# 4. BASIN DRAINAGE PLANS

This section of the Westside Master Drainage Plan presents the analyses, interpretations, options, proposed works, and estimated capital costs associated with each of the primary drainage basins within the study area.

There are twelve sub-sections, one for each sub-basin. Within each sub-section, are five further divisions that address:

- existing drainage
- both existing and future land use
- infiltration potential
- analysis results
- proposed projects, to correct either existing deficiencies or anticipated requirements due to upstream development.

Each section is accompanied by an index map that shows:

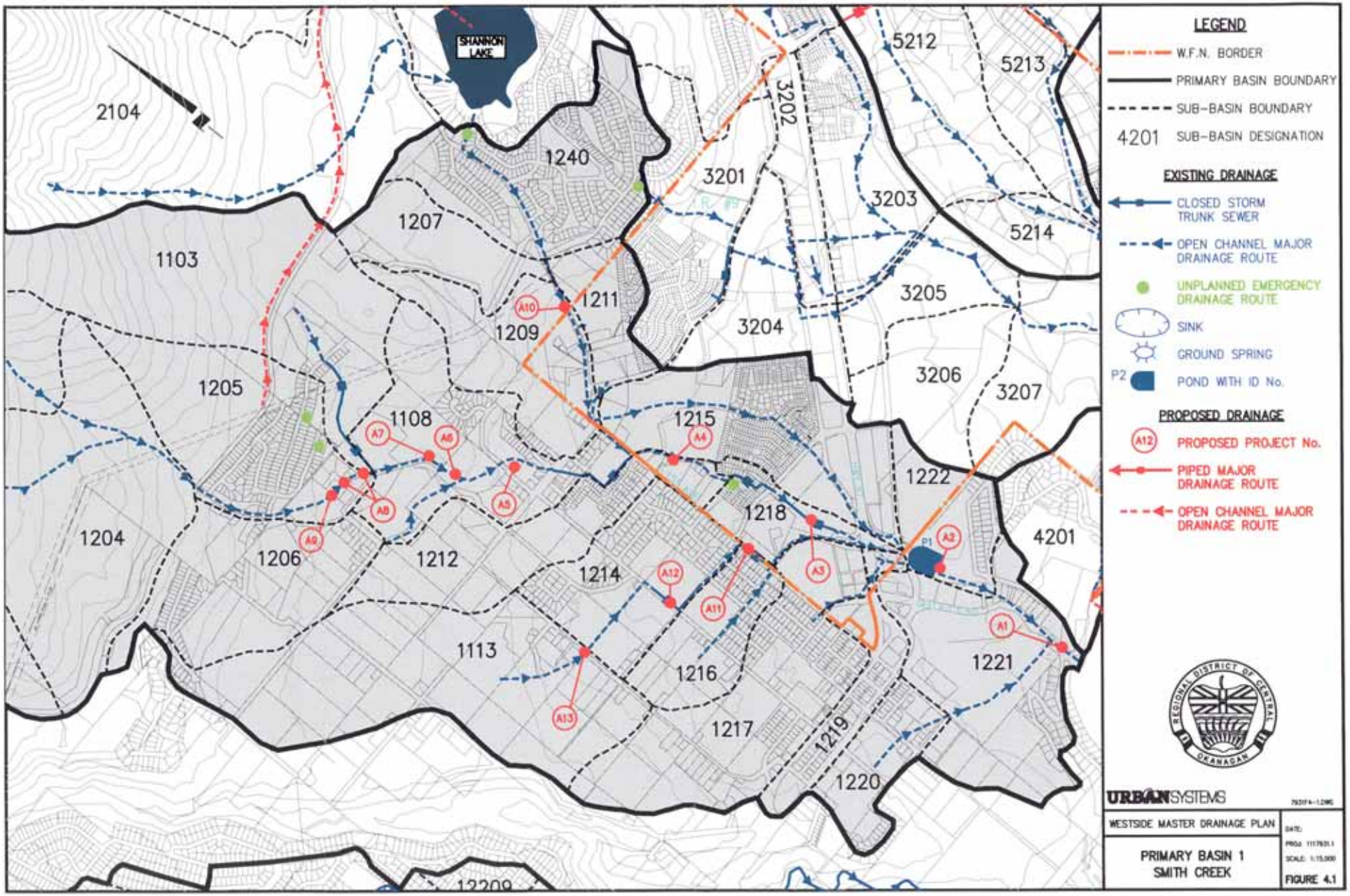
- major/emergency drainage routes (existing and proposed)
- unplanned emergency drainage routes
- proposed project locations.

Each proposed project is presented in its own section and includes:

- an assigned priority
- the design flow (100-year rainfall or snowmelt, whichever is greater)
- the estimated capital cost
- a background discussion that explains why the project is required
- upgrade or improvement concepts
- a description of the proposed works
- a recommended implementation plan

Most, but not all of these projects are also accompanied by a more detailed drawing that shows the proposed works.

***NOTE:*** As discussed in Sections 1.6 and 2.12, the WMDP provides general concepts for addressing stormwater management within the study area. The projects presented in the following sections provide reasonable solutions, but should not be implemented without first obtaining site-specific information and completing detailed analysis and design using that information.


SHANNON LAKE
2104
1240
1207
1103
1211
1209
1205
1108
1215
1204
1206
1212
1214
1218
1222
4201
1113
1216
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3202
3201
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5212
5213
5214
A1
A2
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A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
P1
P2
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
POND WITH ID No.
PROPOSED DRAINAGE
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 1
SMITH CREEK
DATE:
SCALE: 1:15,000
FIGURE 4.1

## 4.1 Basin 1- Smith Creek

The Smith Creek Basin was originally included in the *Westbank Drainage Study*. A significant amount of development has occurred since this study was completed, and therefore many changes to the stormwater management systems have been made. The growth has also created the need to reassess the stormwater management strategy for the area. These issues are presented and discussed in this section.

### 4.1.1 Existing Drainage

The Smith Creek basin contains three secondary basins as follows:

- Smith Creek,
- Westbank Creek, and
- Tomat Creek.

Drainage within these areas consists primarily of ditches along rural road sections, but recent developments are now serviced by curb & gutter and storm sewer systems.

**Smith Creek Sub-Basin**

Smith Creek forms the major drainage route within this primary basin, and discharges surface flows directly into Okanagan Lake at the intersection of Gellatly and Boucherie Roads. Flows which usually occur only during spring freshet, are intermittent within the upper reaches of the channel. This is primarily due to:

- the undeveloped condition of the upper sub-basins, and
- the highly pervious nature of the channel bed.

Perennial flow, fed primarily from ground springs, occurs within the lower reaches of the stream channel. This flow is a direct result of Smith Creek passing through a significant discharge area between Reece Road and Highway 97.

The Smith Creek basin also contains one on-line, man-made pond. It (P1) is located just downstream of Carrington Road. The owner has installed a 1200mm diameter by-pass pipe which manages larger flows. For the purposes of the WMDP, this by-pass is considered the primary route since the pond's

outlet invert is only 100mm lower than the inlet invert. Essentially, the pond has no live storage capacity!

Three ponds that existed in 1993 are now gone:

- P-S1 and P-S2 (see *Westbank Drainage Study)* were located on Old MacDonald's farm just upstream of Louie Road. These have been filled-in and replaced with a 400mm diameter culvert.
- P-S4 (see *Westbank Drainage Study) was* a deep ditch between Highway 97 and Carrington Road. Because the culvert under Carrington Road is extremely large, water has historically never ponded in this area. It was not modeled as a pond, however, since the road fill was not designed to be a water-holding dam.

Other changes to the Smith Creek channel that have occurred since 1993 are as follows:

- A 900mm diameter pipe has replaced the open channel just upstream of Butt Road. As shown in Figure 4.1, the pipe extends through the Sun Village subdivision.
- Smith Creek is now completely piped from Reece Road to Old Okanagan Highway. The original 900mm diameter steel pipe has been connected to the 1000mm diameter CMP that passes through the Westside Care Centre and Leisure Village properties.
- The natural ravine northeast of Rubicon Road has now been replaced by an urban road section.

**Westbank Creek Sub-Basin**

This spring-fed stream originates in the prominent discharge area through which Smith Creek passes. Most of the channel now consists of a piped system as shown on Figure 4.1. Westbank Creek flows perennially, but the flow rate fluctuates seasonally.

**Tomat Creek Sub-Basin**

Tomat Creek also flows perennially from groundwater discharge. The source of this flow is a small groundwater-fed pond located on the west side of Shannon Lake Road just north of Reece Road. The stream discharges into Smith Creek just south of Carrington Road.

An irrigation diversion exists near the Reece Road and 1st Avenue intersection. There is evidence that some of the flow is diverted at this point into the Tomat Creek system, but details about the diversion structure and its operation are currently unknown.

A portion of the channel has been straightened and redefined through the Grandview Terrace development immediately upstream of Butt and Louie Roads intersection. On the downstream side of Butt Road, part of the flow is diverted into a holding pond and on through the Old MacDonald's theme park. It is returned, upstream of Culvert 34, to the ditch along Louie Drive which functions as the Tomat Creek channel.

### 4.1.2 Land Use

Existing

Most of the drainage basin is either agricultural (ALR) or undeveloped (Resource Natural), but residential and commercial development is occurring at a steady rate. Several areas are serviced by storm sewer systems and discharge directly into the Smith Creek or Tomat Creek routes:

- the commercial area within the Westbank “down town”,
- the commercial development on the Westbank First Nation land at the intersection of Highway 97 and Gellatly/Bering roads,
- the Sun Village and Westlake Gardens / Grand Terrace residential developments off Butt Road,
- Leisure Village development off Old Okanagan Highway,
- Deer Run off Reece Road,
- Summerside subdivision off Shelter Drive, and
- Smith Creek Ranch subdivision.

The remaining developed areas are serviced by either open ditches, swales, or drywell systems.

Future

Most of the potential development within the Smith Creek basin is projected to be primarily low-density residential, located above and around Smith Creek Ranch. Pockets of higher density residential development are also projected for areas such as:

- Broadview / Asquith roads
- Brown Road (south), and
- Gellatly Road

Fortunately, from a stormwater management perspective, most of the existing agricultural land is planned to remain undeveloped.

### 4.1.3 Infiltration Potential

Surface Geology

The Smith Creek Basin is characterized by three of the four SCS Soil Groups. Referring to Figure B3 in Appendix B, these are as follows.

- The northern part of the basin consists of Group C soils. Except for the Smith Creek and Summerside subdivisions, this area is primarily above existing and potential development. A small portion of this part of the basin also contains Group D soils.
- The central and western portions of the basin are comprised of Group B soils. Most of this area is irrigated agricultural land.
- The lower portion of the basin contains Group D soils. This is where much of the existing and some of the potential development is located.

Groundwater Conditions

Most of the developed or developable areas within the Smith Creek Basin are located within the groundwater discharge zone. Referring to Figure B4 in Appendix B, only the Smith Creek development is located within the recharge area. An area of well-documented groundwater problems is located within the vicinity of Old Okanagan Highway and Chiefton Road. In addition to groundwater seepage into the ditches, significant groundwater collection works were constructed as part of the Leisure Village development. The Smith Creek drainage route passes right through this area.

Subsurface Drainage Zones

Referring to Figure B5 in Appendix B, the subject basin is divided into the subsurface drainage zones as follows:

- Zone I within the northern part,
- Zone II within the central and western parts, and
- Zone III within the southern part.

The original geotechnical report for the *Westbank Drainage Study* recommended that development within Zone I use in-ground disposal systems rather than storm sewer systems which discharge directly to Smith Creek. By doing this, Golder Associates Ltd. reasoned that the impact to areas with downstream groundwater problems would be minimized since direct discharge to Smith Creek could cause groundwater mounding along the channel. Considering that much of the Smith Creek channel is now piped within the subject areas, this may no longer be much of a concern.

### 4.1.4 Analysis

This basin presents several stormwater management challenges:

- It contains a stream that flows year round with a significant spring freshet;
- Most of the stream has been enclosed in pipes within its lower reaches;
- The lower reaches of Smith Creek passes through highly-developed, high-value areas that contain large amounts of hard surfaces such as buildings and paved parking lots;

- The lakeshore immediately downstream of the discharge location is a prime Kokanee shore spawning area.

The primary analytical challenge was to determine if a detention pond just downstream of the Smith Creek Ranch subdivision could adequately reduce the peak flows from upstream future development. As discussed in Project A7, the proposed detention pond can keep future peak flows at a level that can still be accommodated by the existing trunk sewer system. Therefore, the design flows for projects downstream of the proposed pond location reflect the peak attenuation characteristics of this pond.

### 4.1.5 Projects

The remainder of this section presents the details of each proposed improvement within the Smith Creek basin. Although many of the projects presented are updates of original *Westbank Drainage Study* recommendations, some are new. In addition, a few of the original projects have been completed, while others are no longer valid due to changed conditions.

PHOTO B

PHOTO A

LEGEND

- EMERGENCY DRAINAGE ROUTE (EDR)
- CULVERT
- 168 CULVERT ID (EXISTING)
- 400 CULVERT DIAMETER

GELLATLY RD

A

PROPOSED INLET

10
600

TIE EXISTING 600ø CSP INTO MH

MH

EXISTING BANK UNDERCUT

B

PROPOSED 1600mmø CSP

MH

TIE INTO EXISTING

3
1600

ANGUS RD

DL 4761

BOUCHERIE RD

REGIONAL DISTRICT OF CENTRAL OKANAGAN

URBANSYSTEMS

| | |
|---|---|
| WESTSIDE MASTER DRAINAGE PLAN | DATE: |
| PROJECT A1<br>SMITH CREEK CHANNEL<br>EROSION AT GELLATLY RD | PROJ: 1117931.1<br>SCALE: 1:1500<br>FIGURE 4.1.1 |

## Project A1: Smith Creek Channel Erosion at Gellatly Road

**Priority:** 1

**Pre-Development Flow:** 2.79 $m^3/s$

**Design Flow:** 5.3 $m^3/s$

**Estimated Cost:** $103,700

**Discussion:** The lower portion of the Gellatly Road ditch which functions as the Smith Creek channel is subject to erosion. As shown in Figure 4.1.1, the clay bank just downstream of culvert #10 is being under-cut. This situation requires immediate attention since further erosion will cause more undercutting and ultimate bank failure. There is enough bank overhang to completely block the channel, which would lead to flows on Gellatly Road.

**Concepts:** Although it is possible to stop the erosion process by placing rip-rap within the channel, this approach will not help stabilize the existing overhang. There is a good chance that eventually, the overhang will collapse.

A second alternative is to install a large-diameter pipe for the short section to Boucherie Road. This would allow fill to be placed and compacted in the existing under-cut, which hopefully, will stabilize the overhang.

**Proposed Works:** Considering the potential hazard of the existing overhang and the need to stabilize it, the preferred option would be to install approximately 120 m of 1600 mm diameter culvert as shown in Figure 4.1.1. This will require a concrete, winged inlet structure to provide a smooth transition into the culvert.

**Implementation:** This work should be conducted In the fall, when stream flow subsides. Since this is considered “in stream works”, the Ministry of Environment should be contacted early to determine the exact “window of opportunity” available. Appropriate permits will also have to be obtained.

## Project A2: Carrington Pond

**Priority:** 3

**Pre-Development Flow:** 2.4 $m^3/s$

**Design Flow:** 4.1 $m^3/s$

**Estimated Cost:** $93,900

**Discussion:** A series of two small ponds and one large pond fed by Smith Creek and Tomat Creek West currently exists just south of Carrington Road. They are private ponds used to store irrigation water for the property owner. Since the outlet of the large pond is too small to pass the design flows, and the pond volume is insufficient to store peak runoff until it can be safely discharged, the owner has installed a 1200 mm diameter bypass culvert. Flow into the large pond is controlled by two 600 mm diameter culverts. Excess flow is then directed to the bypass.

The downstream channel and culverts have adequate capacity to manage the design peak flows, so the pond outlet structure must be improved to safely pass the majority of the design flood.

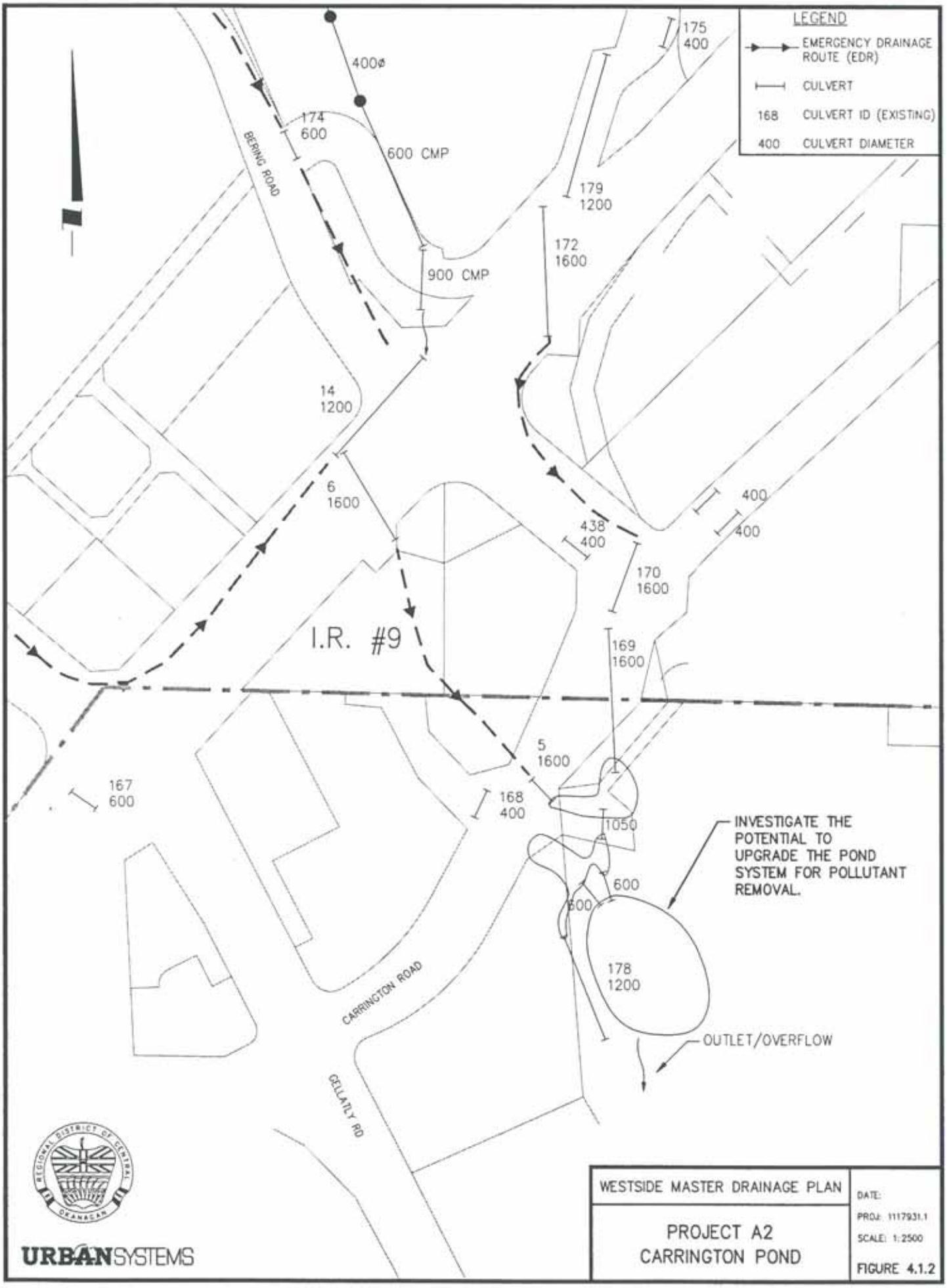
**Concepts:** There appears to be little opportunity to increase the pond's hydraulic capacity and corresponding ability to attenuate peak flows. Analysis indicates that the downstream channels have sufficient capacity to accommodate the design flows, so peak flow attenuation is not an immediate issue. However, the ponds may have value with respect to reducing pollutant loads to the lake. There may be an opportunity to design a more effective system that will increase pollutant removal capacity while maintaining the irrigation capacity for the owner.

**Proposed Works:** Design and conduct a study to:

- Determine current pollutant loads,
- Estimate effectiveness of existing pond system to remove pollutants, and
- Pre-design a more optimal system.

If the study shows that there is a need for better pollutant management, and that upgrading the existing ponds is feasible, then the ponds should be improved.

**Implementation:** Although this is not a high priority project, it does provide a good opportunity for the RDCO to work with the Ministry of Environment on a fish enhancement project. As shown on the map located in Appendix D, the shore area downstream of where Smith Creek discharges into Okanagan Lake is prime Kokanee shore spawning grounds. Perhaps the Ministry of Environment would be willing to participate in terms of expertise and funding. This possibility should be investigated. The property owner should also be contacted to determine his willingness to participate.


LEGEND
EMERGENCY DRAINAGE ROUTE (EDR)
CULVERT
168 CULVERT ID (EXISTING)
400 CULVERT DIAMETER
BERING ROAD
CARRINGTON ROAD
GELLATLY RD
I.R. #9
400ø
600 CMP
900 CMP
174 600
175 400
179 1200
172 1600
14 1200
6 1600
438 400
400
400
170 1600
169 1600
5 1600
167 600
168 400
1050
600
600
178 1200
INVESTIGATE THE POTENTIAL TO UPGRADE THE POND SYSTEM FOR POLLUTANT REMOVAL.
OUTLET/OVERFLOW
REGIONAL DISTRICT OF CENTRAL OKANAGAN
URBANSYSTEMS
WESTSIDE MASTER DRAINAGE PLAN
PROJECT A2
CARRINGTON POND
DATE:
PROJ: 1117931.1
SCALE: 1:2500
FIGURE 4.1.2

## Project A3: Smith Creek - Old MacDonald's Farm

**Priority:** 3

**Pre-Development Flow:** 1.6 $m^3/s$

**Design Flow:** 1.6 $m^3/s$ (100 year Snowmelt)

**Estimated Cost:** $163,100

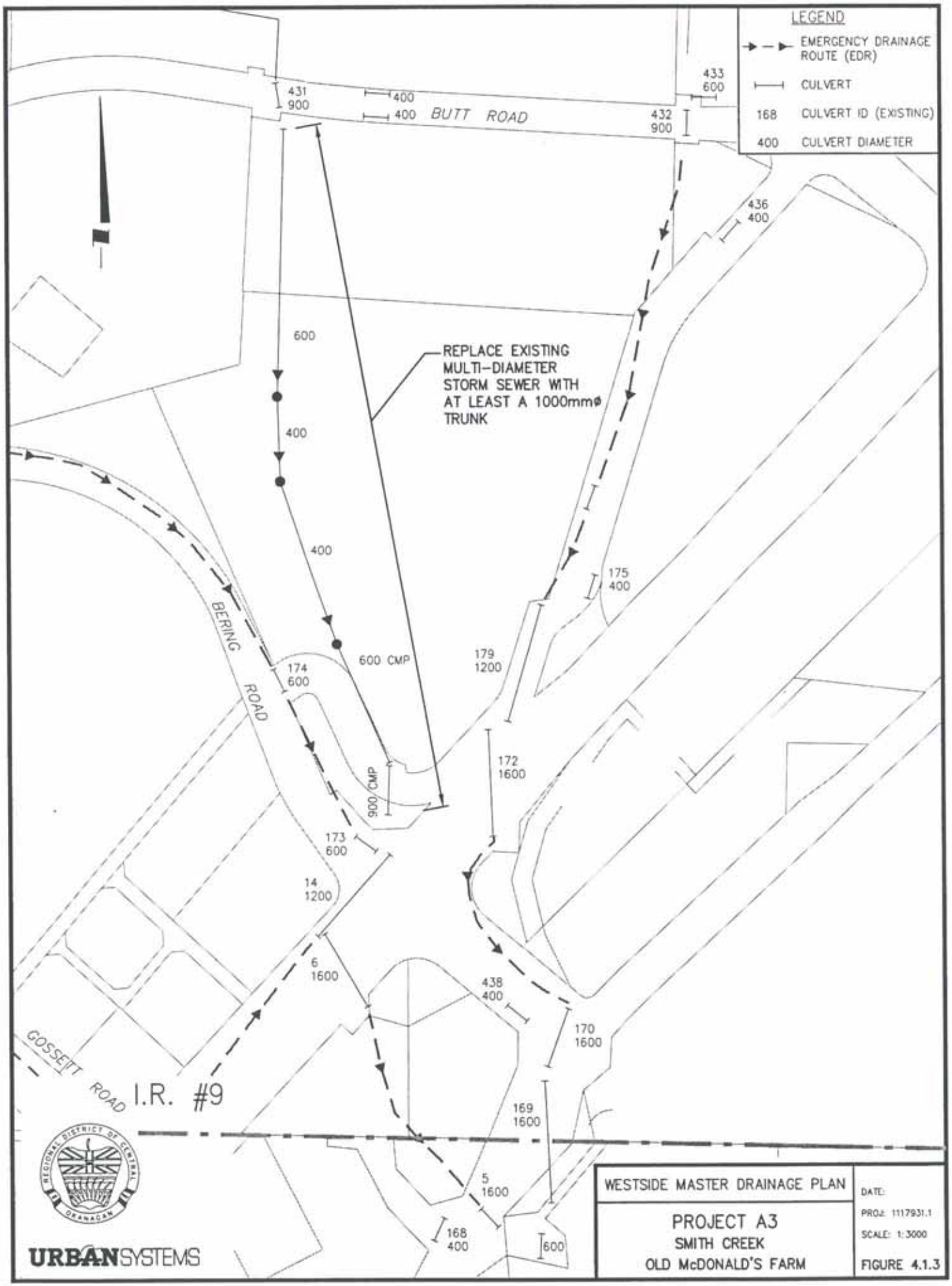
**Discussion:** Most of the Smith Creek channel across the Old MacDonald Farm property has been piped. Figure 4.1.3 shows that this privately-owned system consists of corrugated steel pipes with diameters ranging from 400 to 900 mm. Using data from survey drawings provided by development proponent, the slope of the 400 mm diameter CMP is approximately 3.7%. This yields a capacity of approximately 0.22 $m^3/s$. Based on the 600 mm diameter inlet, the inlet capacity is approximately 0.31 $m^3/s$. Since these capacities are much less than the design peak flow, there is significant potential for overflow through the Old MacDonald's Farm property.

**Concepts:** Ultimately, the pipe should be upsized to accommodate the design flow.

**Proposed Works:** Replace the existing multi-diameter storm sewer with approximately 400 m of 1000 mm pipe.

**Implementation:** Although any overflow would impact the Old MacDonald Farm property, the damage would probably be limited because of the rural nature of the theme park. The overflow would also be re-directed into the Smith Creek storm sewer system via the 1200 mm diameter culvert across Bering Road at Highway 97. Therefore, these works should be completed in conjunction with any major improvements on the subject property adjacent to the existing piped system. It may also be prudent to advise the Owners of the Old MacDonald's Farm property that the current system is undersized.

In terms of "who" should complete the works, this land is within the Westbank First Nation's jurisdiction. The upstream development, however, is within the RDCO's jurisdiction.


LEGEND
EMERGENCY DRAINAGE ROUTE (EDR)
CULVERT
168 CULVERT ID (EXISTING)
400 CULVERT DIAMETER
BUTT ROAD
431 900
400
400
433 600
432 900
436 400
600
400
400
REPLACE EXISTING MULTI-DIAMETER STORM SEWER WITH AT LEAST A 1000mmø TRUNK
BERING ROAD
174 600
600 CMP
900 CMP
175 400
179 1200
172 1600
173 600
14 1200
6 1600
438 400
170 1600
169 1600
5 1600
168 400
600
GOSSETT ROAD
I.R. #9
REGIONAL DISTRICT OF CENTRAL OKANAGAN
URBANSYSTEMS
WESTSIDE MASTER DRAINAGE PLAN
PROJECT A3
SMITH CREEK
OLD McDONALD'S FARM
DATE:
PROJ: 1117931.1
SCALE: 1:3000
FIGURE 4.1.3

## Project A4: Smith Creek Downstream of Old Okanagan Highway

**Priority:** 2

**Pre-Development Flow:** 1.6 $m^3/s$ (100 year Snowmelt)

**Design Flow:** 1.6 $m^3/s$ (100 year Snowmelt)

**Estimated Cost:** $206,100

**Discussion:** When the Sun Village development on Butt Road was constructed, the Smith Creek channel through the development was enclosed in a 900 mm dia. pipe. This increased the major route's capacity, and fulfilled the *Westbank Drainage Study* recommendation to line the channel. The lining was required to prevent surface flow from infiltrating into the ground along the channel and potentially causing groundwater problems for adjacent homeowners.

The remaining open channel is in relatively poor condition, and does not have sufficient capacity to accommodate the design peak flow rate. It is also unlined, and could potentially contribute to local groundwater mounding.

**Concepts:** Considering that significant portions of the creek both upstream and downstream of the subject section have already been piped, the most feasible solution may be to enclose the channel. This would reduce the flooding risk for adjacent homes as well as the number of inlet structures that must be inspected and maintained.

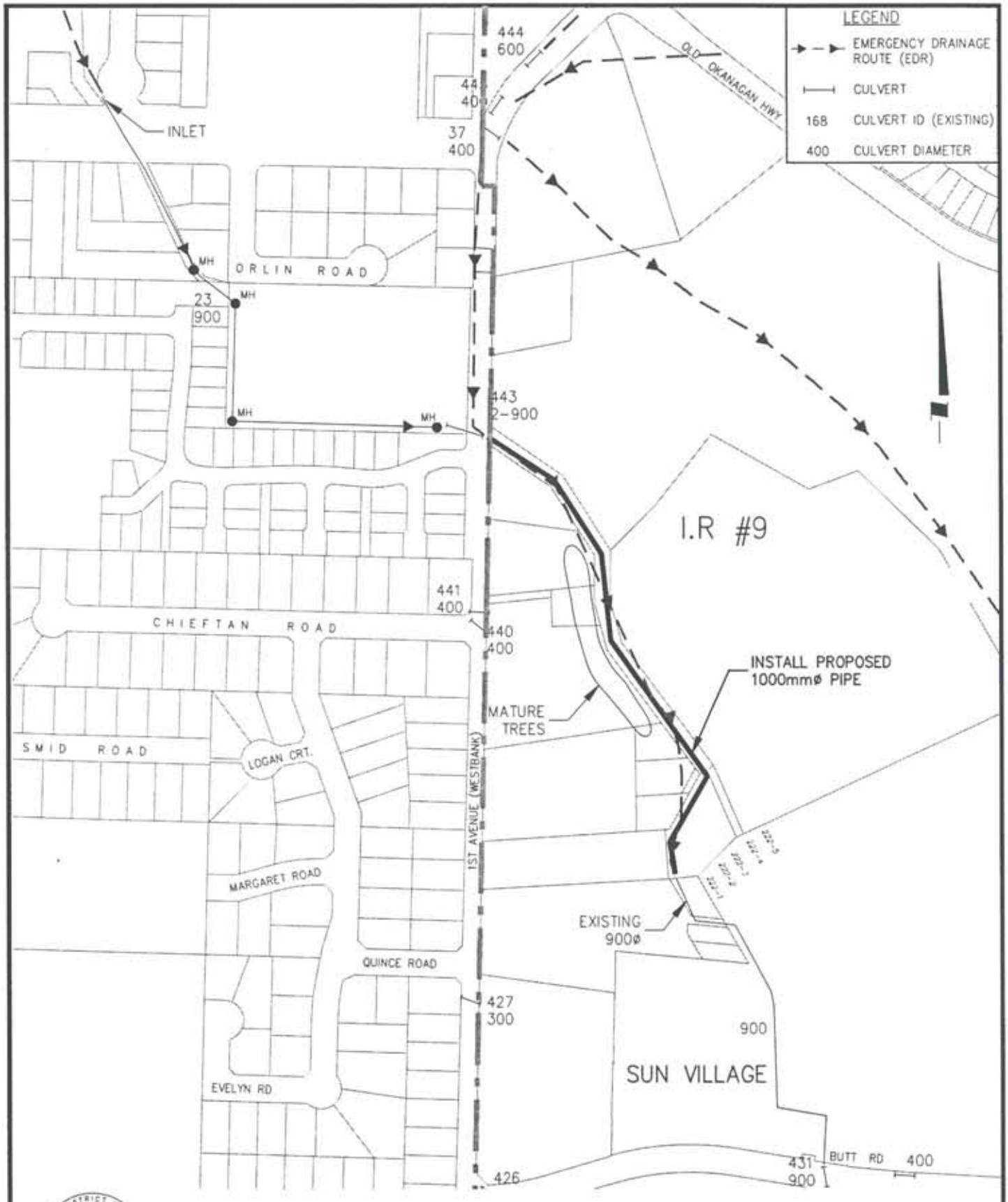
Much, however, depends upon the adjacent property owners' preferences. The existing creek provides a natural aesthetic quality to the area since it is lined on one side by a row of mature trees. It should be possible, however, to bury a pipe partially within the road ROW to avoid having to impact these trees.

**Proposed Works:**

- Install approximately 400 m of 1000 mm dia. pipe;
- Tie into the two existing culverts across the Old Okanagan Highway;
- Tie into the inlet of the existing 900 mm dia. pipe at the Sun Village boundary.

**Implementation:** It is not critical that these works be constructed immediately, but there is a real probability that the channel banks could overflow under a higher-than-normal snowmelt or rainfall event. Since the flow rate rises more slowly under snowmelt than rainfall conditions, residents would probably have sufficient warning to build temporary sand bag dykes if necessary. This opportunity would not be afforded under an more extreme rainfall event. Therefore, these works should be postponed only with a full understanding of the associated risks.

In terms of "who" should complete the works, this land is within the Westbank First Nation's jurisdiction. The upstream development, however, is within the RDCO's jurisdiction.




URBAN SYSTEMS

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| WESTSIDE MASTER DRAINAGE PLAN | DATE: |
| PROJECT A4<br>SMITH CREEK DOWNSTREAM<br>OF OLD OKANAGAN HIGHWAY | PROJ: 1117931.1<br>SCALE: 1:4000<br>FIGURE 4.1.4 |

## Project A5: Smith Creek Between Broadview and Reece Roads

**Priority:** 3

**Pre-Development Flow:** 1.6 $m^3/s$ (100 year Snowmelt)

**Design Flow:** 1.6 $m^3/s$ (100 year Snowmelt)

**Estimated Cost:** $12,400

**Discussion:** The channel downstream of Broadview Road must be better defined to accommodate design flows. Since this channel services lands within Groundwater Zone II, and has a relatively pervious bed, the channel may also need to be lined to minimize potential groundwater problems for adjacent properties.

**Concepts:** There are a couple of ways to both increase the channel capacity and to eliminate infiltration through the bed:

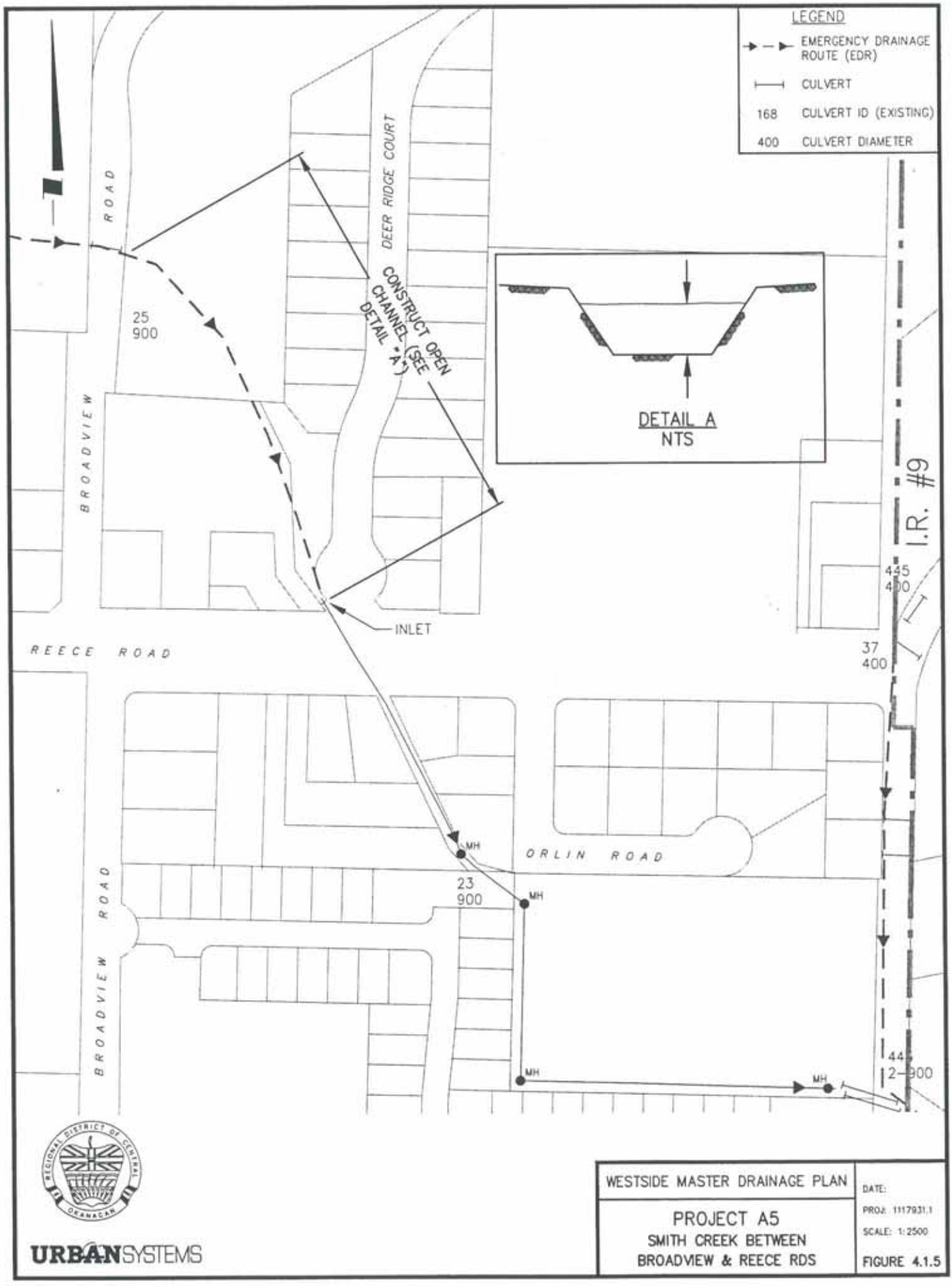
a) construct an engineered, trapezoidal open channel that is lined with an impermeable membrane, or

b) install an enclosed pipe system.

The benefits of using the open channel approach include aesthetics, higher margin-of-safety, and perhaps lower capital costs. A piped system, on the other hand, requires less land and maintenance.

**Proposed Works:** For the purposes of the *Master Drainage Plan*, construct approximately 200 m of trapezoidal channel**.**

**Implementation:** Considering that Smith Creek downstream of the subject location is already piped, either solution could be implemented. Much will depend upon what the developer wants to accomplish with the site if and when it is developed.


LEGEND
EMERGENCY DRAINAGE ROUTE (EDR)
CULVERT
168 CULVERT ID (EXISTING)
400 CULVERT DIAMETER
DEER RIDGE COURT
BROADVIEW ROAD
CONSTRUCT OPEN CHANNEL (SEE DETAIL "A")
25
900
DETAIL A
NTS
I.R. #9
445
400
INLET
REECE ROAD
37
400
ORLIN ROAD
MH
23
900
BROADVIEW ROAD
44
2-900
REGIONAL DISTRICT OF CENTRAL OKANAGAN
URBANSYSTEMS
WESTSIDE MASTER DRAINAGE PLAN
PROJECT A5
SMITH CREEK BETWEEN BROADVIEW & REECE RDS
DATE:
PROJ: 1117931.1
SCALE: 1:2500
FIGURE 4.1.5

## Project A6: Smith Creek through Jensen Property

**Priority:** 1

**Pre-Development Flow:** 1.6 $m^3/s$ (100 year Snowmelt)

**Design Flow:** 1.6 $m^3/s$ (100 year Snowmelt)

**Estimated Cost:** $62,100

**Discussion:**

Smith Creek flows through a narrow ravine on the Jensen property. An autobody shop is located within this ravine immediately next to the channel. The owner has installed approximately 100 m of 600 mm dia. CMP starting just upstream of the workshop, including a winged, concrete headwall.

As shown in Figure 4.1, the Jensen property is immediately downstream of the Smith Creek Ranch and Smith Creek Hill subdivisions. Although the *Westbank Drainage Plan* recommends that these developments be serviced by in-ground disposal systems, they have been constructed with storm sewers that discharge directly into Smith Creek.

Discussions with Mr. Jensen revealed that during rainfall events, the creek flow on his property increases significantly. He also indicated that he must be vigilant against debris blockage since the flow level at the culvert inlet has risen close to capacity. Historically, the inlet has overflowed and significant flooding / erosion has occurred in and near the workshop.

Analysis indicates that the existing 600 mm CMP is undersized to accommodate the design snowmelt event. This culvert is also deficient with respect to adequate capacity for design flows under current development conditions. Therefore, this deficiency must be corrected in order to accommodate additional upstream development.

**Concepts:**

There are two options available to address the insufficient capacity of the existing culvert on the Jensen Property:

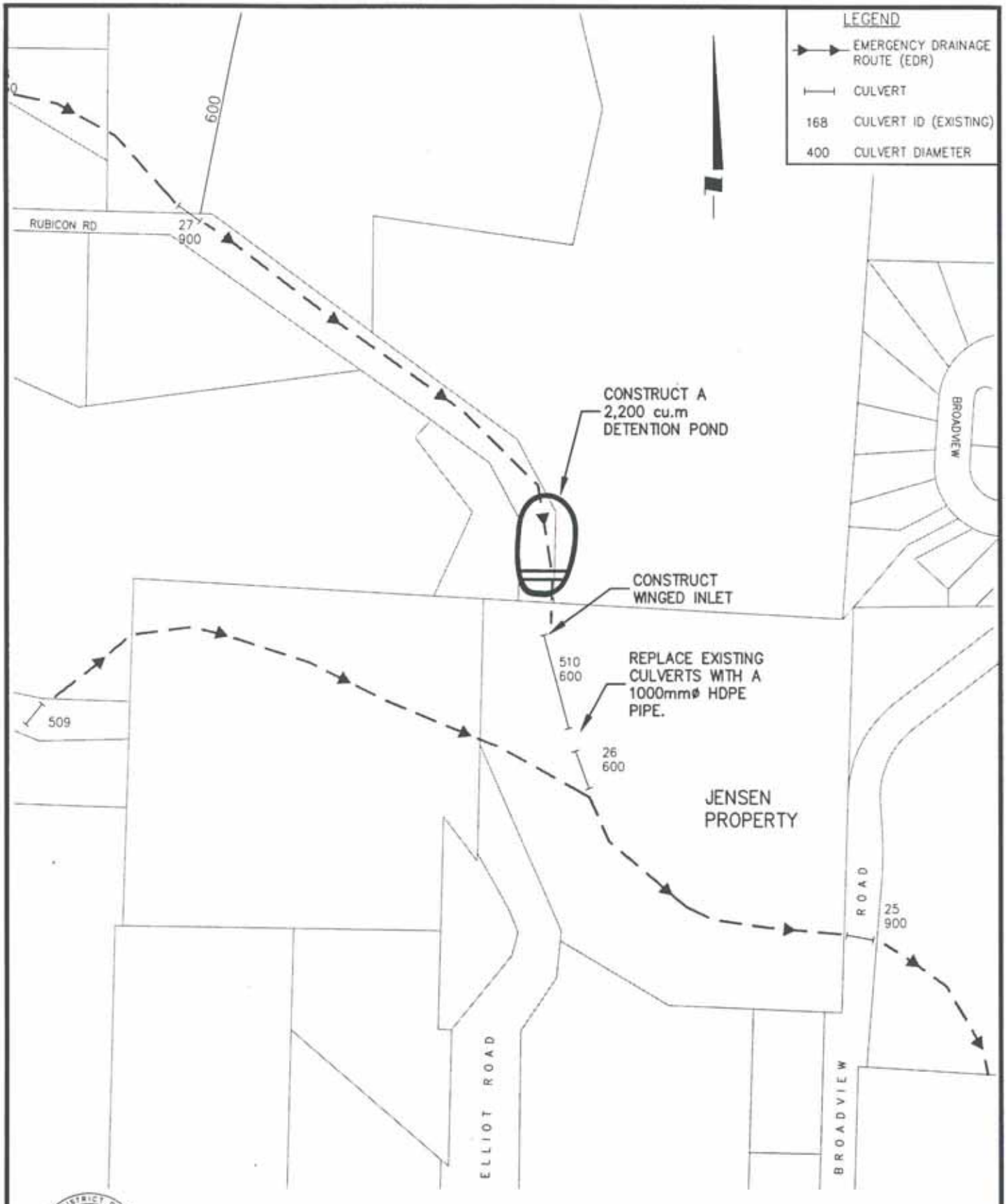
a) install a sufficiently large piped system, or
b) construct an upstream detention pond.

The design flow for this project is given as 1.6 $m^3/s$. This is the 100 year snowmelt. However, if no upstream detention pond is constructed, the potential peak flow from future development under 100 year rainfall conditions would be approximately 2.2 $m^3/s$. This actually exceeds the capacity of most of the piped systems downstream of the subject site. It would therefore be more beneficial if a detention pond were constructed since it would reduce peak flows both on the subject property and for downstream systems. (See Project A7 for more discussion on the detention pond.)

**Proposed Works:** Assuming that the detention pond in Project A7 is constructed, then:

- replace the existing 600 mm diameter culverts with approximately 100 m of 1000 mm CMP;
- construct a winged, concrete inlet structure that will facilitate transition into the culvert.

**Implementation:** These works should be constructed as soon as funds are available, or as part of further upstream development since capacity problems are currently experienced relatively frequently. There is no need to wait until the recommended upstream detention pond is constructed.




REGIONAL DISTRICT OF CENTRAL OKANAGAN

URBANSYSTEMS

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| WESTSIDE MASTER DRAINAGE PLAN | DATE: |
| PROJECT A6 & A7<br>SMITH CREEK THROUGH<br>JENSEN PROPERTY | PROJ: 1117931.1<br>SCALE: 1:3000<br>FIGURE 4.1.6 |

## Project A7: Smith Creek Detention Pond

**Priority:** 2

**Pre-Development Flow:** 1.6 $m^3/s$ (100 year Snowmelt)

**Design Flow:** 2.2 $m^3/s$ (Inflow); 1.6 $m^3/s$ (Outflow)

**Estimated Cost:** $223,500

**Discussion:** A significant number of changes to the Smith Creek channel downstream of Reece Road have occurred during the last five years. Much of the channel has been enclosed in pipe, and development has been constructed within the original route. This has imposed severe restrictions on the system's capacity.

This situation is aggravated by the fact that development upstream of Reece Road, primarily the Smith Creek Ranch, is serviced with a storm sewer system that discharges directly to the creek rather than to an in-ground disposal system as recommended in the *Westbank Drainage Study.* The result is that the streamflow increases significantly during and immediately after rainfall events.

The limiting capacity of the existing system is approximately 1.9 $m^3/s$. Based on the analyses, this is sufficient to accommodate the 100 year snowmelt event. Analyses, however, also indicate that runoff from the 100 year rainfall event under fully developed conditions cannot be accommodated.

**Concepts:** A detention pond located immediately upstream of the Jensen property (Figure 4.1.6) would provide the best opportunity to service the largest catchment area. Runoff from the existing Smith Creek Ranch as well as from other proposed development could all drain into such a facility. The outlet would have to be sized to accommodate the 100 year peak snowmelt since this event usually lasts for several days, generating a volume too large to store and effectively attenuate the peak. During post-development rainfall events, the peak flows last only minutes, and the generated volume can be effectively stored in the pond.

**Proposed Works:** Analysis indicates that a 2,200 $m^3$ detention pond with an outlet capable of discharging the snowmelt peak of 1.6 $m^3/s$ would effectively attenuate the rainfall peak of 2.2 $m^3/s$ to 1.3 $m^3/s$. Therefore, construct an on-stream, dry detention pond with this volume.

**Implementation:** These works should be constructed as part of the off-site requirements of the next upstream development. Negotiations for the required property, however, should start immediately.

## Project A8: Smith Creek Culverts at Rubicon and Rainbow Roads

**Priority:** 3

**Pre-Development Flow:** 1.2 $m^3/s$ (100 year Snowmelt)

**Design Flow:** 1.8 $m^3/s$ (Rubicon Road Culvert)
1.2 $m^3/s$ (Rainbow Road Culvert – 100 year Snowmelt)

**Estimated Cost:** $15,700

**Discussion:** There is a relatively new 900 mm dia. CMP culvert (#27) across Rubicon Road, and a 750 mm dia. culvert (#28) across Rainbow Road. Based on inlet capacities, both of these culverts are undersized with respect to accommodating their respective design peak flows.

**Concepts:**

Rubicon Road

Analysis indicates that even with a winged headwall, the flow would have to surcharge to 0.7 m above the crown of the existing 900 mm diameter culvert in order to pass through. There is insufficient headroom available for this. There is also insufficient headroom available to install a larger diameter culvert. Therefore, a second culvert could be installed to provide the required capacity.

Rainbow Road

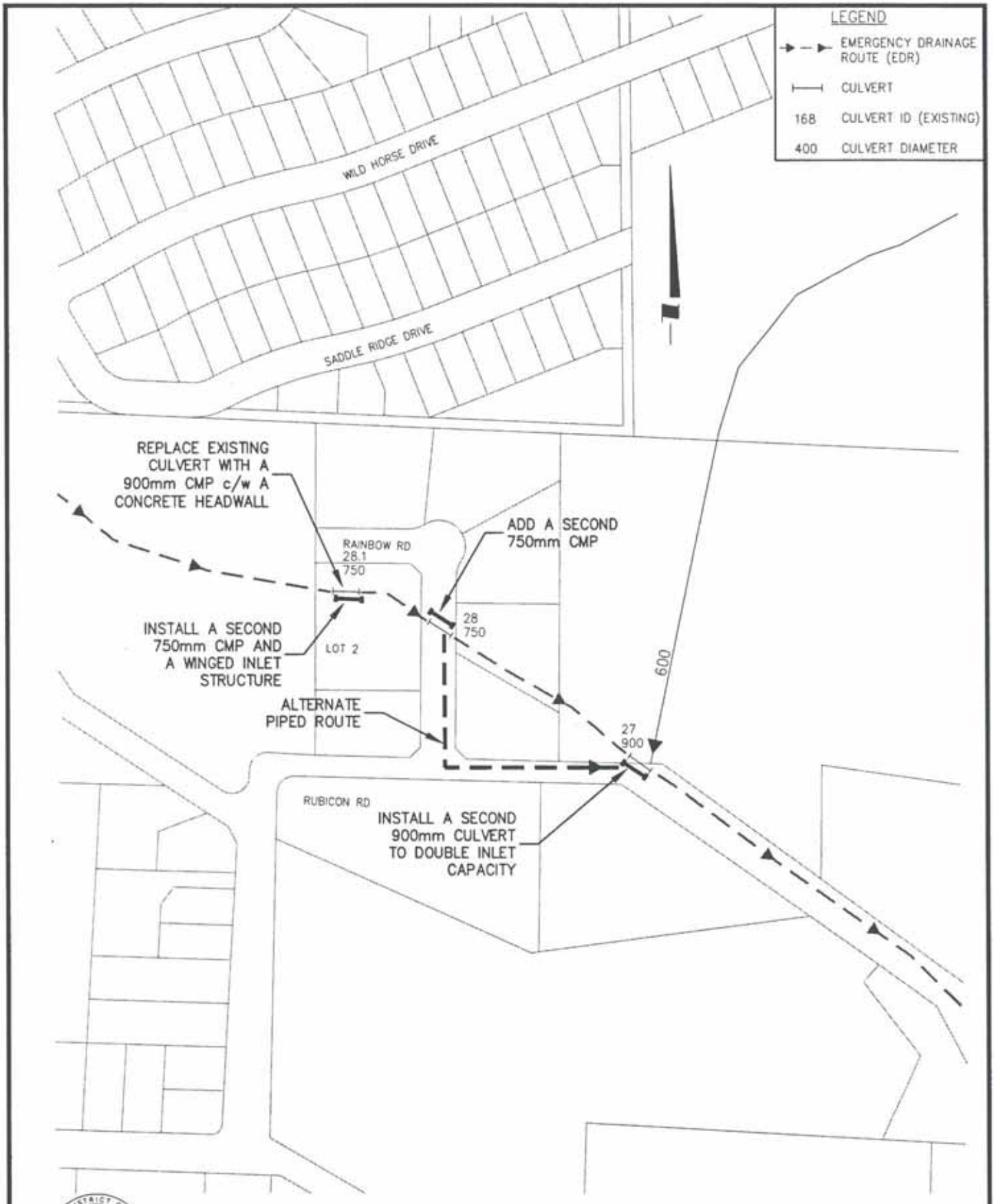
The existing 750 mm diameter culvert would require an additional 0.75 m of headwater to achieve the required capacity. Since there is insufficient room for this, and there is also insufficient room to install a culvert with a diameter large enough to accommodate the design flow, a second culvert with a hydraulically-efficient headwall should be installed.

Alternately, a storm sewer could be installed within the road ROW to divert the creek from private property. This would be a more expensive alternative, and in the long run, may not prevent runoff from flowing through the downstream property anyway. Should the inlet become obstructed, the runoff would return to its existing, natural route.

**Proposed Works:**

- Install a second 900 mm diameter CMP at Rubicon Road;
- Install a second 750 mm culvert on Rainbow Road with a winged inlet structure.

**Implementation:** In both cases, downstream or upstream property damage due to culvert failure will be insignificant if not nil. Therefore, this work should be completed as part of the off-site works for any upstream development.




REGIONAL DISTRICT OF CENTRAL OKANAGAN

URBANSYSTEMS

| | |
|---|---|
| WESTSIDE MASTER DRAINAGE PLAN | DATE: |
| PROJECT A8 & A9<br>CULVERTS ON RUBICON AND RAINBOW ROADS | PROJ: 1117931.1<br>SCALE: 1:3000<br>FIGURE 4.1.7 |

## Project A9: Private Culvert at Lot 2 on Rainbow Road

**Priority:** 1

**Pre-Development Flow:** 1.2 $m^3/s$ (100 year Snowmelt)

**Design Flow:** 1.2 $m^3/s$ (100 year Snowmelt)

**Estimated Cost:** $22,000

**Discussion:** Culvert 28.1 is a 750 mm dia. CMP located across a driveway on private property. Because it is situated in a channel that diverts Smith Creek out of its natural route, any overflow at this location would be directed along the driveway and into the owner's house. Based on the design peak flow and an inlet capacity of 0.55 $m^3/s$, there is potential for this system to fail.

**Concepts:** Although the existing culvert could be replaced with a larger unit, there is insufficient headroom available. Therefore, as with Project A8, a second culvert should be installed with an hydraulically-efficient inlet structure.

**Proposed Works:** Install a second 750 mm diameter CMP and a winged concrete headwall.

**Implementation:** Because of the potential property damage that could occur under failure conditions, this culvert should be replaced as part of MoTH's maintenance program.

## Project A10: Shannon Lake Road; Asquith Road to Reece Road

**Priority:** 3

**Pre-Development Flow:** 0.28 $m^3/s$

**Design Flow:** 1.0 $m^3/s$

**Estimated Cost:** $39,800

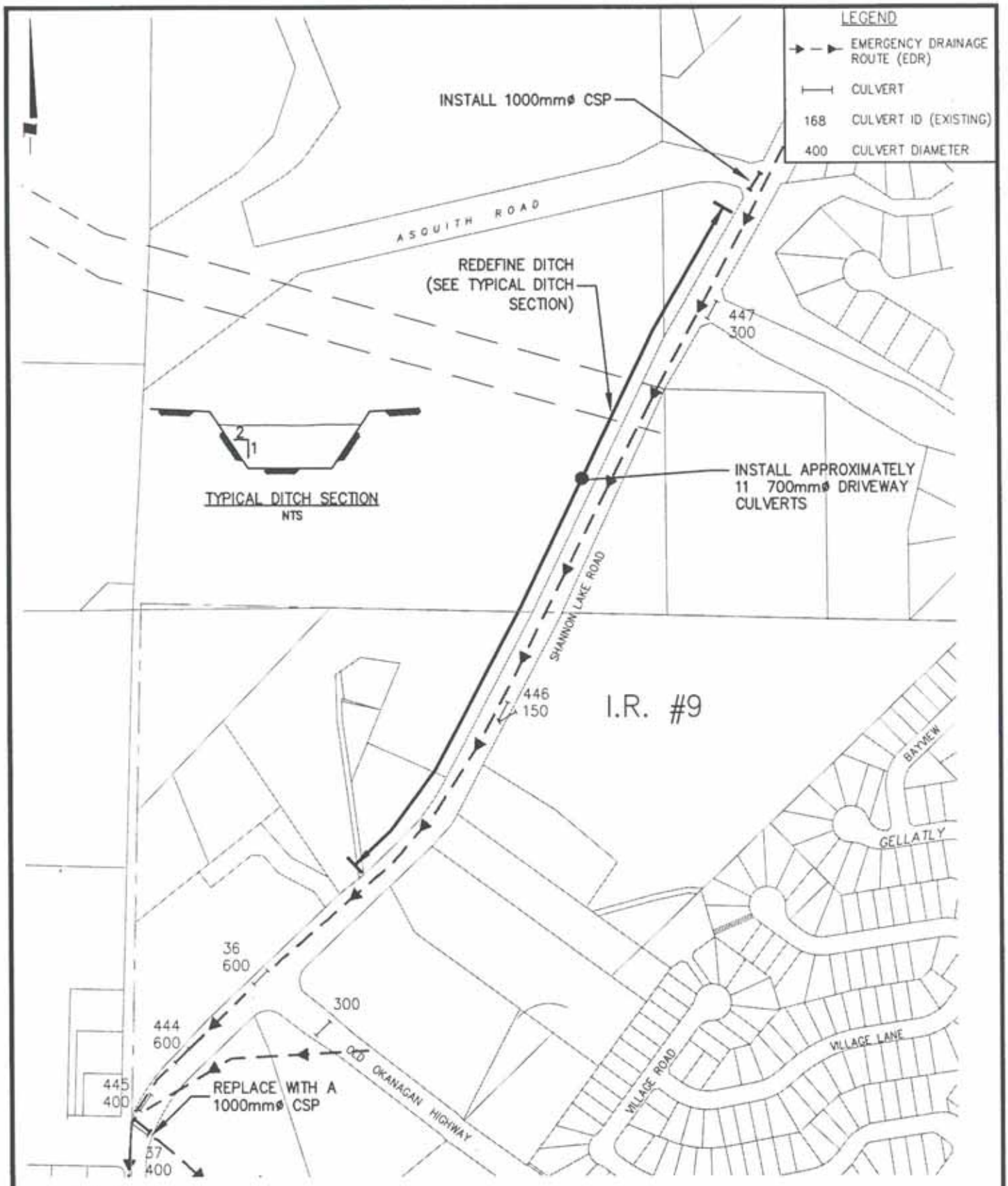
**Discussion:** The current ditch on the west side of Shannon Lake Road is virtually indistinguishable. Considering the amount of residential development that has occurred in the area during the last several years, and the proposed development along Asquith Road, this ditch should be re-defined.

**Concepts:** Assuming that Shannon Lake Road will remain a rural standard road, the existing ditch should be excavated as a trapezoidal channel. It should also be vegetated for erosion protection. Several driveway culverts will be required as well as a culvert across Asquith Road. Note that these have a smaller diameter than the culvert across Asquith Road. This reflects the assumption that because of the higher cost of repairing the road should it be damaged, the risk of damages should be reduced. In other words, driveways do not merit 100-year protection.

**Proposed Works:**

- Construct approximately 600 m of channel as shown in Figure 4.1.8;
- Install eleven 700 mm driveway culverts along the subject route and approximately 12 m of 1000 mm dia. culvert across Asquith Road.
- Replace the existing 400 mm culvert across 1st Avenue at Reece Road with a 1000 mm CSP.

**Implementation:** Development off Asquith Road is anticipated to occur within the next few years. The Shannon Lake Road ditching and culvert installations should be considered part of the downstream, offsite works.




REGIONAL DISTRICT OF CENTRAL OKANAGAN

URBANSYSTEMS

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| WESTSIDE MASTER DRAINAGE PLAN | DATE: |
| PROJECT A10<br>SHANNON LAKE RD;<br>ASQUITH TO REECE RD | PROJ: 1117931.1<br>SCALE: 1:4000<br>FIGURE 4.1.8 |

## Project A11: Westbank Creek along Old Okanagan Highway

**Priority:** 3

**Pre-Development Flow:** 0.14 $m^3/s$

**Design Flow:** 0.34 $m^3/s$

**Estimated Cost:** $37,400

**Discussion:** This section of Westbank Creek is enclosed in a 450 mm diameter storm sewer that extends along the east side of Old Okanagan Highway from Butt Road to Bering Road. It also serves as the downstream trunk for runoff from the western part of the Sun Village development.

Under existing land use conditions, this system has adequate capacity at approximately 0.25 $m^3/$. Analysis indicates, however, that upstream development would increase design peak flows sufficiently to warrant improvements.

**Concepts:** Two approaches to resolving this potential issue can be taken:

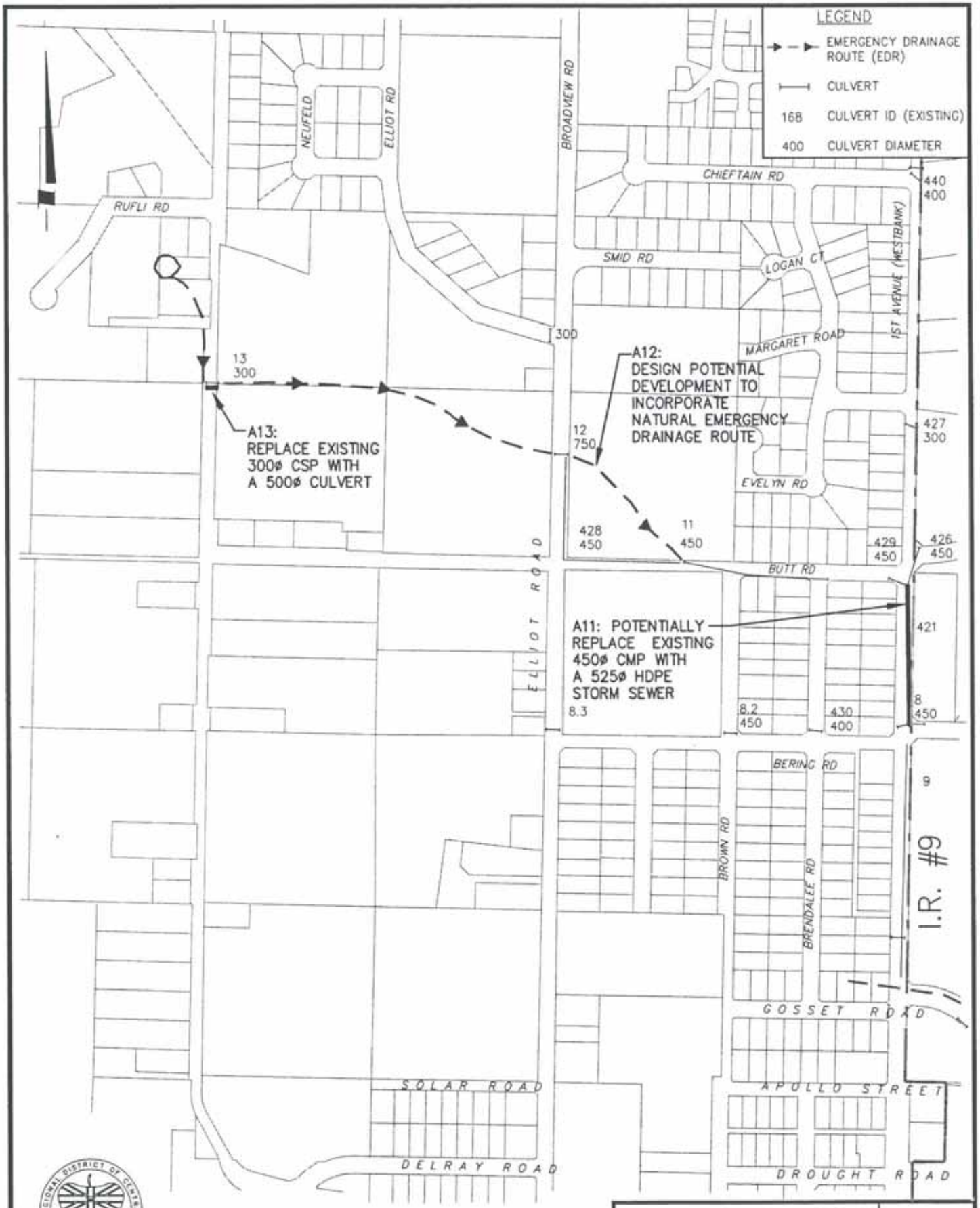
a) replace the existing storm sewer with a larger diameter pipe, or

b) require that all upstream development attenuate their post-development peak runoff to pre-development levels.

The advantage of concept (b) is that the impacts to the remainder of the downstream system are also limited.

**Proposed Works:** For the purposes of the WMDP, it is assumed that the existing 450 mm diameter CMP would be replaced with approximately 180 m of 525 mm HDPE storm sewer.

**Implementation:** Considering that sub-basin drained by this system is relatively small, and that most of it is within the ALR, little development is anticipated. When a proposal for development upstream of the subject site is being considered, however, the Applicant will be asked to prepare a SWM Plan. This plan should address the issue of which concept is most feasible.




URBAN SYSTEMS

WESTSIDE MASTER DRAINAGE PLAN

PROJECTS A11–A13
WESTBANK CREEK

DATE:
PROJ: 1117931.1
SCALE: NTS
FIGURE 4.1.9

## Project A12: Westbank Creek at Elliot Road

**Priority:** 3

**Pre-Development Flow:** 0.09 $m^3/s$

**Design Flow:** 0.23 $m^3/s$

**Estimated Cost:** N/A

**Discussion:** In 1996, a 450 mm dia. CMP was installed from the existing 750 mm dia. culvert across Elliot Road to the inlet of the piped system on Butt Road. The purpose was to re-direct the creek around the perimeter of Lot 10, Plan 761.

This system will function as the major drainage route provided that the inlet on the west side of Elliot Road remains functional. There is high potential for debris or vegetative blockage under design flow conditions, and if this occurs, the original drainage channel will again become the major drainage route. Field reconnaissance also indicates that groundwater is still flowing along the bottom of the original drainage route between Elliot and Butt Roads.

As long as the subject site is used for agricultural purposes, there is no real deficiency. However, if and when development occurs, appropriate measures must be taken to ensure that inlet failure will not lead to significant downstream damage.

**Concepts:** Essentially, two things must be done:

a) conduct a vigilant inspection and maintenance program, and

b) ensure that an overflow route is maintained during the design and construction of and development on Lot 10, Plan 761.

**Proposed Works:** N/A

**Implementation:** This issue does not need to be addressed until the owner of the property intends to initiate development. At that time, it can be included in the required Stormwater Management Plan.

## Project A13: Westbank Creek At Paynter Road

**Priority:** 2

**Pre-Development Flow:** 0.03 $m^3/s$

**Design Flow:** 0.10 $m^3/s$

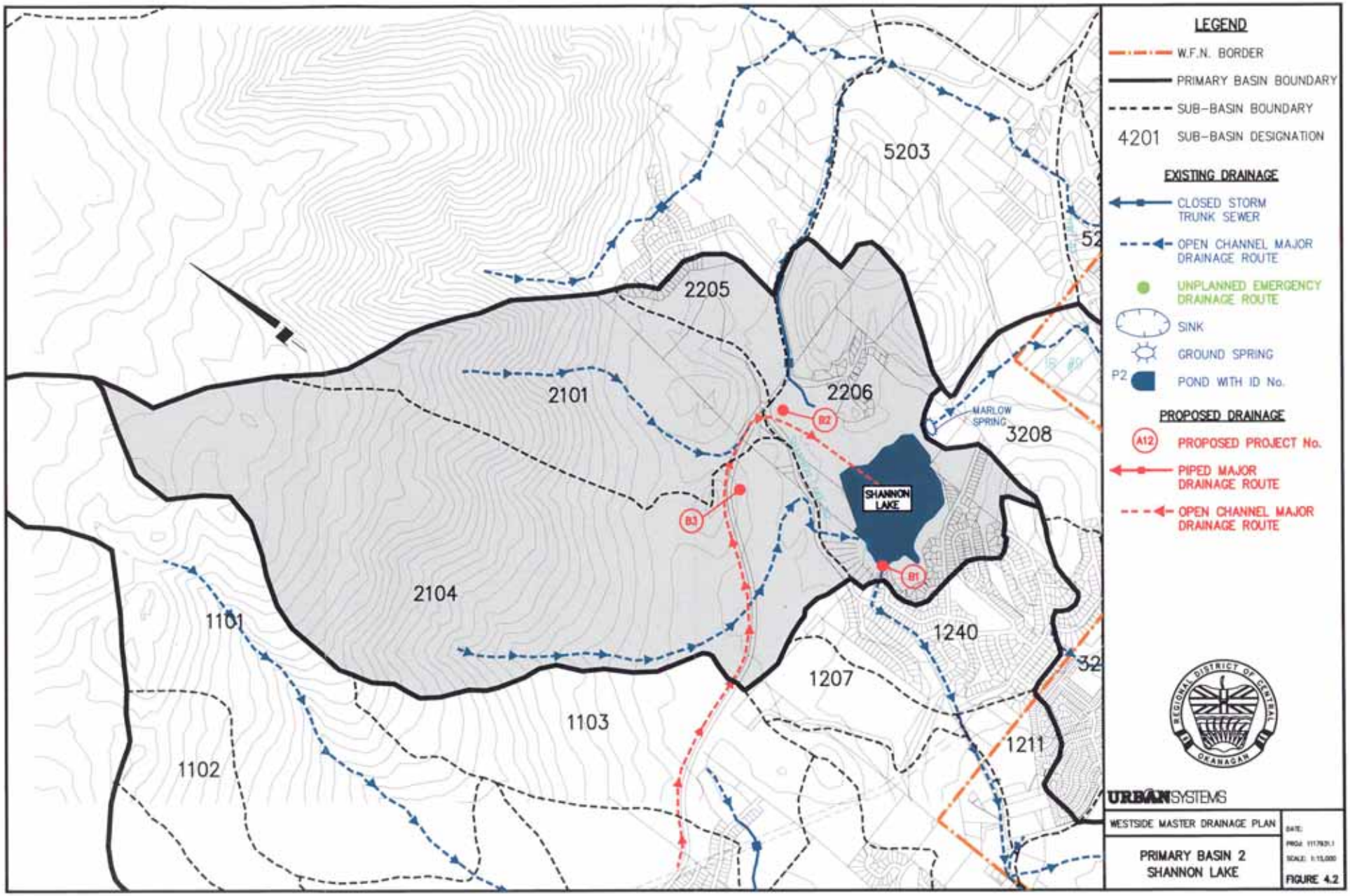
**Estimated Cost:** $3,600

**Discussion:** Culvert 13 is significantly undersized to accommodate design runoff from both existing and future development conditions. Since there is insufficient depth to adequately raise the headwater level to increase inlet capacity, this culvert should be replaced.

**Concepts:** Replace existing culvert with a larger unit.

**Proposed Works:** Replace the existing 300 mm dia. CMP with a 500 mm unit.

**Implementation:** This item should be included in MoTH's annual maintenance plan so that the works are completed within the next five years.


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
5203
2205
2101
2206
MARLOW SPRING
3208
SHANNON LAKE
B2
B3
B1
2104
1101
1240
1207
1103
1211
1102
REGIONAL DISTRICT OF CENTRAL OKANAGAN
URBAN SYSTEMS
WESTSIDE MASTER DRAINAGE PLAN
PRIMARY BASIN 2
SHANNON LAKE
DATE:
PROJ: 111783.1
SCALE: 1:15,000
FIGURE 4.2

## 4.2 Basin 2 - Shannon Lake

### 4.2.1 Existing Drainage

The Shannon Lake basin is a sink that overflows to two separate drainage basins. As the lake water level rises, the spring that feeds Marlow Spring starts to flow. The spring and creek are both within the Central IR9 basin. Although the stream originally flowed southwest, it currently, flows along the Old Okanagan Highway for approximately 300 m before crossing through a 600 mm diameter culvert. From here, it flows within the north ditch along Highway 97 to the Grizzly Road junction, where it crosses the Highway via another 600 mm diameter culvert. The flow eventually disappears into a 500 mm diameter culvert under Grizzly Road and the Berkley Estates mobile home park. Groundwater seepage has, however, been noted on the southwest side of the mobile home park, so perhaps this is where the Marlow Spring flows eventually terminates.

Ultimately, if the Shannon Lake water level continues to rise, it will flow onto Swite Road and then onto Shannon Lake Road. Since the ditching along Shannon Lake Road is inconsistently defined, it is possible that large flows will meander from one side of the road to the other. However, if the flow rate is significant, the water will ultimately arrive at the corner of the Shannon Lake Road and Reece Road intersection. From there, it would flow through the 300 mm dia. culvert across Old Okanagan Highway and enter the Tomat Creek system.

The north ditch along Shannon Lake Road functions as the primary drainage route by directing surface runoff to two culverts which discharge flows towards the lake. A piped diversion to Shannon Lake from McDougall Creek also exists. Holding three licenses, Shannon Lake Golf Course Ltd. has the right to divert a total of 175,200 cu.m. (142 ac-ft) of water annually. This diversion, equivalent to a continuous flow of 5.5 lps, is used to maintain the Shannon Lake water level for irrigation and aesthetic purposes. A piped storm sewer system that discharges directly to Shannon Lake also services the recent Shannon View subdivision. This system, however, is for convenience only; excessive runoff would flow along the roads and through the golf course. Note that although the Shannon Woods storm sewer system

discharges to the same manhole as the Shannon View system, benching within the manhole directs the Shannon Woods flows to McDougall Creek. This, however, functions only under low flow conditions; higher flows overtop the benching and flow toward Shannon Lake.

### 4.2.2 Land Use

Existing

Excluding the golf course, only a small portion of the Shannon Lake basin is currently developed. The majority of the basin is naturally treed, with rural residential development surrounding the lake and flanking Shannon Lake Road. Two relatively new subdivisions with mixed low and medium density residential also exist within the northeast part of the basin.

Future

Other than additional small phases of the Shannon View subdivision, most of the future development within the Shannon Lake basin is planned for the property immediately north of the landfill. This land is currently within the ALR, but a preliminary road plan has been prepared as shown in Figure 4.2. It is anticipated that this subdivision will consist primarily of low density residential development.

### 4.2.3 Infiltration Potential

As shown in Figure B3 in Appendix B, the subject basin contains SCS Soil Groups B, C, and D. The valley floor is within a groundwater discharge zone while areas at higher elevations function as recharge zones. This combination of conditions yields a Zone II potential for using in-ground stormwater disposal systems throughout most of the basin. Only within the few locations where Group B and C soils are within the recharge zone should these systems be considered.

### 4.2.4 Analysis

As shown in Figure 4.2, a new road is proposed that will extend from Smith Creek Road (just above Smith Creek Ranch) to Shannon Lake Road. This would effectively become the new major drainage route for the adjacent upstream area. Based on this assumption, the drainage basin boundaries have been revised accordingly for the analyses under future conditions.

## Project B1: Shannon Lake Overflow

| | |
|---|---|
| **Priority:** | 2 |
| **Pre-Development Flow:** | N/A |
| **Design Flow:** | N/A |
| **Estimated Cost:** | $3,100 |
| **Discussion:** | If Shannon Lake ever rises significantly, the surface overflow route is along the north side of Swite Road and onto Shannon Lake Road. There is no formal, protected channel, so there may be some damage incurred by the owner of the subject property. |
| **Concepts:** | Should the water level in Shannon Lake rise, it would occur over several hours or even days. This should give property owners, who could potentially be impacted, time to construct temporary diversion works such as a sand bag dyke. This potential situation should occur only very infrequently; perhaps once in 100 or more years. |
| **Proposed Works:** | Prepare a written emergency response plan that details exactly what to do should the Shannon Lake water level rise to overflowing. |
| **Implementation:** | This "project" is included in the WMDP primarily for information purposes. The emergency response plan should be prepared relatively soon to ensure rapid response to a potential emergency. This could be done as part of a SWMP for upstream development. The plan should include a topographical survey to accurately delineate the overflow route and to facilitate development of a meaningful response plan. |

*Note: No detailed drawing has been prepared for this project.*

## Project B2: Golf Course Drainage Route

**Priority:** 3

**Pre-Development Flow:** 0.064 $m^3/s$

**Design Flow:** 1.9 $m^3/s$

**Estimated Cost:** $38,700

**Discussion:** Currently, surface runoff that crosses Shannon Lake Road on its way to Shannon Lake must flow across the golf course. The exception are the piped minor system flows from the Shannon View subdivision. If and when the property north of the land fill is developed, and assuming that the access road is constructed as proposed, then both minor and major flows will have to reach the lake from the low point on Shannon Lake Road.

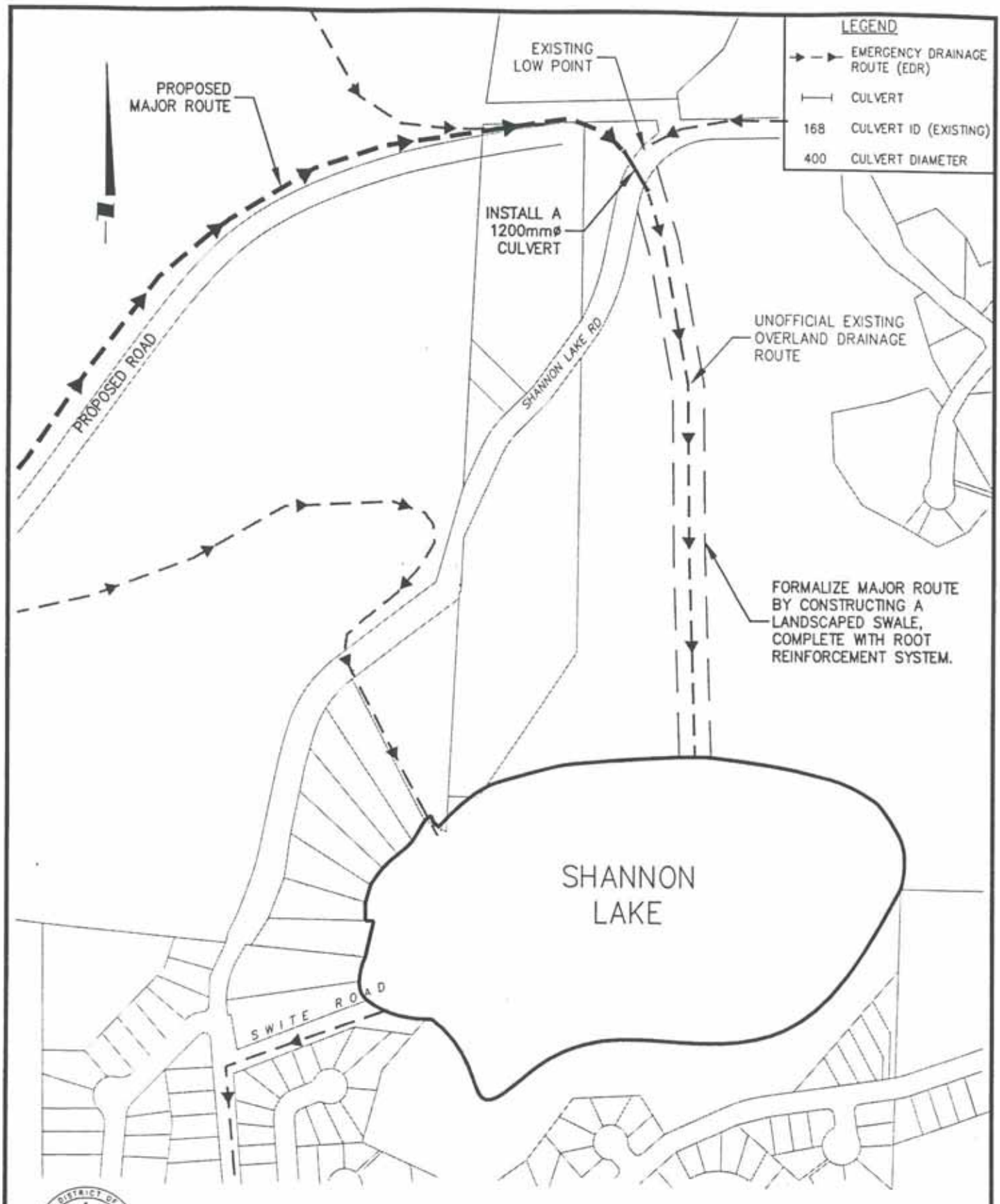
**Concepts:** Although the idea of routing major runoff overland through the golf course may not seem desireable, one must remember that if the minor system is piped to Shannon Lake, the frequency of surface flow events would be very low. A natural route already exists, however, it would be much better to have a designed route that would minimize potential damage to the golf course.

Essentially, runoff would flow along the north ditch of the proposed access road to the road's intersection with Shannon Lake Road. Here, it would flow under Shannon Lake Road via a culvert and would discharge into a gentle, grassed swale. This swale should have a root-reinforcement system to increase tolerance to high velocities. It would also be necessary to install an energy-dissipation structure on the culvert's outlet to ensure a uniform flow distribution into the swale.

**Proposed Works:**

- a 1200 mm diameter culvert across Shannon Lake Road
- 400 m of root-reinforced, grassed swale

**Implementation:** These works would be linked to the construction of the proposed road connecting to Smith Creek Road.




REGIONAL DISTRICT OF CENTRAL OKANAGAN

URBAN SYSTEMS

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| WESTSIDE MASTER DRAINAGE PLAN | DATE: |
| PROJECT B2<br>GOLF COURSE<br>DRAINAGE ROUTE | PROJ: 1117931.1<br>SCALE: 1:5000<br>FIGURE 4.2.1 |

## Project B3: Proposed Road From Smith Creek

**Priority:** 3

**Pre-Development Flow:** 0.004 $m^3/s$

**Design Flow:** 1.2 $m^3/s$

**Estimated Cost:** N/A

**Discussion:** Preliminary development plans have already been submitted to the RDCO that show a proposed road from Smith Creek Road to Shannon Lake Road as shown in Figure 4.2. These plans indicate that the proposed road would function as the emergency drainage route for the upper parts of sub-basins 2101, 2104, 1103, and 1205. All of the runoff collected upstream of the proposed road could be directed toward Shannon Lake Road and ultimately to Shannon Lake. Most of this runoff, however, could also be directed to the existing Smith Creek drainage system.

**Concepts:** It may be possible to direct much of the flow intercepted by the proposed road to the existing Smith Creek drainage system, but it would be much more advantageous to direct it to Shannon Lake Road. This approach would:

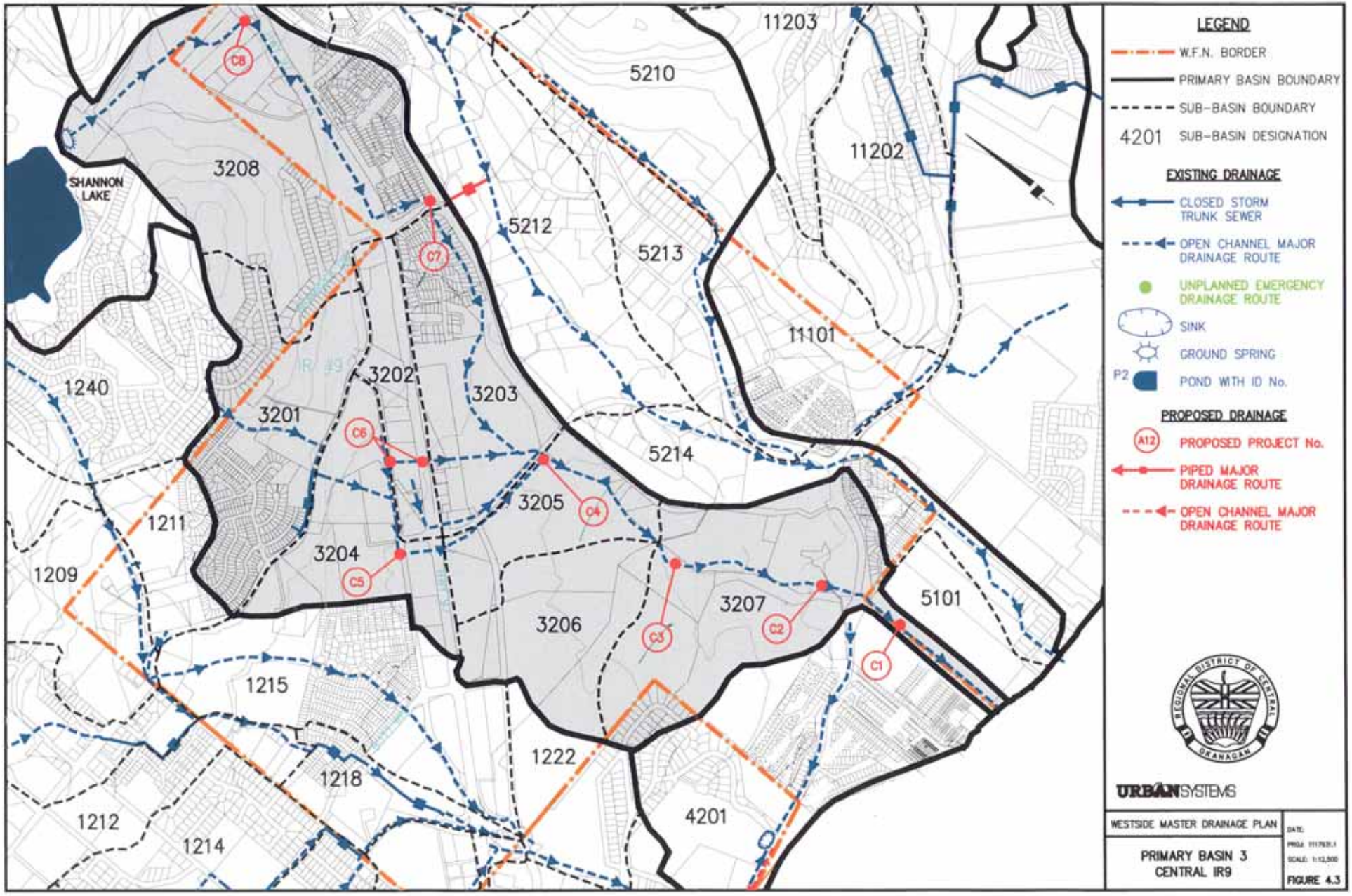
- Reduce potential flows the Smith Creek system and
- help keep Shannon Lake "topped-up".

**Proposed Works:** The major and minor works for the subject area should be directed to Shannon Lake. Since these works are associated with the proposed road, they would be a function of the final development concepts and design. They would also be constructed as part of the potential development.

This "project" has been included in the WMDP for information purposes only; therefore, it is excluded from the cost-recovery analysis.

**Implementation:** The stormwater management works associated with the proposed road will be addressed under the SWM Plan required as part of the development approval process.

*Note: No detailed drawing has been prepared for this project.*


11203
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5101
3206
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1222
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4201
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C1
C2
C3
C4
C5
C6
C7
C8
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
URBAN SYSTEMS
WESTSIDE MASTER DRAINAGE PLAN
PRIMARY BASIN 3
CENTRAL IR9
DATE:
SCALE: 1:12,500
FIGURE 4.3

## 4.3 Basin 3 - Central IR 9

In the *Westbank Drainage Study*, this basin was called the Tomat Creek Basin. Further research, however, revealed that the perennial creek that drains this area has no name. Therefore, because the basin is situated primarily within the IR 9 boundaries, it has been called the Central IR 9 Basin.

### 4.3.1 Existing Drainage

Referring to Figure 4.3, this basin is characterized by an a large number of tributaries which converge at the inlet to Culvert 52 at Elk Road. Although many of these tributaries contain perennial flow produced by discharged groundwater, this flow infiltrates back into the ground through the stream bed prior to reaching Boucherie Road. Flow to these tributaries is facilitated by ditches along the many roads within the basin, and except for the lower reaches just upstream of Okanagan Lake, these channels are relatively well-defined. At Boucherie Road, the drainage route essentially disappears.

### 4.3.2 Land Use

Existing

A small part of the subject basin is comprised of medium density single family residential development. This consists of strata-title communities and manufactured home parks. Another small portion contains low runoff potential industrial land which is characterized by small, mostly gravel parking lots and medium-sized buildings. The remaining area is mostly unirrigated grassland.

Future

A significant amount of future development is planned for the subject basin. Much of it has been designated as higher density residential and light industrial. However, there is at least one large area slated for single family residential between Louie Road and Old Okanagan Highway.

### 4.3.3 Infiltration Potential

Virtually all of the subject basin is within SCS Soil Group D, is within a groundwater discharge area, and is characterized by subsurface drainage Zone III. This explains why there are so many springs and wet areas. It also means that use of in-ground stormwater disposal systems is not appropriate.

### 4.3.4 Analysis

Although current runoff is limited to groundwater flows, it is anticipated to increase significantly once development is complete. The basin drains to a location just upstream of Boucherie Road that is well suited to accommodate a water quality pond. This may eventually be necessary because of the potential water quality issues associated with high density residential and industrial development.

There is little justification to construct a detention pond solely for peak flow attenuation. The distance to the lake is relatively short, and any channel or pipe cost savings due to reduced peak flows would be more than offset by the cost of constructing a detention pond.

| Project C1: | Drainage Route Downstream of Boucherie Road |
|---|---|

**Priority:** 3

**Pre-Development Flow:** 0.64 $m^3/s$

**Design Flow:** 1.3 $m^3/s$

**Estimated Cost:** $20,600

**Discussion:** As shown in Figure 4.3.1, the last portion of the drainage route for the Central IR 9 basin is along a private road extending to the lake from the western intersection of Boucherie and Old Boucherie Roads. It appears that the natural channel was filled-in during road construction. The existing road does not form a channel adequate enough to accommodate design peak runoff generated under even existing development conditions. This poses a potential flood threat to the adjacent mobile home park.

**Concepts:** There are three ways of providing an adequate drainage route to the lake:

a) construct an open, trapezoidal ditch along the private road,

b) install a piped system along the private road, or

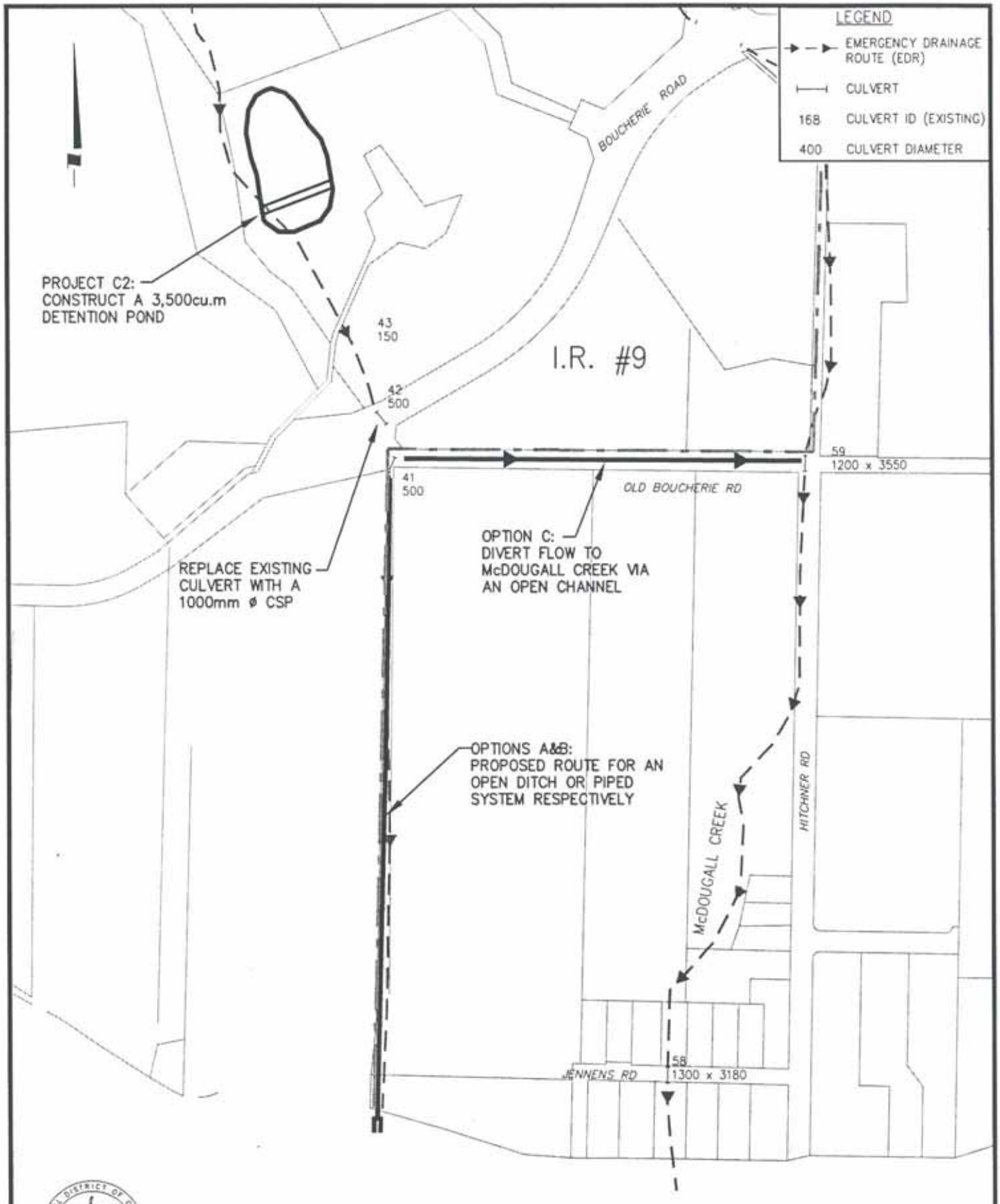
c) divert flow to McDougall Creek along the north ditch of Old Boucherie Road.

Option (c) is the easiest to implement provided that the topography is not a constraint. This would allow the works to be constructed within publicly-owned right-of-ways whenever the project is required. If, however, topography does prove to be a constraint, then a trapezoidal ditch along the private road should be constructed.

It will also be necessary to install a new culvert across Boucherie Road since the existing culverts are both undersized and significantly silted-up.

**Proposed Works:** Construct approximately 400 m of trapezoidal ditch along Old Boucherie Road (Option C) as shown in Figure 4.3.1. Also install approximately 25 m of 1000mm diameter culvert across Boucherie Road. (Note that the culvert diameter is based on the works outlined in Project C2.)

**Implementation:** These works are not necessary until sufficient upstream development occurs. It would, however, be prudent to clean and maintain the existing 500 mm diameter culverts until then. The proposed culvert and ditching could be installed once runoff is noted reaching Boucherie Road during rainfall events.




URBANSYSTEMS

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| WESTSIDE MASTER DRAINAGE PLAN | DATE: |
| PROJECTS C1 &C2<br>BOUCHERIE RD<br>DRAINAGE ROUTE | PROJ: 1117931.1<br>SCALE: 1:5000<br>FIGURE 4.3.1 |

## Project C2: Central IR9 Detention Pond

**Priority:** 3

**Pre-Development Flow:** 0.64 $m^3/s$

**Design Flow:** 1.3 $m^3/s$

**Estimated Cost:** $305,500

**Discussion:** It is assumed that all of the future development within the subject basin will be serviced with storm sewers that discharge directly into the major drainage routes. It is also assumed that a significant portion of the basin will be developed. As the analyses indicate, this means that the fully developed basin will respond quickly to rainfall events, and may exhibit very high peak flows. The primary concern is that pollutants associated with these runoff conditions be captured prior to entering the lake. The subject location would provide an excellent opportunity to develop a water quality / detention pond or other BMP.

**Concepts:** A detention pond located as shown in Figure 4.3.1 would:

- provide initial treatment and a place to implement stormwater quality management when this issue becomes significant, and
- reduce peak flows, thereby potentially reducing the sizes of culverts and channels required downstream from Boucherie Road to Okanagan Lake.

**Proposed Works:** Construct a 3,500 cu. m. detention pond just upstream of Boucherie Road. For purposes of this MDP, it is assumed that this would be a dry pond.

**Implementation:** A lot of development must occur within the subject basin before the proposed pond is required. Once runoff occurs frequently within the downstream reaches, the pond could be constructed.

## Project C3: Ravine Protection Between Elk and Boucherie Roads

**Priority:** 3

**Pre-Development Flow:** 0.64 $m^3/s$

**Design Flow:** 1.4 $m^3/s$

**Estimated Cost:** $110,500

**Discussion:**

Several small swales that drain the sub-basins within the Central IR 9 drainage basin are tributary to a natural ravine that extends from Elk Road to Boucherie Road. Currently, surface flow within this ravine seldom occurs because most of the rain falling on the drainage basin infiltrates into the ground. Some flow does occur during the spring snowmelt season, but even this is mostly lost through infiltration. As upstream development occurs, these flow patterns within the ravine will change significantly. These changes include:

- higher peak flows, and
- more frequent flow events.

Since the ravine is a natural system that has established a level of stability under current hydrological conditions, these changes will also cause changes to the channel itself. Essentially, the ravine will be subject to erosion.

The subject ravine is well vegetated, and therefore has a certain amount of resistance to large-scale erosion. What is likely to happen is that small amounts of the more loose, fine material within the ravine bottom will erode initially. This will result in a newly-cut channel that is stable under peak flow rates up to a certain amount. As more frequent and higher flows occur, the channel will be cut deeper and/or wider. If this process is excessive, works may have to be completed to stabilize the channel. It may be, however, that the channel will remain naturally stable once established.

**Concepts:**

In order to preserve the natural state of the ravine, two types of erosion protection could be employed:

- boulder-style rip-rap, or a
- root reinforcement system.

Since it is likely that development will employ a significant amount of groundwater management works within the subject basin, there will likely be a continuous flow throughout the ravine. In this case, a boulder-style rip-rap would probably be the most appropriate since root reinforcement systems are designed for intermittent flow situations.

**Proposed Works:** Place approximately 750 m of appropriately-sized rip-rap (alluvial, river rocks rather than angular blast rock) within the defined channel in the subject ravine.

**Implementation:** This is a project that may not be required for many years. Much depends upon the ultimate type, quantity, and servicing of upstream development. The most logical approach is to monitor the situation and build a reserve fund to implement the proposed solution when required.

*Note: No detailed drawing has been prepared for this project.*

| Project C4: | Elk Road Culvert |
|---|---|
| **Priority:** | 3 |
| **Pre-Development Flow:** | 0.60 $m^3/s$ |
| **Design Flow:** | 0.79 $m^3/s$ |
| **Estimated Cost:** | $5,700 |
| **Discussion:** | Culvert 52 is located at the confluence of three Central IR 9 basin tributaries, where it crosses Elk Road from north to south. Its current inlet capacity is 0.31 $m^3/s$ when the headwater depth is 0.6m. In order to accommodate the design flow, the headwater would have to rise to 1.4 m. There is currently insufficient depth for this amount of headwater. |
| **Concepts:** | Since the existing capacity is much less than the design flow, and since there is insufficient depth to allow the required headwater, this culvert should eventually be replaced with a larger unit. |
| **Proposed Works:** | Replace the existing 600 mm diameter culvert with a 900 mm diameter CMP. |
| **Implementation:** | This is a project that is linked directly to, and dependent upon development. Therefore, the new culvert can either be installed as part of the off-site works for a developer, or it can be installed by MoTH using funds collected from developers for offsite stormwater management facilities. |

*Note: No detailed drawing has been prepared for this project.*

| Project C5: | Culvert 50 On Louie Road |
|---|---|
| **Priority:** | 3 |
| **Pre-Development Flow:** | 0.48 $m^3/s$ |
| **Design Flow:** | 1.6 $m^3/s$ |
| **Estimated Cost:** | $7,100 |
| **Discussion:** | With inlet surcharge, Culvert 50 across Louie Road currently has adequate capacity for design flows generated under existing development conditions. This capacity, however, will be significantly exceeded when all of the future upstream development is completed. |
| **Concepts:** | Since the existing capacity is so much less than the design flow, this culvert should eventually be replaced with a larger unit. |
| **Proposed Works:** | Replace the existing 500 mm diameter culvert with a 1200 mm diameter CMP. |
| **Implementation:** | This is a project that is linked directly to, and dependent upon development. Therefore, the new culvert can either be installed as part of the off-site works for a developer, or it can be installed by MoTH using funds collected from developers for offsite stormwater management facilities. |

*Note: No detailed drawing has been prepared for this project.*

| Project C6: | Culverts 57 on Louie Road and 56 on Highway 97 |
|---|---|
| **Priority:** | 3 |
| **Pre-Development Flow:** | 0.026 $m^3/s$ |
| **Design Flow:** | 0.79 $m^3/s$ |
| **Estimated Cost:** | $7,800 |
| **Discussion:** | With minor inlet surcharge, Culvert 57 across Louie Road currently has adequate capacity for design flows generated under existing development conditions. This capacity, however, will be significantly exceeded when all of the future upstream development is completed.<br><br>Culvert 56 across Highway 97 has sufficient capacity for current conditions, but will be marginally deficient under future design conditions. |
| **Concepts:** | Since the existing capacity of Culvert 57 is so much less than the design flow, this culvert should eventually be replaced with a larger unit. Culvert 56's inlet capacity could be increased by installing a winged inlet structure or ensuring that at least 0.2 m of surcharge capacity is available. |
| **Proposed Works:** | Replace the existing 500 mm diameter Culvert 57 with a 900mm diameter CMP. Construct a berm on the downstream side of the Culvert 56 inlet to ensure a surcharge capacity of at least 0.2 m. |
| **Implementation:** | These projects are linked directly to, and dependent upon development. Therefore, the proposed works can either be completed as part of the off-site works for a developer, or they can be completed by MoTH using funds collected from developers for offsite stormwater management facilities. |

*Note: No detailed drawing has been prepared for this project.*

## Project C7: Grizzly Road Diversion

**Priority:** 3

**Pre-Development Flow:** 0.10 $m^3/s$

**Design Flow:** 1.4 $m^3/s$

**Estimated Cost:** $147,800

**Discussion:** From discussions with personnel from the Berkley Estates Mobile Home Park, Culvert 69 discharges to the ground. Since a 100 mm diameter PVC pipe discharges to the natural ravine on the south side of the development, it is therefore assumed that this pipe is connected to a perforated pipe system that collects groundwater.

The existing system is currently functioning well since there have been no complaints about either groundwater within Berkely Estates nor about Culvert 69 overflowing. Considering that flow from Marlow Spring has been diverted into this system, and has been flowing continuously for almost two years, the ground obviously has good drainage characteristics.

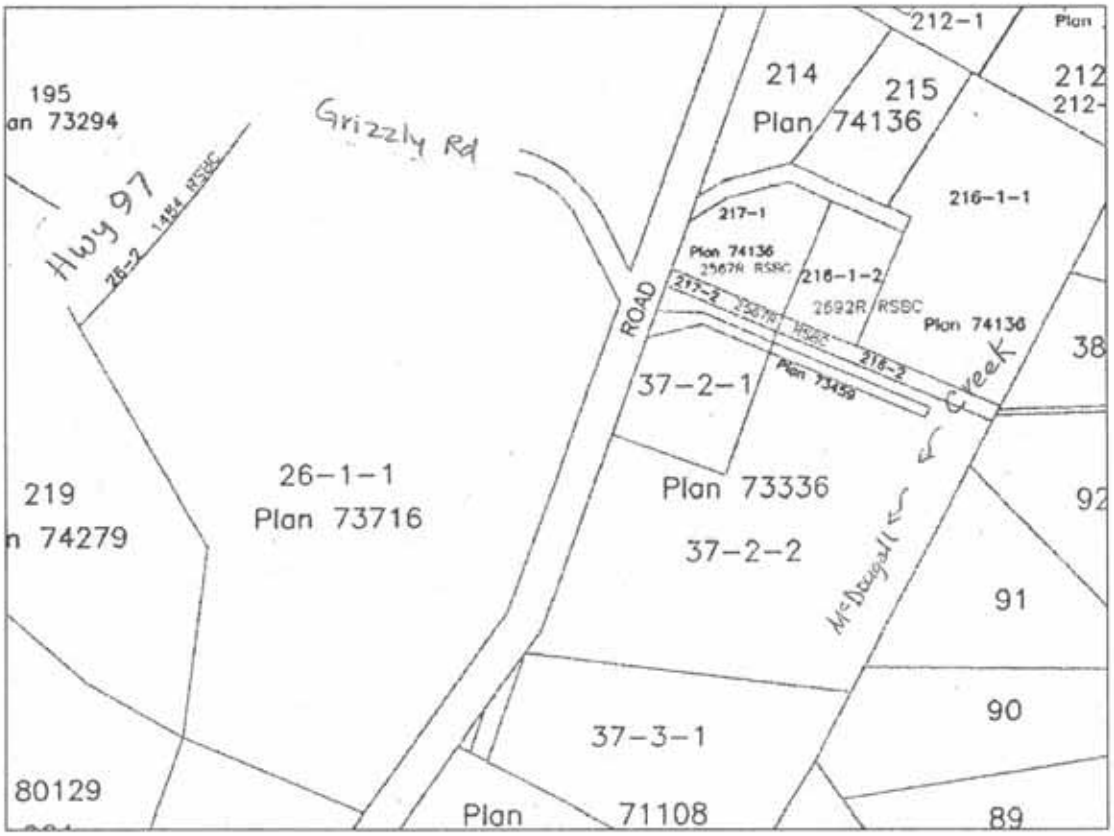
From the perspective of a major drainage route for the existing and planned developments upstream of the subject site, however, the current system is inadequate. If Culvert 69 overflows, the runoff would flow through Berkley Estates.

**Concepts:** Since it is not feasible to construct an emergency drainage route through Berkley Estates, two options should be considered. The first is a diversion to McDougall Creek as shown in Figure 4.3.2. The proposed diversion must be enclosed in a conduit to provide optimum control and to prevent erosion of the steep bank. This system could be designed to function only as an overflow should the capacity of the groundwater discharge system be exceeded.

The second option would be to construct a piped diversion around Berkley Estates. This option may be more expensive than the first option because of the distance, however, it may also be easier to implement because no easements are required.

**Proposed Works:** Install approximately 350 m of 900 diameter CMP. Approximately 200 m of this overflow trunk would be on a steep hillside.

**Implementation:** Since this project is on Westbank First Nation land, and since the last 200 m would require at least two easements, some negotiation will be required. Assuming that the easements can be obtained, the works would not be required until a significant amount of upstream development occurs.


195
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Hwy 97
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215
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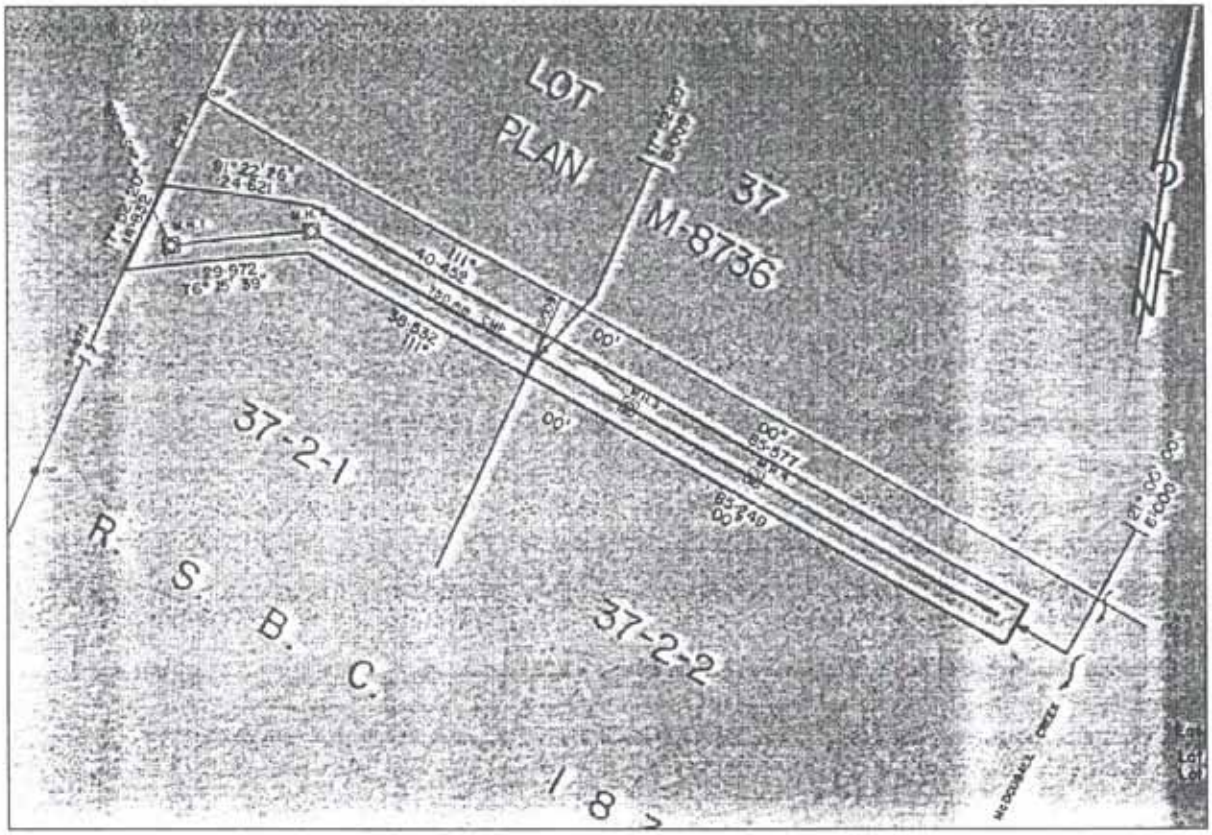
217-1
Plan 74136
216-1-2
ROAD
Plan 74136
38
37-2-1
Plan 73459
Creek
219
n 74279
26-1-1
Plan 73716
Plan 73336
37-2-2
92
91
90
37-3-1
80129
Plan 71108
89


LOT
PLAN
37
M-8736
37-2-1
37-2-2
R. S. B. C.

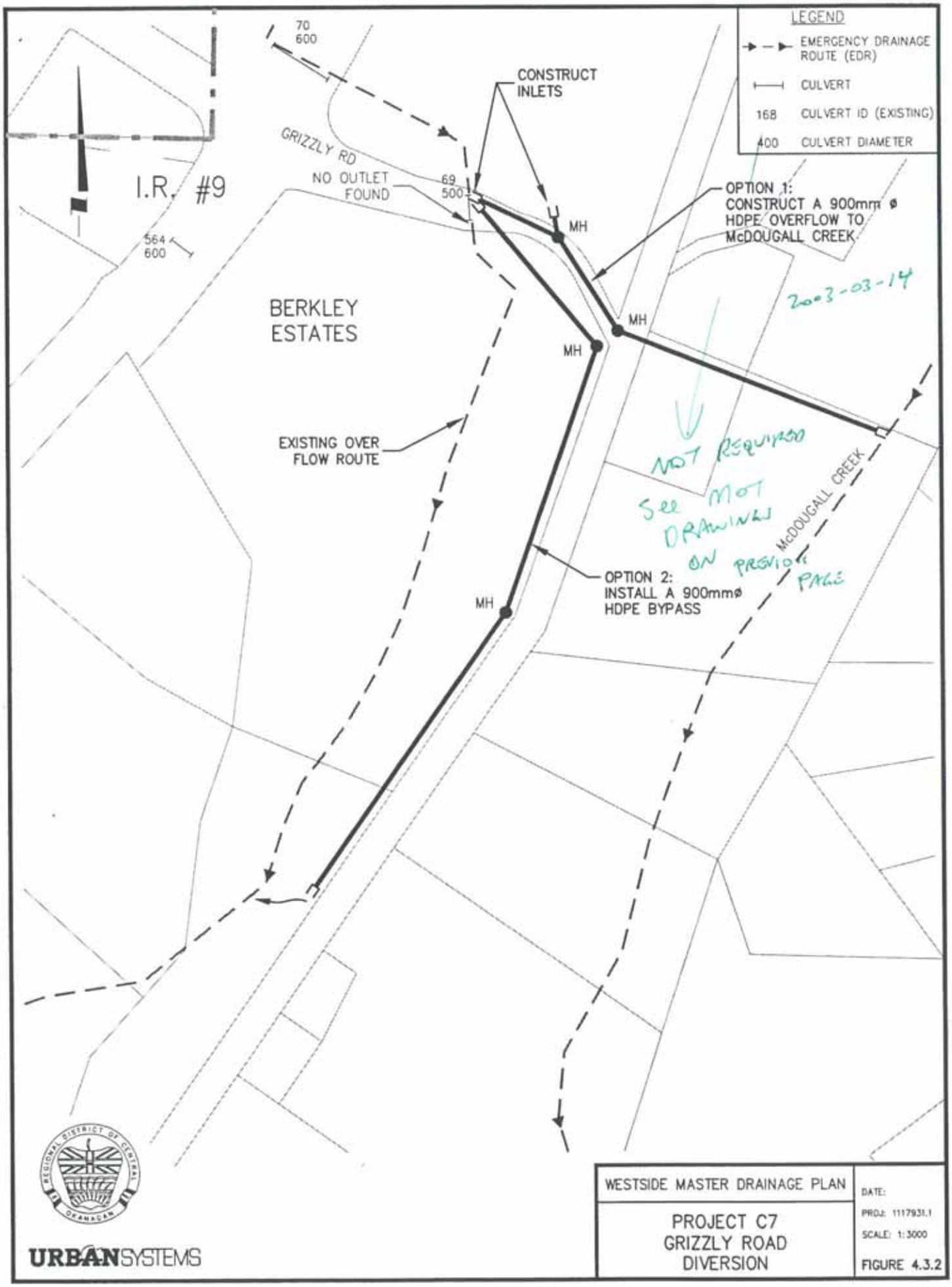
PROVINCE OF BRITISH COLUMBIA
MINISTRY OF TRANSPORTATION AND HIGHWAYS
HIGHWAY DISTRICT

DRAINAGE EASEMENT THROUGH LOTS 37-2-1 AND 37-2-2
PLAN R.S.B.C. 1836 (TSINSTIKEPTUM INDIAN RESERVE NO. 9)
O.D.Y.D.

OKANAGAN SOUTH ELECTORIAL DISTRICT

| | | |
|---|---|---|
| RECOMMENDED DATE | SCALE Horiz. 1:600 Vert. 1 | (SEE BAR SCALE) |
| | DESIGNED JPB DATE MAR. 90 | INDEX NEG. No. |
| | DRAWN DATE | FILE No. 29-632 A EA |
| APPROVED DATE | PROJECT No. REG. No. | DRAWING No. 29(P2)-1010-P2-1 A |

CANCEL PRINTS BEARING EARLIER LETTER


LEGEND
EMERGENCY DRAINAGE ROUTE (EDR)
CULVERT
168 CULVERT ID (EXISTING)
400 CULVERT DIAMETER
70 600
CONSTRUCT INLETS
GRIZZLY RD
NO OUTLET FOUND
69 500
I.R. #9
564 600
BERKLEY ESTATES
MH
MH
MH
MH
OPTION 1: CONSTRUCT A 900mm ø HDPE OVERFLOW TO McDOUGALL CREEK
2003-03-14
EXISTING OVER FLOW ROUTE
NOT REQUIRED
See MOT DRAWING ON PREVIOUS PAGE
McDOUGALL CREEK
OPTION 2: INSTALL A 900mmø HDPE BYPASS
REGIONAL DISTRICT OF CENTRAL OKANAGAN
URBANSYSTEMS
WESTSIDE MASTER DRAINAGE PLAN
PROJECT C7
GRIZZLY ROAD
DIVERSION
DATE:
PROJ: 1117931.1
SCALE: 1:3000
FIGURE 4.3.2

## Project C8: Marlow Spring

**Priority:** 1

**Pre-Development Flow:** 0.30 $m^3/s$

**Design Flow:** 0.30 $m^3/s$

**Estimated Cost:** $100,800

**Discussion:**

In the spring of 1997, Marlow Spring started flowing after many years of dormancy. Apparently, the flow rate is dependent upon the Shannon Lake water level. The freshet in 1997 produced higher runoff volumes than normal, which resulted in a high lake water level. The spring started flowing within its old channel until it reached the ditch on the northwest side of Highway 97. Referring to Figure 4.3.3, the water flowed into the Grizzly Road system (see Project C7).

As the water flowed through the highway ditch, much of it infiltrated back into the ground and emerged on the other, lower side of the highway as groundwater discharge. Several properties within the Westview Mobile Home Park experienced some damage due to this discharge. In an attempt to stem the flow, the mobile home park owner (and/or the residents) lined the highway ditch with poly.

Because of the long-term impact to the mobile home park, something must be done to safely transport the Marlow Spring flow to McDougall Creek without allowing it to infiltrate where it can later emerge to cause damage.

**Concepts:**

Two options for addressing the problems caused by the flow in Marlow Spring have been identified:

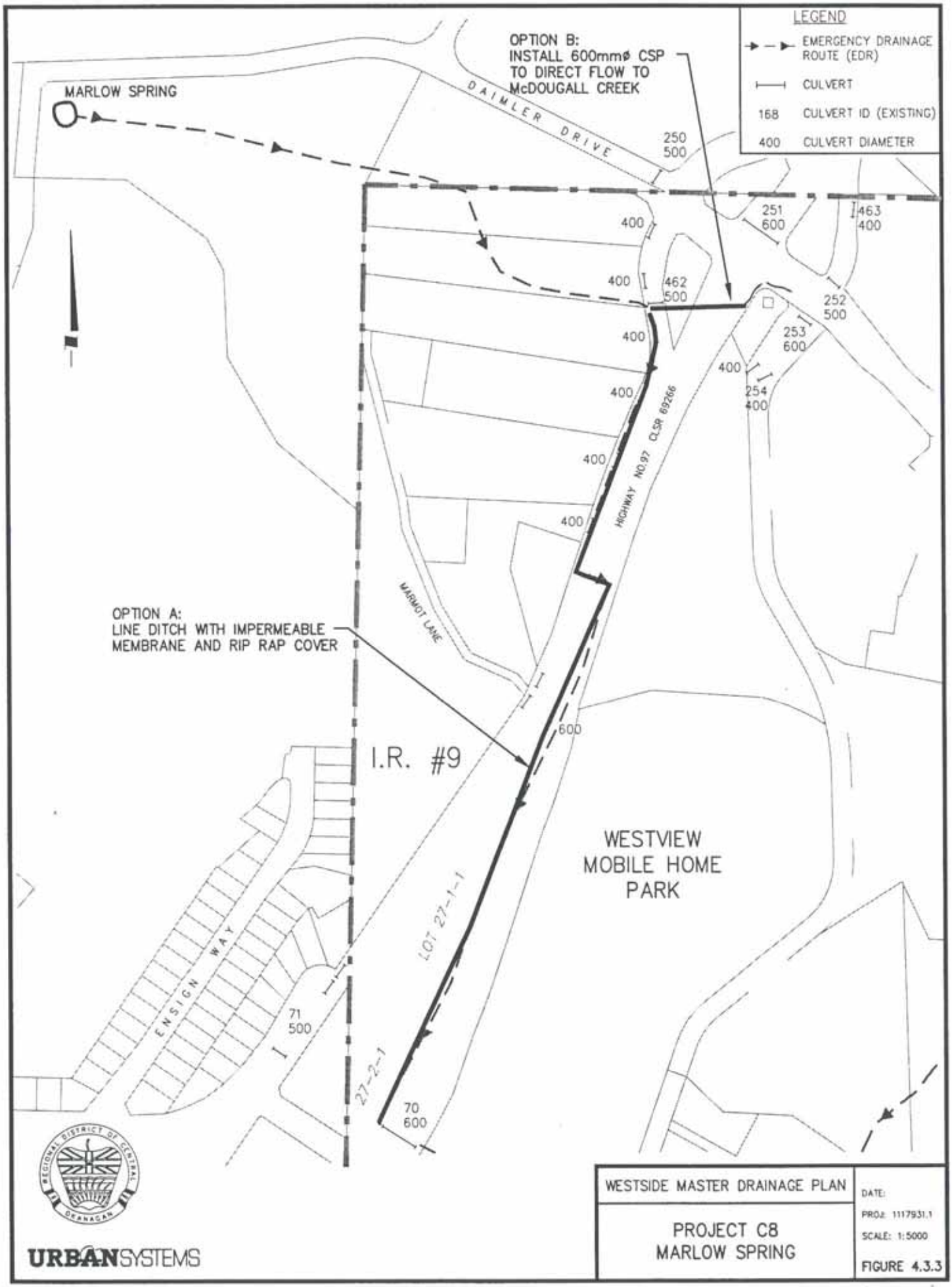
a) line the current drainage route (along Highway 97) with an impermeable membrane to prevent infiltration, or

b) install a diversion culvert to discharge into the ditch on the south side of Daimler Drive.

Option (a) may be less expensive than Option (b) because the only way to install a culvert across Highway 97 would be to bore a crossing. However, Option (a) also adds flow to an already deficient situation. The ditch along Daimler Drive drains directly into McDougall Creek. Therefore, Option (b) is probably the more prudent concept. If, for some reason, the proposed Option (b) system's capacity is exceed during a runoff event, the route along Highway 97 would still be available for overflow purposes.

**Proposed Works:** Install approximately 100 m of 600 mm diameter CMP from the west side of Old Okanagan Highway to the east side of Highway 97, just south of Daimler Drive. Approximately 40 m of this installation will require boring under the highway.

**Implementation:** The current solution of using a poly liner is temporary at best. The proposed works should be installed as soon as financing can be obtained since the potential for more groundwater discharge incidents with the Westview Mobile Home Park is high.


LEGEND
EMERGENCY DRAINAGE ROUTE (EDR)
CULVERT
168 CULVERT ID (EXISTING)
400 CULVERT DIAMETER
OPTION B:
INSTALL 600mmø CSP
TO DIRECT FLOW TO
McDOUGALL CREEK
MARLOW SPRING
DAIMLER DRIVE
250
500
251
600
463
400
400
462
500
252
500
253
600
254
400
HIGHWAY NO.97 OLSR 69266
MARMOT LANE
OPTION A:
LINE DITCH WITH IMPERMEABLE
MEMBRANE AND RIP RAP COVER
I.R. #9
WESTVIEW
MOBILE HOME
PARK
LOT 27-1-1
ENSIGN WAY
71
500
27-2-1
70
600
WESTSIDE MASTER DRAINAGE PLAN
PROJECT C8
MARLOW SPRING
DATE:
PROJ: 1117931.1
SCALE: 1:5000
FIGURE 4.3.3
URBANSYSTEMS