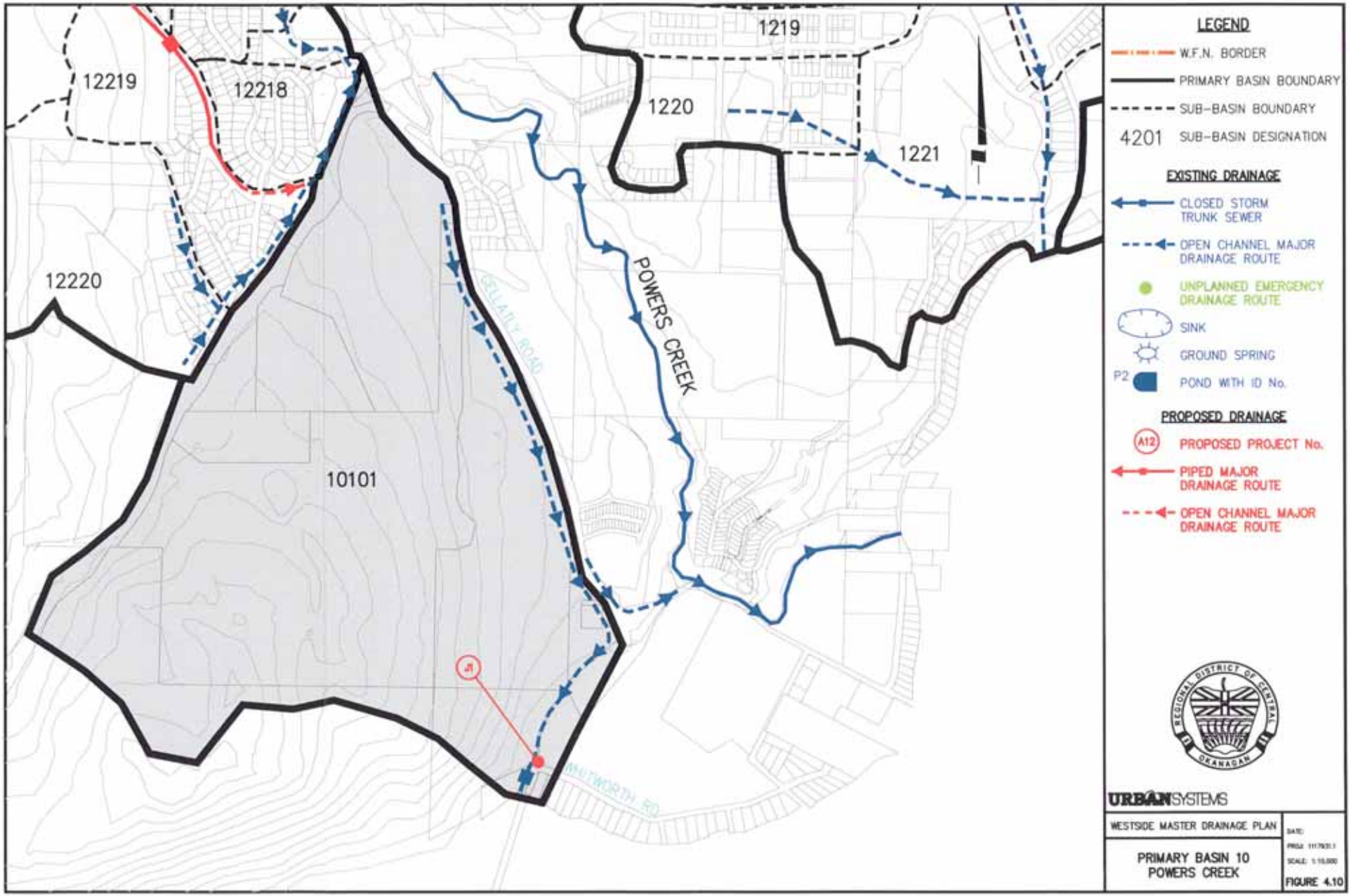
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1219
1220
1221
12220
10101
POWERS CREEK
GILLARD ROAD
WILLOWBROOK RD
J1
LEGEND
W.F.N. BORDER
PRIMARY BASIN BOUNDARY
SUB-BASIN BOUNDARY
4201 SUB-BASIN DESIGNATION
EXISTING DRAINAGE
CLOSED STORM TRUNK SEWER
OPEN CHANNEL MAJOR DRAINAGE ROUTE
UNPLANNED EMERGENCY DRAINAGE ROUTE
SINK
GROUND SPRING
P2 POND WITH ID No.
PROPOSED DRAINAGE
A12 PROPOSED PROJECT No.
PIPED MAJOR DRAINAGE ROUTE
OPEN CHANNEL MAJOR DRAINAGE ROUTE
REGIONAL DISTRICT OF CENTRAL OKANAGAN
URBANSYSTEMS
WESTSIDE MASTER DRAINAGE PLAN
PRIMARY BASIN 10
POWERS CREEK
DATE:
PROJ: 1117833.1
SCALE: 1:10,000
FIGURE 4.10

4.10 Basin 10 – Powers Creek

4.10.1 Existing Drainage

Powers Creek is the largest perennial stream within the WMDP study area. Since most of the basin is located upstream of the developable area, only the area downstream of Highway 97 is evaluated in this document. Gellatly Road flanks the canyon on the west side, leaving a relatively narrow strip of land that drains directly to the creek. All drainage west of this road flows along the ditch and ultimately discharges into a channel along the west side of the sewage treatment plant. This channel continues along the base of the hill, crosses Whitworth Road, and discharges into the lake at the park. A ridge along the east side of the canyon ensures that most drainage flow towards Smith Creek.

Drainage within the delta area immediately south of Powers Creek is difficult to define without very accurate topographical data. The delta is extremely flat and has a long interface zone with the lake. Essentially, runoff reaches the lake via many small swales and ditches. Since analysis of these systems would require detail beyond the scope of this Master Drainage Plan, they are only referenced in general.

4.10.2 Land Use

Existing

There are currently three small, medium density residential developments that drain into Powers Creek. A mix of low density and country residential, plus a camp site, borders the lake. The remainder of Gellatly Flats is actively used for agriculture as a hay meadow and tree nursery. The undeveloped land on the plateaus bordering the canyon are predominantly coniferous forest, as is most of the hillside to the west of Gellatly Road. Approximately 31 ha of orchard is located along Highway 97 and Gellatly Road, and 16 ha west of the road has been stripped, ready for low density residential development.

Future

The Powers Creek Basin narrows into a well defined, canyon-like channel as it passes through the developable portion of the study area. Because of this, development potential is limited to the plateaus on each side of the creek and to the small delta at the creek's mouth. However, a single large parcel within Basin 10 is designated for high density residential development.

4.10.3 Infiltration Potential

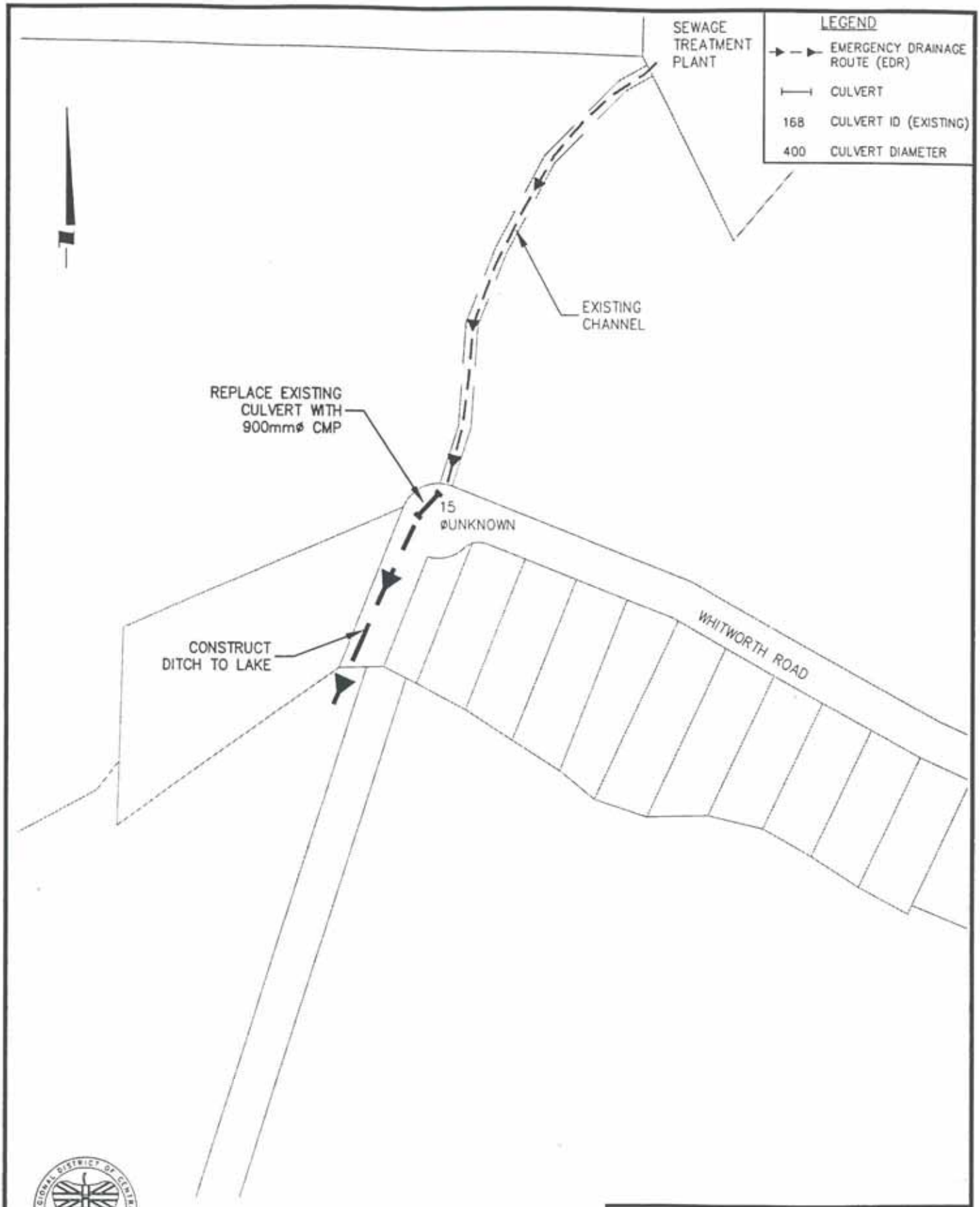
A hydrogeological report on the subject basin was not completed for this MDP. Therefore, SCS Soil Group assumptions have been made for only modeling purposes. No information about groundwater conditions has been obtained or processed, and no inference has been made with respect to suitability for using in-ground stormwater disposal systems. The soil assumptions are shown on Figure B3 in Appendix B.

4.10.4 Analysis

Because development has, and is likely to continue to be adjacent to either Powers Creek or Okanagan Lake, required major drainage routes and stormwater management facilities are difficult to identify. Therefore, this document assumes that all development applications will be accompanied by a Stormwater Management Plan as outlined in Section 2.12. These plans will identify the required routes from each development to either Powers Creek or the lake. They will also identify associated issues and proposed solutions.

The analysis completed for this basin, therefore, focuses on the only single, identifiable drainage route other than Powers Creek. It is addressed as a specific project.

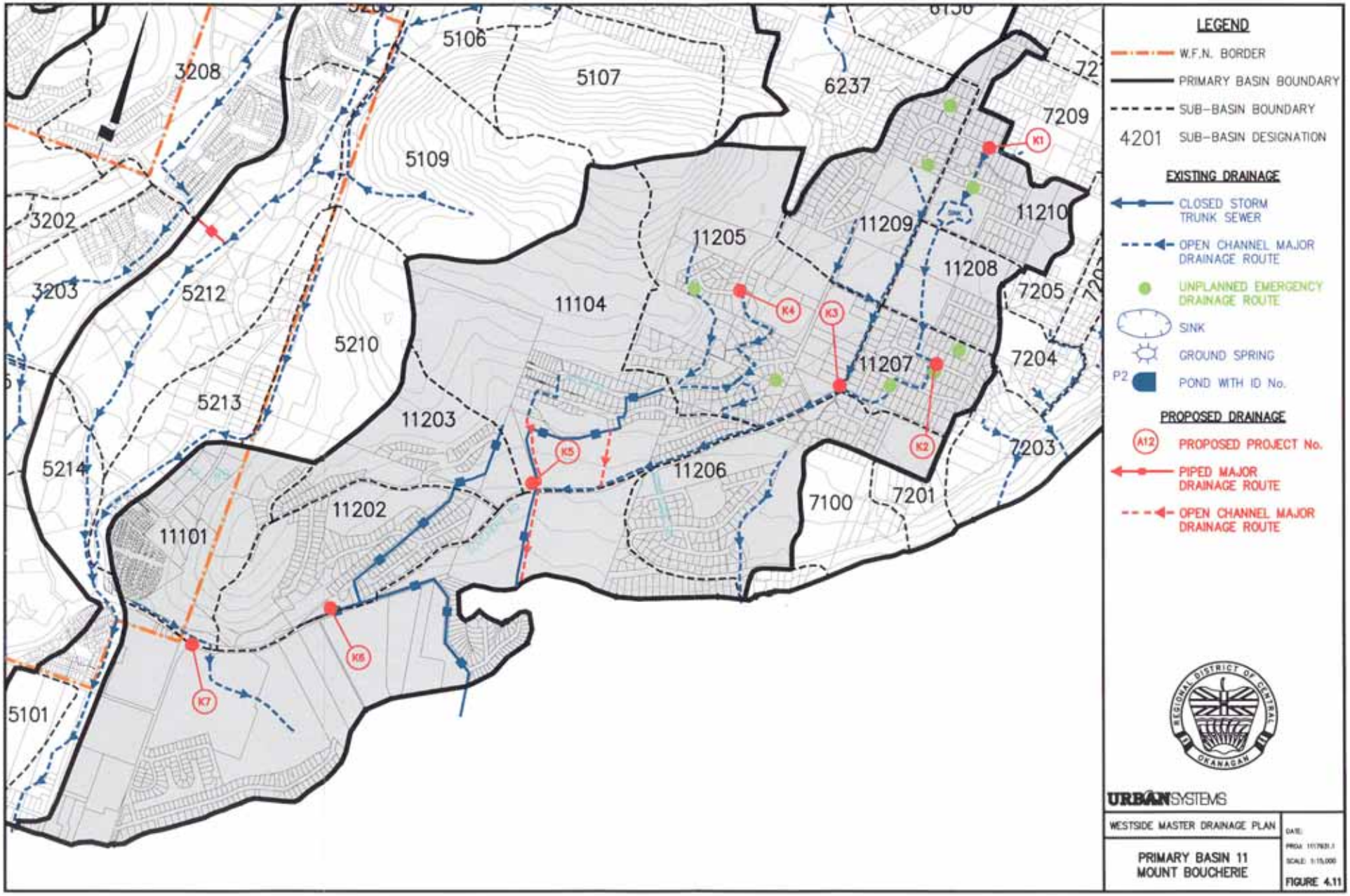
Project J1:	Culvert at Pebble Beach
Priority:	3
Pre-Development Flow:	0.70 m^3/s (100 year Snowmelt)
Design Flow:	0.70 m^3/s
Estimated Cost:	$6,000
Discussion:	Referring to Figure 4.10.1, the ditch along the west side of the sewage treatment plan terminates at Whitworth Road, just across from the Pebble Beach Regional Park. Field reconnaissance indicates that a culvert across the road does exist. However, it is currently buried so much that it is not possible to identify its diameter. The outlet could not even be located. It is possible, but unlikely that the culvert extends right up to the lake. It is more probable that a ditch leading from the culvert's outlet has been filled and obliterated as the park was developed.
Concepts:	The culvert must be either be cleaned or replaced. Since it is located near the park's western property line, it is probably more feasible to re-establish an open channel from Whitworth Road to the lake. A swaled-type channel would probably be the most suitable for the park context.
Proposed Works:	For the purposes of this document, replace the existing culvert with a 900 mm diameter CMP. Construct approximately 60 m of swale from Whitworth Road to the lake.
Implementation:	Under existing conditions, there is potential for runoff from extreme rainfall or snowmelt events to pond and flow over Whitworth Road. The impacts of this happening are not extremely significant because the overflow would find its way through the park and into the lake. These works should, however, be implemented as part of the offsite works for the first development to occur within Basin 10101.



REGIONAL DISTRICT OF CENTRAL OKANAGAN

URBANSYSTEMS

WESTSIDE MASTER DRAINAGE PLAN	DATE:
PROJECT J1 CULVERT AT PEBBLE BEACH	PROJ: 1117931.1 SCALE: 1:2,500 FIGURE 4.10.1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5213
11203
11207
5214
11206
7100
7201
11202
11101
5101
K1
K2
K3
K4
K5
K6
K7
LEGEND
W.F.N. BORDER
PRIMARY BASIN BOUNDARY
SUB-BASIN BOUNDARY
4201 SUB-BASIN DESIGNATION
EXISTING DRAINAGE
CLOSED STORM TRUNK SEWER
OPEN CHANNEL MAJOR DRAINAGE ROUTE
UNPLANNED EMERGENCY DRAINAGE ROUTE
SINK
GROUND SPRING
P2 POND WITH ID No.
PROPOSED DRAINAGE
A12 PROPOSED PROJECT No.
PIPED MAJOR DRAINAGE ROUTE
OPEN CHANNEL MAJOR DRAINAGE ROUTE
REGIONAL DISTRICT OF CENTRAL OKANAGAN
URBANSYSTEMS
WESTSIDE MASTER DRAINAGE PLAN
PRIMARY BASIN 11
MOUNT BOUCHERIE
DATE:
SCALE: 1:15,000
FIGURE 4.11

4.11 Basin 11 – Mount Boucherie

4.11.1 Existing Drainage

This basin consists of two sets of sub-basins as well as a foreshore area along Okanagan Lake. The first set of sub-basins is mostly defined by rural roads. Bounded by Boucherie Road on the west, the sub-basins cascade from north to south starting at Skyline Road and ending at Montigny Road. A ridge just west of Thacker Drive forms the eastern boundary. Also included as the southern-most sub-basin is most of the Sunnyside subdivision.

There is no formal drainage route through the sub-basins north of Montigny Road. Essentially, surface runoff would pond against each road forming the lower boundary of each sub-basin, and would overflow if the runoff volume exceeded the storage volume. At the intersection of Montigny and Boucherie roads, however, a well defined natural channel extends right to the lake.

The second set of sub-basins consists mainly of the area on the eastern and southern slopes of Mount Boucherie, bounded by Boucherie Road starting at Hudson Road, and extending south and west until almost to the intersection with Old Boucherie Road. Since the subject area is wrapped around a mountain rather than located within a “bowl”, it consists of several independent sub-basins. Each would drain directly to Okanagan Lake except for the fact that flows are intercepted by the western / northern ditch along Boucherie Road. Currently, there are few culverts across Boucherie Road, so most runoff flows to a low point just west of the intersection with Green Bay Road. Much of the runoff infiltrates into the ditch bed, but flows that do reach the low point now enter an inlet to a storm sewer trunk that discharges directly to the lake.

Most of the older developments are serviced by ditches and culverts while the newer developments use curb, gutter, and storm sewers. Emergency drainage routes are comprised mostly of road ditches or curb & gutter equipped roads. There are, however, many sections that pass through private property from one road to another. These routes are often poorly defined and may have insufficient capacity to

accommodate design flows. Of particular note is the emergency drainage route for sub-basin 11104. It relies on a 600 mm diameter trunk sewer to direct design flows out of the natural drainage route as shown in Figure 4.11. This was done to avoid impacting the vineyard through which the ravine passes.

4.11.2 Land Use

Existing

Approximately 1/4 of the basin is active agricultural in the form of vineyards and orchards. Another third consists of low density residential. There is also approximately 1.8 ha of high-impervious commercial development off Anders Road. The remaining area is primarily natural with sparse tree cover.

Future

Most of the future development planned for this area is located within the southwest part of the basin. A large low density residential development is planned immediately to the west of Gregory Road. High density residential development is planned on the hillside south of the Mission Hill Winery. Both of these developments have the potential to significantly increase the amount of runoff that must be accommodated by downstream stormwater management systems.

4.11.3 Infiltration Potential

The upper and lower portions of the subject basin (in terms of elevation) consist primarily of SCS Group D soils. There is a band of Group C soils which passes through most of the developed or potentially developable areas. The Mission Hill area is located in a groundwater recharge zone while the areas in the north and east parts of the basin are within a groundwater discharge zone. There is a band of transition through the lower portion of the Mission Hill development that extends to the northeast part of the basin, above existing development.

Referring to Figure B5, the Mission Hill and Trevor Drive areas are the most suited for in-ground stormwater disposal applications. The rest of the area is primarily Zone II with small bands of Zone III. Suitability of in-ground disposal applications within these areas is definitely site-specific since groundwater discharge occurs at several sites.

4.11.4 Analysis

Boucherie Road has, by default, become the major drainage route for this basin. Because the existing ditch has limited capacity, and because there is no well-defined route to the lake once runoff reaches the bottom of the hill, the analyses and subsequent projects focus on diverting runoff to the lake at several locations.

Project K1: Anders, Teal and Stevenson Roads

Priority: 2

Pre-Development Flow: 0.12 m^3/s

Design Flow: 0.17 m^3/s

Estimated Cost: $44,800

Discussion: Referring to Figure 4.11.1, there is an existing emergency drainage route that currently passes through at least two private properties. Runoff from Lot 50, Plan 5381 is unlikely under current land use because it is a sink that is actively farmed. However, if this land is ever developed, the potential for runoff under extreme rainfall events could be significant. The current deficiency is that runoff from both Anders and Skyline Roads can pond at the roads' intersection. From here, it would flow through Lot 4 before spilling onto Teal Road.

Concepts: There are a couple of options that could be implemented to correct the deficiency on Anders Road, but primarily only one for the deficiency on Stevenson Road.

Anders Road

The best option would be to re-grade Anders Road so that the low point would be located at the Teal Road intersection. A preliminary design of this would need to be completed to determine its feasibility. If this is not feasible, either technically or financially, then the alternative is to install an inlet on the south side of Anders Road and pipe the potential runoff to the east side of Teal Road. This option, however, is subject to the inherent limitations of piped systems.

Stevenson Road

Once a system is installed to direct runoff to Teal Road, the ditch on the east side of the road must be better defined. At the Stevenson Road intersection, a culvert should be installed across the road to direct flow along the west property line of Lot 10. Either MoTH or the RDCO should obtain a drainage easement from the property owners. A grassed swale will also be required to direct flow to the orchard.

It is important to note that:

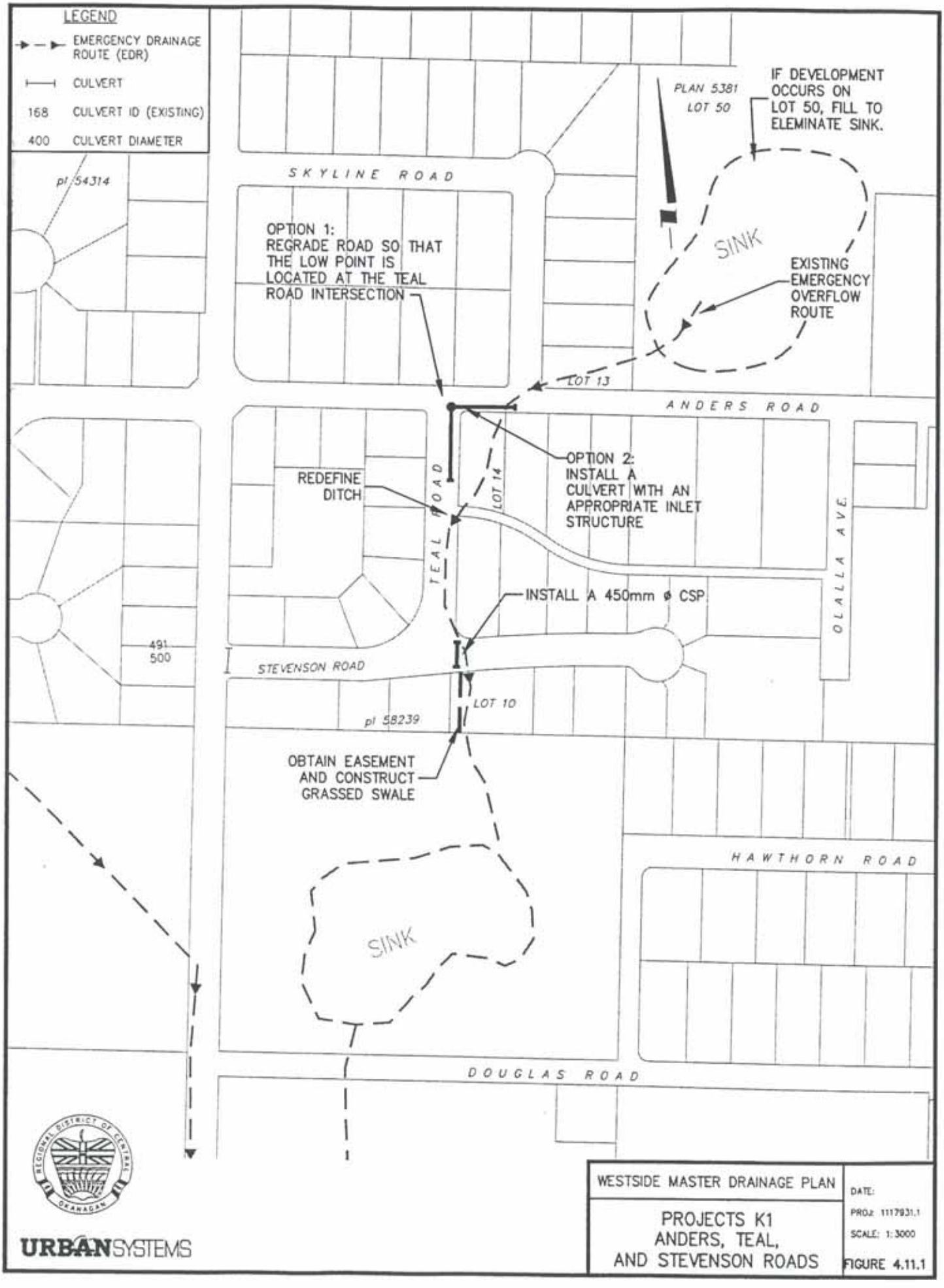
- If and when Lot 50 develops, sufficient fill be placed to eliminate the sink conditions.
- Drainage through Lot 13 be addressed as part of the SWM Plan that would be required as part of the development approval process.

Proposed Works:

- Re-grade approximately 180 m of Anders Road to locate the low point at the Teal Road intersection;
- Re-define approximately 140 m of ditch along the east side of Teal Road;
- Install a 450 mm diameter CMP across Stevenson Road;
- Obtain a minimum 3.0 m wide drainage easement on Lot 10 and construct a 35 m grassed swale.

Implementation:

The most opportune time to construct the proposed works is when either Lot 50 is developed, or when Anders Road requires upgrading / widening / re-paving, etc. The easement and swale across Lot 10 can (and should) be obtained sooner.


LEGEND
EMERGENCY DRAINAGE ROUTE (EDR)
CULVERT
168 CULVERT ID (EXISTING)
400 CULVERT DIAMETER
PLAN 5381
LOT 50
IF DEVELOPMENT OCCURS ON LOT 50, FILL TO ELEMINATE SINK.
SKYLINE ROAD
pl 54314
OPTION 1:
REGRADE ROAD SO THAT THE LOW POINT IS LOCATED AT THE TEAL ROAD INTERSECTION
SINK
EXISTING EMERGENCY OVERFLOW ROUTE
LOT 13
ANDERS ROAD
OPTION 2:
INSTALL A CULVERT WITH AN APPROPRIATE INLET STRUCTURE
REDEFINE DITCH
TEAL ROAD
LOT 14
OLALLA AVE.
INSTALL A 450mm ø CSP
491
500
STEVENSON ROAD
LOT 10
pl 58239
OBTAIN EASEMENT AND CONSTRUCT GRASSED SWALE
HAWTHORN ROAD
SINK
DOUGLAS ROAD
REGIONAL DISTRICT OF CENTRAL OKANAGAN
URBANSYSTEMS
WESTSIDE MASTER DRAINAGE PLAN
PROJECTS K1
ANDERS, TEAL,
AND STEVENSON ROADS
DATE:
PROJ: 1117931.1
SCALE: 1:3000
FIGURE 4.11.1

Project K2 — Emergency Drainage Route – Ogden to Montigny

Priority: 3

Pre-Development Flow: 0.11 m^3/s

Design Flow: 0.15 m^3/s

Estimated Cost: $82,900

Discussion: Referring to Figure 4.11.2, an unplanned emergency drainage route currently exists that passes through several private properties. The route starts as an overflow from Lot 72 and winds its way through three lots until it reaches Westbrook Road. Unfortunately, the low point on this road is located across from Lot 11. Excess runoff would flow through this lot, onto Westview Road, and proceed to the low point on McCartney Road. At this point, excess runoff would flow through lots 15 and 22 in order to reach the culvert across Montigny Road.

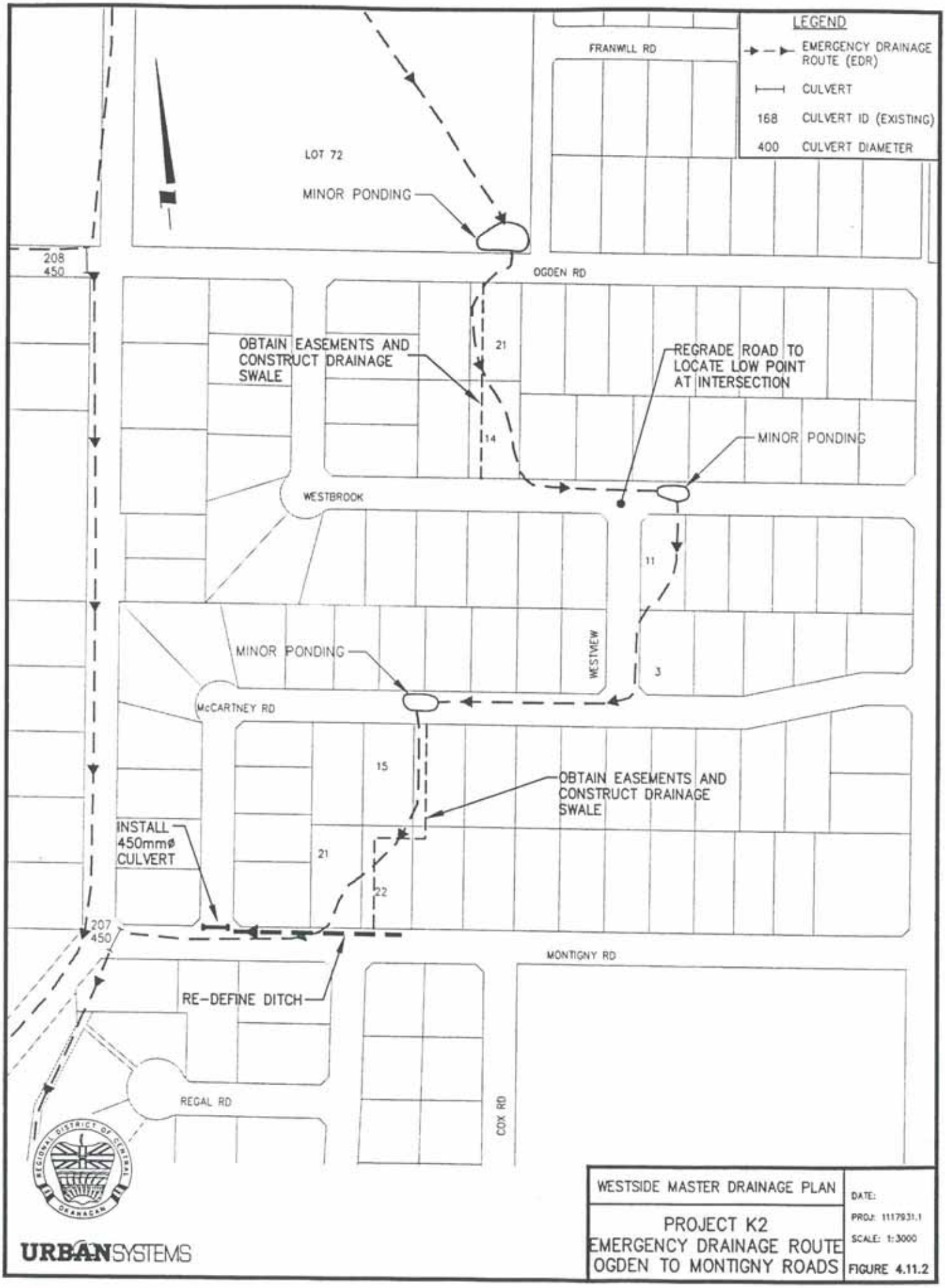
The potential flows through this drainage route are unlikely to be significant as long as Lot 72 and other upstream agricultural land remains undeveloped. There is some potential, however, for concentrated runoff from the roads to have at least minor impacts on the subject properties.

Concepts: Since the subject properties lie within a natural "basin", the only way to divert potential flows around them is with a piped system. Considering the inherent limitations of piped systems, especially in a rural setting, the better approach would be to obtain drainage easements where required and construct appropriate channels through them.

Proposed Works:

- obtain an easement through lots 21 and 14, and construct approximately 120 m of grassed swale;
- re-grade approximately 150 m or Westbrook Road so that the Westview Road intersection is the intentional low point;
- obtain an easement through lots 15 and 22, and construct approximately 125 m grassed swale;
- re-define approximately 110 m of ditch;
- install a 450 mm diameter CMP across McCartney Road at Montigny Road.

Implementation: Under existing conditions, the risk of damage is not substantial. However, if new development occurs upstream, or if larger-than-normal runoff events cause severe annoyances or even minor damage, then the works should be implemented as soon as possible. The works on public property should be completed as part of MoTH's annual maintenance plan. The works on private property should be completed as soon as funds are available.


LEGEND
EMERGENCY DRAINAGE ROUTE (EDR)
CULVERT
168 CULVERT ID (EXISTING)
400 CULVERT DIAMETER
FRANWILL RD
LOT 72
MINOR PONDING
208
450
OGDEN RD
OBTAIN EASEMENTS AND CONSTRUCT DRAINAGE SWALE
21
REGRADE ROAD TO LOCATE LOW POINT AT INTERSECTION
14
MINOR PONDING
WESTBROOK
11
MINOR PONDING
WESTVIEW
3
McCARTNEY RD
15
OBTAIN EASEMENTS AND CONSTRUCT DRAINAGE SWALE
INSTALL 450mmø CULVERT
21
22
207
450
MONTIGNY RD
RE-DEFINE DITCH
REGAL RD
COX RD
REGIONAL DISTRICT OF CENTRAL OKANAGAN
URBANSYSTEMS
WESTSIDE MASTER DRAINAGE PLAN
DATE:
PROJECT K2
EMERGENCY DRAINAGE ROUTE
OGDEN TO MONTIGNY ROADS
PROJ: 1117931.1
SCALE: 1:3000
FIGURE 4.11.2

Project K3: Boucherie Road at Montigny Road

Priority: 3

Pre-Development Flow: 0.13 m^3/s

Design Flow: 0.18 m^3/s

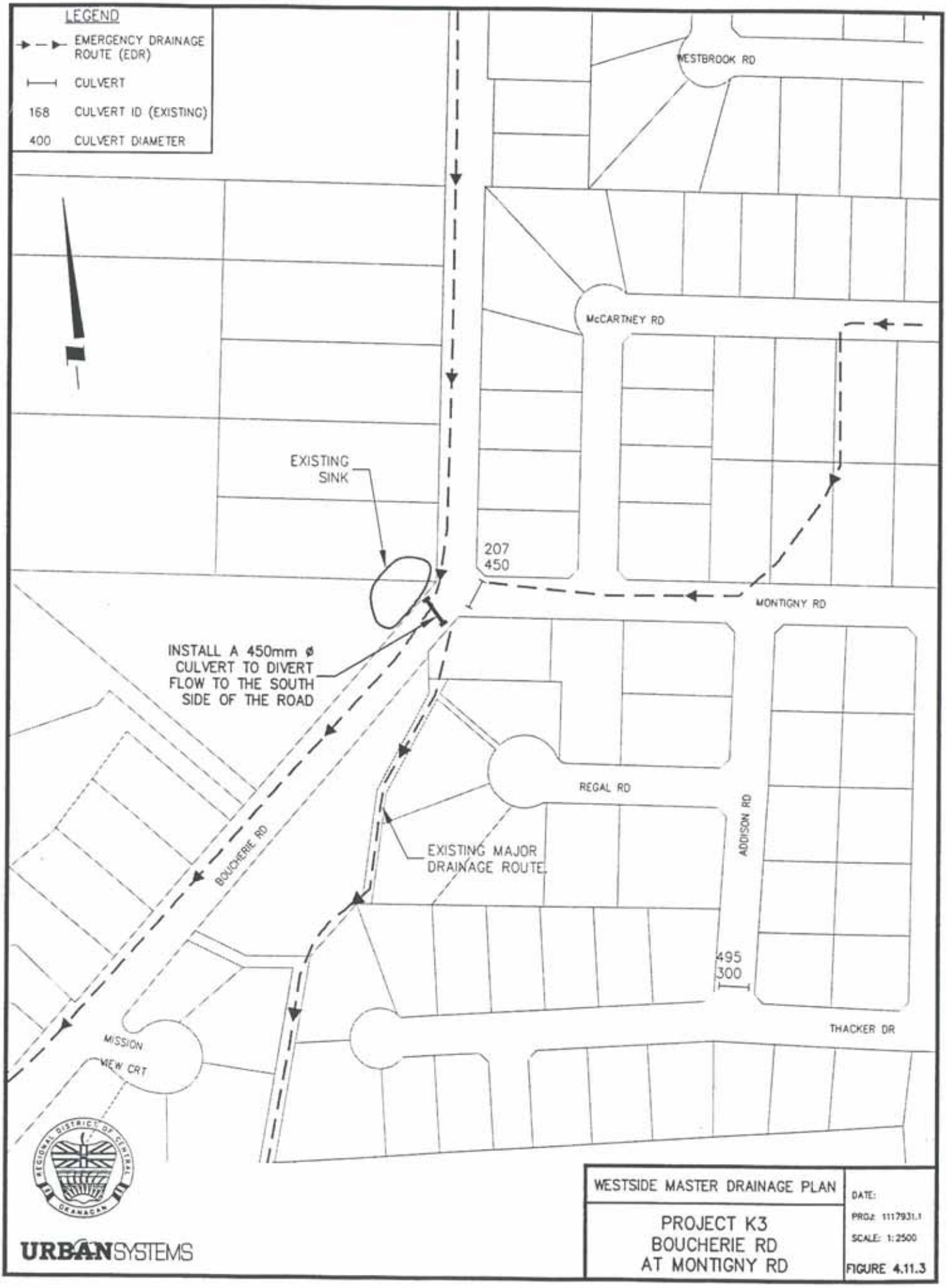
Estimated Cost: $3,300

Discussion: Runoff flowing along the west ditch of Boucherie Road from Hudson Road to Montigny Road eventually terminates at a low point across from the Montigny Road intersection. Under extreme runoff conditions, there is potential for this low point to fill to overflowing. If this happens, it is currently unclear whether runoff would flow along Boucherie Road or overflow into the ravine on the east side of Boucherie Road. This is shown in Figure 4.11.3.

Concepts: Since the ditch along Boucherie Road has far less capacity than the ravine, it would be better to install a culvert across the road.

Proposed Works: Install a 450 mm diameter culvert across Boucherie Road just downstream of the Montigny Road intersection.

Implementation: There is no urgency for these works to occur since most of the upstream drainage area is within the ALR. However, these works should be incorporated into MoTH's annual maintenance program.


LEGEND
EMERGENCY DRAINAGE ROUTE (EDR)
CULVERT
168 CULVERT ID (EXISTING)
400 CULVERT DIAMETER
WESTBROOK RD
McCARTNEY RD
EXISTING SINK
207
450
MONTIGNY RD
INSTALL A 450mm ø CULVERT TO DIVERT FLOW TO THE SOUTH SIDE OF THE ROAD
REGAL RD
ADDISON RD
BOUCHERIE RD
EXISTING MAJOR DRAINAGE ROUTE
495
300
THACKER DR
MISSION MEW CRT
REGIONAL DISTRICT OF CENTRAL OKANAGAN
URBAN SYSTEMS
WESTSIDE MASTER DRAINAGE PLAN
PROJECT K3
BOUCHERIE RD
AT MONTIGNY RD
DATE:
PROJ: 1117931.1
SCALE: 1:2500
FIGURE 4.11.3

Project K4: EDR – Lakeview Cove to Boucherie Road

Priority: 1

Pre-Development Flow: Part A = 0.06 m^3/s
Part B = 0.05 m^3/s
Part C = 0.12 m^3/s .

Design Flow: Part A = 0.21 m^3/s
Part B = 0.20 m^3/s
Part C = 0.40 m^3/s .

Estimated Cost: $238,400

Discussion:

In 1993, the Lakeview Cove subdivision was constructed off the upper end of Trevor Drive. A severe short-duration, high-intensity rainstorm inundated the piped minor system and caused runoff to overflow the curb at the low point above Ourtoland Road. This resulted in severe erosion of the fill bank and deposition of material into the swimming pool on Lot 12 off Saturn Road. An attempt by the developer to create a more functional emergency drainage route (EDR) to Ourtoland Road was made, but recent field inspection revealed that the works (a cut-off road and partial ditch) would not function as proposed.

Referring to Figure 4.11.4, a second EDR through the western part of the Lakeview Cove subdivision also drains to the north ditch along Menu Road, and ultimately to Boucherie Road. Currently, a diversion ditch carries upstream runoff from a relatively small catchment to lot 17, where it eventually drains onto the roadway. In most cases, the runoff enters the minor system. However, the EDR downstream of the low point on the road passes through lots 8 – 12 before leaving the subdivision on its way to Topham Road.

Residents on the northwest side of Lakeview Cove Place have already expressed concerns about the runoff that flows into the diversion ditch from above. There is no record of overflow into the EDR downstream of Lakeview Cove Place.

Both of these deficiencies are relatively serious because of the potential for significant damage to homes and the steep slopes over which the EDRs pass.

Concepts:

Lakeview Cove

The best route to follow for the EDR below Lakeview Cove is the natural ravine that runs along the southwest property line of Lot 4. A ditch must also be constructed along the south property line of Lot 5 to direct flows to the ditch along Ourtoland Road. By combining drainage and pedestrian requirements, an adequate EDR could be constructed using a “staircase channel” on the steeper sections. This would allow pedestrians from the lower subdivisions to access the park off Lakeview Cove Place and provide an effective method of transporting excess runoff to Boucherie Road.

Lakeview Cove Place

The runoff from the upstream, offsite property can be intercepted by an extension of the park access road. This would direct all runoff onto Lakeview Cove Place. Overland flows from the park would have to be managed by lot grading on each of the properties along the road.

The EDR downstream of the low point on Lakeview Cove Place is already in place, however, it is unplanned. It is essential that the lot grading on each of the affected properties be such that the design flow can pass without impacting the houses. Essentially, a swale-type open channel must be constructed if one does not already exist.

Menu Road To Boucherie Road

Most of this route is within well-defined ditches. However, there is a section through two private lots. The primary concern is the low capacity of an existing 300 mm PVC trunk through the lot just off Vector Drive. This should be replaced with a larger pipe.

Proposed Works:

Part A - Lakeview Cove

- Obtain a drainage easement along the south property lines of Lots 4 and 5;
- Install approximately 40 m of staircase channel on the steep slope immediately below the curb;
- Construct approximately 115 m of ditch along the southern property line of Lot 5 using a root-reinforcement system;
- Install a 500 mm CMP across Saturn Road.

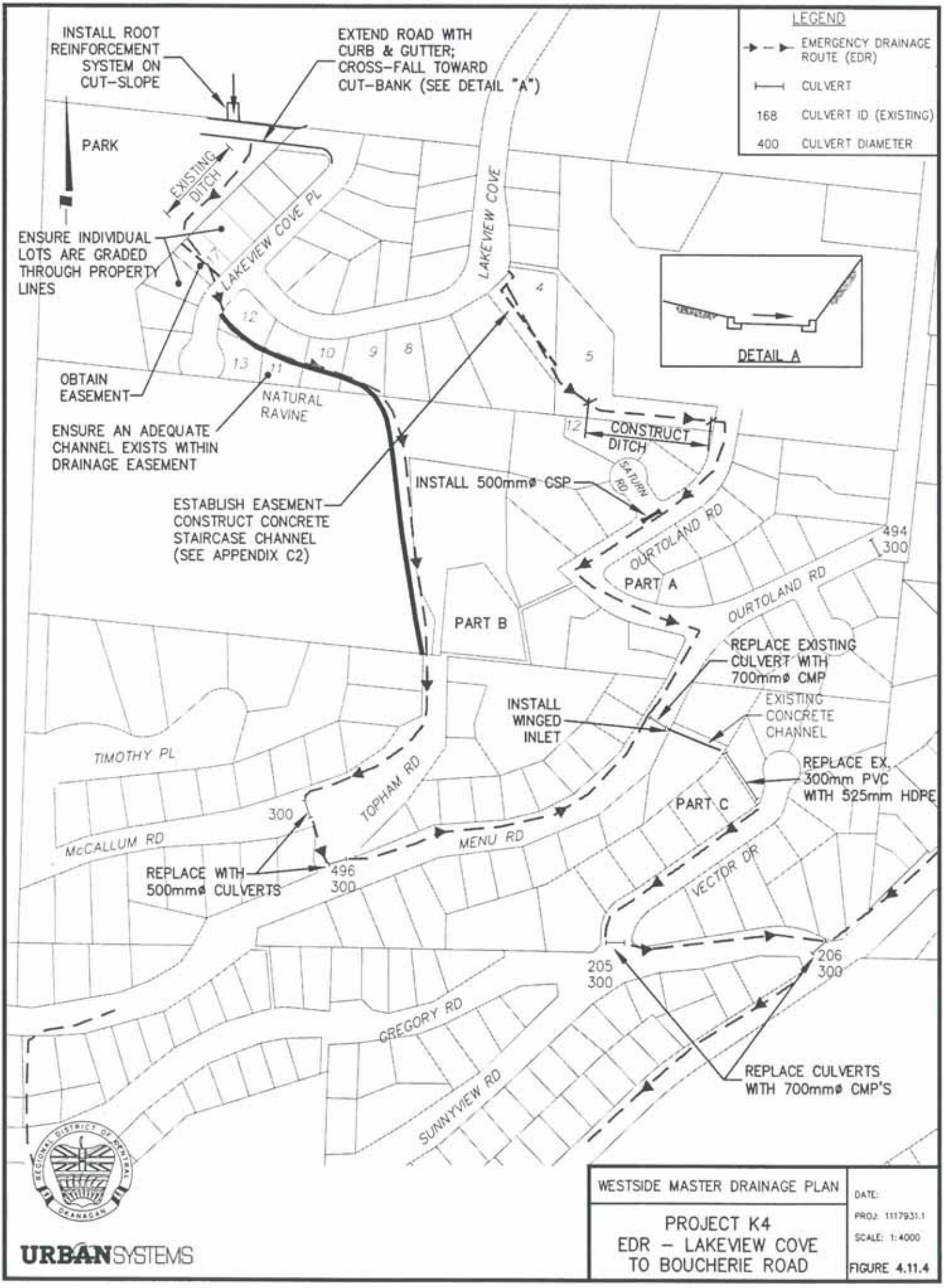
Part B – Lakeview Cove Place

- Extend the park access road for approximately 50 m from Lakeview Cove Place so that it will intercept runoff from the upstream, offsite property. Ensure that the proposed road is graded so that there is crossfall toward the bank (to the north).
- Install approximately 10 m of a root-reinforcement system on the cut bank where runoff from the upstream offsite property flows.
- Obtain a drainage easement through Lots 17 and 8 – 12 off Lakeview Cove and through the properties between Lakeview Cove and Topham Road.
- Work with the owners of the affected lots to ensure that an adequate drainage channel is constructed where one does not currently exist.
- Replace the two 300 mm diameter culverts on McCallum and Topham roads with 500 mm units.

Part C – Menu To Boucherie

- Replace existing culvert across Menu Road with a 700 mm CMP;
- Replace existing 300 mm PVC trunk with 45 m of 525 HDPE pipe;
- Install a winged culvert inlet to the 525 HDPE pipe;
- Replace existing culverts across Vector Drive and Gregory Road with 700 mm diameter units.

Implementation: Since the potential for significant damage exists if excess runoff flows through the existing unplanned EDRs, the proposed works should be implemented as soon as possible. It may be possible to link the works for the Lakeview Cove EDR with development of the property immediately to the north of the Lakeview Cove subdivision.


LEGEND
EMERGENCY DRAINAGE ROUTE (EDR)
CULVERT
168 CULVERT ID (EXISTING)
400 CULVERT DIAMETER
INSTALL ROOT REINFORCEMENT SYSTEM ON CUT-SLOPE
EXTEND ROAD WITH CURB & GUTTER; CROSS-FALL TOWARD CUT-BANK (SEE DETAIL "A")
PARK
EXISTING DITCH
ENSURE INDIVIDUAL LOTS ARE GRADED THROUGH PROPERTY LINES
LAKEVIEW COVE PL
LAKEVIEW COVE
DETAIL A
OBTAIN EASEMENT
NATURAL RAVINE
ENSURE AN ADEQUATE CHANNEL EXISTS WITHIN DRAINAGE EASEMENT
CONSTRUCT DITCH
SATURN RD
INSTALL 500mmø CSP
ESTABLISH EASEMENT CONSTRUCT CONCRETE STAIRCASE CHANNEL (SEE APPENDIX C2)
OURTOLAND RD
494
300
PART A
PART B
OURTOLAND RD
REPLACE EXISTING CULVERT WITH 700mmø CMP
INSTALL WINGED INLET
EXISTING CONCRETE CHANNEL
REPLACE EX. 300mm PVC WITH 525mm HDPE
PART C
TIMOTHY PL
TOPHAM RD
300
McCALLUM RD
MENU RD
REPLACE WITH 500mmø CULVERTS
496
300
VECTOR DR
205
300
206
300
GREGORY RD
SUNNYVIEW RD
REPLACE CULVERTS WITH 700mmø CMP'S
REGIONAL DISTRICT OF NORTH OKANAGAN
URBANSYSTEMS
WESTSIDE MASTER DRAINAGE PLAN
PROJECT K4
EDR – LAKEVIEW COVE TO BOUCHERIE ROAD
DATE:
PROJ: 1117931.1
SCALE: 1:4000
FIGURE 4.11.4

Project K5: EDR – Gregory Road to Boucherie Road

Priority: 1

Pre-Development Flow: 0.65 m^3/s

Design Flow: 1.3 m^3/s

Estimated Cost: $67,000

Discussion:

Referring to Figure 4.11.5, development is occurring upstream of currently active agricultural land. The land is located within a natural "bowl" which is drained by a gentle ravine. The ravine originally extended to the lake, but has been partially filled below Boucherie Road. Field reconnaissance revealed a culvert inlet on the north side of Boucherie Road. It appears that this culvert discharges into a piped system that extends to the lake through the lower vineyard.

The existing developments within the subject area are currently serviced with separate storm sewer systems. Proposed development will be serviced by extensions to these systems. It has already been proposed that a piped major system be constructed to divert excess runoff around the vineyard to Boucherie Road for the development off Mission Hill Road. Considering the recommendations made in Section 2.5, and that the emergency drainage routes (EDRs) for the Menu and Gregory Road developments pass through the vineyard, the natural EDR through the vineyard should be preserved and protected.

When the upper portions of sub-basin 11104 are fully developed, the roads will have low points where they cross the bottom of the natural ravine. These roads will collect and concentrate runoff at the low points where there is potential for overflow into the ravine. Under these conditions, the runoff could flow through the vineyard and cause damage to the vines and perhaps the farm buildings. There is also potential for severe erosion and downstream soil deposition.

Concepts:

Ideally, the required EDRs should be properly identified and protected by easement. If grading is required to better define each route, then this should also be done. Since the routes will not carry frequent flows, they could be designed to provide the required hydraulic capacity without hindering vineyard operations. They should also be properly vegetated to prevent erosion. If necessary, a root-reinforcement system could be incorporated into the design.

Proposed Works: Establish and protect the emergency drainage routes within the existing vineyards which are required to service existing and potential upstream development. For the capital cost estimating purposes of this *Master Drainage Plan,* assume that each EDR will be graded as a ditch. That is:

- 400 m through Lot 1, Plan 13544,
- 350 m through Lot A, Plan B-159, and
- 360 m through Lot A, Plan 8937.

Also install a 1000 mm diameter culvert across Boucherie Road equipped with a grated, concrete inlet structure. Ensure that the tie-in to the existing piped system on Lot A, Plan 8937 allows for overflow should the piped system's capacity is exceeded.

Implementation: Several tasks must be completed to achieve the recommended system:

- Negotiate an "agreement in principle" with the vineyard owners to provide the recommended drainage easements.
- Conduct a thorough topographical survey and define the required routes.
- Design the drainage routes in consultation with the vineyard owners.
- Obtain drainage easements for the identified routes.
- Construct the works.

Since the vineyards are actively producing, works may have to be coordinated with replant activities. There may, however, be opportunities to integrate the required drainage routes into the vineyard road networks without impacting planted areas.

URBAN SYSTEMS® Project No. 1179.00301-C1 Date 2003-07-16

Project RDCO - SWMPLANNING Subject: QUAIL'S GATE DRAINAGE Page ____ of ____

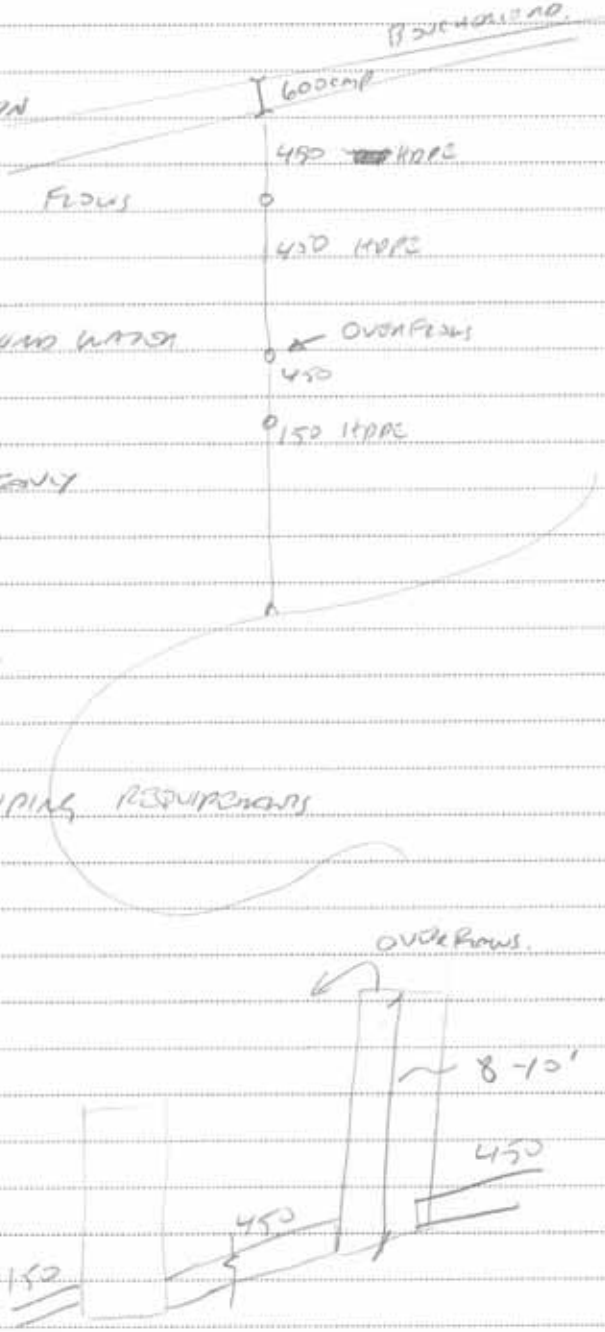
Designed by: _____ Checked by: _____ Rev. No. _____

MET 2 BEN STEWART (QUAIL'S GATE)
HILARY HETTINGA (RDCO)
DAVE SWALES (MoT)
ROBYN CLIFFORD (MOT)

ISSUE: QUAIL'S GATE INTENDS TO U/S 17's 150mm BIG O DRAIN PIPE SINCE IT DOESN'T HAVE SUFFICIENT CAPACITY FOR THE FLOWS DIRECTION TO THE SYSTEM.

SEEMS TO HANDLE THE GROUND WATER WELL ENOUGH (± 30 L/s)

OFTEN OVERFLOWS AFTER HEAVY RAINS.



ACTION: HILARY & DAVE WILL DISCUSS POTENTIAL COST-SHARING.

GLEN WILL (MAY) CONFIRM PIPING REQUIREMENTS WHEN GIVEN THE GO-AHEAD.

FORM 106

2004-01-20 Project Initiation

Background: Quail's Gate in planning to upgrade the part of its vineyards through which a private drainage pipe is located. This pipe drains the north ditch along Boucherie Road from between Montigny Road and Mission View Court.

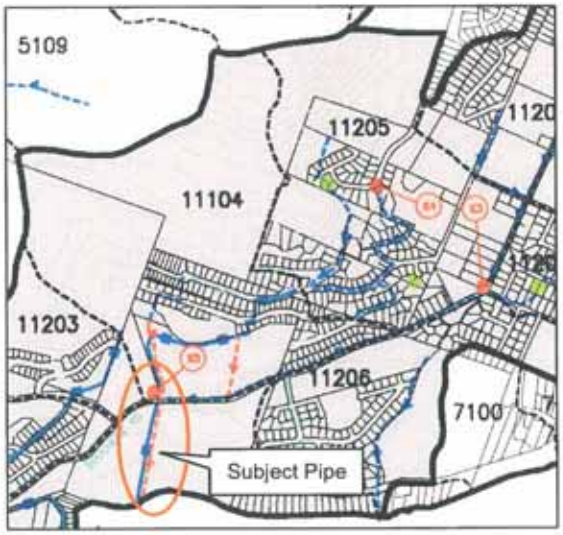
Glen Zachary met with Dave Swales (MoT), Hilary Hettinga (RDCO), Robyn Clifford (MoT), and Ben Stewart (Quail's Gate) on 2003-07-16 to discuss options for improving this drainage route. At that time, nothing was done, but last week, Scott Walker from Quail's Gate called to indicate that they are ready to commence work, and would like to know the required pipe diameter.

Have not been able to contact Hilary nor Dave, but understand that once the minimum pipe diameter has been determined, then MoT, RDCO, and Quail's Gate will negotiate the upgrade.

Objective: To estimate the required minimum pipe diameter for the proposed drainage pipe upgrade on Quail's Gate property.

Analysis: Determine the design peak flow.

Results: As shown on the adjacent excerpt from Figure 4.11 from the *Westside MDP*, the subject pipe originally drained catchments 11104 and 11205. Currently, however, a portion of each of these catchments is diverted to other drainage routes; some through catchment 11206 and some through catchment 11203.



The MDP design flow (100 year) for project K5 was specified as 1.3 cms. Considering the reduced contributing area, this peak flow should also be reduced. While peak flows do not necessarily have a linear correlation to catchment area, we will use this as our initial starting point.

1.3 cms x (199.8 - 24.2 + 23.9) ha / 199.8 ha = 0.99 cms

For the purposes of this assignment, we'll assume our design peak flow is 1.0 cms.

Analysis: Estimate average slope of the proposed pipe.

Results: The approximate pipe length is 435 m. Based on our very old 5m contour maps, the elevation difference is approximately 55 m. The slope is therefore:

55 / 435 = 12.6%

Analysis: Based on the above assumptions, determine the minimum required pipe diameter.

Results: It is assumed that MoT would provide corrugated HDPE pipe for this project. Based on this assumption, the following Flowmaster analysis indicates that the minimum diameter required would be 564mm. Since this is not a nominal pipe diameter, we would recommend a 600mm HDPE corrugated pipe.

Mannings Coefficient:	0.024	Flow Area:	0.2 m²
Channel Slope:	0.126000 m/m	Wetted Perimeter:	1.20 m
Depth:	564 mm	Top Width:	0.00 m
Diameter:	563.8 mm	Critical Depth:	0.55 m
Discharge:	1.0000 m³/s	Percent Full:	100.0 %
		Critical Slope:	0.113301 m/m
		Velocity:	4.01 m/s
		Velocity Head:	0.82 m
		Specific Energy:	1,382 mm
		Froude Number:	0.00
		Maximum Discharge:	1.0757 m³/s
		Discharge Full:	1.0000 m³/s
		Slope Full:	0.126000 m/m
		Flow Type:	N/A

Running with this data, we see that a 600mm HDPE corrugate pipe would have sufficient capacity for the reduced peak flow.

Mannings Coefficient:	0.024	Flow Area:	0.3 m²
Channel Slope:	0.126000 m/m	Wetted Perimeter:	1.88 m
Depth:	600 mm	Top Width:	0.00 m
Diameter:	600 mm	Critical Depth:	0.59 m
Discharge:	1.1806 m³/s	Percent Full:	100.0 %
		Critical Slope:	0.113495 m/m
		Velocity:	4.18 m/s
		Velocity Head:	0.89 m
		Specific Energy:	1,489 mm
		Froude Number:	0.00
		Maximum Discharge:	1.2700 m³/s
		Discharge Full:	1.1806 m³/s
		Slope Full:	0.126000 m/m
		Flow Type:	N/A

Mannings Coefficient:	0.024	Flow Area:	0.2 m²
Channel Slope:	0.126000 m/m	Wetted Perimeter:	1.20 m
Depth:	424 mm	Top Width:	0.00 m
Diameter:	600.0 mm	Critical Depth:	0.58 m
Discharge:	1.0000 m³/s	Percent Full:	70.6 %
		Critical Slope:	0.079275 m/m
		Velocity:	4.68 m/s
		Velocity Head:	1.12 m
		Specific Energy:	1,543 mm
		Froude Number:	2.39
		Maximum Discharge:	1.2700 m³/s
		Discharge Full:	1.1806 m³/s
		Slope Full:	0.090403 m/m
		Flow Type:	Supercritical

Glen Zachary

To: Swales, Dave TRAN:EX
Cc: Hilary Hettinga
Subject: Quail's Gate Drainage Pipe Upgrade

Dave,

Further to our meeting with Ben Stewart of Quail's Gate in July, 2003 and telephone discussions with Scott Walker and Hilary Hettinga, I've reviewed the minimum pipe size required to accommodate potential runoff along Boucherie Road which would drain through the proposed pipe on the Quail's Gate vineyard between Boucherie Road and Okanagan Lake.

Our original design flow (Westside MDP) for this drainage route was 1.3 cms. Considering the recent drainage works completed from Ourtoland Road to Boucherie Road, and that Victor Projects is piping their drainage through Appleway Boulevard, the design peak flow was reduced to 1.0 cms for the purposes of this analysis.

Based on this flow, a slope calculated using available 5 m contour mapping, and the assumption that the pipe would be corrugated HDPE, the required minimum diameter would be 600mm.

I have already called Scott Walker to let him know the recommended minimum pipe diameter. Note that the Westside MDP recommends that the existing culvert across Boucherie Road be replaced with a 1000 mm dia culvert. With a proper headwall structure and some ditch work, the diameter of this proposed culvert could be reduced. We can discuss this further when you intend to upgrade this item.

Please let me know if you have any questions or would like to discuss this further.

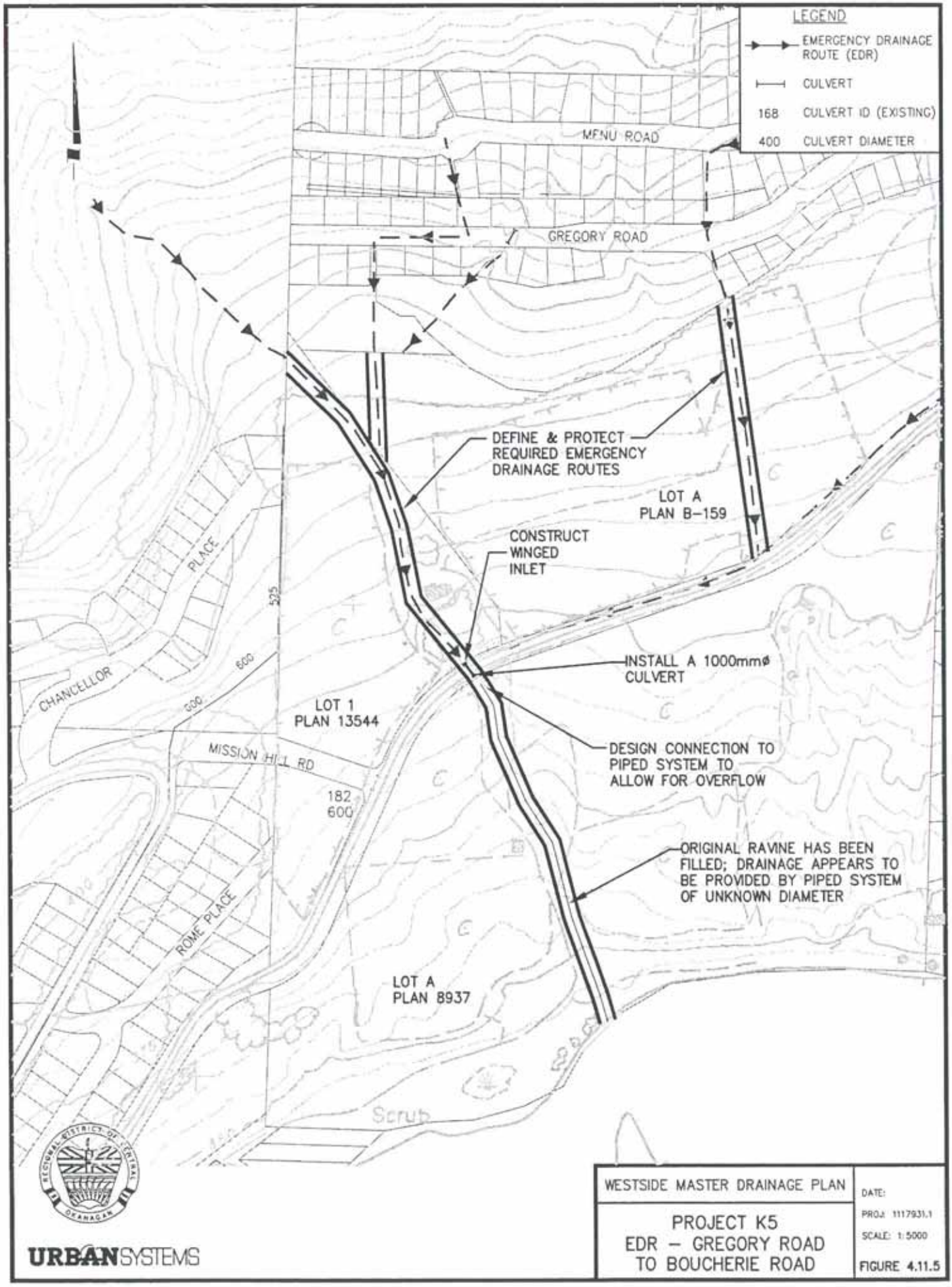
Sincerely,

Glen Zachary

Urban Systems Ltd.
Suite 500 - 1708 Dolphin Avenue
Kelowna, B.C. V1Y 9S4

Tel: 250-762-2517
Fax: 250-763-5266

gzachary@urban-systems.com



URBANSYSTEMS

WESTSIDE MASTER DRAINAGE PLAN	DATE:
PROJECT K5 EDR – GREGORY ROAD TO BOUCHERIE ROAD	PROJ: 1117931.1 SCALE: 1:5000 FIGURE 4.11.5

Project K6: EDR – Boucherie Road to Lake; West of Green Bay

Priority: 2

Pre-Development Flow: 0.26 m^3/s

Design Flow: 1.1 m^3/s

Estimated Cost: $42,600

Discussion:

As shown in Figure 4.11.6, there is a low point along Boucherie Road west of Green Bay Road. Runoff currently ponds on the north side of the road because there is no existing culvert at the location.

Although sub-basin 11202 is serviced by a trunk storm sewer system, which includes a ditch inlet on the north side of the Boucherie and Green Bay roads intersection, there is potential for excess runoff to concentrate at Site A. This runoff could either be generated by an extreme rainfall or snowmelt event or by a blocked catch basin.

Historically, there is no record of runoff overflowing Boucherie Road at the subject location. However, with increased development, the potential does exist. Because the land south of Boucherie Road is under active agricultural use, and because it is relatively level, the potential damage due to erosion is probably minimal. This is, however, a deficiency which must be identified and evaluated.

Concepts:

An access road between Lots 2 and A off Boucherie Road is located near the ponding area. It may be possible to install a culvert across Boucherie Road and construct a ditch along this access road to the lake. This may require some re-grading of the ditch on the north side of Boucherie Road.

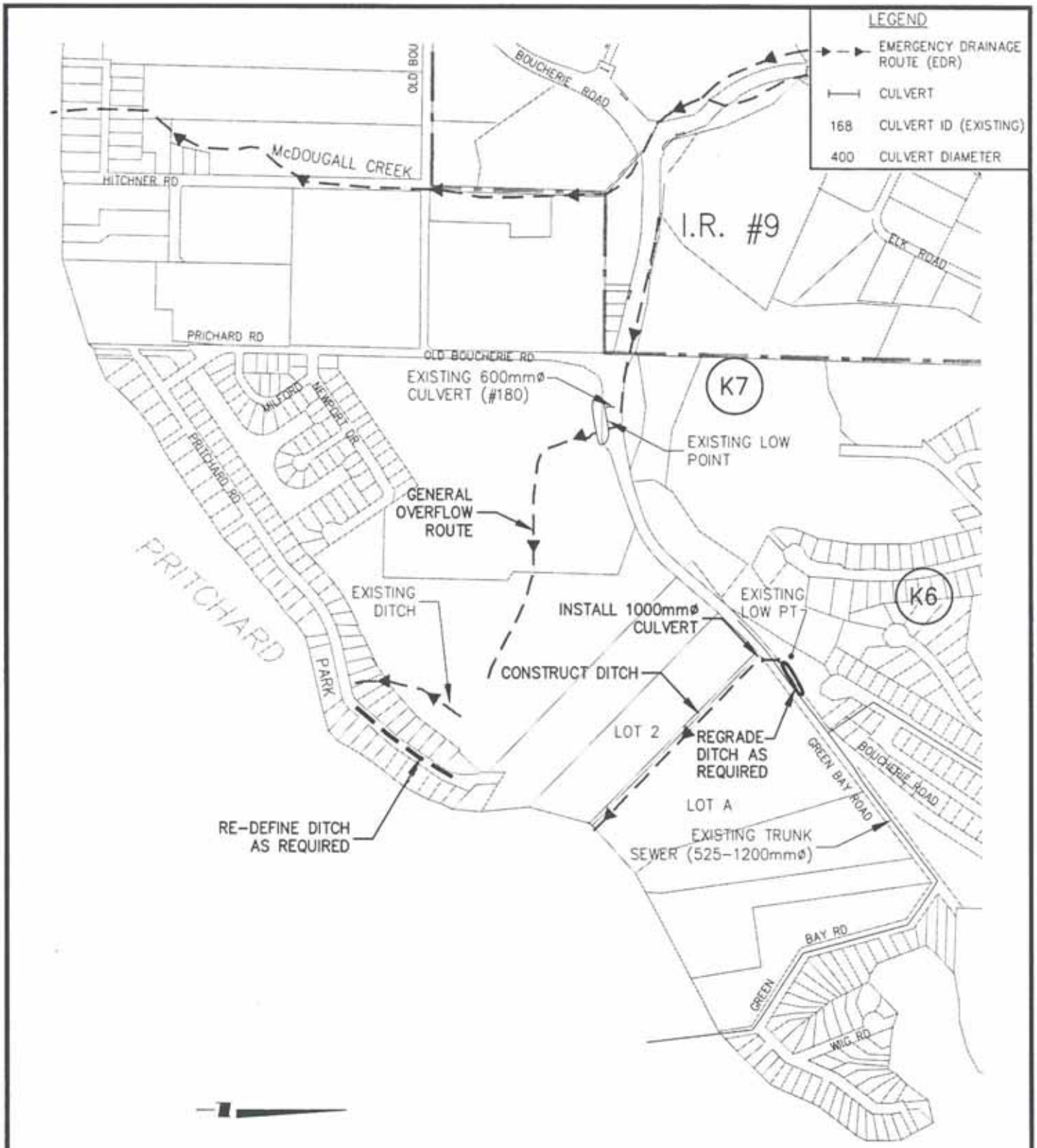
Proposed Works:

The proposed works consist of three items:

- Install a 1000 mm diameter culvert across Boucherie Road;
- Re-grade approximately 100 m of ditch along the north side of Boucherie Road to direct flows to the proposed culvert;
- Construct approximately a 450 m ditch between Lot 2 and Lot A.

Implementation:

In order to confirm the feasibility of the proposed ditch route, a topographical survey of Boucherie Road, its ditches, and the access road between Lots 2 and A should be completed. Assuming that the proposed ditch is feasible, then the work can be completed whenever the Stakeholders deems it necessary.



REGIONAL DISTRICT OF CENTRAL OKANAGAN

URBANSYSTEMS

WESTSIDE MASTER DRAINAGE PLAN	DATE:
PROJECT K6 & K7 EDR BOUCHERIE TO LAKE	PROJ: 1117931.1 SCALE: 1:10,000 FIGURE 4.11.6

Project K7: EDR – Boucherie Road to Lake; East of Old Boucherie

Priority: 2

Pre-Development Flow: 0.11 m^3/s

Design Flow: 0.27 m^3/s

Estimated Cost: $3,500

Discussion:

As shown in Figure 4.11.6, there is a low point along Boucherie Road just east of the Old Boucherie Road inter-section. Runoff ponds on the south side of the road because a 600 mm diameter culvert discharges into a relatively deep depression on that side.

Sub-basin 11101 is primarily undeveloped, and will probably remain that way because of its steep slopes. Runoff is generated within the catchment, however, and does concentrate at Site B. Overflow from the current sink would meander through orchards in the general direction of the eastern part of the Pritchard Drive subdivision; there is no well-defined drainage route.

It is probable that because the subject area is relatively level, the anticipated design flow would be spread over a relatively wide path. If it does reach the lots along Pritchard Drive, the lot grading may be sufficient to pass it on to the lake. According to the Provincial topographic maps, a drainage ditch was constructed along the north side of several lots that discharges onto Pritchard Road across from the public park. This ditch was not readily evident during field reconnaissance.

Concepts:

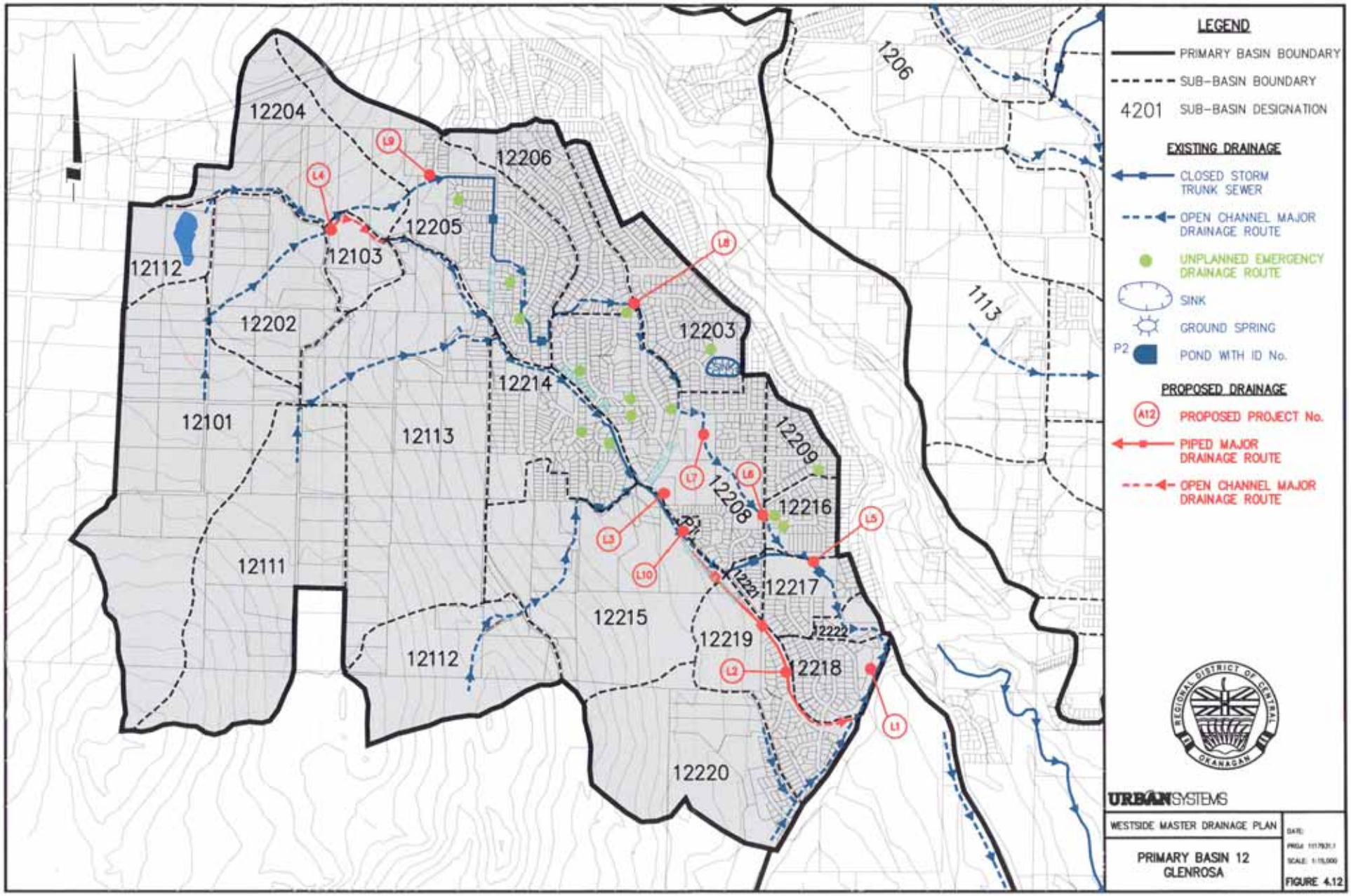
There is probably no reason to construct any works along most of the drainage route from Boucherie Road to the lake except for the portion through the Pritchard subdivision. It may be necessary to construct a ditch along the north side of the lots along the north side of Pritchard Drive and direct it to an appropriate discharge location at the lake.

Proposed Works:

Re-define approximately 250 m of ditch along the north property lines of the lots on the north side of Pritchard Drive, east of the public park.

Implementation:

Although there is no reason to address this deficiency immediately, it would be worthwhile to at least confirm where runoff would flow under existing conditions within the Pritchard Drive subdivision. This would require a topographical survey of the area. Eventually, when the recommended diversion ditch is deemed necessary, the survey can be used for design purposes.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1206
1113
L1
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L3
L4
L5
L6
L7
L8
L9
L10
LEGEND
PRIMARY BASIN BOUNDARY
SUB-BASIN BOUNDARY
4201 SUB-BASIN DESIGNATION
EXISTING DRAINAGE
CLOSED STORM TRUNK SEWER
OPEN CHANNEL MAJOR DRAINAGE ROUTE
UNPLANNED EMERGENCY DRAINAGE ROUTE
SINK
GROUND SPRING
P2 POND WITH ID No.
PROPOSED DRAINAGE
A12 PROPOSED PROJECT No.
PIPED MAJOR DRAINAGE ROUTE
OPEN CHANNEL MAJOR DRAINAGE ROUTE
REGIONAL DISTRICT OF CENTRAL OKANAGAN
URBAN SYSTEMS
WESTSIDE MASTER DRAINAGE PLAN
PRIMARY BASIN 12
GLENROSA
DATE:
SCALE: 1:15,000
FIGURE 4.12

4.12 Basin 12 – Glenrosa

The original *Glenrosa Drainage Study* was completed for this basin in 1992. Some development has occurred since then, along with new or extended drainage systems. Some works have also been completed by MOTH on the emergency drainage systems as outlined below.

4.12.1 Existing Drainage

Since development within this basin occurred one small subdivision at a time, there is little consistency between the various drainage standards used. Some of the developments have curb & gutter with either storm sewers or dry wells while others are serviced by well-defined ditch and culvert systems. Most, however, are serviced by poorly defined ditches and half-buried culverts. Figure 4.12 shows the major drainage routes within the subject basin. These routes service three sets of sub-basins that eventually discharge into Powers Creek on the north side of Salloum Road. Also shown are the areas within Glenrosa that drain to multiple ponding areas.

Webber Road System

This drainage system was originally called the Scottstown Road System in the *Glenrosa Drainage Study*. Prior to development, most of the northern half of the subject basin drained into a pond located at what is now the playground of the Glenrosa Elementary School (McVicar and McNamara Roads). Originally, overflow from this pond found its way to Powers Creek via the natural drainage course which passes through the Webber Road School site. When the current residential development was constructed, no overflow relief was provided for the former pond area.

Fortunately, McIver Road intercepts the major drainage course just downstream from McQueen Road and directs it towards Webber Road. This interception redirects approximately 50% of the study area's runoff away from the original pond site. On the other hand, this route temporarily terminates at a sink on the west side of Webber Road. Under extreme runoff conditions, this sink flows over the road and through the yards of several houses before

entering the major drainage route through the Webber Road School yard. During the fall of 1997 and spring of 1998, the piped sections along Gates, McGuinness, and McQueen roads were installed by MOTH to alleviate nuisance flows associated with spring runoff conditions.

Bradford Brook System

The south-west ditch along Glenrosa Road has become the primary major drainage route within the Glenrosa basin. The piped portion between Ashley Court and Glen Abbey Place was also installed during the fall of 1997 to eliminate channel erosion since the suspended materials were usually deposited within the ditch immediately upstream of the Webber Road Elementary School. This deposition often blocked the entrance to the 600 mm diameter culvert across the school property and required constant surveillance and maintenance during freshet to ensure proper function.

An off-line detention pond is located just upstream of the piped portion of the system between Glenrosa Road and the Webber Road Elementary School. It is currently configured to discharge into the convenience system that services the Glen Abbey subdivision. Runoff will enter this pond, however, only when a diversion structure within the ditch on the west side of Glenrosa Road is manually opened.

Salloum Road System

This small set of sub-basins located in the lower part of Glenrosa drains to the 600 mm diameter trunk system along Salloum Road. Although a portion of this area is serviced by a storm sewer system that is tributary to the trunk system, emergency runoff is directed into a ditch equipped with grated inlets that also drain into the trunk. The Bradford Brook system is also tributary to this trunk, which has a 900 mm diameter from the Bradford Brook inlet to the Powers Creek outlet.

Excluded Areas

Portions of the Glenrosa area have been excluded from the drainage basin because they drain to numerous small ponding sites created by relatively flat ditches that are not connected by culverts. In most cases, snowmelt and rainfall within these areas simply infiltrate into the ground. Under extreme runoff conditions, it is anticipated that the water would be stored in the many surface ponding areas until the water either infiltrates or evaporates away. Therefore, since potential drainage problems within these areas are likely to be insignificant, they have not been analyzed further in the WMDP.

4.12.2 Land Use

Existing

In terms of area, approximately 40% of the existing development within this basin is low density residential with several small parks and school sites. Much of the rest is country residential with small patches of coniferous forest.

Future

Essentially all of the future development within Glenrosa is designated as low density residential, and most of it is located on the uphill side of Glenrosa Road. In most cases, these potential development areas have direct access to Glenrosa Road so there should be little difficulty with future runoff impacting existing development.

4.12.3 Infiltration Potential

Surface Geology

As shown on Figure B3 in Appendix B, the Glenrosa basin is characterized by three US SCS soil groups; B, C, and D. These groups are comprised of three primary surface soil types in addition to bedrock:

- *Raised Terrace Deposits* - which consists of inter-bedded sands and gravels;
- *Mixed Undifferentiated Deposits* - which consists of an inter-layered and mixed sequence of clay to gravel-sized material over shallow or locally exposed bedrock.

- *Lacustrine Sediments* - which is an inter-layered sequence of silt and clay with thin sand layers;

Group B is comprised of the Raised Terrace Deposits, and lies predominantly within existing residential development. This soil group exhibits very good drainage characteristics because of the sands and gravels. Historically, dry wells have been used successfully in this area for disposing of minor runoff. Few drainage problems have been reported by homeowners in this area.

Group C is comprised of the Mixed Undifferentiated Deposits, which cover the southern and western portions of the subject basin. Drainage characteristics within this area are variable, and should be evaluated on a site-specific basis. For purposes of this MDP, however, the average characteristics are assumed to be equivalent to those of Group C soils.

Group D is comprised of the Lacustrine Sediments and exposed bedrock. These are located between the Group B and Group C soils. Drainage through the soil is very poor in these areas, and can often result in drainage problems when development occurs.

Groundwater Conditions

Figure B4 in Appendix B shows the recharge, transition, and discharge areas within the MDP area as well as historical groundwater problem locations. The western part of the Glenrosa basin, where slopes are relatively flat, exhibits recharge characteristics. Groundwater from this area migrates eastward towards Powers Creek and in many instances, discharges at the surface on the steeper slopes between each bench. This is especially true within the SCS Soil Group D areas.

The original *Glenrosa Drainage Study* was initiated because of groundwater problems within the Ranch Road and Country Pines subdivisions. Pockets of groundwater drainage problems still occur throughout the subject basin. Many of the problems are sporadic; they do not occur every year. Many are also due to inadequate or non-existent footing and curtain drains.

Subsurface Drainage Zones

Referring to Figure B5, the north-east benches within the developed portion of the Glenrosa basin fall within Zone I, the western, upper bench area falls within Zone II, and the lower Glenrosa area is within Zone III. These demarcations are generally confirmed by the fact that:

- dry well systems are being used and are functioning adequately within Zone II, and
- there are many documented groundwater drainage problems within Zone III.

4.12.4 Analysis

The 1992 *Glenrosa Drainage Study* recommended that the major drainage route follow Glenrosa Road to a point where it could be diverted to the Bradford Brook system at Inverness Road. This route required purchase of property immediately downstream of the Webber Road School site for a proposed detention pond and storm trunk works. To date, negotiations to purchase the land have proved unfruitful. Therefore, at the initiative of MOTH, and in consultation with the RDCO, an alternative approach to managing drainage within Glenrosa has been considered. It consists of:

- installing a piped storm sewer along Glenrosa Road from, ultimately, Gates Road to Highway 97;
- re-grading Glenrosa Road to function as the emergency drainage route.

The storm sewer is sized to accommodate runoff from the 100 year snowmelt event. Since, under developed conditions, the design peak runoff from a rainfall event is greater than the capacity of the storm sewer, the road would then have to function as the major drainage route.

With this approach, it will be possible to by-pass the diversion to the Bradford Road system. This will free-up the capacity of the existing Bradford Road system for runoff from the areas east of Glenrosa Road. It will also eliminate the previously experienced erosion problems along parts of Glenrosa Road and the resulting sediment deposition immediately upstream of the school site. Eliminating the ditch along Glenrosa Road will also provide more room for pedestrians and cyclists.

Project L1: Salloum Road

Priority: 2

Pre-Development Flow: 0.29 m^3/s at Glenrosa Road inlet
1.36 m^3/s at Bradford Brook inlet

Design Flow: 1.2 m^3/s at Glenrosa Road inlet
1.0 m^3/s at Bradford Brook inlet

Estimated Cost: $26,800

Discussion:

As shown in Figure 4.12.1, a storm sewer trunk currently exists along Salloum Road. Although this trunk drains the small storm sewer collection system that services Glenway Road, it also transports runoff from Glenrosa Road and the Bradford Brook system to Powers Creek. Under extreme runoff conditions, excess runoff flows through the ditches on both sides of Salloum Road.

Historically, there have been events when runoff from the Bradford Brook system could not enter the Salloum Road trunk, primarily due to an inlet blocked by debris. This excess runoff flowed through the ditch, over a private driveway, and down the steep embankment to Powers Creek. The damage to the driveway, and especially to the steep embankment, was significant.

Although the existing trunk has sufficient capacity to accommodate runoff from the 100 year snowmelt event, it does not for the peak flow anticipated from the design 100 year rainfall event under fully developed conditions. Considering that major drainage from the areas above Glenrosa Road will ultimately be directed along the road to Highway 97, the ditching along Salloum Road must function as the emergency drainage route. That is, the ditch along the north side of Salloum Road would serve the areas draining into the Bradford Brook system, and the ditch between Salloum Road and Highway 97 would service runoff from Glenrosa Road.

There is a grated inlet to the 900 mm diameter section of the storm trunk located in the north ditch just upstream of a private driveway. This inlet is currently incapable of diverting all of the design flow into the trunk. No inlet nor trunk system exists to direct runoff from the ditch between Salloum Road and Highway 97 to Powers Creek.

Concepts:

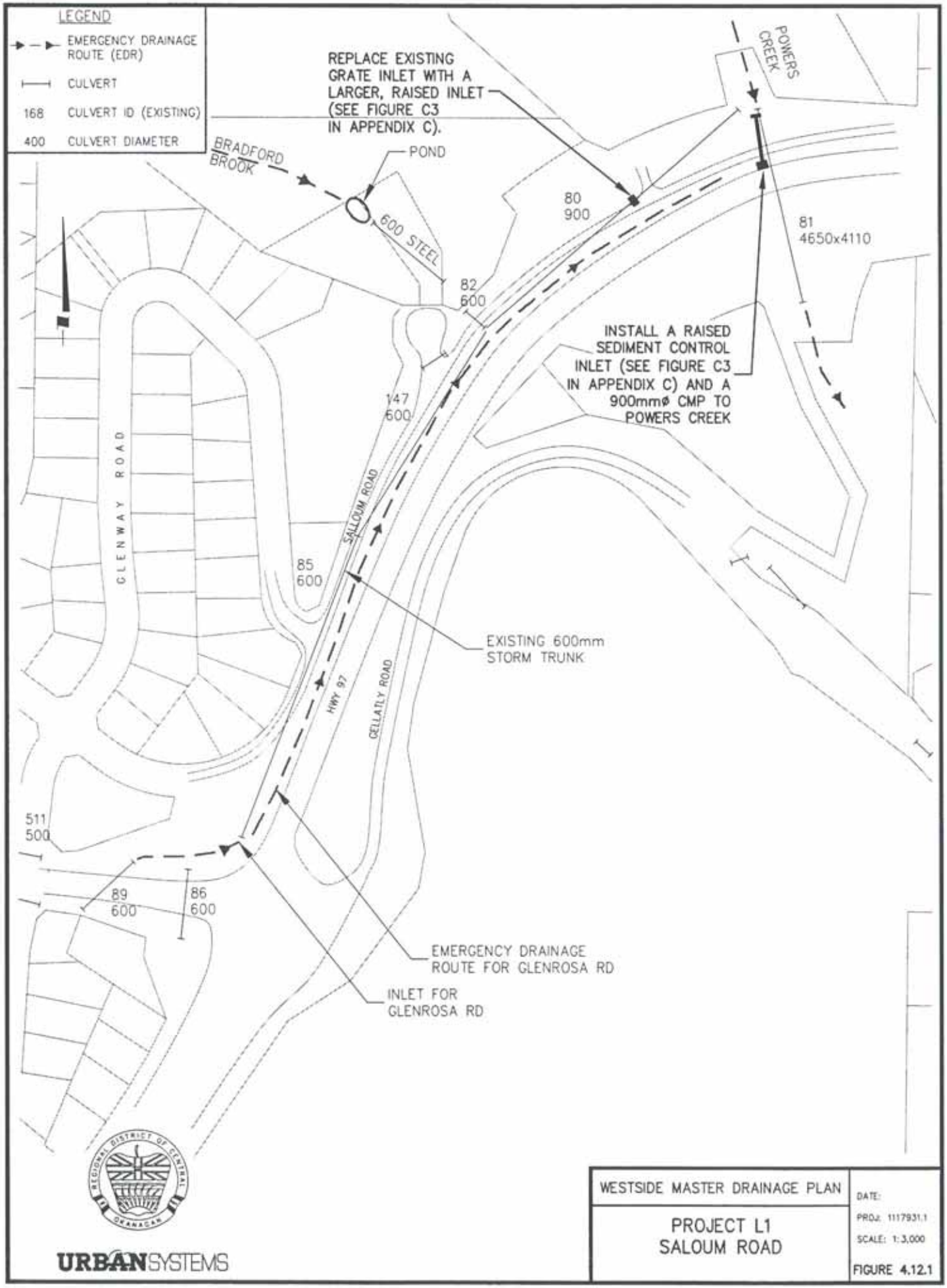
The existing ditch on the north side of Salloum Road has recently been armoured with angular rip rap to minimize erosion. It has sufficient capacity to accommodate the excess runoff which cannot be accommodated by the existing trunk. However, because of the potential for extensive damage to the steep embankment at the end of the ditch, a larger inlet structure should be constructed to direct flows into the 900 mm diameter section down the steep embankment.

An appropriate inlet in the ditch between Salloum Road and Highway 97 must also be constructed. A trunk sewer from this inlet to Powers Creek will be required to prevent erosion to the bank fill.

Proposed Works:

- Install two raised, concrete inlets as shown in Figure 4.12.1;
- Construct approximately 50 m of 900 mm diameter culvert across Salloum road and down the steep embankment to Powers Creek.

Implementation: The inlet for the north ditch should be installed as soon as funds are available since upstream works currently direct runoff to the Bradford Brook system. Once the storm sewer along Glenrosa Road is extended to Highway 97, and Glenrosa Road is regraded as discussed in Project L3, then the inlet in the ditch between Salloum Road and Highway 97, and its associated storm trunk, should be constructed.


LEGEND
EMERGENCY DRAINAGE ROUTE (EDR)
CULVERT
168 CULVERT ID (EXISTING)
400 CULVERT DIAMETER
REPLACE EXISTING GRATE INLET WITH A LARGER, RAISED INLET (SEE FIGURE C3 IN APPENDIX C).
POWERS CREEK
BRADFORD BROOK
POND
600 STEEL
80
900
81
4650x4110
82
600
INSTALL A RAISED SEDIMENT CONTROL INLET (SEE FIGURE C3 IN APPENDIX C) AND A 900mmø CMP TO POWERS CREEK
147
600
GLENWAY ROAD
SALOUM ROAD
85
600
EXISTING 600mm STORM TRUNK
HWY 97
GELLATLY ROAD
511
500
89
600
86
600
EMERGENCY DRAINAGE ROUTE FOR GLENROSA RD
INLET FOR GLENROSA RD
REGIONAL DISTRICT OF CENTRAL OKANAGAN
URBAN SYSTEMS
WESTSIDE MASTER DRAINAGE PLAN
PROJECT L1
SALOUM ROAD
DATE:
PROJ: 1117931.1
SCALE: 1:3,000
FIGURE 4.12.1

Project L2: Glenrosa Road Storm Trunk

Priority: 1

Pre-Development Flow: 0.25 m^3/s

Design Flow: 1.1 m^3/s (100 year snowmelt)

Estimated Cost: $437,500

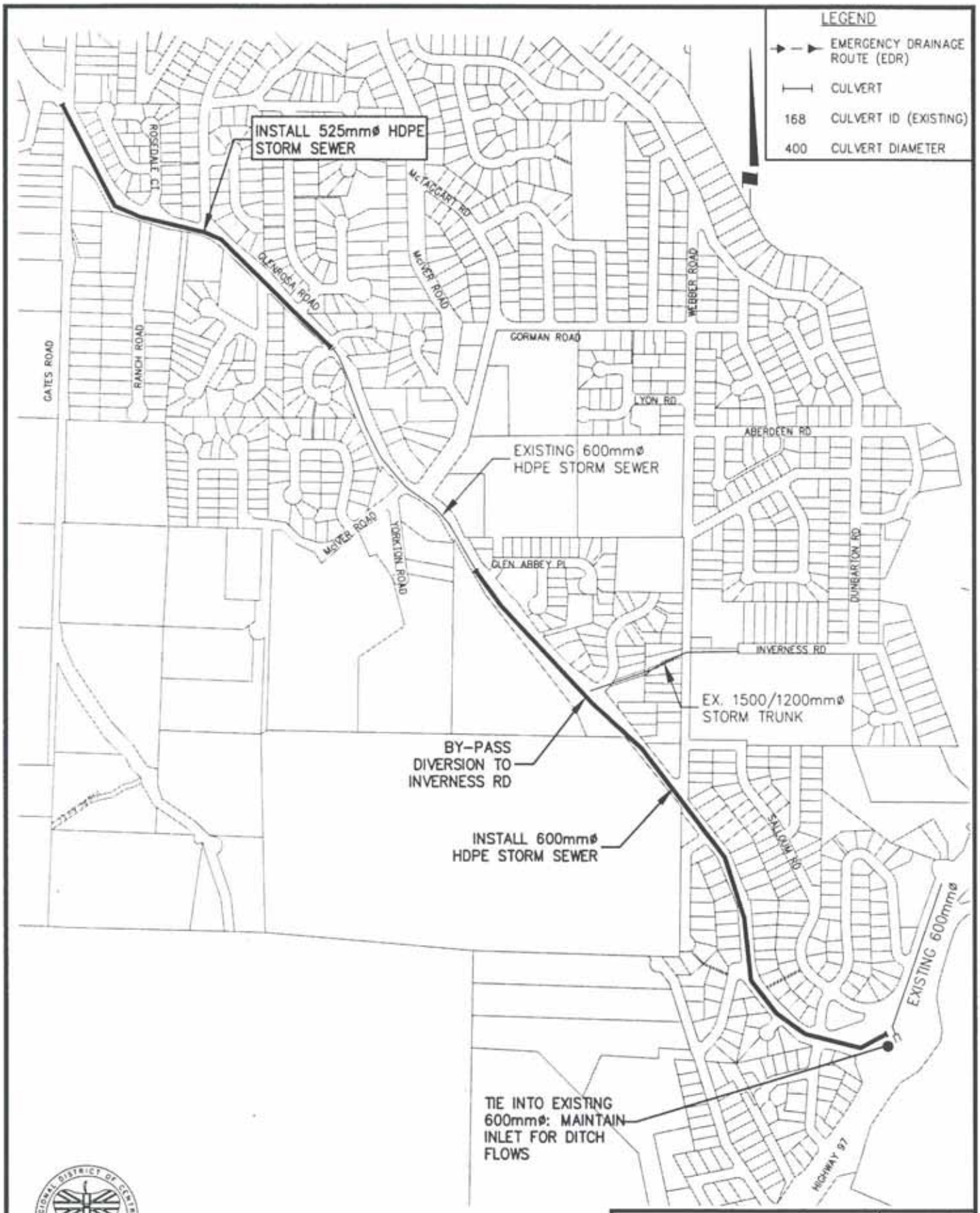
Discussion: As discussed in Section 4.12.4, the Ministry of Transportation and Highways would like to install a storm sewer trunk along Glenrosa Road to Highway 97. Part of this has been completed, but more remains to be done.

Concepts: MoTH installed a 600 mm diameter PE pipe with uniformly-spaced, catchbasin-equipped manholes. Since the design condition is snowmelt, and since the peak snowmelt usually occurs after the snow has melted within the lower parts of the Glenrosa basin, the 600 mm diameter pipe could be extended right down to the highway. (see Project L1). The existing diversion from Glenrosa Road to Inverness Road would be by-passed.

Proposed Works:

- Install approximately 1.2 km of 600 mm diameter HDPE pipe from Glen Abbey Place to Highway 97
- Tie-into the existing 600 mm at Salloum Road;
- By-pass the existing 1500 mm diameter diversion to Inverness Road;
- Install approximately 0.7 km of 525 mm HDPE pipe from Gates Road to Ashley Court.

Implementation: Although these are major works, they need to be implemented as soon as funds are available. If limited funds are available, the section downstream of Glen Abbey Place should be constructed before the section from Gates Road to Ashley Court.


LEGEND
EMERGENCY DRAINAGE ROUTE (EDR)
CULVERT
168 CULVERT ID (EXISTING)
400 CULVERT DIAMETER
INSTALL 525mmø HDPE STORM SEWER
EXISTING 600mmø HDPE STORM SEWER
EX. 1500/1200mmø STORM TRUNK
BY-PASS DIVERSION TO INVERNESS RD
INSTALL 600mmø HDPE STORM SEWER
TIE INTO EXISTING 600mmø: MAINTAIN INLET FOR DITCH FLOWS
EXISTING 600mmø
ROSEDALE CT
McTAGGART RD
McIVER ROAD
GLENROSA ROAD
WEBBER ROAD
GORMAN ROAD
LYON RD
ABERDEEN RD
GATES ROAD
RANCH ROAD
McIVER ROAD
TORKTON ROAD
GLEN ABBEY PL
DUNBARTON RD
INVERNESS RD
SALOOMA RD
HIGHWAY 97
REGIONAL DISTRICT OF CENTRAL OKANAGAN
URBANSYSTEMS
WESTSIDE MASTER DRAINAGE PLAN
PROJECT L2
GLENROSA ROAD
TRUNK STORM SEWER
DATE:
PROJ: 1117931.1
SCALE: 1:10,000
FIGURE 4.12.2

Project L3: Re-Grade Glenrosa Road

Priority: 2

Pre-Development Flow: 0.25 m^3/s and 0.62 m^3/s (downstream and upstream of existing Walnut Glen Road diversion respectively)

Design Flow: 1.3 m^3/s (net 100 year post-development rainfall)

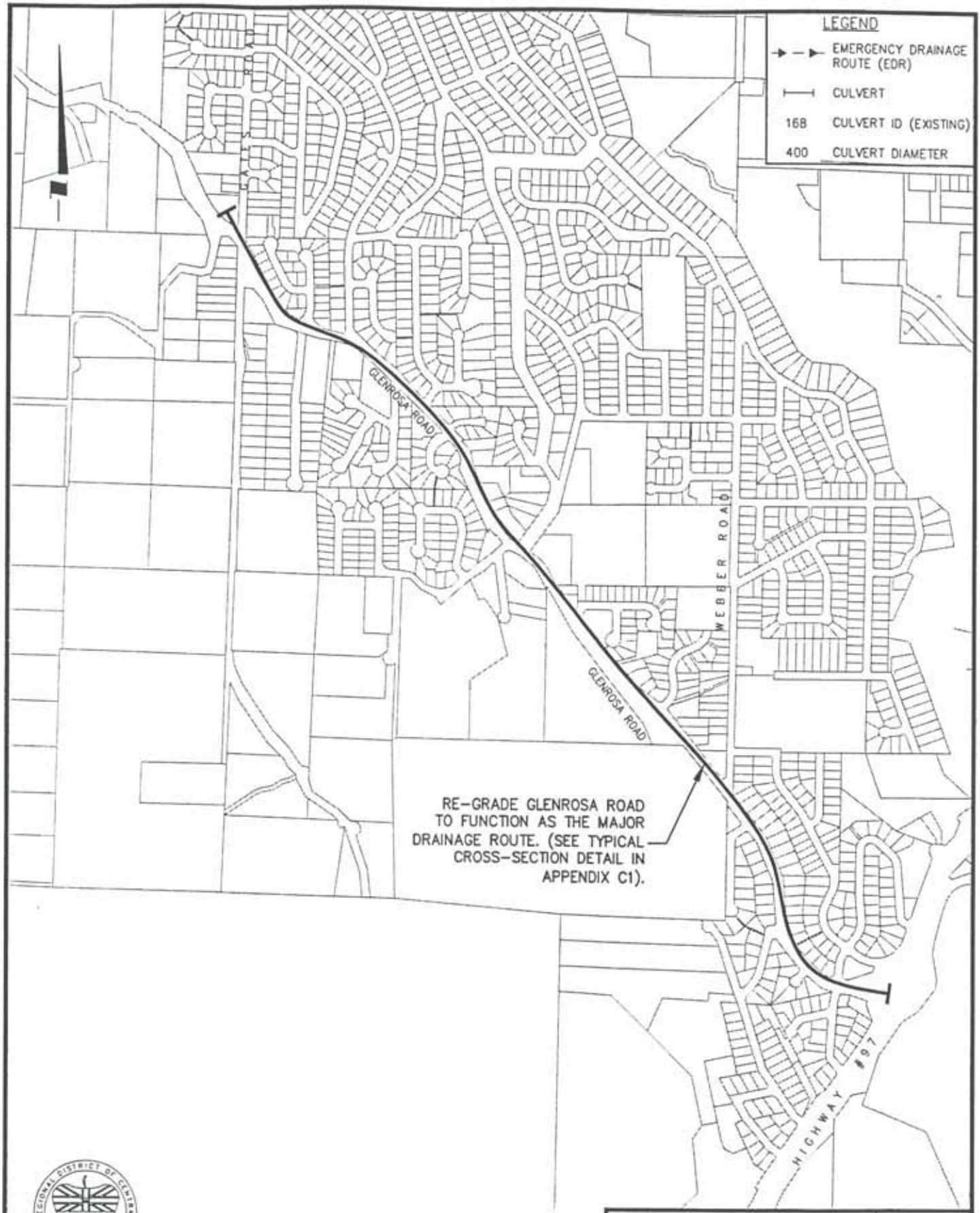
Estimated Cost: $387,900

Discussion: With reference to Section 4.12.4, Glenrosa Road will become the emergency drainage route for all areas draining to it. When the proposed storm trunk is constructed, any excess runoff that cannot enter the trunk will have to flow on the road surface. Currently, the existing road is not constructed to perform this function. Runoff that may be forced onto the road at the inlet of the recently installed 600 mm trunk sewer would quickly flow off the road and onto private property at several locations. This can not be allowed.

Concepts: In order for Glenrosa Road to function successfully as the emergency drainage route, it must be graded with a full cross-fall toward the upper side of the road. This is illustrated in Figure C4 in Appendix C.

Proposed Works: Re-grade approximately 2.5 km of Glenrosa Road as shown in Figure 4.12.3.

Implementation: Currently, most of the drainage along Glenrosa Road is provided by ditching. Therefore, the re-grading is not required until the trunk proposed in Project L2 is constructed. However, since there are curved sections of the road that would result in a reverse-crown situation, it would be prudent to discuss this concept with MoTH as early as possible.



REGIONAL DISTRICT OF CENTRAL OKANAGAN

URBANSYSTEMS

WESTSIDE MASTER DRAINAGE PLAN	DATE:
PROJECT L3 RE-GRADE GLENROSA ROAD	PROJ: 1117931.1 SCALE: 1:12,500 FIGURE 4.12.3

Project L4: Re-Direct Major Route at Turnbull Road

Priority: 2

Pre-Development Flow: 0.75 m^3/s (100-year Snowmelt)

Design Flow: 0.75 m^3/s

Estimated Cost: $1,600

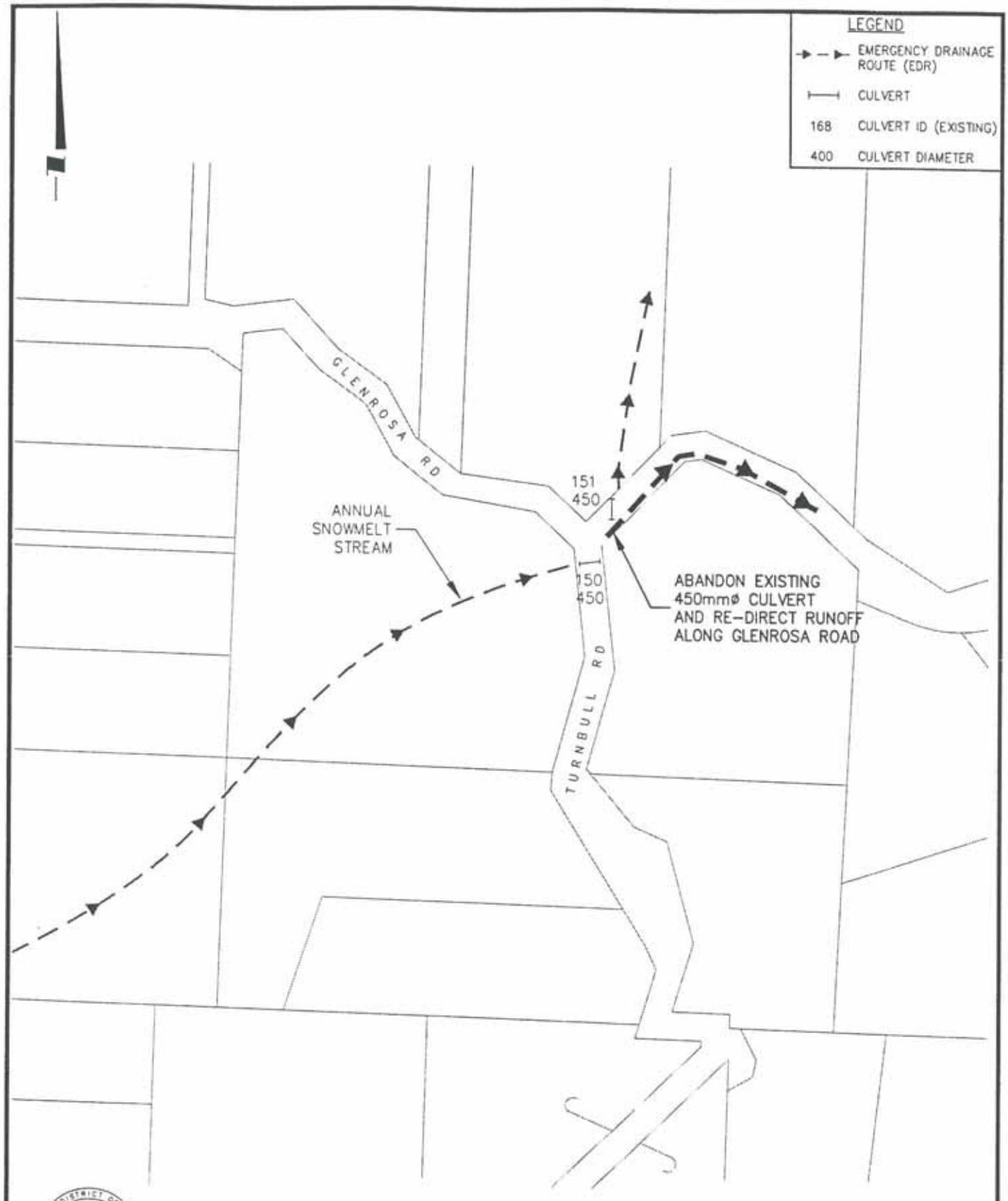
Discussion: During each spring, a significant amount of snowmelt flows from sub basins 12101 and 12202 through the existing culvert across Turnbull Road, through the culvert across Glenrosa Road, and into sub basin 12204. Historically, this flow has caused problems on Stonegate Court and Corral Court because no provisions were made to conveniently transport it to the ditch system along Gates Road (see Project L9).

As shown in Figure 4.12, the major drainage route continues through the developed part of Glenrosa until it reaches Webber Road (Project L6) and the Webber Road School (Project L5). There are several sites along this route that are subject to drainage problems when the runoff from these upper basins is too high.

Concepts: Considering how expensive it is to correct drainage problems in developed areas, and since there is a plan to use Glenrosa Road as the major drainage route, it seems reasonable to re-direct the subject flows to the ditch along Glenrosa Road.

Proposed Works: Seal-off the inlet to Culvert #151.

Implementation: Currently, the most challenging drainage trouble spot is the Webber Road School site. If the flow is diverted to the Glenrosa Road ditch before the Glenrosa trunk sewer (Project L2) is completed, then the flow will reach the Webber Road school site sooner than under current conditions. This will only aggravate the situation even more. Therefore, this project should be completed only after Project L2 (at least the portion downstream of the 1500 mm diversion culvert at Walnut Glen Drive) is completed.



REGIONAL DISTRICT OF CENTRAL OKANAGAN

URBANSYSTEMS

WESTSIDE MASTER DRAINAGE PLAN	DATE:
PROJECT L4 RE-DIRECT MAJOR ROUTE AT TURNBULL	PROJ: 1117931.1 SCALE: 1:4000 FIGURE 4.12.4

Project L5: Webber Road School Site

Priority: 3

Pre-Development Flow: 1.32 m^3/s

Design Flow: 0.53 m^3/s

Estimated Cost: $110,800

Discussion:

The Webber Road school site is situated in the bottom of the natural drainage corridor for the Glenrosa Area. Runoff from the upstream sub basins eventually flows into a ditch along the south side of Inverness Road. From here, it flows through a 600 mm diameter CMP trunk sewer and on to the Salloum Road system where it is eventually discharged to Powers Creek.

In 1997, the Regional District completed a joint-use study of the school site with School District 23. Part of this study looked at how drainage could be managed on the property. The study recommended that the following items be constructed:

- A detention pond on the farm property immediately north of the west end of Inverness Road.
- An underground 1200 mm storm sewer across the school play ground.
- A short section of open channel stream into a wet pond.
- An emergency overland flow route when the piped system capacity is exceeded.

These works were based on the assumption that the existing drainage route would remain the major drainage route. However, this assumption is no longer valid since MoTH wants to bypass the school site and the property immediately downstream of it (see Section 4.12.4). Under the new assumption, the design flow would ultimately be generated only from the sub basins draining to Webber Road system.

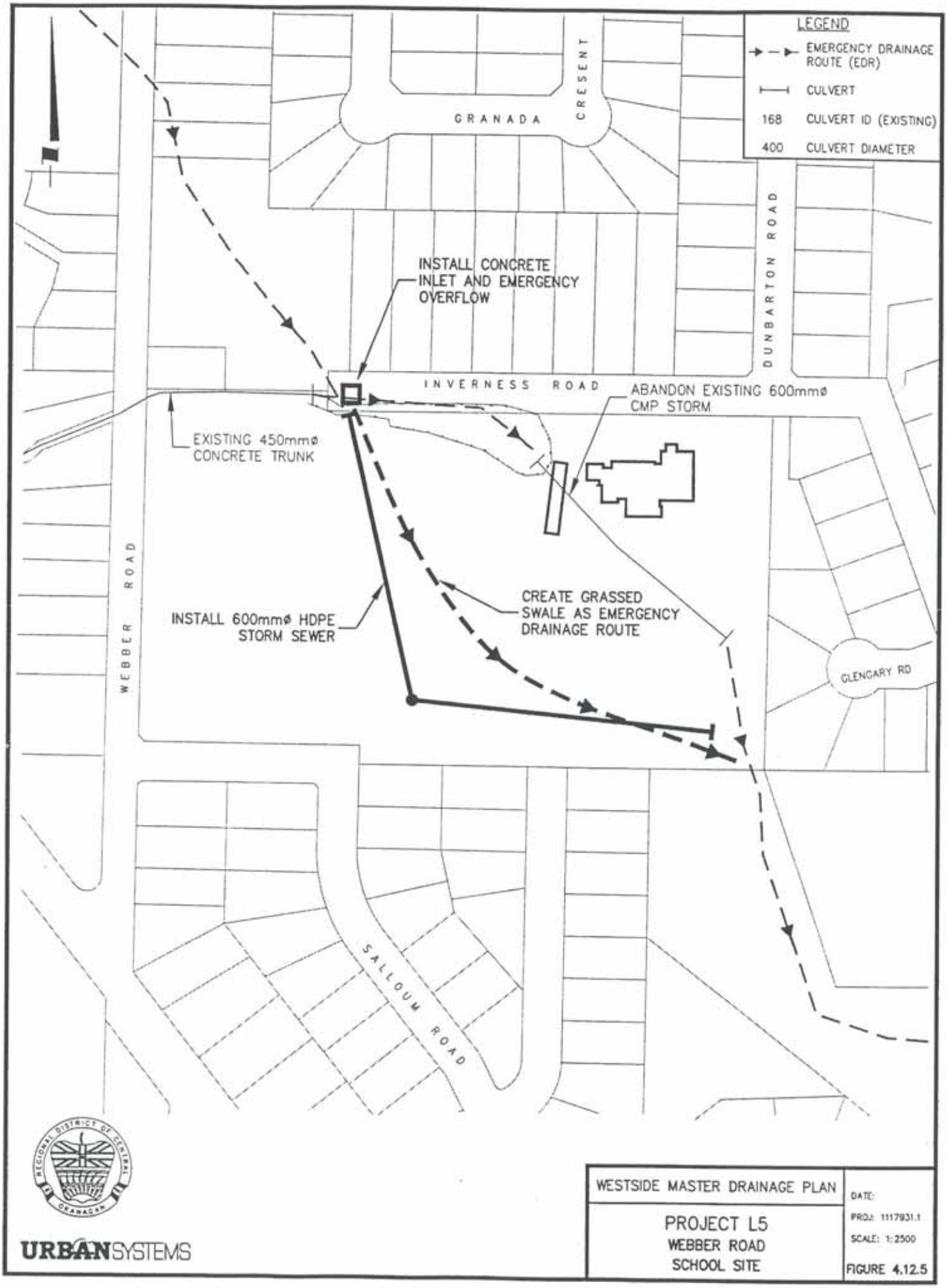
Concepts:

Since the *Webber Road School Joint Development Plan* recommends that the ditch along Inverness Road be filled for additional parking, and potential building expansions could be located above the existing CMP, it will still be necessary to abandon the existing 600mm trunk. Therefore, a new storm trunk would have to be constructed. It would also be prudent to design an emergency overflow route through the playground in case the storm trunk inlet fails.

Proposed Works:

- Construct combination inlet and overflow structure;
- Construct approximately 260 m of 600 mm diameter trunk storm sewer as shown in Figure 4.12.5;
- Also construct approximately 200 m of grassed swale to function as the emergency overflow route.

Implementation: These works would be constructed if and when the *Joint Development Plan* is implemented.


LEGEND
EMERGENCY DRAINAGE ROUTE (EDR)
CULVERT
168 CULVERT ID (EXISTING)
400 CULVERT DIAMETER
GRANADA CRESENT
DUNBARTON ROAD
INSTALL CONCRETE INLET AND EMERGENCY OVERFLOW
INVERNESS ROAD
ABANDON EXISTING 600mmø CMP STORM
EXISTING 450mmø CONCRETE TRUNK
WEBBER ROAD
INSTALL 600mmø HDPE STORM SEWER
CREATE GRASSED SWALE AS EMERGENCY DRAINAGE ROUTE
GLENGARY RD
SALLOUM ROAD
REGIONAL DISTRICT OF CENTRAL OKANAGAN
URBANSYSTEMS
WESTSIDE MASTER DRAINAGE PLAN
PROJECT L5
WEBBER ROAD
SCHOOL SITE
DATE:
PROJ: 1117931.1
SCALE: 1:2500
FIGURE 4.12.5

Project L6: Scotstown and Webber Road

Priority: 2

Pre-Development Flow: 1.09 m^3/s

Design Flow: 0.50 m^3/s

Estimated Cost: $110,800

Discussion: As shown in Figure 4.12.6, the natural drainage route for most of the drainage area east of Glenrosa Road passes through several private properties just south of the Scotstown / Webber Road intersection. Also note that there is no culvert across Webber Road at this location.

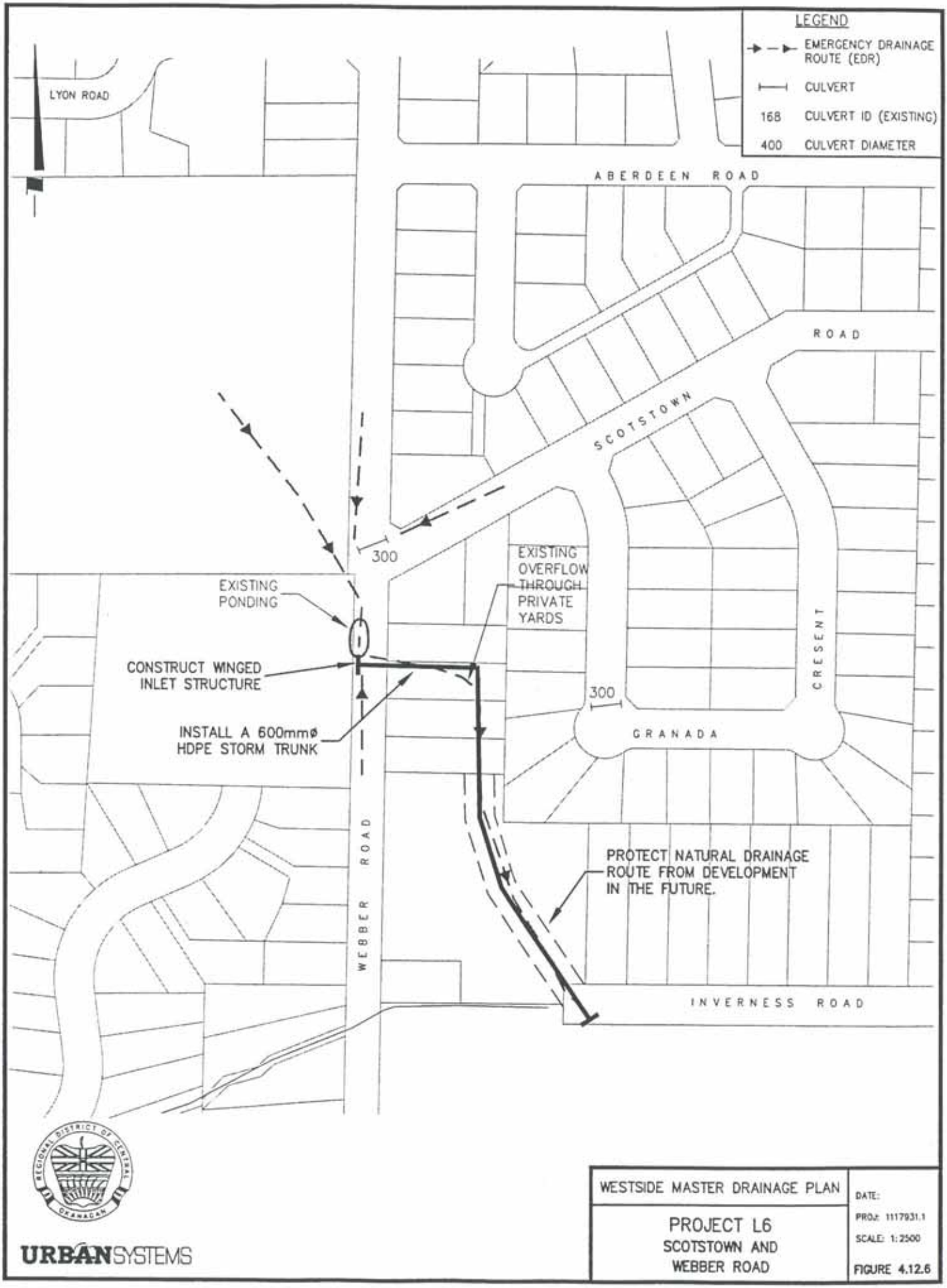
Historically, snowmelt has ponded in the ravine on the west side of Webber Road and has overflowed into the subject residential lots. The potential for this to occur again will increase as upstream drainage deficiencies are corrected. Future development will also aggravate this situation.

Concepts: The topography precludes use of a trunk sewer within the road right-of-way to avoid works on the private properties. Building locations on some of the residential lots also preclude use of an open channel system that follows the natural drainage route. Therefore, the most feasible concept would be to construct a piped system from the west side of Webber Road to the south property line of the residential lots. Here, an open channel could be constructed to direct flows to the system at Inverness Road. (It is assumed that the owners of the farm immediately south of the residential lots would be amiable to the concept.)

Proposed Works:

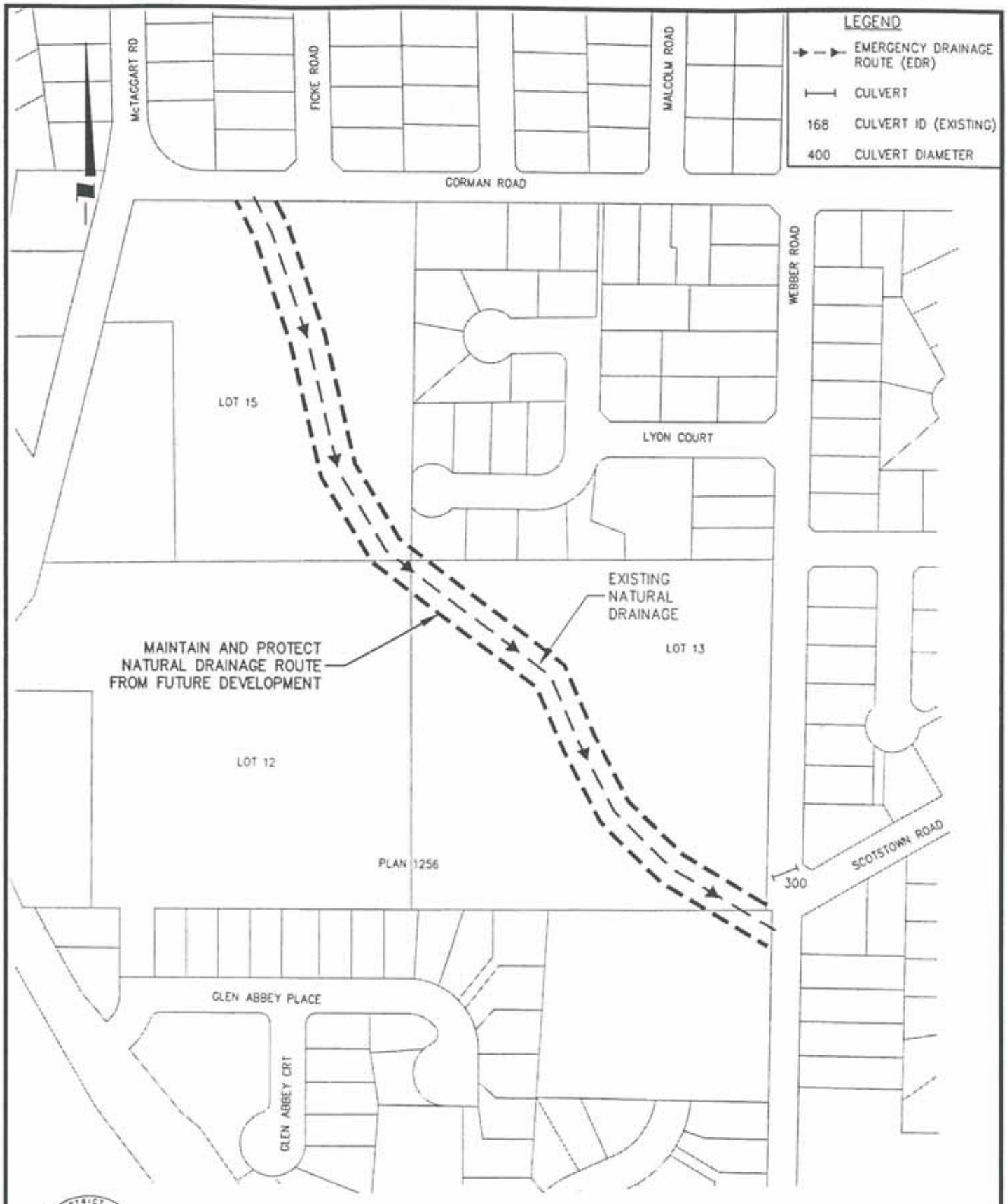
- Winged inlet structure,
- Approximately 130 m of 600mm diameter storm trunk, and
- 130 m of drainage channel as shown in Figure 4.12.6.

Implementation: Although not immediately necessary, these works should be constructed sooner than later because water has and will flow through the subject properties under extreme runoff conditions. The first step would be to initiate discussions with the property owners to determine their willingness to participate by granting easements. The second step would be to conduct a thorough topographical survey and to complete a preliminary design. This would then be used to complete final easement negotiations. Final design and construction could proceed as soon as funds are available.


LEGEND
EMERGENCY DRAINAGE ROUTE (EDR)
CULVERT
168 CULVERT ID (EXISTING)
400 CULVERT DIAMETER
LYON ROAD
ABERDEEN ROAD
SCOTSTOWN ROAD
300
EXISTING PONDING
EXISTING OVERFLOW THROUGH PRIVATE YARDS
CONSTRUCT WINGED INLET STRUCTURE
INSTALL A 600mmø HDPE STORM TRUNK
300
GRANADA CRESENT
WEBBER ROAD
PROTECT NATURAL DRAINAGE ROUTE FROM DEVELOPMENT IN THE FUTURE.
INVERNESS ROAD
REGIONAL DISTRICT OF CENTRAL OKANAGAN
URBAN SYSTEMS
WESTSIDE MASTER DRAINAGE PLAN
PROJECT L6
SCOTSTOWN AND WEBBER ROAD
DATE:
PROJ: 1117931.1
SCALE: 1:2500
FIGURE 4.12.6

Project L7: Gorman/McTaggart To Scotstown/Webber

Priority:	3
Pre-Development Flow:	1.02 m^3/s
Design Flow:	0.50 m^3/s
Estimated Cost:	N/A (by developer)
Discussion:	The existing major drainage route passes through two vacant properties just upstream of the Webber Road / Scotstown Road intersection. There is a reasonable chance that these properties will be developed sometime in the future. It is essential that the major drainage route be protected and maintained during any development process.
Concepts:	The major drainage route should be incorporated into any development plan as part of the road system. The minor system (storm sewer) would intercept the more frequent flows off Gorman Road and transport them to the Webber Road system.
Proposed Works:	Ensure that the major drainage route through Lots 13 and 15 (Plan 1256) is maintained when development is planned and implemented.
Implementation:	These works are directly linked to when development on the subject properties occurs.



REGIONAL DISTRICT OF CENTRAL OKANAGAN

URBAN SYSTEMS

WESTSIDE MASTER DRAINAGE PLAN	DATE:
PROJECT L7 GORMAN/McTAGGART TO SCOTSTOWN/WEBBER	PROJ: 1117931.1 SCALE: 1:3000 FIGURE 4.12.7

Project L8: McIver Road

Priority: 1

Pre-Development Flow: 1.32 m^3/s

Design Flow: 0.50 m^3/s

Estimated Cost: $23,200

Discussion:

In the fall of 1997, MoTH installed a 450 mm diameter HDPE storm sewer and inlet on the major drainage route between McQueen and McIver Roads. Referring to Figure 4.12.8, this was done because of historical flooding problems on Lots 28 and 30. The intent was to intercept the flows and direct them to the ditch on the west side of McIver Road.

Unfortunately, the inlet structure was placed only at the west property line of Lot 30 instead of at the west property line of Lot 28. Field reconnaissance during an intense rainstorm indicated that the culvert discharge from McQueen Road flowed extremely close to the house on Lot 8, and still has the potential to flow onto Lot 28. The field reconnaissance also indicated that the channel upstream of the inlet is poorly defined. This causes the runoff to meander over a wide area, making it difficult to direct it into the inlet structure effectively.

Finally, the new storm trunk discharges into a drywell-style manhole. Excess flow should discharge to the south so that it can follow the Webber Road drainage route. This is intended to prevent ponding on the north side of the manhole where eventually, runoff could overflow McIver Road and flow through several residential lots before ponding in the Glenrosa Elementary school yard. However, the ditch on the south side of the manhole is poorly defined. The grade break, which determines whether runoff would flow north or south may even be slightly south of the manhole.

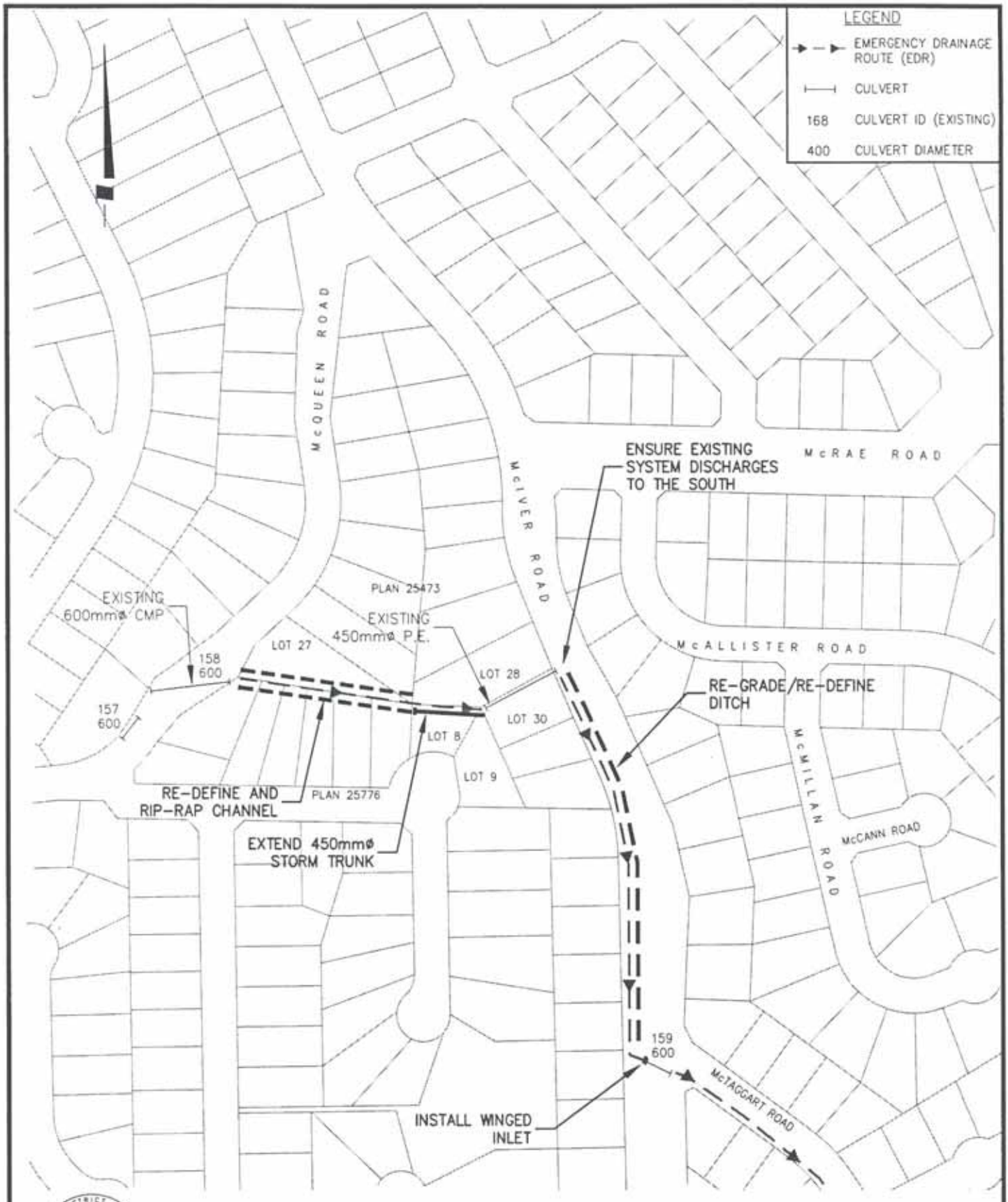
Concepts:

In order to ensure that the runoff discharged through the McQueen Road culvert safely flows into the Webber Road drainage route, the existing storm trunk should be extended, the upstream channel should be re-defined, and the downstream ditch to the south should be re-graded / re-defined. The existing 600 mm culvert across McIver Road at McTaggart Road is undersized based on inlet conditions, and use an hydraulically-efficient inlet.

Proposed Works:

- Extend the existing 450 mm diameter storm trunk approximately 40 m to the southwest corner of Lot 28, Plan 25473.
- Re-define approximately 85 m of channel and line it with rip-rap.
- Re-grade approximately 230 m of ditch on the west side of McIver Road.
- Install a winged inlet structure to the existing 600mm culvert across McIver Road at McTaggart Road.

Implementation: Drainage problems at this site re-occur relatively frequently. Therefore, the recommended works should be constructed as soon as funds are available.



REGIONAL DISTRICT OF CENTRAL OKANAGAN

URBANSYSTEMS

WESTSIDE MASTER DRAINAGE PLAN	DATE:
PROJECT L8 McIVER ROAD	PROJ: 1117931.1 SCALE: 1:3000 FIGURE 4.12.8

Project L9: Corral Court

Priority: 1

Pre-Development Flow: 1.04 m^3/s

Design Flow: 0.40 m^3/s

Estimated Cost: $12,100

Discussion: In February, 1998, MoTH installed a 525 mm diameter HDPE storm sewer along Salmon and Gates Roads to alleviate several drainage problems along that route. One of the problems was that snowmelt from the area west of Stonegate Court and Corral Court would often flow onto residential lots. Property owners on Stonegate Court had constructed a small earth berm along their western property lines to prevent this from occurring. The runoff would then flow to the south, through the park, and over a concrete walkway from the park to Corral Court. There it entered a catch basin to the storm sewer system which eventually discharged into the ditch on the west side of Gates Road.

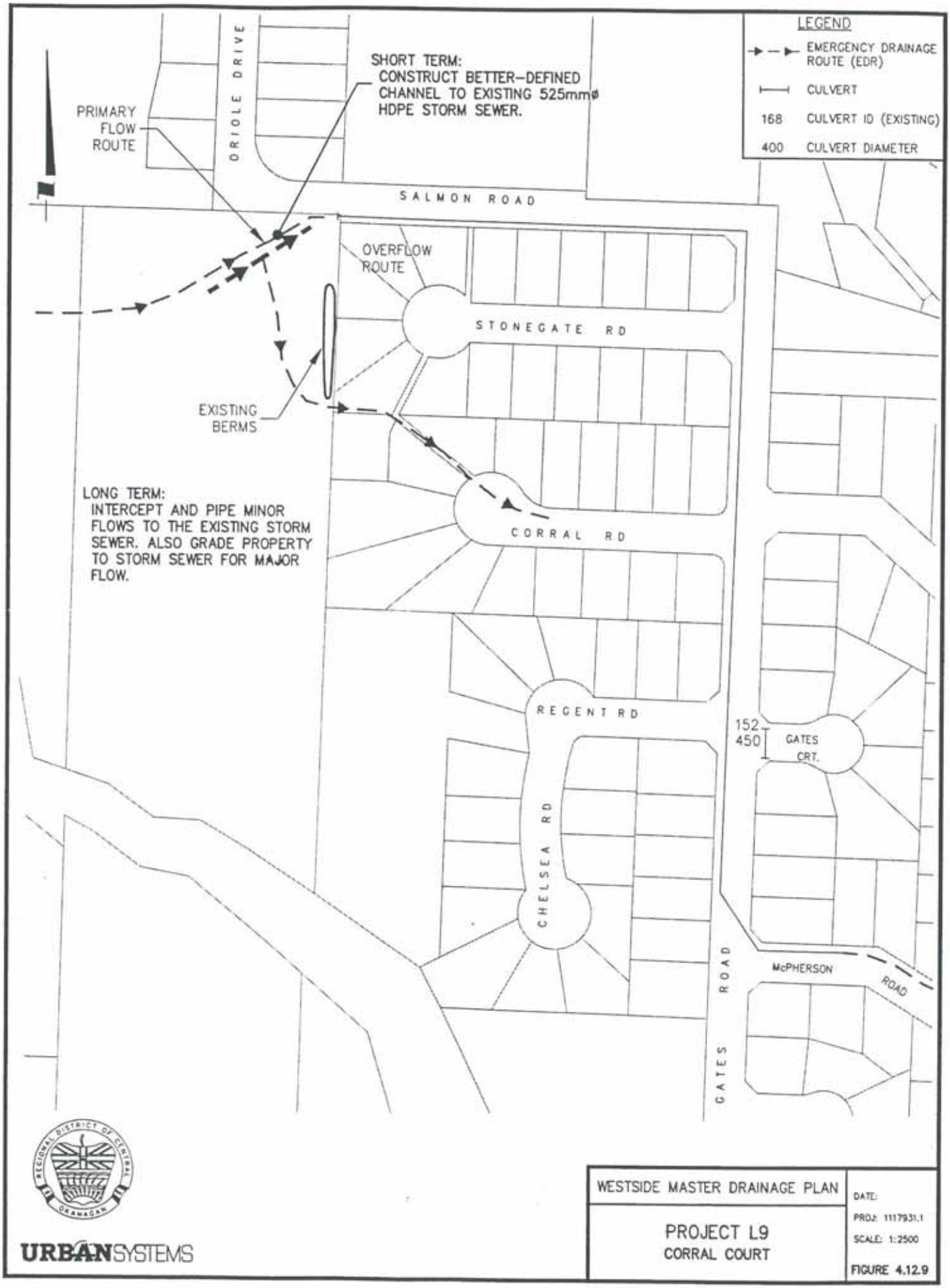
MoTH installed the storm sewer with an inlet on Salmon Road to capture and divert runoff around the two developments. In order for this to work, the contractor had to excavate a swale through the pasture to direct flow to the inlet.

Unfortunately, during a relatively intense rainstorm, debris washed off Oriole Drive and partially blocked the inlet to the storm trunk. This created enough of a back-water effect that runoff from the hills overflowed the excavated swale and proceeded through the natural route to Corral Court.

Concepts: Ultimately, if and when the pasture is developed, the major drainage route must be constructed to direct flows to the storm trunk inlet on Salmon Road. However, in the short term, the most practical solution would be to improve the drainage channel.

Proposed Works: Re-define approximately 100 m of drainage channel as shown on Figure 4.12.9. This may necessitate a compacted earth berm on the south side of the channel.

Implementation: This work should be completed as soon as possible since it will be a re-occurring problem. In order to construct an effective channel, a design should be prepared based on a topographical survey of the area. Development plans for the pasture must include appropriate design measures to ensure that major runoff is directed to the inlet at Salmon Road.



REGIONAL DISTRICT OF CENTRAL OKANAGAN

URBANSYSTEMS

WESTSIDE MASTER DRAINAGE PLAN	DATE:
PROJECT L9 CORRAL COURT	PROJ: 1117931.1 SCALE: 1:2500 FIGURE 4.12.9

Project L10: Glen Abbey Detention Pond

Priority: 2

Pre-Development Flow: 1.47 m^3/s

Design Flow: 2.2 m^3/s (Diversion Structure)
1.1 m^3/s (Pond Inlet)
0.5 m^3/s (Pond Outlet)

Estimated Cost: $86,600

Discussion:

When the Glen Abbey subdivision was developed, a small detention pond was also created with the intention that it be used to attenuate peak runoff from upstream development. Unfortunately, the pond was not designed with an emergency overflow route to accommodate runoff peaks that might exceed its capacity.

Referring to Figure 4.12.10, the existing 250 mm outlet to the storm sewer system on Glen Abbey Court has a capacity of approximately 0.07 m^3/s. This is due to the flat grade necessary to connect the pipe to the Glen Abbey Road storm sewer. (Glen Abbey Court slopes *away* from Glen Abbey Road.) With a discharge rate this small, the pond would likely fill and overflow rapidly under the anticipated design flow conditions. If this happened, the runoff would flow into the cul-de-sac on Glen Abbey Court, and then through Lot 2 and perhaps even Lot 1.

Until this issue is addressed, the detention pond cannot be safely used for peak flow attenuation.

Concepts:

The pond could be operated to attenuate peak flows if inflow to the pond was reduced to the existing outlet capacity once the pond became full. This, however, would require an operator who would have to be mobilized well in advance of full stage so that he could be on-site when necessary. Although technically possible, this approach is impractical because one never knows when such an event could occur.

A safer and more practical approach would be to:

- Construct an overflow pipe from the pond to the proposed Glenrosa Road trunk storm sewer, and
- Install an inlet structure that will divert a select portion of high-peak runoff to the detention pond.

Analysis indicates that the 100 year peak snowmelt is approximately 1.1 m^3/s while the 100 year peak rainfall runoff is 2.2 m^3/s. As outlined in Project L3, Glenrosa Road should eventually be graded to function as the major drainage route. Since the existing 600mm HDPE storm sewer cannot accommodate all of the design flow, some will be flowing on the road surface during these events. The proposed inlet/diversion structure must be able to intercept surface flow while simultaneously managing piped upstream flow.

Analysis also indicates that by diverting 1.1 m^3/s peak to the pond (rainfall conditions), the associated volume is detained long enough to allow all of the anticipated runoff to flow through the proposed Glenrosa storm sewer.

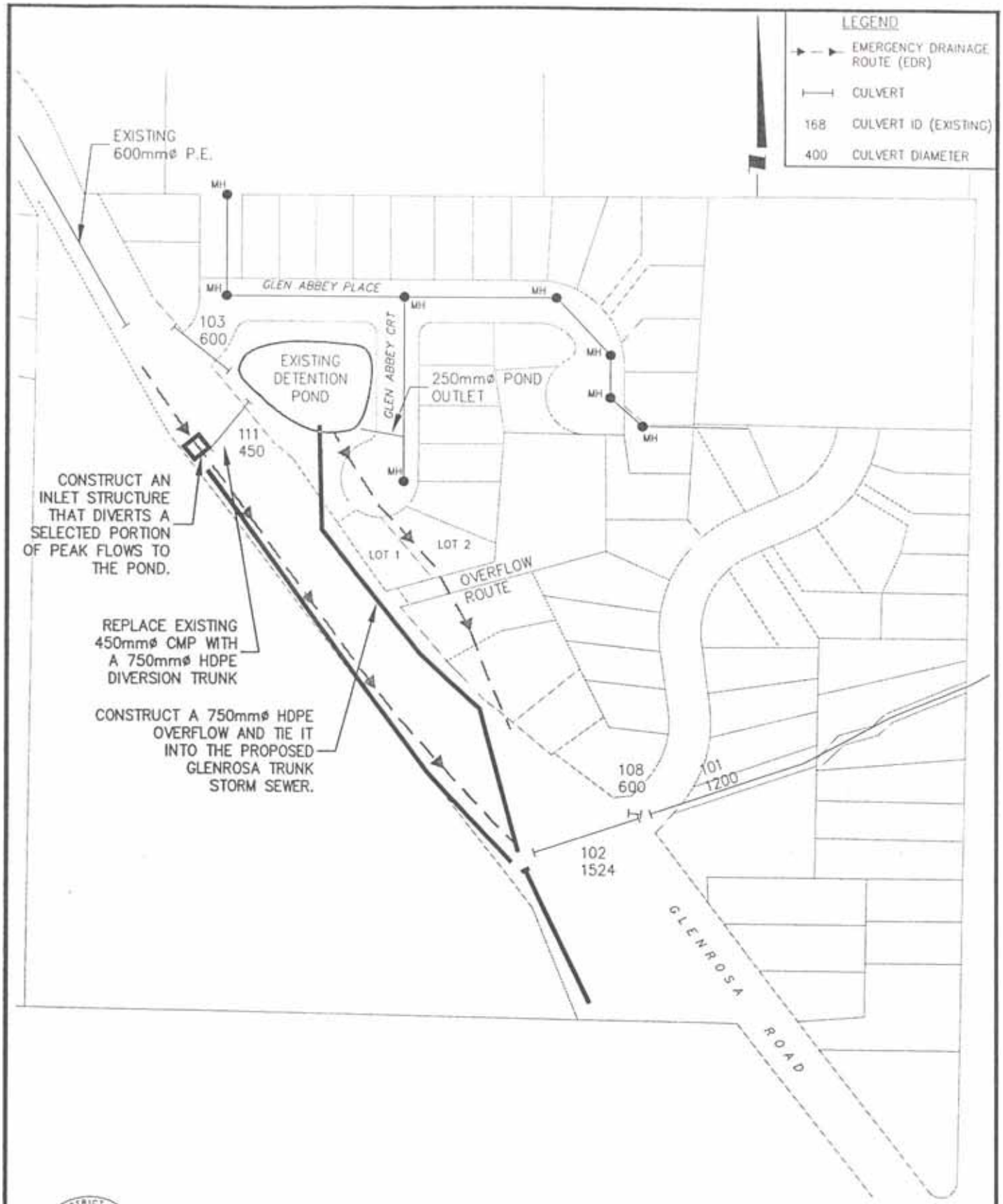
In sizing the emergency overflow from the pond, it is assumed that 100% of the design snowmelt runoff must be able to pass through the pond. Note that a fairly flat slope is required to ensure that an overflow trunk from the pond can be tied into the proposed storm sewer on Glenrosa Road.

Proposed Works:

- Install an inlet / diversion structure in the west side of Glenrosa Road immediately south of the Glen Abbey Road intersection;
- Install approximately 20 m of 750 mm HDPE diversion pipe to the detention pond;
- Construct a vertical oveflow structure in the pond;
- Install approximately 220 m of 750 mm HDPE overflow pipe from the detention pond;
- Tie into the proposed trunk storm sewer on Glenrosa Road.

Implementation:

These works will not be required until significant upstream development occurs. However, two other separate projects could trigger some or all of the works proposed in this project. One is Project L2 and the other is the proposed Glenrosa exchange. When either of these works are initiated, the works proposed in Project L10 should also be constructed.



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URBANSYSTEMS

WESTSIDE MASTER DRAINAGE PLAN	DATE:
PROJECT L10 GLEN ABBEY DETENTION POND	PROJ: 1117931.1 SCALE: 1:2500 FIGURE 4.12.10