

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

700 Long Point Circle
Ottawa, Ontario K1T 4E9

613-425-8044
d.gray@dbgrayengineering.com

DRAINAGE STUDY
PART OF CARDEVCO SUBDIVISION
106 TO 181 WESCAR LANE
& 121 TO 135 CARDEVCO ROAD
AND THE
REMOVAL OF A 9.0M DRAINAGE EASEMENT
AT 151-159 WESCAR LANE, OTTAWA

REPORT No. 22111-DS

JUNE 12, 2024
REVISED JULY 18, 2024

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1.0 INTRODUCTION

It is understood that City staff is prepared to review the request to remove the 9.0 m drainage easement located to the west and south of 151-159 Wescar Lane, provided it can be demonstrated that the removal would not have an adverse impact on the subdivision's drainage system and adjacent properties. This Drainage Study provides relevant background information and demonstrates the impact of the removal of the easement and analyses ditches and culverts in drainage areas that include 106 to 181 Wescar Lane (which includes the proposed development at 151-159 Wescar Lane) and 121 to 135 Cardevco Road.

D. B. Gray Engineering Inc has worked on several properties within the subdivision and have topographic information and/or grading plans for the following properties and adjacent roadside ditches and culverts (refer to Appendices H & I):

- 135 Cardevco Road (topographic survey and grading plan).
- 131 Wescar Lane,
- 151-159 Wescar Lane (subject property),
- 159 Wescar Lane (including part of 151 Wescar Lane and lands to the west),
- 165 Wescar Lane, and
- 172-180 Wescar Lane.

In addition, topographic information and/or grading plans have been obtained for the following properties and adjacent roadside ditches and culverts (refer to Appendix I):

- 123-127 Cardevco Road,
- 123 Wescar Lane,
- 141 Wescar Lane, and
- 123 Wescar Lane.

2.0 DRAINAGE

The Transfer of Easement, dated November 15, 1982, indicates that the Township of West Carleton (now within the City of Ottawa) has the right to enter the easement to "*construct, repair and replace the drainage works*". No purpose other than drainage is identified (refer to Appendix A).

Schedule "R" of the Cardevco Subdivision Agreement (dated November 15, 1982), refers to six subdivision drawings, including a Grading Plan. None of these drawings were initially found; however, the original owner of the subdivision has produced three of the drawings including the Grading Plan (refer to Appendix A).

The subdivision Drainage Report is Schedule "H" of the Cardevco Subdivision Agreement (refer to Appendix A). The following are excerpts (with comments):

- "*Under present conditions, the subdivision lands drain to an existing creek along the southern boundary with the exception of 2.9 hectares which drain to the Old Almonte Road (in the northwest corner).*"
(Old Almonte Road is now known as Cavanmore Road. About 1.7 of the 2.9 ha drains from 159 Wescar Lane. However, based on the subdivision Grading Plan, which indicates 'existing' (i.e. 1980) grade elevations, the area is about 2.2 ha (1.9 ha excluding the 11 m Cavanmore Road road widening of which 1.0 ha is draining from 159 Wescar Lane (refer to Figure 2 in Appendix F). Based on recent topographic surveys, the actual area is about 1.5 ha (1.2 ha excluding the 11 m Cavanmore Road road widening of which 0.6 ha is draining from 159 Wescar Lane (refer to Figure 3 in Appendix F).)
- "*It is intended to direct the runoff from the lands through a series of roadside ditches and rear lot swales to an existing roadside ditch on Regional Road No.5.*"

(Regional Road No.5. is Carp Road. Except for the 2.9 ha it is apparent that the roadside ditches and culverts were intended to be sized to accommodate the entire subdivision. The subdivision Grading Plan indicates that all roadside ditches drain to Carp Road.)

- *"The outlet for the 2.9 hectares in the in the northwest corner of the subdivision will also have to be upgraded."*

(Based on the subdivision Grading Plan the outlet appears to be a 400 mm culvert crossing Cavanmore Road near the northwest corner of the subject property that was intended to be replaced with a 600 mm culvert. The culvert was recently found and measured; it is 400 mm in diameter, so evidently it was not replaced. Also based on the subdivision Grading Plan this culvert outlets to a ditch on the north side of Cavanmore Road that appears to convey the drainage to the west towards the rear yard of 100 Huntley Manor Drive. However, based on recent observations this ditch may no longer exist as it appears that the drainage from the outlet of the culvert is first conveyed about 10 m northeast along the roadside ditch before it drains north, towards the rear lot line of 100 Huntley Manor Drive (refer to Figure 1 in Appendix B).

- *"Rear lot swales shall be a minimum depth of 450 mm to a maximum depth of 1500 mm. The side slope shall be 3 horizontal to 1 vertical." "The rear lot swales shall be provided where it is likely that runoff would occur onto property held by others." "It is not proposed at this time to alter the creek which runs through the most southern section of the subdivision. The development of this land has negligible effect on the amount of runoff to the creek."*

(Based on the subdivision Grading Plan, almost the entire swale (about 540 m) would drain to the creek and only about 50 m would drain northwest to the Cavanmore Road. Since it was the intent that the subdivision would have *"negligible effect on the amount of runoff to the creek"* it is apparent that the swale was intended to convey negligible drainage. Regardless, based on the lot Grading Plan for 123 Wescar Lane (refer to Appendix I) it is not possible construct this rear lot swale to convey drainage to the creek because the stormwater management (SWM) facility for 123 Wescar Lane is located within the easement (this SWM facility is part of an approved site plan, and an Environmental Compliance Approval (ECA) has been issued for this facility). Furthermore, based on individual lot Grading Plans and recent visual inspections, it is evident that the 9.0 m easements on 131 & 141 Wescar Lane are not used to convey drainage to the creek.) Based on the subdivision Drainage Report, the rear lot swales are not intended to convey drainage from adjacent properties; and recent topographic surveys confirm this (refer Figures 1, 2 & 3 and Appendices G & H). Based on the subdivision Grading Plan, topographic surveys and individual lot Grading Plans, about 4.2 ha of the subdivision's pre-development drainage drained to the creek of which 151-159 Wescar Lane contributed about 2.5 ha (refer to Figures 2 & 3 in Appendix F); and about 1.5 ha of the subdivision post development drainage will drain to the creek of which 151-159 Wescar Lane contributes only about 0.3 ha (refer to Figures 1 in Appendix C). Therefore, considering all of the above, especially since drainage to the creek will be reduced by about 88% to about 0.3 ha; the rear lot swales are not required for at least the subject development, and the 9.0m easement can be removed from 151-159 Wescar Lane.)

- *"For the design of the ditches and drainage structures, the Rational Formula was used."*
(As is accepted in the Ottawa Sewer Design Guidelines, Rational Formula was used in the calculations in this report.)
- *"The 10 year rainfall frequency curve was used to determine the ditch and culvert sizing."*
(Except where noted, the 10-year rainfall frequency curve was used in the calculations in this report. Table 6.4 (Road Type vs. Culvert Design Storm) in the Ottawa Sewer Design Guidelines indicates that the design storm for local rural roads is 10 years.)

Excerpt from the City's Phase 3 Pre-Consultation: Review Feedback, dated February 14, 2024 (with comments):

- *"It seems that the direction of drainage of the ... majority of the site draining through the easement system, with final outlet to the tributary south of the site."*
(Based on the above evidence, this was not the intent of the subdivision drainage design.)
- *"As the design is looking to convey water to the Wescar Lane ditch, engineering support must be provided to demonstrate that the Wescar ditch system can accommodate the additional*

flows from the proposed development, as the original subdivision approval did not consider subject land flows to be accommodated through the Wescar Lane ditches.”

(Based on the above evidence, except for about 0.6 to 1.7 ha draining to Cavanmore Road, the original subdivision approval did consider flows from a development on subject property to be accommodated through the Wescar Lane roadside ditches.)

Based on the subdivision Grading Plan, the culvert crossing Wescar Lane at the intersection of Cardevco Road (culvert C-2) was to be 750 mm diameter CSP, but an 800 mm CSP has been installed. Also based on the subdivision Grading Plan, all entrance culverts were to be 600 mm in diameter except at the north and west sides of Cardevco Road which were to be 750 mm in diameter. However, most, if not all, entrance culverts appear to be 500 mm including the two that were measured at 141 Wescar Lane (culvert C-1) and 135 Cardevco Road (culvert C-3). (The Cardevco Road entrance culverts were overtopping following the aftermath of the June 6, 2024 storm (refer to photographs in Appendix J). The Wescar Lane entrance culverts were not observed to be overtopping. According to Environment Canada 44 mm fell at the airport within an hour and estimates based on radar indicated that some parts of the city would have received between 50 and 60 mm. The storm in the Cardevco subdivision area was probably at least a 25-year event, but it could have been a 100-year or rarer event.)

As required by the Ottawa Sewer Design Guidelines, open channel systems (which include ditches) are to be designed based on Manning’s Formula, which was used in the calculations in this report. Based on the subdivision Drainage Report, a Manning’s roughness coefficient (n-value) of 0.027 was used for the roadside ditches. This n-value is typical of ‘gravel / short grass’, which could be considered appropriate for the Cardevco Road ditches and culverts analyzed; however, the Wescar Lane roadside ditches are generally not maintained; therefore, a n-value of 0.10 was used, which is typical of ‘dense weeds and brush as high as flow.

The U.S. Department of Transportation Federal Highway Administration (FHWA) HY-8 Culvert Analysis Program (HY-8) was used to analyze the culverts.

Summaries of the Calculations:

A. Existing Conditions Plus Proposed Development:

(Refer to calculations In Appendix C.)

Based on existing conditions and the existing developments at 106 to 154 & 162 to 173 Wescar Lane and 121 to 127 Cardevco Road plus the proposed development at 151-159 Wescar Lane:

- the calculated peak flow at 141 Wescar Lane is 0.73 m³/s of which 0.25 m³/s overtops the 500 mm culvert (C-1) at a flow depth of about 70 mm,
- the calculated peak flow at the culvert crossing Wescar Lane at the intersection of Cardevco Road (C-2) is 0.76 m³/s of which 0.15 m³/s overtops the 800mm culvert at a flow depth of about 50 mm,
- the calculated peak flow at 135 Cardevco Road is 0.96 m³/s of which 0.78 m³/s overtops the 500 mm culvert (C-3) with a flow depth of about 130 mm,
- during the 2-year storm event the calculated peak flow does not overtop culverts C-1 and C-2, and
- during the 2-year storm event the calculated peak flow at 135 Cardevco Road is 0.58 m³/s of which 0.42 m³/s overtops the 500 mm culvert (C-3) with a flow depth of about 90 mm.

Most, if not all, of the existing entrance culverts in the subdivision are undersized. It is expected that all the entrance culverts on the west and south side of Wescar Lane (south of the proposed development) will overtop during the 10-year event; but will not during the 2-year. The area of the drainage area on the east and west side of Wescar Lane is 69% less than the other side of the road and the peak flow rate is 74% less; therefore, it is expected that the entrance culverts on the east and north side of Wescar Lane will not overtop during the 10-year event. Culvert C-2 crossing Wescar Lane at the intersection of Cardevco Road is 800 mm in diameter but, as per the

subdivision Drainage Report, it should have been only 750 mm. Although it is oversized, the peak flow overtops culvert C-2 during the 10-year event, but not the 2-year. As previously mentioned, the entrance culvert at 135 Cardevco Road (C-3) is 500 mm in diameter but, as per the subdivision Drainage Report, it should have been 750 mm. It is expected that all the entrance culverts on the west and north side of Cardevco Road will overtop during both the 10-year and 2-year events. As previously noted, based on the subdivision Drainage Report, a Manning's n-value of 0.027 (typical of a maintained ditch) was originally used for all ditches; however, since the Wescar Lane roadside ditches are generally not maintained, an n-value of 0.10 (typical of 'dense weeds and brush as high as flow') was used in all calculations (except as noted). If the Wescar Lane roadside ditches are maintained (i.e. with n-value of 0.027) the peak flow would overtop culverts C-2 and C-3 more frequently; and it is expected that all the entrance culverts on the west and north side of Cardevco Road would overtop more frequently.

B. If the Culverts are Sized as per Subdivision Drainage Report and 1.7 ha of the Proposed Development Drained to Cavanmore Road:

(Refer to calculations In Appendix D.)

As previously noted, as per the subdivision Drainage Report, 2.9 ha was intended to drain to Cavanmore Road, of which about 1.7 drains from 159 Wescar Lane. Therefore, based on culverts sized as per original subdivision drainage report, the existing developments at 106 to 154 & 162 to 173 Wescar Lane and 121 to 127 Cardevco Road plus the proposed development at 151-159 Wescar Lane with 1.7 ha draining to Cavanmore Road:

- the calculated peak flow at 141 Wescar Lane is 0.60 m³/s – the flow does not overtop culvert C-1 if it is 600 mm in diameter,
- the calculated peak flow at the culvert crossing Wescar Lane at the intersection of Cardevco Road (C-2) is 0.73 m³/s of which 0.19 m³/s overtops the 750mm culvert at a flow depth of about 50 mm, and
- the calculated peak flow at 135 Cardevco Road is 1.03 m³/s of which 0.45 m³/s overtops the 750 mm culvert (C-3) with a flow depth of about 100 mm.

If the entrance culverts were sized as per the subdivision Grading Plan, the Wescar Lane culverts would not overtop during the 10-year event. However, the culvert crossing Wescar Lane at the intersection of Cardevco Road (C-2) would still overtop during the 10-year event; as would the entrance culvert at 135 Cardevco Road (C-3). If the entrance culverts were sized correctly, it is expected that all the entrance culverts on the west and north side of Cardevco Road would still overtop during the 10-year event. As previously mentioned, based on the subdivision Drainage Report, a Manning's n-value of 0.027 was used for the roadside ditches (typical of a maintained ditch); therefore, 0.027 was used for all ditch calculations in this scenario. However, since the Wescar Lane roadside ditches are generally not maintained (and n-value of 0.10 was used in all other calculations), if 0.10 was used in this scenario the conditions would improve at all culverts.

C. Existing Conditions Plus Proposed Development Using Restricted Flows:

(Refer to calculations In Appendix E.)

It is known that there are existing or proposed stormwater management facilities that include ICDs (inlet control devices) that restrict the flow, at 165, 151-159, 141 & 131 Wescar Lane (and there may be other properties). Based on existing conditions and the existing developments at 106 to 154 & 162 to 173 Wescar Lane and 121 to 127 Cardevco Road plus the proposed development at 151-159 Wescar Lane and using restricted flows at 165, 151-159, 141 & 131 Wescar Lane:

- the calculated peak flow at 141 Wescar Lane is 0.19 m³/s – the flow does not overtop culvert C-1,
- the calculated peak flow at the culvert crossing Wescar Lane at the intersection of Cardevco Road (C-2) is 0.28 m³/s – the flow does not overtop the culvert,

- the calculated peak flow at 135 Cardevco Road is 0.51 m³/s of which 0.35 m³/s overtops the culvert C-3 with a flow depth of about 80 mm,
- during the 2-year storm event the calculated peak flow at 135 Cardevco Road is 0.37 m³/s of which 0.22 m³/s overtops culvert C-3 with a flow depth of about 60 mm.

Accounting that some of the flow is restricted flows through the four known ICDs (there may be more), and although the Wescar Lane entrance culverts are undersized, none will be overtopped during the 10-year event; and the culvert C-2 crossing Wescar Lane at the intersection of Cardevco Road is also no longer overtopped. However, since culvert C-3 at 135 Cardevco Road is overtopped, it is expected that, even accounting for the restricted flows, all the entrance culverts on the west and north side of Cardevco Road are expected to overtop during the 10-year event.

D. Existing Conditions Plus Proposed Development with 0.6 ha of the Proposed Development Draining to Cavanmore Road:

(Refer to calculations In Appendix F.)

As previously noted, as per the subdivision Drainage Report, 2.9 ha was intended to drain to Cavanmore Road, of which about 1.7 drains from 159 Wescar Lane. However, also as previously noted, based on the subdivision Grading Plan, the area is about 2.2 ha of which 1.0 ha is draining from 159 Wescar Lane; and based on recent topographic surveys, the actual area is about 1.5 ha of which 0.6 ha is draining from 159 Wescar Lane. It would not be prudent to increase the area that is currently draining to Cavanmore Road. Therefore, based on the existing developments at 106 to 154 & 162 to 173 Wescar Lane and 121 to 127 Cardevco Road plus the proposed development at 151-159 Wescar Lane with 0.6 ha draining to Cavanmore Road:

- the calculated peak flow at 141 Wescar Lane is 0.65 m³/s of which 0.17 m³/s overtops the culvert C-1 at a flow depth of about 50 mm,
- the calculated peak flow at the culvert crossing Wescar Lane at the intersection of Cardevco Road (C-2) is 0.69 m³/s of which 0.07 m³/s overtops the culvert at a flow depth of about 30 mm, and
- the calculated peak flow at 135 Cardevco Road is 0.90 m³/s of which 0.72 m³/s overtops culvert C-3 with a flow depth of about 120 mm.

With 0.6 ha of 159 Wescar Lane draining to Cavanmore Road the peak flow is less than with scenario A, but it is expected that all the entrance culverts on the west and south side of Wescar Lane (south of the proposed development) will still overtop during the 10-year event (but will not during the 2-year). Culvert C-2 crossing Wescar Lane at the intersection of Cardevco Road is overtopped during the 10-year event, but it is expected that it will not during the 2-year. It is expected that all the entrance culverts on the west and north side of Cardevco Road will still overtop during both the 10-year and 2-year events.

E. Proposed Development at 151-159 Wescar Lane and Its Impact on Flooding on Cardevco Road:

(Refer to calculations In Appendix G.)

As previously noted, most, if not all, of the existing entrance culverts in the subdivision are undersized and it is expected that all the entrance culverts on the west and north side of Cardevco Road will overtop during the 10-year event and cause flooding on Cardevco Road. And as previously mentioned the Cardevco Road entrance culverts were overtopping following the aftermath of the June 6, 2024 storm (probably at least a 25-year event, but it could have been a 100-year or rarer event). Based on the subdivision Grading Plan, about 1.2 ha of the pre-development drainage of 151-159 Wescar Lane drains to the Wescar Lane roadside ditch (refer to Figure 2 in Appendix F); and based on topographic surveys, about 1.7 ha of the pre-development drainage of 151-159 Wescar Lane drains to the Wescar Lane roadside ditch (refer to Figure 3 in Appendix F). Therefore, based on pre-development conditions it is calculated that 121.28 L/s to 176.01 L/s drains to the Wescar lane roadside ditch during the 100-year event; and

62.29 L/s to 90.41 L/s during the 10-year event (the variation depends on whether 1.2 ha or 1.7 ha draining to Wescar Lane is used for the pre-development conditions). The previously proposed stormwater management facility for 151-159 Wescar Lane would have used an ICD with a 154 mm orifice to restrict the flowrate draining to Wescar Lane to 107.04 L/s during the 100-year event; reducing the flowrate by 12% to 39%. However, during the 10-year event, while the flowrate would be restricted 70.78 L/s; the flowrate would be reduced by 22% or increased by 14%, depending on whether 1.2 ha or 1.7 ha is used for the pre-development conditions. To be conservative, the proposed stormwater management facility for 151-159 Wescar Lane now uses an ICD with a 139 mm orifice to restrict the flowrate draining to Wescar Lane to 94.85 L/s during the 100-year event reducing the flowrate by 22% to 46%; and, during the 10-year event the flowrate will be restricted to 62.24 L/s; reducing the flowrate by 0 to 31%. Therefore, due the proposed stormwater management facility, the proposed development 151-159 Wescar Lane, is expected to have no adverse effect on the existing downstream flooding on Cardevco Road.

3.0 CONCLUSIONS

1. Given that:
 - it was the intent that the subdivision would have “*negligible effect on the amount of runoff to the creek*” it is apparent that the rear lot swale was intended to convey negligible drainage;
 - it is not possible construct this rear lot swale to convey drainage to the creek because the SWM facility for 123 Wescar Lane is located within the easement;
 - the 9.0 m easements on 131 & 141 Wescar Lane are not used convey drainage to the creek;
 - the rear lot swales are not intended to convey drainage from adjacent properties;
 - about 2.5 ha of 151-159 Wescar Lane pre-development drainage drained to the creek; and
 - about 0.3 ha of 151-159 Wescar Lane post development drainage will drain to the creek, an 88% reduction.

The rear lot swales are not required at the subject development, and the 9.0m easement can be removed from 151-159 Wescar Lane.

2. As per the subdivision Drainage Report, 2.9 hectares of subdivision land drained to Cavanmore Road, and it was the intent that this area would continue to drain to Cavanmore Road (of which 1.0 ha would be draining from 159 Wescar Lane). However, the actual area is about 1.5 ha (of which 0.6 ha is draining from 159 Wescar Lane). It would not be prudent to increase the area that is currently draining to Cavanmore Road.
3. Except for the 2.9 ha, the intent was to direct the runoff from subdivision via roadside ditches to an existing roadside ditch on Carp Road; therefore, it is apparent that the roadside ditches and culverts were intended to be sized to accommodate the entire subdivision (except for 2.9 ha).
4. The subdivision Drainage Report states: “*The outlet for the 2.9 hectares in the in the northwest corner of the subdivision will also have to be upgraded.*” As per the subdivision Grading Plan the outlet appears to be a 400 mm culvert crossing Cavanmore Road near the northwest corner of the subject property and that it was intended to be replaced with a 600 mm culvert. It was not replaced.
5. Except for the culvert crossing Wescar Lane at the intersection of Cardevco Road, most, if not all, culverts within the subdivision are undersized. As per the subdivision Drainage report entrance culverts were to be 600 mm in diameter except at the north and west sides of Cardevco Road which were to be 750 mm in diameter; however, most, if not all, entrance culverts appear to be 500 mm.
6. The Cardevco Road entrance culverts were overtopping following the aftermath of the June 6, 2024 storm (estimated to be a 25 to 100-year or rarer event). The Wescar Lane entrance culverts were not observed to be overtopping.

7. Assuming existing conditions plus the proposed development, based on the calculations presented in this report:
 - it is expected that all the entrance culverts on the west and south side of Wescar Lane (south of the proposed development) will overtop during the 10-year event; but will not during the 2-year,
 - it is expected that the entrance culverts on the east and north side of Wescar Lane will not overtop during the 10-year event,
 - it is expected that culvert C-2 crossing Wescar Lane at the intersection of Cardevco Road will overtop during the 10-year event, but not the 2-year,
 - it is expected that all the entrance culverts on the west and north side of Cardevco Road will overtop during both the 10-year and 2-year events,
 - Wescar Lane roadside ditches are generally not maintained; but if they were maintained, it is expected that all culverts, especially all the entrance culverts on the west and north side of Cardevco Road, would overtop more frequently.
8. Based on the calculations presented in this report, if the culverts were sized as per the subdivision Grading Plan, during the 10-year event it is expected that the culvert crossing Wescar Lane at the intersection of Cardevco Road and all the entrance culverts on the west and north side of Cardevco Road would still overtop.
9. Based on the calculations presented in this report: Accounting that some of the flow is restricted flows through the four known ICDs (there may be more), Wescar Lane entrance culverts are not overtopped during the 10-year event; as is the culvert crossing Wescar Lane at the intersection of Cardevco Road. However, it is expected that, even accounting for the restricted flows, all the entrance culverts on the west and north side of Cardevco Road are expected to overtop during the 10-year event.
10. Based on the calculations presented in this report, if 0.6 ha of 159 Wescar Lane drained to Cavanmore Road the peak flow is less, but it is expected that:
 - all the entrance culverts on the west and south side of Wescar Lane (south of the proposed development) will still overtop during the 10-year event, but will not during the 2-year,
 - the culvert crossing Wescar Lane at the intersection of Cardevco Road will still overtop during the 10-year event, but not during the 2-year, and
 - it is expected that all the entrance culverts on the west and north side of Cardevco Road will still overtop during both the 10-year and 2-year events.
11. Due the proposed stormwater management facility, the proposed development 151-159 Wescar Lane, is expected to have no adverse effect on the existing downstream flooding on Cardevco Road.

Prepared by D.B. Gray Engineering Inc.



NOT VALID UNLESS
SIGNED & DATED

APPENDIX A

CARDEVCO SUBDIVISION DRAINAGE REPORT & GRADING PLANS

|

SCHEDULE "H"

DRAINAGE REPORT

Under present conditions, the subdivision lands drain to an existing creek along the southern boundary with the exception of 2.9 hectares which drain to the Old Almonte Road (in the northwest corner). The outlet creek, which will continue to provide for the subdivision discharge, is tributary to the Carp River.

It is intended to direct the runoff from the lands through a series of roadside ditches and rear lot swales to an existing roadside ditch on Regional Road No.5. This ditch will have to be upgraded and new culverts installed to accommodate the increased runoff. The outlet for the 2.9 hectares in the northwest corner of the subdivision will also have to be upgraded.

In general, the roadside ditches in the subdivision will follow the gradients of the adjacent roads. The minimum slope will be 0.3% and the maximum slope will be 3.88%. The ditches will be a minimum depth of 860 mm from the crown of the road. The maximum depth shall be 1,000 mm. The ditch side slopes shall be 2 horizontal to 1 vertical.

Rear lot swales shall be a minimum depth of 450 mm to a maximum depth of 1500 mm. The side slopes shall be 3 horizontal to 1 vertical. In all cases, the ditches will be treated with topsoil, seed and mulch. The rear lot swales shall be provided where it is likely that runoff would occur onto property held by others.

For the design of the ditches and drainage structures, the Rational Formula was used. A 1:1 ratio was used for the diameter vs. headwater relationship for the culvert sizing. The 10 year rainfall frequency curve was used to determine the ditch and culvert sizing.

Erosion protection will be provided at all bends in ditches and at the entrance and exits of all culverts. Culverts shall be 1.3 m guage for 600 mm diameter and 1.6 m guage for all others.

Although the culvert under the proposed Cardevco Road has been calculated to be 1380 mm in diameter, an inspection by the Township Engineer in the Spring of 1981 will be required to verify the sizing.

DM
BT as AKC

Calculations: (continued)

2.

Culvert No. 4*-

An arbitrary entry time of 35 min. has been selected for this culvert (conservative)

From existing topographic mapping and visual observation, it has been determined that approximately 80 acres are tributary to this culvert (outside the subdivision).

$$t_c = 35 \text{ min.}$$

$$i = 2.1 \text{ ins per hr.}$$

$$Q_o = 0.15 \times 2.1 \times 80 = 25.2 \text{ cfs}$$

$$Q_i = 0.40 \times 8.71 \times 2.1 = 7.32 \text{ cfs}$$

$$Q_{\text{total}} = 32.52 \text{ cfs}$$

With 3.5 ft. of H_w , $Q_{36"} = 37 \text{ cfs}$

Therefore 36" dia. pipe would be satisfactory

Culvert No. 5 -

$$\text{Flow time} = (420/0.61)/60 = 11.5 \text{ min.}$$

$$t_c = 61.8 \text{ min.}$$

$$i = 1.2 \text{ ins per hr.}$$

$$\text{Area of industrial} = 54.76 \text{ Ac}$$

$$\text{Area of agricultural} = 11.33 \text{ Ac}$$

$$\text{Area of residential} = 2.97 \text{ Ac}$$

$$\text{Therefore flow } Q = (0.40 \times 54.76 \times 1.2) + (0.15 \times 11.33 \times 1.2) \\ + (0.25 \times 2.97 \times 1.2) = 29.22 \text{ cfs}$$

Therefore 36" diameter culvert OK ($Q = 31.2 \text{ cfs}$)

*Although the calculations produce a flow significantly below the capacity of the existing culvert under the Cowan Side Road, we are continuing to investigate the reasons behind the oversizing. In the interim period, it is suggested that a 42" diameter pipe be considered at this location.

MM
BT 43
AKC

Calculations:

General -

Rational Formula - $Q = ciA$ (imperial)

Runoff coefficient $c = 0.40$ (industrial)

$= 0.15$ (agricultural)

$= 0.25$ (rural res.)

Rainfall in ins. per hr. from 10 year curve

Minimum time of concentration = 20 minutes

Flow time from val. = 0.61 m per sec. (assumed)

Note: For culvert No.s, see drainage design sheet

Culvert No.1 -

Flow time = $(420/0.61)/60 = 12.8$ min.

$t_c = 32.8$ min.

$i = 2.22$ ins per hr.

Area = 16.5 Ac.

Therefore $Q = 0.40 \times 2.22 \times 16.5 = 14.65$ cfs

For 30" dia. pipe, $H_v = 2.5$ ft. $S_o = .003$, $Q = 17$ cfs

Culvert No.2 -

Flow time = $(641/0.61)/60 = 17.5$ min.

$t_c = 50.3$ min.

$i = 1.42$ ins per hr.

Area = 54.76 Ac.

Therefore $Q = 0.40 \times 1.42 \times 54.76 = 31.10$ cfs

For 36" dia. pipe, $H_v = 3.0$ ft. $S_o = .003$, $Q = 31.2$ cfs

Culvert No.3 -

Minimum inlet time = 20 min.

$A = 3.8$ Ac.

$Q = 0.40 \times 3.8 \times 3.10 = 4.71$ cfs

Minimum diameter culvert of 24" recommended ($Q = 10$ cfs)

continued.....

M
44 *BB* AKC

Calculations:

3.

Swale and Ditch Cross Sections -

The capacity of the ditches and swales shall be calculated using the Mannings Formula with 'n' = 0.027. The capacities have been calculated to determine the minimum ditch section depths which may be used at any given location. Although in the actual construction, we expect that the 2:1 ditch side slopes will be closer to 3:1, a theoretical 2:1 will be used for these calculations.

Minimum Cross Section:

d = depth of ditch from property line

Assume d = 1.5'

Area = $2d^2$

For s = .003

R = .6706

Flow Q = AV = A (1.486/0.027)R^{2/3}s^{1/2} = 10.40 cfs

Therefore most of the ditch system may have a minimum depth of 1.5' from the property line

For the ditch on the west and north side of Cardevco Lane, a minimum depth of 2' produces the following flow:

s = .003

Area = 8 sq.ft., R = .894

Q = AV = 22.4 cfs

The actual flow into culvert No.1 under the 10 year rainfall curve was calculated to be 14.65 cfs. The 2' or 600 mm depth would therefore be sufficient.

Outlet Ditch on Regional Road No.5 -

Available slope = .003

Minimum capacity = 31.10 cfs

With 2' depth and 3:1 side slopes, the capacity is

Q = AV = 12(1.486/0.027) x .9486^{2/3} x 0.003^{1/2} = 32.92 cfs

JM
45' *AK*

Calculations:

4.

Outlet Ditch - (continued)

The section is therefore of sufficient size to accept the flows directed to it.

Rear Lot Swales will have a minimum 1.5' depth and 3 to 1 side slopes. The capacity produced by this section (16.22 cfs) is more than sufficient to carry flows directed to them. The minimum slope of the rear lot swales will be 0.3%.

It is not proposed at this time to alter the creek which runs through the most southern section of the subdivision. The development of this land has negligible effect on the amount of runoff to the creek.

Standard erosion protection methods will be used to protect the entrance and exit of the culvert proposed on the creek.

GRADING PLAN

The Owner covenants and agrees to grade in accordance with Grading Plan No. 80-1040-GRI as revised on 14/11/80. This plan has been prepared by R. W. Connelly and Associates Limited.

JK
4/8 RB AK

THE LAND TITLES ACT

TRANSFER OF EASEMENT

CARDEVCO INC., hereinafter referred to as the "Transferor" the registered owner of the freehold land registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa those parcels in the register for the Section more particularly described in Schedule "A" annexed hereto, in consideration of the sum of ONE (\$1.00) DOLLAR paid to it transfers to THE CORPORATION OF THE TOWNSHIP OF WEST CARLETON, hereinafter referred to as the "Township", its successors, licencees and assigns, to be used and enjoyed as appurtenant to the lands of the Township described in Schedule "B" hereto annexed the free uninterrupted and unobstructed right and easement, in perpetuity:

1. (a) To enter on and construct, repair and replace the drainage works, catch basins and equipment appurtenant thereto from time to time, including all fixtures and equipment as the Township may from time to time or at any time hereafter deem requisite over, under, along and across the lands described in Schedule "A" together with the right of free and unimpeded access to the Township, its workmen, vehicles, supplies and equipment at all times and for all purposes necessary for or incidental to the exercise and enjoyment of the rights hereby granted, over the lands described in Schedule "A" hereto to and from the said drainage works and fixtures and equipment or any part or parts thereof which are to be constructed, repaired, replaced and maintained;
- (b) to trim, fell and remove any trees and brush necessary and incidental to permit access to construct, maintain and repair any part of the said drainage system.
2. The Township hereby agrees to save harmless and keep indemnified the Transferor from and against all claims and demands and from and against all losses, damages, costs, charges and expenses which the said Transferor may sustain or incur in consequence of the exercise by the Township of the rights granted pursuant to this agreement.
3. The Township covenants in the exercise of the rights and easements hereby granted to it, its successors and assigns, it and they will make good all damage at any time and from time to time caused to or suffered by the said lands described in Schedule "A" hereto annexed.
4. The Transferor shall not call into question, directly or indirectly in any proceeding whatsoever, in law or in equity or before any administrative tribunal, the right of the Township to enter into this Agreement and to enforce each and every term, covenant and condition herein contained.

RECEIVED
1.7 DEC 1982
SC
CLEARED

THIS INDENTURE and everything herein contained shall enure to the benefit of and be binding upon the parties hereto, and their respective successors and assigns.

IN WITNESS WHEREOF the Transferor has hereunto affixed its corporate seal under the hands of its duly authorized signing officers and the Township has hereunto affixed its corporate seal under the hands of its proper signing officers.

DATED at Ottawa this 15th day of November 1982.

GARDEVCO INC.

Per: _____

Per: _____

Sec.

THE CORPORATION OF THE TOWNSHIP
OF WEST CARLETON

Per: _____

Mayor

Per: _____

Clerk

SCHEDULE "A"

FIRSTLY: Part of Block 4 on Plan 4M-356 , Township of West Carleton, registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa, designated as Part 1 on a Plan of Survey of Record deposited in the said Registry Office as No. 4R-3951
Being Part of Parcel 4-1 in the Register for Section 4M-356

SECONDLY: Part of Block 13 on Plan 4M-356 , Township of West Carleton, registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa, designated as Part 3 on a Plan of Survey of Record deposited in the said Registry Office as No. 4R-3951
Being Part of Parcel 13-1 in the Register for Section 4M-356

THIRDLY: Part of Block 14 on Plan 4M-356 , Township of West Carleton, registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa, designated as Part 4 on a Plan of Survey of Record deposited in the said Registry Office as No. 4R-3951
Being Part of Parcel 14-1 in the Register for Section 4M-356

FOURTHLY: Part of Block 15 on Plan 4M-356 , Township of West Carleton, registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa, designated as Part 5 on a Plan of Survey of Record deposited in the said Registry Office as No. 4R-3951
Being Part of Parcel 15-1 in the Register for Section 4M-356

FIFTHLY: Part of Block 31 on Plan 4M-356 , Township of West Carleton, registered in the Land Registry Office No. 4 for the Land Titles Division of Ottawa-Carleton at Ottawa, designated as Part 8 on a Plan of Survey of Record deposited in the said Registry Office as No. 4R-3951
Being Part of Parcel 31-1 in the Register for Section 4M-356

SCHEDULE "B"

The whole of Parcel Streets -1 in the Register for Section 4M- 356

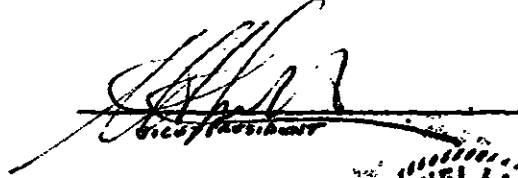
THE LAND TITLES ACT

CONSENT OF CHARGE

IN THE MATTER OF Part of Blocks 4, 13, 14, 15 and 31 on Plan 4M-356
SPRATT SAND AND GRAVEL LIMITED, the Chargee under a Charge registered as
No. 210802, hereby consents to the registration of an Easement over the
above lands.

IN WITNESS WHEREOF the Corporation has affixed its corporate seal
under the hands of its proper signing officers this 15th day of
November, 1982.

SPRATT SAND AND GRAVEL LIMITED


Secretary



Form 1 - Land Transfer Tax Act
AFFIDAVIT OF RESIDENCE AND OF VALUE OF THE CONSIDERATION

THE MATTER OF THE CONVEYANCE OF (insert brief description of land) An easement over Parts of Blocks 4, 13, 14, 15 and 31 on Plan 4M-356 designated as Parts 1, 3, 4, 5 and 8 on Reference Plan 4R-3951

BY (print names of all transferors in full) CARDEVCO INC.

TO (see instruction 1 and print names of all transferees in full) THE CORPORATION OF THE TOWNSHIP OF WEST CARLETON

I, (see instruction 2 and print name(s) in full) Alan K. Cohen

MAKE OATH AND SAY THAT:

1. I am (place a clear mark within the square opposite that one of the following paragraphs that describes the capacity of the deponent(s)): (see instruction 2)

- (a) A person in trust for whom the land conveyed in the above-described conveyance is being conveyed;
- (b) A trustee named in the above-described conveyance to whom the land is being conveyed;
- (c) A transferee named in the above-described conveyance;
- (d) The authorized agent or solicitor acting in this transaction for (insert name(s) of principal(s)) THE CORPORATION OF THE TOWNSHIP OF WEST CARLETON described in paragraph(s) (a), (b), (c) above; (strike out references to inapplicable paragraphs)
- (e) The President, Vice-President, Manager, Secretary, Director, or Treasurer authorized to act for (insert name(s) of corporation(s)) described in paragraph(s) (a), (b), (c) above; (strike out references to inapplicable paragraphs)
- (f) A transferee described in paragraph () (insert only one of paragraph (a), (b) or (c) above, as applicable) and am making this affidavit on my own behalf and on behalf of (insert name of spouse) who is my spouse described in paragraph () (insert only one of paragraph (a), (b) or (c) above, as applicable) and as such, I have personal knowledge of the facts herein deposed to.

2. I have read and considered the definitions of "non-resident corporation" and "non-resident person" set out respectively in clauses 1 (1)(f) and (g) of the Act. (see instruction 3).

3. The following persons to whom or in trust for whom the land conveyed in the above-described conveyance is being conveyed are non-resident persons within the meaning of the Act. (see instruction 4) None.

4. THE TOTAL CONSIDERATION FOR THIS TRANSACTION IS ALLOCATED AS FOLLOWS:

(a) Monies paid or to be paid in cash	\$ 1.00	
(b) Mortgages (i) Assumed (show principal and interest to be credited against purchase price)	\$ nil	
(ii) Given back to vendor	\$ nil	
(c) Property transferred in exchange (detail below)	\$ nil	
(d) Securities transferred to the value of (detail below)	\$ nil	
(e) Liens, legacies, annuities and maintenance charges to which transfer is subject	\$ nil	
(f) Other valuable consideration subject to land transfer tax (detail below)	\$ nil	
(g) VALUE OF LAND, BUILDING, FIXTURES AND GOODWILL SUBJECT TO LAND TRANSFER TAX (TOTAL OF (a) to (f))	\$ 1.00	\$ 1.00
(h) VALUE OF ALL CHATTELS - items of tangible personal property (Detail Sales Tax is payable on the value of all chattels unless exempt under the provisions of the "Retail Sales Tax Act", R.S.O. 1981, c.454, as amended)	\$ nil	
(i) Other consideration for transaction not included in (g) or (h) above	\$ nil	
(j) TOTAL CONSIDERATION	\$ 1.00	\$ 1.00

ALL BLANKS MUST BE FILLED IN. INSERT "NIL" WHERE APPLICABLE.

5. If consideration is nominal, describe relationship between transferor and transferee and state purpose of conveyance. (see instruction 5)
Transfer of an easement to a Municipality

6. If the consideration is nominal, is the land subject to any encumbrance? Yes.
Encumbrance does not form part of the consideration.

7. Other remarks and explanations, if necessary

SWORN before me at the City of Ottawa
in the Regional Municipality of Ottawa-Carleton
this 9 day of Dec 1982.
A Commissioner for taking Affidavits, etc.

Alan K. Cohen
signature(s)

PROPERTY INFORMATION RECORD

- A. Describe nature of instrument: Transfer of Easement
- B. (i) Address of property being conveyed (if available): not available
- (ii) Assessment Roll No. (if available): not available
- C. Mailing address(es) for future Notices of Assessment under the Assessment Act for property being conveyed (see instruction 6):
Township of West Carleton
P. O. Box 410, Carp, Ontario K0A 1T0
- D. (i) Registration number for last conveyance of property being conveyed (if available): not available
- (ii) Legal description of property conveyed: Same as in D.(i) above. Yes No Not Known
- E. Name(s) and address(es) of each transferee's solicitor

SOLOWAY, WRIGHT, HOUSTON
GREENBERG, O'GRADY, MORIN
BARRISTERS & SOLICITORS
170 METCALFE STREET
OTTAWA, ONTARIO
K2P 1P3

For Land Registry Office use only	
REGISTRATION NO.	
Land Registry Office No.	
Registration Date	

(7)

306284

LAND TITLES ACT

No. Received at 3:45 o'clock P.M. on day of

DATED the 15th day of November, 1982.

DEC 17 1982

Land Titles Division of Ottawa-Carleton
No. 4

CARDEVCO INC.

TO

J. E. Staden
JOHN E. STADEN

SENIOR DEPUTY LAND REGISTRAR

THE CORPORATION OF THE TOWNSHIP

OF WEST CARLETON

LAND REGISTRY #4

REC. BY	<i>AS</i>
F.F. NO. OR PAGE	<i>302</i>
ABSL. BY	<i>AS</i>
CHECKED BY	
MICRO. BY	<i>mw</i>

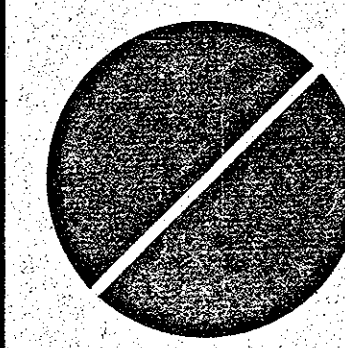
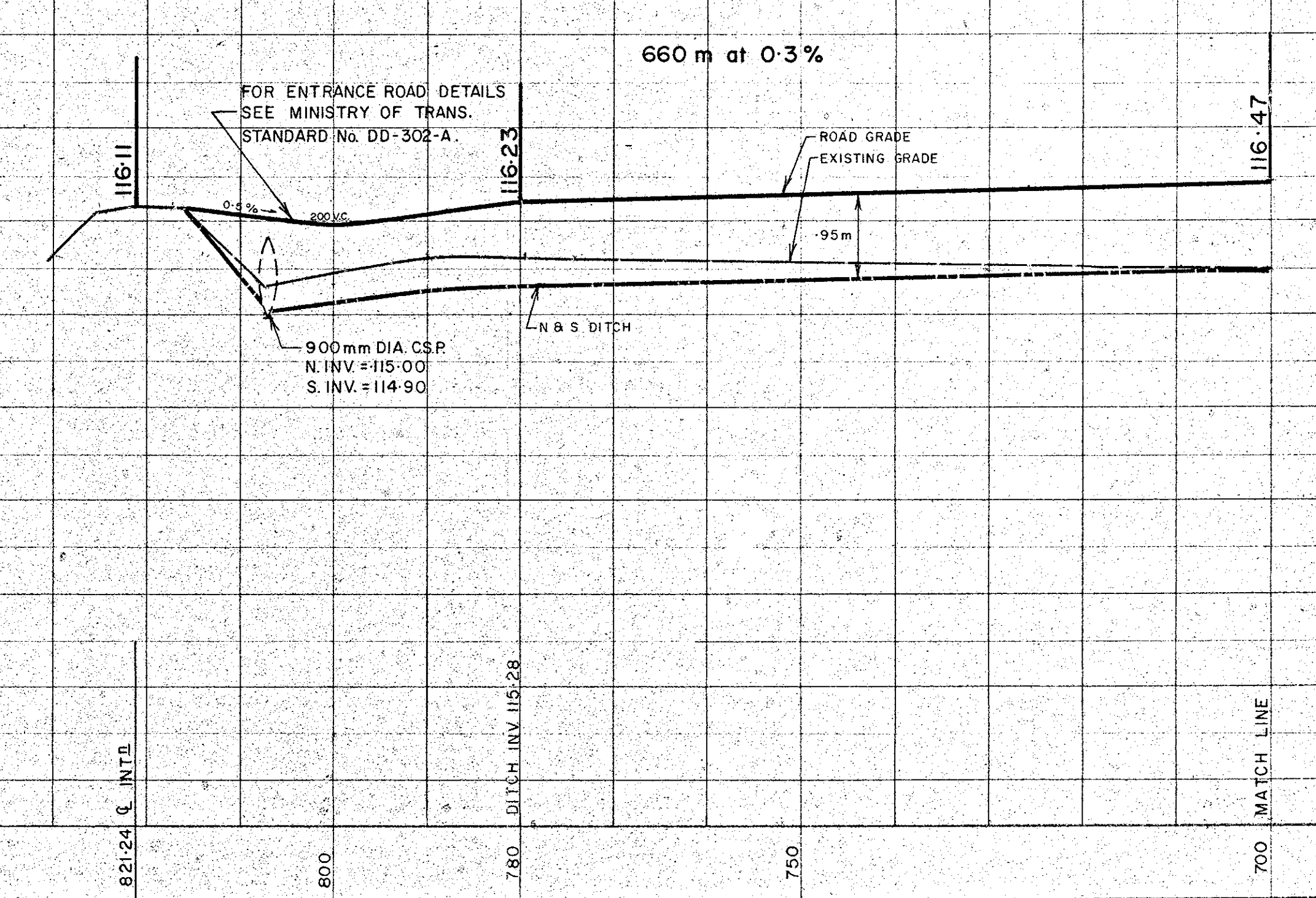
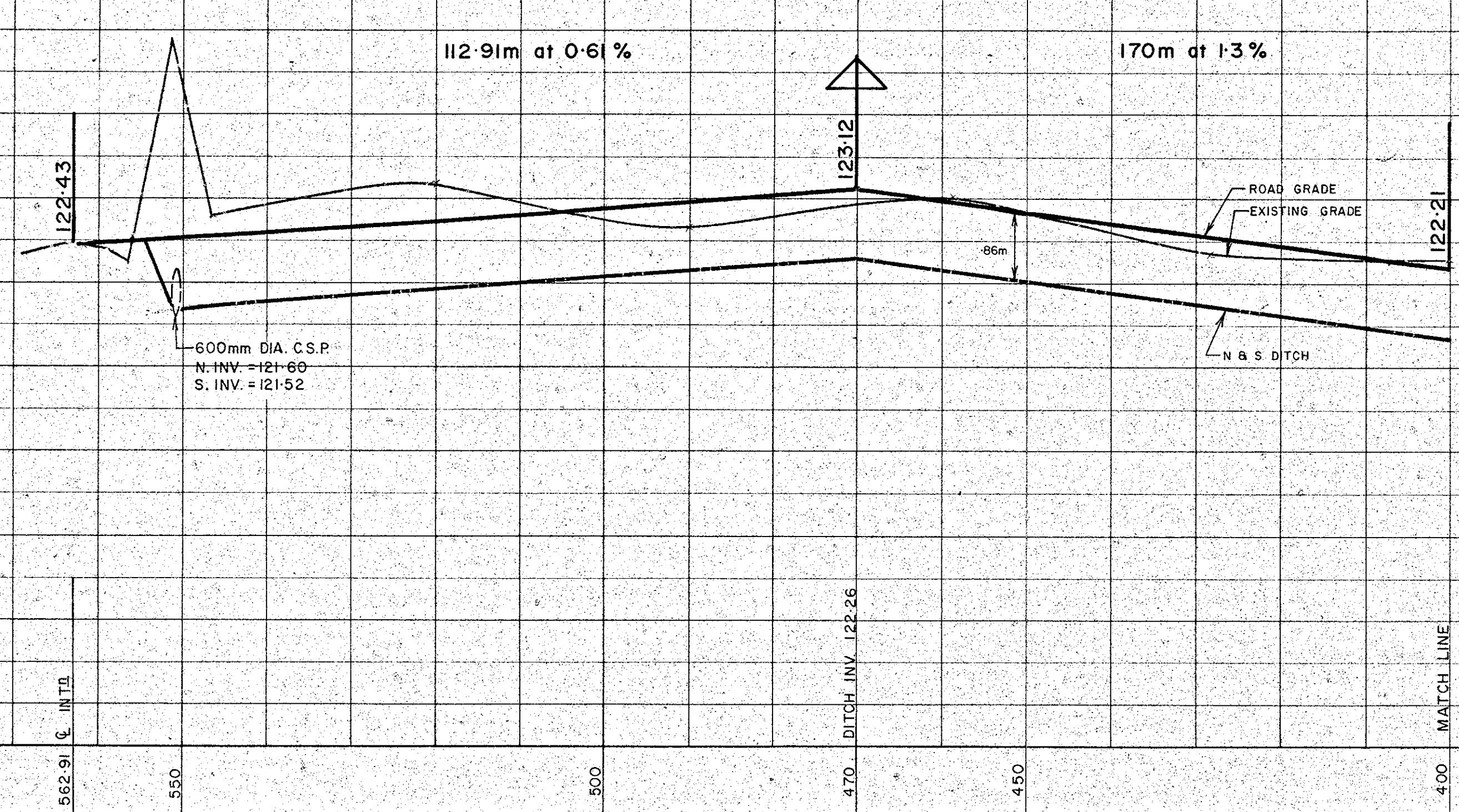
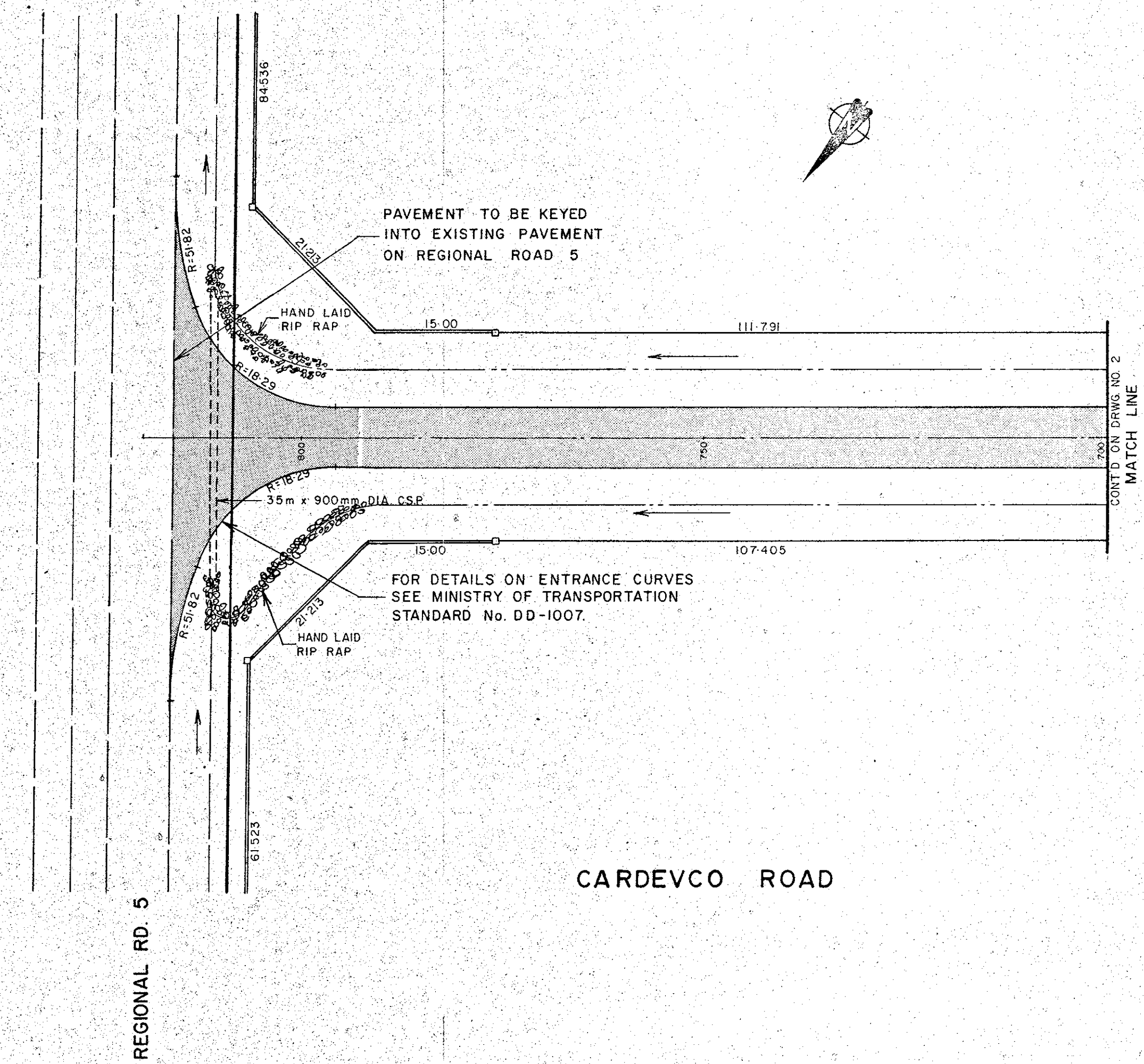
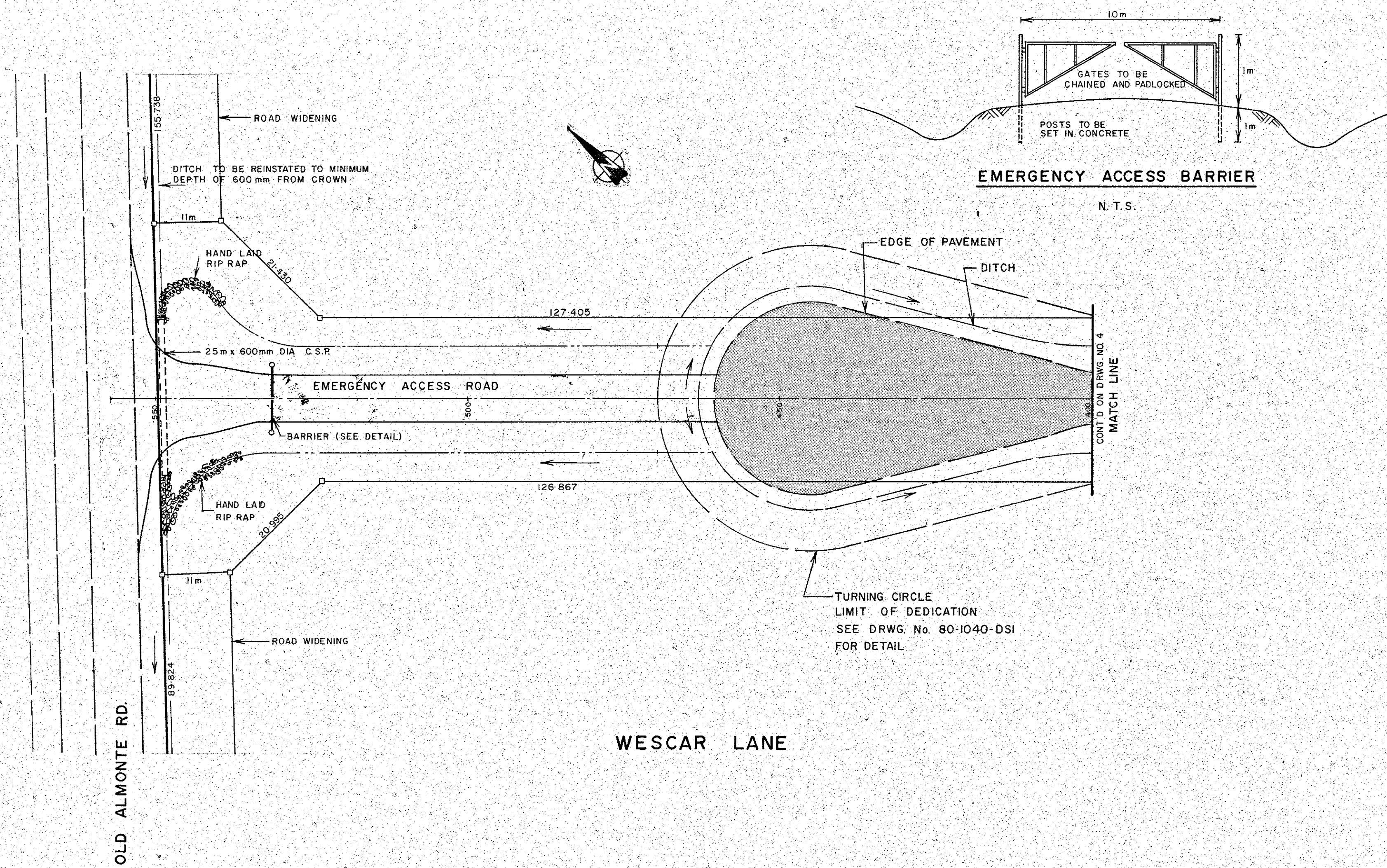
11/27/82

TRANSFER OF EASEMENT

**SOLOWAY, WRIGHT, HOUSTON
GREENBERG, O'GRADY, MORIN**
SOLICITORS & NOTARIES
170 METCALFE STREET
OTTAWA, ONTARIO
K2P 1K6

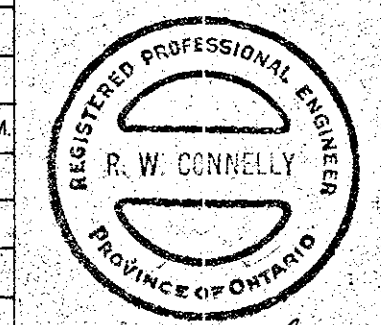
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1254-3070

24.00



Environmental Engineering Consultants Ltd. 43 Eccles St. Ottawa Ontario K1R 6S3 Canada (613) 232 7982

1	AS PER TWP. ENGINEER	11-9-80	B.H.M.
2	ACCESS TO OLD ALMONT RD. CHANGED TO EMERGENCY ACCESS, BARRIER ADDED, ACCESS TO REGIONAL RD. 5 REVISED	14-11-80	B.H.M.
R E V I S I O N S			
NO.	DESCRIPTION	DATE	BY
	DESIGN		R.W.C.
	DRAWN		R.H.M.
	CHECKED		R.W.C.



CLIENT	CARDEVCO DEVELOPMENTS LIMITED
PROJECT	CARDEVCO INDUSTRIAL PARK PART OF LOT 6, CONC. 3, TWP. OF WEST CARLETON (HUNTLEY)
TITLE	CARDEVCO ROAD & WESCAR LANE CH. 700 TO 821-24 CH. 400. TO 562-91
	R.W. CONNELLY ASSOCIATES LTD. R.R. No. 1, DUNROBIN, ONT., K0A 1T0 TEL. 832-2902
DATE	AUGUST 1980
SCALE	HOR. 1:500 VERT. 1:50
DRAWING NO.	80-1040-3
SHEET	2

APPENDIX B

AREA & RUNOFF CALCULATIONS

Existing Conditions
 107 to 154 & 162 to 173 Wescar Lane and 121 to 127 Cardevco Road
 +
 Proposed Development 151-159 Wescar Lane
 Cardevco Subdivision
 Ottawa, Ontario

31-May-24

Drainage Area A

Address	Area Draining to the ROW					ROW Area				TOTAL				
	Roof	Hard	Gravel	Soft	Total	Hard	Gravel	Soft	Total	Roof	Hard	Gravel	Soft	Total
	sq.m.					sq.m.				sq.m.				
173 Wescar			2147		2147	82	150	79	311	0	82	2297	79	2458
165 Wescar	589	868	1055	4064	6576	368	123	483	974	589	1236	1177	4547	7550
159-151 Wescar	3530	31941		6566	42038	772	404	864	2040	3530	32713	404	7430	44078
141 Wescar	535	334	294	1574	2737	313	81	405	799	535	647	374	1980	3536
					53498				4124	4654	34678	4254	14036	57622

C			
Roof Area:	0.47	ha	0.90
Hard Area:	3.47	ha	0.90
Gravel Area:	0.43	ha	0.80
Soft Area:	1.40	ha	0.20

Total Catchment Area: 5.76 ha 0.72

Drainage Area B

Address	Area Draining to the ROW					ROW Area				TOTAL				
	Roof	Hard	Gravel	Soft	Total	Hard	Gravel	Soft	Total	Roof	Hard	Gravel	Soft	Total
	sq.m.					sq.m.				sq.m.				
131 Wescar	585	1302		1150	3037	317	54	305	675	585	1619	54	1455	3712
123 Wescar		329		478	807	227	30	170	427	0	556	30	649	1235
117 Wescar	203	99	965	821	2089	204	34	192	430	203	303	999	1013	2518
107 Wescar	435	980		520	1935	246	27	179	452	435	1226	27	699	2387
121 Cardevco	270	277	1824	2717	5088	901	274	1341	2517	270	1178	2098	4058	7605
					12956				4500	1494	4881	3208	7873	17456

C			
Roof Area:	0.15	ha	0.90
Hard Area:	0.49	ha	0.90
Gravel Area:	0.32	ha	0.80
Soft Area:	0.79	ha	0.20

Total Catchment Area: 1.75 ha 0.57

Drainage Area C

Address	Area Draining to the ROW					ROW Area				TOTAL				
	Roof	Hard	Gravel	Soft	Total	Hard	Gravel	Soft	Total	Roof	Hard	Gravel	Soft	Total
	sq.m.					sq.m.				sq.m.				
180/172 Wescar				161	161	80	45	127	252	0	80	45	287	412
168 Wescar	321	730		435	1486	194	42	125	360	321	924	42	560	1847
162 Wescar	610	770		487	1866	196	50	119	364	610	965	50	605	2231
154 Wescar			216	3384	3600	231	115	407	753	0	231	331	3791	4353
144 Wescar	494	701		554	1748	232	47	113	392	494	933	47	667	2140
138 Wescar	507	506		730	1744	193	40	160	394	507	699	40	891	2138
132 Wescar			935	1007	1942	112	128	144	384	0	112	1063	1151	2326
126 Wescar	484	1074		469	2028	167	59	161	388	484	1241	59	630	2415
118 Wescar	29		3940	267	4236	488	393	642	1523	29	488	4333	909	5759
123 Cardevco					0	360	371	227	957	0	360	371	227	957
					18812				4810	2446	5675	6010	9491	23622

C			
Roof Area:	0.24	ha	0.90
Hard Area:	0.57	ha	0.90
Gravel Area:	0.60	ha	0.80
Soft Area:	0.95	ha	0.20

Total Catchment Area: 2.36 ha 0.59

Drainage Area D

Address	Area Draining to the ROW					ROW Area				TOTAL				
	Roof	Hard	Gravel	Soft	Total	Hard	Gravel	Soft	Total	Roof	Hard	Gravel	Soft	Total
	sq.m.					sq.m.				sq.m.				
123 Cardevco	126	61	3750		3936	360	371	227	957	126	421	4120	227	4894
127 Cardevco	483	537	442	568	2030	226	141	46	413	483	763	583	614	2443
					5966				1370	609	1184	4703	841	7337

C			
Roof Area:	0.06	ha	0.90
Hard Area:	0.12	ha	0.90
Gravel Area:	0.47	ha	0.80
Soft Area:	0.08	ha	0.20

Total Catchment Area: 0.73 ha 0.76

APPENDIX C

DITCH & CULVERT CALCULATIONS

EXISTING CONDITIONS

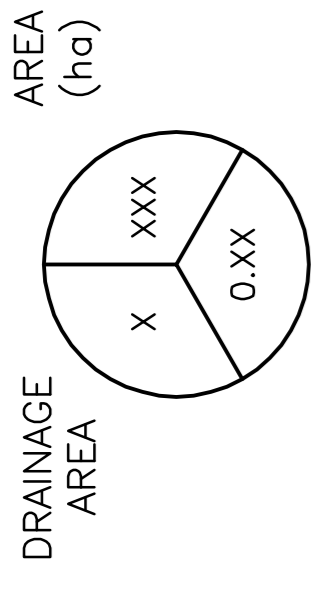
106 TO 154 & 162 TO 173 WESCAR LANE

AND 121 TO 127 CARDEVCO ROAD

+

PROPOSED DEVELOPMENT AT 151-159 WESCAR LANE

LEGEND



DRAINAGE AREA

AREA (ha)

RUNOFF COEFFICIENT

No.	DATE	REVISION
1	JUN 7-24	ISSUED WITH DRAINAGE REPORT

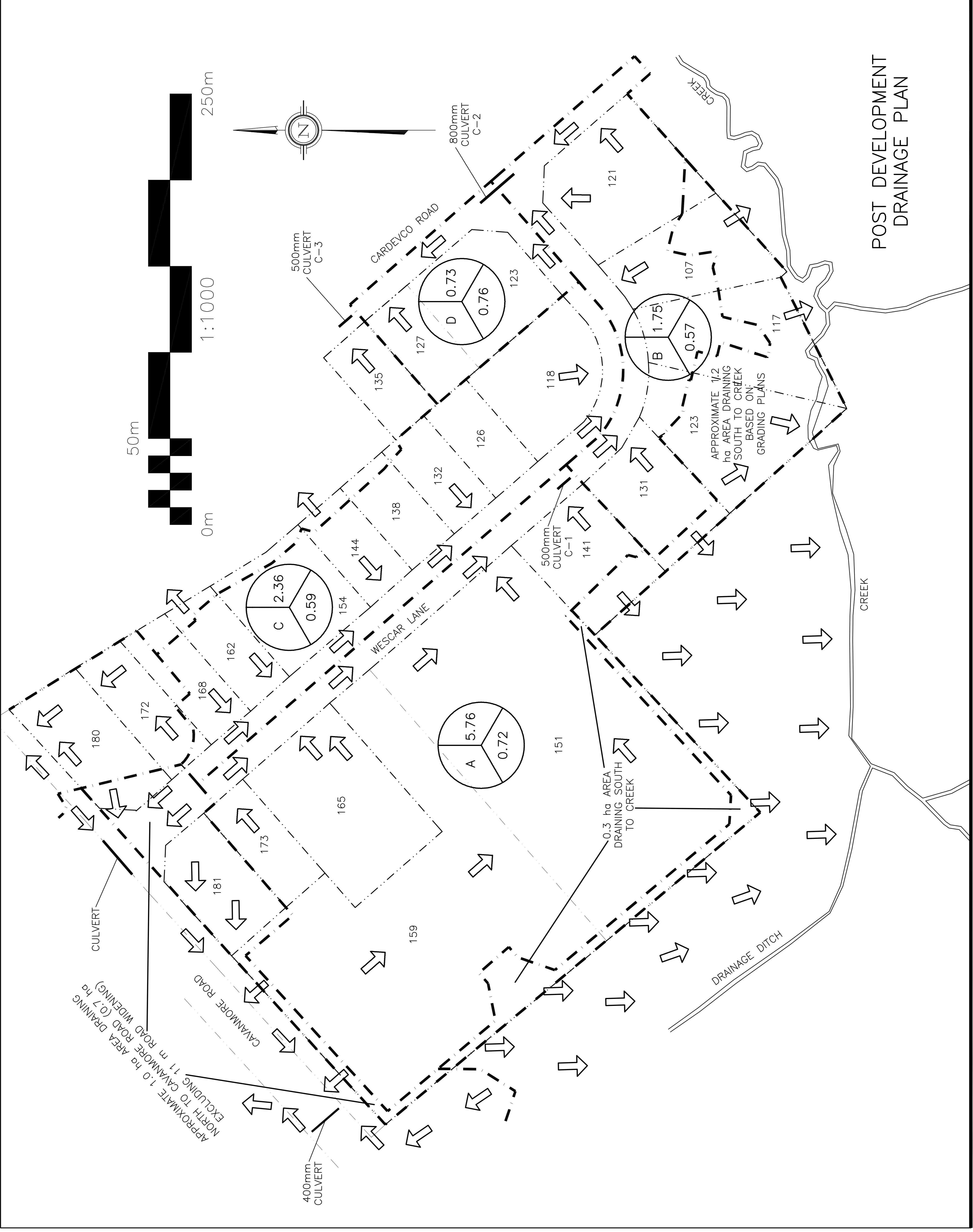
D. B. GRAY ENGINEERING INC.
 Professional Engineer - Ontario
 700 Long Point Circle
 Ottawa, Ontario
 613-425-8044
 d.gray@dbgrayengineering.com

SUNBELT RENTALS INC.
 EQUIPMENT MAINTENANCE FACILITY
 151-159 WESCAR LANE
 CARP, OTTAWA, ONTARIO

Drawing Title
WESCAR LANE / CARDEVCO ROAD POST DEVELOPMENT DRAINAGE PLAN

Engineer's Seal

Drawing No.
FIGURE 1



Peak Flow Calculations - Roadside Ditches
Existing Conditions
106 to 154 & 162 to 173 Wescar Lane
and 121 to 127 Cardevco Road
+
Proposed Development 151-159 Wescar Lane
Cardevco Subdivision
Ottawa, Ontario

10-Year Event

Drainage Area A

		C
Roof Area:	0.47 ha	0.90
Hard Area:	3.47 ha	0.90
Gravel Area:	0.43 ha	0.80
Soft Area:	<u>1.40 ha</u>	<u>0.20</u>
Total Catchment Area:	5.76 ha	0.72
Time of Concentration:	20 min	
Length of Ditch (Ld):	263 m	
Ditch Flow Velocity (V):	0.45 m/s	
Time of Concentration (Ditch Flow):	9.7 min	
Time of Concentration (Tc):	29.7 min	
Area (A):	5.76 ha	
Time of Concentration:	29.7 min	
Rainfall Intensity (i):	63 mm/hr (10-Year Event)	
Runoff Coefficient (C):	0.72	
Rational Method 10-Year Flow (Q):	733.9 L/s	
Ditch Slope:	0.8%	
Ditch Manning Roughness Coefficient n:	0.10 dense weeds / brush as high as flow	
Side Slope:	3 :1	
Lot Side Slope:	3 :1	
Ditch Bottom Width:	1 m	
Water Depth:	0.59 m	
Water Top Width:	4.54 m	
Water Cross-Section Area:	1.63 sq.m	
Wetted Perimeter:	4.73 m	
Hydraulic Radius:	0.35 m	
Velocity:	0.45 m/s	Based on water depth
Velocity:	0.45 m/s	Using Manning's Formula:

Drainage Area B
(10-Year Event)

			C
Roof Area:	0.15	ha	0.90
Hard Area:	0.49	ha	0.90
Gravel Area:	0.32	ha	0.80
Soft Area:	<u>0.79</u>	ha	<u>0.20</u>
Total Catchment Area:	1.75	ha	0.57

Drainage Area A + B

			C
Roof Area:	0.61	ha	0.90
Hard Area:	3.96	ha	0.90
Gravel Area:	0.75	ha	0.70
Soft Area:	<u>2.19</u>	ha	<u>0.20</u>
Total Catchment Area:	7.51	ha	0.68

Time of Concentration: 29.7 min (from Drainage Area A)

Length of Ditch (Ld): 238 m
 Ditch Flow Velocity (V): 0.52 m/s
 Time of Concentration (Ditch Flow): 7.6 min

Time of Concentration (Tc): 37.4 min

Area (A): 7.51 ha
 Time of Concentration: 37.4 min
 Rainfall Intensity (i): 54 mm/hr (10-Year Event)
 Runoff Coefficient (C): 0.68

Rational Method 10-Year Flow (Q): 764.3 L/s

Ditch Slope: 1.2%
 Ditch Manning Roughness Coefficient n: 0.10 dense weeds / brush as high as flow

Road Side Slope: 3 :1
 Lot Side Slope: 3 :1
 Ditch Bottom Width: 1 m
 Water Depth: 0.55 m

Water Top Width: 4.30 m
 Water Cross-Section Area: 1.46 sq.m
 Wetted Perimeter: 4.48 m
 Hydraulic Radius: 0.33 m

Velocity: 0.52 m/s Based on water depth
 Velocity: 0.52 m/s Using Manning's Formula:

Drainage Area C
(10-Year Event)

			C
Roof Area:	0.24	ha	0.90
Hard Area:	0.57	ha	0.90
Gravel Area:	0.60	ha	0.80
Soft Area:	<u>0.95</u>	ha	<u>0.20</u>

Total Catchment Area: **2.36** ha **0.59**

Time of Concentration: **20** min

Length of Ditch (Ld): 452 m

Ditch Flow Velocity (V): 0.36 m/s

Time of Concentration (Ditch Flow): **20.9** min

Time of Concentration (Tc): **40.9** min

Area (A): **2.36** ha

Time of Concentration: **40.9** min

Rainfall Intensity (i): **51** mm/hr (10-Year Event)

Runoff Coefficient (C): **0.59**

Rational Method 10-Year Flow (Q): **198.0** L/s

Ditch Slope: 1.2%

Ditch Manning Roughness Coefficient n: 0.10 dense weeds / brush as high as flow

Side Slope: 3 :1

Lot Side Slope: 3 :1

Ditch Bottom Width: 1 m

Water Depth: 0.30 m

Water Top Width: **2.77** m

Water Cross-Section Area: **0.56** sq.m

Wetted Perimeter: **2.87** m

Hydraulic Radius: **0.19** m

Velocity: **0.36** m/s

Velocity: **0.36** m/s

Based on water depth

Using Manning's Formula:

Drainage Area D
(10-Year Event)

			C
Roof Area:	0.06	ha	0.90
Hard Area:	0.12	ha	0.90
Gravel Area:	0.47	ha	0.80
Soft Area:	<u>0.08</u>	ha	<u>0.20</u>
Total Catchment Area:	0.73	ha	0.76

Drainage Area A + B + C + D

			C
Roof Area:	0.92	ha	0.90
Hard Area:	4.64	ha	0.90
Gravel Area:	1.82	ha	0.80
Soft Area:	<u>3.22</u>	ha	<u>0.20</u>
Total Catchment Area:	10.60	ha	0.67

Time of Concentration: 40.9 min (from Drainage Area C)

Length of Ditch (Ld): 129 m
 Ditch Flow Velocity (V): 0.90 m/s
 Time of Concentration (Ditch Flow): 2.4 min

Time of Concentration (Tc): 43.3 min

Area (A): 10.60 ha
 Time of Concentration: 43.3 min
 Rainfall Intensity (i): 49 mm/hr (10-Year Event)
 Runoff Coefficient (C): 0.67

Rational Method 10-Year Flow (Q): 963.7 L/s

Ditch Slope: 0.3%
 Ditch Manning Roughness Coefficient n: 0.027 gravel / short grass

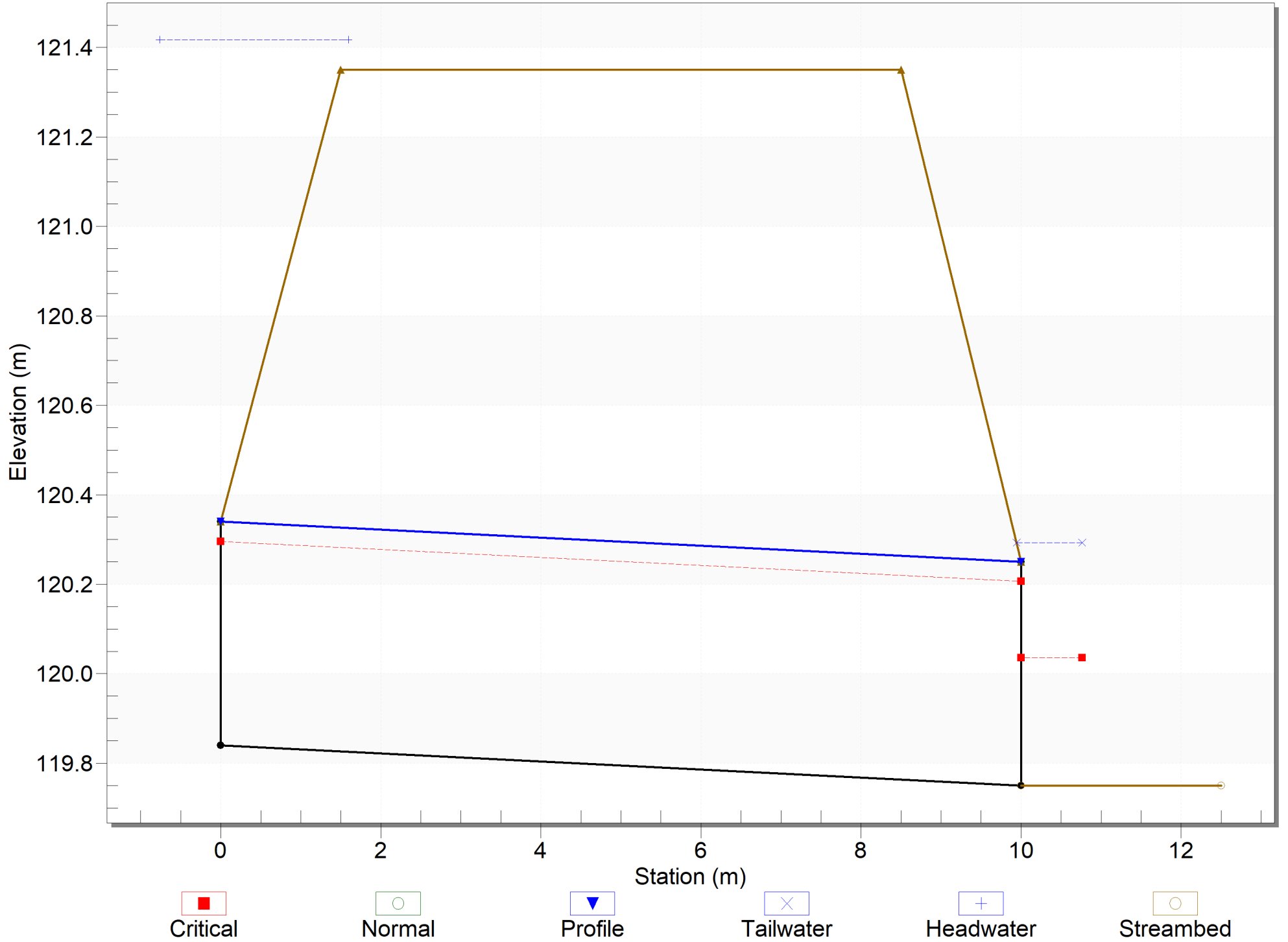
Road Side Slope: 3 :1
 Lot Side Slope: 3 :1
 Ditch Bottom Width: 1 m
 Water Depth: 0.45 m

Water Top Width: 3.72 m
 Water Cross-Section Area: 1.07 sq.m
 Wetted Perimeter: 3.87 m
 Hydraulic Radius: 0.28 m

Velocity: 0.90 m/s Based on water depth
 Velocity: 0.90 m/s Using Manning's Formula:

Crossing - 141 Wescar Ln Entrance Culvert (Drainage Area A), Design Discharge - 0.73 cms

Culvert - C-1 - 10m - 500mm, Culvert Discharge - 0.48 cms



HY-8 Culvert Analysis Report

Culvert Data: C-1 - 10m - 500mm

Culvert Data Summary - C-1 - 10m - 500mm

Barrel Shape: Circular

Barrel Diameter: 500.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting ($K_e=0.9$)

Inlet Depression: None

Site Data - C-1 - 10m - 500mm

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 119.84 m

Outlet Station: 10.00 m

Outlet Elevation: 119.75 m

Number of Barrels: 1

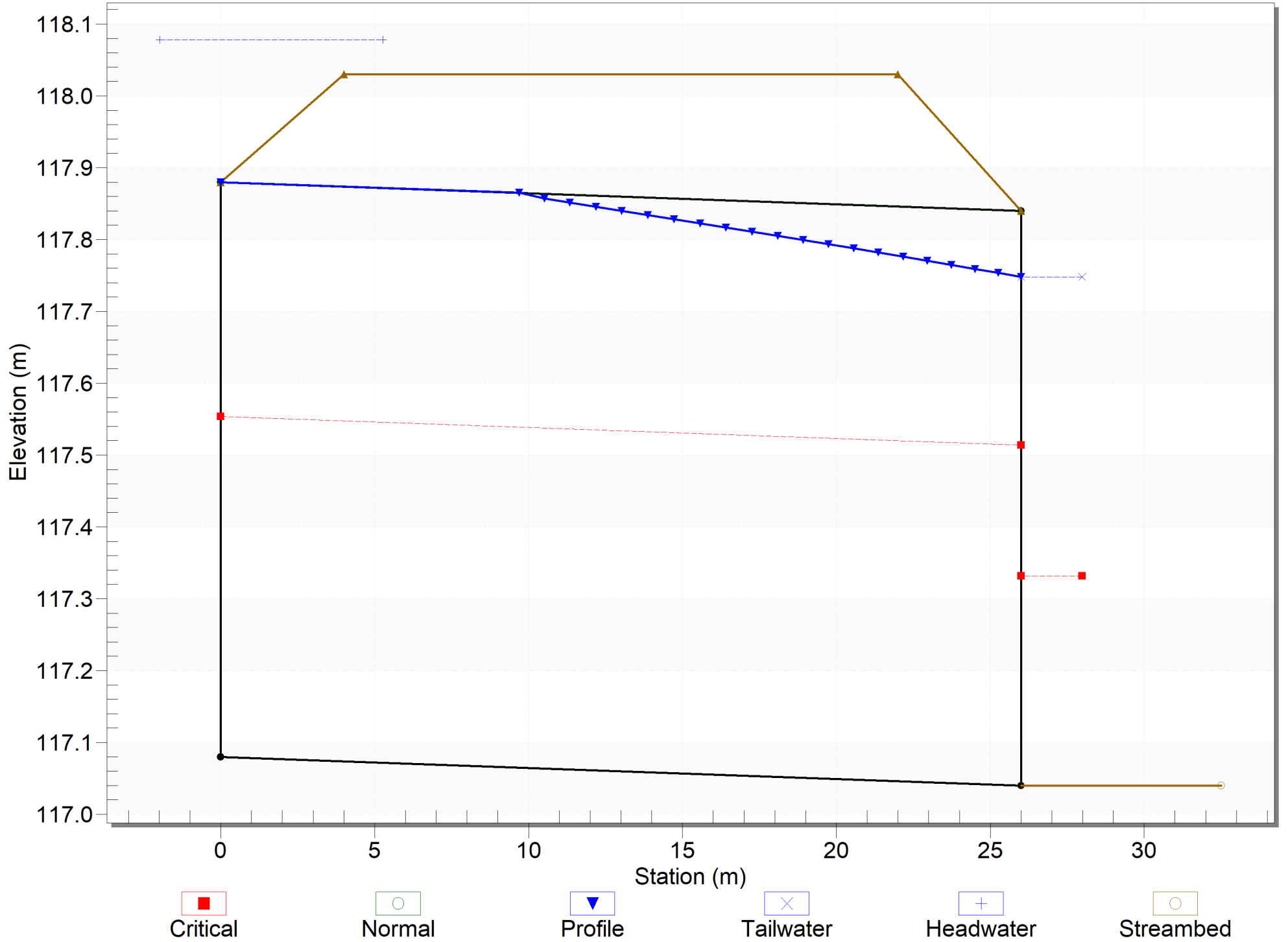
Culvert Crossing: 141 Wescar Ln Entrance Culvert (Drainage Area A)

Culvert Summary Table - C-1 - 10m - 500mm

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	119.84	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.07	0.07	120.14	0.27	0.30	2-M2c	0.21	0.18	0.18	0.17	1.14	0.28
0.15	0.15	120.28	0.41	0.44	2-M2c	0.32	0.26	0.26	0.25	1.42	0.34
0.22	0.22	120.41	0.55	0.57	7-M2c	0.50	0.32	0.32	0.31	1.65	0.37
0.29	0.29	120.60	0.72	0.76	7-M2c	0.50	0.37	0.37	0.35	1.88	0.40
0.37	0.37	120.87	0.93	1.03	7-M2c	0.50	0.41	0.41	0.39	2.12	0.43
0.44	0.44	121.17	1.20	1.33	7-M2c	0.50	0.44	0.44	0.43	2.39	0.45
0.51	0.48	121.37	1.38	1.53	7-M2t	0.50	0.46	0.46	0.46	2.55	0.47
0.59	0.48	121.39	1.39	1.55	7-M2t	0.50	0.46	0.50	0.49	2.48	0.49
0.66	0.48	121.40	1.39	1.56	4-FFf	0.50	0.46	0.50	0.52	2.45	0.50
0.73	0.48	121.42	1.38	1.58	4-FFf	0.50	0.46	0.50	0.54	2.44	0.51

Crossing - Wescar Ln Culvert at Cardevco Rd (Drainage Area A+B), Design Discharge - 0.76 cms

Culvert - C-2 - 26m -800mm, Culvert Discharge - 0.61 cms



HY-8 Culvert Analysis Report

Culvert Data: C-2 - 26m -800mm

Culvert Data Summary - C-2 - 26m -800mm

Barrel Shape: Circular

Barrel Diameter: 800.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting ($K_e=0.9$)

Inlet Depression: None

Site Data - C-2 - 26m -800mm

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 117.08 m

Outlet Station: 26.00 m

Outlet Elevation: 117.04 m

Number of Barrels: 1

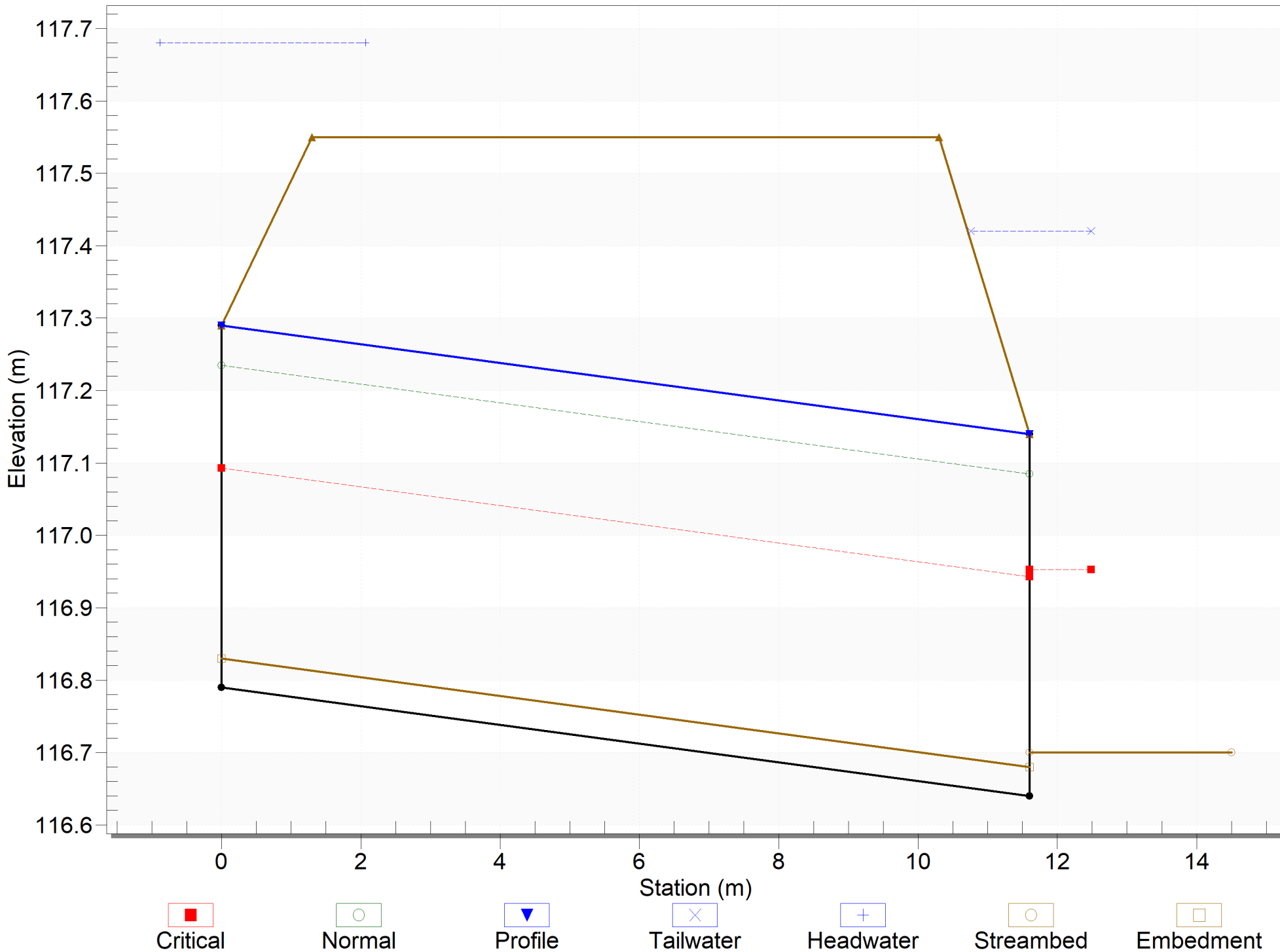
Culvert Crossing: Wescar Ln Culvert at Cardevco Rd (Drainage Area A+B)

Culvert Summary Table - C-2 - 26m -800mm

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	117.08	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.08	0.08	117.37	0.24	0.29	3-M2t	0.28	0.16	0.24	0.24	0.61	0.19
0.15	0.15	117.50	0.34	0.42	3-M2t	0.42	0.23	0.34	0.34	0.77	0.23
0.23	0.23	117.60	0.43	0.52	3-M2t	0.55	0.28	0.41	0.41	0.89	0.25
0.31	0.31	117.68	0.50	0.60	3-M2t	0.80	0.33	0.47	0.47	1.00	0.27
0.38	0.38	117.77	0.57	0.69	3-M2t	0.80	0.37	0.52	0.52	1.11	0.29
0.46	0.46	117.85	0.64	0.77	3-M2t	0.80	0.41	0.56	0.56	1.21	0.30
0.53	0.53	117.93	0.71	0.85	3-M2t	0.80	0.44	0.60	0.60	1.31	0.32
0.61	0.61	118.03	0.78	0.95	7-M2t	0.80	0.47	0.64	0.64	1.42	0.33
0.69	0.62	118.06	0.79	0.98	7-M2t	0.80	0.48	0.68	0.68	1.36	0.34
0.76	0.61	118.08	0.78	1.00	7-M2t	0.80	0.47	0.71	0.71	1.30	0.35

Crossing - 135 Cardevco Rd Entrance Culvert (Drainage Areas A+B+C+D), Design Discharge - 0.96 cms

Culvert - C-3 - 11.6m - 500mm, Culvert Discharge - 0.18 cms



HY-8 Culvert Analysis Report

Culvert Data: C-3 - 11.6m - 500mm

Culvert Data Summary - C-3 - 11.6m - 500mm

Barrel Shape: Circular

Barrel Diameter: 500.00 mm

Barrel Material: Corrugated Steel

Embedment: 40.00 mm

Barrel Manning's n: 0.0240 (top and sides)

Manning's n: 0.0350 (bottom)

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting ($K_e=0.9$)

Inlet Depression: None

Site Data - C-3 - 11.6m - 500mm

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 116.79 m

Outlet Station: 11.60 m

Outlet Elevation: 116.64 m

Number of Barrels: 1

Culvert Crossing: 135 Cardevco Rd Entrance Culvert (Drainage Areas A+B+C+D)

Culvert Summary Table - C-3 - 11.6m - 500mm

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	117.42	0.00	0.59	0-NF	0.00	0.00	0.46	0.72	0.00	0.00
0.10	0.10	117.51	0.31	0.68	4-FFf	0.25	0.18	0.46	0.72	0.51	0.00
0.19	0.13	117.57	0.38	0.74	4-FFf	0.31	0.22	0.46	0.72	0.70	0.00
0.29	0.14	117.59	0.40	0.76	4-FFf	0.33	0.23	0.46	0.72	0.75	0.00
0.39	0.15	117.61	0.41	0.78	4-FFf	0.34	0.24	0.46	0.72	0.79	0.00
0.48	0.15	117.62	0.42	0.79	4-FFf	0.35	0.24	0.46	0.72	0.82	0.00
0.58	0.16	117.64	0.43	0.81	4-FFf	0.36	0.25	0.46	0.72	0.85	0.00
0.67	0.16	117.65	0.44	0.82	4-FFf	0.37	0.25	0.46	0.72	0.88	0.00
0.77	0.17	117.66	0.45	0.83	4-FFf	0.38	0.26	0.46	0.72	0.90	0.00
0.87	0.17	117.67	0.46	0.84	4-FFf	0.39	0.26	0.46	0.72	0.93	0.00
0.96	0.18	117.68	0.47	0.85	4-FFf	0.40	0.26	0.46	0.72	0.95	0.00

Peak Flow Calculations - Roadside Ditches
Existing Conditions
106 to 154 & 162 to 173 Wescar Lane
and 121 to 127 Cardevco Road
+
Proposed Development 151-159 Wescar Lane
Cardevco Subdivision
Ottawa, Ontario

2-Year Event

Drainage Area A

		C
Roof Area:	0.47 ha	0.90
Hard Area:	3.47 ha	0.90
Gravel Area:	0.43 ha	0.80
Soft Area:	<u>1.40 ha</u>	<u>0.20</u>
Total Catchment Area:	5.76 ha	0.72
Time of Concentration:	20 min	
Length of Ditch (Ld):	263 m	
Ditch Flow Velocity (V):	0.39 m/s	
Time of Concentration (Ditch Flow):	11.2 min	
Time of Concentration (Tc):	31.2 min	
Area (A):	5.76 ha	
Time of Concentration:	31.2 min	
Rainfall Intensity (i):	39 mm/hr (2-Year Event)	
Runoff Coefficient (C):	0.72	
Rational Method 2-Year Flow (Q):	450.9 L/s	

Ditch Slope: 0.8%
Ditch Manning Roughness Coefficient n: 0.10 dense weeds / brush as high as flow

Side Slope: 3 :1
Lot Side Slope: 3 :1
Ditch Bottom Width: 1 m
Water Depth: 0.48 m

Water Top Width: 3.85 m
Water Cross-Section Area: 1.15 sq.m
Wetted Perimeter: 4.00 m
Hydraulic Radius: 0.29 m

Velocity: 0.39 m/s Based on water depth
Velocity: 0.39 m/s Using Manning's Formula:

Drainage Area B
(10-Year Event)

			C
Roof Area:	0.15	ha	0.90
Hard Area:	0.49	ha	0.90
Gravel Area:	0.32	ha	0.80
Soft Area:	<u>0.79</u>	ha	<u>0.20</u>
Total Catchment Area:	1.75	ha	0.57

Drainage Area A + B

			C
Roof Area:	0.61	ha	0.90
Hard Area:	3.96	ha	0.90
Gravel Area:	0.75	ha	0.70
Soft Area:	<u>2.19</u>	ha	<u>0.20</u>
Total Catchment Area:	7.51	ha	0.68

Time of Concentration: 31.2 min (from Drainage Area A)

Length of Ditch (Ld): 238 m
 Ditch Flow Velocity (V): 0.46 m/s
 Time of Concentration (Ditch Flow): 8.6 min

Time of Concentration (Tc): 39.8 min

Area (A): 7.51 ha
 Time of Concentration: 39.8 min
 Rainfall Intensity (i): 33 mm/hr (2-Year Event)
 Runoff Coefficient (C): 0.68

Rational Method 2-Year Flow (Q): 464.9 L/s

Ditch Slope: 1.2%
 Ditch Manning Roughness Coefficient n: 0.10 dense weeds / brush as high as flow

Road Side Slope: 3 :1
 Lot Side Slope: 3 :1
 Ditch Bottom Width: 1 m
 Water Depth: 0.44 m

Water Top Width: 3.64 m
 Water Cross-Section Area: 1.02 sq.m
 Wetted Perimeter: 3.78 m
 Hydraulic Radius: 0.27 m

Velocity: 0.46 m/s Based on water depth
 Velocity: 0.46 m/s Using Manning's Formula:

Drainage Area C (10-Year Event)

			C
Roof Area:	0.24	ha	0.90
Hard Area:	0.57	ha	0.90
Gravel Area:	0.60	ha	0.80
Soft Area:	0.95	ha	0.20

Total Catchment Area: 2.36 ha 0.59

Time of Concentration: 20 min

Length of Ditch (Ld): 452 m

Ditch Flow Velocity (V): 0.31 m/s

Time of Concentration (Ditch Flow): 24.3 min

Time of Concentration (Tc): 44.3 min

Area (A): 2.36 ha

Time of Concentration: 44.3 min

Rainfall Intensity (i): 31 mm/hr (2-Year Event)

Runoff Coefficient (C): 0.59

Rational Method 2-Year Flow (Q): 119.2 L/s

Ditch Slope: 1.2%

Ditch Manning Roughness Coefficient n: 0.10 dense weeds / brush as high as flow

Side Slope: 3 :1

Lot Side Slope: 3 :1

Ditch Bottom Width: 1 m

Water Depth: 0.23 m

Water Top Width: 2.36 m

Water Cross-Section Area: 0.38 sq.m

Wetted Perimeter: 2.43 m

Hydraulic Radius: 0.16 m

Velocity: 0.31 m/s

Velocity: 0.31 m/s

Based on water depth

Using Manning's Formula:

Drainage Area D
(10-Year Event)

			C
Roof Area:	0.06	ha	0.90
Hard Area:	0.12	ha	0.90
Gravel Area:	0.47	ha	0.80
Soft Area:	<u>0.08</u>	ha	<u>0.20</u>
Total Catchment Area:	0.73	ha	0.76

Drainage Area A + B + C + D

			C
Roof Area:	0.92	ha	0.90
Hard Area:	4.64	ha	0.90
Gravel Area:	1.82	ha	0.80
Soft Area:	<u>3.22</u>	ha	<u>0.20</u>
Total Catchment Area:	10.60	ha	0.67

Time of Concentration: 44.3 min (from Drainage Area C)

Length of Ditch (Ld): 129 m
Ditch Flow Velocity (V): 0.79 m/s
Time of Concentration (Ditch Flow): 2.7 min

Time of Concentration (Tc): 47.0 min

Area (A): 10.60 ha
Time of Concentration: 47.0 min
Rainfall Intensity (i): 29 mm/hr (2-Year Event)
Runoff Coefficient (C): 0.67

Rational Method 2-Year Flow (Q): 579.1 L/s

Ditch Slope: 0.3%
Ditch Manning Roughness Coefficient n: 0.027 gravel / short grass

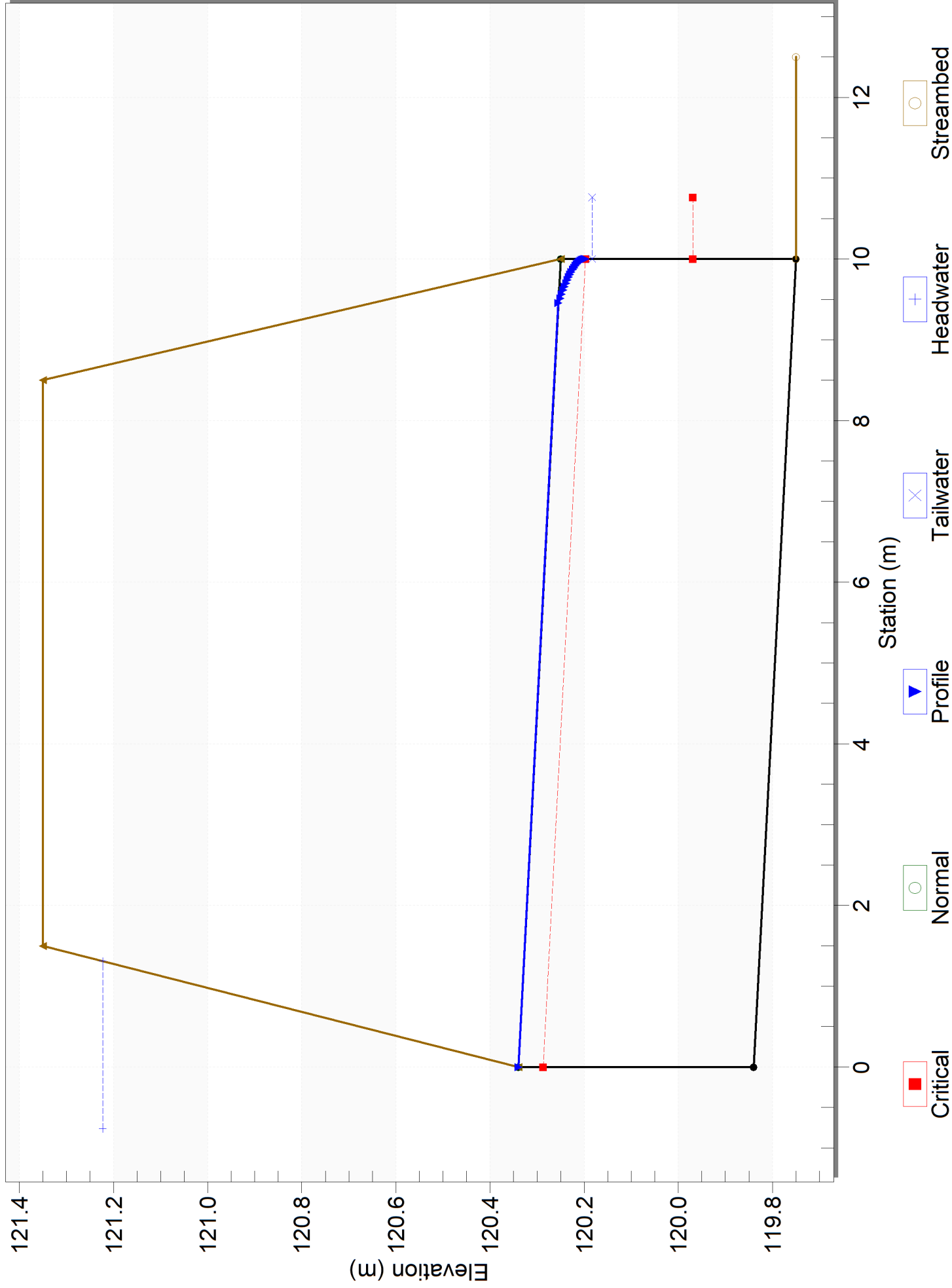
Road Side Slope: 3 :1
Lot Side Slope: 3 :1
Ditch Bottom Width: 1 m
Water Depth: 0.36 m

Water Top Width: 3.14 m
Water Cross-Section Area: 0.74 sq.m
Wetted Perimeter: 3.25 m
Hydraulic Radius: 0.23 m

Velocity: 0.79 m/s Based on water depth
Velocity: 0.79 m/s Using Manning's Formula:

Crossing - 141 Wescar Ln Entrance Culvert (Drainage Area A), Design Discharge - 0.45 cms

Culvert - C-1 - 10m - 500mm, Culvert Discharge - 0.45 cms



HY-8 Culvert Analysis Report

Culvert Data: C-1 - 10m - 500mm

Culvert Data Summary - C-1 - 10m - 500mm

Barrel Shape: Circular

Barrel Diameter: 500.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting ($K_e=0.9$)

Inlet Depression: None

Site Data - C-1 - 10m - 500mm

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 119.84 m

Outlet Station: 10.00 m

Outlet Elevation: 119.75 m

Number of Barrels: 1

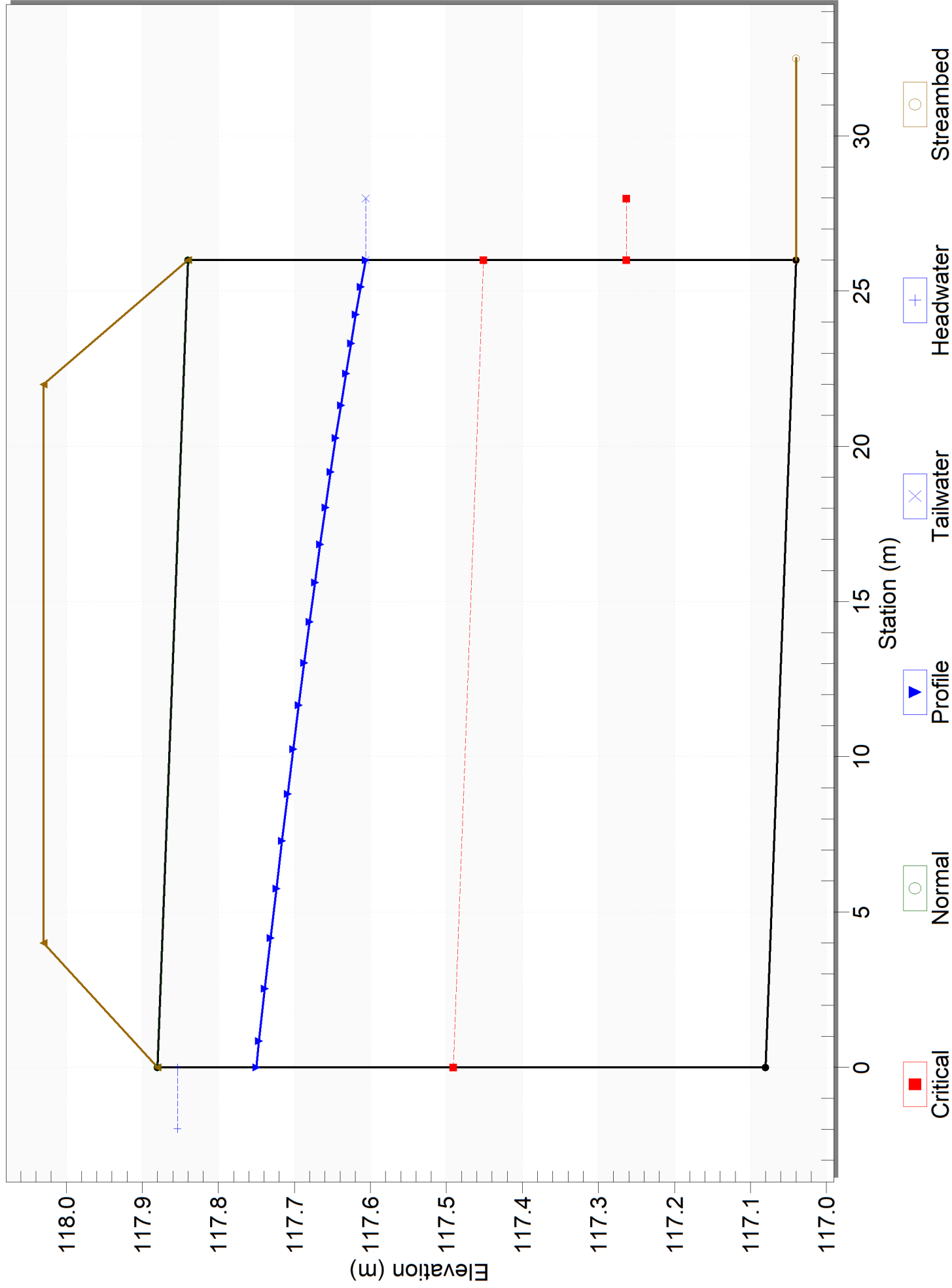
Culvert Crossing: 141 Wescar Ln Entrance Culvert (Drainage Area A)

Culvert Summary Table - C-1 - 10m - 500mm

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	119.84	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.05	0.05	120.07	0.21	0.23	2-M2c	0.16	0.14	0.14	0.13	0.99	0.24
0.09	0.09	120.17	0.30	0.33	2-M2c	0.24	0.20	0.20	0.19	1.22	0.29
0.14	0.14	120.26	0.39	0.42	2-M2c	0.31	0.25	0.25	0.24	1.38	0.33
0.18	0.18	120.34	0.47	0.50	2-M2c	0.38	0.29	0.29	0.28	1.53	0.36
0.23	0.23	120.42	0.56	0.58	7-M2c	0.50	0.33	0.33	0.31	1.67	0.38
0.27	0.27	120.53	0.66	0.69	7-M2c	0.50	0.36	0.36	0.34	1.80	0.40
0.32	0.32	120.67	0.77	0.83	7-M2c	0.50	0.39	0.39	0.37	1.95	0.41
0.36	0.36	120.84	0.91	1.00	7-M2c	0.50	0.41	0.41	0.39	2.10	0.43
0.41	0.41	121.02	1.07	1.18	7-M2c	0.50	0.43	0.43	0.41	2.26	0.44
0.45	0.45	121.22	1.25	1.38	7-M2c	0.50	0.45	0.45	0.43	2.43	0.45

Crossing - Wescar Ln Culvert at Cardevco Rd (Drainage Area A+B), Design Discharge - 0.47 cms

Culvert - C-2 - 26m - 800mm, Culvert Discharge - 0.47 cms



HY-8 Culvert Analysis Report

Culvert Data: C-2 - 26m -800mm

Culvert Data Summary - C-2 - 26m -800mm

Barrel Shape: Circular

Barrel Diameter: 800.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting ($K_e=0.9$)

Inlet Depression: None

Site Data - C-2 - 26m -800mm

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 117.08 m

Outlet Station: 26.00 m

Outlet Elevation: 117.04 m

Number of Barrels: 1

Culvert Crossing: Wescar Ln Culvert at Cardevco Rd (Drainage Area A+B)

Culvert Summary Table - C-2 - 26m -800mm

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	117.08	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.05	0.05	117.31	0.18	0.23	3-M2t	0.22	0.13	0.18	0.18	0.54	0.16
0.09	0.09	117.40	0.26	0.32	3-M2t	0.32	0.18	0.26	0.26	0.65	0.20
0.14	0.14	117.48	0.33	0.40	3-M2t	0.40	0.22	0.32	0.32	0.74	0.22
0.19	0.19	117.54	0.38	0.46	3-M2t	0.47	0.26	0.37	0.37	0.82	0.24
0.23	0.23	117.60	0.43	0.52	3-M2t	0.55	0.29	0.41	0.41	0.90	0.25
0.28	0.28	117.65	0.48	0.57	3-M2t	0.65	0.31	0.45	0.45	0.97	0.27
0.33	0.33	117.71	0.52	0.63	3-M2t	0.80	0.34	0.48	0.48	1.03	0.28
0.37	0.37	117.76	0.56	0.68	3-M2t	0.80	0.37	0.51	0.51	1.10	0.29
0.42	0.42	117.80	0.61	0.72	3-M2t	0.80	0.39	0.54	0.54	1.16	0.30
0.47	0.47	117.85	0.65	0.77	3-M2t	0.80	0.41	0.57	0.57	1.22	0.30

Crossing - 135 Cardevco Rd Entrance Culvert (Drainage Areas A+B+C+D), Design Discharge - 0.58 cms

Culvert - C-3 - 11.6m - 500mm, Culvert Discharge - 0.16 cms



HY-8 Culvert Analysis Report

Culvert Data: C-3 - 11.6m - 500mm

Culvert Data Summary - C-3 - 11.6m - 500mm

Barrel Shape: Circular

Barrel Diameter: 500.00 mm

Barrel Material: Corrugated Steel

Embedment: 40.00 mm

Barrel Manning's n: 0.0240 (top and sides)

Manning's n: 0.0350 (bottom)

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting ($K_e=0.9$)

Inlet Depression: None

Site Data - C-3 - 11.6m - 500mm

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 116.79 m

Outlet Station: 11.60 m

Outlet Elevation: 116.64 m

Number of Barrels: 1

Culvert Crossing: 135 Cardevco Rd Entrance Culvert (Drainage Areas A+B+C+D)

Culvert Summary Table - C-3 - 11.6m - 500mm

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	117.42	0.00	0.59	0-NF	0.00	0.00	0.46	0.72	0.00	0.00
0.06	0.06	117.45	0.22	0.62	4-FFf	0.19	0.14	0.46	0.72	0.31	0.00
0.12	0.12	117.54	0.35	0.71	4-FFf	0.28	0.21	0.46	0.72	0.62	0.00
0.17	0.13	117.57	0.37	0.74	4-FFf	0.31	0.22	0.46	0.72	0.69	0.00
0.23	0.14	117.58	0.39	0.75	4-FFf	0.32	0.23	0.46	0.72	0.72	0.00
0.29	0.14	117.59	0.40	0.76	4-FFf	0.33	0.23	0.46	0.72	0.75	0.00
0.35	0.15	117.60	0.40	0.77	4-FFf	0.33	0.23	0.46	0.72	0.78	0.00
0.41	0.15	117.61	0.41	0.78	4-FFf	0.34	0.24	0.46	0.72	0.80	0.00
0.46	0.15	117.62	0.42	0.79	4-FFf	0.35	0.24	0.46	0.72	0.82	0.00
0.52	0.16	117.63	0.43	0.80	4-FFf	0.36	0.24	0.46	0.72	0.84	0.00
0.58	0.16	117.64	0.43	0.81	4-FFf	0.36	0.25	0.46	0.72	0.85	0.00

APPENDIX D

DITCH & CULVERT CALCULATIONS
CULVERTS SIZED AS PER ORIGINAL DRAINAGE REPORT
106 TO 154 & 162 TO 173 WESCAR LANE
AND 121 TO 127 CARDEVCO ROAD
+
PROPOSED DEVELOPMENT 151-159 WESCAR LANE
WITH 1.7 HA DRAINING TO CAVANMORE ROAD

Peak Flow Calculations - Roadside Ditches
Existing Conditions
106 to 154 & 162 to 173 Wescar Lane
and 121 to 127 Cardevco Road
+
Proposed Development 151-159 Wescar Lane
(with 1.7 ha draining to Cavanmore Road)
Cardevco Subdivision
Ottawa, Ontario

10-Year Event

Drainage Area A (5.76 ha less 1.0 ha)

	C	
Roof Area:	0.33	ha 0.90
Hard Area:	2.44	ha 0.90
Gravel Area:	0.30	ha 0.80
Soft Area:	0.99	ha 0.20
Total Catchment Area:	4.06	ha 0.72
Time of Concentration:	20	min
Length of Ditch (Ld):	263	m
Ditch Flow Velocity (V):	1.11	m/s
Time of Concentration (Ditch Flow):	3.9	min
Time of Concentration (Tc):	23.9	min
Area (A):	4.06	ha
Time of Concentration:	23.9	min
Rainfall Intensity (i):	73	mm/hr (10-Year Event)
Runoff Coefficient (C):	0.72	
Rational Method 10-Year Flow (Q):	597.5	L/s
Ditch Slope:	0.8%	
Ditch Manning Roughness Coefficient n:	0.027	gravel / short grass
Side Slope:	3	:1
Lot Side Slope:	3	:1
Ditch Bottom Width:	1	m
Water Depth:	0.29	m
Water Top Width:	2.73	m
Water Cross-Section Area:	0.54	sq.m
Wetted Perimeter:	2.82	m
Hydraulic Radius:	0.19	m
Velocity:	1.11	m/s
Velocity:	1.11	m/s

Based on water depth
Using Manning's Formula:

Drainage Area B (10-Year Event)

			C
Roof Area:	0.15	ha	0.90
Hard Area:	0.49	ha	0.90
Gravel Area:	0.32	ha	0.80
Soft Area:	0.79	ha	0.20
Total Catchment Area:	1.75	ha	0.57

Drainage Area A + B

			C
Roof Area:	0.48	ha	0.90
Hard Area:	2.93	ha	0.90
Gravel Area:	0.62	ha	0.70
Soft Area:	1.78	ha	0.20
Total Catchment Area:	5.81	ha	0.66

Time of Concentration: 23.9 min (from Drainage Area A)

Length of Ditch (Ld): 238 m

Ditch Flow Velocity (V): 1.34 m/s

Time of Concentration (Ditch Flow): 3.0 min

Time of Concentration (Tc): 26.9 min

Area (A): 5.81 ha

Time of Concentration: 26.9 min

Rainfall Intensity (i): 68 mm/hr (10-Year Event)

Runoff Coefficient (C): 0.66

Rational Method 10-Year Flow (Q): 727.9 L/s

Ditch Slope: 1.2%

Ditch Manning Roughness Coefficient n: 0.027 gravel / short grass

Road Side Slope: 3 :1

Lot Side Slope: 3 :1

Ditch Bottom Width: 1 m

Water Depth: 0.29 m

Water Top Width: 2.74 m

Water Cross-Section Area: 0.54 sq.m

Wetted Perimeter: 2.83 m

Hydraulic Radius: 0.19 m

Velocity: 1.34 m/s

Velocity: 1.34 m/s

Based on water depth
Using Manning's Formula:

Drainage Area C (10-Year Event)

			C
Roof Area:	0.24	ha	0.90
Hard Area:	0.57	ha	0.90
Gravel Area:	0.60	ha	0.80
Soft Area:	0.95	ha	0.20

Total Catchment Area: 2.36 ha 0.59

Time of Concentration: 20 min

Length of Ditch (Ld): 452 m

Ditch Flow Velocity (V): 1.00 m/s

Time of Concentration (Ditch Flow): 7.5 min

Time of Concentration (Tc): 27.5 min

Area (A): 2.36 ha

Time of Concentration: 27.5 min

Rainfall Intensity (i): 67 mm/hr (10-Year Event)

Runoff Coefficient (C): 0.59

Rational Method 10-Year Flow (Q): 260.3 L/s

Ditch Slope: 1.2%

Ditch Manning Roughness Coefficient n: 0.027 gravel / short grass

Side Slope: 3 :1

Lot Side Slope: 3 :1

Ditch Bottom Width: 1 m

Water Depth: 0.17 m

Water Top Width: 2.03 m

Water Cross-Section Area: 0.26 sq.m

Wetted Perimeter: 2.09 m

Hydraulic Radius: 0.12 m

Velocity: 1.00 m/s

Velocity: 1.00 m/s

Based on water depth

Using Manning's Formula:

Drainage Area D
(10-Year Event)

			C
Roof Area:	0.06	ha	0.90
Hard Area:	0.12	ha	0.90
Gravel Area:	0.47	ha	0.80
Soft Area:	0.08	ha	0.20

Total Catchment Area: 0.73 ha 0.76

Drainage Area A + B + C + D

			C
Roof Area:	0.78	ha	0.90
Hard Area:	3.62	ha	0.90
Gravel Area:	1.69	ha	0.80
Soft Area:	2.81	ha	0.20

Total Catchment Area: 8.90 ha 0.66

Time of Concentration: 27.5 min (from Drainage Area C)

Length of Ditch (Ld): 129 m

Ditch Flow Velocity (V): 0.91 m/s

Time of Concentration (Ditch Flow): 2.4 min

Time of Concentration (Tc): 29.9 min

Area (A): 8.90 ha

Time of Concentration: 29.9 min

Rainfall Intensity (i): 63 mm/hr (10-Year Event)

Runoff Coefficient (C): 0.66

Rational Method 10-Year Flow (Q): 1032.7 L/s

Ditch Slope: 0.3%

Ditch Manning Roughness Coefficient n: 0.027 gravel / short grass

Road Side Slope: 3 :1

Lot Side Slope: 3 :1

Ditch Bottom Width: 1 m

Water Depth: 0.47 m

Water Top Width: 3.82 m

Water Cross-Section Area: 1.13 sq.m

Wetted Perimeter: 3.97 m

Hydraulic Radius: 0.28 m

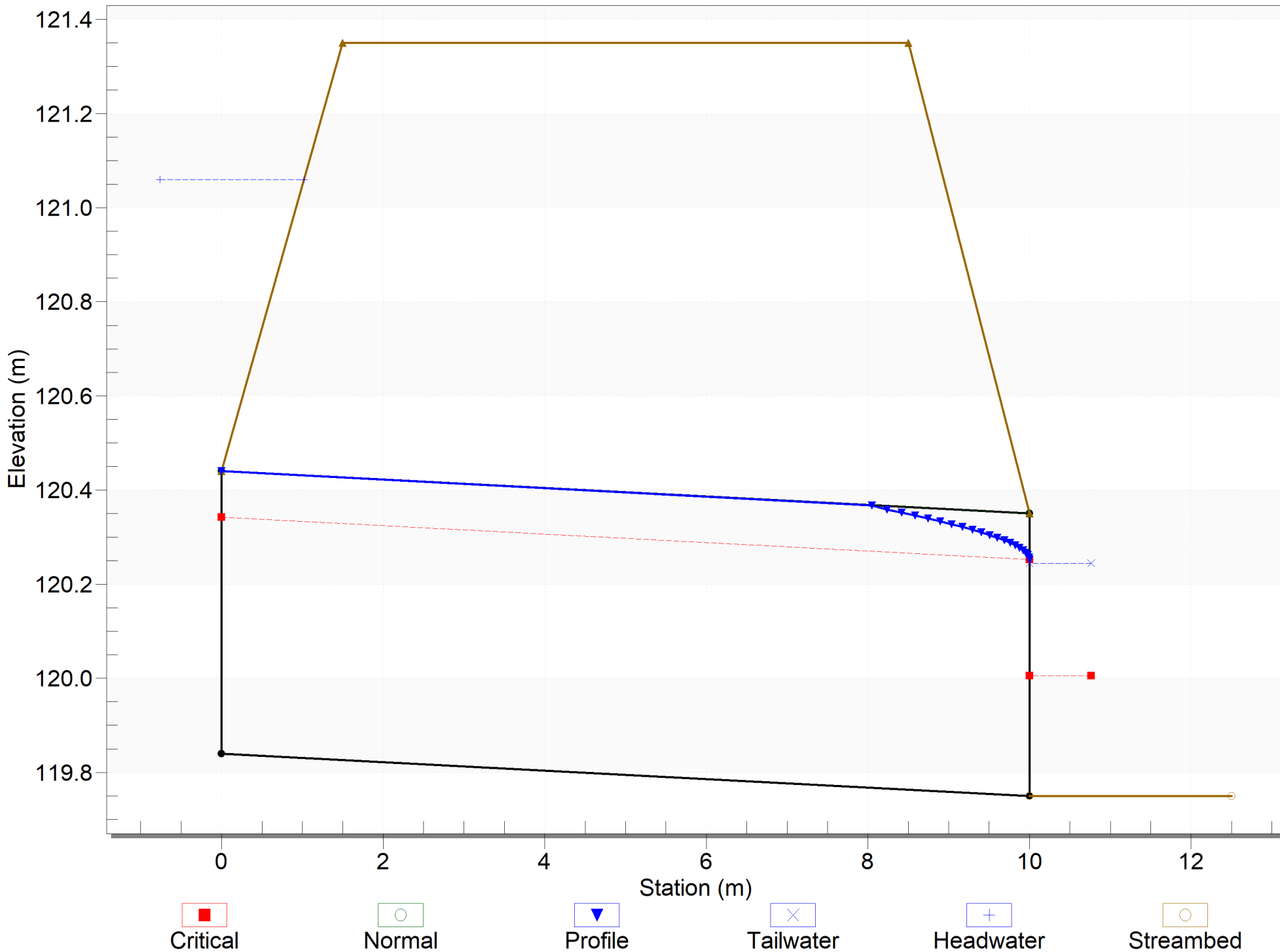
Velocity: 0.91 m/s

Velocity: 0.91 m/s

Based on water depth
Using Manning's Formula:

Crossing - 141 Wescar Ln Entrance Culvert (Drainage Area A), Design Discharge - 0.60 cms

Culvert - C-1 - 10m - 600mm, Culvert Discharge - 0.60 cms



HY-8 Culvert Analysis Report

Culvert Data: C-1 - 10m - 600mm

Culvert Data Summary - C-1 - 10m - 600mm

Barrel Shape: Circular

Barrel Diameter: 600.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting ($K_e=0.9$)

Inlet Depression: None

Site Data - C-1 - 10m - 600mm

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 119.84 m

Outlet Station: 10.00 m

Outlet Elevation: 119.75 m

Number of Barrels: 1

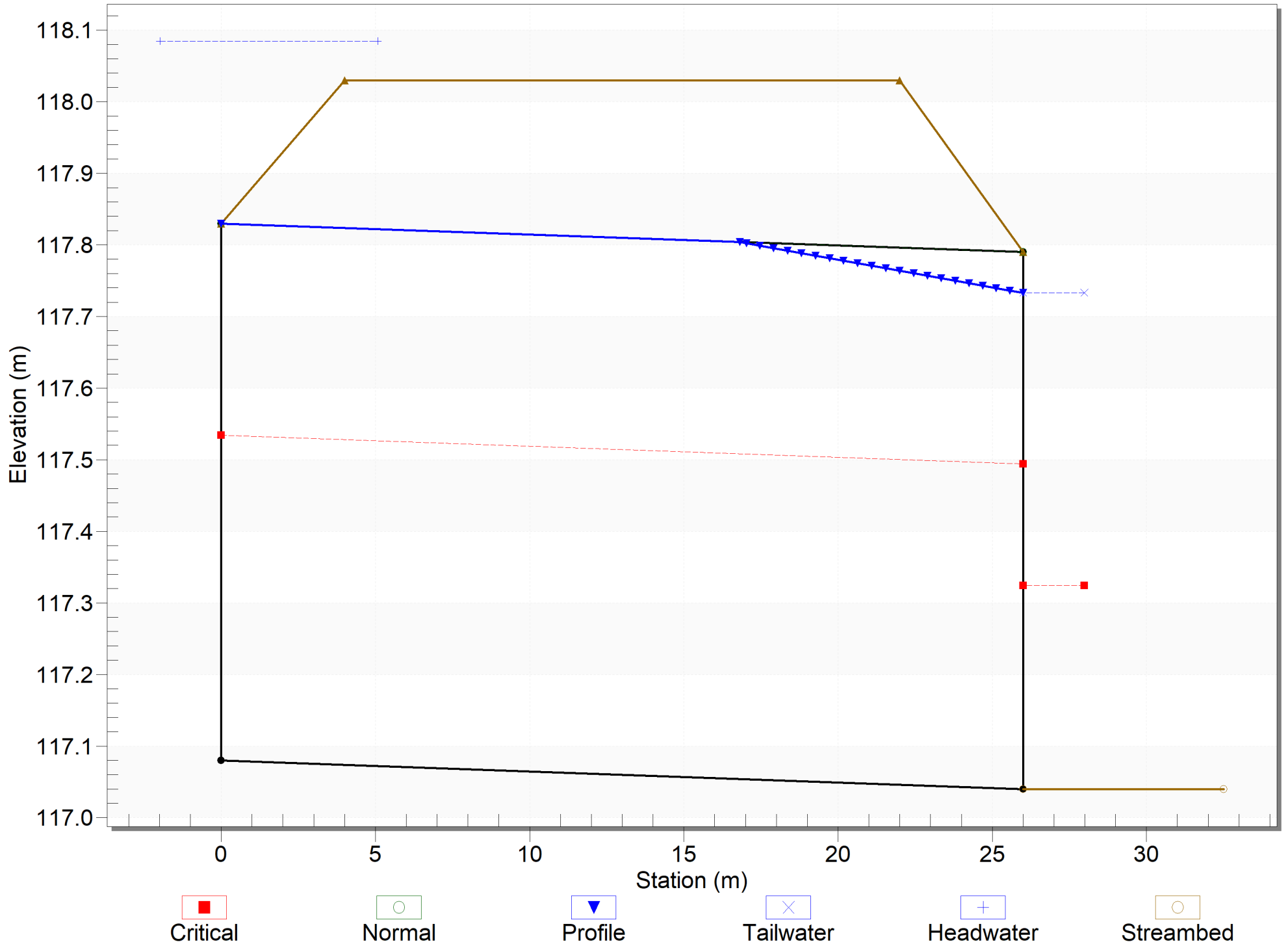
Culvert Crossing: 141 Wescar Ln Entrance Culvert (Drainage Area A)

Culvert Summary Table - C-1 - 10m - 600mm

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	119.84	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.06	0.06	120.09	0.23	0.25	3-M2t	0.18	0.15	0.16	0.16	1.02	0.26
0.12	0.12	120.20	0.33	0.36	3-M2t	0.26	0.22	0.23	0.23	1.23	0.32
0.18	0.18	120.29	0.42	0.45	3-M2t	0.32	0.27	0.28	0.28	1.41	0.35
0.24	0.24	120.38	0.50	0.54	3-M2t	0.39	0.32	0.32	0.32	1.57	0.38
0.30	0.30	120.46	0.59	0.62	7-M2c	0.46	0.36	0.36	0.36	1.71	0.41
0.36	0.36	120.54	0.68	0.70	7-M2c	0.60	0.39	0.39	0.39	1.83	0.43
0.42	0.42	120.63	0.78	0.79	7-M2c	0.60	0.42	0.42	0.42	1.96	0.44
0.48	0.48	120.75	0.89	0.91	7-M2c	0.60	0.45	0.45	0.45	2.09	0.46
0.54	0.54	120.90	1.02	1.06	7-M2c	0.60	0.48	0.48	0.47	2.22	0.47
0.60	0.60	121.06	1.17	1.22	7-M2c	0.60	0.50	0.50	0.49	2.37	0.49

Crossing - Wescar Ln Culvert at Cardevco Rd (Drainage Area A+B), Design Discharge - 0.73 cms

Culvert - C-2 - 26m -750mm, Culvert Discharge - 0.54 cms



HY-8 Culvert Analysis Report

Culvert Data: C-2 - 26m -750mm

Culvert Data Summary - C-2 - 26m -750mm

Barrel Shape: Circular

Barrel Diameter: 750.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting ($K_e=0.9$)

Inlet Depression: None

Site Data - C-2 - 26m -750mm

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 117.08 m

Outlet Station: 26.00 m

Outlet Elevation: 117.04 m

Number of Barrels: 1

Culvert Crossing: Wescar Ln Culvert at Cardevco Rd (Drainage Area A+B)

Culvert Summary Table - C-2 - 26m -750mm

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	117.08	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.07	0.07	117.37	0.24	0.29	3-M2t	0.29	0.16	0.23	0.23	0.63	0.19
0.15	0.15	117.49	0.34	0.41	3-M2t	0.42	0.23	0.33	0.33	0.79	0.22
0.22	0.22	117.60	0.43	0.52	3-M2t	0.57	0.28	0.40	0.40	0.92	0.25
0.29	0.29	117.69	0.50	0.61	3-M2t	0.75	0.33	0.46	0.46	1.04	0.27
0.36	0.36	117.77	0.58	0.69	3-M2t	0.75	0.37	0.51	0.51	1.15	0.29
0.44	0.44	117.86	0.65	0.78	3-M2t	0.75	0.41	0.55	0.55	1.26	0.30
0.51	0.51	117.96	0.72	0.88	7-M2t	0.75	0.44	0.59	0.59	1.37	0.31
0.58	0.55	118.05	0.77	0.97	7-M2t	0.75	0.46	0.63	0.63	1.41	0.32
0.66	0.55	118.07	0.76	0.99	7-M2t	0.75	0.46	0.66	0.66	1.33	0.33
0.73	0.54	118.08	0.75	1.00	7-M2t	0.75	0.45	0.69	0.69	1.27	0.34

HY-8 Culvert Analysis Report

Culvert Data: C-3 - 11.6m - 750mm

Culvert Data Summary - C-3 - 11.6m - 750mm

Barrel Shape: Circular

Barrel Diameter: 750.00 mm

Barrel Material: Corrugated Steel

Embedment: 75.00 mm

Barrel Manning's n: 0.0240 (top and sides)

Manning's n: 0.0350 (bottom)

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting ($K_e=0.9$)

Inlet Depression: None

Site Data - C-3 - 11.6m - 750mm

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 116.67 m

Outlet Station: 11.60 m

Outlet Elevation: 116.62 m

Number of Barrels: 1

Culvert Crossing: 135 Cardevco Rd Entrance Culvert (Drainage Areas A+B+C+D)

Culvert Summary Table - C-3 - 11.6m - 750mm

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	116.75	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.10	0.10	117.04	0.25	0.29	2-M2c	0.28	0.15	0.15	0.15	1.14	0.47
0.21	0.21	117.19	0.39	0.44	2-M2c	0.43	0.23	0.23	0.22	1.40	0.58
0.31	0.31	117.31	0.51	0.56	2-M2c	0.68	0.30	0.30	0.27	1.60	0.64
0.41	0.41	117.43	0.62	0.68	7-M2c	0.68	0.35	0.35	0.31	1.76	0.70
0.52	0.52	117.55	0.74	0.80	7-M2c	0.68	0.40	0.40	0.34	1.92	0.74
0.62	0.54	117.58	0.77	0.83	7-M2c	0.68	0.41	0.41	0.38	1.95	0.78
0.72	0.56	117.60	0.79	0.85	7-M2c	0.68	0.42	0.42	0.40	1.97	0.81
0.83	0.57	117.61	0.80	0.86	7-M2t	0.68	0.42	0.43	0.43	1.93	0.84
0.93	0.57	117.63	0.81	0.88	7-M2t	0.68	0.42	0.46	0.46	1.84	0.86
1.03	0.58	117.64	0.82	0.89	7-M2t	0.68	0.42	0.48	0.48	1.78	0.89

APPENDIX E

DITCH & CULVERT CALCULATIONS

EXISTING CONDITIONS

106 TO 154 & 162 TO 173 WESCAR LANE

AND 121 TO 127 CARDEVCO ROAD

+

PROPOSED DEVELOPMENT 151-159 WESCAR LANE

RESTRICTED FLOWS OF

165, 151-159, 141 & 131 WESCAR LANE

Peak Flow Calculations - Roadside Ditches
Existing Conditions 107 to 154 & 162 to 173 Wescar Lane
and 121 to 127 Cardevco Road

+

Proposed Development 151-159 Wescar Lane
Cardevco Subdivision
Ottawa, Ontario

10-Year Event (restricted flow)
(restricted flows of 165, 151-159, 141 & 131 Wescar Lane)

Drainage Area A
(restricted flows of 165, 151-159 & 141 Wescar Lane)

				C
Roof Area:	0.00	ha		0.90
Hard Area:	0.15	ha		0.90
Gravel Area:	0.29	ha		0.70
Soft Area:	0.18	ha		0.20
Total Catchment Area:	0.63	ha		0.60

Time of Concentration: 20 min

Length of Ditch (Ld): 263 m

Ditch Flow Velocity (V): 0.31 m/s

Time of Concentration (Ditch Flow): 14.1 min

Time of Concentration (Tc): 34.1 min

Area (A): 0.63 ha

Time of Concentration: 34.1 min

Rainfall Intensity (i): 58 mm/hr (10-Year Event)

Runoff Coefficient (C): 0.60

Rational Method 10-Year Flow (Q): 60.7 L/s

Restricted flow 165 Wescar Lane 32.9 L/s

Restricted flow 151-159 Wescar Lane 67.2 L/s

Restricted flow 141 Wescar Lane 30.4 L/s

Q: 191.1 L/s

Ditch Slope: 0.8%

Ditch Manning Roughness Coefficient n: 0.10 dense weeds as high as flow

Side Slope: 3 :1

Lot Side Slope: 3 :1

Ditch Bottom Width: 1 m

Water Depth: 0.32 m

Water Top Width: 2.89 m

Water Cross-Section Area: 0.61 sq.m

Wetted Perimeter: 2.99 m

Hydraulic Radius: 0.20 m

Velocity: 0.31 m/s

Velocity: 0.31 m/s

Based on water depth

Using Manning's Formula:

Drainage Area B

(10-Year Event (restricted flow)

(restricted flows of 131 Wescar Lane)

			C
Roof Area:	0.09	ha	0.90
Hard Area:	0.36	ha	0.90
Gravel Area:	0.32	ha	0.70
Soft Area:	0.67	ha	0.20
Total Catchment Area:	1.44	ha	0.53

Drainage Area A + B

(restricted flows of 165, 151-159, 141 & 131 Wescar Lane)

			C
Roof Area:	0.09	ha	0.90
Hard Area:	0.51	ha	0.90
Gravel Area:	0.61	ha	0.70
Soft Area:	0.86	ha	0.20
Total Catchment Area:	2.07	ha	0.55

Time of Concentration: 34.1 min (from Drainage Area A)

Length of Ditch (Ld): 238 m

Ditch Flow Velocity (V): 0.40 m/s

Time of Concentration (Ditch Flow): 9.9 min

Time of Concentration (Tc): 44.0 min

Area (A): 2.07 ha

Time of Concentration: 44.0 min

Rainfall Intensity (i): 48 mm/hr (10-Year Event)

Runoff Coefficient (C): 0.55

Rational Method 10-Year Flow (Q): 152.9 L/s

Restricted flow 165 Wescar Lane 32.9 L/s

Restricted flow 151-159 Wescar Lane 67.2 L/s

Restricted flow 141 Wescar Lane 30.4 L/s

Restricted flow 131 Wescar Lane 27.7 L/s

Q: 283.3 L/s

Ditch Slope: 1.2%

Ditch Manning Roughness Coefficient n: 0.10 dense weeds as high as flow

Side Slope: 3 :1

Lot Side Slope: 3 :1

Ditch Bottom Width: 1 m

Water Depth: 0.35 m

Water Top Width: 3.07 m

Water Cross-Section Area: 0.70 sq.m

Wetted Perimeter: 3.18 m

Hydraulic Radius: 0.22 m

Velocity: 0.40 m/s

Velocity: 0.40 m/s

Based on water depth

Using Manning's Formula:

Drainage Area C

(10-Year Event (restricted flow))

(restricted flows of 165, 151-159, 141 & 131 Wescar Lane)

			C
Roof Area:	0.24	ha	0.90
Hard Area:	0.57	ha	0.90
Gravel Area:	0.60	ha	0.80
Soft Area:	0.95	ha	0.20

Total Catchment Area: 2.36 ha 0.59

Time of Concentration: 20 min

Length of Ditch (Ld): 452 m

Ditch Flow Velocity (V): 0.36 m/s

Time of Concentration (Ditch Flow): 20.9 min

Time of Concentration (Tc): 40.9 min

Area (A): 2.36 ha

Time of Concentration: 40.9 min

Rainfall Intensity (i): 51 mm/hr (10-Year Event)

Runoff Coefficient (C): 0.59

Rational Method 10-Year Flow (Q): 198.0 L/s

Ditch Slope: 1.2%

Ditch Manning Roughness Coefficient n: 0.10 dense weeds as high as flow

Side Slope: 3 :1

Lot Side Slope: 3 :1

Ditch Bottom Width: 1 m

Water Depth: 0.30 m

Water Top Width: 2.77 m

Water Cross-Section Area: 0.56 sq.m

Wetted Perimeter: 2.87 m

Hydraulic Radius: 0.19 m

Velocity: 0.36 m/s

Velocity: 0.36 m/s

Based on water depth

Using Manning's Formula:

Drainage Area D

(10-Year Event (restricted flow))

			C
Roof Area:	0.06	ha	0.90
Hard Area:	0.12	ha	0.90
Gravel Area:	0.47	ha	0.70
Soft Area:	0.08	ha	0.20
Total Catchment Area:	0.73	ha	0.69

Drainage Area A + B + C + D

			C
Roof Area:	0.40	ha	0.90
Hard Area:	1.20	ha	0.90
Gravel Area:	1.68	ha	0.70
Soft Area:	1.89	ha	0.20
Total Catchment Area:	5.17	ha	0.58

Time of Concentration: 44.0 min (from Drainage Area A + B)

Length of Ditch (Ld): 129 m

Ditch Flow Velocity (V): 0.76 m/s

Time of Concentration (Ditch Flow): 2.8 min

Time of Concentration (Tc): 46.9 min

Area (A): 5.17 ha

Time of Concentration: 46.9 min

Rainfall Intensity (i): 46 mm/hr (10-Year Event)

Runoff Coefficient (C): 0.58

Rational Method 10-Year Flow (Q): 383.1 L/s

Restricted flow 165 Wescar Lane 32.9 L/s

Restricted flow 151-159 Wescar Lane 67.2 L/s

Restricted flow 141 Wescar Lane 30.4 L/s

Restricted flow 131 Wescar Lane 27.7 L/s

Q: 513.5 L/s

Ditch Slope: 0.3%

Ditch Manning Roughness Coefficient n: 0.027 gravel / short grass

Side Slope: 3 :1

Lot Side Slope: 3 :1

Ditch Bottom Width: 1 m

Water Depth: 0.34 m

Water Top Width: 3.01 m

Water Cross-Section Area: 0.67 sq.m

Wetted Perimeter: 3.12 m

Hydraulic Radius: 0.22 m

Velocity: 0.76 m/s

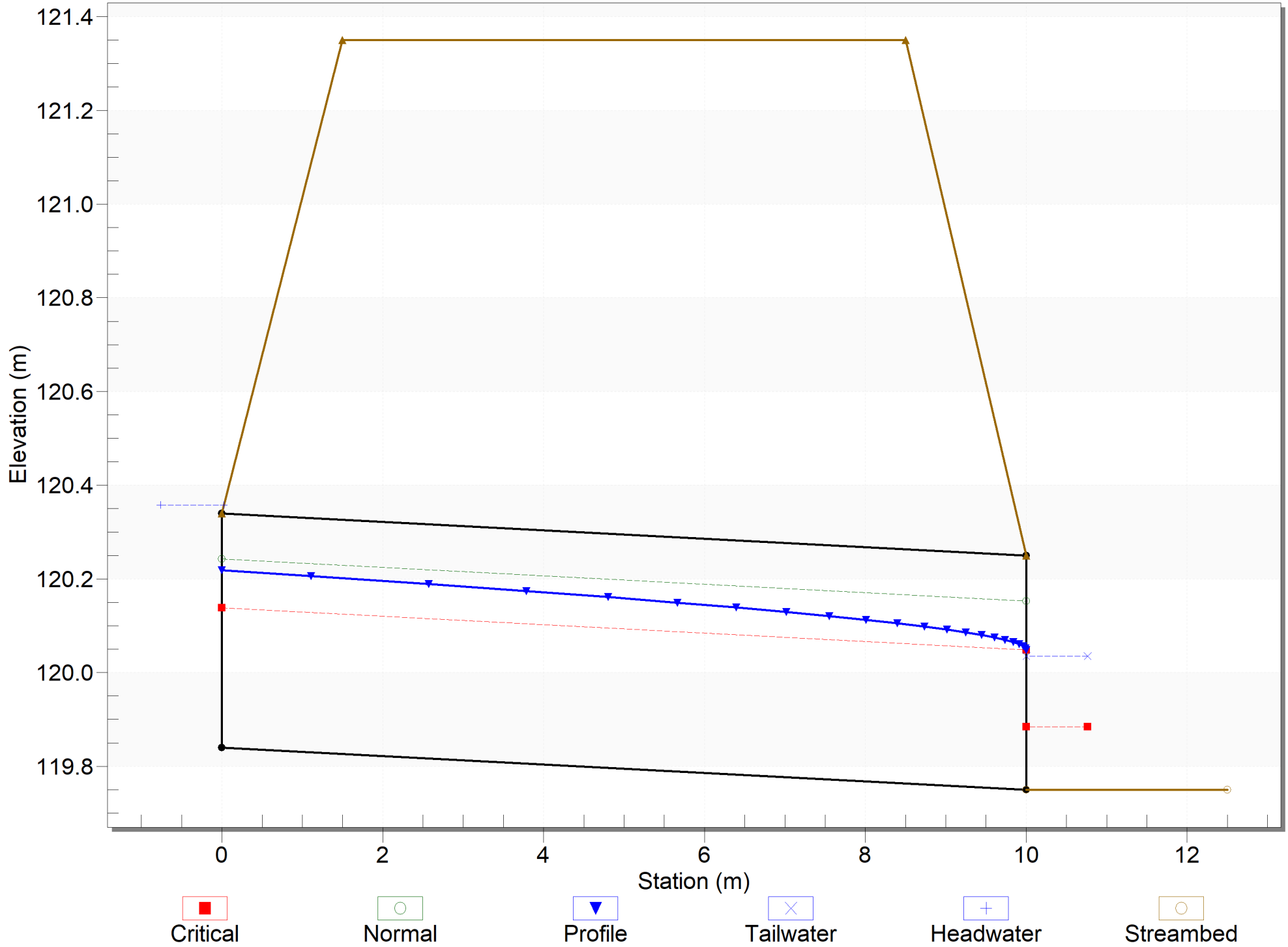
Velocity: 0.76 m/s

Based on water depth

Using Manning's Formula:

Crossing - 141 Wescar Ln Entrance Culvert (Drainage Area A), Design Discharge - 0.19 cms

Culvert - C-1 - 10m - 500mm, Culvert Discharge - 0.19 cms



HY-8 Culvert Analysis Report

Culvert Data: C-1 - 10m - 500mm

Culvert Data Summary - C-1 - 10m - 500mm

Barrel Shape: Circular

Barrel Diameter: 500.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting ($K_e=0.9$)

Inlet Depression: None

Site Data - C-1 - 10m - 500mm

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 119.84 m

Outlet Station: 10.00 m

Outlet Elevation: 119.75 m

Number of Barrels: 1

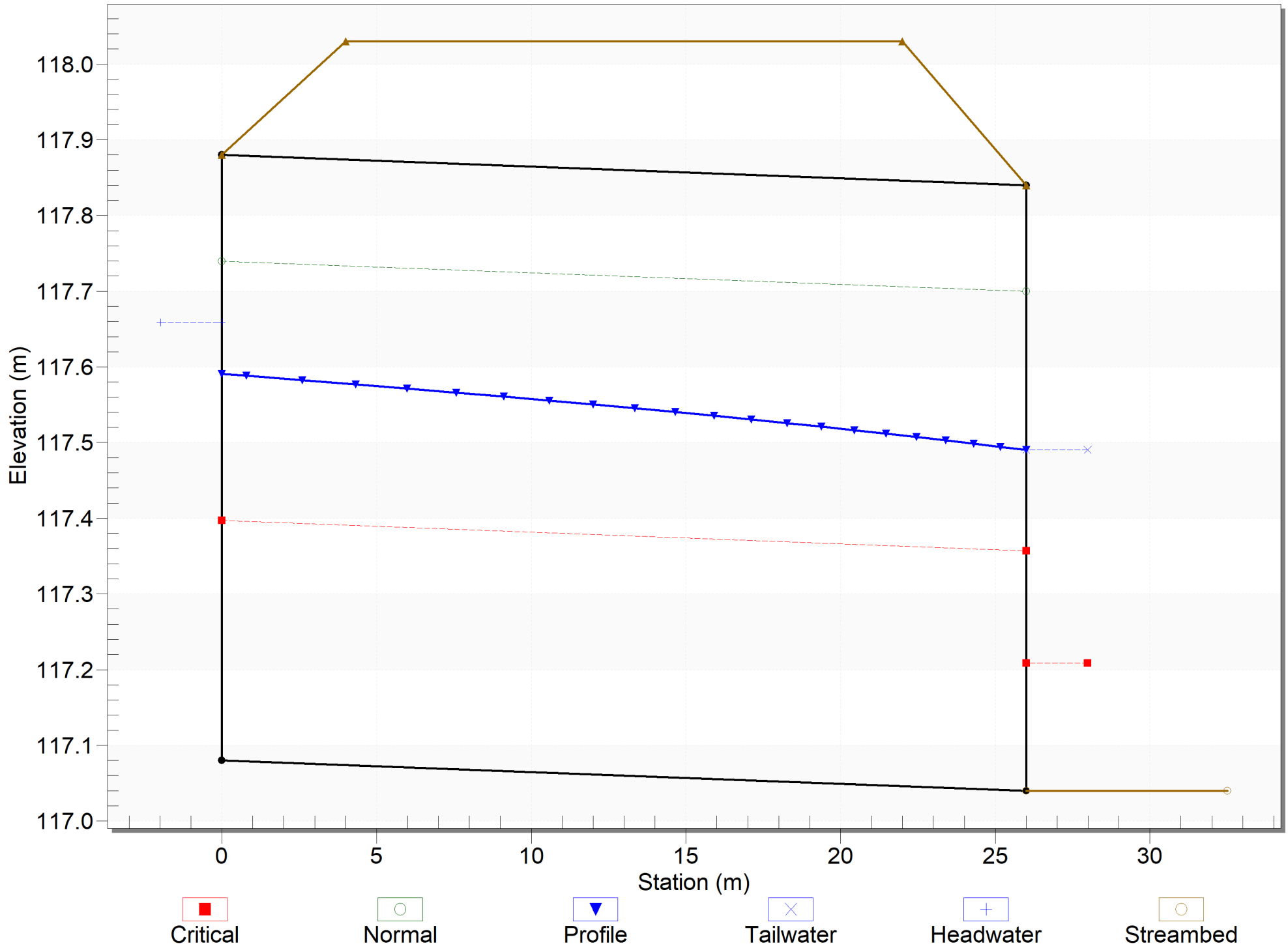
Culvert Crossing: 141 Wescar Ln Entrance Culvert (Drainage Area A)

Culvert Summary Table - C-1 - 10m - 500mm

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	119.84	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.02	0.02	119.98	0.13	0.14	2-M2c	0.11	0.09	0.09	0.08	0.79	0.18
0.04	0.04	120.05	0.19	0.21	2-M2c	0.15	0.13	0.13	0.12	0.95	0.23
0.06	0.06	120.10	0.24	0.26	2-M2c	0.19	0.16	0.16	0.15	1.06	0.26
0.08	0.08	120.14	0.28	0.30	2-M2c	0.22	0.18	0.18	0.18	1.16	0.28
0.10	0.10	120.18	0.31	0.34	2-M2c	0.25	0.21	0.21	0.20	1.24	0.30
0.11	0.11	120.22	0.35	0.38	2-M2c	0.28	0.23	0.23	0.22	1.31	0.31
0.13	0.13	120.25	0.39	0.41	2-M2c	0.30	0.25	0.25	0.24	1.38	0.33
0.15	0.15	120.29	0.42	0.45	2-M2c	0.33	0.27	0.27	0.26	1.44	0.34
0.17	0.17	120.32	0.45	0.48	2-M2c	0.37	0.28	0.28	0.27	1.50	0.35
0.19	0.19	120.36	0.49	0.52	7-M2c	0.40	0.30	0.30	0.29	1.56	0.36

Crossing - Wescar Ln Culvert at Cardevco Rd (Drainage Area A+B), Design Discharge - 0.28 cms

Culvert - C-2 - 26m -800mm, Culvert Discharge - 0.28 cms



HY-8 Culvert Analysis Report

Culvert Data: C-2 - 26m -800mm

Culvert Data Summary - C-2 - 26m -800mm

Barrel Shape: Circular

Barrel Diameter: 800.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting ($K_e=0.9$)

Inlet Depression: None

Site Data - C-2 - 26m -800mm

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 117.08 m

Outlet Station: 26.00 m

Outlet Elevation: 117.04 m

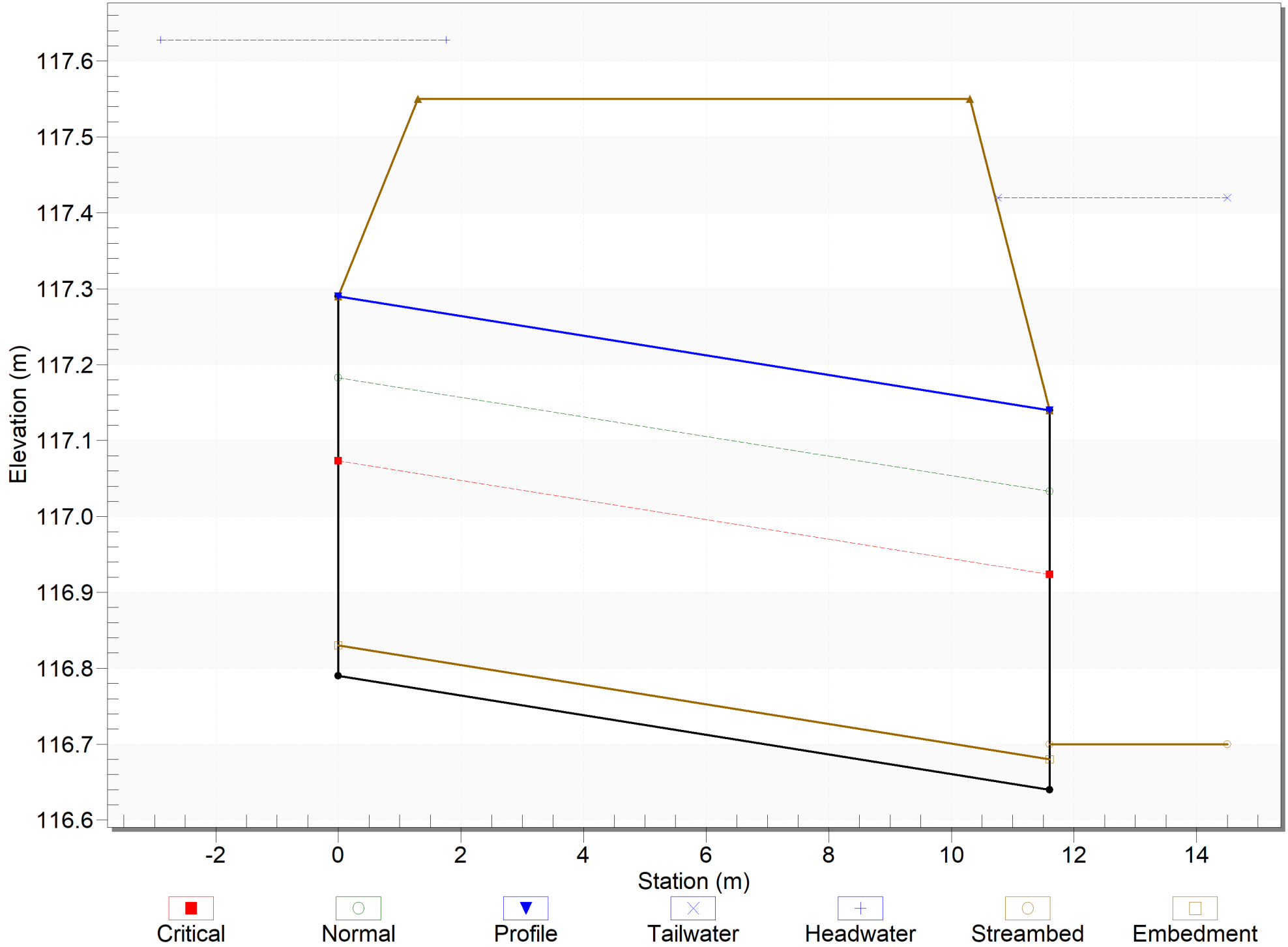
Number of Barrels: 1

Culvert Crossing: Wescar Ln Culvert at Cardevco Rd (Drainage Area A+B)

Culvert Summary Table - C-2 - 26m -800mm

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	117.08	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.03	0.03	117.26	0.14	0.18	3-M2t	0.17	0.10	0.14	0.14	0.48	0.14
0.06	0.06	117.33	0.20	0.25	3-M2t	0.24	0.14	0.20	0.20	0.56	0.17
0.08	0.08	117.39	0.25	0.31	3-M2t	0.30	0.17	0.25	0.25	0.63	0.19
0.11	0.11	117.44	0.29	0.36	3-M2t	0.35	0.20	0.29	0.29	0.69	0.21
0.14	0.14	117.48	0.33	0.40	3-M2t	0.40	0.22	0.32	0.32	0.74	0.22
0.17	0.17	117.52	0.36	0.44	3-M2t	0.45	0.24	0.35	0.35	0.79	0.23
0.20	0.20	117.56	0.39	0.48	3-M2t	0.49	0.26	0.38	0.38	0.84	0.24
0.23	0.23	117.59	0.42	0.51	3-M2t	0.54	0.28	0.41	0.41	0.89	0.25
0.25	0.25	117.63	0.45	0.55	3-M2t	0.60	0.30	0.43	0.43	0.93	0.26
0.28	0.28	117.66	0.48	0.58	3-M2t	0.66	0.32	0.45	0.45	0.97	0.27

Crossing - 135 Cardevco Rd Entrance Culvert (Drainage Areas A+B+C+D), Design Discharge - 0.51 cms
 Culvert - C-3 - 11.6m - 500mm, Culvert Discharge - 0.16 cms



HY-8 Culvert Analysis Report

Culvert Data: C-3 - 11.6m - 500mm

Culvert Data Summary - C-3 - 11.6m - 500mm

Barrel Shape: Circular

Barrel Diameter: 500.00 mm

Barrel Material: Corrugated Steel

Embedment: 40.00 mm

Barrel Manning's n: 0.0240 (top and sides)

Manning's n: 0.0350 (bottom)

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting ($K_e=0.9$)

Inlet Depression: None

Site Data - C-3 - 11.6m - 500mm

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 116.79 m

Outlet Station: 11.60 m

Outlet Elevation: 116.64 m

Number of Barrels: 1

Culvert Crossing: 135 Cardevco Rd Entrance Culvert (Drainage Areas A+B+C+D)

Culvert Summary Table - C-3 - 11.6m - 500mm

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	117.42	0.00	0.59	0-NF	0.00	0.00	0.46	0.72	0.00	0.00
0.05	0.05	117.45	0.20	0.62	4-FFf	0.17	0.13	0.46	0.72	0.27	0.00
0.10	0.10	117.52	0.32	0.69	4-FFf	0.26	0.19	0.46	0.72	0.55	0.00
0.15	0.13	117.56	0.37	0.73	4-FFf	0.30	0.22	0.46	0.72	0.68	0.00
0.21	0.13	117.58	0.38	0.75	4-FFf	0.31	0.22	0.46	0.72	0.71	0.00
0.26	0.14	117.59	0.39	0.76	4-FFf	0.32	0.23	0.46	0.72	0.74	0.00
0.31	0.14	117.60	0.40	0.77	4-FFf	0.33	0.23	0.46	0.72	0.76	0.00
0.36	0.15	117.61	0.41	0.78	4-FFf	0.34	0.24	0.46	0.72	0.78	0.00
0.41	0.15	117.61	0.41	0.78	4-FFf	0.34	0.24	0.46	0.72	0.80	0.00
0.46	0.15	117.62	0.42	0.79	4-FFf	0.35	0.24	0.46	0.72	0.82	0.00
0.51	0.16	117.63	0.42	0.80	4-FFf	0.35	0.24	0.46	0.72	0.83	0.00

Peak Flow Calculations - Roadside Ditches
Existing Conditions 107 to 154 & 162 to 173 Wescar Lane
and 121 to 127 Cardevco Road

+

Proposed Development 151-159 Wescar Lane
Cardevco Subdivision
Ottawa, Ontario

2-Year Event (restricted flow)
(restricted flows of 165, 151-159, 141 & 131 Wescar Lane)

Drainage Area A

(restricted flows of 165, 151-159 & 141 Wescar Lane)

					C
Roof Area:	0.00	ha			0.90
Hard Area:	0.15	ha			0.90
Gravel Area:	0.29	ha			0.70
Soft Area:	0.18	ha			0.20

Total Catchment Area: 0.63 ha 0.60

Time of Concentration: 20 min

Length of Ditch (Ld): 263 m

Ditch Flow Velocity (V): 0.30 m/s

Time of Concentration (Ditch Flow): 14.6 min

Time of Concentration (Tc): 34.6 min

Area (A): 0.63 ha

Time of Concentration: 34.6 min

Rainfall Intensity (i): 36 mm/hr (2 Year Event)

Runoff Coefficient (C): 0.60

Rational Method 2-Year Flow (Q): 38.2 L/s

Restricted flow 165 Wescar Lane 32.9 L/s

Restricted flow 151-159 Wescar Lane 67.2 L/s

Restricted flow 141 Wescar Lane 30.4 L/s

Q: 168.6 L/s

Ditch Slope: 0.8%

Ditch Manning Roughness Coefficient n: 0.10 dense weeds as high as flow

Side Slope: 3 :1

Lot Side Slope: 3 :1

Ditch Bottom Width: 1 m

Water Depth: 0.30 m

Water Top Width: 2.77 m

Water Cross-Section Area: 0.56 sq.m

Wetted Perimeter: 2.87 m

Hydraulic Radius: 0.19 m

Velocity: 0.30 m/s

Velocity: 0.30 m/s

Based on water depth

Using Manning's Formula:

Drainage Area B

(2-Year Event (restricted flow))
(restricted flows of 131 Wescar Lane)

			C
Roof Area:	0.09	ha	0.90
Hard Area:	0.36	ha	0.90
Gravel Area:	0.32	ha	0.70
Soft Area:	0.67	ha	0.20
Total Catchment Area:	1.44	ha	0.53

Drainage Area A + B

(restricted flows of 165, 151-159, 141 & 131 Wescar Lane)

			C
Roof Area:	0.09	ha	0.90
Hard Area:	0.51	ha	0.90
Gravel Area:	0.61	ha	0.70
Soft Area:	0.86	ha	0.20
Total Catchment Area:	2.07	ha	0.55

Time of Concentration: 34.6 min (from Drainage Area A)

Length of Ditch (Ld): 238 m

Ditch Flow Velocity (V): 0.38 m/s

Time of Concentration (Ditch Flow): 10.4 min

Time of Concentration (Tc): 45.0 min

Area (A): 2.07 ha

Time of Concentration: 45.0 min

Rainfall Intensity (i): 30 mm/hr (2 Year Event)

Runoff Coefficient (C): 0.55

Rational Method 2-Year Flow (Q): 95.9 L/s

Restricted flow 165 Wescar Lane 32.9 L/s

Restricted flow 151-159 Wescar Lane 67.2 L/s

Restricted flow 141 Wescar Lane 30.4 L/s

Restricted flow 131 Wescar Lane 27.7 L/s

Q: 226.3 L/s

Ditch Slope: 1.2%

Ditch Manning Roughness Coefficient n: 0.10 dense weeds as high as flow

Side Slope: 3 :1

Lot Side Slope: 3 :1

Ditch Bottom Width: 1 m

Water Depth: 0.31 m

Water Top Width: 2.86 m

Water Cross-Section Area: 0.60 sq.m

Wetted Perimeter: 2.96 m

Hydraulic Radius: 0.20 m

Velocity: 0.38 m/s

Velocity: 0.38 m/s

Based on water depth
Using Manning's Formula:

Drainage Area C

(2-Year Event (restricted flow))

(restricted flows of 165, 151-159, 141 & 131 Wescar Lane)

			C
Roof Area:	0.24	ha	0.90
Hard Area:	0.57	ha	0.90
Gravel Area:	0.60	ha	0.80
Soft Area:	0.95	ha	0.20

Total Catchment Area: 2.36 ha 0.59

Time of Concentration: 20 min

Length of Ditch (Ld): 452 m

Ditch Flow Velocity (V): 0.32 m/s

Time of Concentration (Ditch Flow): 23.5 min

Time of Concentration (Tc): 43.5 min

Area (A): 2.36 ha

Time of Concentration: 43.5 min

Rainfall Intensity (i): 31 mm/hr (2 Year Event)

Runoff Coefficient (C): 0.59

Rational Method 2-Year Flow (Q): 120.7 L/s

Ditch Slope: 1.2%

Ditch Manning Roughness Coefficient n: 0.10 dense weeds as high as flow

Side Slope: 3 :1

Lot Side Slope: 3 :1

Ditch Bottom Width: 1 m

Water Depth: 0.23 m

Water Top Width: 2.36 m

Water Cross-Section Area: 0.38 sq.m

Wetted Perimeter: 2.44 m

Hydraulic Radius: 0.16 m

Velocity: 0.32 m/s

Velocity: 0.32 m/s

Based on water depth

Using Manning's Formula:

Drainage Area D

(2-Year Event (restricted flow))

		C
Roof Area:	0.06 ha	0.90
Hard Area:	0.12 ha	0.90
Gravel Area:	0.47 ha	0.70
Soft Area:	0.08 ha	0.20
Total Catchment Area:	0.73 ha	0.69

Drainage Area A + B + C + D

		C
Roof Area:	0.40 ha	0.90
Hard Area:	1.20 ha	0.90
Gravel Area:	1.68 ha	0.70
Soft Area:	1.89 ha	0.20
Total Catchment Area:	5.17 ha	0.58

Time of Concentration: 45.0 min (from Drainage Area A + B)

Length of Ditch (Ld): 129 m

Ditch Flow Velocity (V): 0.70 m/s

Time of Concentration (Ditch Flow): 3.1 min

Time of Concentration (Tc): 48.1 min

Area (A): 5.17 ha

Time of Concentration: 48.1 min

Rainfall Intensity (i): 29 mm/hr (2 Year Event)

Runoff Coefficient (C): 0.58

Rational Method 2-Year Flow (Q): 239.7 L/s

Restricted flow 165 Wescar Lane 32.9 L/s

Restricted flow 151-159 Wescar Lane 67.2 L/s

Restricted flow 141 Wescar Lane 30.4 L/s

Restricted flow 131 Wescar Lane 27.7 L/s

Q: 370.1 L/s

Ditch Slope: 0.3%

Ditch Manning Roughness Coefficient n: 0.027 gravel / short grass

Side Slope: 3 :1

Lot Side Slope: 3 :1

Ditch Bottom Width: 1 m

Water Depth: 0.29 m

Water Top Width: 2.71 m

Water Cross-Section Area: 0.53 sq.m

Wetted Perimeter: 2.80 m

Hydraulic Radius: 0.19 m

Velocity: 0.70 m/s

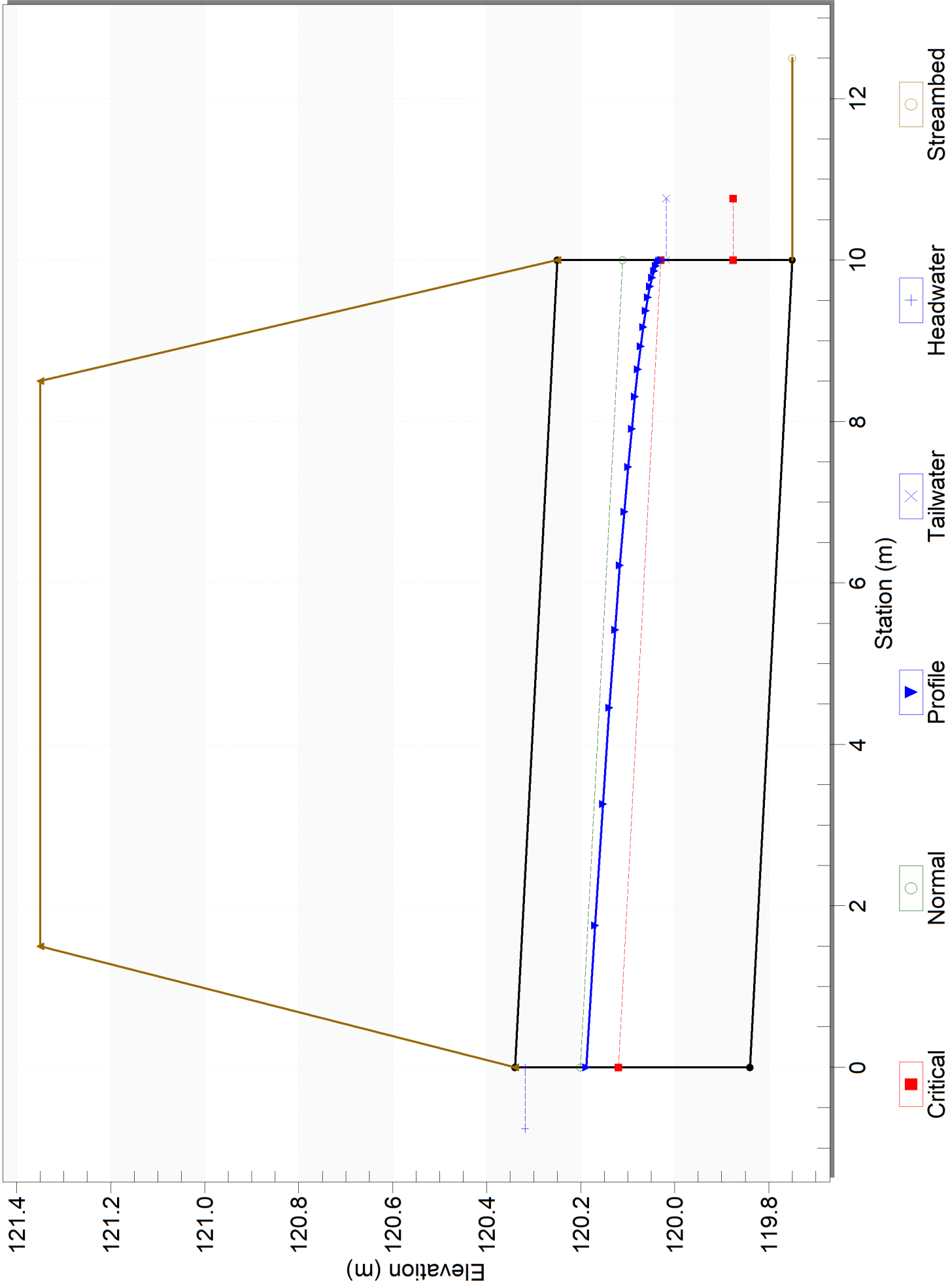
Velocity: 0.70 m/s

Based on water depth

Using Manning's Formula:

Crossing - 141 Wescar Ln Entrance Culvert (Drainage Area A), Design Discharge - 0.17 cms

Culvert - C-1 - 10m - 500mm, Culvert Discharge - 0.17 cms



HY-8 Culvert Analysis Report

Culvert Data: C-1 - 10m - 500mm

Culvert Data Summary - C-1 - 10m - 500mm

Barrel Shape: Circular

Barrel Diameter: 500.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting ($K_e=0.9$)

Inlet Depression: None

Site Data - C-1 - 10m - 500mm

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 119.84 m

Outlet Station: 10.00 m

Outlet Elevation: 119.75 m

Number of Barrels: 1

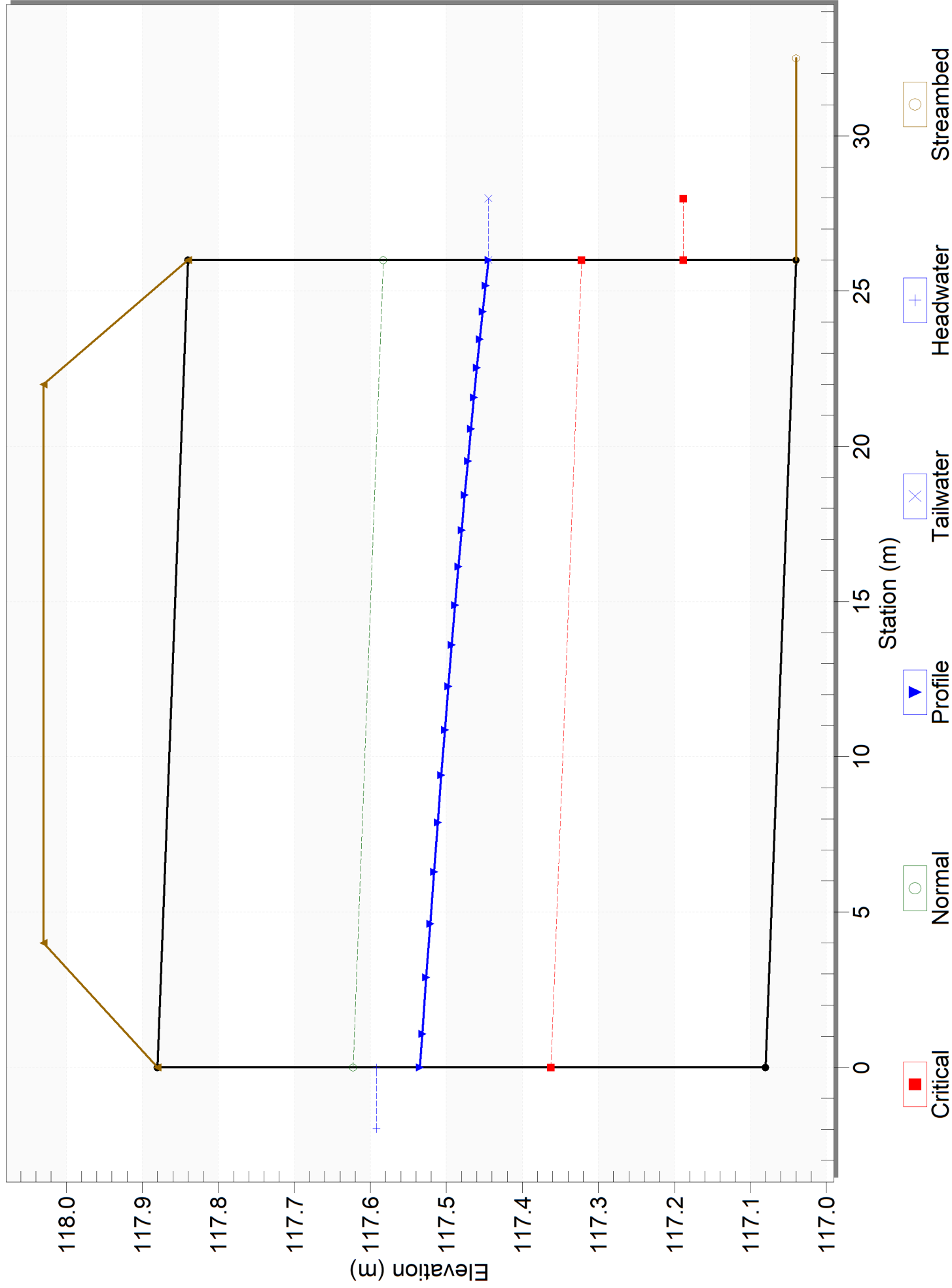
Culvert Crossing: 141 Wescar Ln Entrance Culvert (Drainage Area A)

Culvert Summary Table - C-1 - 10m - 500mm

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	119.84	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.02	0.02	119.98	0.12	0.14	2-M2c	0.10	0.09	0.09	0.08	0.76	0.18
0.03	0.03	120.03	0.18	0.19	2-M2c	0.14	0.12	0.12	0.11	0.92	0.22
0.05	0.05	120.08	0.22	0.24	2-M2c	0.17	0.15	0.15	0.14	1.03	0.25
0.07	0.07	120.12	0.26	0.28	2-M2c	0.20	0.17	0.17	0.17	1.12	0.27
0.08	0.08	120.16	0.29	0.32	2-M2c	0.23	0.19	0.19	0.19	1.19	0.29
0.10	0.10	120.19	0.32	0.35	2-M2c	0.26	0.21	0.21	0.21	1.26	0.30
0.12	0.12	120.23	0.36	0.39	2-M2c	0.28	0.23	0.23	0.22	1.33	0.32
0.14	0.14	120.26	0.39	0.42	2-M2c	0.31	0.25	0.25	0.24	1.38	0.33
0.15	0.15	120.29	0.42	0.45	2-M2c	0.33	0.26	0.26	0.25	1.44	0.34
0.17	0.17	120.32	0.45	0.48	2-M2c	0.36	0.28	0.28	0.27	1.50	0.35

Crossing - Wescar Ln Culvert at Cardevco Rd (Drainage Area A+B), Design Discharge - 0.23 cms

Culvert - C-2 - 26m -800mm, Culvert Discharge - 0.23 cms



HY-8 Culvert Analysis Report

Culvert Data: C-2 - 26m -800mm

Culvert Data Summary - C-2 - 26m -800mm

Barrel Shape: Circular

Barrel Diameter: 800.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting ($K_e=0.9$)

Inlet Depression: None

Site Data - C-2 - 26m -800mm

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 117.08 m

Outlet Station: 26.00 m

Outlet Elevation: 117.04 m

Number of Barrels: 1

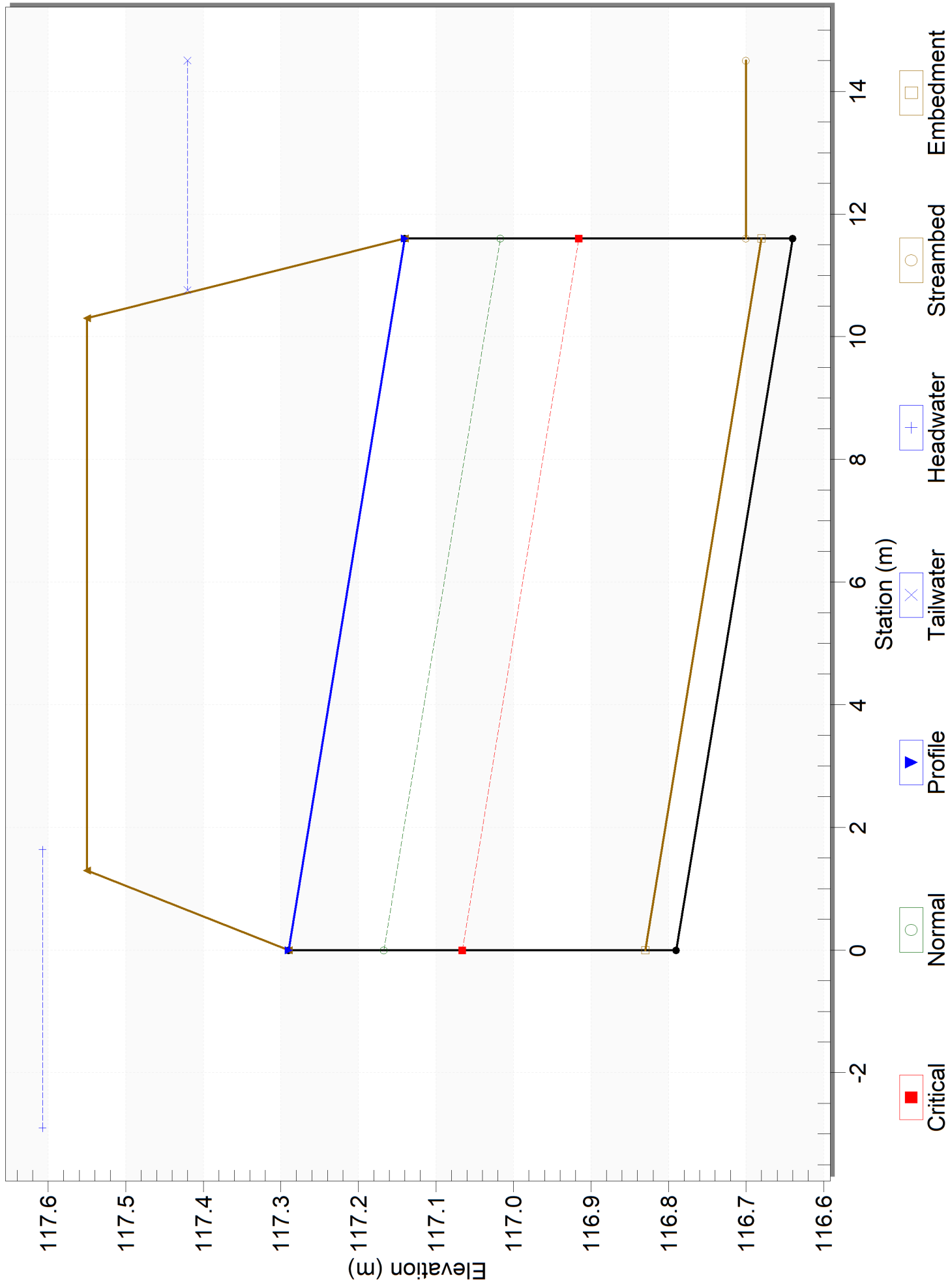
Culvert Crossing: Wescar Ln Culvert at Cardevco Rd (Drainage Area A+B)

Culvert Summary Table - C-2 - 26m -800mm

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	117.08	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.02	0.02	117.24	0.13	0.16	3-M2t	0.15	0.09	0.12	0.12	0.45	0.13
0.05	0.05	117.30	0.18	0.22	3-M2t	0.22	0.12	0.18	0.18	0.53	0.16
0.07	0.07	117.35	0.22	0.27	3-M2t	0.27	0.15	0.22	0.22	0.59	0.18
0.09	0.09	117.40	0.26	0.32	3-M2t	0.31	0.18	0.26	0.26	0.64	0.20
0.11	0.11	117.44	0.29	0.36	3-M2t	0.35	0.20	0.29	0.29	0.69	0.21
0.14	0.14	117.47	0.32	0.39	3-M2t	0.39	0.22	0.32	0.32	0.73	0.22
0.16	0.16	117.50	0.35	0.42	3-M2t	0.43	0.23	0.34	0.34	0.77	0.23
0.18	0.18	117.53	0.37	0.45	3-M2t	0.47	0.25	0.36	0.36	0.81	0.24
0.20	0.20	117.56	0.40	0.48	3-M2t	0.50	0.27	0.38	0.38	0.85	0.25
0.23	0.23	117.59	0.42	0.51	3-M2t	0.54	0.28	0.40	0.40	0.89	0.25

Crossing - 135 Cardevco Rd Entrance Culvert (Drainage Areas A+B+C+D), Design Discharge - 0.37 cms

Culvert - C-3 - 11.6m - 500mm, Culvert Discharge - 0.15 cms



HY-8 Culvert Analysis Report

Culvert Data: C-3 - 11.6m - 500mm

Culvert Data Summary - C-3 - 11.6m - 500mm

Barrel Shape: Circular

Barrel Diameter: 500.00 mm

Barrel Material: Corrugated Steel

Embedment: 40.00 mm

Barrel Manning's n: 0.0240 (top and sides)

Manning's n: 0.0350 (bottom)

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting ($K_e=0.9$)

Inlet Depression: None

Site Data - C-3 - 11.6m - 500mm

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 116.79 m

Outlet Station: 11.60 m

Outlet Elevation: 116.64 m

Number of Barrels: 1

Culvert Crossing: 135 Cardevco Rd Entrance Culvert (Drainage Areas A+B+C+D)

Culvert Summary Table - C-3 - 11.6m - 500mm

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	117.42	0.00	0.59	0-NF	0.00	0.00	0.46	0.72	0.00	0.00
0.04	0.04	117.43	0.16	0.60	4-FFf	0.14	0.11	0.46	0.72	0.20	0.00
0.07	0.07	117.47	0.26	0.64	4-FFf	0.22	0.16	0.46	0.72	0.39	0.00
0.11	0.11	117.53	0.34	0.70	4-FFf	0.28	0.20	0.46	0.72	0.59	0.00
0.15	0.13	117.56	0.37	0.73	4-FFf	0.30	0.22	0.46	0.72	0.67	0.00
0.18	0.13	117.57	0.38	0.74	4-FFf	0.31	0.22	0.46	0.72	0.70	0.00
0.22	0.14	117.58	0.38	0.75	4-FFf	0.32	0.22	0.46	0.72	0.72	0.00
0.26	0.14	117.59	0.39	0.76	4-FFf	0.32	0.23	0.46	0.72	0.74	0.00
0.30	0.14	117.59	0.40	0.76	4-FFf	0.33	0.23	0.46	0.72	0.75	0.00
0.33	0.14	117.60	0.40	0.77	4-FFf	0.33	0.23	0.46	0.72	0.77	0.00
0.37	0.15	117.61	0.41	0.78	4-FFf	0.34	0.24	0.46	0.72	0.78	0.00

APPENDIX F

DITCH & CULVERT CALCULATIONS

EXISTING CONDITIONS

106 TO 154 & 162 TO 173 WESCAR LANE

AND 121 TO 127 CARDEVCO ROAD

+

**PROPOSED DEVELOPMENT 151-159 WESCAR LANE
WITH 0.6 HA DRAINING TO CAVANMORE ROAD**

LEGEND

DRAINAGE AREA

AREA (ha)

Runoff Coefficient

x xxx
0.xx

No.	DATE	ISSUED WITH DRAINAGE REPORT	REVISION
1	JUN 7-24	ISSUED WITH DRAINAGE REPORT	

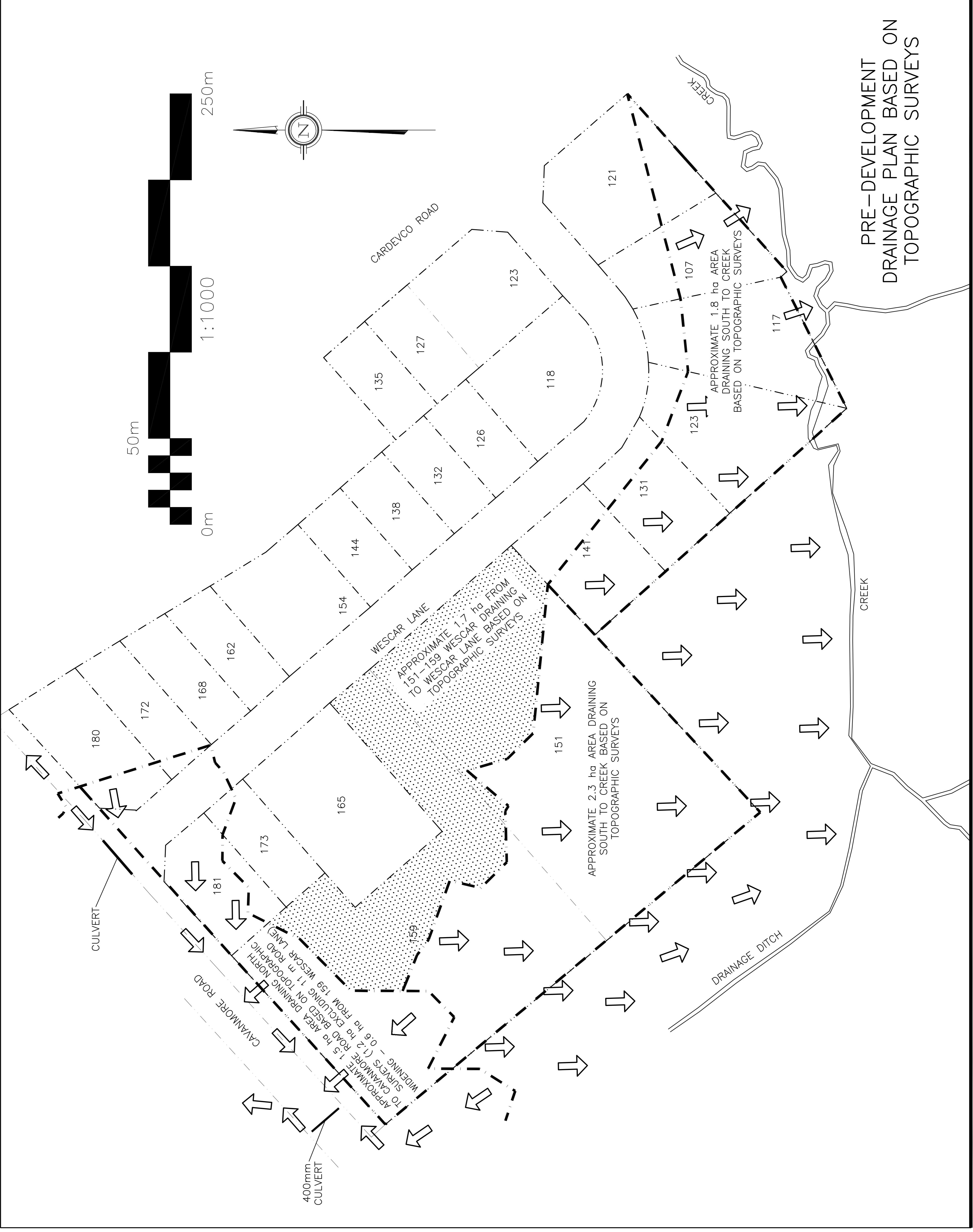
D.B. GRAY ENGINEERING INC.
 Professional Engineer - Ontario
 700 Long Point Circle
 Ottawa, Ontario
 613-425-8044
 d.gray@dbgrayengineering.com

SUNBELT RENTALS INC.
 EQUIPMENT MAINTENANCE FACILITY
 151-159 WESCAR LANE
 CARP, OTTAWA, ONTARIO

Project
 WESCAR LANE / CARDEVCO ROAD
 PRE-DEVELOPMENT DRAINAGE PLAN

Drawn: D.B.G.
 H. Scale: 1:1000
 V. Scale: 1:1000
 Date: MAY 31-24
 Job No.: 22111

Drawing No. **FIGURE 3**



Peak Flow Calculations - Roadside Ditches
Existing Conditions
106 to 154 & 162 to 173 Wescar Lane
and 121 to 127 Cardevco Road
 +
Proposed Development 151-159 Wescar Lane
(with 0.6 ha draining to Cavanmore Road)
Cardevco Subdivision
Ottawa, Ontario

10-Year Event

Drainage Area A (5.76 ha less 0.6 ha)

		C
Roof Area:	0.42 ha	0.90
Hard Area:	3.11 ha	0.90
Gravel Area:	0.38 ha	0.80
Soft Area:	<u>1.26 ha</u>	<u>0.20</u>
Total Catchment Area:	5.16 ha	0.72

Time of Concentration: **20 min**

Length of Ditch (Ld): 263 m

Ditch Flow Velocity (V): 0.43 m/s

Time of Concentration (Ditch Flow): **10.2 min**

Time of Concentration (Tc): **30.2 min**

Area (A): **5.16 ha**

Time of Concentration: **30.2 min**

Rainfall Intensity (i): **63 mm/hr (10-Year Event)**

Runoff Coefficient (C): **0.72**

Rational Method 10-Year Flow (Q): **650.8 L/s**

Ditch Slope: 0.8%

Ditch Manning Roughness Coefficient n: 0.10 dense weeds / brush as high as flow

Side Slope: 3 :1

Lot Side Slope: 3 :1

Ditch Bottom Width: 1 m

Water Depth: 0.56 m

Water Top Width: **4.36 m**

Water Cross-Section Area: **1.50 sq.m**

Wetted Perimeter: **4.54 m**

Hydraulic Radius: **0.33 m**

Velocity: **0.43 m/s**

Velocity: **0.43 m/s**

Based on water depth

Using Manning's Formula:

Drainage Area B
(10-Year Event)

			C
Roof Area:	0.15	ha	0.90
Hard Area:	0.49	ha	0.90
Gravel Area:	0.32	ha	0.80
Soft Area:	<u>0.79</u>	ha	<u>0.20</u>
Total Catchment Area:	1.75	ha	0.57

Drainage Area A + B

			C
Roof Area:	0.57	ha	0.90
Hard Area:	3.59	ha	0.90
Gravel Area:	0.70	ha	0.70
Soft Area:	<u>2.04</u>	ha	<u>0.20</u>
Total Catchment Area:	6.91	ha	0.67

Time of Concentration: 30.2 min (from Drainage Area A)

Length of Ditch (Ld): 238 m
 Ditch Flow Velocity (V): 0.51 m/s
 Time of Concentration (Ditch Flow): 7.8 min

Time of Concentration (Tc): 38.0 min

Area (A): 6.91 ha
 Time of Concentration: 38.0 min
 Rainfall Intensity (i): 54 mm/hr (10-Year Event)
 Runoff Coefficient (C): 0.67

Rational Method 10-Year Flow (Q): 691.8 L/s

Ditch Slope: 1.2%
 Ditch Manning Roughness Coefficient n: 0.10 dense weeds / brush as high as flow

Road Side Slope: 3 :1
 Lot Side Slope: 3 :1
 Ditch Bottom Width: 1 m
 Water Depth: 0.53 m

Water Top Width: 4.17 m
 Water Cross-Section Area: 1.36 sq.m
 Wetted Perimeter: 4.34 m
 Hydraulic Radius: 0.31 m

Velocity: 0.51 m/s Based on water depth
 Velocity: 0.51 m/s Using Manning's Formula:

Drainage Area C
(10-Year Event)

			C
Roof Area:	0.24	ha	0.90
Hard Area:	0.57	ha	0.90
Gravel Area:	0.60	ha	0.80
Soft Area:	<u>0.95</u>	ha	<u>0.20</u>

Total Catchment Area: **2.36** ha **0.59**

Time of Concentration: **20** min

Length of Ditch (Ld): 452 m

Ditch Flow Velocity (V): 0.36 m/s

Time of Concentration (Ditch Flow): **20.9** min

Time of Concentration (Tc): **40.9** min

Area (A): 2.36 ha

Time of Concentration: 40.9 min

Rainfall Intensity (i): 51 mm/hr (10-Year Event)

Runoff Coefficient (C): 0.59

Rational Method 10-Year Flow (Q): **198.0** L/s

Ditch Slope: 1.2%

Ditch Manning Roughness Coefficient n: 0.10 dense weeds / brush as high as flow

Side Slope: 3 :1

Lot Side Slope: 3 :1

Ditch Bottom Width: 1 m

Water Depth: 0.30 m

Water Top Width: **2.77** m

Water Cross-Section Area: 0.56 sq.m

Wetted Perimeter: 2.87 m

Hydraulic Radius: **0.19** m

Velocity: **0.36** m/s

Velocity: **0.36** m/s

Based on water depth

Using Manning's Formula:

Drainage Area D
(10-Year Event)

			C
Roof Area:	0.06	ha	0.90
Hard Area:	0.12	ha	0.90
Gravel Area:	0.47	ha	0.80
Soft Area:	<u>0.08</u>	ha	<u>0.20</u>
Total Catchment Area:	0.73	ha	0.76

Drainage Area A + B + C + D

			C
Roof Area:	0.87	ha	0.90
Hard Area:	4.28	ha	0.90
Gravel Area:	1.77	ha	0.80
Soft Area:	<u>3.08</u>	ha	<u>0.20</u>
Total Catchment Area:	10.00	ha	0.67

Time of Concentration: 40.9 min (from Drainage Area C)

Length of Ditch (Ld): 129 m
Ditch Flow Velocity (V): 0.88 m/s
Time of Concentration (Ditch Flow): 2.4 min

Time of Concentration (Tc): 43.3 min

Area (A): 10.00 ha
Time of Concentration: 43.3 min
Rainfall Intensity (i): 49 mm/hr (10-Year Event)
Runoff Coefficient (C): 0.67

Rational Method 10-Year Flow (Q): 904.1 L/s

Ditch Slope: 0.3%
Ditch Manning Roughness Coefficient n: 0.027 gravel / short grass

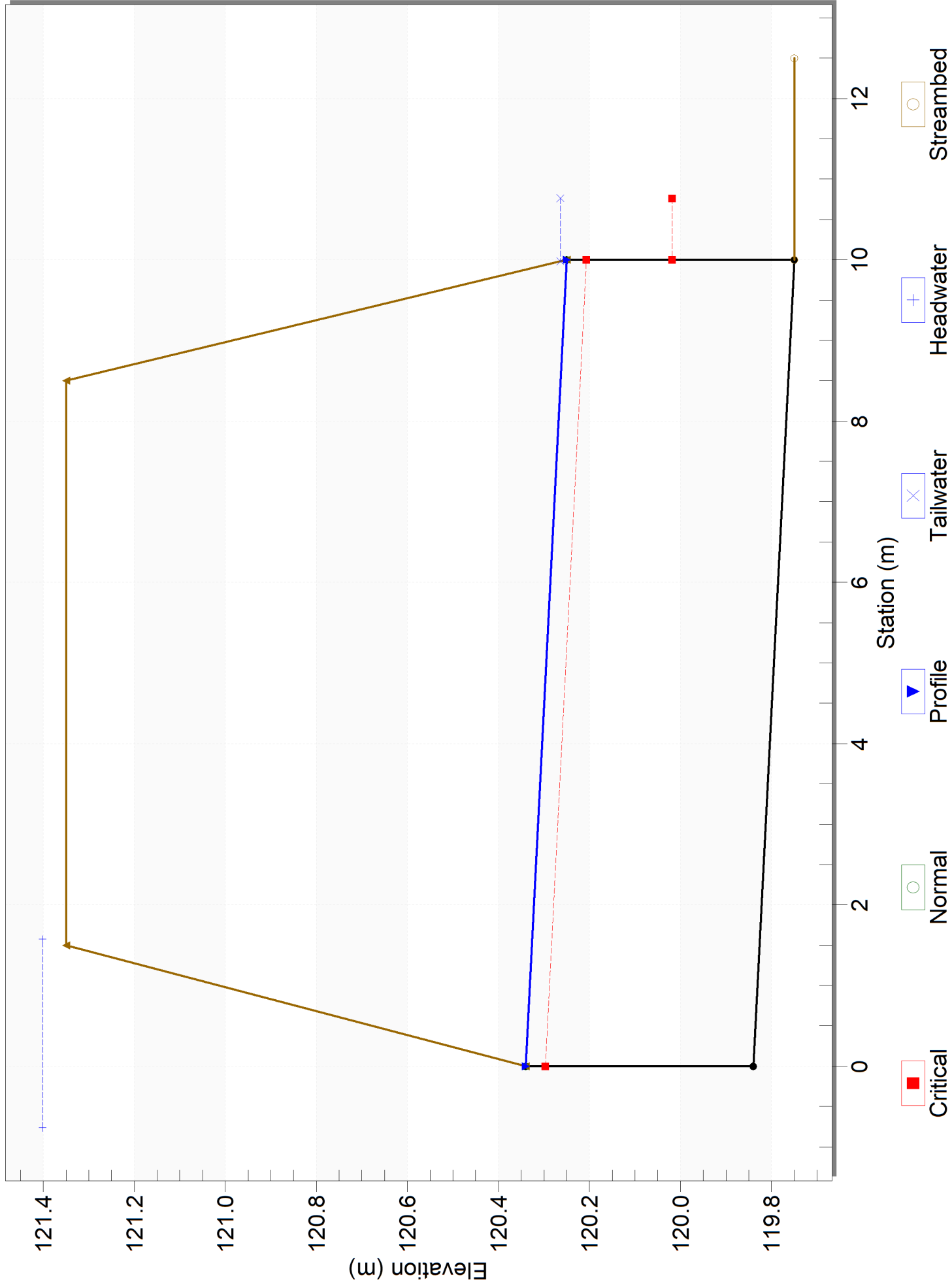
Road Side Slope: 3 :1
Lot Side Slope: 3 :1
Ditch Bottom Width: 1 m
Water Depth: 0.44 m

Water Top Width: 3.65 m
Water Cross-Section Area: 1.03 sq.m
Wetted Perimeter: 3.80 m
Hydraulic Radius: 0.27 m

Velocity: 0.88 m/s Based on water depth
Velocity: 0.88 m/s Using Manning's Formula:

Crossing - 141 Wescar Ln Entrance Culvert (Drainage Area A), Design Discharge - 0.65 cms

Culvert - C-1 - 10m - 500mm, Culvert Discharge - 0.48 cms



HY-8 Culvert Analysis Report

Culvert Data: C-1 - 10m - 500mm

Culvert Data Summary - C-1 - 10m - 500mm

Barrel Shape: Circular

Barrel Diameter: 500.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting ($K_e=0.9$)

Inlet Depression: None

Site Data - C-1 - 10m - 500mm

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 119.84 m

Outlet Station: 10.00 m

Outlet Elevation: 119.75 m

Number of Barrels: 1

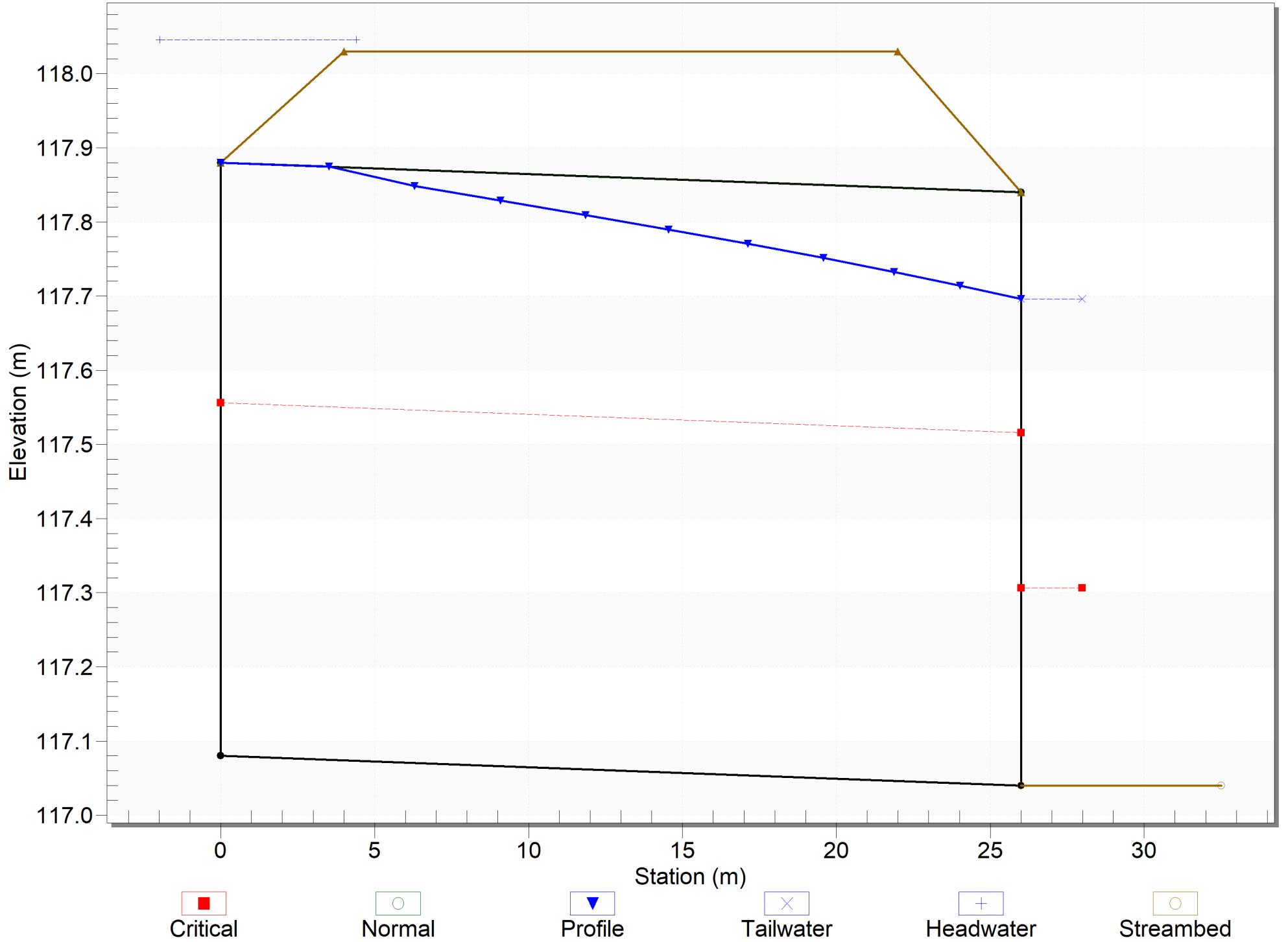
Culvert Crossing: 141 Wescar Ln Entrance Culvert (Drainage Area A)

Culvert Summary Table - C-1 - 10m - 500mm

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	119.84	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.07	0.07	120.12	0.25	0.28	2-M2c	0.20	0.17	0.17	0.16	1.10	0.27
0.13	0.13	120.25	0.38	0.41	2-M2c	0.30	0.24	0.24	0.24	1.37	0.32
0.20	0.20	120.37	0.50	0.53	7-M2c	0.41	0.30	0.30	0.29	1.58	0.36
0.26	0.26	120.49	0.64	0.65	7-M2c	0.50	0.35	0.35	0.33	1.77	0.39
0.33	0.33	120.71	0.80	0.87	7-M2c	0.50	0.39	0.39	0.37	1.98	0.42
0.39	0.39	120.96	1.01	1.12	7-M2c	0.50	0.42	0.42	0.40	2.20	0.44
0.46	0.46	121.24	1.27	1.40	7-M2c	0.50	0.45	0.45	0.43	2.45	0.45
0.52	0.48	121.37	1.39	1.53	7-M2t	0.50	0.46	0.46	0.46	2.54	0.47
0.59	0.48	121.39	1.40	1.55	7-M2t	0.50	0.46	0.50	0.49	2.48	0.49
0.65	0.48	121.40	1.39	1.56	4-FFf	0.50	0.46	0.50	0.51	2.46	0.50

Crossing - Wescar Ln Culvert at Cardevco Rd (Drainage Area A+B), Design Discharge - 0.64 cms

Culvert - C-2 - 26m -800mm, Culvert Discharge - 0.62 cms



HY-8 Culvert Analysis Report

Culvert Data: C-2 - 26m -800mm

Culvert Data Summary - C-2 - 26m -800mm

Barrel Shape: Circular

Barrel Diameter: 800.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting ($K_e=0.9$)

Inlet Depression: None

Site Data - C-2 - 26m -800mm

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 117.08 m

Outlet Station: 26.00 m

Outlet Elevation: 117.04 m

Number of Barrels: 1

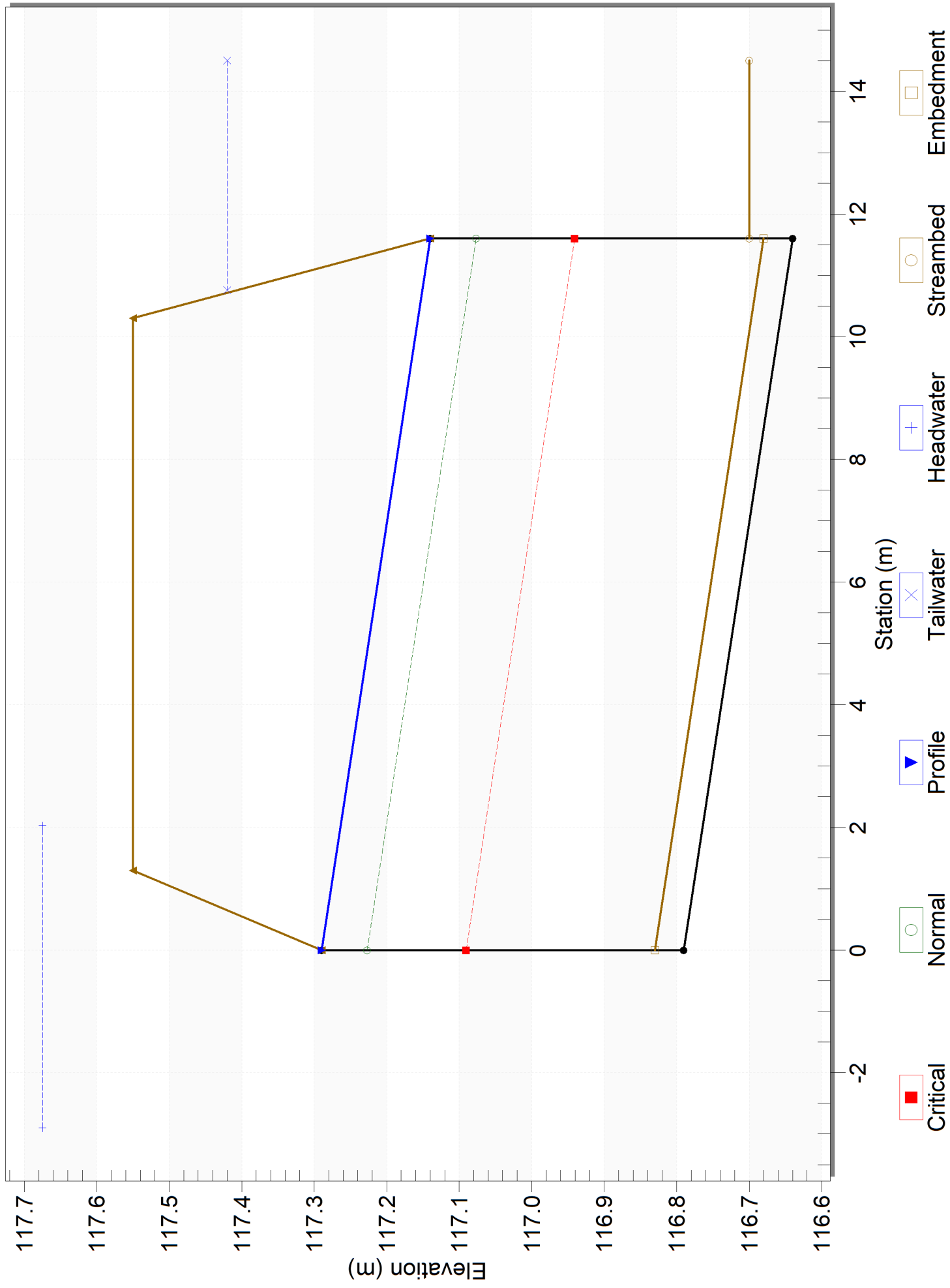
Culvert Crossing: Wescar Ln Culvert at Cardevco Rd (Drainage Area A+B)

Culvert Summary Table - C-2 - 26m -800mm

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	117.08	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.07	0.07	117.36	0.23	0.28	3-M2t	0.27	0.15	0.23	0.23	0.60	0.18
0.14	0.14	117.48	0.32	0.40	3-M2t	0.40	0.22	0.32	0.32	0.74	0.22
0.21	0.21	117.57	0.40	0.49	3-M2t	0.51	0.27	0.39	0.39	0.86	0.25
0.28	0.28	117.65	0.47	0.57	3-M2t	0.64	0.31	0.45	0.45	0.96	0.27
0.35	0.35	117.73	0.54	0.65	3-M2t	0.80	0.35	0.49	0.49	1.06	0.28
0.42	0.42	117.80	0.60	0.72	3-M2t	0.80	0.39	0.54	0.54	1.16	0.30
0.48	0.48	117.87	0.67	0.79	3-M2t	0.80	0.42	0.58	0.58	1.25	0.31
0.55	0.55	117.95	0.73	0.87	3-M2t	0.80	0.45	0.61	0.61	1.34	0.32
0.62	0.62	118.03	0.79	0.95	7-M2t	0.80	0.48	0.65	0.65	1.42	0.33
0.69	0.62	118.06	0.79	0.98	7-M2t	0.80	0.48	0.68	0.68	1.36	0.34

Crossing - 135 Cardevco Rd Entrance Culvert (Drainage Areas A+B+C+D), Design Discharge - 0.90 cms

Culvert - C-3 - 11.6m - 500mm, Culvert Discharge - 0.18 cms



HY-8 Culvert Analysis Report

Culvert Data: C-3 - 11.6m - 500mm

Culvert Data Summary - C-3 - 11.6m - 500mm

Barrel Shape: Circular

Barrel Diameter: 500.00 mm

Barrel Material: Corrugated Steel

Embedment: 40.00 mm

Barrel Manning's n: 0.0240 (top and sides)

Manning's n: 0.0350 (bottom)

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting ($K_e=0.9$)

Inlet Depression: None

Site Data - C-3 - 11.6m - 500mm

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 116.79 m

Outlet Station: 11.60 m

Outlet Elevation: 116.64 m

Number of Barrels: 1

Culvert Crossing: 135 Cardevco Rd Entrance Culvert (Drainage Areas A+B+C+D)

Culvert Summary Table - C-3 - 11.6m - 500mm

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	117.42	0.00	0.59	0-NF	0.00	0.00	0.46	0.72	0.00	0.00
0.09	0.09	117.50	0.29	0.67	4-FFf	0.24	0.18	0.46	0.72	0.48	0.00
0.18	0.13	117.57	0.38	0.74	4-FFf	0.31	0.22	0.46	0.72	0.70	0.00
0.27	0.14	117.59	0.39	0.76	4-FFf	0.32	0.23	0.46	0.72	0.74	0.00
0.36	0.15	117.61	0.41	0.78	4-FFf	0.34	0.24	0.46	0.72	0.78	0.00
0.45	0.15	117.62	0.42	0.79	4-FFf	0.35	0.24	0.46	0.72	0.81	0.00
0.54	0.16	117.63	0.43	0.80	4-FFf	0.36	0.25	0.46	0.72	0.84	0.00
0.63	0.16	117.64	0.44	0.81	4-FFf	0.37	0.25	0.46	0.72	0.87	0.00
0.72	0.17	117.65	0.45	0.82	4-FFf	0.38	0.25	0.46	0.72	0.89	0.00
0.81	0.17	117.66	0.46	0.83	4-FFf	0.39	0.26	0.46	0.72	0.91	0.00
0.90	0.18	117.67	0.47	0.84	4-FFf	0.40	0.26	0.46	0.72	0.93	0.00

APPENDIX G

DRAINAGE AND STORMWATER MANAGEMENT
CALCULATIONS
PROPOSED DEVELOPMENT AT 151-159 WESCAR LANE
AND ITS IMPACT ON FLOODING ON CARDEVCO ROAD

SUMMARY TABLES

100-YEAR EVENT				
Drainage Area	Pre-Development Flow Rate (L/s)	Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
AREA I (Uncontrolled Flow Off Site)	-	38.46	-	-
AREA II	-	56.39	2027.10	2027.10
TOTAL	121.28	94.85	2027.10	2027.10

10-YEAR EVENT				
Drainage Area	Pre-Development Flow Rate (L/s)	Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
AREA I (Uncontrolled Flow Off Site)	-	22.03	-	-
AREA II	-	40.21	1212.38	1212.38
TOTAL	62.29	62.24	1212.38	1212.38

151-159 Wescar Lane

Ottawa, Ontario

STORMWATER MANAGEMENT CALCULATIONS

Modified Rational Method

PRE-DEVELOPMENT CONDITIONS

(Area Draining to Wescar Lane

Based on Subdivision Grading Plan - Refer to Figure 2)

100-YEAR EVENT

Total Catchment Area: 11,776 sq.m

C
0.375

1.25 x Woodland or
Pasture - Flat - Clay and
Silt Loam as per Table 5.7
Ottawa Sewer Design
Guidelines

Airport Formula (Used when C < 0.40)

$$T_c = \frac{3.26 \cdot (1.1 - C) \cdot L^{1/2}}{S_w^{0.33}} \text{ min}$$

Runoff Coefficient (C): 0.375

Sheet Flow Distance (L): 130 m

Slope of Land (Sw): 1 %

Time of Concentration (Sheet Flow): 27 min

Rainfall Intensity (i): 99 mm/hr (100-year event)

100-Year Pre-Development Flow Rate (2.78AiC): 121.28 L/s

10-YEAR EVENT

Total Catchment Area: 11,776 sq.m

C
0.30

Woodland or Pasture -
Flat - Clay and Silt Loam
as per Table 5.7 Ottawa
Sewer Design Guidelines

Airport Formula (Used when C < 0.40)

$$T_c = \frac{3.26 \cdot (1.1 - C) \cdot L^{1/2}}{S_w^{0.33}} \text{ min}$$

Runoff Coefficient (C): 0.30

Sheet Flow Distance (L): 130 m

Slope of Land (Sw): 1 %

Time of Concentration (Sheet Flow): 30 min

Rainfall Intensity (i): 63 mm/hr (10-Year Event)

5-Year Pre-Development Flow Rate (2.78AiC): 62.29 L/s

100-YEAR EVENT

DRAINAGE AREA I (Uncontrolled Flow Off Site Towards Wescar Lane)

(100-YEAR EVENT)

			C
Roof Area:	0	sq.m	1.00
Hard Area:	290	sq.m	1.00
Detention Area:	0	sq.m	1.00
Gravel Area:	0	sq.m	1.00
Soft Area:	<u>1,939</u>	<u>sq.m</u>	<u>0.25</u>
Total Catchment Area:	2,229	sq.m	0.35
Area (A):	2,229	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	179	mm/hr (100-year event)	
Runoff Coefficient (C):	0.35		
Flow Rate (2.78AiC):	38.46	L/s	

DRAINAGE AREA II

(100-YEAR EVENT)

			C
Roof Area:	3,566	sq.m	1.00
Asphalt/Concrete Area:	31,076	sq.m	1.00
Detention Area:	897	sq.m	1.00
Gravel Area:	0	sq.m	1.00
Soft Area:	4,603	sq.m	0.25

Total Catchment Area: 40,142 sq.m 0.91

Water Elevation: 122.18 m

Head: 1.88 m

Centroid of ICD Orifice: 120.30 m

(ICD in Inlet of Culvert)

Invert of Inlet of Culvert: 121.04 m

Orifice Diameter: 139 mm

Orifice Area: 15,218 sq.mm

Discharge Coefficient: 0.61

Maximum Release Rate: 56.39 L/s

Surface Ponding

Above	CB or	Top Area	Depth	Volume	
CB/MH		(sq.m)	(m)		
CB-1		5	0.02	0.04	cu.m
CB-5		5	0.02	0.04	cu.m
CB-6		543	0.20	36.32	cu.m
CB-7		197	0.31	46.51	cu.m
CB/MH-8		10	0.02	0.07	cu.m
CB-9		732	0.20	48.97	cu.m
CB-10		805	0.20	53.81	cu.m
CB-10A		430	0.43	125.26	cu.m
CB/MH-11		805	0.20	53.81	cu.m
CB-12		234	0.20	15.67	cu.m
CB-12A		320	0.20	21.39	cu.m
CB/MH-14		678	0.20	45.34	cu.m
CB/MH-15		232	0.18	13.94	cu.m
CB-16		742	0.20	49.64	cu.m
CB/MH-17		761	0.20	50.85	cu.m
CB-18		501	0.20	33.50	cu.m
CB/MH-19		646	0.20	43.18	cu.m
CB-20		747	0.20	49.98	cu.m
CB/MH-21		844	0.20	56.44	cu.m
CB-22		355	0.20	23.74	cu.m
CB/MH-23		499	0.20	33.36	cu.m
CB/MH-24		631	0.20	42.18	cu.m
CB/MH-25		366	0.20	24.48	cu.m
Volume Stored:				868.52	cu.m

Stormwater Detention Area (above outlet invert elevation: 121.04)

Average	Average		Volume	
Length	Width	Depth		
(sq.m)	(sq.m)	(m)		
68.5	12.7	1.14	988.91	cu.m

Stormwater Detention Area (below outlet invert elevation: 121.04)

Length	Width	Depth	Volume	
(sq.m)	(sq.m)	(m)		
66.8	12.7	0.20	169.67	cu.m

Maximum Volume Stored: 2027.10 cu.m

Maximum Volume Required: 2027.10 cu.m

DRAINAGE AREA II (Continued)

(100-YEAR EVENT)

Time (min)	i (mm/hr)	2.78AiC (L/s)	ICD Release Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	179	1821.26	56.39	1764.87	1058.92
15	143	1457.48	56.39	1401.10	1260.99
20	120	1223.46	56.39	1167.08	1400.49
25	104	1059.21	56.39	1002.83	1504.24
30	92	937.03	56.39	880.64	1585.16
35	83	842.28	56.39	785.89	1650.37
40	75	766.46	56.39	710.07	1704.18
45	69	704.30	56.39	647.91	1749.35
50	64	652.32	56.39	595.93	1787.78
55	60	608.15	56.39	551.76	1820.80
60	56	570.11	56.39	513.72	1849.40
65	53	536.98	56.39	480.59	1874.31
70	50	507.84	56.39	451.45	1896.10
75	47	481.99	56.39	425.61	1915.22
80	45	458.90	56.39	402.51	1932.03
85	43	438.12	56.39	381.73	1946.82
90	41	419.32	56.39	362.93	1959.83
95	39	402.22	56.39	345.84	1971.26
100	38	386.60	56.39	330.21	1981.27
105	36	372.26	56.39	315.88	1990.01
110	35	359.06	56.39	302.67	1997.60
115	34	346.85	56.39	290.46	2004.15
120	33	335.52	56.39	279.13	2009.74
125	32	324.98	56.39	268.59	2014.45
130	31	315.15	56.39	258.76	2018.36
135	30	305.96	56.39	249.57	2021.53
140	29	297.34	56.39	240.95	2024.01
145	28	289.25	56.39	232.86	2025.85
150	28	281.62	56.39	225.23	2027.10
180	24	243.80	56.39	187.41	2024.04
210	21	215.67	56.39	159.28	2006.92
240	19	193.85	56.39	137.46	1979.49
270	17	176.40	56.39	120.01	1944.17
300	16	162.09	56.39	105.70	1902.60
330	15	150.12	56.39	93.73	1855.94
360	14	139.96	56.39	83.57	1805.06
390	13	131.20	56.39	74.81	1750.61
420	12	123.58	56.39	67.19	1693.11
450	11	116.87	56.39	60.48	1632.95
480	11	110.92	56.39	54.53	1570.48
510	10	105.60	56.39	49.21	1505.96
540	9.9	100.82	56.39	44.43	1439.62
570	9.5	96.50	56.39	40.11	1371.63
600	9.1	92.56	56.39	36.17	1302.17
630	8.7	88.96	56.39	32.58	1231.36
660	8.4	85.67	56.39	29.28	1159.34
690	8.1	82.63	56.39	26.24	1086.19
720	7.8	79.82	56.39	23.43	1012.01
750	7.6	77.21	56.39	20.82	936.88
780	7.3	74.78	56.39	18.39	860.88
810	7.1	72.52	56.39	16.13	784.05
840	6.9	70.41	56.39	14.02	706.47
870	6.7	68.42	56.39	12.03	628.17
900	6.5	66.56	56.39	10.17	549.20

10-YEAR EVENT

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(10-YEAR EVENT)

			C
Roof Area:	0	sq.m	0.90
Hard Area:	290	sq.m	0.90
Detention Area:	0	sq.m	0.90
Gravel Area:	0	sq.m	0.80
Soft Area:	<u>1,939</u>	<u>sq.m</u>	<u>0.20</u>
Total Catchment Area:	2,229	sq.m	0.29
Area (A):	2,229	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	122	mm/hr (10-Year Event)	
Runoff Coefficient (C):	0.29		
Flow Rate (2.78AiC):	22.03	L/s	

DRAINAGE AREA II

(10-YEAR EVENT)

			C
Roof Area:	3,566	sq.m	0.90
Asphalt/Concrete Area:	31,076	sq.m	0.90
Detention Area:	897	sq.m	1.00
Gravel Area:	0	sq.m	0.80
Landscaped Area:	4,603	sq.m	0.20

Total Catchment Area: 40,142 sq.m 0.82

Water Elevation: 122.07 m

Head: 0.96 m

Centroid of ICD Orifice: 121.11 m

(ICD in Inlet of Culvert)

Invert of Inlet of Culvert: 121.04 m

Orifice Diameter: 139 mm

Orifice Area: 15,218 sq.mm

Discharge Coefficient: 0.61

Maximum Release Rate: 40.21 L/s

Surface Ponding

Above	Top Area	Depth	Volume	
CB or CB/MH	(sq.m)	(m)		
CB-1	0	0.00	0.00	cu.m
CB-5	0	0.00	0.00	cu.m
CB-6	99	0.09	2.84	cu.m
CB-7	178	0.20	23.74	cu.m
CB/MH-8	0	0.00	0.00	cu.m
CB-9	134	0.09	3.82	cu.m
CB-10	147	0.09	4.20	cu.m
CB-10A	396	0.32	75.66	cu.m
CB/MH-11	147	0.09	4.20	cu.m
CB-12	43	0.09	1.22	cu.m
CB-12A	58	0.09	1.67	cu.m
CB/MH-14	124	0.09	3.54	cu.m
CB/MH-15	31	0.07	0.67	cu.m
CB-16	136	0.09	3.88	cu.m
CB/MH-17	139	0.09	3.97	cu.m
CB-18	92	0.09	2.62	cu.m
CB/MH-19	118	0.09	3.37	cu.m
CB-20	137	0.09	3.90	cu.m
CB/MH-21	154	0.09	4.41	cu.m
CB-22	65	0.09	1.85	cu.m
CB/MH-23	91	0.09	2.61	cu.m
CB/MH-24	115	0.09	3.29	cu.m
CB/MH-25	67	0.09	1.91	cu.m

Volume Stored: 153.38 cu.m

Stormwater Detention Area

(above outlet invert elevation: 121.04)

Average Length	Average Width	Depth	Volume	
(sq.m)	(sq.m)	(m)		
68.5	12.7	1.03	889.33	cu.m

Stormwater Detention Area

(below outlet invert elevation: 121.04)

Length	Width	Depth	Volume	
(sq.m)	(sq.m)	(m)		
66.8	12.7	0.20	169.67	cu.m

Maximum Volume Stored: 1212.38 cu.m

Maximum Volume Required: 1212.38 cu.m

DRAINAGE AREA II (Continued)

(10-YEAR EVENT)

Time (min)	i (mm/hr)	2.78AiC (L/s)	ICD Release Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	122	1120.37	40.21	1080.16	648.10
15	98	897.57	40.21	857.36	771.62
20	82	754.09	40.21	713.89	856.66
25	71	653.32	40.21	613.11	919.66
30	63	578.30	40.21	538.09	968.57
35	57	520.09	40.21	479.89	1007.76
40	52	473.50	40.21	433.29	1039.89
45	47	435.27	40.21	395.06	1066.67
50	44	403.30	40.21	363.09	1089.27
55	41	376.12	40.21	335.91	1108.50
60	38	352.70	40.21	312.50	1124.99
65	36	332.31	40.21	292.10	1139.18
70	34	314.36	40.21	274.15	1151.43
75	33	298.43	40.21	258.23	1162.02
80	31	284.20	40.21	243.99	1171.17
85	30	271.40	40.21	231.19	1179.06
90	28	259.81	40.21	219.60	1185.83
95	27	249.26	40.21	209.06	1191.62
100	26	239.63	40.21	199.42	1196.52
105	25	230.78	40.21	190.58	1200.63
110	24	222.64	40.21	182.43	1204.02
115	23	215.10	40.21	174.89	1206.76
120	23	208.11	40.21	167.90	1208.90
125	22	201.61	40.21	161.40	1210.49
130	21	195.54	40.21	155.33	1211.57
135	21	189.86	40.21	149.65	1212.19
140	20	184.54	40.21	144.33	1212.38
145	20	179.54	40.21	139.33	1212.17
150	19	174.83	40.21	134.62	1211.59
180	17	151.46	40.21	111.25	1201.48
210	15	134.06	40.21	93.85	1182.53
240	13	120.56	40.21	80.35	1157.11
270	12	109.76	40.21	69.55	1126.71
300	11	100.89	40.21	60.69	1092.37

SUMMARY TABLES

100-YEAR EVENT				
Drainage Area	Pre-Development Flow Rate (L/s)	Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
AREA I (Uncontrolled Flow Off Site)	-	38.46	-	-
AREA II	-	56.39	2027.10	2027.10
TOTAL	176.01	94.85	2027.10	2027.10

10-YEAR EVENT				
Drainage Area	Pre-Development Flow Rate (L/s)	Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
AREA I (Uncontrolled Flow Off Site)	-	22.03	-	-
AREA II	-	40.21	1212.38	1212.38
TOTAL	90.41	62.24	1212.38	1212.38

151-159 Wescar Lane

Ottawa, Ontario

STORMWATER MANAGEMENT CALCULATIONS

Modified Rational Method

PRE-DEVELOPMENT CONDITIONS

(Area Draining to Wescar Lane
Based on Topographical Surveys - Refer to Figure 3)

100-YEAR EVENT

Total Catchment Area: 17,091 sq.m

C
0.375

1.25 x Woodland or
Pasture - Flat - Clay and
Silt Loam as per Table 5.7
Ottawa Sewer Design
Guidelines

Airport Formula (Used when C < 0.40)

$$T_c = \frac{3.26 \cdot (1.1 - C) \cdot L^{1/2}}{S_w^{0.33}} \text{ min}$$

Runoff Coefficient (C): 0.375

Sheet Flow Distance (L): 130 m

Slope of Land (Sw): 1 %

Time of Concentration (Sheet Flow): 27 min

Rainfall Intensity (i): 99 mm/hr (100-year event)

100-Year Pre-Development Flow Rate (2.78AiC): 176.01 L/s

10-YEAR EVENT

Total Catchment Area: 17,091 sq.m

C
0.30

Woodland or Pasture -
Flat - Clay and Silt Loam
as per Table 5.7 Ottawa
Sewer Design Guidelines

Airport Formula (Used when C < 0.40)

$$T_c = \frac{3.26 \cdot (1.1 - C) \cdot L^{1/2}}{S_w^{0.33}} \text{ min}$$

Runoff Coefficient (C): 0.30

Sheet Flow Distance (L): 130 m

Slope of Land (Sw): 1 %

Time of Concentration (Sheet Flow): 30 min

Rainfall Intensity (i): 63 mm/hr (10-Year Event)

5-Year Pre-Development Flow Rate (2.78AiC): 90.41 L/s

100-YEAR EVENT

DRAINAGE AREA I (Uncontrolled Flow Off Site Towards Wescar Lane)

(100-YEAR EVENT)

			C
Roof Area:	0	sq.m	1.00
Hard Area:	290	sq.m	1.00
Detention Area:	0	sq.m	1.00
Gravel Area:	0	sq.m	1.00
Soft Area:	<u>1,939</u>	<u>sq.m</u>	<u>0.25</u>
Total Catchment Area:	2,229	sq.m	0.35
Area (A):	2,229	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	179	mm/hr	
Runoff Coefficient (C):	0.35		
Flow Rate (2.78AiC):	38.46	L/s	

DRAINAGE AREA II

(100-YEAR EVENT)

			C
Roof Area:	3,566	sq.m	1.00
Asphalt/Concrete Area:	31,076	sq.m	1.00
Detention Area:	897	sq.m	1.00
Gravel Area:	0	sq.m	1.00
Soft Area:	4,603	sq.m	0.25

Total Catchment Area: 40,142 sq.m 0.91

Water Elevation: 122.18 m

Head: 1.88 m

Centroid of ICD Orifice: 120.30 m
(ICD in Inlet of Culvert)

Invert of Inlet of Culvert: 121.04 m

Orifice Diameter: 139 mm

Orifice Area: 15,218 sq.mm

Discharge Coefficient: 0.61

Maximum Release Rate: 56.39 L/s

Surface Ponding

Above	CB or	Top Area	Depth	Volume	
CB/MH		(sq.m)	(m)		
CB-1		5	0.02	0.04	cu.m
CB-5		5	0.02	0.04	cu.m
CB-6		543	0.20	36.32	cu.m
CB-7		197	0.31	46.51	cu.m
CB/MH-8		10	0.02	0.07	cu.m
CB-9		732	0.20	48.97	cu.m
CB-10		805	0.20	53.81	cu.m
CB-10A		430	0.43	125.26	cu.m
CB/MH-11		805	0.20	53.81	cu.m
CB-12		234	0.20	15.67	cu.m
CB-12A		320	0.20	21.39	cu.m
CB/MH-14		678	0.20	45.34	cu.m
CB/MH-15		232	0.18	13.94	cu.m
CB-16		742	0.20	49.64	cu.m
CB/MH-17		761	0.20	50.85	cu.m
CB-18		501	0.20	33.50	cu.m
CB/MH-19		646	0.20	43.18	cu.m
CB-20		747	0.20	49.98	cu.m
CB/MH-21		844	0.20	56.44	cu.m
CB-22		355	0.20	23.74	cu.m
CB/MH-23		499	0.20	33.36	cu.m
CB/MH-24		631	0.20	42.18	cu.m
CB/MH-25		366	0.20	24.48	cu.m
Volume Stored:				868.52	cu.m

Stormwater Detention Area (above outlet invert elevation: 121.014)

Average	Average			
Length	Width	Depth	Volume	
(sq.m)	(sq.m)	(m)		
68.5	12.7	1.14	988.91	cu.m

Stormwater Detention Area (below outlet invert elevation: 121.04)

Length	Width	Depth	Volume	
(sq.m)	(sq.m)	(m)		
66.8	12.7	0.20	169.67	cu.m

Maximum Volume Stored: 2027.10 cu.m

Maximum Volume Required: 2027.10 cu.m

DRAINAGE AREA II (Continued)

(100-YEAR EVENT)

Time (min)	i (mm/hr)	2.78AiC (L/s)	ICD Release Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	179	1821.26	56.39	1764.87	1058.92
15	143	1457.48	56.39	1401.10	1260.99
20	120	1223.46	56.39	1167.08	1400.49
25	104	1059.21	56.39	1002.83	1504.24
30	92	937.03	56.39	880.64	1585.16
35	83	842.28	56.39	785.89	1650.37
40	75	766.46	56.39	710.07	1704.18
45	69	704.30	56.39	647.91	1749.35
50	64	652.32	56.39	595.93	1787.78
55	60	608.15	56.39	551.76	1820.80
60	56	570.11	56.39	513.72	1849.40
65	53	536.98	56.39	480.59	1874.31
70	50	507.84	56.39	451.45	1896.10
75	47	481.99	56.39	425.61	1915.22
80	45	458.90	56.39	402.51	1932.03
85	43	438.12	56.39	381.73	1946.82
90	41	419.32	56.39	362.93	1959.83
95	39	402.22	56.39	345.84	1971.26
100	38	386.60	56.39	330.21	1981.27
105	36	372.26	56.39	315.88	1990.01
110	35	359.06	56.39	302.67	1997.60
115	34	346.85	56.39	290.46	2004.15
120	33	335.52	56.39	279.13	2009.74
125	32	324.98	56.39	268.59	2014.45
130	31	315.15	56.39	258.76	2018.36
135	30	305.96	56.39	249.57	2021.53
140	29	297.34	56.39	240.95	2024.01
145	28	289.25	56.39	232.86	2025.85
150	28	281.62	56.39	225.23	2027.10
180	24	243.80	56.39	187.41	2024.04
210	21	215.67	56.39	159.28	2006.92
240	19	193.85	56.39	137.46	1979.49
270	17	176.40	56.39	120.01	1944.17
300	16	162.09	56.39	105.70	1902.60
330	15	150.12	56.39	93.73	1855.94
360	14	139.96	56.39	83.57	1805.06
390	13	131.20	56.39	74.81	1750.61
420	12	123.58	56.39	67.19	1693.11
450	11	116.87	56.39	60.48	1632.95
480	11	110.92	56.39	54.53	1570.48
510	10	105.60	56.39	49.21	1505.96
540	9.9	100.82	56.39	44.43	1439.62
570	9.5	96.50	56.39	40.11	1371.63
600	9.1	92.56	56.39	36.17	1302.17
630	8.7	88.96	56.39	32.58	1231.36
660	8.4	85.67	56.39	29.28	1159.34
690	8.1	82.63	56.39	26.24	1086.19
720	7.8	79.82	56.39	23.43	1012.01
750	7.6	77.21	56.39	20.82	936.88
780	7.3	74.78	56.39	18.39	860.88
810	7.1	72.52	56.39	16.13	784.05
840	6.9	70.41	56.39	14.02	706.47
870	6.7	68.42	56.39	12.03	628.17
900	6.5	66.56	56.39	10.17	549.20

10-YEAR EVENT

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(10-YEAR EVENT)

			C
Roof Area:	0	sq.m	0.90
Hard Area:	290	sq.m	0.90
Detention Area:	0	sq.m	0.90
Gravel Area:	0	sq.m	0.80
Soft Area:	<u>1,939</u>	<u>sq.m</u>	<u>0.20</u>
Total Catchment Area:	2,229	sq.m	0.29
Area (A):	2,229	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	122	mm/hr (10-Year Event)	
Runoff Coefficient (C):	0.29		
Flow Rate (2.78AiC):	22.03	L/s	

DRAINAGE AREA II

(10-YEAR EVENT)

			C
Roof Area:	3,566	sq.m	0.90
Asphalt/Concrete Area:	31,076	sq.m	0.90
Detention Area:	897	sq.m	1.00
Gravel Area:	0	sq.m	0.80
Landscaped Area:	4,603	sq.m	0.20
Total Catchment Area:	40,142	sq.m	0.82
Water Elevation:	122.07	m	
Head:	0.96	m	
Centroid of ICD Orifice: (ICD in Inlet of Culvert)	121.11	m	
Invert of Inlet of Culvert:	121.04	m	
Orifice Diameter:	139	mm	
Orifice Area:	15,218	sq.mm	
Discharge Coefficient:	0.61		
Maximum Release Rate:	40.21	L/s	

Surface Ponding

Above	Top Area	Depth	Volume	
CB or CB/MH	(sq.m)	(m)		
CB-1	0	0.00	0.00	cu.m
CB-5	0	0.00	0.00	cu.m
CB-6	99	0.09	2.84	cu.m
CB-7	0	0.20	23.74	cu.m
CB/MH-8	0	0.00	0.00	cu.m
CB-9	134	0.09	3.82	cu.m
CB-10	147	0.09	4.20	cu.m
CB-10A	0	0.32	75.66	cu.m
CB/MH-11	147	0.09	4.20	cu.m
CB-12	43	0.09	1.22	cu.m
CB-12A	58	0.09	1.67	cu.m
CB/MH-14	124	0.09	3.54	cu.m
CB/MH-15	31	0.07	0.67	cu.m
CB-16	136	0.09	3.88	cu.m
CB/MH-17	139	0.09	3.97	cu.m
CB-18	92	0.09	2.62	cu.m
CB/MH-19	118	0.09	3.37	cu.m
CB-20	137	0.09	3.90	cu.m
CB/MH-21	154	0.09	4.41	cu.m
CB-22	65	0.09	1.85	cu.m
CB/MH-23	91	0.09	2.61	cu.m
CB/MH-24	115	0.09	3.29	cu.m
CB/MH-25	67	0.09	1.91	cu.m

Volume Stored: 153.38 cu.m

Stormwater Detention Area (above outlet invert elevation: 121.04)

Average Length (sq.m)	Average Width (sq.m)	Depth (m)	Volume
68.5	12.7	1.03	889.33 cu.m

Stormwater Detention Area (below outlet invert elevation: 121.04)

Length (sq.m)	Width (sq.m)	Depth (m)	Volume
66.8	12.7	0.20	169.67 cu.m

Maximum Volume Stored: 1212.38 cu.m

Maximum Volume Required: 1212.38 cu.m

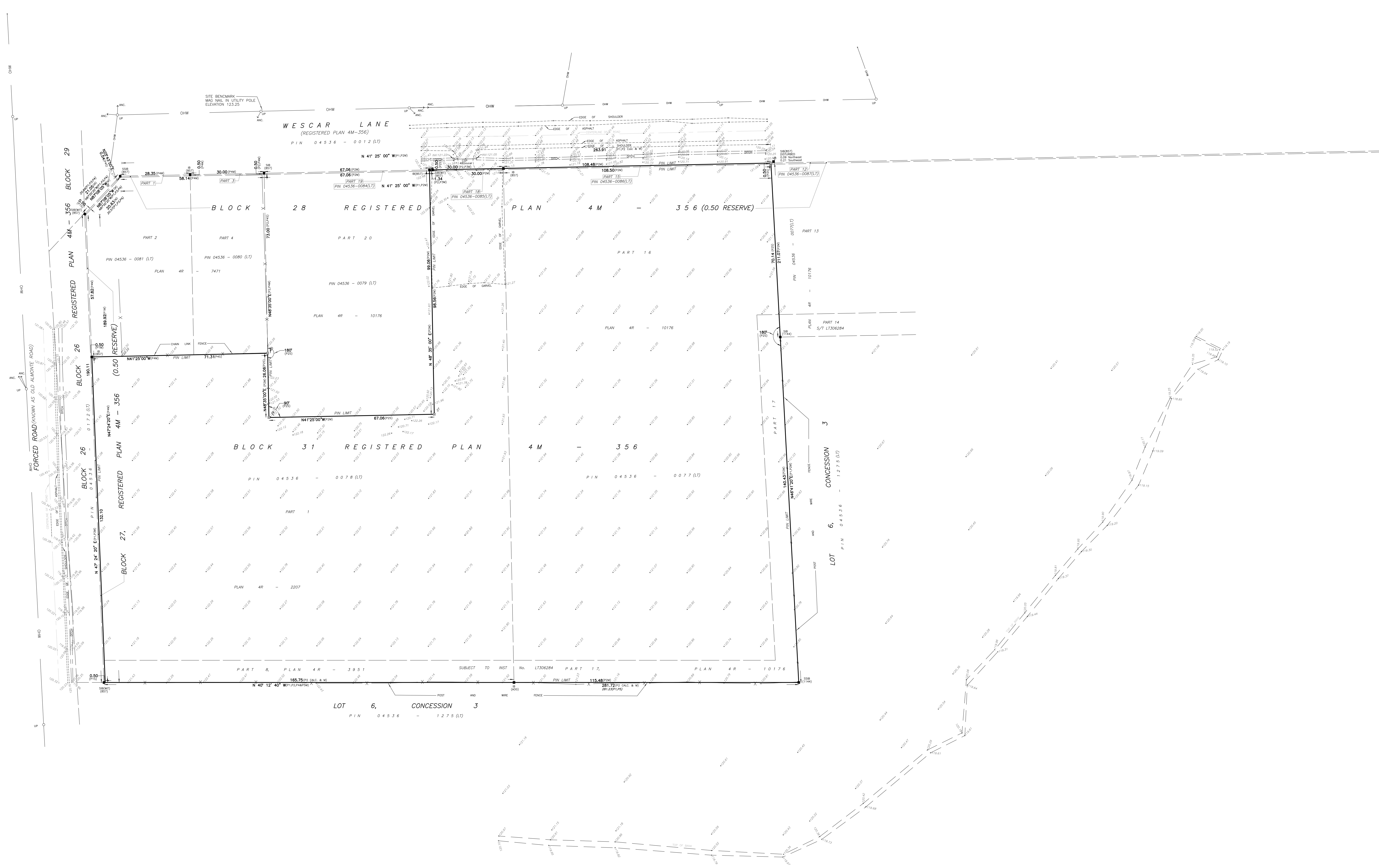
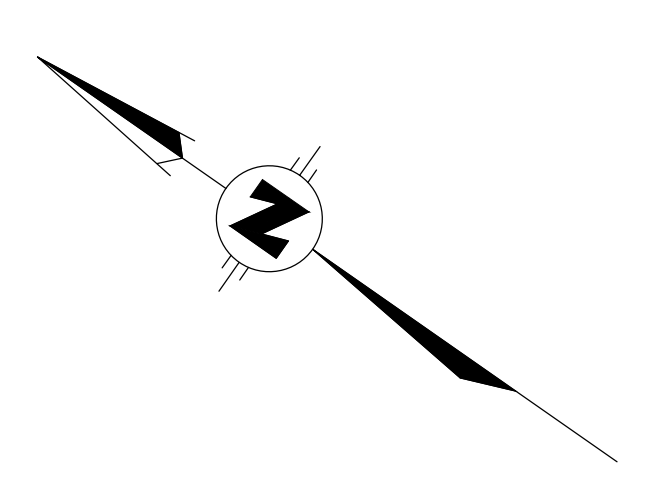
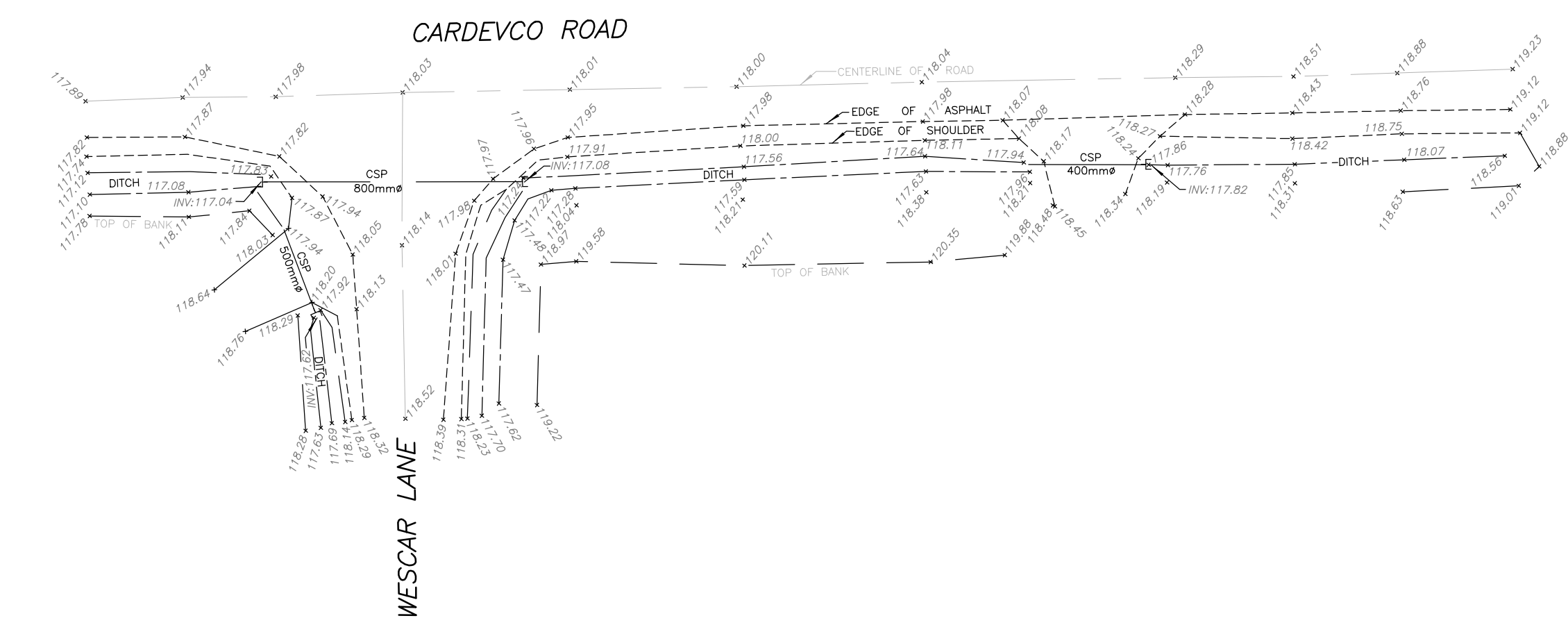
DRAINAGE AREA II (Continued)

(2-YEAR EVENT)

Time (min)	i (mm/hr)	2.78AiC (L/s)	ICD Release Rate (L/s)	Stored Rate (L/s)	Required Storage Volume (cu.m)
10	122	1120.37	40.21	1080.16	648.10
15	98	897.57	40.21	857.36	771.62
20	82	754.09	40.21	713.89	856.66
25	71	653.32	40.21	613.11	919.66
30	63	578.30	40.21	538.09	968.57
35	57	520.09	40.21	479.89	1007.76
40	52	473.50	40.21	433.29	1039.89
45	47	435.27	40.21	395.06	1066.67
50	44	403.30	40.21	363.09	1089.27
55	41	376.12	40.21	335.91	1108.50
60	38	352.70	40.21	312.50	1124.99
65	36	332.31	40.21	292.10	1139.18
70	34	314.36	40.21	274.15	1151.43
75	33	298.43	40.21	258.23	1162.02
80	31	284.20	40.21	243.99	1171.17
85	30	271.40	40.21	231.19	1179.06
90	28	259.81	40.21	219.60	1185.83
95	27	249.26	40.21	209.06	1191.62
100	26	239.63	40.21	199.42	1196.52
105	25	230.78	40.21	190.58	1200.63
110	24	222.64	40.21	182.43	1204.02
115	23	215.10	40.21	174.89	1206.76
120	23	208.11	40.21	167.90	1208.90
125	22	201.61	40.21	161.40	1210.49
130	21	195.54	40.21	155.33	1211.57
135	21	189.86	40.21	149.65	1212.19
140	20	184.54	40.21	144.33	1212.38
145	20	179.54	40.21	139.33	1212.17
150	19	174.83	40.21	134.62	1211.59
180	17	151.46	40.21	111.25	1201.48
210	15	134.06	40.21	93.85	1182.53
240	13	120.56	40.21	80.35	1157.11
270	12	109.76	40.21	69.55	1126.71
300	11	100.89	40.21	60.69	1092.37

APPENDIX H

TOPOGRAPHIC SURVEYS



LOT 6, CONCESSION 3
P.I.N. 04536 - 1275 (LT)

LOT 6, CONCESSION 6
P.I.N. 04536 - 1275 (LT)

BLOCK 31 REGISTERED PLAN 4M - 356
P.I.N. 04536 - 0078 (LT)

BLOCK 28 REGISTERED PLAN 4M - 356 (0.50 RESERVE)
P.I.N. 04536 - 0012 (LT)

WESCAR LANE
(REGISTERED PLAN 4M-356)
P.I.N. 04536 - 0012 (LT)

FORCED ROAD (KNOWN AS OLD ALMONTE ROAD)

SITE BENCHMARK
MAG. NAIL IN UTILITY POLE
ELEVATION 123.25

OHW
MHO
S
E

APPENDIX I

GRADING PLANS
123-127 & 135 CARDEVCO ROAD
AND
123, 131, 141, 165, & 180 WESCAR LANE

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The Contractor shall verify and be responsible for all dimensions. DO NOT scale the drawing - any errors or omissions shall be reported to Stantec without delay. The Copyrights to all designs and drawings are the property of Stantec. Reproduction or use for any purpose other than that authorized by Stantec is forbidden.

Legend

- ORIGINAL GROUND ELEVATIONS
- PROPOSED ELEVATION
- PROPOSED LOT CORNER ELEVATION
- EXISTING ELEVATION AT LOT CORNER
- FLOW DIRECTION AND GRADE
- FINISHED FIRST ELEVATION
- TOP OF FOUNDATION ELEVATION
- UNDERSIDE OF FOOTING ELEVATION
- TERRACING 3:1 SLOPE MAXIMUM (UNLESS OTHERWISE SHOWN)
- PROPOSED SWALE
- DIRECTION OF OVERLAND FLOW
- PROPOSED STORM SEWER MANHOLE
- PROPOSED CATCHBASIN
- PROPOSED DEPRESSED CURB LOCATIONS
- PROPOSED HEAVY DUTY ASPHALT
- PROPERTY LINE
- EXISTING WELL
- PROPOSED BUILDING ENTRANCE
- PROPOSED PAVEMENT MARKINGS (REFER TO ARCHITECTURAL DWGS)

Notes

1. SITE PLAN PREPARED BY BLANCHARD LETENDRE ENGINEER, DRAWING NO. SP-1, DATED MAY 26, 2021.
2. TOPOGRAPHIC SURVEY SUPPLIED BY STANTEC GEOMATICS LTD. DATED OCTOBER 2, 2019. ELEVATIONS ARE DERIVED FROM THE CAN-NET VRS NETWORK MONUMENT: OTTAWA ELEVATION=95.230.
3. GEOTECHNICAL REPORT PREPARED BY GEMTEC, PROJECT 62565.03, DATED SEPTEMBER 29, 2017.

Revision	By	Appd.	YY.MM.DD
2	WAJ	KJK	21.10.13
1	WAJ	KJK	20.02.07

File Name: 160401519-08 Dwn. Chkd. Dgn. YY.MM.DD

Permit-Seal



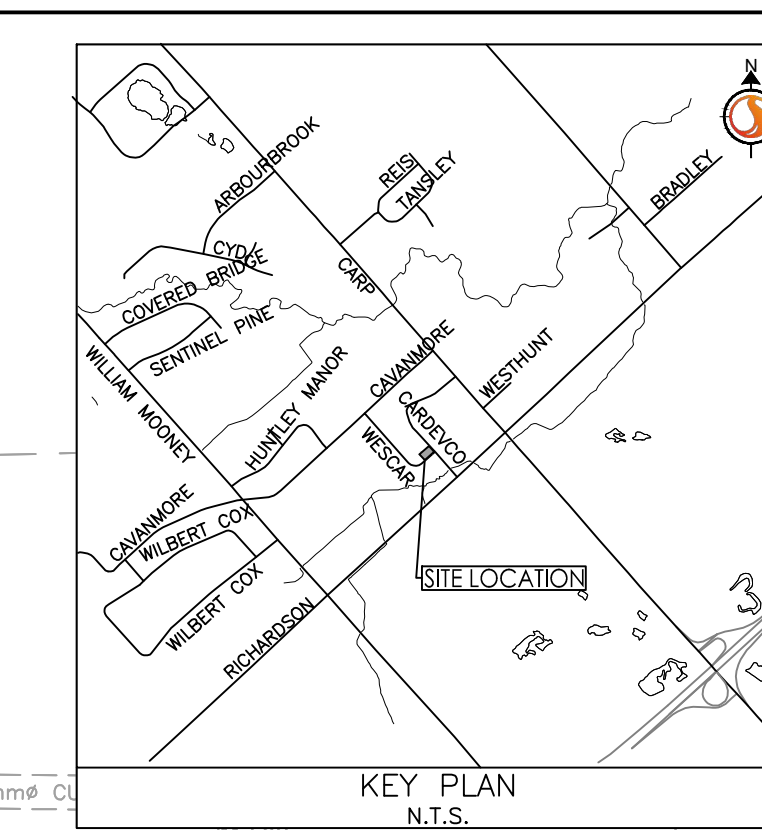
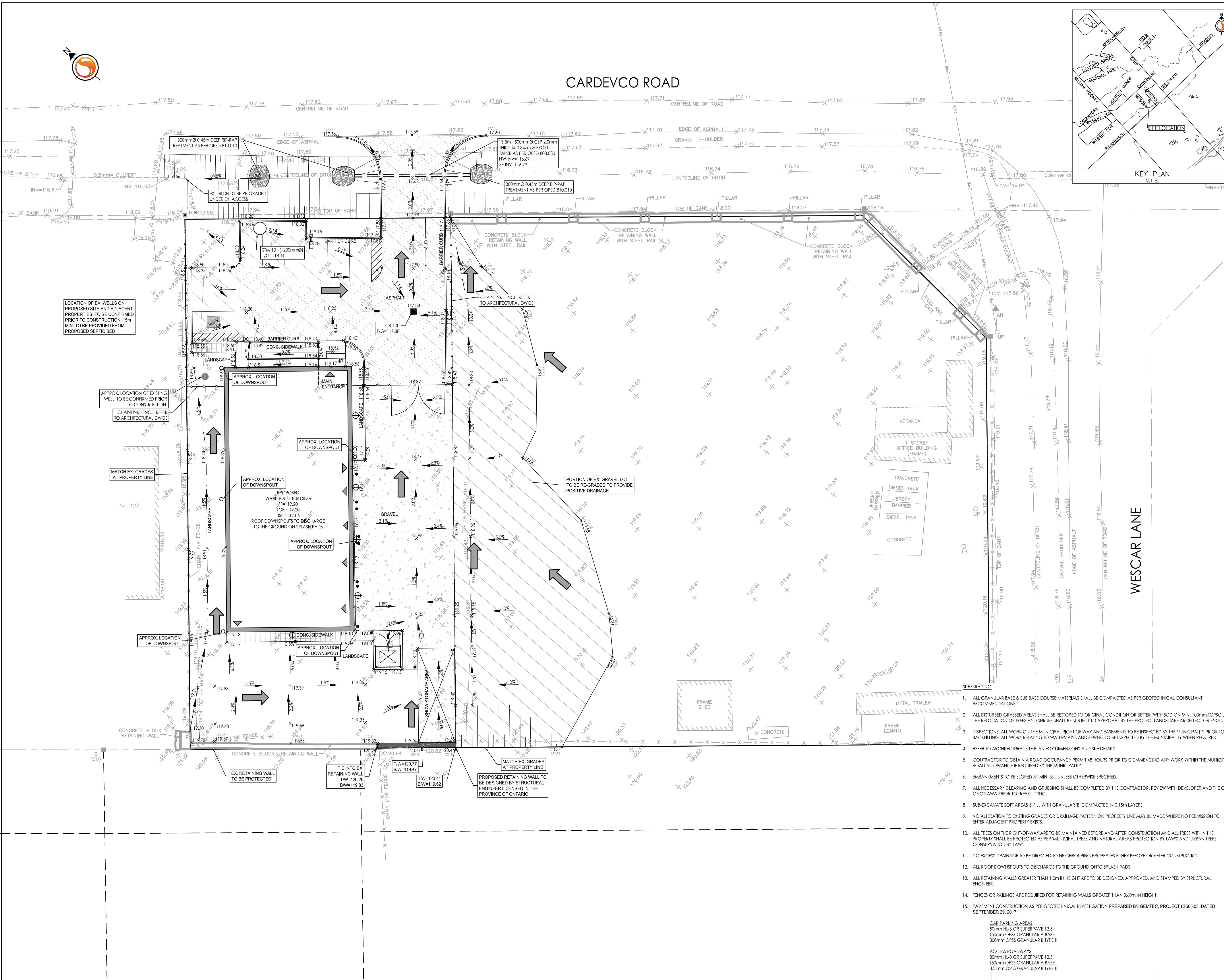
Client/Project
AKM CONSTRUCTION
123 Cardevco Rd, Carp, Ontario

PROPOSED WAREHOUSE
127 CARDEVCO ROAD
OTTAWA, ON

Title
GRADING PLAN

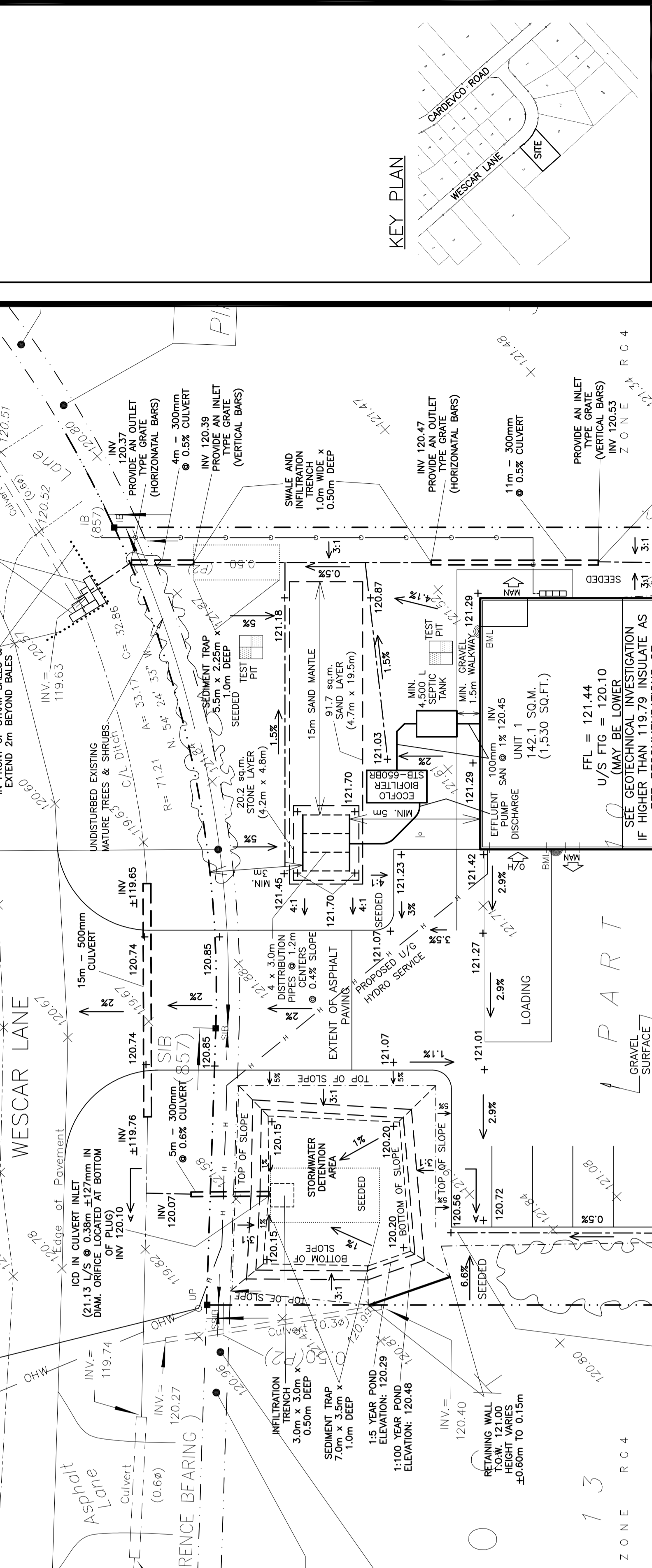
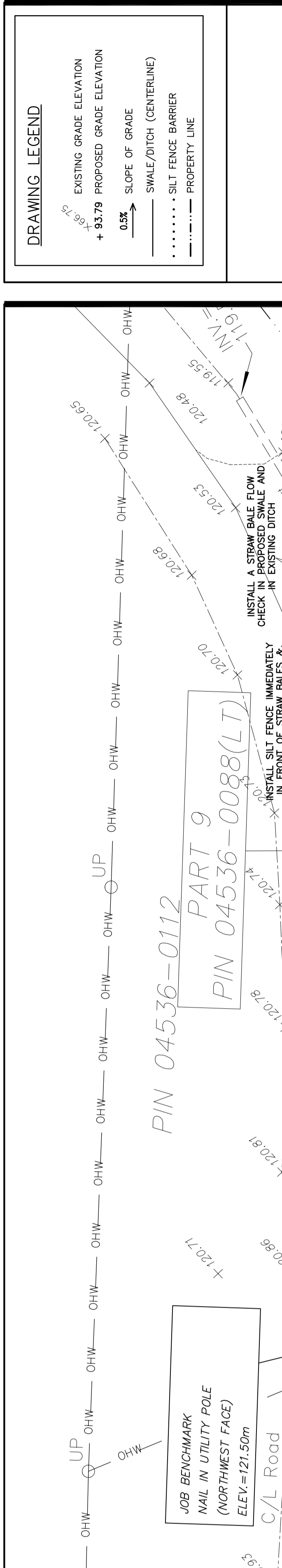
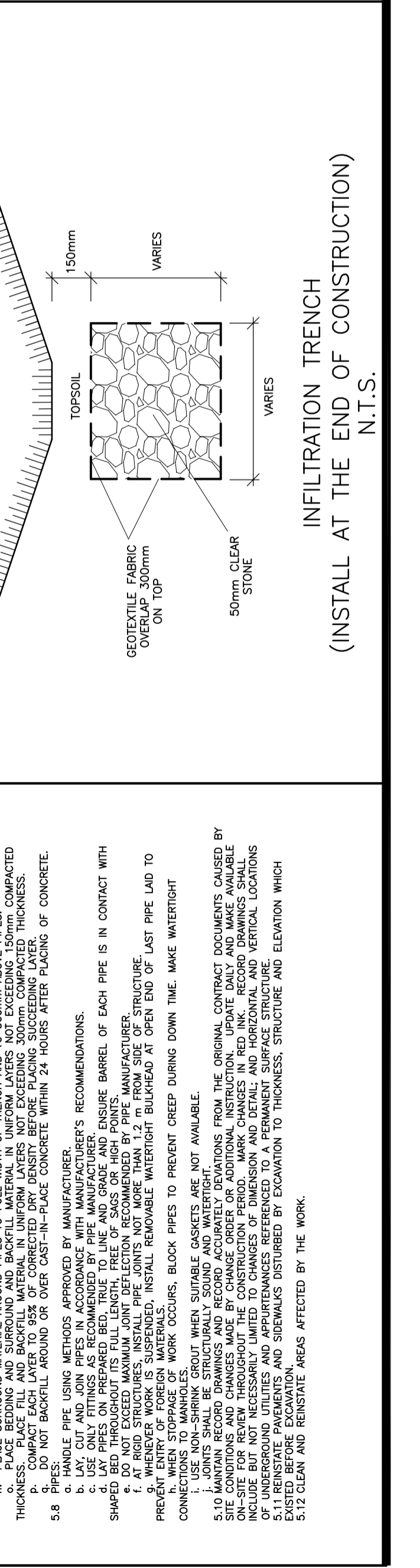
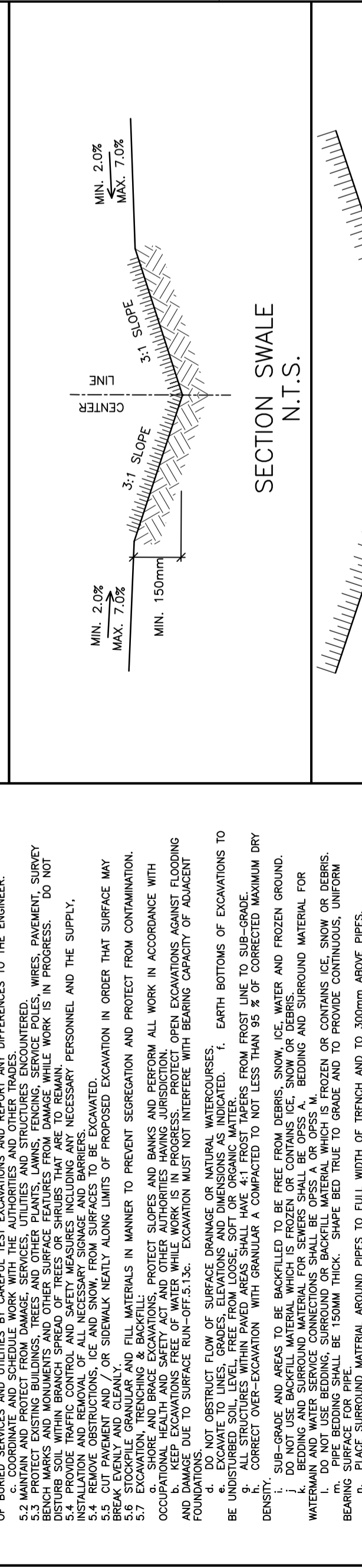
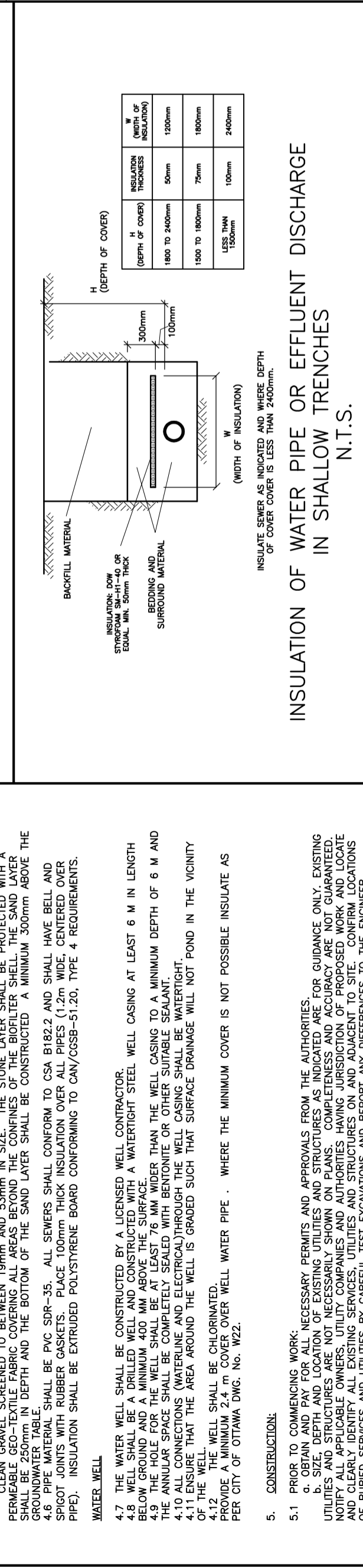
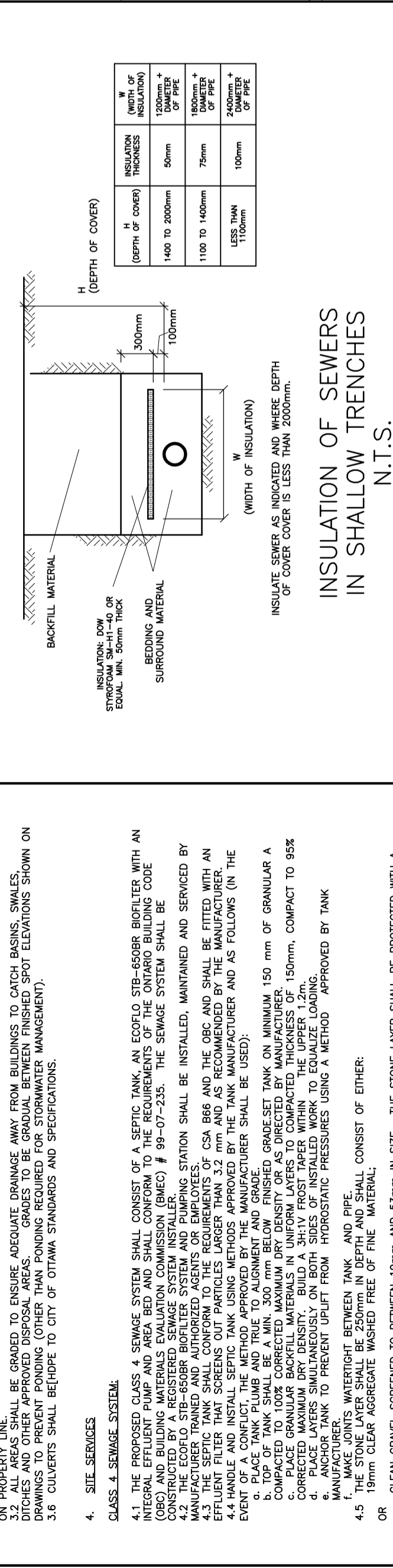
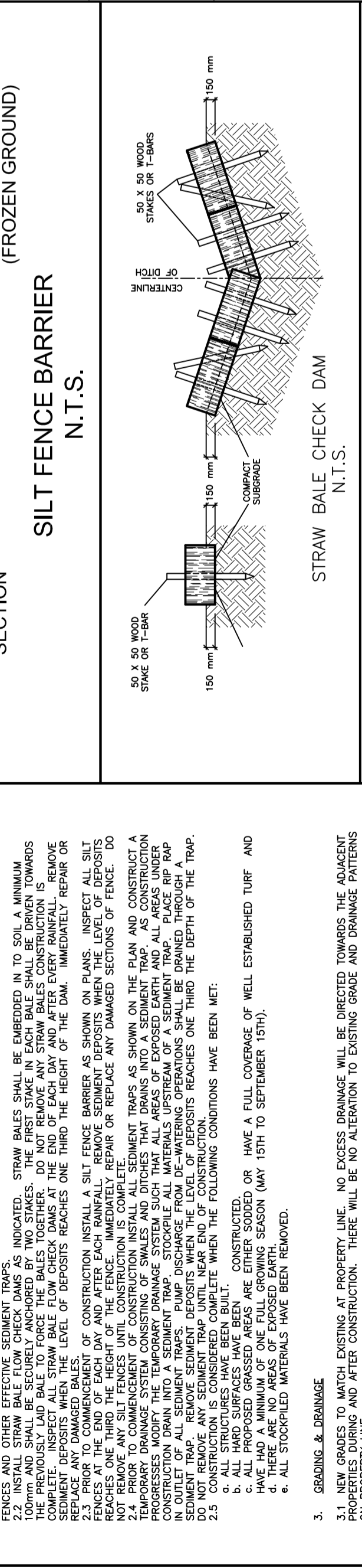
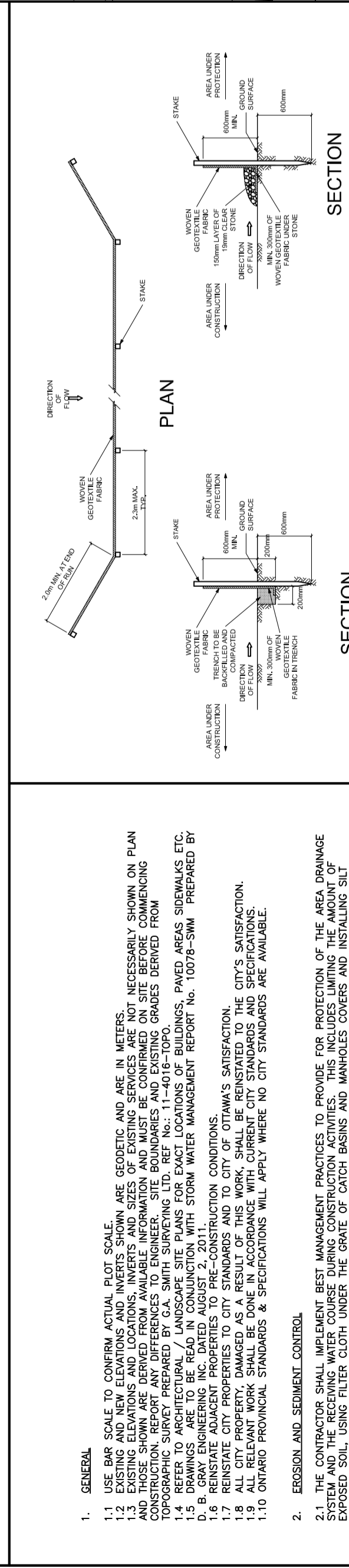
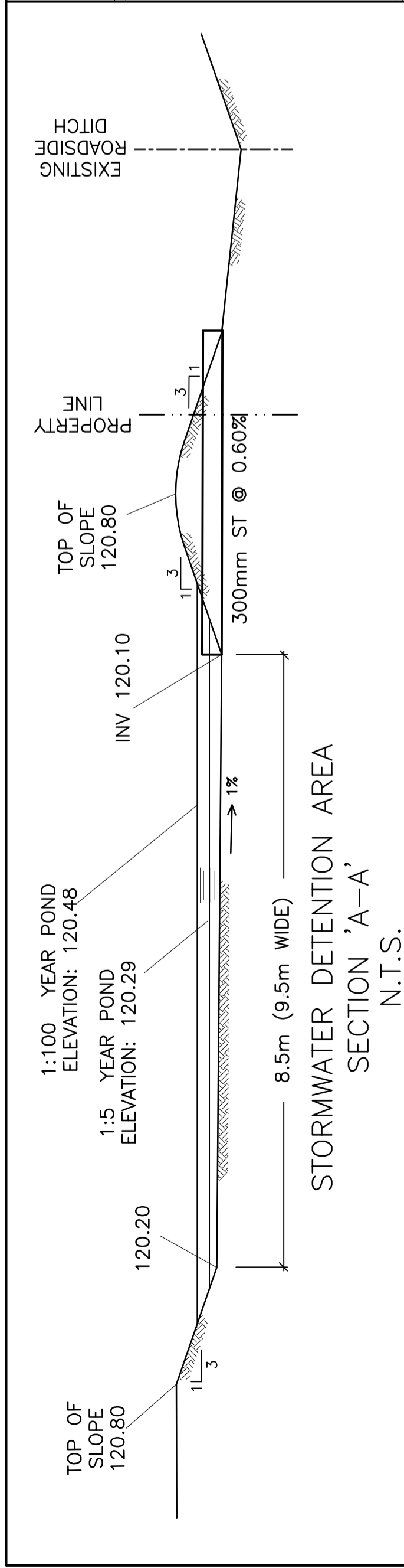
Project No. 160401519	Scale 1:100	Sheet 3 of 5	Revision 2
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Drawing No. GP-1



- SITE GRADING**
1. ALL GRANULAR BASE & SUB BASE COURSE MATERIALS SHALL BE COMPACTED AS PER GEOTECHNICAL CONSULTANT RECOMMENDATIONS.
 2. ALL DISTURBED GRASSED AREAS SHALL BE RESTORED TO ORIGINAL CONDITION OR BETTER, WITH SOD ON MIN. 100mm TOPSOIL. THE RELOCATION OF TREES AND SHRUBS SHALL BE SUBJECT TO APPROVAL BY THE PROJECT LANDSCAPE ARCHITECT OR ENGINEER.
 3. INSPECTIONS: ALL WORK ON THE MUNICIPAL RIGHT OF WAY AND EASEMENTS TO BE INSPECTED BY THE MUNICIPALITY PRIOR TO BACKFILLING. ALL WORK RELATING TO WATERMAINS AND SEWERS TO BE INSPECTED BY THE MUNICIPALITY WHEN REQUIRED.
 4. REFER TO ARCHITECTURAL SITE PLAN FOR DIMENSIONS AND SITE DETAILS.
 5. CONTRACTOR TO OBTAIN A ROAD OCCUPANCY PERMIT 48 HOURS PRIOR TO COMMENCING ANY WORK WITHIN THE MUNICIPAL ROAD ALLOWANCE IF REQUIRED BY THE MUNICIPALITY.
 6. EMBANKMENTS TO BE SLOPED AT MIN. 3:1, UNLESS OTHERWISE SPECIFIED.
 7. ALL NECESSARY CLEARING AND GRUBBING SHALL BE COMPLETED BY THE CONTRACTOR. REVIEW WITH DEVELOPER AND THE CITY OF OTTAWA PRIOR TO TREE CUTTING.
 8. SUB-EXCAVATE SOFT AREAS & FILL WITH GRANULAR 'B' COMPACTED IN 0.15m LAYERS.
 9. NO ALTERATION TO EXISTING GRADES OR DRAINAGE PATTERN ON PROPERTY LINE MAY BE MADE WHERE NO PERMISSION TO ENTER ADJACENT PROPERTY EXISTS.
 10. ALL TREES ON THE RIGHT-OF-WAY ARE TO BE MAINTAINED BEFORE AND AFTER CONSTRUCTION AND ALL TREES WITHIN THE PROPERTY SHALL BE PROTECTED AS PER MUNICIPAL TREES AND NATURAL AREAS PROTECTION BY-LAWS AND URBAN TREES CONSERVATION BY-LAW.
 11. NO EXCESS DRAINAGE TO BE DIRECTED TO NEIGHBOURING PROPERTIES EITHER BEFORE OR AFTER CONSTRUCTION.
 12. ALL ROOF DOWNSPOUTS TO DISCHARGE TO THE GROUND ONTO SPLASH PADS.
 13. ALL RETAINING WALLS GREATER THAN 1.0m IN HEIGHT ARE TO BE DESIGNED, APPROVED, AND STAMPED BY STRUCTURAL ENGINEER.
 14. FENCES OR RAILINGS ARE REQUIRED FOR RETAINING WALLS GREATER THAN 0.60m IN HEIGHT.
 15. PAVEMENT CONSTRUCTION AS PER GEOTECHNICAL INVESTIGATION PREPARED BY GEMTEC, PROJECT 62565.03, DATED SEPTEMBER 29, 2017.
- CAR PARKING AREAS**
30mm HL-3 OR SUPERPAVE 12.5
150mm OPSS GRANULAR A BASE
300mm OPSS GRANULAR B TYPE II
- ACCESS ROADWAYS**
80mm HL-3 OR SUPERPAVE 12.5
150mm OPSS GRANULAR A BASE
375mm OPSS GRANULAR B TYPE II

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 2021/10/13 10:54 AM By: Johnson, Adam
 ORIGINAL SHEET - ARCH D



No.	Date	Revision
1	MAY 3-11	ISSUED FOR APPROVAL
2	AUG 2-11	REVISED AS PER IAC & CITY COMMENTS RE-ISSUED FOR APPROVAL

D. B. GRAY ENGINEERING INC.
 Stormwater Management, Grading & Drainage, Sewer & Sanitary Sewer, Watermain
 1052 Karsh Drive
 Ottawa, Ontario, K1G 4N1
 Tel: (613) 249-8044
 Fax: (613) 249-9815
 email: dgray@dbgray.com

MARNICK HOLDINGS WAREHOUSE
 131 WESCAR LANE
 OTTAWA, ONTARIO.

SITE SERVING PLAN & GRADING PLAN

Project: MARNICK HOLDINGS WAREHOUSE 131 WESCAR LANE OTTAWA, ONTARIO.

Drawing Title: SITE SERVING PLAN & GRADING PLAN

Scale: 1:200

Date: APR 19-11

Job: 10078

Drawing No.: SG-1 of 1

Engineer's Seal: D.B. GRAY 17016502

NOT VALID UNLESS SIGNED & DATED

1. GENERAL
 1.1 USE BAR SCALE TO CONFIRM ACTUAL PLOT SCALE.
 1.2 EXISTING AND PROPOSED GRADE ELEVATIONS AND SLOPES SHALL BE SHOWN ON PLAN AND THESE SHALL BE DERIVED FROM AVAILABLE INFORMATION AND MUST BE CONFIRMED ON SITE BEFORE COMMENCING CONSTRUCTION.
 1.3 ALL DIMENSIONS ARE TO FACE UNLESS OTHERWISE NOTED.
 1.4 ALL DIMENSIONS ARE TO BE READ IN CONJUNCTION WITH STORM WATER MANAGEMENT REPORT NO. 10078-SWM, PREPARED BY D.B. GRAY ENGINEERING INC. ON BEHALF OF MARNICK HOLDINGS.
 1.5 ALL DIMENSIONS ARE TO BE READ IN CONJUNCTION WITH STORM WATER MANAGEMENT REPORT NO. 10078-SWM, PREPARED BY D.B. GRAY ENGINEERING INC. ON BEHALF OF MARNICK HOLDINGS.
 1.6 ALL DIMENSIONS ARE TO BE READ IN CONJUNCTION WITH STORM WATER MANAGEMENT REPORT NO. 10078-SWM, PREPARED BY D.B. GRAY ENGINEERING INC. ON BEHALF OF MARNICK HOLDINGS.
 1.7 ALL DIMENSIONS ARE TO BE READ IN CONJUNCTION WITH STORM WATER MANAGEMENT REPORT NO. 10078-SWM, PREPARED BY D.B. GRAY ENGINEERING INC. ON BEHALF OF MARNICK HOLDINGS.
 1.8 ALL DIMENSIONS ARE TO BE READ IN CONJUNCTION WITH STORM WATER MANAGEMENT REPORT NO. 10078-SWM, PREPARED BY D.B. GRAY ENGINEERING INC. ON BEHALF OF MARNICK HOLDINGS.
 1.9 ALL DIMENSIONS ARE TO BE READ IN CONJUNCTION WITH STORM WATER MANAGEMENT REPORT NO. 10078-SWM, PREPARED BY D.B. GRAY ENGINEERING INC. ON BEHALF OF MARNICK HOLDINGS.
 1.10 ALL DIMENSIONS ARE TO BE READ IN CONJUNCTION WITH STORM WATER MANAGEMENT REPORT NO. 10078-SWM, PREPARED BY D.B. GRAY ENGINEERING INC. ON BEHALF OF MARNICK HOLDINGS.

2. EROSION AND SEDIMENT CONTROL
 2.1 THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES TO PROVIDE PROTECTION FOR THE ADJACENT PROPERTIES DURING AND AFTER CONSTRUCTION. THERE WILL BE NO ALLEGATION TO EXISTING GRASS AND DRAINAGE PATTERNS.
 2.2 ALL AREAS SHALL BE GRADED TO ENSURE ADEQUATE DRAINAGE AWAY FROM BUILDINGS TO CATCH BASINS, SWALES, OR DRAINAGE TO PREVENT FLOODING (OTHER THAN FLOODING REQUIRED FOR STORMWATER MANAGEMENT).
 2.3 CULVERTS SHALL BE INSTALLED TO CITY OF OTTAWA STANDARDS AND SPECIFICATIONS.

3. GRADING & DRAINAGE
 3.1 NEW GRASSES TO MATCH EXISTING AT PROPERTY LINE. NO EXCESS DRAINAGE WILL BE DIRECTED TOWARDS THE ADJACENT PROPERTIES DURING AND AFTER CONSTRUCTION.
 3.2 ALL AREAS SHALL BE GRADED TO ENSURE ADEQUATE DRAINAGE AWAY FROM BUILDINGS TO CATCH BASINS, SWALES, OR DRAINAGE TO PREVENT FLOODING (OTHER THAN FLOODING REQUIRED FOR STORMWATER MANAGEMENT).
 3.3 CULVERTS SHALL BE INSTALLED TO CITY OF OTTAWA STANDARDS AND SPECIFICATIONS.

4. SITE SERVICES
 4.1 THE CONTRACTOR SHALL PROVIDE A SEWER SYSTEM SHALL CONSIST OF A SEWER TANK AN EXISTING 150mm DIA. SEWER WITH AN INTERIOR EFFLUENT PUMP AND AREA BED AND SHALL CONFORM TO THE REQUIREMENTS OF THE OTTAWA BUILDING CODE (CONSTRUCTION OF SEWER SYSTEMS) (MAY 15TH TO SEPTEMBER 15TH). THE SEWER SYSTEM SHALL BE INSTALLED, MAINTAINED AND SERVICED BY THE OWNER.
 4.2 THE 150mm DIA. SEWER SHALL BE INSTALLED TO THE REQUIREMENTS OF CSA B66 AND THE GRE AND SHALL BE FITTED WITH AN INTERIOR EFFLUENT PUMP AND AREA BED AND SHALL CONFORM TO THE REQUIREMENTS OF THE OTTAWA BUILDING CODE (CONSTRUCTION OF SEWER SYSTEMS) (MAY 15TH TO SEPTEMBER 15TH). THE SEWER SYSTEM SHALL BE INSTALLED, MAINTAINED AND SERVICED BY THE OWNER.
 4.3 THE SEWER TANK SHALL CONFORM TO THE REQUIREMENTS OF CSA B66 AND THE GRE AND SHALL BE FITTED WITH AN INTERIOR EFFLUENT PUMP AND AREA BED AND SHALL CONFORM TO THE REQUIREMENTS OF THE OTTAWA BUILDING CODE (CONSTRUCTION OF SEWER SYSTEMS) (MAY 15TH TO SEPTEMBER 15TH). THE SEWER TANK SHALL BE INSTALLED, MAINTAINED AND SERVICED BY THE OWNER.
 4.4 THE SEWER TANK SHALL CONFORM TO THE REQUIREMENTS OF CSA B66 AND THE GRE AND SHALL BE FITTED WITH AN INTERIOR EFFLUENT PUMP AND AREA BED AND SHALL CONFORM TO THE REQUIREMENTS OF THE OTTAWA BUILDING CODE (CONSTRUCTION OF SEWER SYSTEMS) (MAY 15TH TO SEPTEMBER 15TH). THE SEWER TANK SHALL BE INSTALLED, MAINTAINED AND SERVICED BY THE OWNER.
 4.5 THE SEWER TANK SHALL CONFORM TO THE REQUIREMENTS OF CSA B66 AND THE GRE AND SHALL BE FITTED WITH AN INTERIOR EFFLUENT PUMP AND AREA BED AND SHALL CONFORM TO THE REQUIREMENTS OF THE OTTAWA BUILDING CODE (CONSTRUCTION OF SEWER SYSTEMS) (MAY 15TH TO SEPTEMBER 15TH). THE SEWER TANK SHALL BE INSTALLED, MAINTAINED AND SERVICED BY THE OWNER.

4.7 THE WATER WELL SHALL BE CONSTRUCTED BY A LICENSED WELL CONTRACTOR.
 4.8 THE WATER WELL SHALL BE CONSTRUCTED BY A LICENSED WELL CONTRACTOR.
 4.9 THE WATER WELL SHALL BE CONSTRUCTED BY A LICENSED WELL CONTRACTOR.
 4.10 THE WATER WELL SHALL BE CONSTRUCTED BY A LICENSED WELL CONTRACTOR.
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 4.17 THE WATER WELL SHALL BE CONSTRUCTED BY A LICENSED WELL CONTRACTOR.
 4.18 THE WATER WELL SHALL BE CONSTRUCTED BY A LICENSED WELL CONTRACTOR.
 4.19 THE WATER WELL SHALL BE CONSTRUCTED BY A LICENSED WELL CONTRACTOR.
 4.20 THE WATER WELL SHALL BE CONSTRUCTED BY A LICENSED WELL CONTRACTOR.

5. CONSTRUCTION
 5.1 PRIOR TO COMMENCING WORK, THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF OTTAWA AND THE PROVINCE OF ONTARIO.
 5.2 THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF OTTAWA AND THE PROVINCE OF ONTARIO.
 5.3 THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF OTTAWA AND THE PROVINCE OF ONTARIO.
 5.4 THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF OTTAWA AND THE PROVINCE OF ONTARIO.
 5.5 THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF OTTAWA AND THE PROVINCE OF ONTARIO.
 5.6 THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF OTTAWA AND THE PROVINCE OF ONTARIO.
 5.7 THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF OTTAWA AND THE PROVINCE OF ONTARIO.
 5.8 THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF OTTAWA AND THE PROVINCE OF ONTARIO.

5.9 THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF OTTAWA AND THE PROVINCE OF ONTARIO.
 5.10 THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF OTTAWA AND THE PROVINCE OF ONTARIO.
 5.11 THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF OTTAWA AND THE PROVINCE OF ONTARIO.
 5.12 THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF OTTAWA AND THE PROVINCE OF ONTARIO.
 5.13 THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF OTTAWA AND THE PROVINCE OF ONTARIO.
 5.14 THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF OTTAWA AND THE PROVINCE OF ONTARIO.
 5.15 THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF OTTAWA AND THE PROVINCE OF ONTARIO.

APPENDIX J

PHOTOGRAPHS
JUNE 6, 2024 STORM
121 TO 135 CARDEVCO ROAD



H
2021

ruelle Wescar Lane
107 → 101

H
100m





Yellow sign on the stone wall, partially obscured by a tree.

PARKING sign in the distance on the right side of the road.



TARSTONE
813-978-2874

WALK
STOP

NO PARKING



MOLNIR
CONSTRUCTION
TRUCKS - FENCES - CONFINEMENT - BARRIERS

AKMAN

53'