west;
- re-grading the agricultural portion of the site by:
    - removing the eastern portions of the existing racetrack;
    - deepening and formalizing an east-west drain channel inside the former racetrack;
    - installing a downstream control structure in the west portion of the existing racetrack to restrict/control outflow west to the Wsikem Creek catchment while maintaining a base flow;
    - allowing stormwater to be temporarily stored when capacity in the downstream drain is exceeded during larger events; and
    - facilitating draining of stored stormwater from the agricultural land back to the McDonald Park Road Drain following a large event.

The construction of the elements listed above are to address existing constraints in the McDonald Park Road Drain system downstream of the Sandown property. As indicated above, these constraints were identified in the study completed in 2000.

As part of the servicing works, the developer would upgrade the cross-section of the drain channel fronting the development and will be installing appropriately sized culverts at each of the new accesses to the development consistent with the capacity upgrades identified in the 2000 study. The costs of these works are the responsibility of the developer.

Also as part of the development, the portion of Glamorgan Road adjacent to proposed commercial property will be upgraded to accommodate traffic to the site. Staff recommend that the culvert crossing of Glamorgan Road, which is currently a constraint along the McDonald Park Road Drain, be upgraded (upsized to a 900x1800mm box culvert) concurrently with the upgrade to the roadworks. This would be done to accommodate off-site (i.e. upstream) municipal stormwater and would effectively complete Phase 4 of the works identified in the 2000 drainage study. As the culvert upgrade is not required to service the development and would be to the benefit to the District's regional stormwater system upstream of the development, the cost of the upgrade should be borne by the District.

The elements and costs of this concept were provided by KWL (Table 1 of Attachment B) are summarized in the following:

Table 2: Cost Estimate for Stormwater Detention on Sandown

Component	Estimated Project Cost
Diversion Structure at McDonald Park Road	$20,000
Diversion Piping	$340,000
Agricultural Channel Regrading	$175,000
Outlet Structure and Berm (West End of Race Track)	$40,000
Glamorgan Culvert Crossing Upgrade to 900x1800mm Box Culvert	$90,000
Total	**$665,000**

It is not uncommon for municipalities to require the costs associated with capacity upgrades to existing utilities be shared by developers connecting to those systems. One means of achieving this is for a municipality to implement development cost charges (DCC) to recover the costs associated with a capacity upgrade needed to accommodate development. The costs of the upgrade required can then be distributed to the benefiting development properties based on the area of the development or on their share of the use of the upgraded amenity (e.g. proportion of flow). Development cost charges for the McDonald Park Road Drain have not been implemented or contemplated and there are relatively limited opportunities in this catchment for development to recover such costs. Also, the capacity constraints are not the result of redevelopment in the area but are a function of existing conditions.

Another approach is to have a developer complete some or all of the required works as part of their servicing agreement. In this case, the District could require that the developer absorb these costs associated with the stormwater storage concept constructed as part of the development works and reclamation of the agricultural lands.

However, in this case, the agreement with the developer will result in the transfer of agricultural lands, the majority of the former Sandown property, to the District. It will also include the demolition of the existing buildings on the site and reclamation of the agricultural lands as described in the developer's reclamation plan. As such, the District is receiving a significant amenity from the developer. Moreover, the drainage works associated with the stormwater detention are the result of a constraint in the District's regional drainage system which flooded the property being developed.

As such, it is the developer's position that the cost of these works should be borne by the District. Note, the costs shown in Table 2 include $31,000 in costs which should be borne by the developer (see Table 3 of Attachment B). Subtracting these costs from the total in Table 2 above results in an estimate of $634,000 which would be borne by the District. These works would be completed in phases corresponding to the development of the commercial site. The majority of the works (representing approximately $351,000) would take place in Phase 1 and would be completed in 2018. The remaining works, representing approximately $283,000, would be included as part of Phase 2 of the development which could be completed in 2019 depending on when tenants are secured for the north portion of the commercial site.

Features of the Proposed Stormwater Management Concept

The proposed works would provide approximately 60,000 m³ in stormwater storage in the area bounded by the former racetrack. The ditch re-grading (i.e. deepening) would also improve the drainage of the agricultural site itself by allowing the land to be dewatered more quickly following storm events in comparison to the extended periods of ponding and saturated soil conditions which currently exist on the site.

As indicated above, the stormwater diversion and storage concept proposed by the developer's designer serves a number of purposes. The storage provided attenuates flow to the downstream drainage systems (McDonald Park Road Drain and Wsikem Creek) by allowing the temporary stored flows to slowly be drained to the existing drain and improves the grading and drainage of the existing agricultural lands in the area of the existing racetrack.

The storage concept also reduces the size and cost of the capacity upgrades required to the downstream stormwater system and also defers the need for these upgrades. Based on the preliminary analysis completed by KWL, using the proposed storage concept and associated upgrades, there is a reduction in the size of the approximately 470m of downstream stormwater sewer piping from 1,350 to 1,050mm in diameter. The actual diameter required will need to be confirmed through flow monitoring and recalibration of the model if/when the downstream upgrades proceed on the McDonald Park Road Drain. It is estimated that the storage could reduce the costs of the system upgrades downstream of diversion structure by approximately $524,000 (Attachment B), i.e. a value comparable to the cost of the upgrades required to develop the storage.

The construction of the proposed storage facility concept:

- is compatible with reclamation of the agricultural site as it formalizes and improves drainage on that portion of the site via a formalized and upgraded (widened and deepened) drainage channel;
- allows the commercial site to be developed and protects it from flooding from the municipal drain; and
- formalizes a relief element for the currently under-sized McDonald Park Road Drain in an area which was already previously flooded by the drain.

The storage facility would also allow the significantly more costly downstream upgrades to be deferred. With the detention storage upgrades in place, the primary benefit of completing the downstream upgrades on the McDonald Park Road Drain would be to dewater the lower elevation portions of the agricultural site more rapidly following a given storm event. A benefit-cost analysis of completing the downstream upgrades could be completed to determine their value to the District and justify when these works should be completed in the future.

Due to the existing constraints in the drainage system, development of the Sandown site cannot proceed without addressing the current constraints in the McDonald Park Road Drain. Two alternatives have been identified to address the drainage constraint and allow the development to proceed:

1) Construct the stormwater management concept utilizing storage on the agricultural parcel as described above at an estimated District cost of $569,000 (not including the upgrade to the Glamorgan culvert crossing). These works would be completed by the developer at the District's cost and would defer the need for and reduce the costs of downstream upgrades; or
2) Construct the downstream 1,350mm storm sewer upgrade on the McDonald Park Road Drain at a currently estimated District cost of $2.3 million. It is estimated that design, tendering and construction of this upgrade would require a minimum of 18 months to complete and would require consultation/approval from the Ministry of Transportation for

the Patricia Bay Highway crossing and from the Town of Sidney for the works on McDonald Park Road north of the highway. Other temporary works may be required to accommodate Phase 1 of the commercial development while the downstream storm sewer upgrades are being completed.

OPTIONS:

Council can:

1) Approve District funding of $65,000 from the General Infrastructure Reserve for the Glamorgan crossing upgrade to a 900x1800mm box culvert to be constructed by the developer of the Sandown site; and
2) Approve District funding of $569,000 from the General Infrastructure Reserve for the proposed stormwater management concept on the Sandown site to address the capacity constraint on the McDonald Park Road Drain to be constructed by the developer of the Sandown property; or
3) Approve $2.3 million in funding for approximately 470m of 1,350mm diameter of storm sewer upgrade of the McDonald Park Road Drain from reserves; or
4) Other.

FINANCIAL IMPLICATIONS:

Funds for the proposed drainage works are proposed to be drawn from the General Infrastructure Reserve. It is forecast that there will be $728,000 of funds available in this reserve at the end of 2017. Additional funds would be required to complete the significantly more costly downstream storm sewer upgrade of the McDonald Park Road Drain. These could be drawn from other reserves including the New Works Reserve and General Amenity Reserve which are anticipated to have balances of $940,000 and $1.7 million at the end of 2017 respectively. Future tax revenues from the commercial development and lease revenues from the cellular communications tower on the agricultural site could be used to replenish these reserves.

LEGAL IMPLICATIONS:

None anticipated.

CONSULTATIONS:

None.

INTERDEPARTMENTAL INVOLVEMENT/IMPLICATIONS:

This report was circulated to Directors for their review, input and concurrence.

SUMMARY/CONCLUSION:

The Sandown property straddles two drainage catchments in North Saanich, the McDonald Park Road Drain, which outlets to into Tsehum Harbour and Wsikem Creek which outlets into Patricia Bay. The commercial development portion of the property, which fronts on McDonald Park Road, is connected to and will be serviced by the McDonald Park Road Drain. The agricultural portion of the site connects both drainage catchments.

Upgrades to the McDonald Park Road Drain were identified in study completed in 2000. The first phase of the recommended upgrades (Outlet to Resthaven Avenue) was completed in 2009 at an approximate cost of $1.3 million. As part of their work for the Platform Properties, Kerr Wood Leidal (KWL) estimated the costs to complete the upgrade to the McDonald Park Road Drain from the northeast corner of the proposed Sandown commercial development to the intersection of Resthaven Avenue and McDonald Park Road at $2.3 million.

The Sandown property functions as an overflow or relief for the McDonald Park Drain during large storm events which compensates for lack of downstream conveyance capacity. Taking into consideration the existing servicing and flooding constraints, a stormwater management concept was developed involving storage on the Sandown site to compensate for the lack of downstream system capacity, thereby formalizing and enhancing the storage conditions which already existed.

The stormwater diversion and storage concept proposed by the developer's designer attenuates flow to the downstream drainage systems (McDonald Park Road Drain and Wsikem Creek) by allowing the temporary stored flows to slowly be drained to the existing drain and improves the grading and drainage of the existing agricultural lands in the area of the existing racetrack.

The proposed storage concept and associated upgrades reduces the size of the 470m of downstream stormwater sewer piping from 1,350 to 1,050mm in diameter resulting in a corresponding reduction of the costs of downstream upgrades by an estimated $524,000. Implementation of this storage concept would also defer the significantly more costly upgrades to the downstream stormwater drainage system.

The construction of the proposed storage facility concept:

- is compatible with reclamation of the agricultural site as it formalizes and improves drainage on that portion of the site via a formalized and upgraded (widened and deepened) drainage channel;
- allows the commercial site to be developed and protects it from flooding from the municipal drain; and
- formalizes a relief element for the currently under-sized McDonald Park Road Drain in an area which was already previously flooded by the drain.

Due to the existing constraints in the drainage system, development of the Sandown site cannot proceed without addressing the constraints in the McDonald Park Road Drain. Staff recommend construction of the stormwater management concept utilizing storage on the agricultural parcel at an estimated District cost of $569,000. These works would be completed by the developer at the District's cost and would defer the need for and reduce the costs of downstream upgrades. Staff also recommend the Glamorgan crossing be upgraded to a 900x1800mm box culvert at a District cost of $65,000 also to be constructed by the developer of the Sandown site. Staff propose to these works be funded from the General Infrastructure Reserve.

Respectfully submitted,

Eymond Toupin
Director of Infrastructure Services

Concurrence,

Rob Buchan
Chief Administrative Officer

Concurrence:

Stephanie Munro, Director Financial Services

Anne Berry, Director Planning & Community Services

Curt Kingsley, Director Corporate Services

John Trelford, Director Emergency Services

KERR WOOD LEIDAL
consulting engineers

Vancouver Island
201 - 3045 Douglas Street
Victoria, BC V8T 4N2
T 250 595 4223
F 250 595 4224

Technical Memorandum

DATE: October 10, 2017

TO: Andrew Sinclair – Development & Acquisitions
Platform Properties Ltd.

FROM: David Zabil, M.A.Sc., P.Eng.
Chris Johnston, P.Eng.

RE: **PLATFORM PROPERTIES**
Sandown Lands – Onsite and Offsite Stormwater Management Plan
Our File 3641.001-300

1. Introduction

Sandown Properties Ltd. has engaged KWL to complete a civil site servicing design for a property on the eastern edge of the old Sandown Race Track lands (development site) to meet the requirements put forward in the District of North Saanich's preliminary layout assessment (PLA) dated February 17, 2017.

This technical memorandum presents the stormwater management plan for both the development site and the area surrounding the proposed development site to offset any drainage impacts of the development fill and to further improve the agricultural lands to the west of the development site.

2. Existing Catchments and Drainage

The development site is located at the northwest corner of McDonald Park Road and Glamorgan Road. During low flows (minimal rainfall), the site drains to an existing culvert under McDonald Park Road which is connected to a culvert under the Pat Bay Highway which then drains to Shoal Harbour via a storm sewer. During heavier rainfall, the culverts under McDonald Park Road and the Pat Bay Highway cannot convey the peak flows and water ponds on the Sandown Race Track lands (including the portion that is the development site) effectively acting as a detention pond for the entire upstream catchment. This ponded water can then flow over land westward to the west end of the race track and into Wsikem Creek via a culvert under the track. Wsikem Creek then discharges to Patricia Bay.

The catchment area draining to the Pat Bay Highway culvert is a 91.2 ha catchment that includes the Sandown site, a small area north of the Sandown site, area south of Glamorgan Road east of Littlewood Road, and a northern portion of the Victoria Airport. This entire catchment contributes to the existing flooding of the Sandown Race Track lands.

2.1 Existing Flooding Extents

Flooding occurs frequently on the existing site. The development site and associated agricultural lands (including the race track) form a "sump" that stores catchment flows prior to draining via the culvert under McDonald Park Road and the Pat Bay Highway or crossing the catchment divide to the west and flowing into Wsikem Creek. Observations of water levels during a rainfall event that was approximately a 2-year return period showed that the west end of the culvert under McDonald Park Road was surcharged with water levels nearly at the road elevation (El. 10.6 m at the edge of pavement). This suggests a ponding water level of approximately El. 10.0 m on the property during a 2-year event. Flood elevations are not expected to exceed this elevation because above this elevation, the ponding begins to decant westward into Wsikem Creek, which may contribute to existing flooding issues in the Wsikem Creek System.

Figure 1 shows the flooding extents at the 10.0 m water surface elevation. As shown, the flooding extends through the middle portion of the proposed development site, through the low interior of the race track, and an area in between. The western edge of the race track acts as a barrier to flow to the west up to an elevation of approximately 10.0m, with the exception of a culvert under the west end of the track that slowly drains the inner track area into the existing drainage ditch/Wsikem Creek.

Due to the low elevations of the sump and because there is only minor ditching within the sump, stormwater resides in the area for extended periods after an event. The agricultural land is unable to drain effectively in the existing condition.

3. Future Conditions

The proposed development includes filling the development site to prevent flooding. The elevation of fill will be higher than El. 10.0 m and therefore has the effect of displacing the available flood storage that is currently on the development site. The fill would reduce flood storage by approximately 9,000 m^3 below El. 10.0 m. The following onsite and offsite stormwater management plan addresses the loss of flood storage while also improving the flooding and drainage conditions in the farmland west of the development site, and the properties along the Wsikem Creek System.

3.1 Stormwater Management Plan

The proposed overall stormwater management plan includes onsite and offsite components.

Onsite Stormwater Plan

The onsite components include:

- Development site detention to attenuate peak flows;
- Flood protection for all buildings;
- Reasonable flood protection for parking areas (Larger events will pond in the rain gardens and adjacent parking areas);
- Development site rain gardens to store and treat parking lot runoff;
- Development site drainage system to convey site flows into the offsite system for minor and major events; and
- Low permeable fill material along the edges and bottom of the development site to separate upstream catchment rainwater in the McDonald Park Road ditch from the development site's sub-surface storage.

Details of the performance criteria to meet the above components are provided in Section 4.1. The resulting layout and sizing of the onsite components is presented in Section 4.5 and shown on the development design drawings.

Offsite Stormwater Plan

The proposed offsite stormwater management plan includes short term, medium and long-term upgrades as follows:

1. Development On-Site Fill - prevent flooding of the development site.
2. East-West Drainage Connection – provide baseflows from the McDonald Park Road ditch into Wsikem Creek and provide better drainage for the agricultural land "sump" toward the Pat Bay Highway culvert.
3. Enlarged McDonald Park Road Ditch - contain the flows from the catchments south of Glamorgan Road and route to the Flow Control Structure.
4. North Berm and Swale - prevent flows from north of the site from contributing to the flooding in the "sump".
5. New Drainage Ditches - provide improved drainage and freeboard during baseflows to the agricultural lands and offset the loss of storage due to filling.
6. Remove Elevated Track – restore area for farming by removing a majority of the track material and offset the loss of storage due to filling.
7. West Berm and Spillway – Prevent peak flows into Wsikem Creek during small rainfall events while the "sump" and agricultural lands flood. Once the flooding in the agricultural land exceeds a 10.0 m Elev, the spillway will decant excess flows into the creek (short term). Over the long term, no stormwater is to decant west towards Wsikem Creek.
8. Wsikem Creek Baseflow Structure – Improve baseflows in the creek by providing an adjustable orifice in the West Berm.

The long-term plan includes the Pat Bay Highway / McDonald Park Road culvert and downstream drainage system upgrades as proposed in the "McDonald Park Road Drainage Study" (Reid Crowther, 2000). These upgrades will eliminate flows from the McDonald Park Road ditch into the agricultural area and into Wsikem Creek, thereby further improving the flooding in those locations in the long term. However, given the anticipated time frame of the long-term upgrades versus the timing of the development of the Sandown Site, this technical memorandum addresses the short and medium-term conditions only.

The proposed short and medium term offsite drainage system is shown in Figure 2 and its components are described below.

Agricultural Improvements

As mentioned previously, the agricultural land can be characterized as a "sump" meaning the land is low and rainwater ponds prior to draining to neighbouring receiving waters. There are also major hydraulic restrictions preventing the proper draining of the area. Specifically, due to the lack of drainage ditches, cut-off trenches, and conveyance measures within the sump, drainage water remains on the land for extended periods following rainfall events. To remedy this, the agricultural plan proposes to improve the drainage ditch through the centre of the sump to lower standing water levels, provide proper conveyance, and reduce residency times of floodwaters. However, to ultimately eliminate the existing flood frequency, the long-term offsite drainage improvements (described above) are required. Additional modifications to the Reid Crowther plan could include the further lowering of the proposed agricultural ditch and utilizing ditch storage to reduce the size of the proposed Pat Bay Highway / McDonald Park Road culvert upgrade.

Development Site Fill and Agricultural Land

The commercial development site is currently too low and prone to flooding. Fill will be placed to raise the site above the flood level and to allow the site drainage systems to drain into the McDonald Park Road ditch.

East-West Drainage Connection

A connection between the McDonald Park Road culvert (also known as the Pat Bay Highway culvert/crossing) (see Figure 2) and the agricultural land west of the proposed development will be provided in the short term (Phase 1 of development) by an open channel along the north end of the Phase 1 fill. In the medium term, once Phase 2 is built, the ditch will be enclosed and the connection will be provided by a 1350 mm pipe under Phase 2. Because the open channel and 1350 mm pipe will be at a lower elevation than the McDonald Park Road culvert, baseflows from the McDonald Park Road ditch will flow toward Wsikem Creek. Higher flows in the ditch will be split between flowing toward the agricultural area and the McDonald Park Road culvert. The flow split percentage will depend on the water levels in the agricultural ditch. Stored water in the agricultural ditches will drain back to the McDonald Park Road culvert after the peak flows in the McDonald Park Road ditch recede. The open channel and pipe east-west drainage connection will be flat to allow two-way flow.

Enlarged McDonald Park Road Ditch and Culverts

The existing ditch along the west side of McDonald Park Road will be enlarged to convey the design flow (25-year return period) with a water level drop between Glamorgan Road and the Flow Control Structure to not exceed approximately 1 m, the grade of McDonald Park Road. Culverts under driveways, and the Glamorgan Road culvert that is to be upgraded, are also to be sized for minimal head loss. The ditch invert elevation at the McDonald Park Road culvert will be 8.6 m to match the culvert invert and 10.3 m at Glamorgan Road.

North Swale and Berm

A shallow swale along the north property line and a berm along its south side are proposed. This swale would run from the northwest corner of the development site, along the north property line to the west berm (see West Berm and Spillway) and then south to the watercourse. This swale would intercept the flow from the properties to the north, preventing them from contributing to the floodwater in the agricultural area. The north berm would be constructed to Elevation 10.3 m.

New Drainage Ditches

New deeper drainage ditches are proposed within the agricultural area for several reasons. The deeper ditches will more effectively and quickly drain the farm fields by connecting the "sump" area to the McDonald Park Road culvert. The excavated ditch volume will partially offset the storage loss due to the development fill. The ditches will provide more freeboard for the agricultural land during baseflows to allow more of the agricultural land to drain. The ditches will also provide a link between the McDonald Park Road ditch and Wsikem Creek for sustained baseflows.

Remove Elevated Track

The track is composed of a compacted gravel material not suitable as a growing media. The majority of the track material will be removed and the area regraded to remove the elevated berm formed by the track surface. A narrow portion of the north and west edges of the track may be kept to form a berm (see West Berm and Spillway for details). The track material is intended to be used as part of the fill material for the development site.

West Berm and Spillway

Because there are known flooding issues farther downstream along Wsikem Creek, it is proposed that the flows from the Sandown Race Track lands into the top of Wsikem Creek be regulated. A partial barrier to overland flow to the west already exists as the west portion of the Sandown track is elevated above the natural ground levels and the ground south of the track is naturally higher. There is also an existing 400 mm diameter culvert that will also contribute to regulating the flows. However, if the entire track material were removed and regraded, this barrier to flow would need to be re-established. It is therefore proposed that a berm be constructed. This west berm would need to be tied into the high ground to the south and into the proposed north berm. The proposed west berm would have a crest elevation of 10.3 m and would incorporate a spillway to protect the berm during storm events that would otherwise overtop the berm. This spillway would be a 15 m wide section of berm armoured to prevent erosion with a lower crest elevation (El. 10.0 m). The ideal location for the spillway would be on the Wsikem Creek/tributary ditch alignment so that overflows would immediately enter the watercourse.

The berm could also have either a 400 mm diameter culvert (as currently in place) or a low level drain for baseflows as described in the next section. In addition, two options for the location of this West Berm have been evaluated: Option 1 –West End of Sandown Race Track and Option 2 –West End of Area Currently Proposed for Reclamation (approximately 200m west of the west end of the Sandown Race Track). The two options will be evaluated in Section 4.

Wsikem Creek Baseflow Structure

An orifice outlet through the west berm would allow baseflows to continue down Wsikem Creek. Sustaining baseflows to Wsikem Creek would provide additional environmental benefits to the creek system. These baseflows would drain toward the orifice outlet via the proposed agricultural ditches. The most reliable source of baseflows may be from the McDonald Park Road ditch that has a large catchment area. As noted above, the East-West Connection will send baseflows toward the agricultural ditches and Wsikem Creek

The exact baseflow rate can be adjusted through discussion with District staff. For the purposes of this study it was assumed that a 23 L/s baseflow would be desired. This is based on a 0.25 L/s/ha unit baseflow rate and the McDonald Park Road ditch catchment area of 91 ha. Of interest, 0.25 L/s/ha is the generally accepted winter baseflow by DFO for coastal BC creeks.

No watercourse upgrades downstream of the baseflow orifice structure are anticipated.

4. Modeling and Analysis

The existing conditions and the proposed stormwater management plan were modelled using the PCSWMM software to size the offsite conveyance elements and to assess the flows, water levels, and flooding durations during design events.

4.1 Stormwater Criteria

The following criteria guided the development of this offsite SWMP as well as the onsite stormwater capture, detention and storage. The District of North Saanich have recommended that the proposed development adopt the drainage criteria from the District of Saanich. Additional criteria for the agricultural land have been adopted from BC Ministry of Agriculture (ARDSA) and are widely used on similar lowland areas in the City of Surrey and Abbotsford.

Conveyance

The offsite drainage system is designed to convey the 25-year peak flow without flooding adjacent roadways.

The onsite storm drains have been designed to convey the 10-year peak flow, calculated using the rational method. The minimum onsite pipe diameter for storm drains is 200 mm. All the onsite storm drains will have a diameter less than 900 mm.

Detention

The onsite drainage system is sized to detain the 2-year storm to 10 L/s/ha with a storage volume of 100 m3/ha. This is based on the District of Saanich detention criterion for discharge to non-sensitive watercourses. The Sandown Site primarily discharges to a storm sewer leading to the ocean as the flows toward Wsikem Creek will be restricted to baseflows rates during 2-year return period storms. All surfaces both parking lot area and roof tops will need to meet these criteria. Maximum discharge to any offsite connections shall not exceed 10 L/s/ha under the 2-year design flow.

Parking Stall Flooding

The height of the development site will be set such that parking stall flooding will be limited to less than 20% of the stalls under a 2-year storm and less than 30% of the stalls under a 10-year storm. The minimum parking lot height that achieves this objective is 10.3 m. Figures 3 and 4 show the extents of onsite flooding under the 2-year and 10-year storm events. The analysis was completed assuming a McDonald Road ditch HGL of 10.2 m and the rain garden storage completely filled.

Rain Garden Design Criteria

The rain gardens should be designed to meet the following criteria:

- Maximum impervious area to pervious are ratio of 20 (I/P = 20);
- Store and infiltrate the 2–year storm such that the release rate of the site does not exceed the detention criteria of 10 L/s/ha;
- Filter 90%+ of the runoff leaving the parking areas using the growing medium of the rain gardens for 90 % of the annual rainfall events;
- The minimum width of a rain garden should not be less than 1.47 m; and
- The minimum depth of a rain garden shall be 0.3 m.

Also, filter fabric should be used to separate both growing medium and rock storage areas as well as road base material and rock storage areas.

Baseflows to Wsikem Creek

The target baseflow rate selected for Wsikem Creek is 23 L/s which is based on a 0.25 L/s/ha unit baseflow rate and the McDonald Park Road catchment area of 91 ha. This rate may be adjusted if more or less baseflow in Wsikem Creek is desired by the District.

ARDSA Criteria

The agricultural areas were assessed based on the level of service described in the Agri-Food Regional Development Subsidiary Agreement (ARDSA). The ARDSA criteria can be summarized as follows:

- Limit flooding to a maximum of 5 days during the 10-year 5-day winter storm (November 1 to February 28);
- Limit flooding to a maximum of 2 days during the 10-year 2-day growing season storm (March 1 to October 31); and
- Maintain the water level in ditches 1.2 m below the average ground level between storm events, and in periods when drainage is required, to provide a free outlet for drains (spring, fall).

Typically, the lowest 5% of land is excluded from having to meet the criteria in order to minimize ditch depths. The areas that are lower than the elevation at the 5% cutoff may be reclaimed up to the 5% elevation.

Design storms

The design storms used for the conveyance and detention assessment are the Environment Canada Atmospheric Environment Service (AES) BC Coast distributions (Hogg, 1980). The short duration storms (1-, 2-, and 6-hour) use the 30th percentile distribution while the long duration storm (12- and 24-hour) use the 50th percentile distribution.

The ARDSA 10-year 2-day and 10-year 5-day storm distributions were first developed for assessing the Serpentine/Nicomekl Rivers floodplain farmland in Surrey. These storms were scaled for the Site location.

The Victoria International Airport AES Station 1018621 IDF was used for the storm depths. The 2-day and 5-day storms were scaled based on the 24-hour storm depth as a long IDF showing 2-day and 5-day 10-year storm depths was not readily available.

The design storms are summarized in Appendix A.

4.2 Storage Volume Mitigation

Filling the development site will reduce the flood storage volume. To offset the impacts of the fill, additional storage volume will be provided by excavating major ditches in the farmland west of the development and removing the track berm. Figure 5 shows the storage volume versus elevation curves for the existing, future unmitigated, and future mitigated conditions.

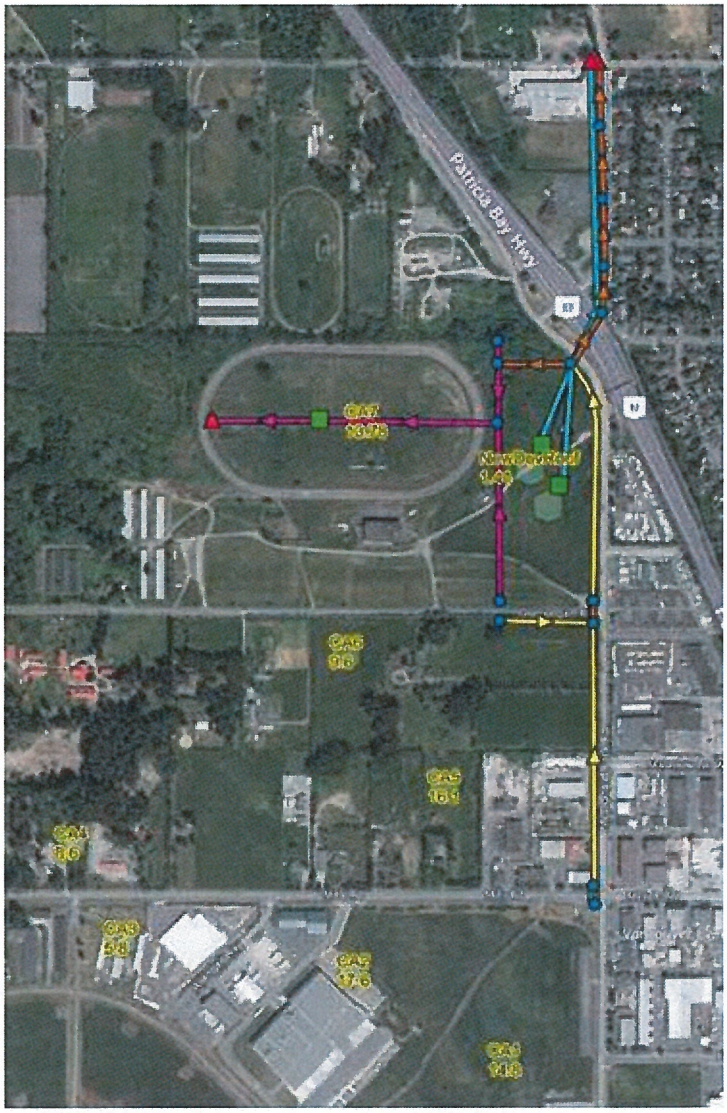
The blue curve on Figure 5 shows the existing storage volume up to elevation 10.0 m. Above 10.0 m, flood water would decant to Wsikem Creek via the proposed spillway and therefore higher elevations are not shown.

The red curve on Figure 5 shows the reduced storage due to filling of the development site. The green shaded zone between the blue and red curves is the development fill and is approximately 7,200 m^3 in volume at the 10.0 m elevation. The yellow curve represents the storage after the ditches are excavated and the track is lowered. As shown, the yellow curve is to the right of the blue curve meaning that there is more storage volume at all elevations in the mitigated condition than in the existing condition and storage impacts of the development fill are offset.

Figure 5 also shows the elevations of the two outlets out of the area. The Wsikem Creek culvert (and future orifice) is slightly lower than the McDonald Park Road culvert which will ensure that baseflows drain to the creek before overflowing toward the highway.

4.3 Model Setup

A PCSWMM model was built using information from GIS data, site survey, and previous modelling studies. The extents of the hydrologic model included the catchment upstream of the Pat Bay Highway culvert. The hydraulic model included the McDonald Park Road ditch from just upstream of the Mills Road culvert to the downstream end of the McDonald Park Road culvert, the culvert under the Pat Bay Highway, and the 600 mm diameter storm sewer downstream to Resthaven Drive (see inset to the right).



A free outfall condition was applied at the downstream end of the 600 mm storm sewer where it transitions to a 1350 mm storm sewer.

The Sandown development site was represented by two storage nodes representing the rooftop and rain garden storage volumes with 10 L/s/ha low-level outlets and overflows at the full (2-year) storage volume. The agricultural area west of the development model included the proposed ditches and the control structure (orifice and weir) at the upstream end of Wsikem Creek. A storage area versus elevation relationship was included to allow the flooding to be assessed for the ARDSA events. In the existing condition model, the storage area was divided into two areas, inside the track and outside of the track as each drains independently.

Calibration data was not available. The model peak flows in the McDonald Park Road ditch were calibrated to match the 25-year peak flows in the previous study. Table 1 below shows the results of the comparison. As shown, the current flows are in line with the previously-modelled flows. The differences in peak flows may be attributable to the design storm shapes and the hydrologic calculation methods used in the two studies. The peak flows and flow volumes utilized are conservative and could be refined should calibration data become available.

Table 1: Peak Flow Comparison

Location	RC 2000[1]	KWL 2017
10-Year ARDSA Storm		
Mills Road culvert	1.08	1.34
Glamorgan Road culvert	2.13	2.46[3]
25-Year AES Storms		
Mills Road culvert	1.31	1.54[2]
Glamorgan Road culvert	2.59	2.49[3]

1. McDonald Park Road Drainage Study, Reid Crowther 2000.
2. Includes Mills Road overtopping as well as the culvert flow.
3. Includes Glamorgan Road overtopping as well as the culvert flow.

4.4 Model Results

Existing Conditions

Under existing conditions, the Sandown lands flood progressively from east to west. The McDonald Park Road ditch flows exceed the capacity of the 750 mm diameter culvert under McDonald Park Road (and under Pat Bay Highway) and the ditch flows spill into the low-lying area immediately west. Once the water level in this area rises to approximately 10.1 m, the south side of the Sandown Race Track overtops and the inside of the track floods. After the storm passes, the inside of the track is able to drain via a 400 mm diameter culvert under the west end of the track (invert elevation 8.48 m). The area outside of the track is unable to drain and appears to rely on infiltration to drain standing water.

The ARDSA storms were run through the existing conditions model. Table 2 summarizes the model results of the existing and future scenarios. The future condition assumes a berm is built to mimic the function of the existing race track and include the existing 400 mm culvert to Wsikem Creek.

Table 2: Model Results Comparison

Model Scenario	10-Year 2-Day			10-Year 5-Day			Ground El. Meeting ARDSA Baseflow Freeboard (m)
	Peak WL (m)	Ground El. Meeting 2-Day Drain Time (m)	% Area Meeting 2-Day Drain Time	Peak WL (m)	Ground El. Meeting 5-Day Drain Time (m)	% Area Meeting 5-Day Drain Time	
Existing Condition							
Inside Track	9.52	8.99	82%	9.68	8.62	95%	9.8
Outside Track	10.15	9.66	86%	10.18	9.67	86%	10.9
Combined Existing Condition	**10.15**	**9.3**	**85%**	**10.18**	**9.2**	**89%**	**10.8**
Future Condition							
WC BCS at West End of Track	**9.75**	**9.09**	**87%**	**9.8**	**8.85**	**94%**	**9.9**

Based on the above, the filling of the development site can be adequately off-set by the construction of the new agricultural ditch as the drain times and peak water levels are comparable. It should be noted that the above results do not include a baseflow control structure to Wsikem Creek. The impact of this addition is discussed later in this section.

Pipe Sizing

The proposed offsite pipes include the McDonald Park Road culverts, and the ditch (Phase 1) and pipe (Phase 2) under the north end of the development site transferring water between the McDonald Park Road ditch and the agricultural ditches. The following sections summarize the design flows and required sizes.

McDonald Park Road Ditch Culverts

The 25-year peak flow in the ditch fronting the development site is 2.49 m^3/s. The goal is to minimize the head loss through these driveway culverts given the relatively flat grade of this section of ditch. Box culverts 1.8 m wide x 0.9 m tall are able to pass this design flow with less than a 0.2 m head loss.

East-West Connection Pipe under Site (Phase 2)

The purpose of this pipe is to minimize flows toward Wsikem Creek and to allow two-way flow between the McDonald Park Road ditch flow control structure and the proposed agricultural ditches. The head loss through this pipe needs to be minimized to allow the water levels on either end of the pipe to equalize. A 1350 mm diameter pipe allows the flow transfer to occur with a maximum head loss of approximately 0.6 m and allows the water levels on either end to equalize quickly.

Wsikem Creek Baseflow Control Structure

The purpose of the proposed Wsikem Creek Baseflow Control Structure (WC BCS), acting in conjunction with the proposed West Berm, is to prevent high flows while feeding baseflows to the creek. The WC BCS also includes an overflow spillway to protect the berm and decant excess flood flows during extreme events to the west, into the creek. The spillway could be constructed from a variety of materials including riprap, and can be constructed separately into the berm. It should safely allow major storm events up to the 25-year return period assuming a blocked Pat Bay Culvert system (larger storm events will not reach the development site and will overflow to other areas upstream).

The baseflow orifice is sized to deliver the desired 23 L/s baseflow into the creek during low flow events. During high water levels (2-year to 25-year events), the peak baseflow rate would be approximately 50 L/s. The orifice invert elevation matches the existing creek invert elevation. No watercourse upgrades downstream of the baseflow orifice structure are anticipated.

The spillway should be approximately 15 m wide to limit the peak water levels to no more than a few centimeters above elevation 10.0 m for the 25-year flow. The berm should have freeboard above this peak water level and should therefore have a crest elevation of 10.3 m.

Two options were explored for the location of the WC BCS, at the west edge of the Sandown Race Track and at the west edge of the area currently proposed for reclamation located approximately 200m west of the west end of the race track. The following section describes the advantages of each option.

Option 1: WC BCS at West End of Sandown Race Track

The advantages of constructing the WC BCS at this location are:

- Less disturbance to Wsikem Ditch/Creek as a berm and culvert already exist at this location
- A portion of the race track may be used as the berm with very little raising required (0.3m) assuming the race track material is acceptable.

The disadvantage of this option is less contiguous arable land, although the same total area of arable land would be achieved.

The baseflow orifice required at this location is 150 mm diameter with an invert elevation of 8.5 m. The peak 2-year and 25-year peak water levels in the agricultural ditches upstream of the WC BCS are 9.52 m, and 9.97 m, respectively. The ARDSA assessment results are presented later in this section.

Option 2: WC BCS at West End of Area Currently Proposed for Reclamation

This option was explored at the request of the ALC and the District. The inset below shows the alignment of the berm in this option. Essentially, the existing berm proposed along the north property line is extended westward to encompass the area currently proposed for reclamation west of the Sandown Race Track.

The advantage of constructing the WC BCS at this location is that it increases the contiguous arable field size. The disadvantages are:

- A longer berm needs to be constructed along the north property line.
- The western, less productive, farmland would become flooded as well as the eastern better-suited farmland.
- The peak flood levels are not significantly reduced. This is because more upstream catchment would become tributary to the bermed-off area (31 ha additional area draining from the south)
- A 200 m longer length of Wsikem Ditch/Creek would become backwatered by the berm/orifice.
- Instream works permit may be required to build the berm and orifice structure at this location.

The baseflow orifice required at this location is 130 mm diameter with an invert elevation of 7.5 m. The peak 2-year and 25-year peak water levels in the agricultural ditches upstream of the WC BCS are 9.45 m, and 9.9 m, respectively. These peak water levels are only slightly lower than Option 1. The ARDSA assessment results are presented in the next section.

ARDSA Assessment

The 10-year 2-day growing season and 10-year 5-day winter storms were run through the models to assess whether the ARDSA criteria would be met in the short and medium terms, prior to the Pat Bay Highway drainage improvements being constructed. The results of the two WC BCS (Wsikem Creek Baseflow Control Structure) location options are summarized below.

Table 3: Results of ARDSA Assessment

Model Scenario	10-Year 2-Day			10-Year 5-Day			Ground El. Meeting ARDSA Baseflow Freeboard (m)
	Peak WL (m)	Ground El. Meeting 2-Day Drain Time (m)	% Area Meeting 2-Day Drain Time	Peak WL (m)	Ground El. Meeting 5-Day Drain Time (m)	% Area Meeting 5-Day Drain Time	
Existing (Results east of west end of track only)							
Inside Track	9.52	8.99	82%	9.68	8.62	95%	9.8
Outside Track	10.15	9.66	86%	10.18	9.67	86%	10.9
Combined Existing Condition	**10.15**	**9.3**	**85%**	**10.18**	**9.2**	**89%**	**10.8**
Future without Baseflow Orifice to Wsikem Creek							
WC BCS at West End of Track (Option 1)	9.75	9.09	87%	9.8	8.85	94%	9.9
WC BCS 200m West of Track (Option 2)	9.63	9.09	81%	9.70	8.75	91%	9.1
Future with Baseflow Orifice							
WC BCS at West End of Track (Option 1)	9.92	9.63	45%	9.99	9.57	49%	10.0
WC BCS 200m West of Track (Option 2)	9.88	9.67	45%	10.03	9.79	42%	10.0

Option 1: WC BCS at West End of Sandown Race Track

With the WC BCS located at the west end of the current Sandown Race Track, the models show the following results. The peak 10-year water level in the agricultural area reaches an elevation of 9.75 with a 400 mm culvert similar to the existing conditions, and 9.92 m with a smaller baseflow orifice, which would not overtop the spillway in the West Berm. Furthermore, this elevation is approximately equal to the anecdotal peak water level of approximately 10 m observed during a 2-year event under the existing conditions.

With the baseflow orifice in place, the land above elevation 9.6 m will flood for less than 2 days in the growing season storm and less than 5 days in the winter storm, meaning that approximately 45% of the farmland east of the berm would meet the ARDSA flooding duration criteria. As shown in Table 3 above, if the orifice were removed the elevation meeting the ARDSA criteria would be lowered to approximately 9.1 m which is a 0.5 m improvement. Without the baseflow orifice, the Option 1 results are better than the combined existing condition.

The water level during baseflow in the proposed agricultural ditches is 8.8 m and therefore only land above elevation 10.0 m will receive 1.2 m or more freeboard, meaning that 35% of the area east of the berm would meet the full 1.2m freeboard criterion. This restriction is structural based on the current inverts of Wsikem Creek and the existing Pat Bay Culvert invert (i.e. it is not possible / practical to achieve the 1.2 m freeboard). As an aside, Madrone Environmental Services found that the excess soil moisture limitation to farming requires a minimum of 0.2 m of freeboard. This would mean that areas above elevation 9.0 m (92% of the area) would meet this reduced freeboard criterion.

Option 2: WC BCS at West End of Area Currently Proposed for Reclamation

With the WC BCS located at the west end of the area currently proposed for reclamation, the models show the following results. The peak 10-year water level in the agricultural area reaches an elevation of 10.03 m with the baseflow orifice and 9.70 m without it. This is actually slightly higher than Option 1 with the WC BCS located at the west end of the Sandown Race Track. The peak water level is not lower due to the additional 31 ha of catchment area that would flow into the bermed farmland area if the berm was moved 200 m to the west.

East of the berm, the land above elevation 9.67 m would flood for less than 2 days in the growing season storm and less than 5 days in the winter storm, meaning that 45% of the farmland east of the berm would meet the ARDSA flooding duration criteria with a baseflow orifice. Without the baseflow orifice, like Option 1, the peak levels drop. In other words, moving the berm to the Option 2 location slightly increases the level of flooding and slightly reduces the ARDSA level of service.

It is recommended that the Option 2 berm alignment not be implemented due to its numerous disadvantages and limited benefits. The benefits of Option 1 over Option 2 are less disturbance to Wsikem Ditch/Creek, less berming required both in terms of length and height, smaller area of flooding upstream of the berm in the near term, no instream works and therefore no permitting required, and a lower cost.

Discussion of Baseflow Orifice Results

Table 4 provides a summary of the above conclusions using the selected Option 1 location and the "combined" existing condition.

Table 4: Impact of Wsikem Creek Baseflow Orifice

Model Scenario	10-Year 2-Day			10-Year 5-Day			Ground El. Meeting ARDSA Baseflow Freeboard (m)
	Peak WL (m)	Ground El. Meeting 2-Day Drain Time (m)	% Area Meeting 2-Day Drain Time	Peak WL (m)	Ground El. Meeting 5-Day Drain Time (m)	% Area Meeting 5-Day Drain Time	
Existing Condition (Results east of west end of track)	10.15	9.3	85%	10.18	9.2	89%	10.8
Future Condition (without Baseflow Orifice to Wsikem Creek)	9.75	9.09	87%	9.8	8.85	94%	9.9
Future Condition (with Baseflow Orifice to Wsikem Creek)	9.92	9.63	45%	9.99	9.57	49%	10.0

The results suggest that with the introduction of the baseflow orifice to Wsikem Creek, the peak water levels in the agricultural areas will increase by roughly 0.6 to 0.7 m, and the % area meeting the drain time criteria will decrease by 50%. However, due to the improved connectivity of the agricultural land with the proposed agricultural ditch, flood storage is improved such that storm flows to Wsikem Creek are reduced compared to the existing condition. Stated another way, storm flows to Wsikem creek from the McDonald Park system begin to occur at a 2-year return period under existing conditions. With the baseflow orifice, the level of protection to Wsikem Creek is increased to a 10-year level. Since there are concerns with existing flooding issues, and it has now been determined that the McDonald Park drainage system is interconnected with the Wsikem Creek catchment it is therefore recommended that the Wsikem Creek orifice be installed and its removal and/or adjustment considered when long term drainage improvements are further investigated and implemented.

4.5 Detailed Onsite Stormwater Management Plan – Phase 1

Stormwater flows from the proposed commercial development site will be managed to meet the criteria presented in Section 4.1 prior to release into the McDonald Park Road drainage system. This section presents the components of the onsite stormwater management system. The rain garden, manhole and pipe identifiers refer to the labels shown on the design drawings which are not included as part of this report.

Table 5 summarizes the various land covers in Phase 1 and their areas.

Table 5: Phase 1 Areas

Type	Area (m^2)
Building (roof)	4,579
Pavement	10,495
Rain Garden	682
Planter	17
Total	**15,773**

The proposed development will increase the onsite impervious area from 2% to 92%. The following Low Impact Development (LID) techniques and stormwater Best Management Practices (BMPs) are proposed to manage the site flows:

1. The impervious percentage of the site has been minimized with the installation of 680 m^2 of rain gardens and a 17 m^2 planter within the parking lot. Additional pervious areas are located offsite in an absorbent topsoil infiltration slope along the west side of the site and in the green space between the pathway and parking lot on the east side of the site.
2. Flows from the parking lot will be treated for water quality and detained by the rain gardens and further detained in underground rock trenches below the rain gardens.
3. The building roofs on the site have 25 mm of rooftop storage, which will regulate and detain peak flows.
4. Runoff from the areas on the west side of the buildings (2040 m^2) is treated and infiltrated to ground in an absorbent topsoil layer located west of the western property line.

The proposed system improves stormwater quality by directing runoff from the paved areas to rain gardens in the parking lot and absorbent topsoil slope along the west side of the site. Events up to the 2-year return period will infiltrate into the soils.

Storm Sewers

The storm drains were sized for the 10-year return period event using the Rational Method. Pipe velocities shown are for full flow conditions. All storm pipes have been sized to have 90% of their pipe full capacity be larger than the calculated design flow. Table 4 summarizes the Rational calculations and pipe sizing

Table 6: Storm Drain Calculations

	Incremental Area (ha)	Area (ha)	Time of Concentration (min)	Rainfall Intensity (mm/hr)	Runoff Coefficient	Actual Flow (m3/s)	Pipe Size (mm)	Slope (%)	Length (m)	Manning's n	Flow Capacity (m3/s)	Velocity (m/s)	Travel Time (min)	Remarks
A to MH2	0.07	0.07	5	53.6	1	0.011	200	1	23.4	0.013	0.033	1.04	0.4	Rain Garden A
MH1 to MH2	1.53	1.53	10	35.5	1	0.151	525	0.3	10.3	0.013	0.235	1.09	0.2	Phase 3
MH2 to MH3	0	1.6	10	35.5	1	0.158	525	0.3	20.7	0.013	0.235	1.09	0.3	Trunk A to C
B to MH3	0.06	0.06	5	53.6	1	0.01	200	1	15	0.013	0.033	1.04	0.2	Rain Garden B
C to MH3	0.01	0.01	5	53.6	1	0.001	150	1	3.4	0.013	0.015	0.86	0.1	Rain Garden C
MH3 to MH4	0	1.68	10.3	35.5	1	0.166	525	0.3	17.7	0.013	0.235	1.09	0.3	Trunk C to D
D to MH4	0.08	0.08	5	53.6	1	0.012	150	1	15	0.013	0.015	0.86	0.3	Rain Garden D
MH4 to MH5	0	1.76	10.6	35.5	1	0.174	525	0.3	17.7	0.013	0.235	1.09	0.3	Trunk D to E
E to MH5	0.18	0.18	5	53.6	1	0.027	200	1	15	0.013	0.033	1.04	0.2	Rain Garden E
MH5 to GTMH6	0	1.94	10.9	35.5	1	0.191	600	0.3	18	0.013	0.336	1.19	0.3	Trunk E to G
Roof to GTMH6	0.45	0.45	5	53.6	1	0.067	300	1	23	0.013	0.097	1.37	0.3	Building A Roof
F to GTMH6	0.04	0.04	5	53.6	1	0.006	150	1	21.5	0.013	0.015	0.86	0.4	Rain Garden F
H to GTMH6	0.02	0.02	5	53.6	1	0.003	150	1	13.9	0.013	0.015	0.86	0.3	Rain Garden H
GTMH6 to GTMH7	0.03	2.48	11.1	35.5	1	0.245	600	0.3	17.3	0.013	0.336	1.19	0.2	Trunk G to K
J to GTMH7	0.04	0.04	5	53.6	1	0.006	150	1	21.5	0.013	0.015	0.86	0.4	Rain Garden J
L to GTMH7	0.02	0.02	5	53.6	1	0.003	150	1	13.9	0.013	0.015	0.86	0.3	Rain Garden L
I to GTMH7	0.22	0.22	5	53.6	1	0.032	250	1	36.3	0.013	0.059	1.21	0.5	Rain Garden I
GTMH7 to MH8	0.04	2.76	11.4	35.5	1	0.272	600	0.3	20.7	0.013	0.336	1.19	0.3	Trunk K to M
M to MH8	0.2	0.2	5	53.6	1	0.029	250	1	20.8	0.013	0.059	1.21	0.3	Rain Garden M
MH8 to MH9	0	2.96	11.6	35.5	1	0.292	600	0.3	8.7	0.013	0.336	1.19	0.1	Trunk M to Phase 2
CB1 to GTMH-N1	0.03	0.03	5	53.6	1	0.004	150	1	22	0.013	0.015	0.86	0.4	North of Building A
CB2 to GTMH-N1	0.03	0.03	5	53.6	1	0.004	150	1	18	0.013	0.015	0.86	0.3	North of Building A
CB3 to GTMH-N1	0.02	0.07	5.4	53.6	1	0.011	200	1	13	0.013	0.033	1.04	0.2	North of Building A
GTMH-N1 to MH9	0.02	0.15	5.6	53.6	1	0.022	200	1	50	0.013	0.033	1.04	0.8	North of Building A

Outlet Ditch

In the short term, stormwater will be conveyed from MH9 in Phase 1 through the future Phase 2 via an open channel. The ditch has been sized to convey the 1:10 year storm event flow of 0.314 m^3/s.

The ditch has been sized to convey this flow with a freeboard of 0.15 m. The outlet ditch will have side slopes of 5H:1V, a bottom width of 1.2 m and a depth of 0.4 m.

In the medium term, once Phase 2 is built, this ditch will be replaced by a 600-mm diameter storm pipe.

Rain Gardens

Rain gardens have been designed to have an Impervious to Pervious (I/P) ratio less than or equal to 20:1 to handle the pollutants from the pavement areas. Table 7 summarizes each rain garden catchment area, top area, ponding area, I/P ratio and ponding volume in the rain garden between the invert and the lawn basin rim. The I/P ratio was calculated based on the ponding area which is an average of the top area and bottom area of the rain gardens.

Table 7: Rain Garden Design Details

Rain Garden	Catchment Area (m^2)	Rain Garden Area (m^2)	I/P Ratio	Ponding Volume (m^3)
A	739	42.1	18	8.1
B	649	45.8	14	9.0
C	86	15.3	6	2.8
D	838	68.6	12	12.8
E	1788	122.6	15	24.0
F	405	24.7	16	4.5
G	344	33.7	10	6.2
H	186	24.6	8	4.5
I	2169	149.2	15	29.4
J	426	24.7	17	4.5
K	362	33.7	11	6.2
L	195	24.6	8	4.5
M	1710	99.3	17	13.6
Totals	10160	680	-	116

The rain gardens have been designed with a surface depression depth of 300 mm to accommodate sediment storage over multiple years between cleanings. There will be a 50 mm vertical drop from the edge of curb into the rain gardens to prevent buildup of pollutants at the pavement edge. The side slopes of the rain gardens below the 50 mm vertical drop will be 1.5H:1V and stabilized with plantings.

The inverts of the rain gardens have been kept above 10.0 m elevation to avoid backwatering of the rain gardens from the McDonald Park Road ditch high water levels. Each rain garden will have an effective ponding depth of 250 mm. A 600 mm by 600 mm lawn basin (Langley Concrete Victoria) will be used as an overflow inlet with the rim elevation 250 mm above the rain garden invert. The lawn basin will be complete with a R-4353 Beehive Grate manufactured by Neenah Enterprises Ltd to prevent blocking by gross pollutants or other debris.

Raised curbs adjacent to rain gardens will have curb-cuts to allow the pavement to drain into the rain garden at distributed locations.

Runoff will enter the rain gardens as distributed flow off the parking lot through the curb -cuts. Runoff concentration at the curb-cuts will be minimized using frequent spacing of cuts.

The topsoil layer in the rain gardens will be 450 mm thick. The topsoil used in the rain gardens must have an infiltration rate of 70 mm/hr. A geotextile filter material will be placed between the topsoil layer and the underlying drain rock layer as well as between the drain rock layer and the existing site fill. The geotextile reduces the migration of soil into the drain rock which increases the lifespan of the rain garden.

There will be a 100 mm diameter perforated underdrain at the bottom of the drain rock layer underneath each rain garden to convey excess flows into the storm sewer and prevent saturated topsoil conditions.

The selection of suitable vegetation for the rain gardens is essential to their functionality and lifespan. The vegetation must be able to survive high sediment loading, periodic inundation and in well-draining soils. It is important that plantings in the rain gardens avoid or minimize the use of deciduous trees which drop their leaves into rain gardens and clog the soil.

Rain Garden Structures

Several of the rain gardens will require structures to ensure functionality.

Rain Gardens A and M will require pipes underneath the sidewalk to convey runoff from the parking stalls adjacent to the sidewalks to the rain gardens on the other side of the sidewalk near the drive aisles. Pipes will also be required to connect the rain garden areas on either side of the sidewalk in Rain Garden M.

Grading constraints on the site cause variations in rain garden top elevations. In order to maintain ponding depths and flat rain garden bottoms weir structures are required. Rain Gardens D, E and M will require several weirs to allow water ponding at different bottom elevations along the length of the rain garden. Rain Gardens B, F, H, J and L will require a single weir at the T intersection between the larger north-south bulb and smaller east-west rectangular section.

Absorbent Topsoil Infiltration Slope

Along the west side of the development a 5H:1V infiltration slope is proposed for the paved areas along the west side of the building which cannot be picked up by the drainage system on the east side of the building. The slope will be covered with 700 mm of absorbent topsoil with an infiltration rate of 70 mm/hr. 2040 m^2 of impervious area drain towards the west infiltration slope.

The length of the infiltration slope is approximately 175 m. The infiltration slope ranges in width from 3.1 m to 8.1 m. The total area of the infiltration slope is 920 m^2 yielding and I/P ratio of 2.2.

The runoff from this impervious site area will provide water to the fruit trees that are proposed to be planted on the slope and in turn the topsoil will provide water quality treatment and infiltration.

Detention Storage Volume

The required storage volume for Phase 1 of the site is 158 m^3 (1.58 ha x 100 m^3/ha). The roof areas (0.46 ha) act independently of the pavement area and provide their required storage volume in the 25 mm rooftop ponding (250 m^3/ha provided). The pavement areas (totalling 1.12 ha including the rain garden areas) require 112 m^3 of storage which is provided by the ponding volume in the rain gardens (116 m^3 provided).

In addition to this volume, there is also storage in the rock trenches underneath the rain gardens.

4.6 Conceptual Onsite Stormwater Management Plan – Phases 2&3

The details of the development for the two future phases have not been finalized and therefore detailed sizing has not yet been undertaken. It is anticipated that Phases 2 and 3 will be serviced in a similar fashion as Phase 1 with rain gardens and detention storage for the pavement areas and rooftop detention.

5. Summary

The following Phase 1 onsite works are proposed.

1. Construct storm sewers to convey the minor 10-year flows to the outlet of Phase 1.
2. Construct an open channel through Phase 2 to connect the Phase 1 storm sewers to the McDonald Park Road ditch.
3. Construct rain gardens in the parking lot for pavement runoff treatment and 2-year infiltration and peak flow attenuation.
4. Place absorbent topsoil on the western fill slope to receive runoff from the small areas on the west side of the proposed buildings.

The above Phase 1 onsite works will allow the development to meet the stated criteria. Even though details of the second and third phases of development are not yet known, it is anticipated that Phases 2&3 would be serviced in a similar fashion to Phase 1.

In addition to the onsite works, the following offsite stormwater upgrades are proposed.

1. Construct ditches in the agricultural area with an invert elevation of 8.5 m, a 3m bottom width, and 2H:1V side slopes.
2. Remove the Sandown Race Track material and regrade the track area to match the surrounding ground.
3. Construct a berm at the west side of the Sandown Race Track and along the north property line with a crest elevation of 10.3 m. Construct an armored spillway with a crest elevation of 10.0 m and 15 m width in the berm at the Wsikem Creek alignment.
4. Construct a 400 mm diameter culvert with a 150 mm diameter orifice plate under the berm at the Wsikem Creek alignment. The invert elevation of the upstream (east) end of the culvert and the orifice is 8.5 m.
5. Upgrade the McDonald Park Road ditch to V-shaped with 2H:1V side slopes and install 1.8 m x 0.9 m box culverts at the three driveways into the Site and under Glamorgan Road. The ditch has a constant longitudinal slope with an invert elevation of 10.3 m at Glamorgan Road and 8.6 m at the 750 mm culvert under McDonald Park Road. The culvert inverts match the ditch grade.
6. Construct a ditch (during Phase 1 of development) and replace with a 1350 mm diameter culvert under Phase 2 of the development site (during Phase 2 of development) linking the McDonald Park Road ditch to the agricultural ditch. The invert elevation of both ends of the ditch/culvert is 8.5 m to match the farm ditch invert.
7. Initially install the Wsikem Creek baseflow orifice to reduce flooding issues on Wsikem Creek. Potentially remove the orifice once the long-term drainage improvements have been made and/or the drainage conditions on Wsikem Creek are better understood.

Model results have shown that the above upgrades will provide better drainage to the agricultural land, will contain the 25-year flows so that McDonald Park Road does not overtop, and will reduce the peak flows to Wsikem Creek to 25 to 50 L/s (baseflow rate) during most annual rainfall events. The peak water level in the agricultural land rises to a maximum of approximately 10.0 m during the 25-year return period event.

Model results show that the peak water levels in the agricultural area will be lower than observed existing ponded water levels. Farmland above elevation 9.6 m would meet the ARDSA duration criteria. Land above 10.0 m would meet the ARDSA 1.2 m freeboard criterion which is constrained by the existing Wsikem Creek capacity and the invert elevation of the existing 750 mm culvert under McDonald Park Road (Pat Bay Culvert).

In the long term, should the Pat Bay Highway culvert and downstream storm sewer be upgraded, the ARDSA service level will improve as McDonald Park Road ditch flows will no longer need to enter the farmlands for storage, and the peak water levels surrounding the Sandown Development site will decrease. Additional freeboard during baseflow in the agricultural area could also be achieved by limiting the amount of baseflow toward the agricultural area to the capacity of the WC BCS orifice and with additional ditching and ditch deepening in the agricultural area.

6. Conclusion

We trust the above information is adequate to describe the onsite and offsite stormwater works proposed for the Sandown Development Site.

KERR WOOD LEIDAL ASSOCIATES LTD.

Prepared by:

This document is a copy of the sealed and signed hard copy original retained on file. The content of the electronically transmitted document can be confirmed by referring to the filed original.

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA D. ZABIL #27382 10 Oct 2017

David Zabil, P.Eng.
Stormwater Specialist

Reviewed by:

Chris Johnston, P.Eng.
Principal

DZ/CJ/abc

Encl.: Figure 1 – Current Flooding Extent During ~2 Year Rain
Figure 2 – Proposed Improvement Plan
Figure 3 – Cumulative Storage Volumes vs Elevation (Graph)
Figure 4 – Approximate 2-Year Return Period Flood Elevation (C201)
Figure 5 – Approximate 10-Year Return Period Flood Elevation (C201)

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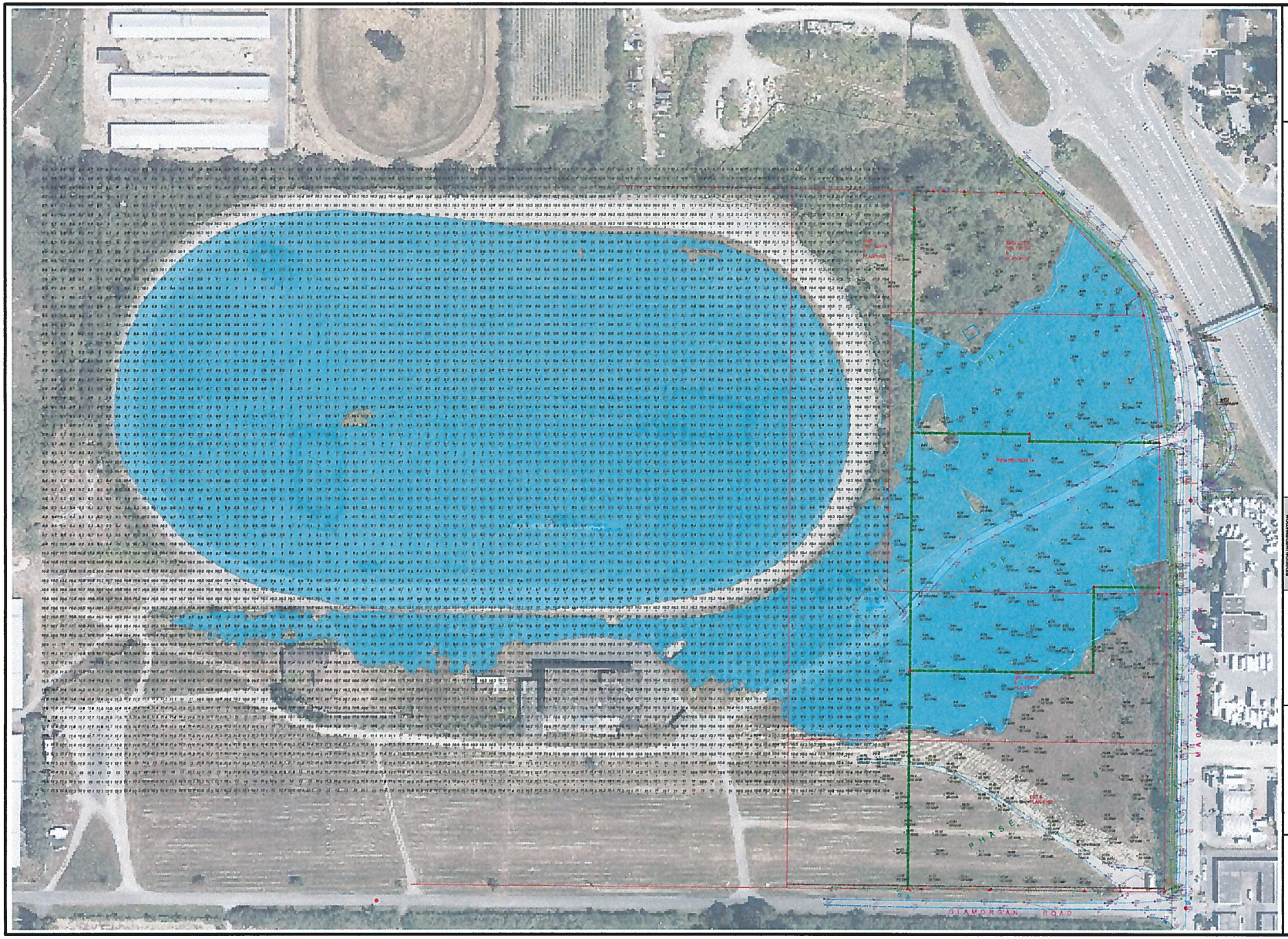
Revision Table

Revision #	Date	Status	Description	Author
0	Oct 10, 2017	Final		DZ
A	Sep 18, 2017	Draft		DZ



SANDOWN DEVELOPMENT

Legend

KERR WOOD LEIDAL
consulting engineers

REVISION INFORMATION	Rev. No.	Date	Drawn	Checked	Description of Revisions

Date April 2017

Project Number 3641-001

N

-20 0 20 (m)
1:2,000

CURRENT FLOODING EXTENTS DURING APPROX 2-YEAR RAIN

FIGURE 1

Path: R:\3600-3699\3641-001\43-GIS\MXD\WK3641001_WA_ExistingFlooding-rpt.mxd Date Saved: 12/04/2017 10:08:42 AM
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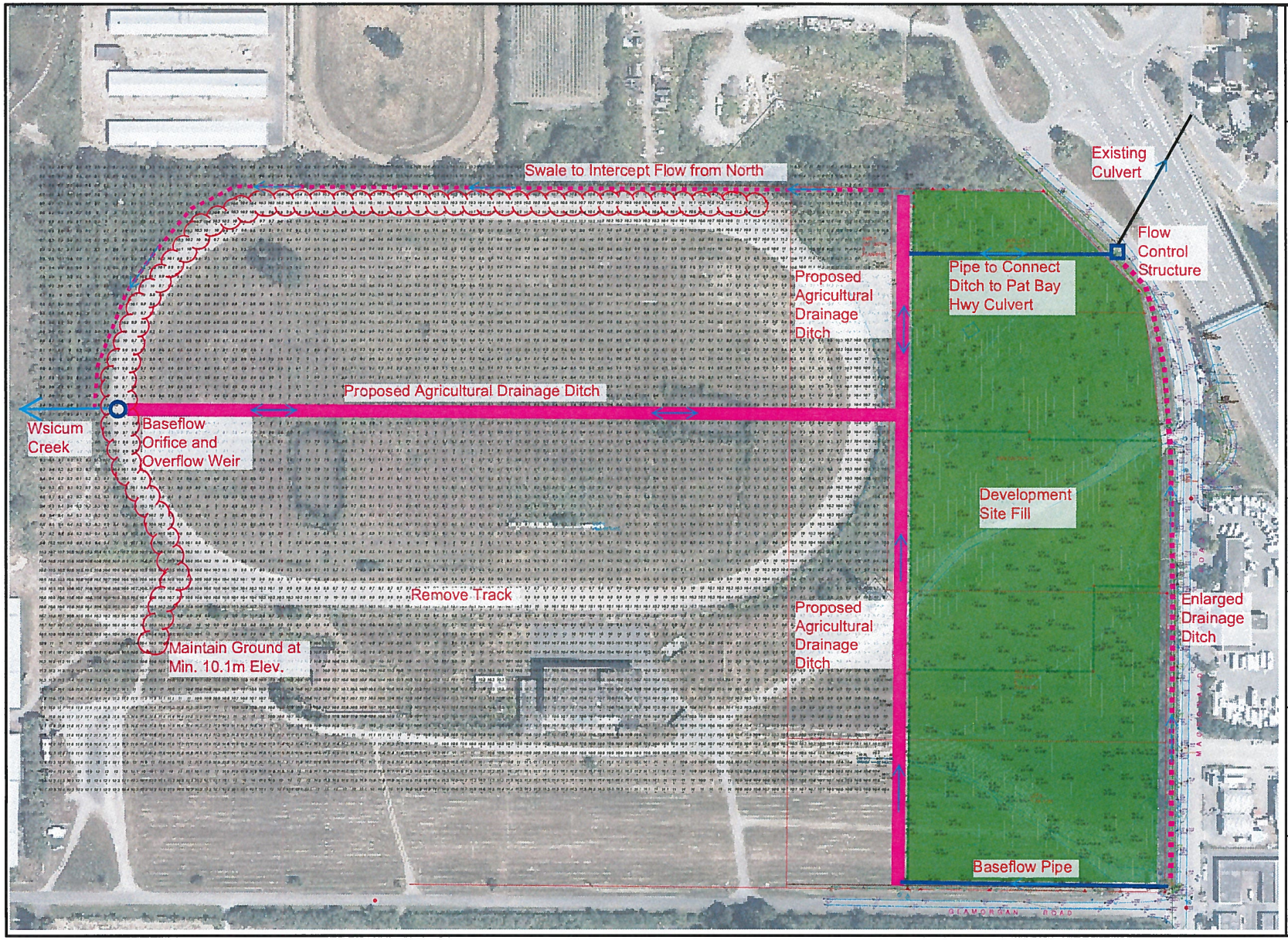

SANDOWN DEVELOPMENT

Legend

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REVISION INFORMATION	Rev. No.	Date	Drawn	Checked	Description of Revisions

Date: April 2017

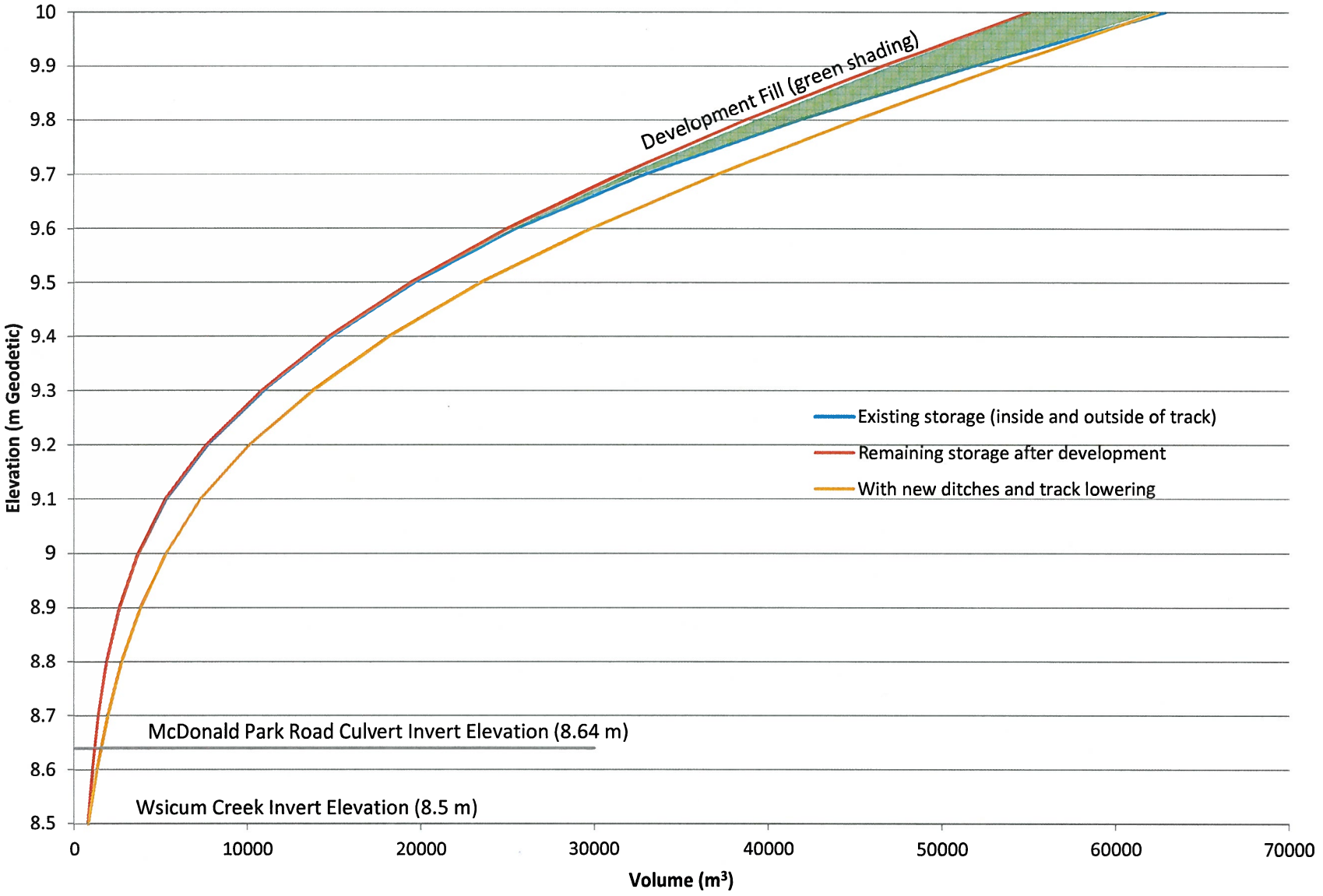
Project Number: 3641-001

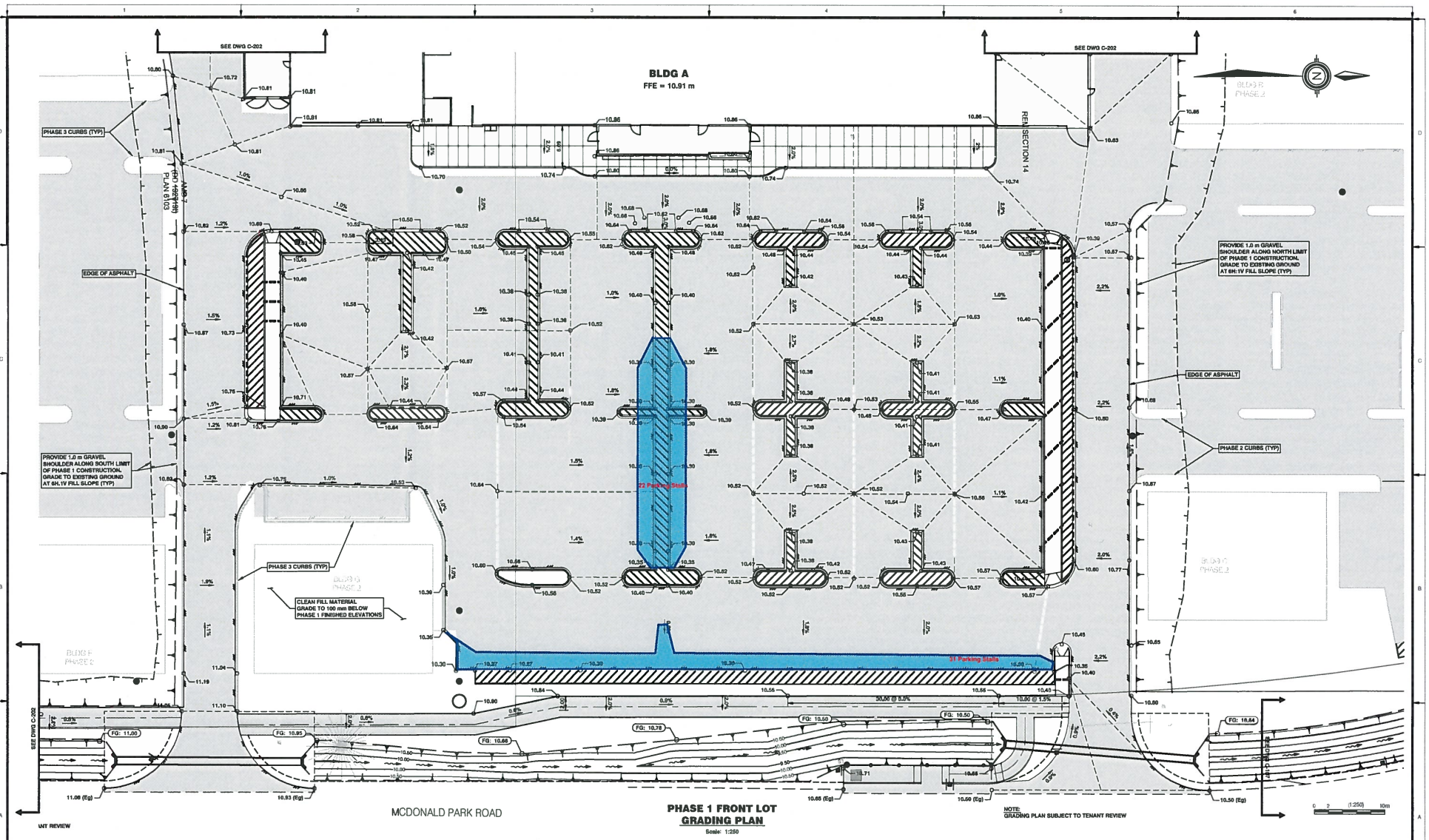
0 10 20 (m)
1:2,000

PROPOSED IMPROVEMENT PLAN

FIGURE 2

Figure 3. Cumulative Storage Volumes vs Elevation





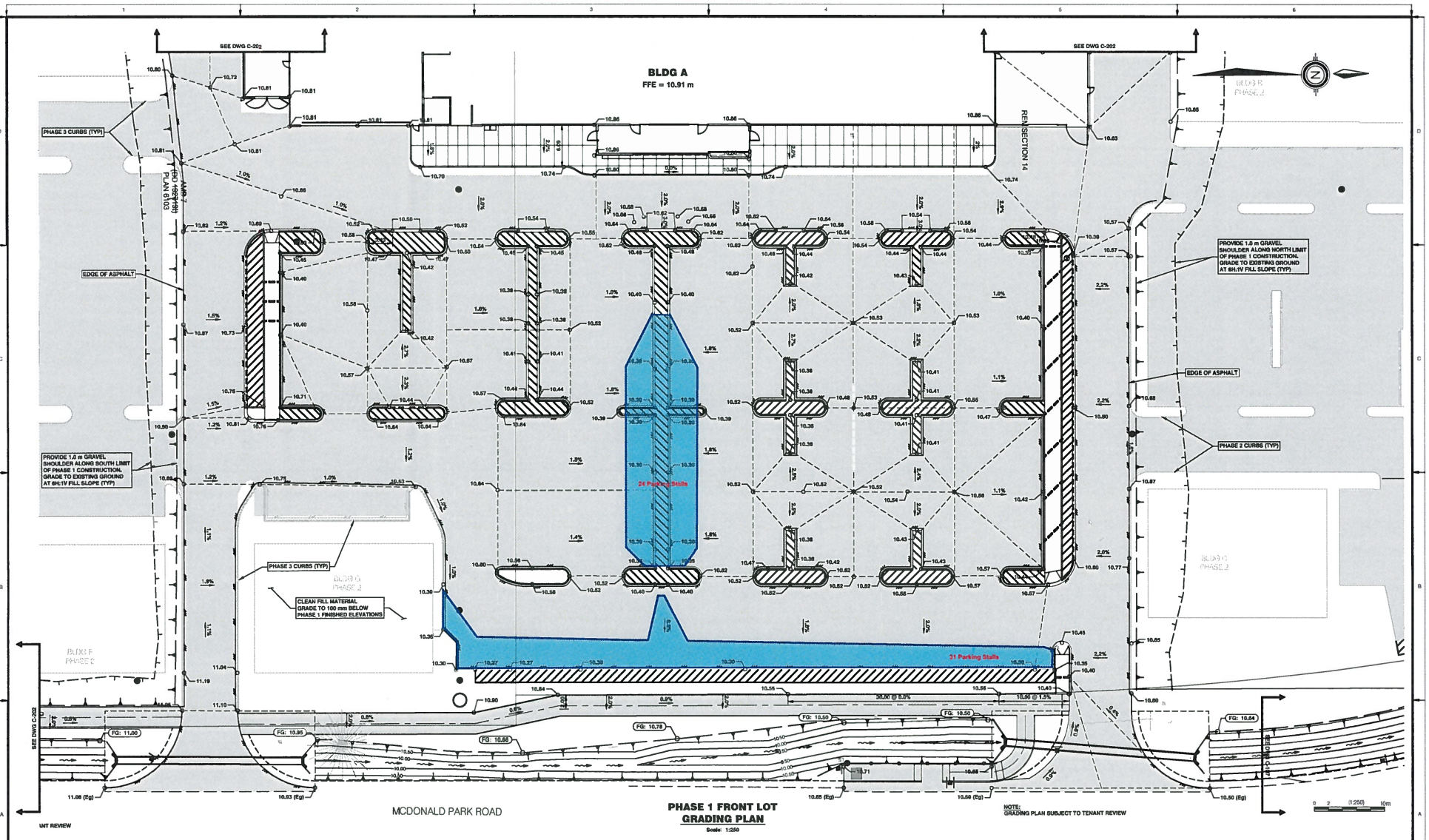
KERR WOOD LEIDAL
consulting engineers
201 - 3045 Douglas Street
Victoria, BC V8N 4N2
T (250) 595-4223 F (250) 595-4224
E island@kwl.ca

Rev	Date	Des	Dwn	Chk	Description of Revision
A	2017-04-27	RL	MRM		PRELIMINARY
B	2017-06-26	RL	MRM		DISTRICT SUBMISSION

SANDOWN PROPERTIES LTD
SANDOWN PARK SHOPPING CENTRE

APPROXIMATE 2YR RETURN PERIOD FLOOD ELEVATION.

Project No. 3641-001
Group CIVIL
Drawing No. C-201
Rev. ----



PHASE 1 FRONT LOT GRADING PLAN
Scale: 1:250

NOTE: GRADING PLAN SUBJECT TO TENANT REVIEW

UNT REVIEW

KERR WOOD LEIDAL
consulting engineers
201 - 3046 Douglas Street
Victoria, BC V8N 4N2
T (250) 686-4223 F (250) 686-4224
E island@kwl.ca

Rev	Date	Des	Dwn	Chk	Description of Revision
A	2017-04-27	RL	MRM		PRELIMINARY
B	2017-06-06	RL	MRM		DISTRICT SUBMISSION

SANDOWN PROPERTIES LTD
SANDOWN PARK SHOPPING CENTRE

APPROXIMATE 10YR RETURN PERIOD FLOOD ELEVATION.

Project No. 3641-001
Drawing No. C-201
Group: CIVIL
Rev. B

KERR WOOD LEIDAL
consulting engineers

Vancouver Island
201 - 3045 Douglas Street
Victoria, BC V8T 4N2
T 250 595 4223
F 250 595 4224

Cost Estimate Basis

DATE: October 12, 2017

TO: Andrew Sinclair
Sandown Properties Ltd.

FROM: Ryan Lesyshen, M.Sc., P.Eng

RE: **Sandown Properties**
Costs for the Management of Offsite Stormwater - Revised
Our File 3461.001-700

1. Introduction

Please find the following Class B cost estimate which summarizes the expected costs for design items associated with the management of stormwater from the McDonald Park catchment area upstream of the Sandown properties to avoid or mitigate upgrades to the downstream storm system, including the crossing of the Pat Bay Highway.

Also presented in this letter are the costs associated with the upgrade of the downstream storm system to convey a 25 year return period storm, with and without the proposed improvements by Sandown Properties.

1.1 Background

The Sandown Properties are located at the northwest corner of McDonald Park Road and Glamorgan Road. During low flows (minimal rainfall), approximately 4.5 Ha of the site drains to an existing culvert under McDonald Park Road which is connected to a culvert under the Pat Bay Highway which then drains to Shoal Harbour via a storm sewer. The remainder of the lands drain towards Wsikem Creek. During heavier rainfall, the culverts under McDonald Park Road and the Pat Bay Highway cannot convey the peak flows and water overflows onto the Sandown Park properties, effectively acting as a detention pond for the entire upstream catchment. This ponded water can then flow over land westward to the west end of the race track and into Wsikem Creek via a culvert under the track. Wsikem Creek then discharges to Patricia Bay.

The catchment area draining to the Pat Bay Highway culvert (under low rainfall events) is a 91.2 ha catchment that includes the Sandown site, a small area north of the Sandown site, an area south of Glamorgan Road and east of Littlewood Road, and a northern portion of the Victoria Airport. This entire catchment contributes to the existing flooding of the Sandown Race Track lands.

Further information on existing drainage conditions and proposed upgrades on the Sandown Site to manage offsite stormwater can be found in Kerr Wood Leidal's October 10, 2017 technical memorandum titled "Sandown Lands – Onsite and Offsite Stormwater Management Plan".

1.2 Scope

The attached Figure 1 is a markup of design drawing C100 highlighting design items associated with the management of stormwater from the upstream McDonald Park Road Catchment on the Sandown site. These are described as follows:

Item 1: Earthworks to raise the West end of the existing Sandown Racetrack by approximately 300mm (1a) and construction of a 15m wide weir/spillway (1b);

Item 2: A 15.6m long 200mm diameter PVC pipe through the West end of the existing Sandown Racetrack (2a) complete with a pre-cast concrete headwall and orifice plate to restrict/control stormwater discharge to the West (2b);

Item 3: Agricultural drainage ditch connecting the McDonald Park Road Catchment to the area within the existing Sandown Race track;

Item 4: A 97m long, 0.6m high berm around the existing cell tower.

Item 5: A 34m long 450mm diameter culvert (5a) complete with two pre-cast concrete headwalls (5b), and 1050mm manhole (5c) to keep the alignment of the agricultural ditch within the 15m buffer to the commercial property as required by the Agricultural Land Commission (ALC) at the location of the existing cell tower. Also included in this line item is a catchbasin, 200mm lead, and flap valve to allow drainage of the cell tower enclosure (5d).

Item 6: A 27m long 900mmx1800mm box culvert crossing Glamorgan Road; and

Item 7: A 128m long 1350mm diameter drainage pipe connecting the McDonald Park Road Ditch to the agricultural drainage ditch. This will consist of a cast-in-place flow control headwall (7a), 20m long pipe section installed in Phase 1 (7b), and a 108m long extension installed within the agricultural ditch during Phase 2 (7c).

The attached Figure 2 is a markup of Figure 3 from the June 29, 2000 "McDonald Park Road Drainage Study", showing the upgrades completed to date within the downstream section of the McDonald Park Road catchment, and the upgrades proposed in the drainage study which are mitigated by the proposed works on the Sandown property and ditch and culvert upgrades along the McDonald Park Road frontage.

The scope of the estimate for costs associated with improvements downstream of the Sandown site proposed in the McDonald Park Road Drainage Study include:

DS 1: 410 m of 1350mm concrete sewer, complete with pipe, manholes, tie-ins, dewatering, imported backfill, asphalt restoration, and traffic control. The alignment consists of approximately 100 m on the west side of the highway, and 310 m running north on McDonald road on the east side of the highway.

DS 2: 70 m of 1350mm concrete sewer pipe bored and jacked under the highway. This work includes excavating jacking pits, dewatering, supply of Class V straight wall tongue and groove concrete pipe, and mobilization and demobilization of the boring/jacking equipment.

1.3 Currency

The estimate is developed and adjusted to September 2017 costs and in Canadian dollars.

1.4 Classification and Accuracy

Sandown Site Classification and Accuracy

The estimate of costs on the Sandown site are considered a Class B estimate, based on the October 3, 2017 "Revisions following ALC Review" drawing set which has progressed to a level equivalent to a 90% Detailed Design submission. It is prepared using costs from KWL cost estimate databases.

Downstream Improvements Classification and Accuracy

The estimate of costs for upgrades to the McDonald Park catchment storm drain downstream of the Sandown site are considered a Class D estimate, which means that it is prepared with limited site information, and is suitable for planning purposes only. The estimate is prepared using costs from KWL cost estimate databases and the alignment and grades proposed in the June 29, 2000 "McDonald Park Road Drainage Study".

High and low estimates are developed by modeling key estimate parameters with appropriate probability distribution functions, and simulated using Monte Carlo simulations in order to extract cost percentiles. For this estimate the 15th, 50th, and 85th percentiles are reported.

The P15 estimate is 23% lower than the P50, and the P85 estimate is 28% higher than the P50.

1.5 Engineering

Engineering is included at 15% of the base project cost. Engineering tasks generally include field investigations, conceptual and preliminary designs, detailed designs, permitting and regulatory support, and limited construction field inspections.

1.6 Contingency

A 20% contingency for Class B estimates and 30% contingency for Class D estimates are applied to the base project costs. Contingency as used in this estimate is similar to that used in the AACEi Recommended Practice No. 10S-90, Cost Engineering Terminology:

> *Contingency is an amount added to an estimate to allow for items, conditions, or events for which the state, occurrence, or effect is uncertain and that experience shows would likely result, in aggregate, in additional costs.*

In other words, contingency is expected to be spent, and should be considered separately from risk items.

Contingency items include, but are not limited to, the following:

- Planning and estimating errors and omissions;
- Minor price fluctuations (other than general escalation);
- Design and scope changes; and
- Variations in market and environmental conditions.

Contingency excludes the following:

- Major scope changes;
- Extraordinary events such as strikes and natural disasters;

- Management reserves; and
- Escalation and currency effects.

2. Cost Summary

2.1 Costs Associated with the Management of Offsite Stormwater

The following table summarizes the project costs associated with the management of offsite stormwater, as described above and shown on Figure 1.

Table 1: Class B Cost Estimate Summary for Costs Associated with Management of Offsite Stormwater

Item #	QTY	Unit	Unit Cost	Cost	15% Eng.	20% Cont.	TOTAL
1a -Raise West End of Race Track	120	m^3	$58.00	$6,960	$1,044	$1,392	$9,396
1b – 15m Wide Riprap Spillway	110	m^3	$100.00	$11,000	$1,650	$2,200	$14,850
2a- 200mm diameter PVC pipe	15.6	Lin. m	$310.00	$4,836	$725	$967	$6,529
2b – Type 11-13 headwall control structure	1	Ea.	$6,000	$6,000	$900	$1,200	$8,100
3 - Agricultural drainage ditch	7500	m^3	$12.50	$93,750	$14,063	$18,750	$126,563
4 – Cell Tower Berm	163	m^3	$58.00	$9,454	$1,418	$1,891	$12,763
5a – 450mm Culvert	34	Lin. m	$350	$11,900	$1,785	$2,380	$16,065
5b – Type 11-13 headwall	2	Ea.	$3,500	$7,000	$1,050	$1,400	$9,450
5c –1050mm Manhole	1	Ea.	$4,000	$4,000	$600	$800	$5,400
5d –Catchbasin and Lead	1	LS	$5,000	$5,000	$750	$1,000	$6,750
6 - 900mmx1800mm box culvert crossing Glamorgan Road	27	Lin. m	$2,430.00	$65,610	$9,842	$13,122	$88,574
7a – Mcdonald Park Road Headwall Control Structure	1	Ea.	$15,800.00	$15,800	$2,370	$3,160	$21,330
7b – Phase 1 1350mm culvert	20	Lin. m	$2,091.00	$41,820	$6,273	$8,364	$56,457
7c – Phase 2 1350mm culvert	108	Lin.m	$1,940.00	$209,520	$31,428	$41,904	$282,852
TOTAL				**$492,650**	**$73,898**	**$98,530**	**$665,078**

2.2 Costs Estimate for Upgrading the Downstream McDonald Park System

The project costs for upgrading the McDonald Park System downstream of the Sandown site to 1350mm diameter are provided in Table 2:

Table 2: Class D Cost Estimate Summary for Downstream McDonald Park System Improvements (1350mm Diameter)

Item	Quantity	Unit	Unit Cost	Item Total (rounded)
Mob/Demob	2	ea	$ 25,440	$ 51,000
Jacking Pits	2	ea	$ 24,687	$ 49,000
Dewatering	24	days	$ 3,888	$ 94,000
Directional Drilling/Jacking	70	m	$ 3,296	$ 231,000
Concrete Pipe Supply	70	m	$ 1,200	$ 84,000
Pipeline Installation	410	m	$ 2,626	$ 1,077,000
			Subtotal	**$ 1,586,000**
			Contingency @ 30%	$ 476,000
			Engineering @ 15%	$ 238,000
			P50 Project Total	**$ 2,300,000**
			Low P15 (-23%)	**$ 1,771,000**
			High P85 (+28%)	**$ 2,944,000**

3. Comparative Costs

3.1 Comparative Development Costs

If there was no need to deal with offsite stormwater and existing capacity constraints, items 3 and 6 would still be required but at a lesser size.

The existing agricultural ditch would be cleared and likely extended to deal with agricultural drainage. This drainage ditch would follow a similar East to West alignment, with a base elevation of 9.4m at the east side of the agricultural land and 8.5m at the western edge of the race track. This 425m long ditch would have a 1.0m wide bottom and 2:1 side slopes. The estimated volume of excavation for this ditch is 377 m^3.

The existing culvert crossing Glamorgan Road is a 600mm diameter corrugated steel pipe in poor condition. The Sandown development requires the Glamorgan intersection to be improved for the purposes of the commercial development. North Saanich would require that the existing culvert would be replaced at the time of these improvements given the existing condition.

The costs and comparative difference for a smaller agricultural ditch and 600mm culvert across Glamorgan Road are provided in Table 3:

Table 3: Class B Cost Estimate Summary

Description	Comparative Item #	QTY	Unit	Unit Cost	Cost	15% Eng.	20% Cont.	TOTAL
Smaller Agricultural Ditch	3	377	m^3	$12.50	$4,713	$707	$943	**$6,363**
600mm culvert crossing Glamorgan Road	4	27	m	$670.00	$18,090	$2,714	$3,618	**$24,422**

The estimated additional cost for these improvements is $634,000.

3.2 Comparative Regional Drainage Costs

The design 25 year return period storm can be contained within the agricultural area with the proposed improvements and without an upgrade to the downstream McDonald Park Road system.

The criteria set by the Agri-Food Regional Development Subsidiary Agreement (ARDSA) for the duration of time in which farm land floods during both the growing season and dormant season cannot be met without an upgrade to the downstream system. To meet the ARDSA criteria, 480m of the downstream system must be upgraded to a 1050mm diameter pipe including the crossing of the Pat Bay Highway.

The cost savings associated with reducing the proposed downstream improvements from a 1350mm diameter pipe to a 1050mm diameter pipe are largely associated with the reduced supply costs of the pipe. The difference in supply cost between 1050mm and 1350mm pipe is approximately $580 per meter.

The project costs for upgrading the McDonald Park System downstream of the Sandown site to 1050mm diameter are provided in Table 4:

Table 4: Class D Cost Estimate Summary for Downstream McDonald Park System Improvements (1050mm Diameter)

Item	Quantity	Unit	Unit Cost	Item Total (rounded)
Mob/Demob	2	ea	$ 25,440	$ 51,000
Jacking Pits	2	ea	$ 24,687	$ 49,000
Dewatering	24	days	$ 3,888	$ 94,000
Directional Drilling/Jacking	70	m	$ 2,720	$ 190,000
Concrete Pipe Supply	70	m	$ 620	$ 43,000
Pipeline Installation	410	M	$ 1,946	$ 798,000
			Subtotal	**$ 1,225,000**
			Contingency @ 30%	$ 368,000
			Engineering @ 20%	$ 184,000
			P50 Project Total	**$ 1,776,000**
			Low P15 (-23%)	**$ 1,368,000**
			High P85 (+28%)	**$ 2,274,000**

The proposed improvements on the Sandown lands will:

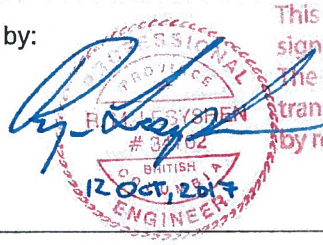
- improve the current levels of service by containing the 25 year design storm for the McDonald Park Catchment that cannot be serviced by the existing downstream infrastructure;
- decrease the rate and volume of water passing from the McDonald Park Catchment to the Wiskem Creek catchment during storms with a 2 year return period and greater;
- defer costs of downstream improvements in the medium term, estimated at $2,300,000; and
- reduce the future cost of downstream improvements by an estimated $523,000.

4. Closing

We trust the foregoing is clear. Please contact either of the undersigned if you have any questions or require clarifications.

KERR WOOD LEIDAL ASSOCIATES LTD.

Prepared by: Reviewed by:



Ryan Lesyshen, M.Sc., P.Eng
Project Engineer

Rob Warren, P.Eng
Senior Engineer

RYL/

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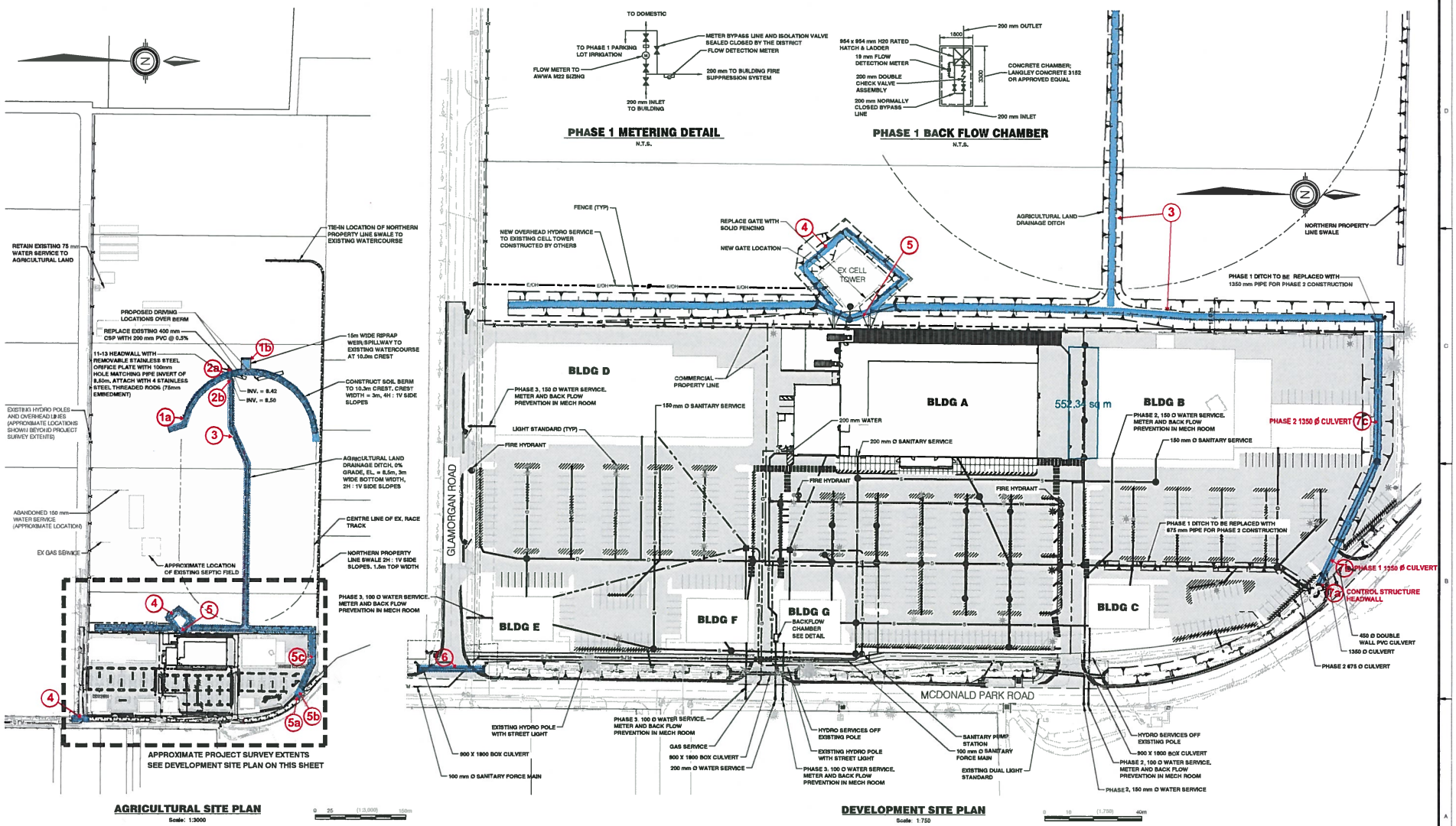
Revision History

Revision #	Date	Status	Revision Description	Author
A	September 19, 2017	Draft	Draft submission	RYL
B	October 5, 2017	DRAFT	Revisions to Onsite Costs and Addition of Downstream Costs	RYL
C	October 6, 2017	FINAL	FINALIZED	RYL
D	October 12, 2017	FINAL	Changed date of issuance for SWMP to October 10, 2017	RYL

OQM | Organizational Quality Management Program



KERR WOOD LEIDAL
consulting engineers
201 - 3045 Douglas Street
Victoria, BC V8N 4M2
T (250) 595-4223 F (250) 595-4224
E island@kwl.ca

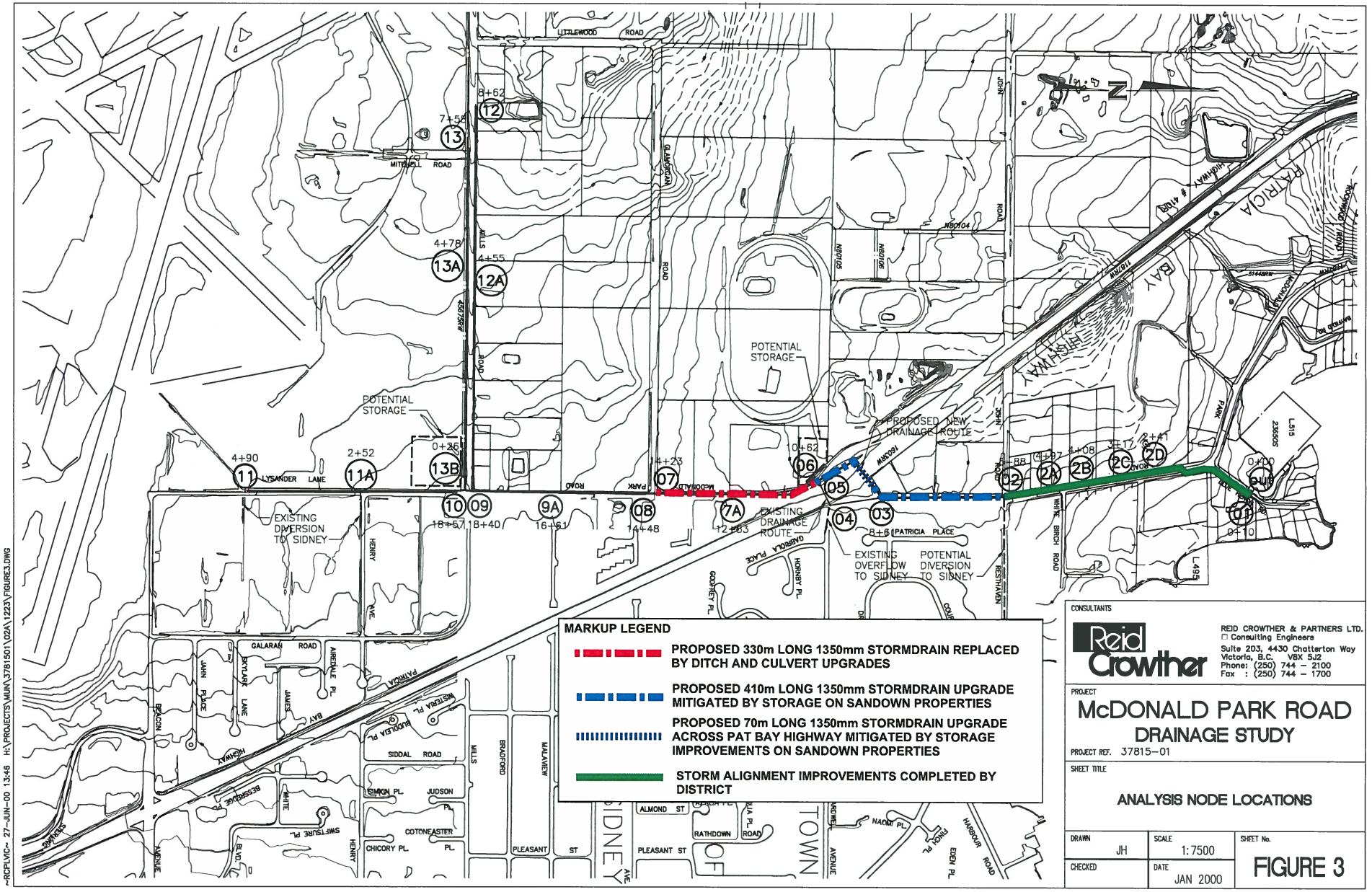
REGIONAL STORMWATER MANAGEMENT DESIGN ITEMS (MCDONALD PARK ROAD CATCHMENT)

Rev	Date	Des	Dwn	Chk	Description of Revision
A	2017-04-27	RL	MRM		PRELIMINARY
B	2017-06-01	RL	MRM		DISTRICT SUBMISSION
C	2017-06-26	RL	MRM		DISTRICT RE-SUBMISSION
D	2017-08-01	RL	MRM		REVISIONS FOLLOWING DISTRICT REVIEW
E	2017-08-24	RL	MRM		REVISIONS FOLLOWING DISTRICT REVIEW
F	2017-09-21	RL	MRM		REVISIONS FOLLOWING DISTRICT REVIEW - UPDATE
G	2017-10-03	RL	DL		REVISIONS FOLLOWING ALC REVIEW

SANDOWN PROPERTIES LTD
SANDOWN PARK SHOPPING CENTRE

OVERALL DEVELOPMENT UTILITY PLAN
- MARKUP OF REGIONAL STORMWATER MANAGEMENT DESIGN ITEMS

Project No. 3641-001
Drawing No. C-100
Rev. G
Group CIVIL



CONSULTANTS

Reid Crowther

REID CROWTHER & PARTNERS LTD.
Consulting Engineers
Suite 203, 4430 Chatterton Way
Victoria, B.C. V8X 5J2
Phone: (250) 744 – 2100
Fax : (250) 744 – 1700

PROJECT

McDONALD PARK ROAD DRAINAGE STUDY

PROJECT REF. 37815–01

SHEET TITLE

ANALYSIS NODE LOCATIONS

DRAWN	SCALE	SHEET No.
JH	1:7500	FIGURE 3
CHECKED	DATE JAN 2000	

~RCPLWIC~ 27-JUN-00 13:46 H:\PROJECTS\MUN\37815\01\02A\123\FIGURE3.DWG

Platform Properties Ltd
900-1200 West 73rd Avenue
Vancouver BC V6P 6G5 Canada

platformproperties.ca
t +1 (604) 563 5000
f +1 (604) 563 5001

plat:form

October 11, 2017

District of North Saanich
1620 Mills Road,
North Saanich, BC
V8L 5S9

Attention: Mr. Eymond Toupin, Director of Infrastructure Services

Dear Eymond,

RE: Sandown – 1810 Glamorgan Road
Offsite Stormwater Management

Further to our recent discussions, Kerr Wood Leidal's (KWL) cost estimate dated October 6, 2017, and KWL's Stormwater Management Plan dated October 10, 2017, I am writing for the District's consideration of a phased capital expenditure relating to stormwater management for the McDonald Park Road catchment. As has been detailed in a previous study completed for the District in 2000, as well as KWL's work, the District's stormwater infrastructure in the catchment is undersized. As a result, stormwater frequently backs up onto the Sandown lands, which flood and store catchment flows prior to draining north or crossing the catchment divide and flowing west, further impacting private lands.

As you're aware, the cost of upgrading the McDonald Park Road drainage infrastructure is estimated to be in the vicinity of $2,300,000, which is cost prohibitive. As a result, an alternative concept has been designed, and the proposed reclamation & drainage works on the agricultural property have been updated to reflect the design, which has now been reviewed and accepted by the Agricultural Land Commission. The cost of the additional offsite stormwater works (including a larger culvert at Glamorgan Road) is estimated to be ~$665,000, less ~$31,000 for works to be completed if there was sufficient stormwater capacity, for a net cost of ~$634,000. The costs for the required works will be broken up into phases, namely ~$351,000 for Phase 1, and ~$283,000 for Phase 2. The works proposed will also defer downstream improvements until such time as the District elects to proceed, and reduce the scope to an estimated ~$1,775,000 depending on the level of service required.

When the Sandown project was initially proposed by the District, the arrangement contemplated the commercial property being developed, and the dedication of the agricultural property, with demolition and reclamation works being the responsibility of the District. After approval from the ALC, the concept was altered to make Sandown responsible for costs associated with demolition and reclamation. These costs have turned out to be significantly greater than originally envisioned.

We believe the alternative concept proposed is a win-win for the District, as the stormwater infrastructure must be upgraded for the larger catchment area to function, and the cost is significantly less than would be required with the previously proposed upgrades. It will also improve the conditions for properties to the west of Sandown that are currently experiencing flooding issues. Lastly, the concept will enable the development of the Sandown lands to proceed, which will generate significant property tax revenues to offset the capital expenditure, and include the reclamation and dedication of ~80 acres of land to the District for use as a significant community amenity. Accordingly, we request the District consider the phased capital expenditure outlined above.

Best regards,

Andrew Sinclair