December 13, 2020 File: 0925.0036.01

Town of Black Diamond
Box 10
Black Diamond AB T0L 0H0

Attention: **Sharlene Brown, CAO**

RE: DIAMOND VALLEY INDUSTRIAL SWMP - UPDATE

INTRODUCTION

The Diamond Valley Industrial Stormwater Management Plan was prepared by T. Fenton Consulting Ltd in September 2004. The plan describes a study area that includes industrial land uses with overland discharge to a system of internal roadside ditches. Discharge from the area enters a dry pond that discharges to a drainage ditch and then on to the Sheep River.

- Site Legal Description: SW ¼ Sec 16-20-2-5
- Site Boundaries: Centre Avenue (Highway 7) to the south, Regional Sewage Commission Land to the north, a natural escarpment on the west, and undeveloped land to the east.

This letter has been prepared to provide a minor update to the drainage scheme originally described in the above-mentioned report. This memo is intended to be attached to the Diamond Valley Industrial Stormwater Management Plan (T. Fenton 2004) for future use by the Town of Black Diamond.

Since the plan was prepared most lots within the area have been developed, though some lots drain to different ditches than originally planned. **Figure 1** illustrates the revised catchment plan. All lots appear to have an appropriate discharge location to an adjacent roadside ditch.

Assessment of LiDAR and survey of the existing culverts reveals that some ditches within the Industrial Subdivision have not been constructed with the geometry recommended in the 2004 report. In most areas, the ditches are too shallow. **Figure 2** and **Figure 3** illustrate the existing culvert sizes, locations and inverts.

Ditch geometry from the Diamond Valley Industrial Stormwater Management Plan (T. Fenton, Sept 2004) is shown below in **Figure 4.**

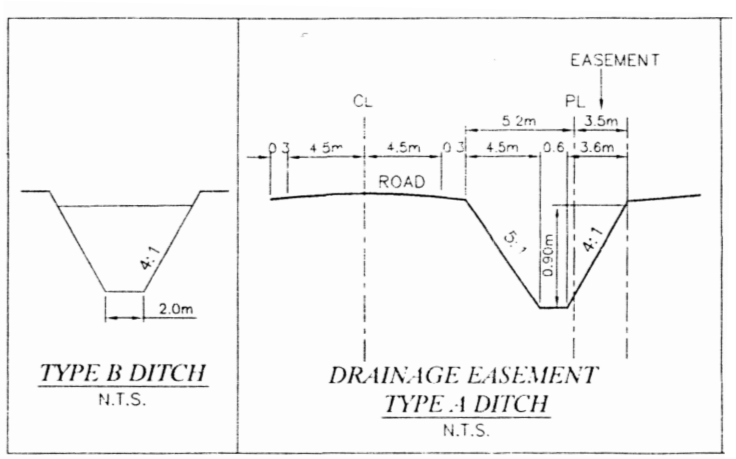

FIGURE 4 – Ditch Design (Diamond Valley Industrial Stormwater Management Plan, T. Fenton, Sept 2004)

ANALYSIS

Survey of the ditches reveals that no ditches have the depth (0.9 meters) prescribed by the 2004 Industrial Stormwater Management Report. Actual ditch depths range from approximately 0.3 meters to 0.6 meters. All culvert inverts drain in the correct direction toward the dry pond in the north west corner of the plan area. There is one exception, highlighted on Figure 3, where inverts of adjacent culverts are mis-aligned by -0.06 meters. Given that these culverts are close together, it is possible that some ponding or flooding may occur at this location during very large rainfall events.

The capacity of the as-built ditches was not assessed at this time.

RECOMMENDATIONS

Future Development: Remaining undeveloped lots within the area should reference the culvert and ditch survey information provided with this letter. Future development applications should use the “Type A” ditch design indicated in the Diamond Valley Industrial Stormwater Management Plan prepared by T. Fenton Consulting Ltd in September 2004 with the revised drainage directions shown in **Figure 1**. Applications should be reviewed to ensure that positive drainage is maintained along the constructed ditches with reference to the culvert and ditch survey information provided in **Figures 2** and **Figure 3** with this letter.

Capacity Assessment: Should concerns arise regarding the capacity of the roadside ditches to provide adequate drainage during an extreme rainfall event, an overland drainage analysis should be undertaken, and ditch retrofit works undertaken. This would include analysis of the existing culverts and ditch capacities, and design recommendations to deepen the ditches and lower the driveway culverts. Some grading work within lots may also be required to raise the perimeter elevations.

The material in this letter reflects the best judgment of Urban Systems Ltd. based on the information available at the time of preparation. Any use, which a third party makes of this letter, or reliance on or decisions made based on it, is the responsibilities of the third party. Urban Systems Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this letter.

Sincerely,

URBAN SYSTEMS LTD.

Brier Reid, MEDes. P.Eng. RPP MCIP
Stormwater Planning Engineer

/BR
Enclosure

cc: Meghan Aebig P.Eng, Urban Systems Ltd.

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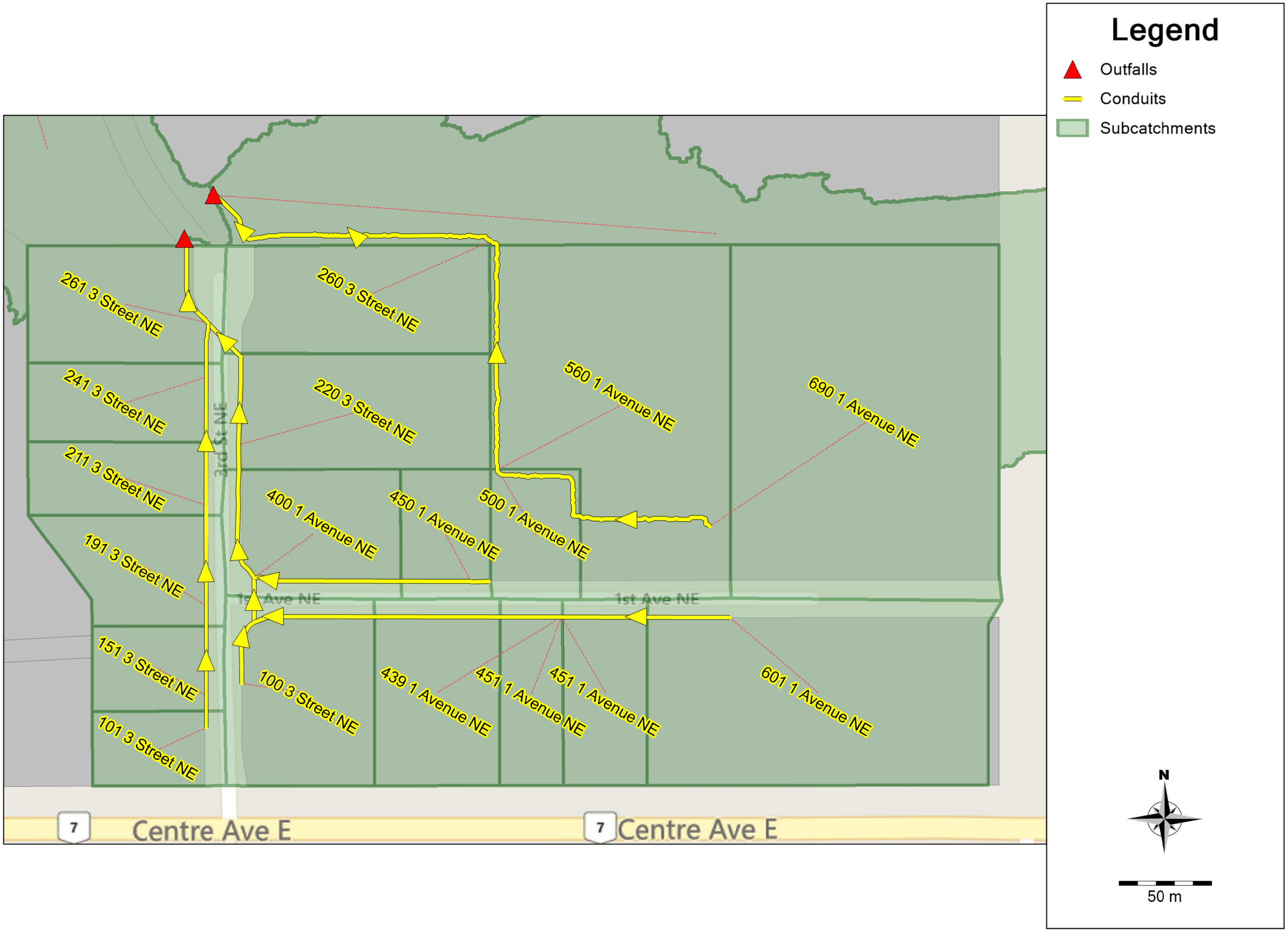

Legend
Outfalls
Conduits
Subcatchments
261 3 Street NE
241 3 Street NE
211 3 Street NE
191 3 Street NE
151 3 Street NE
101 3 Street NE
260 3 Street NE
220 3 Street NE
400 1 Avenue NE
450 1 Avenue NE
500 1 Avenue NE
560 1 Avenue NE
690 1 Avenue NE
100 3 Street NE
439 1 Avenue NE
451 1 Avenue NE
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601 1 Avenue NE
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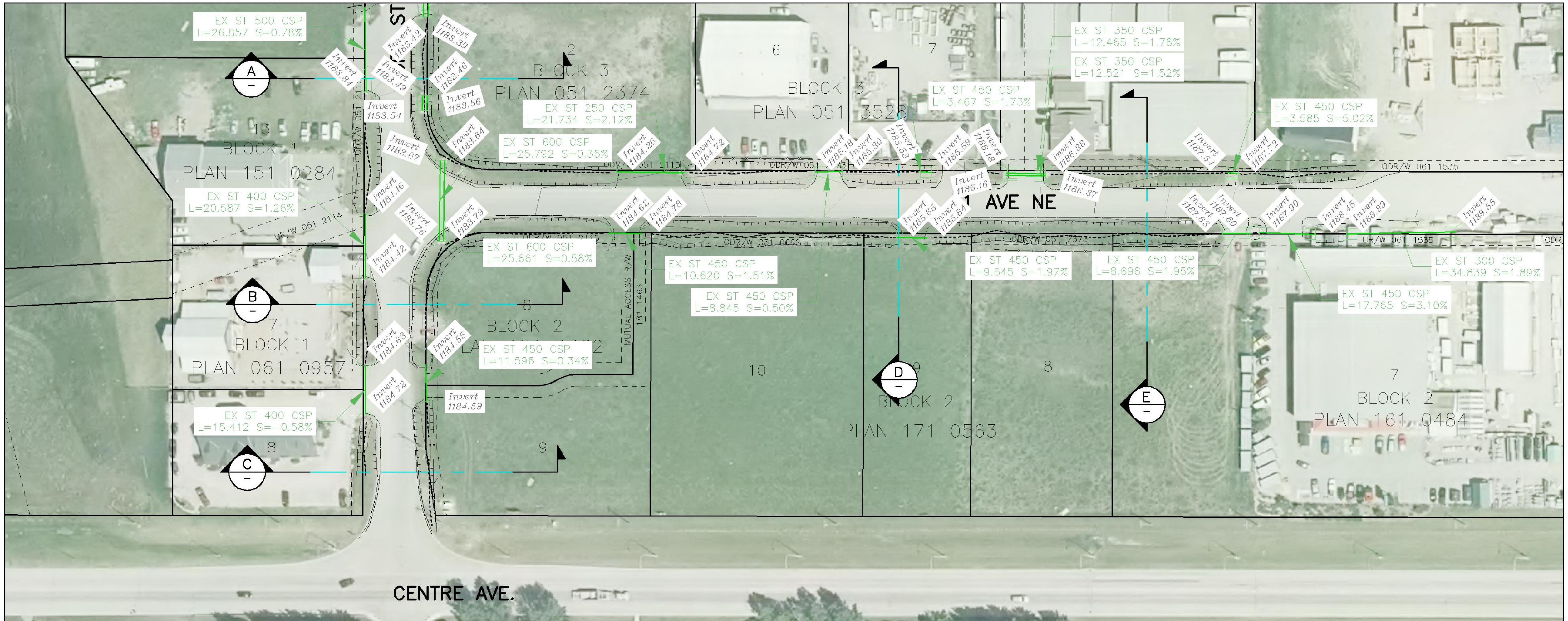
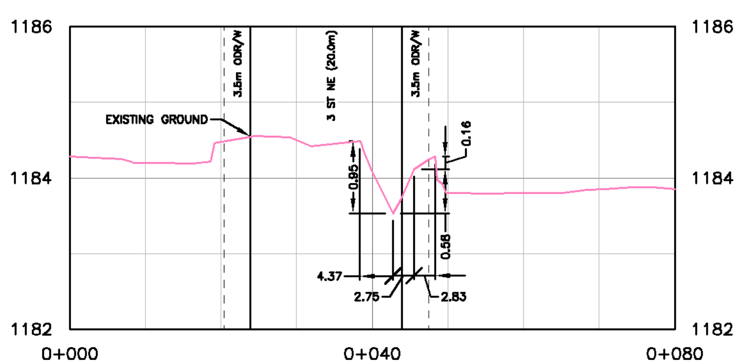
7
Centre Ave E
N
50 m





SECTION A
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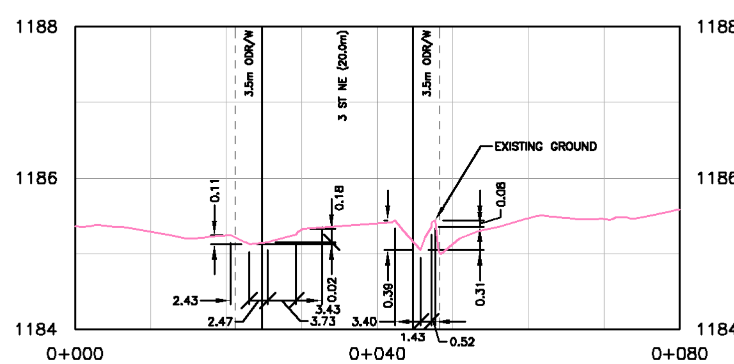
H 1:1000 V 1:100



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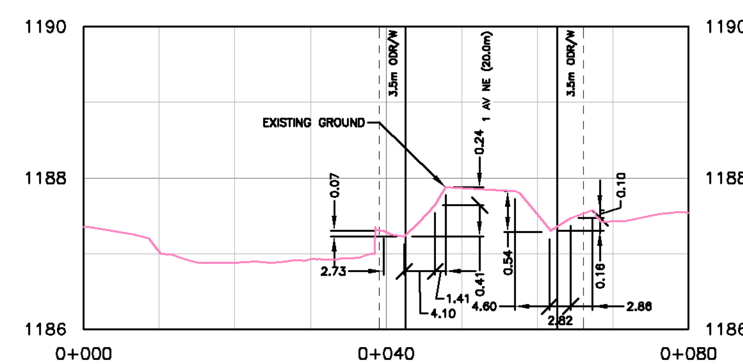

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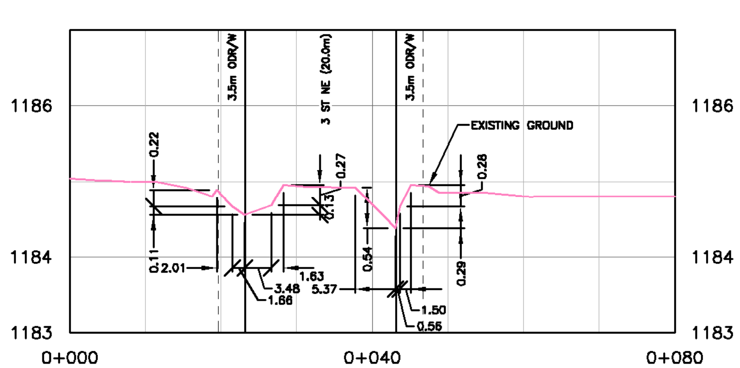

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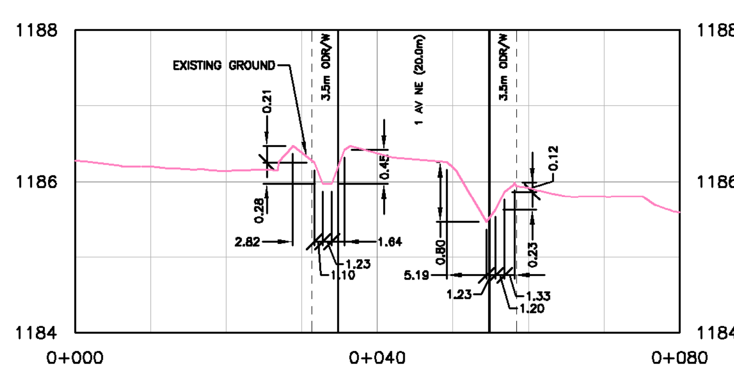


SECTION D
LOOKING WEST
H 1:1000 V 1:100

Town of Black Diamond

Industrial Area Stormwater

Elevations Profiles

15m 0 15 30 45

Coordinate System: Coordinate System: NAD 1983 3TM 114

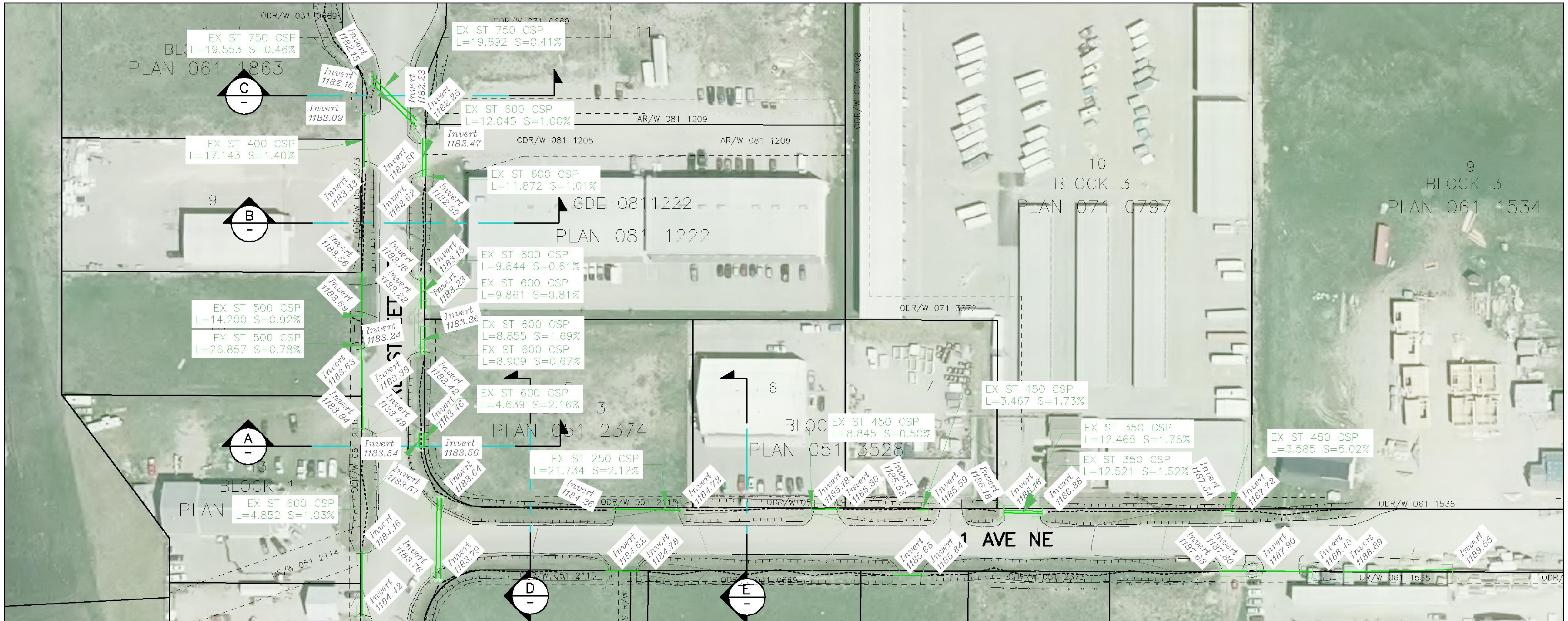
Scale: 1:1500

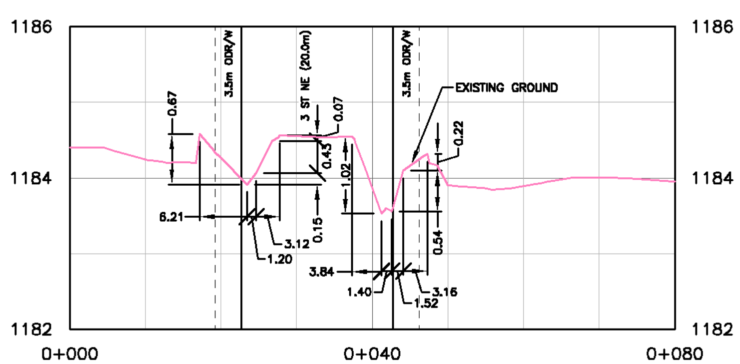
Data Sources:
- Data provided by Town of Black Diamond and AEP.

Project #: 0925.0036.01
Author: WM
Checked: BR
Status: Final
Revision: A
Date: 2020-11-20

URBAN systems

FIGURE 2





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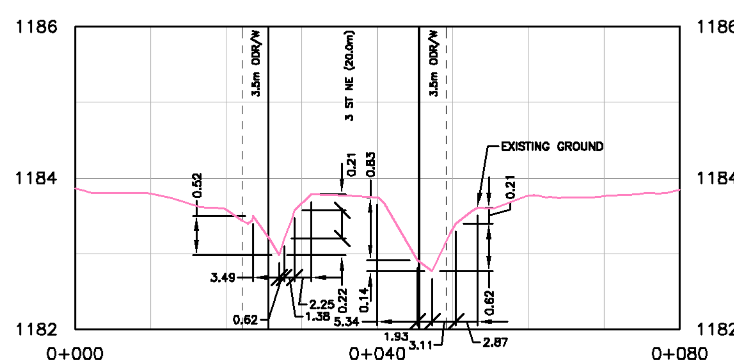

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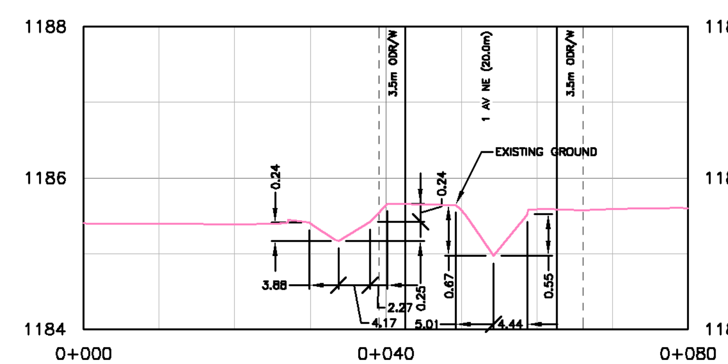

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LOOKING WEST
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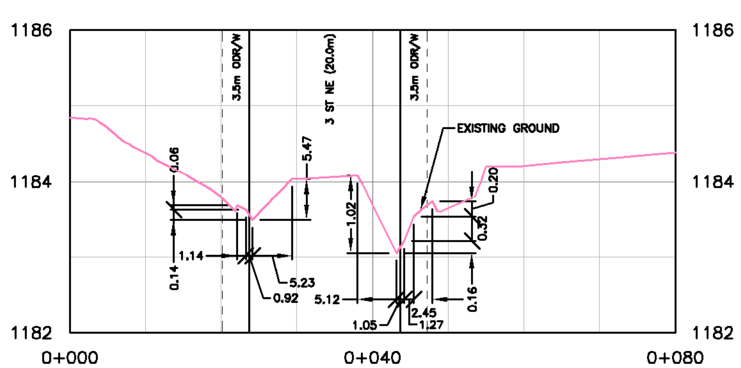

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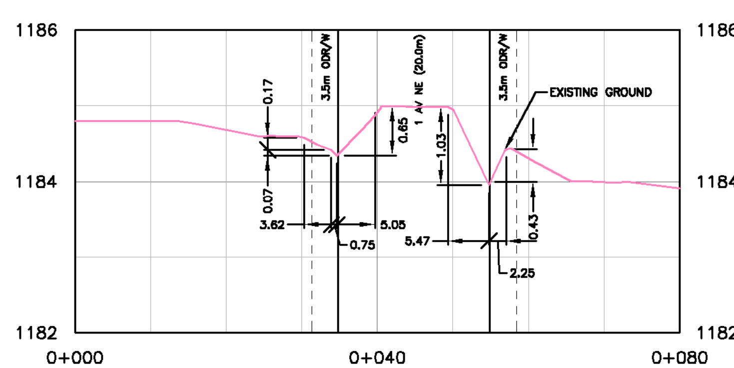

SECTION D
LOOKING WEST
H 1:1000 V 1:100

Town of Black Diamond

Industrial Area Stormwater

Elevations Profiles

The accuracy and completeness of information shown on this drawing is not guaranteed. It will be the responsibility of the user of the information shown on this drawing to locate and establish the precise location of all existing information whether shown or not.

15m 0 15 30 45

Coordinate System:
Coordinate System: NAD 1983 3TM 114

Scale:
1:1500

Data Sources:
- Data provided by Town of Black Diamond and AEP.

Project #:	0925.0036.01
Author:	WM
Checked:	BR
Status:	Final
Revision:	A
Date:	2020-11-20

URBAN systems

FIGURE 3

STORMWATER MANAGEMENT REPORT

for

DIAMOND VALLEY INDUSTRIAL PARK

BLACK DIAMOND, ALBERTA

SW ¼ Sec 16-20-2-5

Prepared for:

by:

T. Fenton Consulting Ltd.

Revised
September 2004

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Location: Lots 1 to 4, Block 1 Plan 991 0437
Lots 1 Block 2 Plan 991 0437

Site Legal Description: SW ¼ Sec 16-20-2-5

The study area of total 14.68 ha consists of two properties:

- Industrial Development Centre - 7.66 ha
- Modular Homes for Manufacture and Sales to be developed in the future – 7.02 ha

Site boundaries:

- Centre Avenue (Highway #7) on the south
- Regional Sewage Commission Land on the north
- Natural escarpment on the west designated Environmental Reserve
- Town boundary and an undeveloped land on the east

The site is located on the upland slopes of the river valley. The presently undeveloped, farmed land naturally drains northwest towards the Sheep River. An average slope within the site is about 2.1%.

2.0 STORM DRAINAGE

2.1 Existing Drainage

The study area belongs to Sheep River drainage basin, the River being at a distance of about 800 meters. The existing drainage system is shown in Figure 2. The natural runoff reaches the Sheep River floodplain and the existing creek through the coulee located in northwest corner of study area.

The drainage ditch along southern side of Centre Avenue (Highway No #7) borders the study area. The ditch, about 15 meters wide and 0.8 meter deep, drains the area of about 8.0 hectares, of partially developed land and discharges to the coulee west of the study area. Catchbasins installed in Centre Avenue are connected directly to the ditch.

Based on the Master Drainage Plan (Westhoff Engineering Resources Ltd., December 2003), the maximum flow reaching the ditch from catchments HWY1 and HWY2 is 550 L/s. The runoff collected in the ditch enters the natural coulee about 600 m west from the study area boundary and reaches the Sheep River through the existing watercourse.

2.2 Proposed Drainage

The proposed drainage system is shown in Figure 3. The site will drain overland to the ditch system and the runoff will collect in the proposed dry pond. The dry pond located outside of the study area receives the runoff from the study area, the pond area, and the undeveloped land on the east which naturally drains to the pond location site. The total pond drainage area is 19.10 hectares

The controlled discharge from the pond will enter the natural coulee and through a new culvert in the existing road will enter the floodplain and the existing creek. The rate of discharge will be controlled by an orifice installed in the pond outlet manhole. The unit rate of discharge was assumed to be 2.5 L/s/ha, in total 47.75 L/s. The pond discharge will be directed to the oil / grit removing system.

The parcels of the Diamond Valley Industrial Park will be graded allowing an overland discharge to the system of internal roadside ditches. Back portion of Lot 1 which slopes towards the coulee on the west will be filled up to reverse the slope towards the east. A small area in the southwest corner which can not be filled will be landscaped and allowed to drain to the coulee at natural rates.

The ditch to be constructed along the western boundary of the Modular Homes property will convey the discharge from this area towards the north and, within the Regional Sewage Commission land, to the west, parallel to the northern study area boundary. The back of Lot 3 will discharge to this ditch. The ditch is sized to carry a 100-year flow. However, once the Modular Homes property enters the development phase they must obtain their own storm drainage plan.

As shown on Figure 2, the runoff from the land east of the town boundary is directed towards the southwest however in the natural stage it does not enter the roadside ditch of Highway #7, finding its way through the southern portion of the study area. A cutoff ditch has already been constructed adjacent to the highway. This ditch is to be extended up to the northern edge of the study area, so that the existing roadside ditch will convey the pre-development runoff from this area to the river.

3.0 CALCULATIONS

3.1 Models Applied

A hydrologic analysis to determine the required detention volume and the peak flows was carried out in accordance with the City of Calgary and the Alberta Environment Stormwater Management Design Guidelines. The simulations were performed using two computer models: the single storm event INTERHYMO, and a continuous simulation Qualhymo. The results of both models were compared and the larger volume required used in the pond design.

3.2 Design Storm

The design storm applied is the Interhymo model is of the Chicago distribution with IDF data for the Calgary International Airport. The storm duration used:

- 24- hour duration storm was applied in the pond volume calculations,
- 1-hour duration storm was applied in peak flow calculations.

3.3 Model Parameters

The input data for the models include drainage areas and land surface characteristics. The drainage areas used in simulations for calculations of pond volume and peak flows are summarized in two tables below.

Table 3.1 Catchment areas for pond volume calculations

Development type	Area (ha)	Imperviousness ratio
Diamond Valley Industrial Park	7.66	0.85
Future Manufactured Homes development	7.02	0.85
Pond area	1.42	0.20
Undeveloped land on east	3.00	0.00
Total	19.10	

Division into catchments for ditch flow calculations is based on the preliminary grading plan of the site and marked on the plan, Figure 3. The discharge points from Table 3.2 are marked on the plan Figure G-1

Table 3.2 Catchment areas for ditch flow calculations

Catchment No.	Location	Area in ha	Discharge Point
100	Lot 4, 1/2 rd	1.78	1
110	Lot 3, 1/2 rd	0.60	2
120	Lot 3, 1/2 rd	1.95	3
130	Lot 3 to back ditch	0.77	5
140	Lot 1, 1/2 rd	0.66	6
150	Lot 2, 1/2 rd	1.91	7
160	Manufactured Homes	7.02	4
170	Undeveloped land on north	3.00	5

CN and Imperviousness Ratio
Consistent with the Stormwater Management Guidelines for Calgary
CN* = 72, 69 for undeveloped land.
Ia = 1.6 / 3.4 mm
Imperviousness Ratio
- Diamond Valley Park and Manufactured Homes sites - for 0.85
- Dry Pond and adjacent ditch areas - 0.20

Model Schematic
The model schematic for the pond volume calculations is shown in Figure 1-A, Appendix A, for the peak flow calculations in Figure 1-B, Appendix B.

3.4 Pond Discharge

The rating curve was developed based on an assumption that the discharge rate from the pond is regulated by the ICD R50 installed in the outlet manhole. The invert elevation of the outlet pipe where the ICD is installed is 1180.25.

Table 3.3 Pond discharge rating curve

Pond Depth (m)	Depth to orifice (m)	Elevation (m)	Pond Volume (m^3)	Discharge (L/s)
0.00	0.65	1181.00	10	24.2
0.50	1.15	1181.50	706	32.2
1.00	1.65	1182.00	4018	38.6
1.50	2.15	1182.50	9109	44.1
1.75	2.40	1182.85	12981	47.5
2.00	2.65	1183.00	14723	48.9

4.0 RESULTS SUMMARY

4.1 Pond Design

The printouts of the pond volume modelling using the Interhymo model are included in Appendix A, the results of the Qualhymo model in Appendix C. The final results of the modelling used in the design are shown on Drawing G1 and summarized in Table 4.1.

4.1.1 Interhymo Model Analysis

100-year volume required: 10,270 m^3
Maximum discharge rate: 46 L/s
Maximum depth: 1.70

4.1.2 Qualhymo Model Analysis

Below is the summary of the maximum pond volumes which occurred during a 35-year period of 1964 - 1994, displayed in the format used in the frequency analysis program.

1651,1764,2330,4726,4622,4909,5667,1636,
4242,2706,1465,2485,5212,1809,3058,1440,
3261,2441,6036,2466,4270,2590,1884,2799,
3789,10399,4627,2791,6759,1767,2660,2935,
5957,3535,2539,

It can be noted that the maximum pond volume of 10,399 m^3 occurred during the storm of September 12 1985. This volume is significantly higher than the maximums of the remaining years. During this storm, the total 24-hour rainfall exceeded the statistical value for a 100 year, 24 hour storm.

Statistical analysis using the Hyrisk model was carried out on the volume series to determine the volumes for return periods of 2, 5, 10, 20, 50, and 100 years. The curve fitting was performed using several distributions. The results for the 100-year volume estimation are summarized in the table below. The printout of I /O files of the Hyrisk model is included in Appendix C.

Table 4.1 Summary of Statistical Analysis

DISTRIBUTION	100-year Volume (m^3)	Sd (m^3)	Sd /Vol ratio
Log Pearson 3 - Method of Moments	11,270	3328	0.29
Log Pearson 3 - Method of Maximum Likelihood	13,428	4280	0.31
Log Normal 3 - Method of Moments	9,827	2691	0.27
Log Normal 3 - Method of Maximum Likelihood	12,785	3462	0.27
Log Normal 2 - Method of Moments	10,004	1638	0.16

The results of the applied distributions and methods vary from 9827 m^3 to 13,428 m^3. The average value of 100-year volumes is 11,450 m^3. The lowest ratio of standard deviation to volume is 0.18 in Log Normal 2 distribution, volume of 10,004 m^3, which is very close to the value obtained using the Interhymo model.

4.1.3 Final Results

The final 100-year flood volume in the proposed stormwater ponds was assumed based on the Qualhymo model, the Log Pearson 3 distribution, Method of Moments of 11,270 m^3. The actual pond volume with the 0.15 m freeboard is 12,981, therefore it could store without any spillage the value obtained from the Log Normal 3 distribution equal to 12,785 m^3.

Table 4.2 Pond Design Summary

Pond drainage area (ha)	19.10
100-year volume required (m^3):	11,270
Volume up to 0.15m freeboard	12,981
Unit detention rate (m^3/ha):	590
100-year rate of discharge (m^3/s):	0.048
Unit discharge rate (L/s/ha):	2.51
100-year maximum depth (m):	1.73
100-year minimum depth (m)	0.73
Pond depth including freeboard (m):	2.00
Pond outlet elevation:	1181.00
100-year elevation:	1182.73
Top of pond elevation:	1183.00
Spillway elevation:	1182.85
Pond inside side slopes:	5:1
Minimum bottoms slope %:	1.2
Discharge control:	ICD R50

4.2 Conveyance System Design

The printouts of overland flow calculations are included in Appendix B. The results of the calculations and the details of ditch and culvert design are shown on Drawing G-1 and are summarized in Table 4.3

The entire conveyance system was designed for 100-year flows without detention on sites. As shown in Drawing G-1 there are two types of grassed ditches used on the site:

Type A - Internal roadside ditch, roadside slope 5:1, on site slope: 4:1, B = 0.6 m
Type B – Modular Homes ditch; side slopes 4:1, B = 2.0 m

The capacity of grassed ditches was calculated using Manning's equation with roughness coefficient of 0.065, which corresponds to Bermuda grass cut to 0.06m. The flow depth will also be affected by backwater resulting from culvert passage.

Table 4.3 Ditch system design

Catchment No.	Point of discharge	Discharge (m3/s)	Flow depth (m)	Velocity (m/s)	Slope %	Conveyance type
100	1	0.37	0.40	0.50	0.78	Type A
100&110	2	0.50	0.45	0.47	0.60	Type A
100 - 120	3	0.91	0.61	0.57	0.60	Type A
140	4	0.14	0.30	0.37	0.60	Type A
140&150	5	0.55	0.50	0.50	0.60	Type A
100-150	6	1.46	0.62	0.59	0.50	Type B
160	7	1.47	0.67	0.55	0.50	Type B
130,160,170	8	1.64	0.55	0.98	0.40	Type B

4.3 Culverts

4.3.1 Culverts within the Study Area

The culverts were generally designed to carry 100-year flows. The following types of culverts were used:

1) CSP 450mm in upstream access roads, where expected flows do not exceed 220L/s. These culverts may be constructed with inlet projecting from fill.
2) The maximum diameter to be used in lot access roads is 700 mm. this may be used in west access to Lot 3
3) Double CSP 600 mm will cross the road to the Modular Homes property. They should be constructed with square inlet headwall.
4) Double CSP 700 mm, skewed at 45° will carry flow from east to west ditch. Culverts should be mitered and have a square edge headwall.
5) Double CSP 800 mm will be installed on the pond entrance from the both ditches. These may be with slanted inlets.

4.3.2 Culvert in Access Road to the Study Area

Concrete pipe 600-mm diameter culvert will be installed in the access road to the study area. As the existing catchbasins opposite 3rd Street SE discharge to the ditch in the future access road location, we propose to construct a culvert with a manhole in the access road, which will collect the discharge from catchbasins and pass it to the culvert.

Required culvert capacity:
Based on calculations included in the Master Drainage Plan for Town of Black Diamond (Westhoff Engineering Resources, December 20030), the following maximum flows are expected in the culvert:

Catchment	Area (ha)	Discharge (m3/s)
HWY-3	3.48	0.22
HWY-2	5	0.33
East Hill from study area	4.35	0.08
Total	12.83	0.63

The concrete pipe 0.6 m diameter culvert design is shown in Engineering Drawings, profile 201. Based on the slopes provided the proposed culvert will carry the design 100-year flow at the upstream water level 0.2 m above the pipe obvert.

5.0 WATER QUALITY

The proposed dry pond with a low release rate will provide a primary treatment in removal of sediments, heavy metals and oils. The controlled discharge from the pond will enter the oil/ grit separator, which will provide additional treatment removing over 85% of sediments particles 75 microns and greater and capturing the oils.

The Stormceptor unit STA 4000 of maximum flow 50 l/s will provide the treatment required. The other option is to use Vortechs 2000. Installation of Stormceptor is less expensive therefore using the Vortechs 2000 would be justified only if in the future more developed land discharging to the pond would be expected.

The sedimentation bay will be constructed at the culvert inlets. As shown in Drawing G-1 the proposed forebay is 30 m long, 12 m wide at the bottom, 1.5 m deep below the pond inlet grade, total capacity 850 m^3 will provide initial sediment settlement. Additionally the gravel/rock berm about 0.5 m high on filter fabric will be constructed along the internal bay edges to filter the low flows. The berm will be vegetated.

6.0 CONCLUSIONS AND RECCOMMENDATIONS

1 The proposed subdivision drainage system conforms to the Stormwater Management Guidelines for the Province of Alberta, 1999 and to the Stormwater Management Design Manual for the City of Calgary.

2 The proposed pond will provide the volume required of 11,270 m^3 for the study area at the maximum depth of 1.73 at the pond outlet. Presently the pond of total depth 2.0 m including the freeboard has a spare capacity of about 1,700 m^3.

3 The overland drainage system was designed for a 100-year discharge. However, to perform as designed, the grassed ditches and culverts must be regularly maintained by the adjacent property owners

4 The oil / grit separator on the pond outlet will provide the secondary treatment to the entire flow leaving the development.

APPENDIX A

Interhymo I/O Files - Pond Volume Calculations

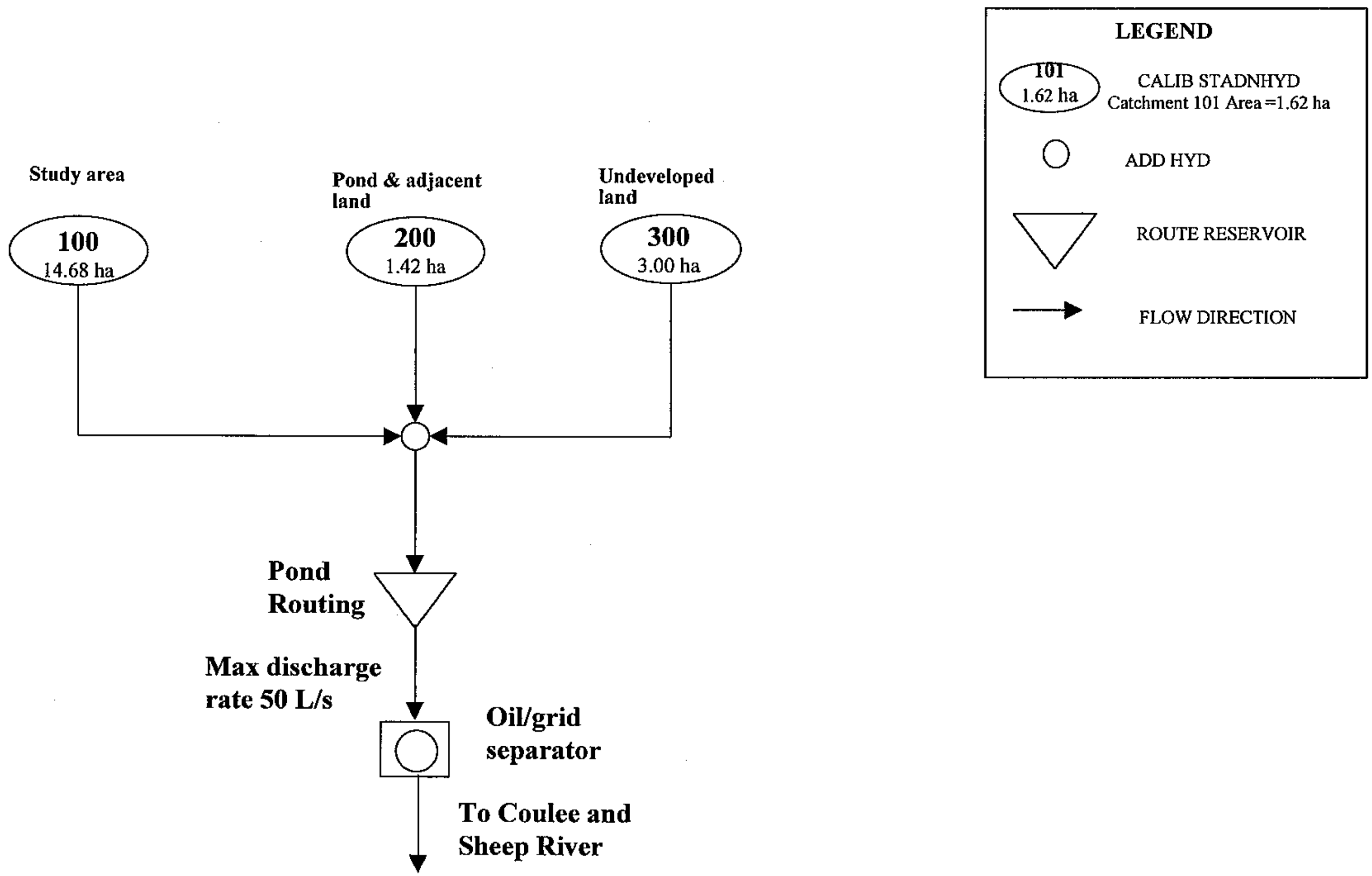

FIGURE 1-A

Diamond Valley Industrial Park

Pond Volume Modelling Schematic

```
2
*        Black Diamond - Industrial Park
*        Stormwater Management Plan
*        Design Storm: Chicago, 1 in 100 year, 24 hour duration
*        September 2004
*        EL
*
START                TIME= 0.0  IUNITS= 2
*
*  derive a 24 hour Chicago storm
CHICAGO STORM        IUNITS=2 TD=24 HOURS R=0.333 SDT=15 MIN ICASE=1
                     A= 663.1 B=1.87 C=0.712
*******************************************************************
* Developed Portion
CALIB STANDHYD       ID=1  NHYD=100   DT=5 min  AREA=14.68 HA
                     XIMP=.85  TIMP=.85 DWF=0 LOSS=2 CN=72
                     PERVIOUS DPSP=3.4 MM SLOPE=2% LGP=40 M MNP=0.25 SCP=0
                     IMPERVIOUS DPSI=1.6MM SLOPE=1.5% LGI=80 M MNI=0.013 SCI=0
                     END=-1
* Pond
CALIB STANDHYD       ID=2  NHYD=200   DT=5 min  AREA=1.41 HA
                     XIMP=.20  TIMP=.20 DWF=0 LOSS=2 CN=72
                     PERVIOUS DPSP=3.4 MM SLOPE=2% LGP=40 M MNP=0.25 SCP=0
                     IMPERVIOUS DPSI=1.6MM SLOPE=2.5% LGI=80 M MNI=0.013 SCI=0
                     END=-1
* Total
ADD HYD              ID=3 NHYD=1000 IDONE=1 IDTWO=2
* Undeveloped land
CALIB NASHYD         ID=4  NHYD=300  DT=5 min  AREA= 3.00 ha  DWF=0  CN=69
                     IA=12 mm  N=2.5 TP=0.20 hr  -1
* Total Inflow to dry Pond
ADD HYD              ID=5 NHYD=1010 IDONE=3 IDTWO=4
*********************************************************************
* Unit discharge 2.5 L/s
ROUTE RESERVOIR      ID=6 NHYD=130 IDIN=5
                     Discharge  Storage
                         0.0      0.0
                           0.024    0.001
                         0.032    0.071
                         0.039    0.402
                         0.044         0.911
                         0.047    1.187
                         0.049    1.479 -1
*
FINISH
```

```
===============================================================================

        OOO    TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    I N T E R H Y M O
       O   O     T      T    H   H   Y Y   MM MM  O   O   * * * 1989b * * *
       O   O     T      T    HHHHH    Y    M M M  O   O
       O   O     T      T    H   H    Y    M   M  O   O
        OOO      T      T    H   H    Y    M   M   OOO    E-9516061302141

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  Input   filename: bd-ind.dat
  Output  filename: bd-ind.out
  Summary filename: bd-ind.sum


DATE: 09-12-2004                       TIME: 16:20:34

COMMENTS: ____________________________________________________________

-------------------------------------------------------------------------------
*        Black Diamond - Industrial Park
*        Stormwater Management Plan
*        Design Storm: Chicago, 1 in 100 year,24 hour duration
*        September 2004
*        EL
*
  ****************************
  ** SIMULATION NUMBER:   1 **
  ****************************

*
*  derive a 24 hour Chicago storm
--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 663.100
| Ptotal= 89.67 mm |                          B=   1.870
--------------------                          C=    .712
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  = 24.00 hrs
                        Storm time step    = 15.00 min
                        Time to peak ratio =   .33

                 TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                  .25    1.11 |  6.25    3.27 | 12.25    2.77 | 18.25    1.48
                  .50    1.13 |  6.50    3.67 | 12.50    2.66 | 18.50    1.46
                  .75    1.16 |  6.75    4.21 | 12.75    2.56 | 18.75    1.43
                 1.00    1.19 |  7.00    4.99 | 13.00    2.47 | 19.00    1.41
                 1.25    1.22 |  7.25    6.24 | 13.25    2.39 | 19.25    1.39
                 1.50    1.26 |  7.50    8.71 | 13.50    2.31 | 19.50    1.36
                 1.75    1.29 |  7.75   17.31 | 13.75    2.24 | 19.75    1.34
                 2.00    1.33 |  8.00   88.69 | 14.00    2.17 | 20.00    1.32
                 2.25    1.37 |  8.25   21.72 | 14.25    2.11 | 20.25    1.30
                 2.50    1.42 |  8.50   12.91 | 14.50    2.05 | 20.50    1.29
                 2.75    1.47 |  8.75    9.62 | 14.75    1.99 | 20.75    1.27
                 3.00    1.52 |  9.00    7.81 | 15.00    1.94 | 21.00    1.25
                 3.25    1.58 |  9.25    6.66 | 15.25    1.89 | 21.25    1.23
                 3.50    1.64 |  9.50    5.84 | 15.50    1.85 | 21.50    1.22
                 3.75    1.71 |  9.75    5.23 | 15.75    1.81 | 21.75    1.20
                 4.00    1.78 | 10.00    4.75 | 16.00    1.77 | 22.00    1.19
                 4.25    1.87 | 10.25    4.37 | 16.25    1.73 | 22.25    1.17
                 4.50    1.97 | 10.50    4.05 | 16.50    1.69 | 22.50    1.16
                 4.75    2.08 | 10.75    3.78 | 16.75    1.66 | 22.75    1.14
                 5.00    2.20 | 11.00    3.56 | 17.00    1.62 | 23.00    1.13
                 5.25    2.34 | 11.25    3.36 | 17.25    1.59 | 23.25    1.12
                 5.50    2.51 | 11.50    3.19 | 17.50    1.56 | 23.50    1.10
                 5.75    2.72 | 11.75    3.03 | 17.75    1.53 | 23.75    1.09
                 6.00    2.96 | 12.00    2.90 | 18.00    1.51 | 24.00    1.08

-------------------------------------------------------------------------------
*******************************************************************
```

```
* Developed Portion
--------------------
| CALIB              |
| STANDHYD  (0100) |   Area    (ha)=  14.68
|ID= 1 DT= 5.0 min |   Total Imp(%)=  85.00   Dir. Conn.(%)=  85.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area      (ha)=    12.48         2.20
     Dep. Storage      (mm)=     1.60         3.40
     Average Slope      (%)=     1.50         2.00
     Length             (m)=    80.00        40.00
     Mannings n           =      .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                            IMPERVIOUS    PERVIOUS (i)
     Max.eff.Inten.(mm/hr)=    88.69        39.22
               over (min)      5.00        10.00
     Storage Coeff.  (min)=     2.08 (ii)    5.78 (ii)
     Unit Hyd. Tpeak (min)=     5.00        10.00
     Unit Hyd. peak  (cms)=      .31          .15
                                                          *TOTALS*
     PEAK FLOW        (cms)=     3.07          .20          3.27 (iii)
     TIME TO PEAK     (hrs)=     8.00         8.00          8.00
     RUNOFF VOLUME     (mm)=    88.07        40.22         80.89
     TOTAL RAINFALL    (mm)=    89.67        89.67         89.67
     RUNOFF COEFFICIENT   =       .98          .45           .90

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
          CN*  =  72.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
* Pond
--------------------
| CALIB              |
| STANDHYD  (0200) |   Area    (ha)=   1.41
|ID= 2 DT= 5.0 min |   Total Imp(%)=  20.00   Dir. Conn.(%)=  20.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area      (ha)=      .28         1.13
     Dep. Storage      (mm)=     1.60         3.40
     Average Slope      (%)=     2.50         2.00
     Length             (m)=    80.00        40.00
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=    88.69        36.11
               over (min)      5.00        15.00
     Storage Coeff.  (min)=     1.78 (ii)   12.39 (ii)
     Unit Hyd. Tpeak (min)=     5.00        15.00
     Unit Hyd. peak  (cms)=      .32          .08
                                                          *TOTALS*
     PEAK FLOW        (cms)=      .07          .07           .13 (iii)
     TIME TO PEAK     (hrs)=     8.00         8.17          8.00
     RUNOFF VOLUME     (mm)=    88.07        40.22         49.78
     TOTAL RAINFALL    (mm)=    89.67        89.67         89.67
     RUNOFF COEFFICIENT   =       .98          .45           .56

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
          CN*  =  72.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
* Total

--------------------
| ADD HYD   (1000) |
|  1 + 2 = 3       |        AREA    QPEAK    TPEAK     R.V.
--------------------        (ha)    (cms)    (hrs)     (mm)
         ID1= 1 (0100):    14.68     3.27     8.00    80.89
       + ID2= 2 (0200):     1.41      .13     8.00    49.78
         ==================================================
         ID = 3 (1000):    16.09     3.40     8.00    78.16
```

```
     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
* Undeveloped land
--------------------
| CALIB              |
| NASHYD     (0300) |   Area     (ha)=    3.00   Curve Number    (CN)= 69.0
|ID= 4 DT= 5.0 min |   Ia       (mm)=   12.00   # of Linear Res.(N)= 2.50
--------------------   U.H. Tp(hrs)=     .20

     Unit Hyd Qpeak  (cms)=     .490

     PEAK FLOW       (cms)=     .128 (i)
     TIME TO PEAK    (hrs)=    8.083
     RUNOFF VOLUME    (mm)=   31.232
     TOTAL RAINFALL   (mm)=   89.665
     RUNOFF COEFFICIENT   =     .348

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
* Total Inflow to dry Pond

--------------------
| ADD HYD    (1010) |
|   3 +  4 =  5     |         AREA     QPEAK     TPEAK      R.V.
--------------------          (ha)     (cms)     (hrs)      (mm)
          ID1= 3 (1000):     16.09      3.40      8.00     78.16
        + ID2= 4 (0300):      3.00       .13      8.08     31.23
          =====================================================
          ID = 5 (1010):     19.09      3.51      8.00     70.79

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
************************************************************************
* Unit discharge 2.5 L/s
--------------------
| RESERVOIR (0130) |
| IN= 5---> OUT= 6 |
| DT=  5.0 min     |       OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------        (cms)     (ha.m.)   |   (cms)     (ha.m.)
                             .000       .000    |    .044       .911
                             .024       .001    |    .047      1.187
                             .032       .071    |    .049      1.479
                             .039       .402    |    .000       .000

                                AREA     QPEAK     TPEAK         R.V.
                                (ha)     (cms)     (hrs)         (mm)
     INFLOW : ID= 5 (1010)     19.09      3.51      8.00        70.79
     OUTFLOW: ID= 6 (0130)     19.09       .05     24.00        62.02

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  1.291
                  TIME SHIFT OF PEAK FLOW         (min)=960.000
                  MAXIMUM  STORAGE   USED       (ha.m.)=  1.027

--------------------------------------------------------------------------------
*

 FINISH
================================================================================
```

APPENDIX B

Interhymo I/O Files - Ditch Flow Calculations

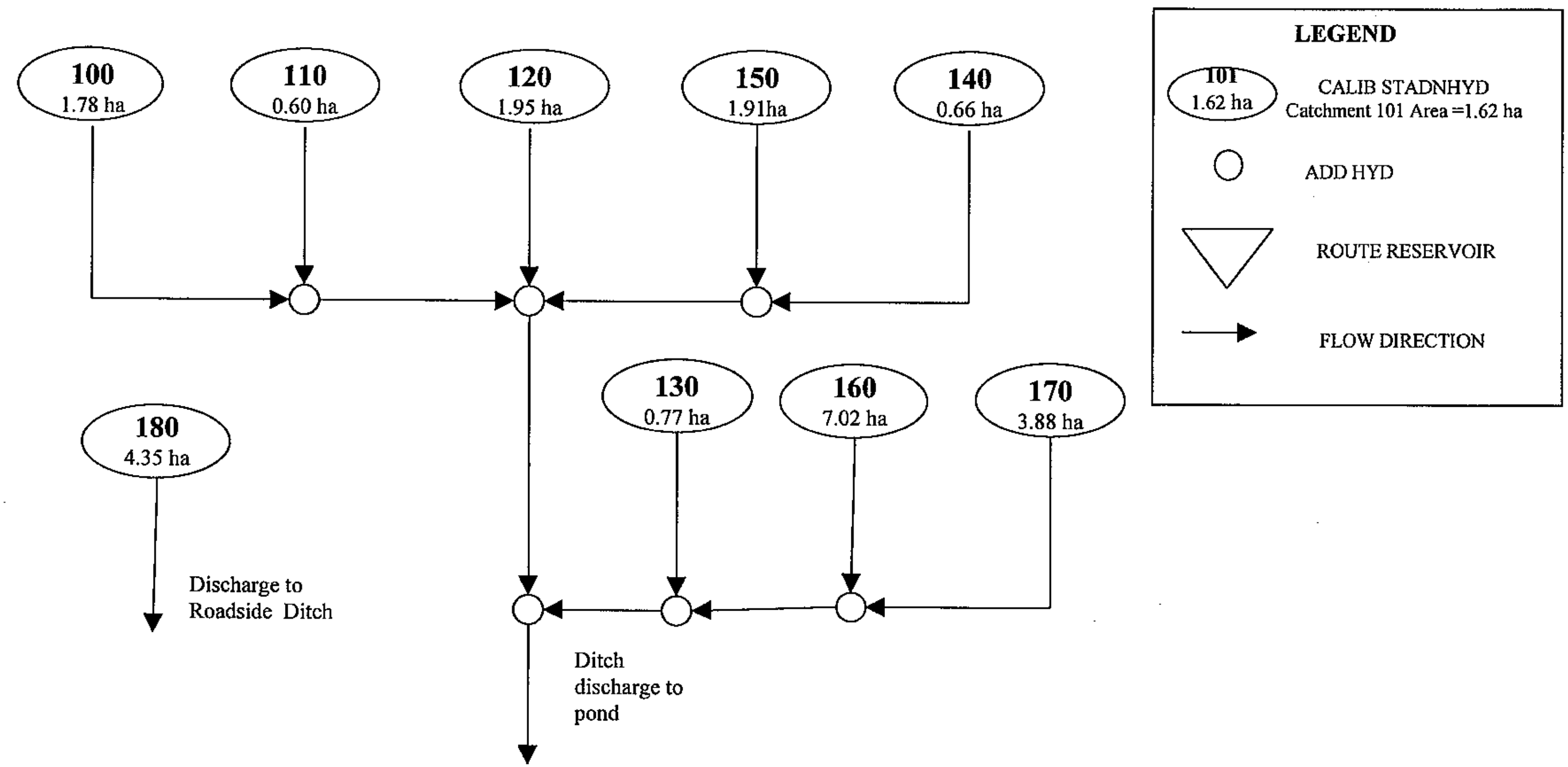

FIGURE 1-B

Diamond Valley Industrial Park

Ditch Flow Modelling Schematic

```
2
*        Black Diamond - Industrial Park
*        Stormwater Management Plan
*        Peak flows in ditches
*        Design Storm: Chicago, 1 in 100 year, 1 hour duration
*        September 2004
*        EL
*
START               TIME= 0.0  IUNITS= 2
*
*  derive a 1 hour Chicago storm
CHICAGO STORM       IUNITS=2 TD=1 HOURS R=0.333 SDT=15 MIN ICASE=1
                    A= 663.1 B=1.87 C=0.712
*****************************************************************
* Lot 4  (point #1)
CALIB STANDHYD      ID=1  NHYD=100   DT=5 min  AREA=1.78 HA
                    XIMP=.85  TIMP=.85 DWF=0 LOSS=2 CN=72
                    PERVIOUS DPSP=3.4 MM SLOPE=2% LGP=40 M MNP=0.25 SCP=0
                    IMPERVIOUS DPSI=1.6MM SLOPE=0.9% LGI=100 M MNI=0.018 SCI=0
                    END=-1
* Lot 3
CALIB STANDHYD      ID=2  NHYD=110   DT=5 min  AREA=0.60 HA
                    XIMP=.85  TIMP=.85 DWF=0 LOSS=2 CN=72
                    PERVIOUS DPSP=3.4 MM SLOPE=2% LGP=40 M MNP=0.25 SCP=0
                    IMPERVIOUS DPSI=1.6MM SLOPE=0.9% LGI=50 M MNI=0.018 SCI=0
                    END=-1
* Total ditch flow at #2
ADD HYD             ID=3 NHYD=1010 IDONE=1 IDTWO=2
* Lot 3
CALIB STANDHYD      ID=4  NHYD=120   DT=5 min  AREA=1.95 HA
                    XIMP=.85  TIMP=.85 DWF=0 LOSS=2 CN=72
                    PERVIOUS DPSP=3.4 MM SLOPE=2% LGP=40 M MNP=0.25 SCP=0
                    IMPERVIOUS DPSI=1.6MM SLOPE=0.9% LGI=100 M MNI=0.018 SCI=0
                    END=-1
* Total ditch flow at #3

ADD HYD             ID=5 NHYD=1020 IDONE=3 IDTWO=4
* Lot 1 (point #4)
CALIB STANDHYD      ID=6  NHYD=140   DT=5 min  AREA=0.66 HA
                    XIMP=.85  TIMP=.85 DWF=0 LOSS=2 CN=72
                    PERVIOUS DPSP=3.4 MM SLOPE=2% LGP=40 M MNP=0.25 SCP=0
                    IMPERVIOUS DPSI=1.6MM SLOPE=0.9% LGI=40 M MNI=0.018 SCI=0
                    END=-1
* Lot 2
CALIB STANDHYD      ID=7  NHYD=150   DT=5 min  AREA=1.91 HA
                    XIMP=.85  TIMP=.85 DWF=0 LOSS=2 CN=72
                    PERVIOUS DPSP=3.4 MM SLOPE=2% LGP=40 M MNP=0.25 SCP=0
                    IMPERVIOUS DPSI=1.6MM SLOPE=0.9% LGI=60 M MNI=0.018 SCI=0
                    END=-1
* Total flow, west ditch #5
ADD HYD             ID=8 NHYD=1030 IDONE=6 IDTWO=7
* Total flow at #6
ADD HYD             ID=9 NHYD=1040 IDONE=5 IDTWO=8
****************************************************
* Lots Block 2 to back ditch at point #7
CALIB STANDHYD      ID=1  NHYD=160   DT=5 min  AREA=7.02 HA
                    XIMP=.85  TIMP=.85 DWF=0 LOSS=2 CN=72
                    PERVIOUS DPSP=3.4 MM SLOPE=2% LGP=40 M MNP=0.25 SCP=0
                    IMPERVIOUS DPSI=1.6MM SLOPE=0.9% LGI=100 M MNI=0.018 SCI=0
                    END=-1
* Lot 3, to back ditch
CALIB STANDHYD      ID=2  NHYD=130   DT=5 min  AREA=0.77 HA
                    XIMP=.85  TIMP=.85 DWF=0 LOSS=2 CN=72
                    PERVIOUS DPSP=3.4 MM SLOPE=2% LGP=40 M MNP=0.25 SCP=0
                    IMPERVIOUS DPSI=1.6MM SLOPE=0.9% LGI=100 M MNI=0.018 SCI=0
                    END=-1
* Total flow industrial at 8
ADD HYD             ID=3 NHYD=1050 IDONE=1 IDTWO=2
* Discharge from undeveloped land
CALIB NASHYD        ID=4  NHYD=170  DT=5 min  AREA= 3.00 ha  DWF=0  CN=69
                    IA=12 mm  N=2.5 TP=0.20 hr  -1
* Total flow at #8
ADD HYD             ID=5 NHYD=1060 IDONE=3 IDTWO=4
* Summed 100-year inflow to pond
ADD HYD             ID=6 NHYD=1070 IDONE=9 IDTWO=5
*
* Undeveloped land on the east discharging to roadside ditch
CALIB NASHYD        ID=1  NHYD=180  DT=5 min  AREA= 4.35 ha  DWF=0  CN=69
                    IA=12 mm  N=2.5 TP=0.45 hr  -1
*
FINISH
```

```
==============================================================================

     000   TTTTT  TTTTT  H   H  Y   Y  M   M   000    I N T E R H Y M O
    O   O    T      T    H   H   Y Y   MM MM  O   O   * * * 1989b * * *
    O   O    T      T    HHHHH    Y    M M M  O   O
    O   O    T      T    H   H    Y    M   M  O   O
     000     T      T    H   H    Y    M   M   000    E-9516061302142

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  Input   filename: bd-flow.dat
  Output  filename: bd-flow.out
  Summary filename: bd-flow.sum

DATE: 09-14-2004                    TIME: 16:30:35

COMMENTS: ____________________________________________________

------------------------------------------------------------------------------
*        Black Diamond - Industrial Park
*        Stormwater Management Plan
*        Peak flows in ditches
*        Design Storm: Chicago, 1 in 100 year, 1 hour duration
*        September 2004
*        EL
*
  ****************************
  ** SIMULATION NUMBER:   1 **
  ****************************

*
*  derive a 1 hour Chicago storm
--------------------
| CHICAGO STORM    |     IDF curve parameters: A= 663.100
| Ptotal= 33.24 mm |                           B=   1.870
--------------------                           C=    .712
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm  =  1.00 hrs
                         Storm time step    = 15.00 min
                         Time to peak ratio =   .33

                  TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                   .25   88.69 |   .50   21.72 |   .75   12.91 |  1.00    9.62


------------------------------------------------------------------------------
*******************************************************************
* Lot 4  (point #1)
--------------------

| CALIB            |
| STANDHYD  (0100) |   Area    (ha)=    1.78
|ID= 1 DT= 5.0 min |   Total Imp(%)=  85.00   Dir. Conn.(%)=  85.00
--------------------
                              IMPERVIOUS   PERVIOUS (i)
     Surface Area    (ha)=        1.51          .27
     Dep. Storage    (mm)=        1.60         3.40
     Average Slope    (%)=         .90         2.00
     Length           (m)=      100.00        40.00
     Mannings n          =        .018         .250

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                              IMPERVIOUS   PERVIOUS (i)
     Max.eff.Inten.(mm/hr)=      88.69        17.06
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.36 (ii)    7.06 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=        .26          .14
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .37          .01           .37 (iii)
     TIME TO PEAK    (hrs)=        .25          .33           .25
```

```
    RUNOFF VOLUME     (mm)=        31.64         6.92            27.93
    TOTAL RAINFALL    (mm)=        33.24        33.24            33.24
    RUNOFF COEFFICIENT    =          .95          .21              .84

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
          CN*  =  72.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
* Lot 3
--------------------
| CALIB              |
| STANDHYD  (0110)   |   Area    (ha)=    .60
|ID= 2 DT= 5.0 min   |   Total Imp(%)=  85.00   Dir. Conn.(%)=  85.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
    Surface Area      (ha)=       .51           .09
    Dep. Storage      (mm)=      1.60          3.40
    Average Slope      (%)=       .90          2.00
    Length             (m)=     50.00         40.00
    Mannings n            =      .018          .250

    Max.eff.Inten.(mm/hr)=      88.69         17.06
               over (min)        5.00         10.00
    Storage Coeff.  (min)=       2.22 (ii)     5.92 (ii)
    Unit Hyd. Tpeak (min)=       5.00         10.00
    Unit Hyd. peak  (cms)=        .30           .15
                                                           *TOTALS*
    PEAK FLOW       (cms)=        .13           .00           .13 (iii)
    TIME TO PEAK    (hrs)=        .25           .33           .25
    RUNOFF VOLUME    (mm)=      31.64          6.92         27.92
    TOTAL RAINFALL   (mm)=      33.24         33.24         33.24
    RUNOFF COEFFICIENT   =        .95           .21           .84

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
          CN*  =  72.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
* Total ditch flow at #2

--------------------
| ADD HYD   (1010)   |
|   1 + 2 = 3        |          AREA     QPEAK     TPEAK      R.V.
--------------------            (ha)     (cms)     (hrs)      (mm)
         ID1= 1 (0100):         1.78       .37       .25     27.93
       + ID2= 2 (0110):          .60       .13       .25     27.92
         ==================================================
         ID = 3 (1010):         2.38       .50       .25     27.93

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
* Lot 3
--------------------
| CALIB              |
| STANDHYD  (0120)   |   Area    (ha)=   1.95
|ID= 4 DT= 5.0 min   |   Total Imp(%)=  85.00   Dir. Conn.(%)=  85.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
    Surface Area      (ha)=      1.66           .29
    Dep. Storage      (mm)=      1.60          3.40
    Average Slope      (%)=       .90          2.00
    Length             (m)=    100.00         40.00
    Mannings n            =      .018          .250

    Max.eff.Inten.(mm/hr)=      88.69         17.06
               over (min)        5.00         10.00
    Storage Coeff.  (min)=       3.36 (ii)     7.06 (ii)
    Unit Hyd. Tpeak (min)=       5.00         10.00
    Unit Hyd. peak  (cms)=        .26           .14
                                                           *TOTALS*
    PEAK FLOW       (cms)=        .40           .01           .41 (iii)
```

```
    TIME TO PEAK    (hrs)=        .25          .33            .25
    RUNOFF VOLUME    (mm)=      31.64         6.92          27.93
    TOTAL RAINFALL   (mm)=      33.24        33.24          33.24
    RUNOFF COEFFICIENT   =        .95          .21            .84

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  72.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
* Total ditch flow at #3

--------------------
| ADD HYD   (1020) |
|   3 + 4 = 5      |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 3 (1010):      2.38      .50      .25    27.93
        + ID2= 4 (0120):      1.95      .41      .25    27.93
          ==================================================
          ID = 5 (1020):      4.33      .91      .25    27.93

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
* Lot 1 (point #4)
--------------------
| CALIB            |
| STANDHYD  (0140) |   Area     (ha)=     .66
|ID= 6 DT= 5.0 min |   Total Imp(%)=  85.00   Dir. Conn.(%)=  85.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
    Surface Area     (ha)=        .56          .10
    Dep. Storage     (mm)=       1.60         3.40
    Average Slope     (%)=        .90         2.00
    Length            (m)=      40.00        40.00
    Mannings n           =       .018         .250

    Max.eff.Inten.(mm/hr)=      88.69        17.06
               over (min)        5.00        10.00
    Storage Coeff.  (min)=       1.94 (ii)    5.64 (ii)
    Unit Hyd. Tpeak (min)=       5.00        10.00
    Unit Hyd. peak  (cms)=        .31          .15
                                                          *TOTALS*
    PEAK FLOW       (cms)=        .14          .00            .14 (iii)
    TIME TO PEAK    (hrs)=        .25          .33            .25
    RUNOFF VOLUME    (mm)=      31.64         6.92          27.92
    TOTAL RAINFALL   (mm)=      33.24        33.24          33.24
    RUNOFF COEFFICIENT   =        .95          .21            .84

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  72.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
* Lot 2
--------------------
| CALIB            |
| STANDHYD  (0150) |   Area     (ha)=    1.91
|ID= 7 DT= 5.0 min |   Total Imp(%)=  85.00   Dir. Conn.(%)=  85.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
    Surface Area     (ha)=       1.62          .29
    Dep. Storage     (mm)=       1.60         3.40
    Average Slope     (%)=        .90         2.00
    Length            (m)=      60.00        40.00
    Mannings n           =       .018         .250

    Max.eff.Inten.(mm/hr)=      88.69        17.06
               over (min)        5.00        10.00
    Storage Coeff.  (min)=       2.48 (ii)    6.18 (ii)
    Unit Hyd. Tpeak (min)=       5.00        10.00
    Unit Hyd. peak  (cms)=        .29          .15
                                                          *TOTALS*
```

```
    PEAK FLOW       (cms)=        .40           .01              .41 (iii)
    TIME TO PEAK    (hrs)=        .25           .33              .25
    RUNOFF VOLUME    (mm)=      31.64          6.92            27.93
    TOTAL RAINFALL   (mm)=      33.24         33.24            33.24
    RUNOFF COEFFICIENT  =         .95           .21              .84

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* = 72.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

* Total flow, west ditch #5

--------------------
| ADD HYD   (1030) |
|   6 + 7 = 8      |         AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 6 (0140):       .66      .14      .25    27.92
        + ID2= 7 (0150):      1.91      .41      .25    27.93
          ===============================================
          ID = 8 (1030):      2.57      .55      .25    27.93

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
* Total flow at #6

--------------------
| ADD HYD   (1040) |
|   5 + 8 = 9      |         AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 5 (1020):      4.33      .91      .25    27.93
        + ID2= 8 (1030):      2.57      .55      .25    27.93
          ===============================================
          ID = 9 (1040):      6.90     1.46      .25    27.93

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
****************************************************
* Lots Block 2 to back ditch at point #7
--------------------
| CALIB            |
| STANDHYD  (0160) |   Area    (ha)=   7.02
|ID= 1 DT= 5.0 min |   Total Imp(%)=  85.00   Dir. Conn.(%)=  85.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
    Surface Area     (ha)=      5.97          1.05
    Dep. Storage     (mm)=      1.60          3.40
    Average Slope     (%)=       .90          2.00
    Length            (m)=    100.00         40.00
    Mannings n           =      .018          .250

    Max.eff.Inten.(mm/hr)=     88.69         17.06
               over (min)      5.00          10.00
    Storage Coeff.  (min)=     3.36 (ii)      7.06 (ii)
    Unit Hyd. Tpeak (min)=     5.00          10.00
    Unit Hyd. peak  (cms)=      .26            .14
                                                          *TOTALS*
    PEAK FLOW       (cms)=      1.44            .04             1.47 (iii)
    TIME TO PEAK    (hrs)=       .25            .33              .25
    RUNOFF VOLUME    (mm)=     31.64           6.92            27.93
    TOTAL RAINFALL   (mm)=     33.24          33.24            33.24
    RUNOFF COEFFICIENT  =        .95            .21              .84

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* = 72.0    Ia = Dep. Storage  (Above)

     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
* Lot 3, to back ditch
```

```
--------------------
| CALIB             |
| STANDHYD  (0130)  |   Area     (ha)=     .77
|ID= 2 DT= 5.0 min  |   Total Imp(%)=  85.00    Dir. Conn.(%)=  85.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area       (ha)=      .65          .12
     Dep. Storage       (mm)=     1.60         3.40
     Average Slope       (%)=      .90         2.00
     Length              (m)=   100.00        40.00
     Mannings n             =     .018         .250

     Max.eff.Inten.(mm/hr)=      88.69        17.06
               over (min)         5.00        10.00
     Storage Coeff.  (min)=       3.36 (ii)    7.06 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=        .26          .14
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .16          .00           .16 (iii)
     TIME TO PEAK    (hrs)=        .25          .33           .25
     RUNOFF VOLUME   (mm)=       31.64         6.92         27.92
     TOTAL RAINFALL  (mm)=       33.24        33.24         33.24
     RUNOFF COEFFICIENT   =        .95          .21           .84

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  72.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
* Total flow industrial at #8

--------------------
| ADD HYD   (1050) |
|   1 + 2 = 3      |          AREA     QPEAK     TPEAK     R.V.
--------------------          (ha)     (cms)     (hrs)     (mm)
          ID1= 1 (0160):      7.02      1.47       .25    27.93
        + ID2= 2 (0130):       .77       .16       .25    27.92
          ===================================================
          ID = 3 (1050):      7.79      1.63       .25    27.93

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
* Discharge from undeveloped land
--------------------
| CALIB             |
| NASHYD    (0170)  |   Area     (ha)=   3.00   Curve Number    (CN)= 69.0
|ID= 4 DT= 5.0 min  |   Ia       (mm)=  12.00   # of Linear Res.(N)= 2.50
--------------------    U.H. Tp(hrs)=     .20

     Unit Hyd Qpeak  (cms)=    .490

     PEAK FLOW       (cms)=    .031 (i)
     TIME TO PEAK    (hrs)=    .583
     RUNOFF VOLUME   (mm)=    3.307
     TOTAL RAINFALL  (mm)=   33.236
     RUNOFF COEFFICIENT   =    .100

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
* Total flow at #8

--------------------
| ADD HYD   (1060) |
|   3 + 4 = 5      |          AREA     QPEAK     TPEAK     R.V.
--------------------          (ha)     (cms)     (hrs)     (mm)
          ID1= 3 (1050):      7.79      1.63       .25    27.93
        + ID2= 4 (0170):      3.00       .03       .58     3.31
          ===================================================
          ID = 5 (1060):     10.79      1.64       .25    21.08

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
* Summed 100-year inflow to pond
```

```
--------------------
| ADD HYD   (1070) |
|  9 + 5 =  6      |          AREA     QPEAK     TPEAK      R.V.
--------------------          (ha)     (cms)     (hrs)      (mm)
        ID1= 9 (1040):        6.90      1.46       .25     27.93
      + ID2= 5 (1060):       10.79      1.64       .25     21.08
        ===================================================
        ID = 6 (1070):       17.69      3.10       .25     23.75

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
*
* Undeveloped land on the east discharging to roadside ditch
--------------------
| CALIB            |
| NASHYD    (0180) |  Area     (ha)=   4.35  Curve Number   (CN)= 69.0
|ID= 1 DT= 5.0 min |  Ia       (mm)=  12.00  # of Linear Res.(N)= 2.50
--------------------  U.H. Tp(hrs)=     .45

    Unit Hyd Qpeak  (cms)=    .315

    PEAK FLOW        (cms)=    .080 (i)
    TIME TO PEAK     (hrs)=   1.000
    RUNOFF VOLUME     (mm)=   3.326
    TOTAL RAINFALL    (mm)=  33.236
    RUNOFF COEFFICIENT   =     .100

    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
*

 FINISH
================================================================================
```

APPENDIX C

Qualhymo I/O Files - Pond Volume Calculations

```
1234567890 *./-
21
START                    1 27
STORE                    2  4
GENERATE                 3 52
PRINT SPAN               4 10
PLOT SPAN                5 10
ADD SERIES               6  4
POND                     7310
REACH                    8310
CALIBRATE                9310
POLLUTANT TSERIES        10  9
SPLIT SERIES            11310
DUMP PRINT              12  1
EXCEEDANCE CURVES       13310
DUMP PLOT               14  9
SHEAR1                  15310
MAXFLW                  16  8
SERIES STATS            17  7
PRINT FLOWS             18  8
ROUTE RESERVOIR         19 64
SCAN SERIES             20 16
FINISH                  21  0
*
*******************    Q  U  A  L  H  Y  M  O    **************
*
*                           VERSION 2.12
*                Diamond Valley Industrial Park
*                     Dry Pond Calculations
*                     Maximum discharge 50 L/s
*               ====  input file: "BD-Q.dat"  ====
*               ====  rain file: "raindata.pre" ====
*               ====  output file: BD-Q.out  ====
*
*               prepared by EL, September, 2004
****************************************************************

START                START DATE OF SIMULATION          60 05 01
                     END DATE OF SIMULATION            95 06 30
                     RAINFALL WILL BE READ ON DEVICE   IRAIN  9
                     PRECIP IS IN AES HOURLY FORMAT    IPFORM 1
                     FLOW FILE WILL BE READ ON DEVICE  IFLOW 10
                     SET POLLUTANT FLAG OFF            IFDECA 0
                     SET SEDIMENTATION FLAG OFF        IFSEDT 0
*
GENERATE             ID=1 ISER=100 DT=1.0  DA=16.10 HA
                                   AB=0         FRIMP=0.79
                     ====IMPERVIOUS AREA====
                     NASH UNIT HYD AA=1           N=3.5         TP=0.17 HRS
                                   ABSIMP=1.6 MM                 RIMP=0.95
                      ====PERVIOUS AREA=====
                     NASH UNIT HYD AA=1           N=2.5         TP=0.40 HRS
                                   SMIN=40 MM   SMAX=265 MM  SK=0.035
                                   APIK=0.9     APII=60 MM   IA=3.4 MM
                     NUMBER OF GROUNDWATER RESERVOIRS NSVOL=0
                     MINIMUM BASE FLOW                BASMIN=0.0
                     BASE FLOW DEPLETION FACTOR       BFACR=2.0
                     STARTING SOIL MOISTURE           SVOL=2.0 MM
                     SOIL MOISTURE AT WILTING PT      SWILT=0.01 MM
                     SOIL MOISTURE AT FIELD CAPACITY  SFIELD=0.1 MM
                     BASE RECESSION CONSTANT          SLOSKA=0.00001
                     BASE FLOW REDUCTION FACTOR       SLOSKB=0.15
*
* Undeveloped land with ditch
GENERATE             ID=2 ISER=200 DT=1.0  DA=3.00 HA
                                   AB=0         FRIMP=0.05
                     ====IMPERVIOUS AREA====
                     NASH UNIT HYD AA=1           N=3.5         TP=0.09 HRS
                                   ABSIMP=1.6 MM                 RIMP=0.95
                      ====PERVIOUS AREA=====
                     NASH UNIT HYD AA=1           N=2.5         TP=0.30 HRS
                                   SMIN=40 MM   SMAX=265 MM  SK=0.035
                                   APIK=0.9     APII=60 MM   IA=12.0 MM
                      ====BASE FLOW  DATA====
                     NUMBER OF GROUNDWATER RESERVOIRS NSVOL=0
                     MINIMUM BASE FLOW                BASMIN=0.0
                     BASE FLOW DEPLETION FACTOR       BFACR=2.0
                     STARTING SOIL MOISTURE           SVOL=2.0 MM
                     SOIL MOISTURE AT WILTING PT      SWILT=0.01 MM
```

```
                    SOIL MOISTURE AT FIELD CAPACITY  SFIELD=0.1 MM
                    BASE RECESSION CONSTANT          SLOSKA=0.00001
                    BASE FLOW REDUCTION FACTOR       SLOSKB=0.15
*
ADD SERIES          IDOUT=4 ISER=1000 IDONE=1 IDTWO=2
*
ROUTE RESERVOIR     IDIN=4 IDOUT=5 SERIES=2000 IDVOL=3
                    OUTFLAG=0 NINTER=1 SSTORAGE=0
                    NPAIRS=5
                     VOLUME (CUM)       OUTFLOW (CUMS)
                       0                   0
                       10                  0.024
                     706                   0.032
                     4018                  0.039
                     9109                  0.044
                    11874                  0.047
*
* ANNUAL MAXIMUM VOLUMES FROM LAKE STORAGE SERIES
MAXFLW              IDVOL=3 IOPT=-1
                    IFY=60 IFM=05 IFD=02
                    IFY=95 IFM=06 IFD=30
FINISH
*
```

```
 ********  Q   U   A   L   H   Y   M   O   ********
 ****                                          ****
 ****              Supported by                ****
 ****   Water Resources Software Group         ****
 ****   Centre for Water Resources Studies     ****
 ****    Technical University of Nova Scotia   ****
 ****          P. O. Box 1000                  ****
 ****          Halifax, Nova Scotia            ****
 ****          Canada  B3J 2X4                 ****
 ****                                          ****
 ****          (902)420-7857  (phone)          ****
 ****          (902)420-7551  (fax)            ****
 ****                                          ****
 **************************************************


           Q U A L H Y M O   M O D E L   O U T P U T

    Program Execution Started on   9-13-2004 at time 17:16:19

           ZALFA = 1234567890 *./-


               COMMAND TABLE

         START                  1 27
         STORE                  2  4
         GENERATE               3 52
         PRINT SPAN             4 10
         PLOT SPAN              5 10
         ADD SERIES             6  4
         POND                   7310
         REACH                  8310
         CALIBRATE              9310
         POLLUTANT TSERIES      1  0
         SPLIT SERIES          11310
         DUMP PRINT            12  1
         EXCEEDANCE CURVES     13310
         DUMP PLOT             14  9
         SHEAR1                15310
```

```
        MAXFLW              16  8
        SERIES STATS        17  7
        PRINT FLOWS         18  8
        ROUTE RESERVOIR     19 64
        SCAN SERIES         20 16
        FINISH              21  0
    *
    ********************    Q  U  A  L  H  Y  M  O    *********************
    *
    *                            VERSION 2.12

                      Diamond Valley Industrial Park
                         Dry Pond Calculations
                         Maximum discharge 50 L/s
                  ==== input file: "BD-Q.dat" ====
                   ==== rain file: "raindata.pre" ====
                   ==== output file: BD-Q.out ====
                   prepared by EL, September, 2004
    ****************************************************************
    *
    START               START DATE OF SIMULATION          60 05 01
                        END DATE OF SIMULATION            95 06 30
                        RAINFALL WILL BE READ ON DEVICE  IRAIN  9
                        PRECIP IS IN AES HOURLY FORMAT   IPFORM 1
                        FLOW FILE WILL BE READ ON DEVICE IFLOW 10
                        SET POLLUTANT FLAG OFF           IFDECA 0
                        SET SEDIMENTATION FLAG OFF       IFSEDT 0
 FLOW RECORDS SOUGHT ON DEVICE          10
    *
    GENERATE            ID=1 ISER=100 DT=1.0  DA=16.10 HA
                                      AB=0       FRIMP=0.793
                        ====IMPERVIOUS AREA====
                        NASH UNIT HYD AA=1        N=3.5        TP=0.17 HRS
                                      ABSIMP=1.6 MM              RIMP=0.95
                         ====PERVIOUS AREA=====
                        NASH UNIT HYD AA=1        N=2.5        TP=0.40 HRS
                                      SMIN=40 MM   SMAX=265 MM  SK=0.035
                                      APIK=0.9     APII=60 MM   IA=3.4 MM
                        NUMBER OF GROUNDWATER RESERVOIRS NSVOL=0
                        MINIMUM BASE FLOW                BASMIN=0.0
                        BASE FLOW DEPLETION FACTOR       BFACR=2.0
                        STARTING SOIL MOISTURE           SVOL=2.0 MM
                        SOIL MOISTURE AT WILTING PT      SWILT=0.01 MM
                        SOIL MOISTURE AT FIELD CAPACITY  SFIELD=0.1 MM
                        BASE RECESSION CONSTANT          SLOSKA=0.00001
                        BASE FLOW REDUCTION FACTOR       SLOSKB=0.15

====== IMPERVIOUS AREA UNIT HYDROGRAPH DATA ======

 - SHAPE CONSTANT, N =  3.500          - UNIT PEAK,QP =   .1273 CMS
 - THE UH YIELDS   3.5895 MM VOL SO MULT BY    .2786 WILL ENSURE A 1 MM UH.

======= PERVIOUS AREA UNIT HYDROGRAPH DATA =======

 - SHAPE CONSTANT, N =  2.500          - UNIT PEAK,QP =   .0107 CMS
 - THE UH YIELDS   1.1724 MM VOL SO MULT BY    .8530 WILL ENSURE A 1 MM UH.

        API REDUCTION FACTOR IS   .996E+00 PER TIME STEP OR   .900E+00 PER DAY


 RECESSION CONSTANT BASE FLOW INVOKED

 RAINFALL AND DIRECT  RUNOFF TOTALS OVER THE SIMULATION TIME SPAN ==========
   RAINFALL  PERVIOUS  IMPERVIOUS   TOTAL
              RUNOFF     RUNOFF     RUNOFF
     (MM)      (MM)       (MM)       (MM)
  9528.6300   650.5561  7081.4260  5750.2320
    *
    * Undeveloped land with ditch
    GENERATE            ID=2 ISER=200 DT=1.0  DA=3.00 HA
                                      AB=0       FRIMP=0.05
                        ====IMPERVIOUS AREA====
                        NASH UNIT HYD AA=1        N=3.5        TP=0.09 HRS
                                      ABSIMP=1.6 MM              RIMP=0.95
                         ====PERVIOUS AREA=====
                        NASH UNIT HYD AA=1        N=2.5        TP=0.30 HRS
                                      SMIN=40 MM   SMAX=265 MM  SK=0.035
                                      APIK=0.9     APII=60 MM   IA=12.0 MM
                         ====BASE FLOW  DATA====
                        NUMBER OF GROUNDWATER RESERVOIRS NSVOL=0
                        MINIMUM BASE FLOW                BASMIN=0.0
```

```
                        BASE FLOW DEPLETION FACTOR       BFACR=2.0
                        STARTING SOIL MOISTURE           SVOL=2.0 MM
                        SOIL MOISTURE AT WILTING PT      SWILT=0.01 MM
                        SOIL MOISTURE AT FIELD CAPACITY  SFIELD=0.1 MM
                        BASE RECESSION CONSTANT          SLOSKA=0.00001
                        BASE FLOW REDUCTION FACTOR       SLOSKB=0.15

====== IMPERVIOUS AREA UNIT HYDROGRAPH DATA ======

 - SHAPE CONSTANT, N =  3.500           - UNIT PEAK,QP =    .0028 CMS
 - THE UH YIELDS   6.7801 MM VOL SO MULT BY    .1475 WILL ENSURE A 1 MM UH.

======= PERVIOUS AREA UNIT HYDROGRAPH DATA =======

 - SHAPE CONSTANT, N =  2.500           - UNIT PEAK,QP =    .0122 CMS
 - THE UH YIELDS   1.5445 MM VOL SO MULT BY    .6475 WILL ENSURE A 1 MM UH.

          API REDUCTION FACTOR IS   .996E+00 PER TIME STEP OR   .900E+00 PER DAY


 RECESSION CONSTANT BASE FLOW INVOKED

 RAINFALL AND DIRECT  RUNOFF TOTALS OVER THE SIMULATION TIME SPAN ==========
   RAINFALL  PERVIOUS  IMPERVIOUS   TOTAL
              RUNOFF     RUNOFF     RUNOFF
     (MM)      (MM)       (MM)       (MM)
  9528.6300   297.4305  7081.4260   636.6302
     *
     ADD SERIES          IDOUT=4 ISER=1000 IDONE=1 IDTWO=2

              ADD BEGINS AT  60  5  1
              USES TIME STEP OF   .100E+01 HOURS
              AND ENDS AT    95  6  1

     *
     ROUTE RESERVOIR      IDIN=4 IDOUT=5 SERIES=2000 IDVOL=3
                          OUTFLAG=0 NINTER=1 SSTORAGE=0
                          NPAIRS=5
                           VOLUME (CUM)      OUTFLOW (CUMS)
                             0                  0
                             10               0.024
                            706               0.032
                            4018              0.039
                            9109              0.044
                           11874              0.047


          Printing Lake Storage is requested


 SIMPLE RESERVOIR ROUTE:
      Inflow series ID      =  4 with DT =    1.00 hours
      Lake Volume series ID =  3
      Outflow series ID     =  5
      Outflow series ISER   = 2000


        Max hourly inflow rate   =      .6980m3/s
        Max hourly outflow rate  =      .0453m3/s
        Max hourly storage       =    10399.1m3
        Starting storage     =             .0m3
        Total inflow volume  =     982667.2m3
        Total outflow volume =     982668.5m3
        Final storage        =             .0m3
   Note that above maxima are maximum averages for each interval of DT =  1.00 hrs.

     Peak outflow computed in intermediate steps =      .0453 m3/s
     Peak storage computed in intermediate steps =    10399.1 m3
        Hours of extrapolated outflows =       16.00
     *
     * ANNUAL MAXIMUM VOLUMES FROM LAKE STORAGE SERIES
     MAXFLW               IDVOL=3 IOPT=-1
                          IFY=60 IFM=05 IFD=02
                          IFY=95 IFM=06 IFD=30

       THIS IS A MODIFIED MAXFLW COMMAND PREPARED FOR:
       WER ENGINEERING in Calgary, Alberta

THE SELECTED OPTION "-1"INDICATE THAT MAXIMUM LAKE
STORGE VOLUMES WILL BE CALCULATED INSTEAD OF MAXIMUM FLOWS
```

```
START DATE: 60 5 2
STOP DATA: 95 630

ANNUAL MAXIMUM FLOOD SERIES

Peak Volume:      1651.48100 M**3  Date (YrMoDy):  60  7 20
Peak Volume:      1764.15900 M**3  Date (YrMoDy):  61  7 21
Peak Volume:      2330.87200 M**3  Date (YrMoDy):  62  8  5
Peak Volume:      4726.04800 M**3  Date (YrMoDy):  63  6 22
Peak Volume:      4622.49500 M**3  Date (YrMoDy):  64  6 21
Peak Volume:      4909.53700 M**3  Date (YrMoDy):  65  7 21
Peak Volume:      5667.74200 M**3  Date (YrMoDy):  66  7  3
Peak Volume:      1636.70200 M**3  Date (YrMoDy):  67  6 16
Peak Volume:      4242.66200 M**3  Date (YrMoDy):  68  7 20
Peak Volume:      2706.49700 M**3  Date (YrMoDy):  69  6 25
Peak Volume:      1465.63000 M**3  Date (YrMoDy):  70  7 27
Peak Volume:      2485.90700 M**3  Date (YrMoDy):  71  6  5
Peak Volume:      5212.25600 M**3  Date (YrMoDy):  72  6 10
Peak Volume:      1809.98600 M**3  Date (YrMoDy):  73  8  7
Peak Volume:      3058.23400 M**3  Date (YrMoDy):  74  4 27
Peak Volume:      1440.99600 M**3  Date (YrMoDy):  75  7 21
Peak Volume:      3261.29000 M**3  Date (YrMoDy):  76  8  9
Peak Volume:      2441.82300 M**3  Date (YrMoDy):  77  7 12
Peak Volume:      6036.20200 M**3  Date (YrMoDy):  78  8 17
Peak Volume:      2466.22200 M**3  Date (YrMoDy):  79  6 20
Peak Volume:      4270.55900 M**3  Date (YrMoDy):  80  5 24
Peak Volume:      2590.49200 M**3  Date (YrMoDy):  81  9 19
Peak Volume:      1884.92900 M**3  Date (YrMoDy):  82  6 30
Peak Volume:      2799.03500 M**3  Date (YrMoDy):  83  8 18

Peak Volume:      3789.79200 M**3  Date (YrMoDy):  84  9  7
Peak Volume:     10399.09000 M**3  Date (YrMoDy):  85  9 12
Peak Volume:      4627.37300 M**3  Date (YrMoDy):  86  6 29
Peak Volume:      2791.81000 M**3  Date (YrMoDy):  87  7  4
Peak Volume:      6759.16200 M**3  Date (YrMoDy):  88  8  2
Peak Volume:      1767.84700 M**3  Date (YrMoDy):  89  7 10
Peak Volume:      2660.82400 M**3  Date (YrMoDy):  90  8 18
Peak Volume:      2935.20900 M**3  Date (YrMoDy):  91  6 21
Peak Volume:      5957.32000 M**3  Date (YrMoDy):  92  6 14
Peak Volume:      3535.88300 M**3  Date (YrMoDy):  93  6 29
Peak Volume:      2539.09100 M**3  Date (YrMoDy):  94  6  6
    FINISH

   Execution was terminated on 9-13-2004 at time 17:18:12
      Q U A L H Y M O    M O D E L    S T O P
```

6.0 CONCLUSIONS AND RECCOMMENDATIONS

1 The proposed subdivision drainage system conforms to the Stormwater Management Guidelines for the Province of Alberta, 1999 and to the Stormwater Management Design Manual for the City of Calgary.

2 The proposed pond will provide the volume required of 11,270 m^3 for the study area at the maximum depth of 1.73 at the pond outlet. Presently the pond of total depth 2.0 m including the freeboard has a spare capacity of about 1,700 m^3.

3 The overland drainage system was designed for a 100-year discharge. However, to perform as designed, the grassed ditches and culverts must be regularly maintained by the adjacent property owners

4 The oil / grit separator on the pond outlet will provide the secondary treatment to the entire flow leaving the development.

PROFESSIONAL ENGINEER
ELZBIETA LIPOWSKA
ALBERTA
Sept. 14, 2004

PERMIT TO PRACTICE
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Signature ____________
Date ____________
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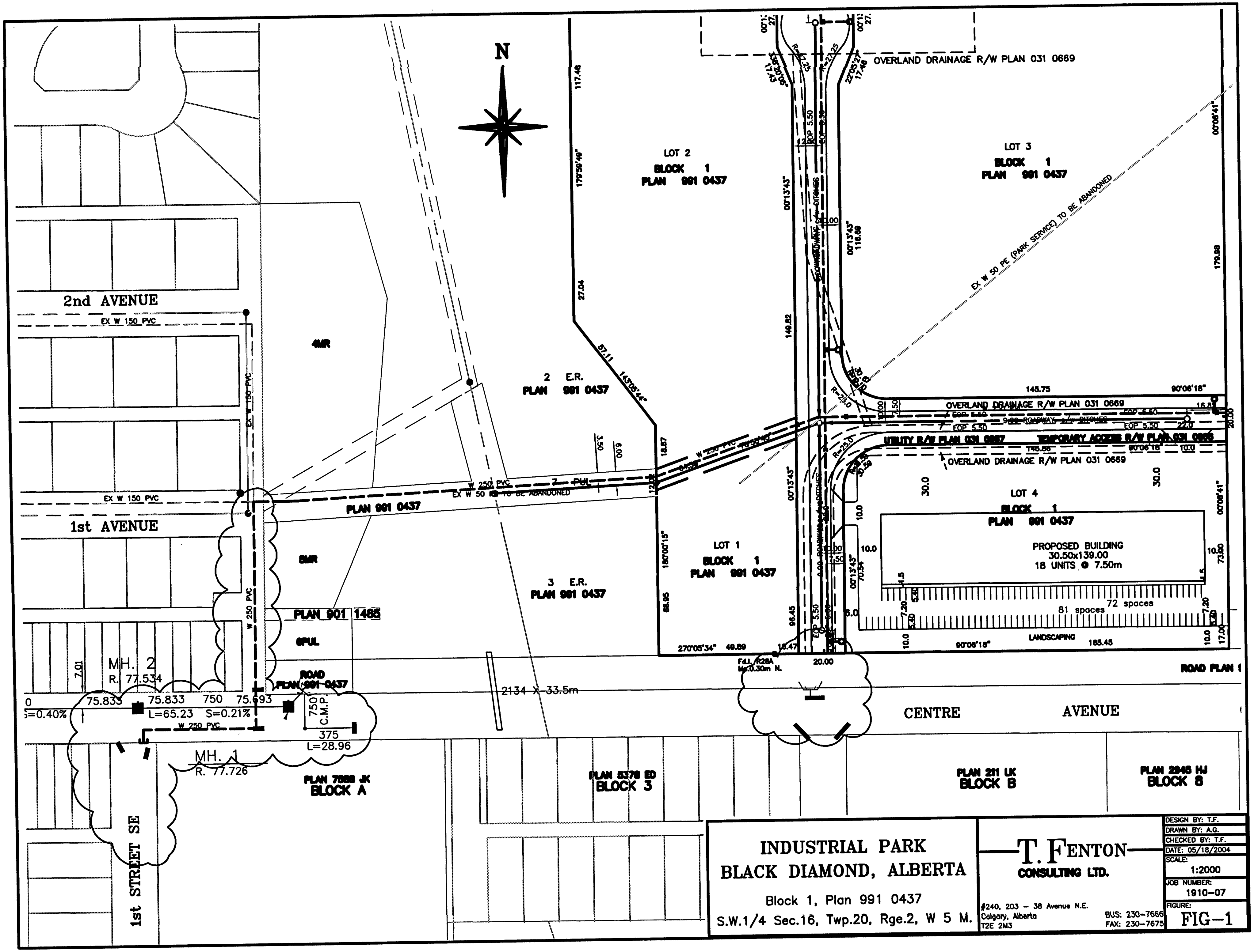
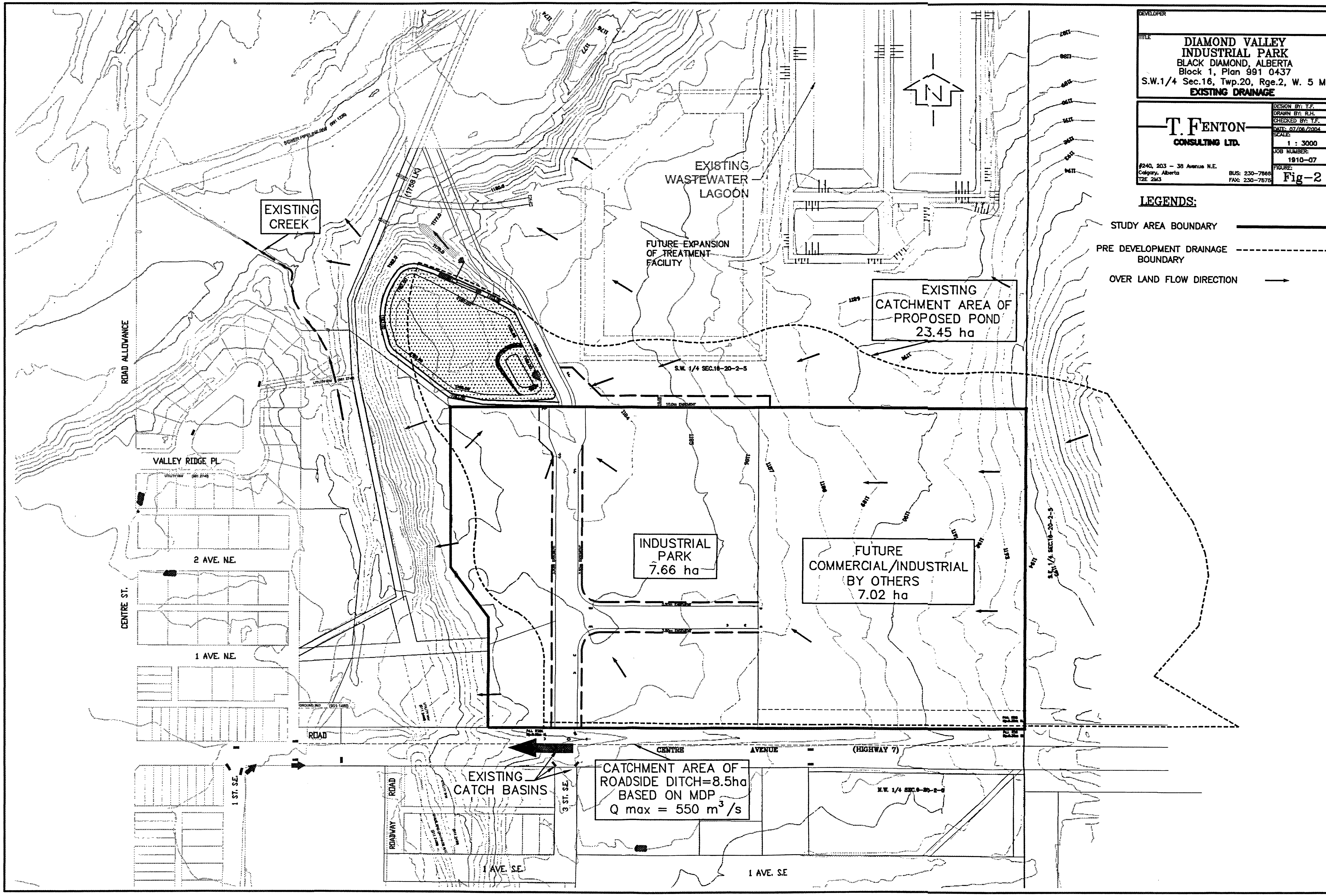

2nd AVENUE
1st AVENUE
1st STREET SE
CENTRE AVENUE
N
EX W 150 PVC
W 250 PVC
EX W 50 PE TO BE ABANDONED
EX W 50 PE (PARK SERVICE) TO BE ABANDONED
PLAN 991 0437
4MR
5MR
6PUL
PLAN 901 1485
ROAD PLAN 991 0437
2 E.R. PLAN 991 0437
3 E.R. PLAN 991 0437
LOT 1 BLOCK 1 PLAN 991 0437
LOT 2 BLOCK 1 PLAN 991 0437
LOT 3 BLOCK 1 PLAN 991 0437
LOT 4 BLOCK 1 PLAN 991 0437
PROPOSED BUILDING 30.50x139.00 18 UNITS @ 7.50m
81 spaces
72 spaces
LANDSCAPING
OVERLAND DRAINAGE R/W PLAN 031 0669
UTILITY R/W PLAN 031 0667
TEMPORARY ACCESS R/W PLAN 031 0666
MH. 2 R. 77.534
MH. 1 R. 77.726
75.833 750 75.693
L=65.23 S=0.21%
S=0.40%
750 C.M.P.
375 L=28.96
2134 X 33.5m
PLAN 7886 JK BLOCK A
PLAN 5378 ED BLOCK 3
PLAN 211 LK BLOCK B
PLAN 2945 HJ BLOCK 8
ROAD PLAN
INDUSTRIAL PARK
BLACK DIAMOND, ALBERTA
Block 1, Plan 991 0437
S.W.1/4 Sec.16, Twp.20, Rge.2, W 5 M.
T. FENTON CONSULTING LTD.
#240, 203 – 38 Avenue N.E.
Calgary, Alberta
T2E 2M3
BUS: 230-7666
FAX: 230-7675
DESIGN BY: T.F.
DRAWN BY: A.G.
CHECKED BY: T.F.
DATE: 05/18/2004
SCALE: 1:2000
JOB NUMBER: 1910-07
FIGURE: FIG–1


DEVELOPER
TITLE
DIAMOND VALLEY
INDUSTRIAL PARK
BLACK DIAMOND, ALBERTA
Block 1, Plan 991 0437
S.W.1/4 Sec.16, Twp.20, Rge.2, W. 5 M.
EXISTING DRAINAGE
T. FENTON
CONSULTING LTD.
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Calgary, Alberta
T2E 2M3
BUS: 230-7868
FAX: 230-7878
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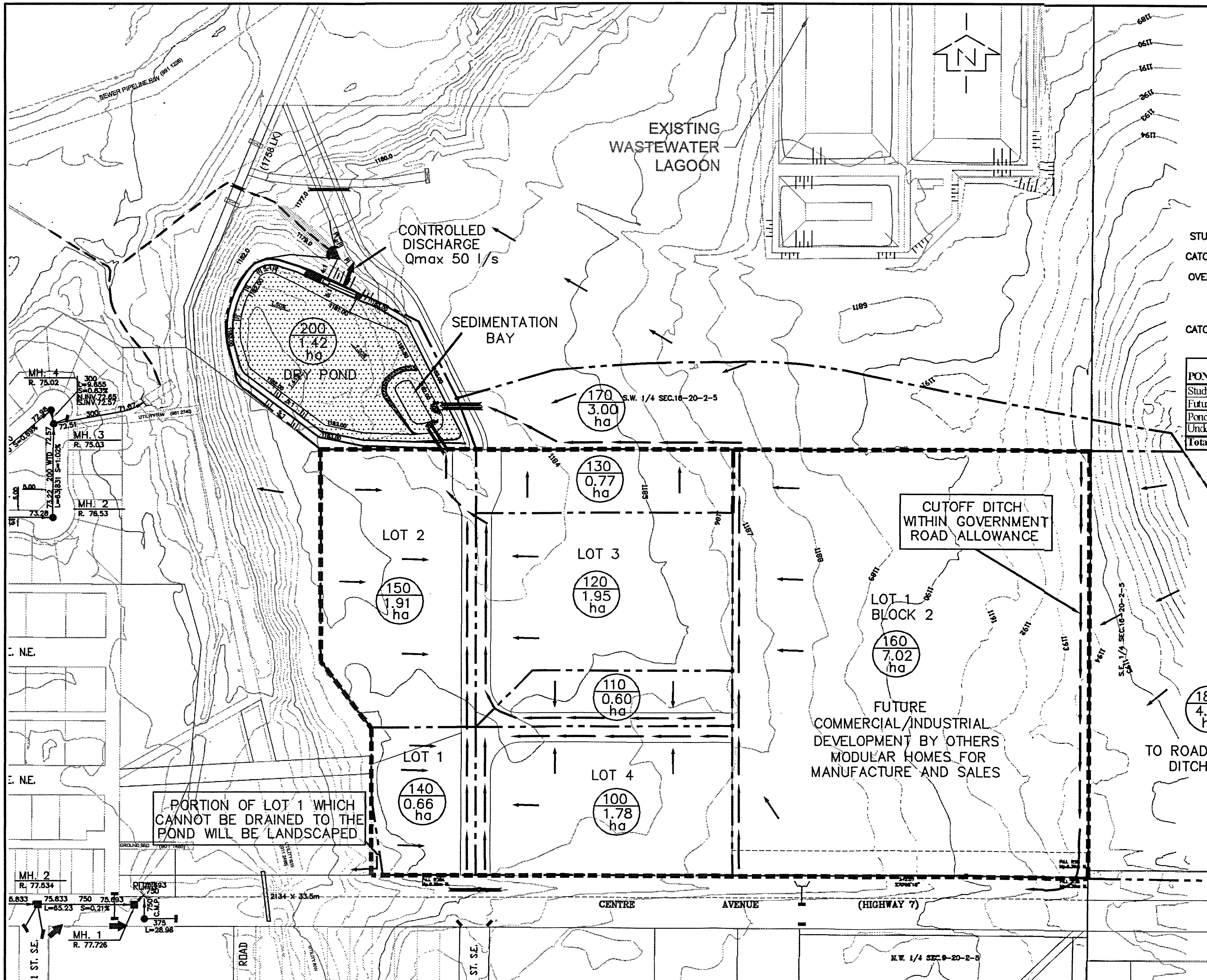
DRAWN BY: R.H.
CHECKED BY: T.F.
DATE: 07/06/2004
SCALE:
1 : 3000
JOB NUMBER:
1910-07
FIGURE:
Fig-2
LEGENDS:
STUDY AREA BOUNDARY
PRE DEVELOPMENT DRAINAGE BOUNDARY
OVER LAND FLOW DIRECTION
N
EXISTING CREEK
EXISTING WASTEWATER LAGOON
FUTURE EXPANSION OF TREATMENT FACILITY
EXISTING CATCHMENT AREA OF PROPOSED POND 23.45 ha
S.W. 1/4 SEC.16-20-2-5
ROAD ALLOWANCE
VALLEY RIDGE PL
2 AVE. N.E.
CENTRE ST.
1 AVE. N.E.
INDUSTRIAL PARK 7.66 ha
FUTURE COMMERCIAL/INDUSTRIAL BY OTHERS 7.02 ha
ROAD
CENTRE AVENUE (HIGHWAY 7)
EXISTING CATCH BASINS
CATCHMENT AREA OF ROADSIDE DITCH=8.5ha BASED ON MDP Q max = 550 m³/s
1 ST. S.E.
3 ST. S.E.
ROAD
ROADWAY
1 AVE. S.E.
1 AVE. S.E
N.W. 1/4 SEC.9-20-2-5



DEVELOPER

DON BEATON

TITLE

DIAMOND VALLEY INDUSTRIAL PARK
BLACK DIAMOND, ALBERTA
Block 1, Plan 991 0437
S.W.1/4 Sec.16, Twp.20, Rge.2, W. 5 M.
DRAINAGE CONCEPT & CATCHMENT AREAS

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Calgary, Alberta
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DESIGN BY: T.F.
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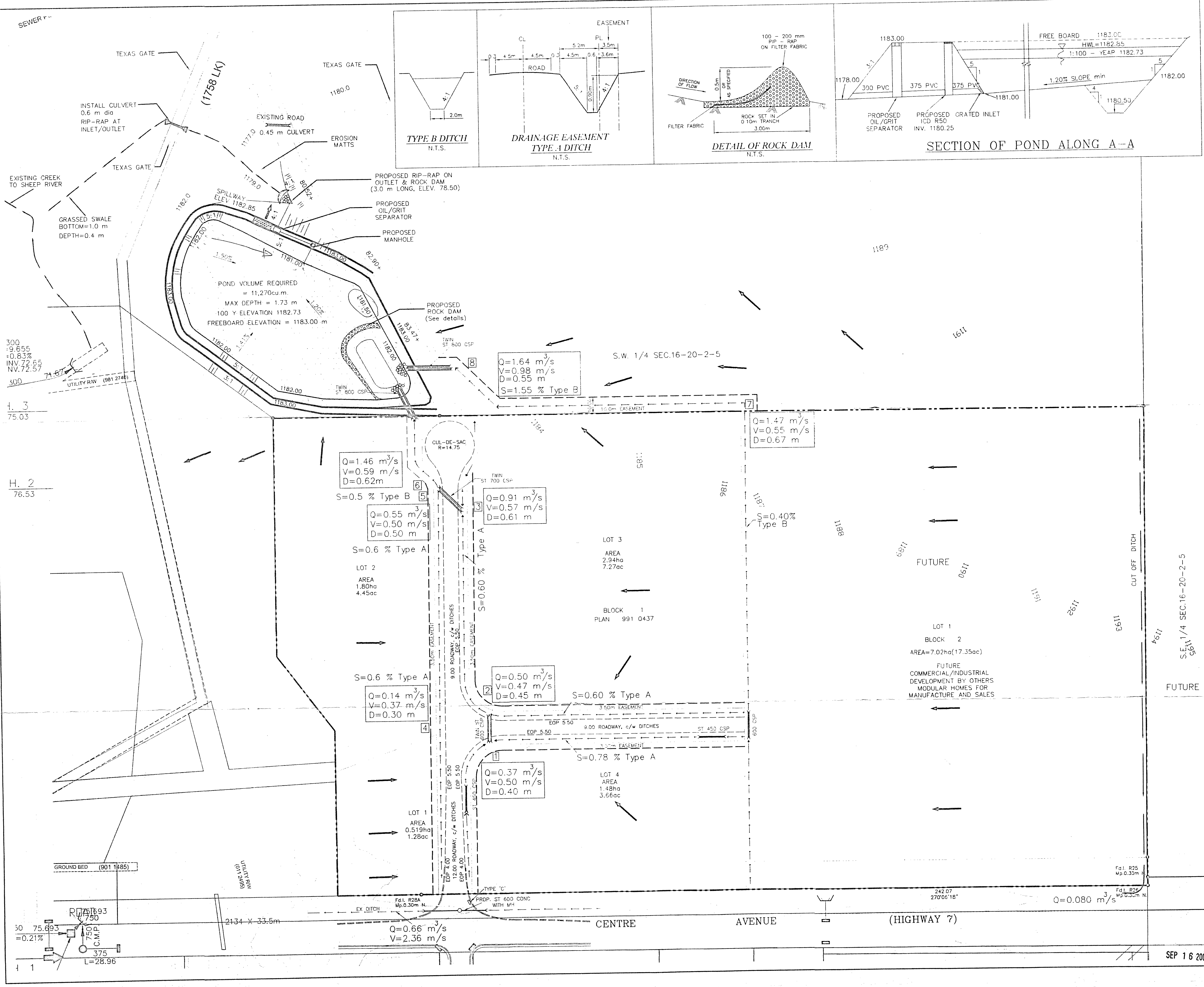
CHECKED BY: T.F.
DATE: 07/08/2004
SCALE: 1 : 2500
JOB NUMBER: 1910-07
FIGURE: Fig-3

LEGENDS:

STUDY AREA BOUNDARY
CATCHMENT BOUNDARIES
OVER LAND FLOW DIRECTION
DITCH FLOW
CATCHMENT AREA & No. (170 / 4.42 ha)

POND DRAINAGE AREA SUMMARY	Area (ha)
Study Area	7.66
Future Commercial/industrial by others	7.02
Pond area	1.42
Undeveloped land on east	3.00
Total	19.10



NOTES

1. All work to conform to current Town of Black Diamond specifications.
2. City of Calgary specifications shall govern if any item is not covered by Town of Black Diamondspecifications.
3. All elevations referenced to 1100m Geodetic Datum.
   ie 41.36 = 1141.36

LEGEND

- EXISTING STORM SEWER & TYPE 5A MANHOLE
- PROPOSED STORM SEWER & TYPE 5A MANHOLE
- CONSTRUCTION BOUNDARY
- OVERLAND FLOW
- PROPOSED DITCH
- PROPOSED POND
- CATCHMENT BOUNDARY
- PROPOSED SPILLWAY
- PROPOSED RIP-RAP AND ROCK DAM
- PROPO. EROSION MATTS
- OVERFLOW FROM POND

No	DATE	REVISION DESCRIPTION	BY
1	09/13/04	REVISED AS PER COMMENTS OF TOWN	AG

No	DRAWING STATUS	DATE	APP
6	MICROFILMED		
5	PLAN OF RECORD		
4	CONSTRUCTION APPROVAL		
3	FOR TENDER		
2	FINAL APPROVAL		
1	PRELIMINARY APPROVAL		

PERMIT

PERMIT TO PRACTICE
T. FENTON CONSULTING LTD.
Signature: [signature]
Date: Sept 16/04
PERMIT NUMBER: P 4760
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

STAMP

DEVELOPER

TITLE

DIAMOND VALLEY INDUSTRIAL PARK
BLACK DIAMOND, ALBERTA
Block 1, Plan 991 0437
S.W.1/4 Sec.16, Twp.20, Rge.2, W. 5 M.
STORM DRAINAGE PLAN

T. FENTON CONSULTING LTD.
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Calgary, Alberta
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BUS: 230-7666
FAX: 230-7675

DESIGN BY: T.F.
DRAWN BY: A.G.
CHECKED BY: T.F.
DATE: 05/10/04
SCALE: 1 : 1000
JOB NUMBER: 1910-07
DRAWING NUMBER: G-1