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Hamilton Rapid Transit Preliminary Design and Feasibility Study

B-LINE

PRELIMINARY DRAINAGE REPORT

Version:1.0

METROLINX

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DIALOG

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Table of Contents

1.0 Introduction

Most of the Hamilton LRT B-Line will be constructed along existing City roads allowances. To provide storm drainage, it is proposed to connect the LRT to the existing City storm drainage systems, wherever possible. It is necessary to determine if the existing storm sewers are capable of accepting these flows. Where the existing system has insufficient capacity or is not in an appropriate location, modifications or additions to the storm sewer network may be required.

The City prefers to have no active utility pipes within the zone of loading influence under the LRT. Potential conflicts between the LRT and storm/combined sewer alignments in this regard have been identified previously. The required storm and combined sewer relocations are presented on the utility re-location plans.

This scope of the preliminary drainage assessment is:

- Definition of existing storm drainage systems in proximity to the LRT alignment,
- Definition of drainage catchment boundaries along the LRT alignment,
- Identification of upstream drainage areas contributing to the affected storm sewers,
- Calculation of the additional pavement area resulting from LRT construction in each catchment,
- Estimation of the potential impacts on the existing storm sewers due to increased runoff and,
- Identification of locations where the existing storm drainage system needs to be analysed in more detail due to potentially significant drainage impacts from the LRT.

This purpose of this document is to present a screening assessment of the potential hydrologic impact of the LRT construction on the existing storm drainage systems along the alignment and to identify those locations where additional capacity may be required. However, the analysis of the additional requirements is not included in this report. This will be done at the next stage of design.

There are two locations where more detailed drainage assessment and design will be required. The first one is at west end of the project at McMaster University, the LRT traverses areas that are currently grassed. A separate stormwater management analysis will be required to address the LRT drainage at this location. The second location is the LRT overpass at Highway 403, a new drainage system will be required for the new bridge and the area adjacent to the grade separation. These studies are not included in this report.

2.0 Project Configuration

The B-Line consists of 13.9 km of dual track, 16 on-street stops and two terminals (See Figure 2.1). The project begins at McMaster University in the west and travels along Main Street to the Highway 403 overpass. After crossing Highway 403, the alignment swings north and follows King Street to the eastern terminus west of Centennial Parkway. At the time of writing this document, the Maintenance and Storage Facility (MSF) has yet to be determined.

From a drainage perspective the relevant design information for the LTRT is

- the design of the LRT trackwork, platforms and other structures,
- its alignment and placement within the road allowance
- the degree of imperviousness of the new construction compared to the existing areas it replaces and
- the relationship to existing drainage infrastructure

The preliminary design has identified the proposed LRT alignment and numerous track and platform configurations for specific locations and conditions. The alignment is shown in the design drawings which are under separate cover. Typical cross-sections along the guideway showing the track and platform locations are shown in Appendix A.

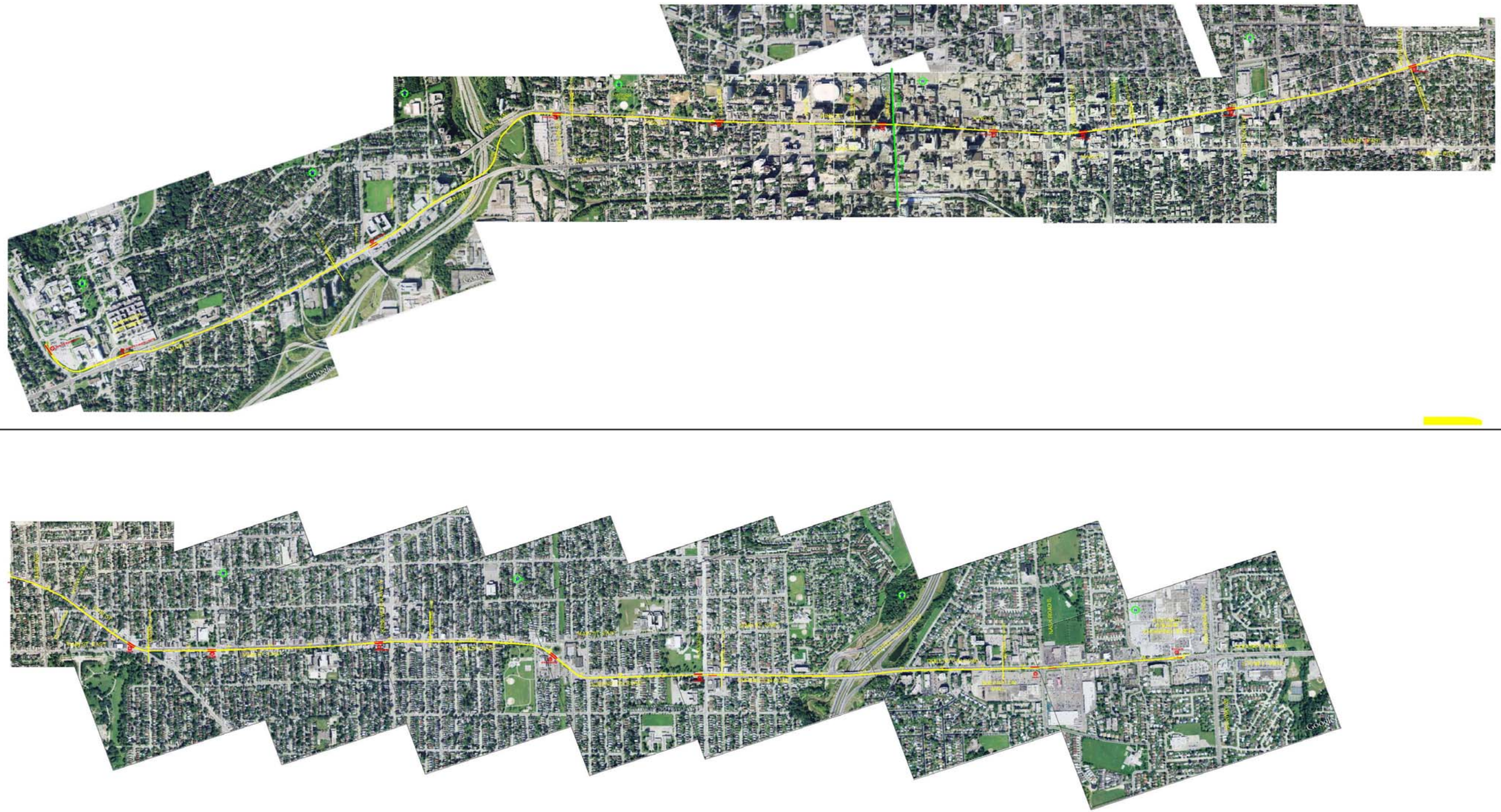

FIGURE 2.1 Proposed Hamilton B-Line from Sta 0+000 to 13+900

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3.0 Existing Storm Drainage Systems

3.1 Storm and Combined Sewers

The existing storm drainage along the LRT alignment contains both combined and separated storm sewers. West of Redhill Creek, the system consists of combined sewers with numerous storm relief sewers. East of Redhill Creek, the system is entirely separated.

3.2 Catchment Boundaries

Most of the drainage flows from south to north across the Main Street and King Street alignments. Catchment boundaries have been defined based on the existing major drainage outlets and the existing storm and combined sewer pipes along the alignment.

The basis for the catchment areas was the combined sewer catchment boundary plan obtained from the City of Hamilton. There is some overlap between the boundaries due to the storm relief sewers that cross some of the combined sewer areas. These areas have been combined for the purposes of this preliminary assessment. This has resulted in 25 outlet catchments, which were used for the impact analysis.

4.0 Potential Drainage Impacts

4.1 LRT Drainage

The cross sections in Appendix A indicate the proposed storm drainage concepts for each of the design configurations. It has been assumed initially that the LRT drainage would be taken to the existing local storm sewers and that the storm sewers will have sufficient capacity to accept these connections. This assumption needs to be verified at all locations along the alignment.

4.2 Increased Impervious Areas

The LRT system will consist of a dual track on a concrete guideway. The alignment is located on one side of the existing road for most of the length. However, there are sections where the new guideway is located on the existing boulevard or down the central median of the road.

The principle impact on the hydrologic regime from LRT construction is the conversion of areas from grass (pervious) to pavement (impervious). This occurs mainly where the alignment is located on the boulevards and medians that are currently not paved. To a lesser extent, there are small areas of additional pavement where the LRT requires minor widening of the existing roads and adjustments at intersections. In some locations, these adjustments will also result in an increase in impervious area

All of the areas of increased imperviousness have been compiled and quantified on a block-to-block basis for all sections of the LRT B-Line alignment, with the exception of the connection to the maintenance yard and the maintenance yard site because the preliminary design is not yet available.

The impervious area calculations are summarized in Table 1.

Additionally, the McMaster University area has been quantified based on a conceptual design as sufficient base information was not available at the time of this assessment.

Table 1A

Pervious Areas Converted to Impervious Areas

Design Sheet	Location	Segment	Outlet No.	Pervious Converted to Impervious (m^2)				Impervious Converted to Pervious (m^2)				Net Imp. Area
				North	South	Center	Total	North	South	Center	Total	
0	McMaster	Leland to Emerson	1A + 1B	5626			5626					6886
1	McMaster	Emerson to Bowman		903			903					
2	Main Street	Bowman to Stroud			41		41					
3	Main Street	Stroud to Dalewood			26		26					
3	Main Street	Dalewood to Gary		104	56	96	257					
3	Main Street	Gary to Haddon		33	149	14	196					624
4	Main Street	Haddon to Cline	2		44	44	88					
4	Main Street	Cline to Dow	3A + 3B + 3C	191	374		564					3204
4	Main Street	Dow to Newton		180	477	29	686					
5	Main Street	Newton to Paisley		278	279	90	648					
6	Main Street	Paisley to Bond		132	66	58	256					
6	Main Street	Bond to Longwood		83		16	99					
6	Main Street	Longwood to Paradise		735		627	1362			37	37	
7	Main Street	Paradise to Macklin	4A	5	61		66					66
8	Main Street	Macklin to 403 Overpass			402		402					
10	King Street	Breadalbane to Dundurn	4B	155	73		229					379
11	King Street	Dundurn to New		23	8		31					
11	King Street	New to Strathcona		2	26		28					
12	King Street	Strathcona to Locke			32		32					
12	King Street	Locke to Pearl			2		2					
13	King Street	Pearl to Ray		57			57					

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Table 1B

Pervious Areas Converted to Impervious Areas

Design Sheet	Location	Segment	Outlet No.	Pervious Converted to Impervious (m^2)				Impervious Converted to Pervious (m^2)				Net Imp. Area
				North	South	Center	Total	North	South	Center	Total	
13	King Street	Ray to Queen	5	242	100		342					342
14	King Street	Queen to Hess			56		56					
18	King Street	John to Catherine	7	13			13					13
19	King Street	Ferguson to Spring	8		1		1					203
20	King Street	Wellington to West		189	13		202					
25	King Street	St. Clair to Sherman	12	5	3		8					8
26	King Street	Barnesdale and Carrick	13		13		13					431
26	King Street	Carrick to Spadina			10		10					
27	King Street	Spadina to Melrose		94			94					
27	King Street	Melrose to Prospect			66		66					
27	King Street	Prospect to Leinster		205	43		248					
28	King Street	Leinster to Balsam	14	14	27		41					193
28	King Street	Connaught to Gage			6		6					
28	King Street	Gage to Fairview			9		9					
29	King Street	Fairview to East Bend			24		24					
29	King Street	East Bend to Dunsmure			5		5					
30	King Street	Glendale to Belview			4		4					
30	King Street	Belmont to Kensington		37		66	104					
31	Main Street	Kensington to Rosslyn	15		35		35					76
31	Main Street	Balmoral to Grosvenor		4	17		21					
32	Main Street	Grovenor to Ottawa		10	11		21					
33	Main Street	Graham to Houghton	16		29		29					54
34	Main Street	Houghton to Wexford			19		19					
35	Main Street	Tuxedo to Kenilworth			6		6					

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Table 1C

Pervious Areas Converted to Impervious Areas

Design Sheet	Location	Segment	Outlet No.	Pervious Converted to Impervious (m^2)				Impervious Converted to Pervious (m^2)				Net Imp. Area
				North	South	Center	Total	North	South	Center	Total	
35	Main Street	Garside to Cameron	17		6		6					6
36	Main Street	Cameron to Barons	18		26		26					111
36	Main Street	Barons to Tragina			50		50					
36	Main Street	Tragina to Weir			34		34					
37	Main Street	Weir to Berry	19		91		91					141
37	Main Street	Berry to Bell/Strathearne		23	34	396	453			543	543	
38	Main Street	Queenston Circle				941	941			1168	1168	
38	Queenston Road	Bell/Strathearne to Cochrane		82	59	226	367					
38	Queenston Road	Rosewood to Craigroyston	20	34	15		49					1866
39	Queenston Road	Walter to Jefferson		23	108		132					
39	Queenston Road	Jefferson to Isabel/Termoli		135	173		309					
40	Queenston Road	Isabel/Tormoli to Parkdale		759	618		1377					
41	Queenston Road	Parkdale to Glassco	21		78		78					583
41	Queenston Road	Delena to Beland			20		20					
42	Queenston Road	Reid to SB Hwy ramp		238	147		385					
43	Queenston Road	SB Hwy ramp to NB Hwy ramp		82	18		100					
44	Queenston Road	NB Hwy ramp to Pottruff	22	167	202		369					1541
44	Queenston Road	Pottruff to Woodman		436	736		1172					
45	Queenston Road	Woodman to Nash	23	821	1289		2109					3311
47	Queenston Road	Nash to Clapham		614	588		1202					
47	Queenston Road	Clapham to Kenora	24	483	79		562					3370
48	Queenston Road	Kenora to Centanial		2451	357		2808	2812			2812	

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5.0 Impact Assessment

5.1 Method

The method of determining potential impacts is based on computing the incremental change in impervious area within the catchment of each existing drainage outlet. The capacity of the local sewers was not evaluated. It has been assumed that either the existing local sewer will accommodate the new drainage requirements or a new storm sewer will be installed to connect to the existing outlets.

Catchment areas were measured from the City combined sewer catchment boundary plan at a scale of 1:10 000. The total drainage areas and the size of the existing sewers (outlets and local sewers) were included in the evaluation table. Existing average impervious ratios were estimated from the aerial photos for each catchment.

The potential impacts of the LRT were estimated by determining the percentage increase in impervious area compared to the existing impervious area for each drainage outlet location. Since larger pipes are less sensitive to increased runoff, the size of the sewers and total catchment area were also tabulated to provide additional information for assessment.

5.2 Results

The results of the assessment are given in Tables 2A and 2B. They are also presented graphically in Figures 5-1A, 5-1B and 5-1C. In general the increase in impervious area is very small and will not have any impact on the runoff to the existing drainage system. In most cases the increase is negligible (less than 0.3%). Only at outlets 1, 2 and 3 are the increases greater than about 1%. These areas represent about 1800m of alignment length compared to 13, 483m total project length (13%).

Outlet 1
At the west end of the project from McMaster University to Dalewood Ave. (Outlet 1), the alignment enters the university property on what is now a grass boulevard. The estimated increase in impervious area at this location 6.4%. The available existing outlet sewers are a 750mm combined sewer and a 1350mm storm relief sewer. In general, it would be preferable to connect any new/increased drainage to the separated storm sewer to minimize potential impacts on the combined sewer overflows in the system. Although the existing storm relief sewer may have sufficient capacity to accept the additional runoff, a stormwater management study is recommended for this area to explore possible mitigation measures for both peak flow control and water quality treatment for the new runoff generated from the LRT construction.

Outlet 2
At the Outlet 2 catchment (Dalewood to Dow), the increase is about 7.3%. One reason for the large relative impact at this location is the small catchment area (7.3ha). The actual amount of new impervious area is quite small (0.32ha). The available outlets for this section are a 450mm combined sewer and a 1050storm relief sewer. Because the area is small it is expected that the large existing storm relief sewer has sufficient capacity to absorb the potential flow increase. However, the existing catchment area for the storm relief sewer should be reviewed in detail at the next design stage and measures to minimize the flow increase should also be explored, if necessary.

Outlets 4A and 4B
Outlets 4A and 4B are on the east and west sides of Highway 403. This is the location of the proposed LRT overpass over the highway. The preliminary design plan and profile plates for the overpass showing the existing drainage outlets in the area are presented in Appendix C. At Outlet 4A from Paradise Ave. to the east side of Highway 403, the LRT-Highway 403 overpass results in an increase in impervious area of 4.9% for this small catchment area (11.0ha). A large 4200mm x 3000 pipe that conveys Chedoke Creek through this area crosses under the LRT alignment close to the profile sag. This pipe will be able to absorb this small increase in runoff at this location.

On the east side of the bridge, the relative increase in impervious area is very small due to the large catchment area (44.0ha). It is not possible to connect the drainage from the east side to the large storm sewer on the west side due to the intervention of Highway 403. There is a 1200mm combined sewer on King Street that probably has the capacity to accept the new drainage from the bridge

Drainage options for the 403 bridge are discussed further in the Section 6.

Table 2A

Relative Impacts: Changes in Impervious Area

Existing Conditions				LRT Impact			Existing Sewers				
Outlet No.	Toal Catch-ment Area	Est. Imp. Ratio	Exist. Imp. Area	New Imp. Area	% of Total Area	% Change in Imp. Area	Type	Largest Local Sewer	Outlet Sewer Size	Existing Outlet Sewer Location	Commemt
	(ha)		(ha)	(ha)	(%)	(%)		(mm)	(mm)		
1A + 1B	19.6	0.55	10.78	0.689	3.5	6.4	Combined	750	750	Forsyth Ave.	Address with McMaster Area SWM plan
							Storm Relief	750	1350	Brookhouse Ave.	
2	10.6	0.55	5.83	0.062	0.6	1.1	Combined	450	450	Clive Ave.	Increase not significant
							Storm Relief	-	-		
3A + 3B + 3C	7.3	0.60	4.38	0.320	4.4	7.3	Combined	300	375 / 450	Newton Ave. & Paisley Ave	Existing Large STM Relief Probably adequate.
							Storm Relief	900	1050	Longwood Rd.	
4A	11.0	0.55	6.05	0.295	3.0	4.9	Combined	375	600	Tope Cresc.	LRT Overpass (West) - Detailed Study needed.
							Storm Relief	-	4200x3000	403/Tope Cresc.	
4B	44.0	0.55	24.20	0.153	0.5	0.6	Combined	1200	1200	Tope Cresc.	LRT Overpass (East) - Detailed Study needed.
							Storm Relief	900	-		
5	24.0	0.65	15.60	0.034	0.1	0.2	Combined	1050	1050 (est.)	Bay St.	No Impact
							Storm Relief	1050	1350	McNab St.	
6	10.1	0.75	7.58	0.000	0.0	0.0	Combined	1345	1345	James St.	No Impact
							Storm Relief	Unknown	1300	John St.	
7	30.3	0.75	22.73	0.001	0.0	0.0	Combined	1345	1345	Catherine St.	No Impact
							Storm Relief	-	-		
8	31.1	0.75	23.33	0.020	0.1	0.1	Combined	375 / 450	1350	Jarvis	No Impact
							Storm Relief	600 / 450	-	Jarvis	
9	15.2	0.65	9.88	0.000	0.0	0.0	Combined	300	450	Victoria St.	No Impact
							Storm Relief	450	1800 x 1500 + 1850	West Ave. & Victoria St.	
10	36.3	0.65	23.60	0.000	0.0	0.0	Combined	375	920	Tisdale Ave.	No Impact
							Storm Relief	525	525	East Ave.	
11	98.1	0.55	53.96	0.000	0.0	0.0	Combined	450	1300	Sanford Ave.	No Impact
							Storm Relief	1200x1350	1500	Wentworth St.	

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Table 2B

Relative Impacts: Changes in Impervious Area

Existing Conditions				LRT Impact			Existing Sewers				
Outlet No.	Toal Catch-ment Area (ha)	Est. Imp. Ratio	Exist. Imp. Area (ha)	New Imp. Area (ha)	% of Total Area (%)	% Change in Imp. Area (%)	Type	Largest Local Sewer (mm)	Outlet Sewer Size (mm)	Existing Outlet Sewer Location	Commemt
12	16.5	0.55	9.08	0.001	0.0	0.0	Combined	300	450	Sherman Ave.	No Impact
							Storm Relief	525	600	Sherman Ave.	
13	25.9	0.55	14.25	0.043	0.2	0.3	Combined	600 / 375	900	Lotridge	Increase not significant
							Storm Relief	525	600	Bransdale Blvd.	
14	107.9	0.55	59.35	0.019	0.0	0.0	Combined	600 / 450	1200	Gage St.	No Impact
							Storm Relief	-	1350	Gage St.	
15	71.6	0.55	39.38	0.008	0.0	0.0	Combined	375	600	King St.	No Impact
							Storm Relief	750	1500	Kensington Ave.	
16	90.8	0.55	49.94	0.005	0.0	0.0	Combined	500	1800x1350	Edgemont St.	No Impact
							Storm Relief	-	1650x1275	Edgemont St.	
17	36.3	0.55	19.97	0.001	0.0	0.0	Combined	1150	900	Kenilworth Ave.	No Impact
							Storm Relief	-	-		
18	25.9	0.55	14.25	0.011	0.0	0.1	Combined	900	525	Cope Ave.	No Impact
							Storm Relief	-	-		
19	28.0	0.45	12.60	0.014	0.1	0.1	Combined	1200	1200	Strathearne Ave.	No Impact
							Storm Relief	-	-		
20	48.9	0.55	26.90	0.187	0.4	0.7	Combined	1200	1200	Rosewood Rd.	Increase not significant
							Storm Relief	-	-		
21	19.7	0.50	9.85	0.058	0.3	0.6	Combined	375 / 1500	1500	Adair Ave.	Increase not significant
							Storm Relief	1500	1500	SB Ramp to 403	
22	64.2	0.55	35.31	0.154	0.2	0.4	-	-	-	Separated system	Increase not significant
							Storm	1350	1350	NB Ramp to 403	
23	37.5	0.55	20.63	0.331	0.9	1.6	-	-	-	Separated system	Increase not significant
							Storm	600 / 750	1350	Nash Rd.	
24	58.7	0.55	32.29	0.337	0.6	1.0	-	-	-	Separated system	Increase not significant
							Storm	450 / 600	1200	Kenora Dr.	

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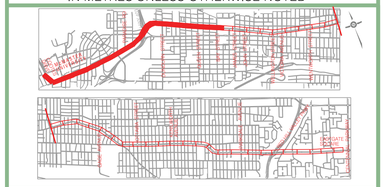

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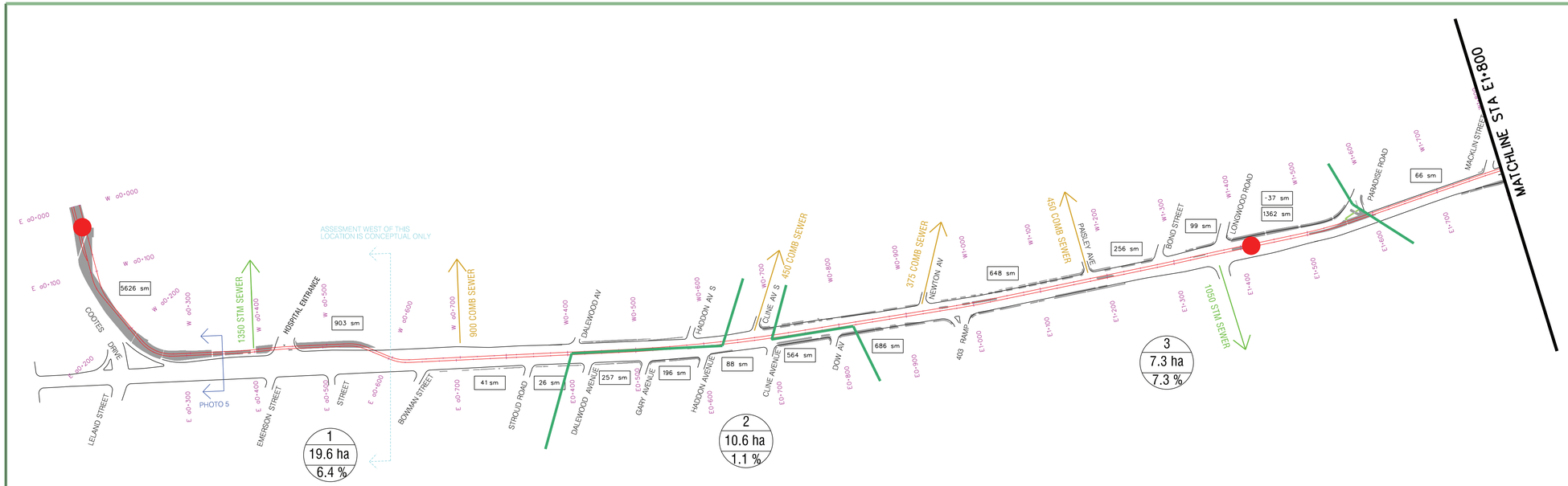
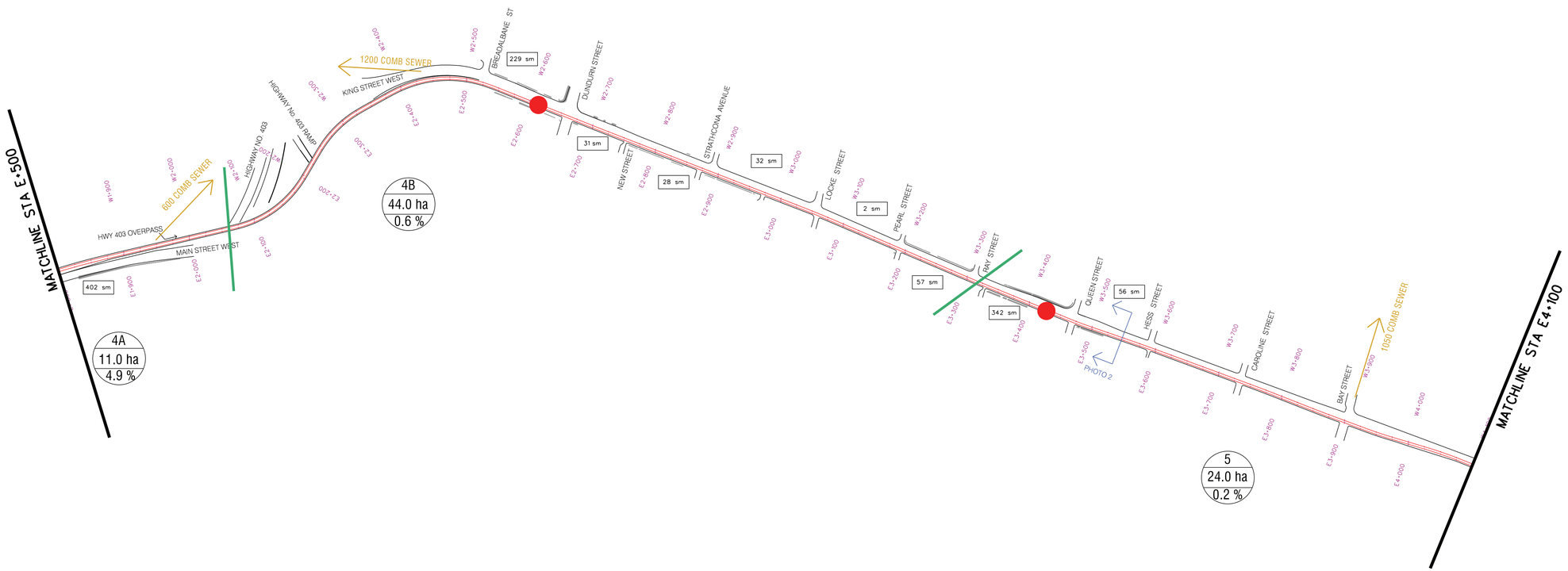
- LRT STOP LOCATIONS
- E0+000.00 — STATIONING ON EB TRACK
- W0+000.00 — STATIONING ON WB TRACK





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basemap2.dwg (MAY 19, 2011)
Design Plans : LRT_Roadway.dgn
Sewer Plans :
Water Plans :

Geodetic Bench Mark Index Elevation=
Borehole Report -

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Project Manager
NAME

Manager of Design
NAME

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DRAWN ANNA MARKOVICHINA
CHECKED JUAN LIMANA
APPROVED STEPHAN MEHER
DATE 2011/09/20

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HAMILTON LRT 'B' LINE

IMPACT OF LRT CONSTRUCTION ON CHANGE IN IMPERVIOUS AREA

Fig 5-1A

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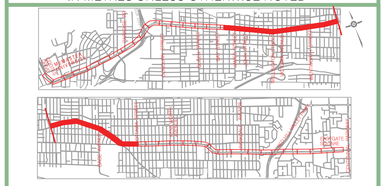

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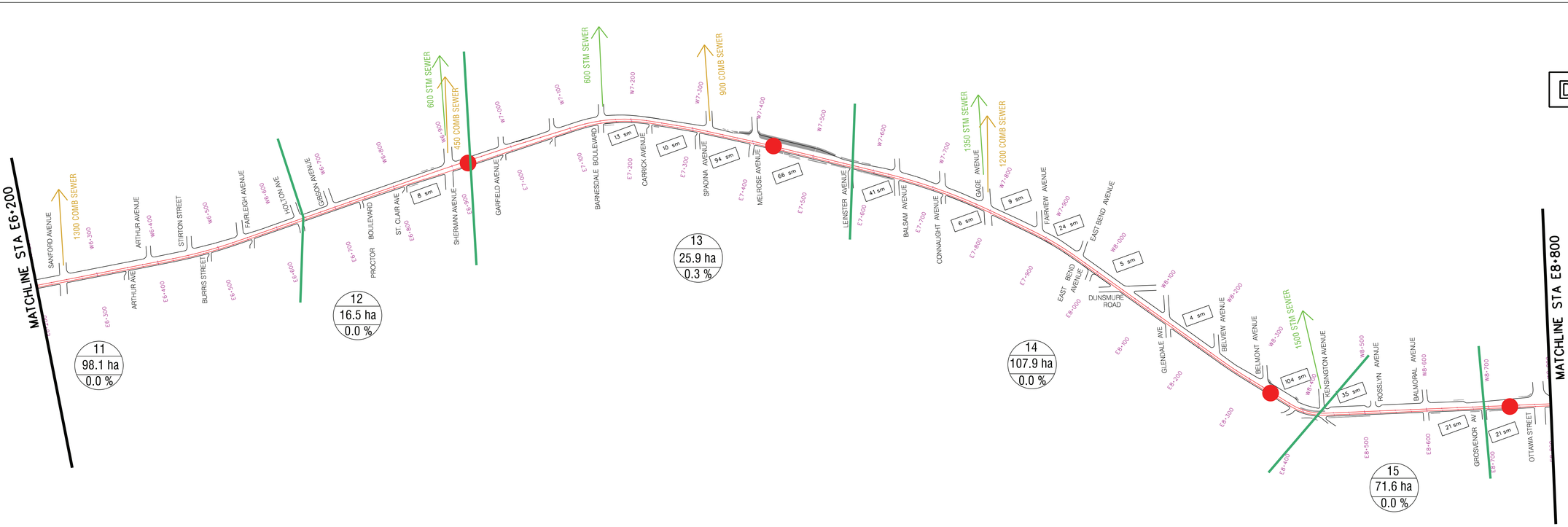

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Sewer Plans :
Water Plans :

Geodetic Bench Mark Index Elevation=
Borehole Report -

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Project Manager
NAME

Manager of Design
NAME

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DRAWN ANNA MARKOLICHINA
CHECKED JUAN LIMANA
APPROVED STEPHAN MEHR
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HAMILTON LRT 'B' LINE

IMPACT OF LRT CONSTRUCTION ON CHANGE IN IMPERVIOUS AREA

Fig 5-1B

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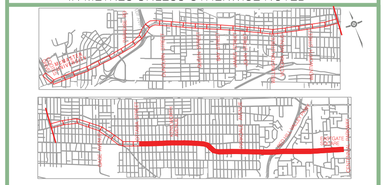

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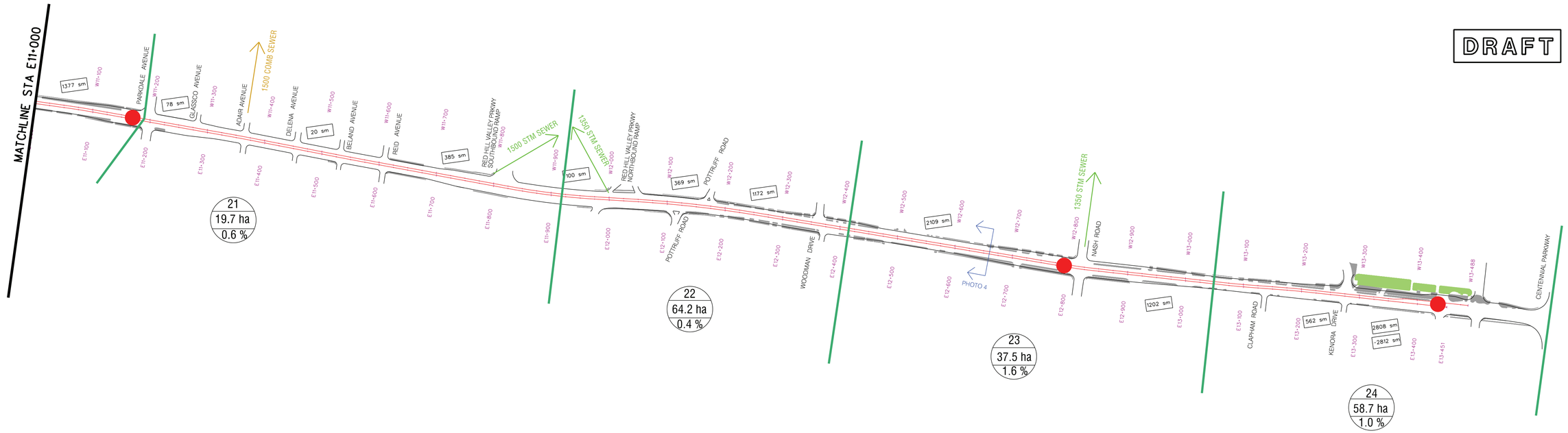
- LRT STOP LOCATIONS
- E0+000.00 — STATIONING ON EB TRACK
- W0+000.00 — STATIONING ON WB TRACK



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No.	REVISIONS	INITIAL	DATE

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basemap2.dwg (MAY 19, 2011)
Design Plans : LRT_Roadway.dgn
Sewer Plans :
Water Plans :

Geodetic Bench Mark Index Elevation=
Borehole Report -

NOT TO SCALE

Project Manager
NAME

Manager of Design
NAME

SNC·LAVALIN steer davies gleave DIALOG

DRAWN ANNA MARKOLICHINA
CHECKED JUAN LIMANA
APPROVED STEPHAN MEHR
DATE 2011/09/20

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HAMILTON LRT 'B' LINE

IMPACT OF LRT CONSTRUCTION ON CHANGE IN IMPERVIOUS AREA

Fig 5-1C

09-H-00 (1)

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6.0 Highway 403 Overpass

The proposed LRT 403 overpass structure is about 525m in length. The drainage from the overpass bridge will be divided unevenly between the east and west outlets with 375m draining west to Main Street and 150m draining east to King Street. The west outlet is at a sag in the profile at Sta1+850 that will collect runoff from an additional 324m of LRT guideway from the west. The design plates for the overpass location are given in Appendix C.

A new storm sewer is proposed at this location to connect the sag drainage to the 4200 x 3000 Chedoke Creek culvert that passes below Main Street at this location. The proposed scheme is shown conceptually in Figure 6.1. The design flow calculations are presented in Appendix C "Bridge over Highway 403 Overpass Design Data" and summarized in Table 3. The 5-yr design flow for the west sag is 136L/s and the 100-yr flow is 240L/s. Assuming a pipe slope of 1.0%, the required pipe sizes for storm drainage are 375mm and 450mm respectively for the 5-yr and 100-yr design.

The connection to the Chedoke Creek culvert appears to be the most convenient but it might be difficult due to the depth of the pipe and the need to break into the large concrete structure. Other options for the sag drainage are to discharge to the surface between Tope Crescent and the 403 ramp or piping all the way to Chedoke Creek, perhaps on Tope Avenue. The feasibility of these options would have to be examined through further study.

At the east end, the guideway runoff will spill on to King Street, which slopes down to the west at this location. The estimated runoff rates from the east end of the bridge are 30L/s and 53L/s for the 5-yr and 100-yr design respectively. These small flows can probably be accommodated in the King Street drainage systems. However, this should be confirmed at the next design stage.

Table 3
403 Overpass Design Flows

Location	From	To	Total Area	5-yr		100-yr	
				Design Q	Pipe Size	Design Q	Pipe Size
	(m)	(m)	(m^2)	(L/s)	(mm)	(L/s)	(mm)
Main St. West Sag 1+850	1+536	2+225	5291	136	375	240	450
King St. 2+375	2+225	2+375	1152	30	Connect to King St. STM	53	Connect to King St. Major System

7.0 Other Drainage System Impacts

7.1 Alignment Conflicts

The City of Hamilton criteria for utility and underground services conflicts are summarized in Table 4. The City does not allow storm or combined sewers to be located within the zone of loading influence under the transit guideway. The conflicts with storm and combined sewers have been identified and they are documented in the Utility re-location drawings.

7.2 Catch Basin Relocations

In many locations, the LRT construction will require the re-location of catch basins to maintain the existing roadway drainage. This could be minor re-locations to accommodate road widening or intersection improvements or new locations where the LRT is in conflict with the existing catch basin locations. These relocations will be identified at the detailed design stage.

8.0 Conclusions

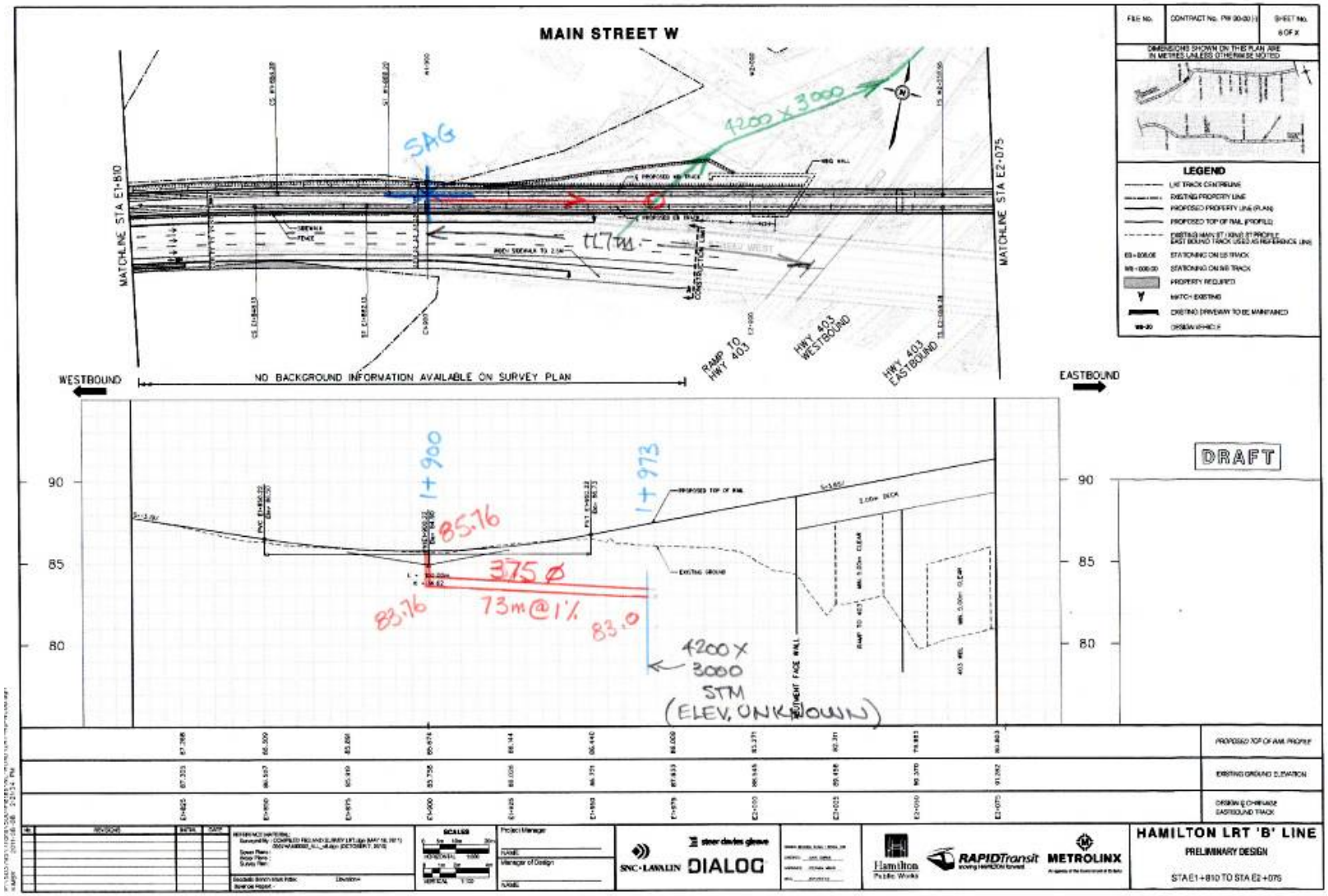
1. A screening level analysis has been carried out to determine the relative magnitude of the potential impacts of the LRT B–Line construction on the existing drainage systems along the alignment. It was found that there will be a negligible increase in impervious areas for about 87% of the project length. As a result, there will be no impact on the existing storm drainage systems in these areas.

2. Potential impacts on the storm drainage system have been identified at three locations:

    - At the west end of the project from McMaster University to Dalewood Ave. (Outlet 1), the estimated increase in impervious area at this location 6.4%. A stormwater management study is recommended for this area to explore possible mitigation measures for both peak flow control and water quality treatment for the new runoff generated from the LRT construction.
    - At the Outlet 2 catchment (Dalewood to Dow), the increase is about 7.3%. The existing 1050mm storm relief sewer appears to have sufficient capacity to absorb this increase. However, the catchment area for the storm relief sewer should be reviewed in detail at the next design stage and measures to minimize the flow increase should also be explored, if necessary.
    - At Outlet 4A from Paradise Ave. to the east side of Highway 403, the LRT-Highway 403 overpass results in an increase in impervious area of 4.9%. However, the 4200mm x 3000 Chedoke Creek culvert is available in the area, which will be able to absorb this small increase in runoff at this location.

3. The overpass at Highway 403 will require a new storm drainage system on the west side of the structure. A preliminary drainage concept has been developed including a new storm sewer outlet to the Chedoke Creek culvert at Sta 1+973. The feasibility of this connection needs to be confirmed at the next design stage. Other options for drainage at this location include piping to a surface outlet between Tope Crescent and the 403 ramp or piping to Chedoke Creek.

4. On the east side of the 403 overpass, the small amount of additional runoff from the new structure can be accommodated in the existing King Street drainage systems.



Proposed Storm sewer outlet at West End of 403 Overpass

Figure 6.1

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Table 4

Utility Clearance Criteria

	ROW	Offset to Transitway Edge	Storm/Sanitary Sewer (outer edge)	Watermain (outer edge	Hydro Ducts	Gas Main	Bell Ducts	Notes
ROW	--	--	--	--	--	--	--	
Storm/Sanitary Sewer (outer edge)	3 m	not in transitway loading zone	0.5 m minimum	2.5 m minimum; if less, must have 0.5 m vertical clearance	--	--	--	3 m to ROW - assumption from AECOM life cycle report; 0.5 m min and 2.5 min from City of Hamilton Standards
Watermain (outer edge)	3 m	not in transitway loading zone	2.5 m minimum; if less, must have 0.5 m vertical clearance	--	--	--	--	
Hydro Ducts	1.75 m	not in transitway loading zone	--	some vertical clearance required	--	--	--	
Gas Main	0.75 m	not in transitway loading zone	--	--	--	--	--	
Bell Ducts	1.75 m	not in transitway loading zone	--	--	--	--	--	

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Disclaimer

This document contains the expression of the professional opinion of Steer Davies Gleave North America Inc. ("SDG") as to the matters set out herein, using its professional judgment and reasonable care. It is to be read in the context of the agreement (the "Agreement") between SDG and the City of Hamilton (the "Client") for the Rapid Transit Preliminary Design and Feasibility Study (reference C11-12-10), and the methodology, procedures and techniques used, SDG's assumptions, and the circumstances and constrains under which its mandate was performed. This document is written solely for the purpose stated in the Agreement, and for the sole and exclusive benefit of the Client, whose remedies are limited to those set out in the Agreement. This document is meant to be read as a whole, and sections or parts thereof should thus not be read or relied upon out of context.

SDG has, in preparing the Agreement outputs, followed methodology and procedures, and exercised due care consistent with the intended level of accuracy, using its professional judgment and reasonable care.

However, no warranty should be implied as to the accuracy of the Agreement outputs, forecasts and estimates. This analysis is based on data supplied by the client/collected by third parties. This has been checked whenever possible; however SDG cannot guarantee the accuracy of such data and does not take responsibility for estimates in so far as they are based on such data.

SDG disclaims any liability to the Client and to third parties in respect of the publication, reference, quoting, or distribution of this report or any of its contents to and reliance thereon by any third party.

DOCUMENT END

Appendix A
Typical LRT Cross Sections

Appendix B
Photographs of Typical LRT Sites and Related Impervious Area Impacts

DIMENSIONS SHOWN ON THIS PLAN ARE IN METRES UNLESS OTHERWISE NOTED	CONTRACT No. DRAWING No. 503795-2000-41-DD-001 FILE No.	SHEET No. 1 OF 15

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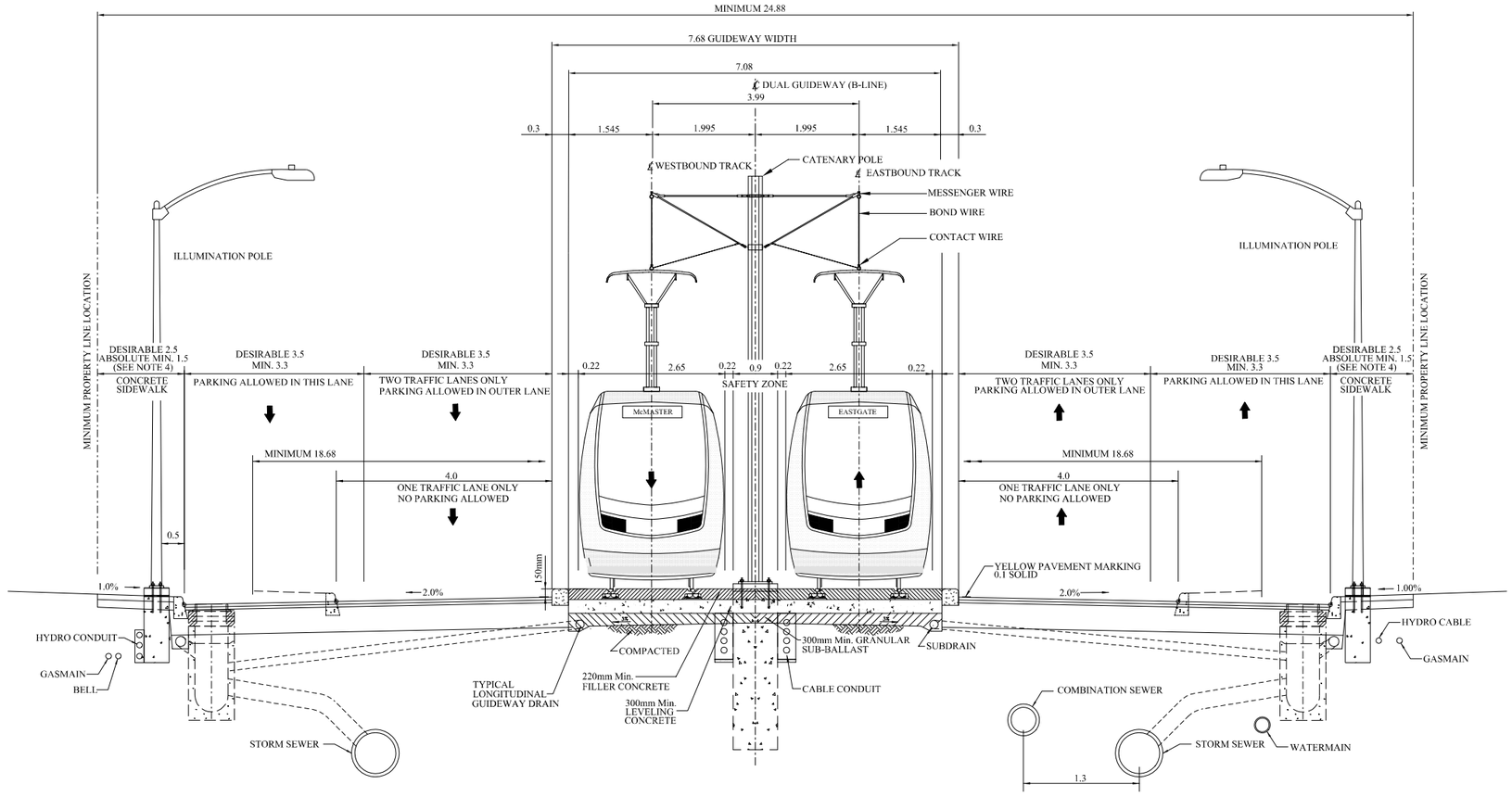

TANGENT TRACK
TYPICAL DUAL GUIDEWAY CROSS - SECTION
GUIDEWAY IN CENTRE WITH CENTRAL CATENARY SUPPORT
TRACK CENTRES 3.99 m

NOTES:

1. LOCATION OF CABLE CONDUITS FOR LRT TO BE DETERMINED.
2. HEIGHT OF CATENARY SUPPORT POLES TO BE DETERMINED.
3. LOCATIONS AND DEPTHS OF UTILITIES SHOWN ARE TYPICAL /INDICATIVE ONLY.
4. WHERE SIDEWALK IS MODIFIED, A DESIRABLE WIDTH OF 2.5m, MINIMUM WIDTH OF 2m, AND ABSOLUTE MINIMUM WIDTH OF 1.5m WILL BE MAINTAINED.

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Water Plans :
Survey Plan :

Geodetic Bench Mark Index Elevation=
Borehole Report -

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Project Manager (Design)
NAME
Manager of Design
NAME

SNC·LAVALIN steer davies gleave DIALOG

DRAWN JUAN C. ZAPATA
CHECKED ATI MINCHEV
APPROVED STEPHAN MEHR

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HAMILTON LRT 'B' LINE
Typical Dual Guideway Cross Section
GUIDEWAY IN CENTRE WITH CENTRAL CATENARY SUPPORT
TRACK CENTRES 3.99 m

DIMENSIONS SHOWN ON THIS PLAN ARE IN METRES UNLESS OTHERWISE NOTED	CONTRACT No. DRAWING No. 503795-2000-41-DD-002 FILE No.	SHEET No. 2 OF 15

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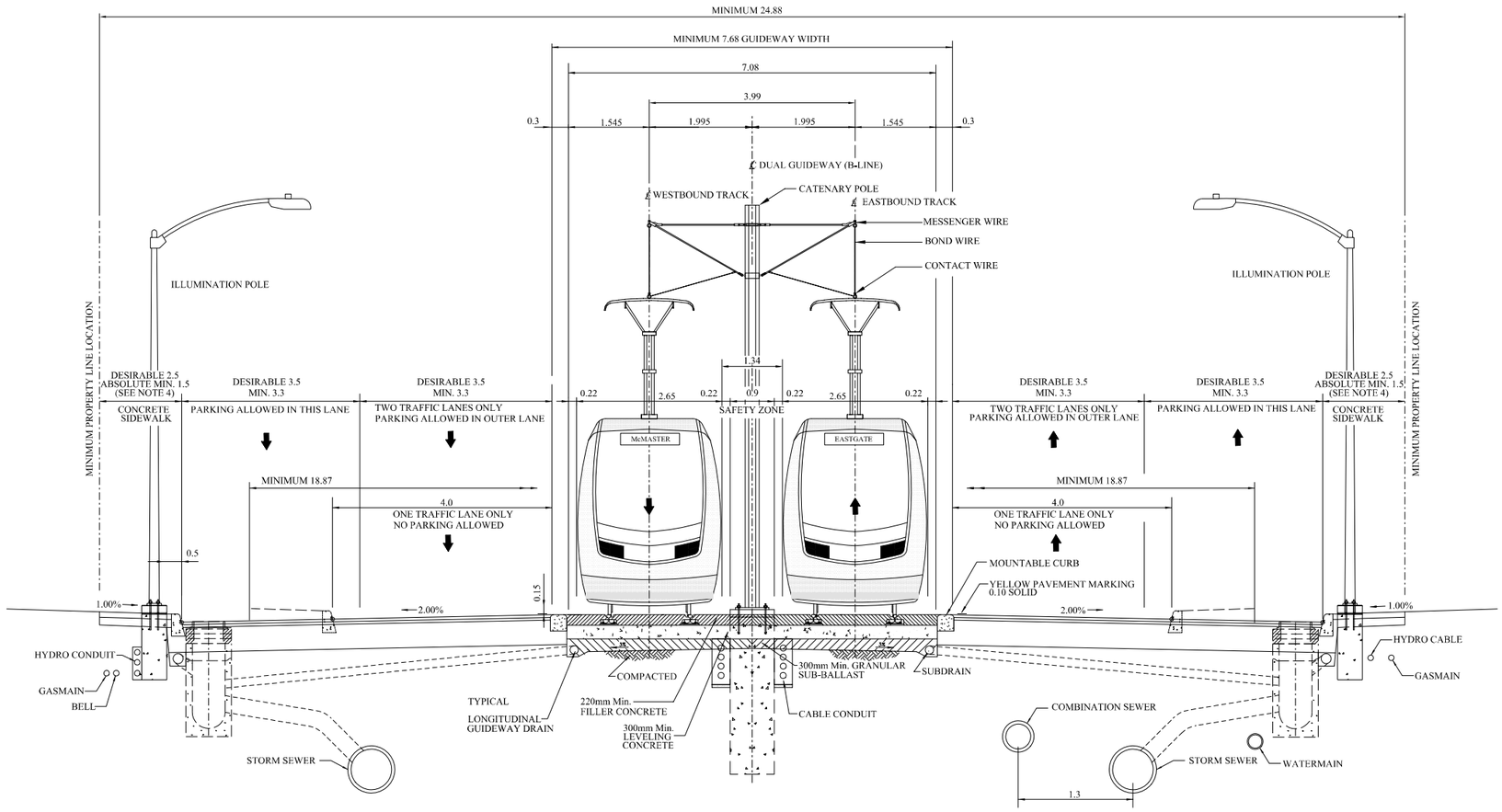

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GUIDEWAY IN CENTRE WITH CENTRAL CATENARY SUPPORT
TRACK CENTRES 3.99 m
MOUNTABLE GUIDEWAY AT INTERSECTIONS

NOTES:

1. LOCATION OF CABLE CONDUITS FOR LRT TO BE DETERMINED.
2. HEIGHT OF CATENARY SUPPORT POLES TO BE DETERMINED.
3. LOCATIONS AND DEPTHS OF UTILITIES SHOWN ARE TYPICAL /INDICATIVE ONLY.
4. WHERE SIDEWALK IS MODIFIED, A DESIRABLE WIDTH OF 2.5m, MINIMUM WIDTH OF 2m, AND ABSOLUTE MINIMUM WIDTH OF 1.5m WILL BE MAINTAINED.

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Water Plans :
Survey Plan :

Geodetic Bench Mark Index Elevation=
Borehole Report -

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Project Manager (Design)
NAME
Manager of Design
NAME

SNC·LAVALIN steer davies gleave DIALOG

DRAWN JUAN C. ZAPATA
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APPROVED STEPHAN MEHR

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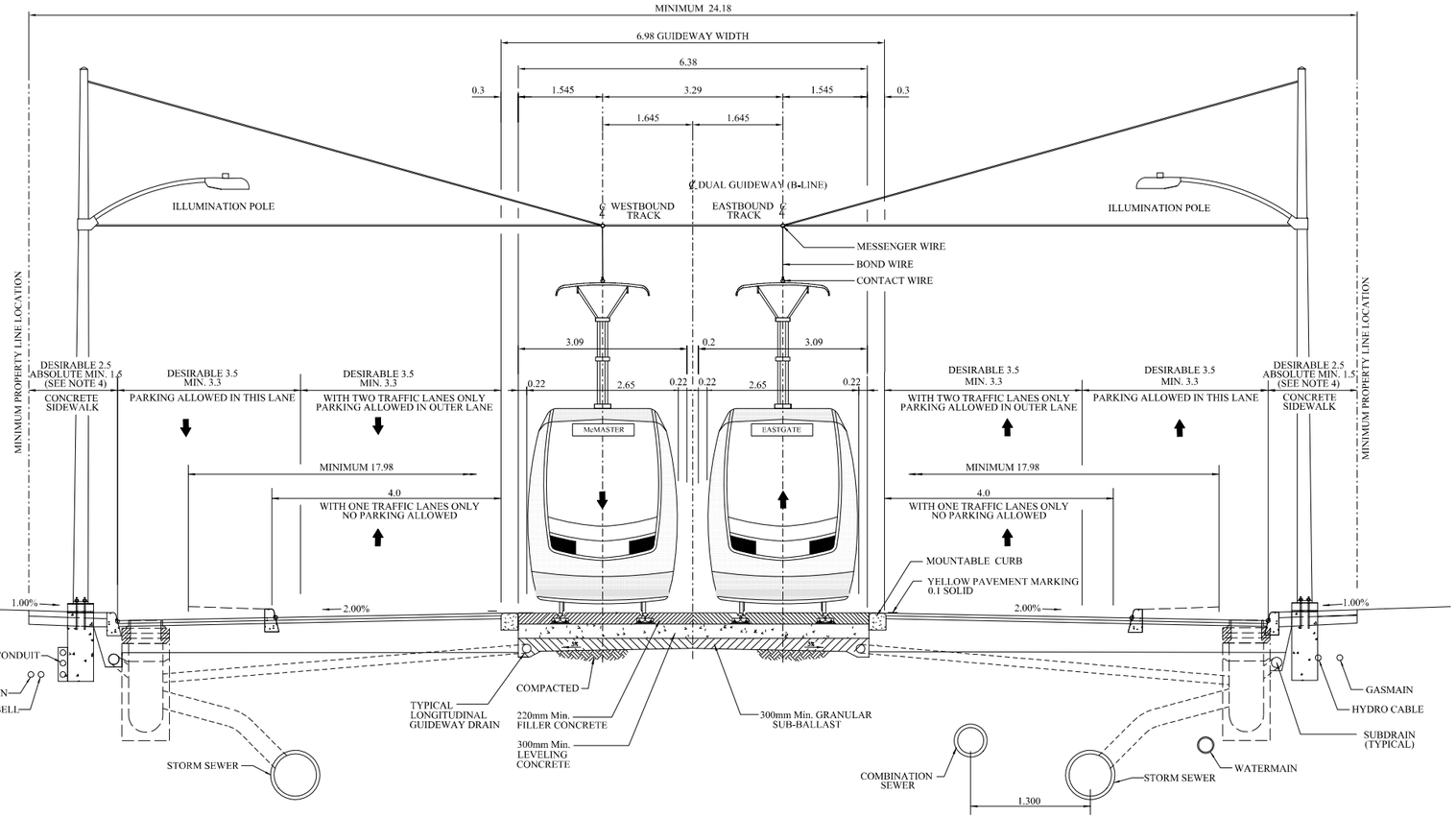
HAMILTON LRT 'B' LINE
Typical Dual Guideway Cross Section
GUIDEWAY IN CENTRE WITH CENTRAL CATENARY SUPPORT
TRACK CENTRES 3.99 m

TYPICAL SECTION 003



TANGENT TRACK
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GUIDEWAY IN CENTRE WITH SIDE CATENARY SUPPORT
TRACK CENTRES 3.29 m

NOTES:

1. LOCATION OF CABLE CONDUITS FOR LRT TO BE DETERMINED.
2. HEIGHT OF CATENARY SUPPORT POLES TO BE DETERMINED.
3. LOCATIONS AND DEPTHS OF UTILITIES SHOWN ARE TYPICAL /INDICATIVE ONLY.
4. WHERE SIDEWALK IS MODIFIED, A DESIRABLE WIDTH OF 2.5m, MINIMUM WIDTH OF 2m, AND ABSOLUTE MINIMUM WIDTH OF 1.5m WILL BE MAINTAINED.

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Water Plans :
Survey Plan :

Geodetic Bench Mark Index Elevation=
Borehole Report -

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Project Manager (Design)
NAME
Manager of Design
NAME

steer davies gleave
SNC·LAVALIN DIALOG

DRAWN JUAN C. ZAPATA
CHECKED ATI MINCHEV
APPROVED STEPHAN MEHR

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HAMILTON LRT 'B' LINE
Typical Dual Guideway Cross Section
GUIDEWAY IN CENTRE WITH SIDE CATENARY SUPPORT
TRACK CENTRES 3.29 m

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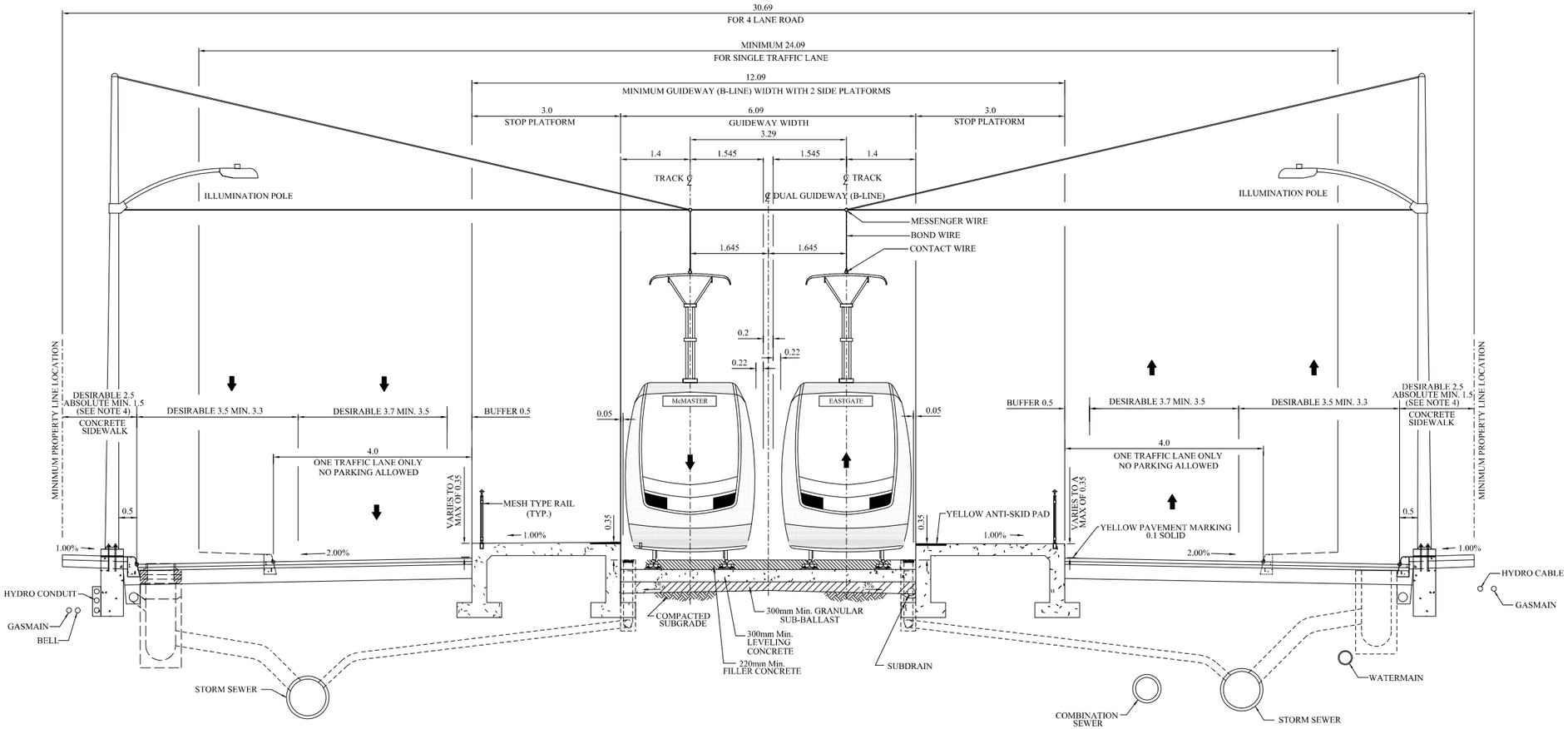

TANGENT TRACK
TYPICAL DUAL GUIDEWAY CROSS - SECTION
GUIDEWAY WITH PARALLEL STOP PLATFORMS IN CENTRE OF EXISTING ROADWAYS
WITHOUT CENTRAL POLE CATENARY SUPPORT
TRACK CENTRES 3.29 m

NOTES:

1. LOCATION OF CABLE CONDUITS FOR LRT TO BE DETERMINED.
2. HEIGHT OF CATENARY SUPPORT POLES TO BE DETERMINED.
3. LOCATIONS AND DEPTHS OF UTILITIES SHOWN ARE TYPICAL /INDICATIVE ONLY.
4. WHERE SIDEWALK IS MODIFIED, A DESIRABLE WIDTH OF 2.5m, MINIMUM WIDTH OF 2m, AND ABSOLUTE MINIMUM WIDTH OF 1.5m WILL BE MAINTAINED.
5. IF REQUIRED, POLES CAN BE PLACED ON THE BACK SIDE WITHIN THE PLATFORM.

PRELIMINARY

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REFERENCE MATERIAL:
Surveyed By : name
Sewer Plans :
Water Plans :
Survey Plan :

Geodetic Bench Mark Index Elevation=
Borehole Report -

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Project Manager (Design)
NAME
Manager of Design
NAME

SNC·LAVALIN | steer davies gleave | DIALOG

DRAWN JUAN C. ZAPATA
CHECKED ATI MINCHEV
APPROVED STEPHAN MEHR

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HAMILTON LRT 'B' LINE
Typical Dual Guideway Cross Section
GUIDEWAY WITH PARALLEL STOP PLATFORMS
IN CENTRE OF EXISTING ROADWAYS
WITHOUT CENTRAL POLE CATENARY SUPPORT
TRACK CENTRES 3.29 m

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CONTRACT No.

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FILE No.

SHEET No. 5 OF 15

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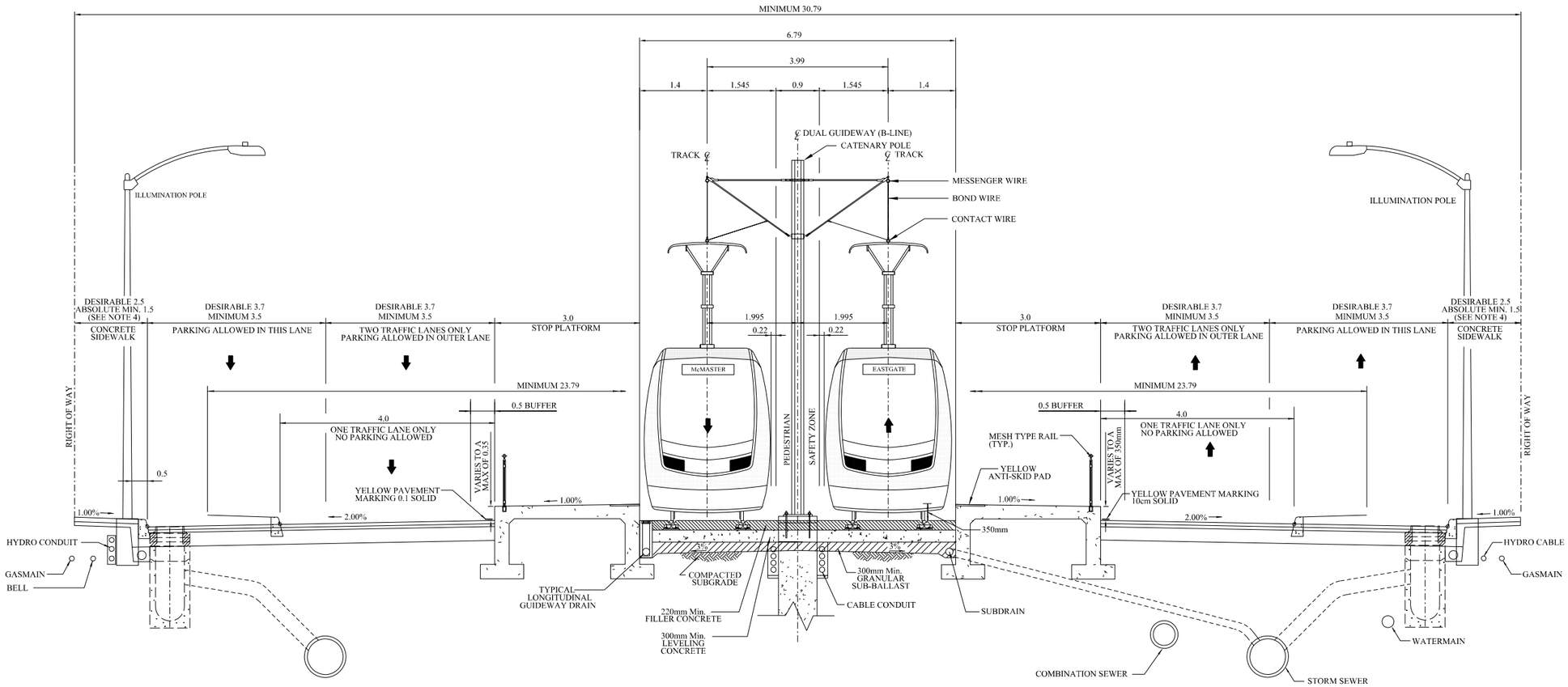

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GUIDEWAY WITH PARALLEL STOP PLATFORMS IN CENTRE OF EXISTING ROADWAYS
WITH SINGLE AND/OR DOUBLE TRAFFIC LANE OPTIONS
WITH CENTRAL POLE CATENARY SUPPORT
TRA CK CENTRES 3.99 m

NOTES:

1. LOCATION OF CABLE CONDUITS FOR LRT TO BE DETERMINED.
2. HEIGHT OF CATENARY SUPPORT POLES TO BE DETERMINED.
3. LOCATIONS AND DEPTHS OF UTILITIES SHOWN ARE TYPICAL /INDICATIVE ONLY.
4. WHERE SIDEWALK IS MODIFIED, A DESIRABLE WIDTH OF 2.5m, MINIMUM WIDTH OF 2m, AND ABSOLUTE MINIMUM WIDTH OF 1.5m WILL BE MAINTAINED.

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Water Plans :
Survey Plan :

Geodetic Bench Mark Index Elevation=
Borehole Report -

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Project Manager (Design)
NAME
Manager of Design
NAME

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HAMILTON LRT 'B' LINE
Typical Dual Guideway Cross Section
GUIDEWAY WITH PARALLEL STOP PLATFORMS
IN CENTRE OF EXISTING ROADWAYS
WITH SINGLE AND/OR DOUBLE TRAFFIC LANE OPTIONS
WITH CENTRAL POLE CATENARY SUPPORT

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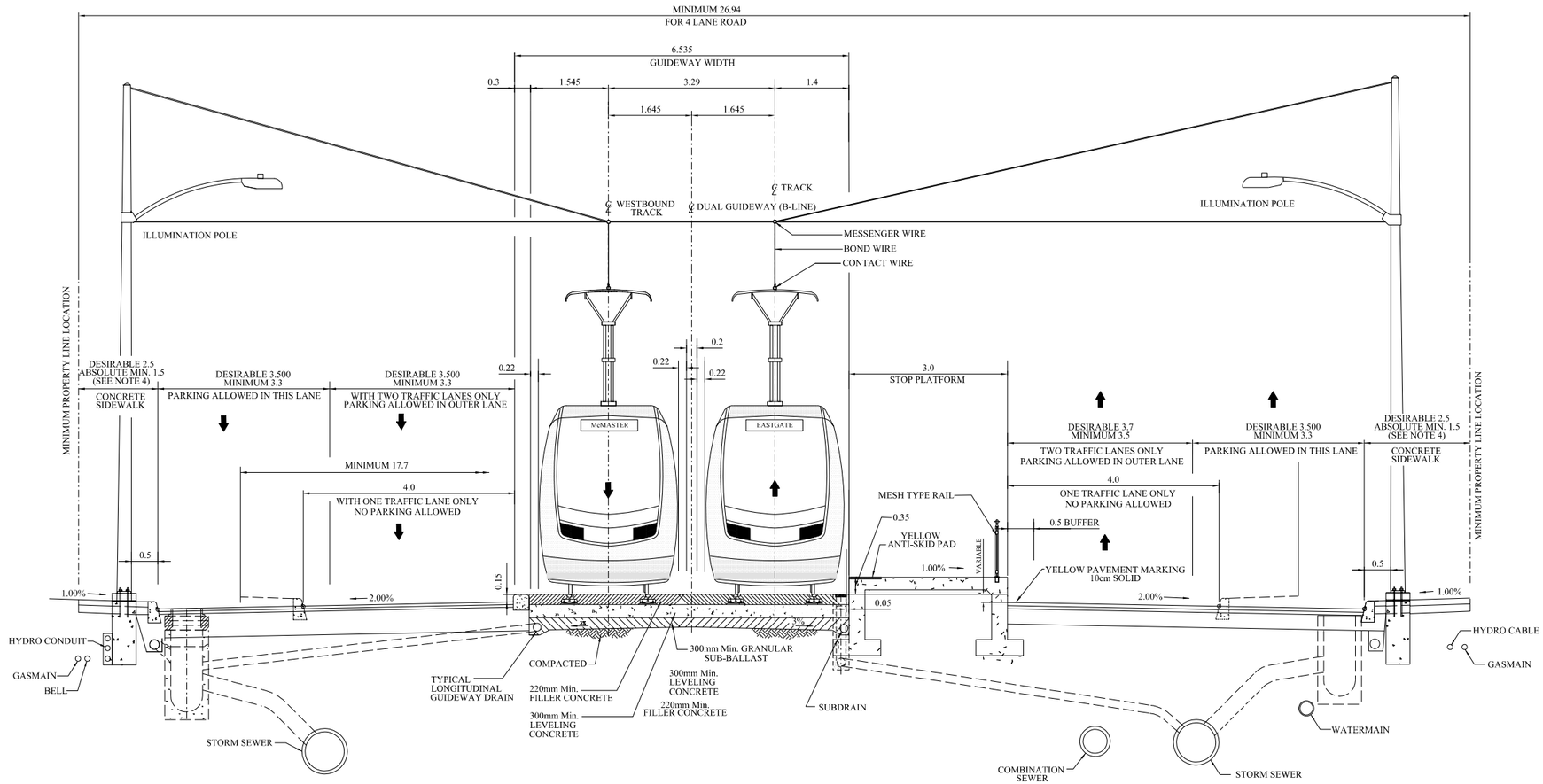

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GUIDEWAY WITH OFFSET STOP PLATFORM IN CENTRE OF EXISTING ROADWAYS
WITH SINGLE AND/OR DOUBLE TRAFFIC LANE OPTIONS
TRACK CENTRES 3.29 m

NOTES:

1. LOCATION OF CABLE CONDUITS FOR LRT TO BE DETERMINED.
2. HEIGHT OF CATENARY SUPPORT POLES TO BE DETERMINED.
3. LOCATIONS AND DEPTHS OF UTILITIES SHOWN ARE TYPICAL /INDICATIVE ONLY.
4. WHERE SIDEWALK IS MODIFIED, A DESIRABLE WIDTH OF 2.5m, MINIMUM WIDTH OF 2m, AND ABSOLUTE MINIMUM WIDTH OF 1.5m WILL BE MAINTAINED.

PRELIMINARY

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Water Plans :
Survey Plan :

Geodetic Bench Mark Index Elevation=
Borehole Report -

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Project Manager (Design)
NAME
Manager of Design
NAME

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APPROVED STEPHAN MEHR

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HAMILTON LRT 'B' LINE
Typical Dual Guideway Cross Section
GUIDEWAY WITH OFFSET STOP PLATFORM IN CENTRE OF EXISTING ROADWAYS WITH SINGLE AND/OR DOUBLE TRAFFIC LANE OPTIONS
TRACK CENTRES 3.29 m

DIMENSIONS SHOWN ON THIS PLAN ARE IN METRES UNLESS OTHERWISE NOTED	CONTRACT No. DRAWING No. 503795-2000-41-DD-007 FILE No.	SHEET No. 7 OF 15

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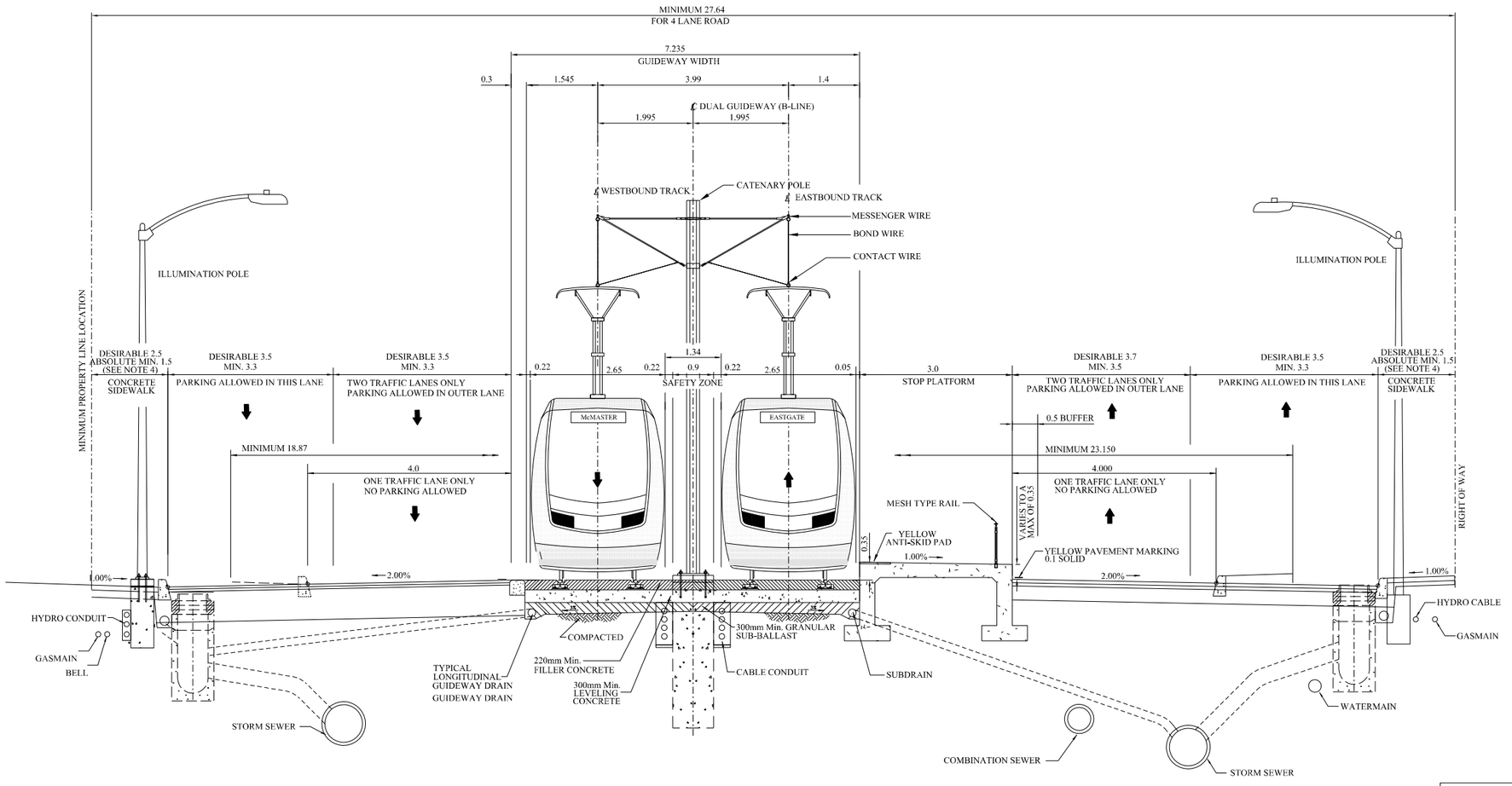

TANGENT TRACK
TYPICAL DUAL GUIDEWAY CROSS - SECTION
GUIDEWAY IN CENTRE WITH CENTRAL CATENARY SUPPORT
TRACK CENTRES 3.99 m

NOTES:

1. LOCATION OF CABLE CONDUITS FOR LRT TO BE DETERMINED.
2. HEIGHT OF CATENARY SUPPORT POLES TO BE DETERMINED.
3. LOCATIONS AND DEPTHS OF UTILITIES SHOWN ARE TYPICAL /INDICATIVE ONLY.
4. WHERE SIDEWALK IS MODIFIED, A DESIRABLE WIDTH OF 2.5m, MINIMUM WIDTH OF 2m, AND ABSOLUTE MINIMUM WIDTH OF 1.5m WILL BE MAINTAINED.

PRELIMINARY

No.	REVISIONS	INITIAL	DATE

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REFERENCE MATERIAL:
Surveyed By : name
Sewer Plans :
Water Plans :
Survey Plan :

Geodetic Bench Mark Index Elevation=
Borehole Report -

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Project Manager (Design)
NAME
Manager of Design
NAME

SNC·LAVALIN steer davies gleave DIALOG

DRAWN JUAN C. ZAPATA
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APPROVED STEPHAN MEHR

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HAMILTON LRT 'B' LINE
Typical Dual Guideway Cross Section
GUIDEWAY IN CENTRE WITH CENTRAL CATENARY SUPPORT
TRACK CENTRES 3.99 m

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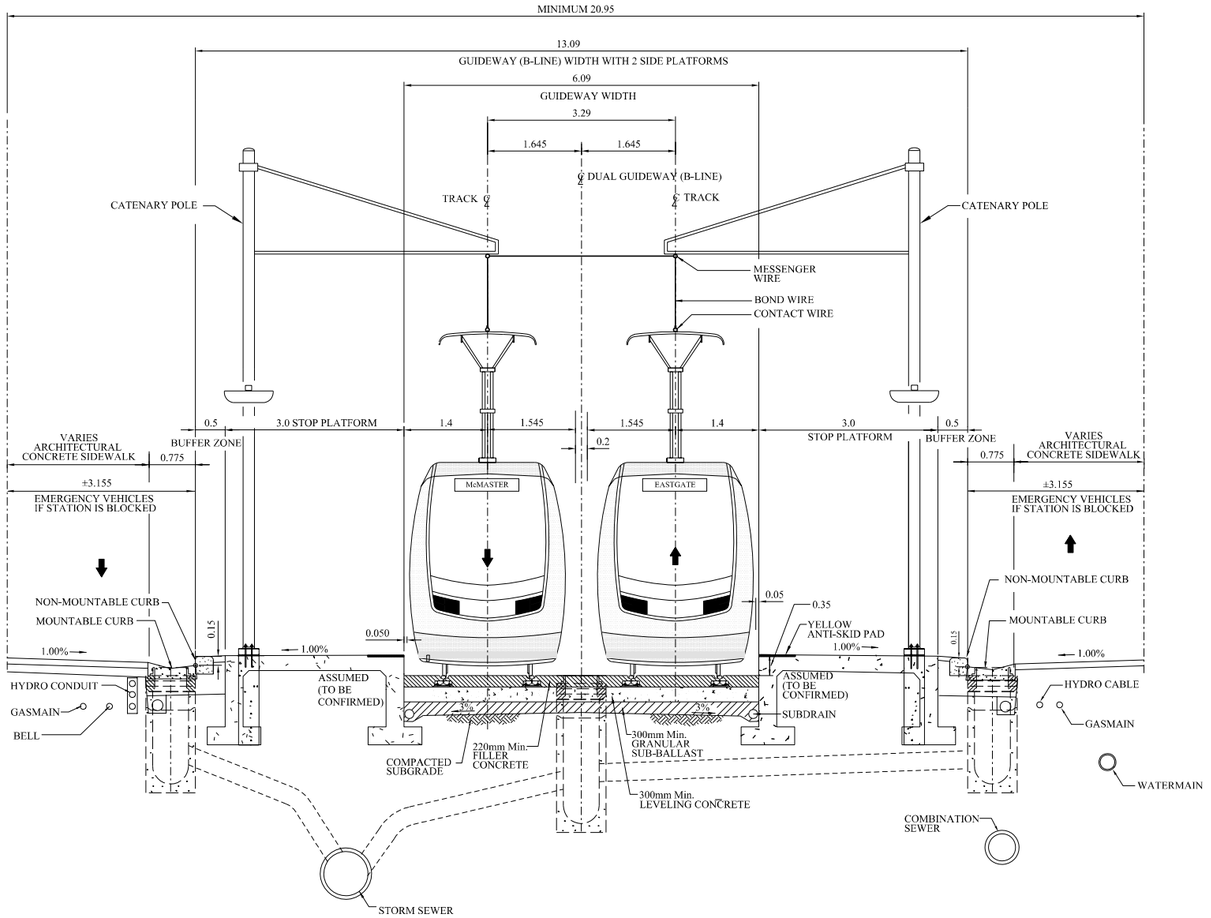

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GUIDEWAY WITH PARALLEL STOP PLATFORMS IN CENTRE OF EXISTING ROADWAYS
WITH PEDESTRIAN TRAFFIC AND EMERGENCY VEHICLE ACCESS ONLY
TRACK CENTRES 3.29 m

NOTES:
1. LOCATION OF CABLE CONDUITS FOR LRT TO BE DETERMINED.
2. HEIGHT OF CATENARY SUPPORT POLES TO BE DETERMINED.
3. LOCATIONS AND DEPTHS OF UTILITIES SHOWN ARE TYPICAL /INDICATIVE ONLY.
4. SPECIAL STREET LIGHTING TO BE DESIGNED.

PRELIMINARY

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REFERENCE MATERIAL:
Surveyed By : name
Sewer Plans :
Water Plans :
Survey Plan :

Geodetic Bench Mark Index Elevation=
Borehole Report -

SCALES
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HORIZONTAL 1:50

Project Manager (Design)
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Manager of Design
NAME

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HAMILTON LRT 'B' LINE
Typical Dual Guideway Cross Section
GUIDEWAY WITH PARALLEL STOP PLATFORMS IN CENTRE OF EXISTING ROADWAYS WITH PEDESTRIAN TRAFFIC AND EMERGENCY VEHICLE ACCESS ONLY IN THE DOWNTOWN TOURIST AND BUSINESS AREAS

P:\503795\Trans\508-Typicals_Details\DGN\503795-2000-41DD-008.dgn
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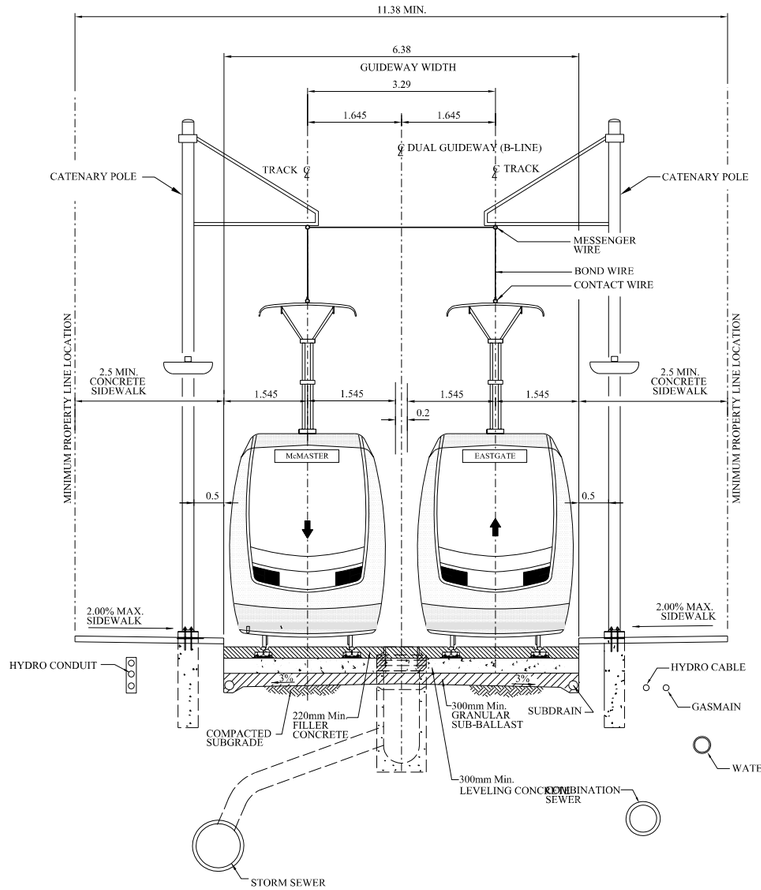
TYPICAL SECTION 009



TANGENT TRACK
TYPICAL DUAL GUIDEWAY CROSS - SECTION
GUIDEWAY ADJACENT WITH EXISTING SIDEWALKS
WITH PEDESTRIAN TRAFFIC AND EMERGENCY VEHICLE ACCESS ON GUIDEWAY ONLY
TRACK CENTRES 3.29 m

NOTES:

1. LOCATION OF CABLE CONDUITS FOR LRT TO BE DETERMINED.
2. HEIGHT OF CATENARY SUPPORT POLES TO BE DETERMINED.
3. LOCATIONS AND DEPTHS OF UTILITIES SHOWN ARE TYPICAL /INDICATIVE ONLY.
4. SPECIAL STREET LIGHTING TO BE DESIGNED.

PRELIMINARY

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WONGE4 2011-09-28 11:22:06 AM

No.	REVISIONS	INITIAL	DATE

DRAWN BY: initials — DATE:

REFERENCE MATERIAL:
Surveyed By : name
Sewer Plans :
Water Plans :
Survey Plan :

Geodetic Bench Mark Index — Elevation=
Borehole Report -

SCALES
0 0.5m 1m 2m
HORIZONTAL 1:50

Project Manager (Design)
NAME
Manager of Design
NAME

SNC·LAVALIN steer davies gleave DIALOG

DRAWN JUAN C. ZAPATA
CHECKED ATUMNOHEV
APPROVED STEPHAN MEHR

Hamilton Public Works
RAPIDTransit moving HAMILTON forward
METROLINX An agency of the Government of Ontario

HAMILTON LRT 'B' LINE
Typical Dual Guideway Cross Section
GUIDEWAY WITH PARALLEL STOP PLATFORMS
IN CENTRE OF EXISTING ROADWAYS WITH
PEDESTRIAN TRAFFIC AND EMERGENCY VEHICLE ACCESS ONLY
IN THE DOWNTOWN TOURIST AND BUSINESS AREAS

DIMENSIONS SHOWN ON THIS PLAN ARE IN METRES UNLESS OTHERWISE NOTED

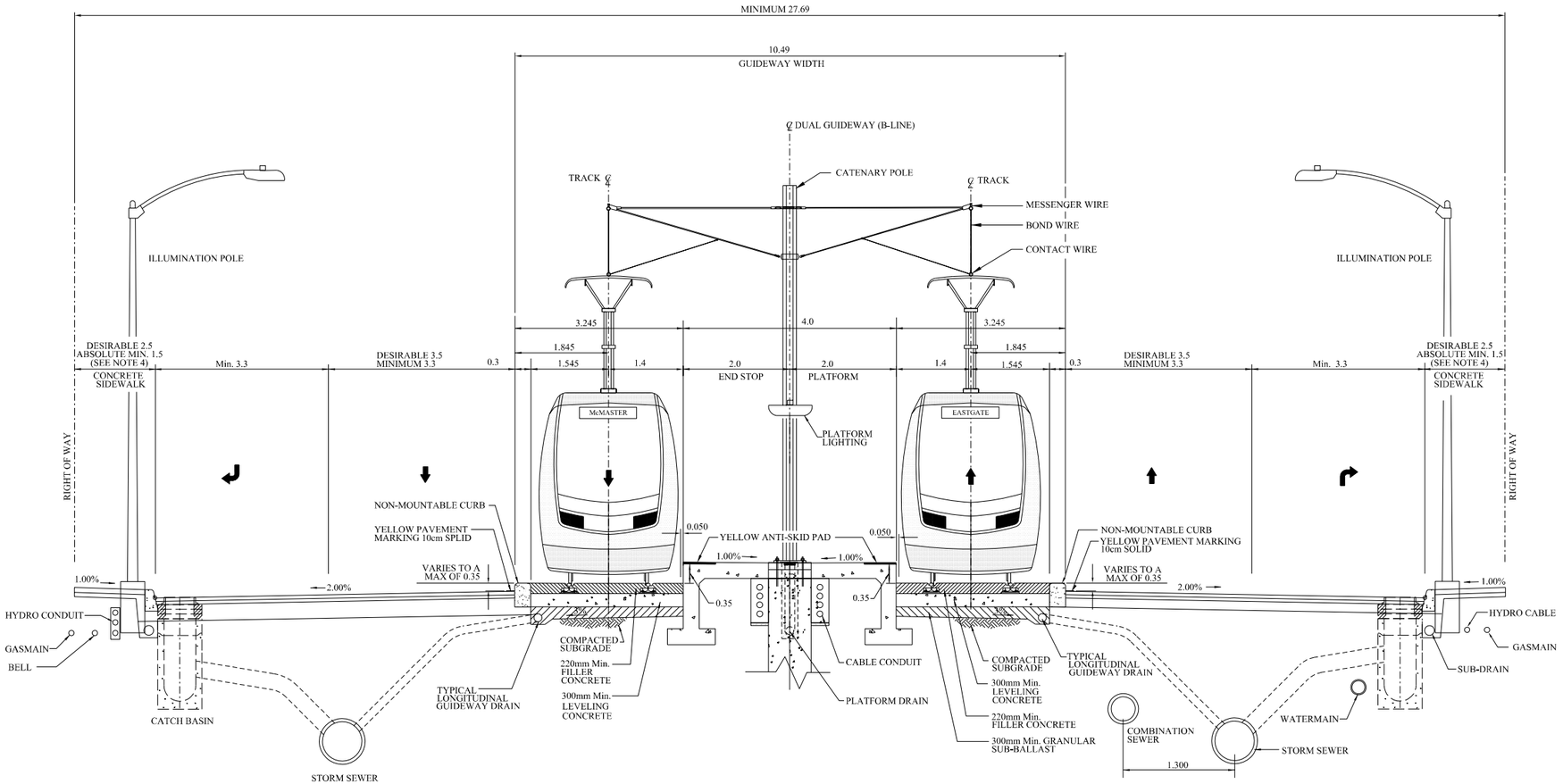
CONTRACT No.

DRAWING No. 503795-2000-41-DD-010

FILE No.

SHEET No. 10 OF 15

TYPICAL SECTION 010



TANGENT TRACK
TYPICAL DUAL GUIDEWAY CROSS-SECTION
GUIDEWAY WITH CENTRAL PLATFORM STOP
WITH 4.000 m WIDE PLATFORM

NOTES:

1. LOCATION OF CABLE CONDUITS FOR LRT TO BE DETERMINED.
2. HEIGHT OF CATENARY SUPPORT POLES TO BE DETERMINED.
3. LOCATIONS AND DEPTHS OF UTILITIES SHOWN ARE TYPICAL /INDICATIVE ONLY.
4. WHERE SIDEWALK IS MODIFIED, A DESIRABLE WIDTH OF 2.5m, MINIMUM WIDTH OF 2m, AND ABSOLUTE MINIMUM WIDTH OF 1.5m WILL BE MAINTAINED.

PRELIMINARY

No.	REVISIONS	INITIAL	DATE

DRAWN BY: initials | DATE:

REFERENCE MATERIAL:
Surveyed By : name
Sewer Plans :
Water Plans :
Survey Plan :

Geodetic Bench Mark Index Elevation=
Borehole Report -

SCALES
0 0.5m 1m 2m
HORIZONTAL 1:50

Project Manager (Design)
NAME
Manager of Design
NAME

SNC·LAVALIN | steer davies gleave | DIALOG

DRAWN JUAN C. ZAPATA
CHECKED ATI MINCHEV
APPROVED STEPHAN MEHR

Hamilton Public Works | RAPIDTransit moving HAMILTON forward | METROLINX An agency of the Government of Ontario

HAMILTON LRT 'B' LINE
Typical Dual Guideway Cross Section
GUIDEWAY WITH CENTRAL PLATFORM STOP
WITH 4.000m WIDE PLATFORM

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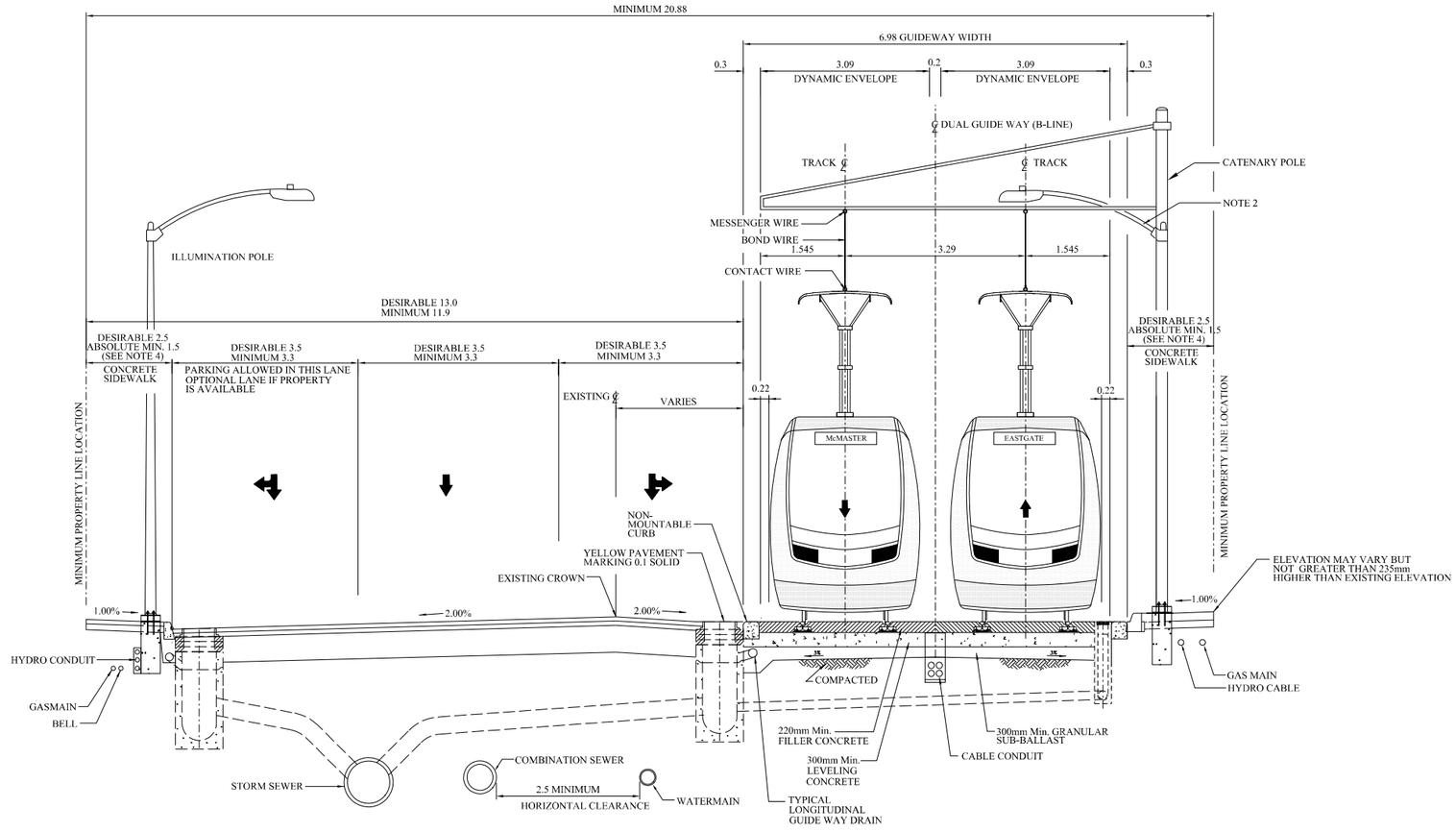
WONGE4 2011-09-28 11:22:55 AM

DIMENSIONS SHOWN ON THIS PLAN ARE IN METRES UNLESS OTHERWISE NOTED	CONTRACT No. DRAWING No. 503795-2000-41-DD-011 FILE No.	SHEET No. 11 OF 15

TYPICAL SECTION 11



TANGENT TRACK
TYPICAL DUAL GUIDE WAY CROSS - SECTION
GUIDE WAY ON CURBSIDE ON EXISTING ROADWAY
WITH DOUBLE AND/OR TRIPLE TRAFFIC LANE OPTIONS ON ONE SIDE ONLY
TRACK CENTRES 3.29 m

NOTES:

1. LOCATION OF CABLE CONDUITS FOR LRT TO BE DETERMINED.
2. HEIGHT OF CATENARY SUPPORT POLES TO BE DETERMINED.
3. LOCATIONS AND DEPTHS OF UTILITIES SHOWN ARE TYPICAL /INDICATIVE ONLY.
4. WHERE SIDEWALK IS MODIFIED, A DESIRABLE WIDTH OF 2.5m, MINIMUM WIDTH OF 2m, AND ABSOLUTE MINIMUM WIDTH OF 1.5m WILL BE MAINTAINED.
5. HAVING THE LRT R.O.W AND THE SIDEWALK AT THE SAME ELEVATION IS UNDESIRABLE. THE SIDEWALK SHOULD BE 150mm HIGHER. THIS WILL INCREASE THE ELEVATION DIFFERENCE AT THE R.O.W TO 365mm-385mm.
6. LIGHT FIXTURE AND CATENARY TO BE COMBINED ON A POLE AS MUCH AS POSSIBLE.

PRELIMINARY

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No.	REVISIONS	INITIAL	DATE

DRAWN BY: initials | DATE:

REFERENCE MATERIAL:
Surveyed By : name
Sewer Plans :
Water Plans :
Survey Plan :

Geodetic Bench Mark Index Elevation=
Borehole Report -

SCALES
0 0.5m 1m 2m
HORIZONTAL 1:50

Project Manager (Design)
NAME
Manager of Design
NAME

SNC·LAVALIN | steer davies gleave | DIALOG

DRAWN JUAN C. ZAPATA
CHECKED ATI MINCHEV
APPROVED STEPHAN MEHR

Hamilton Public Works

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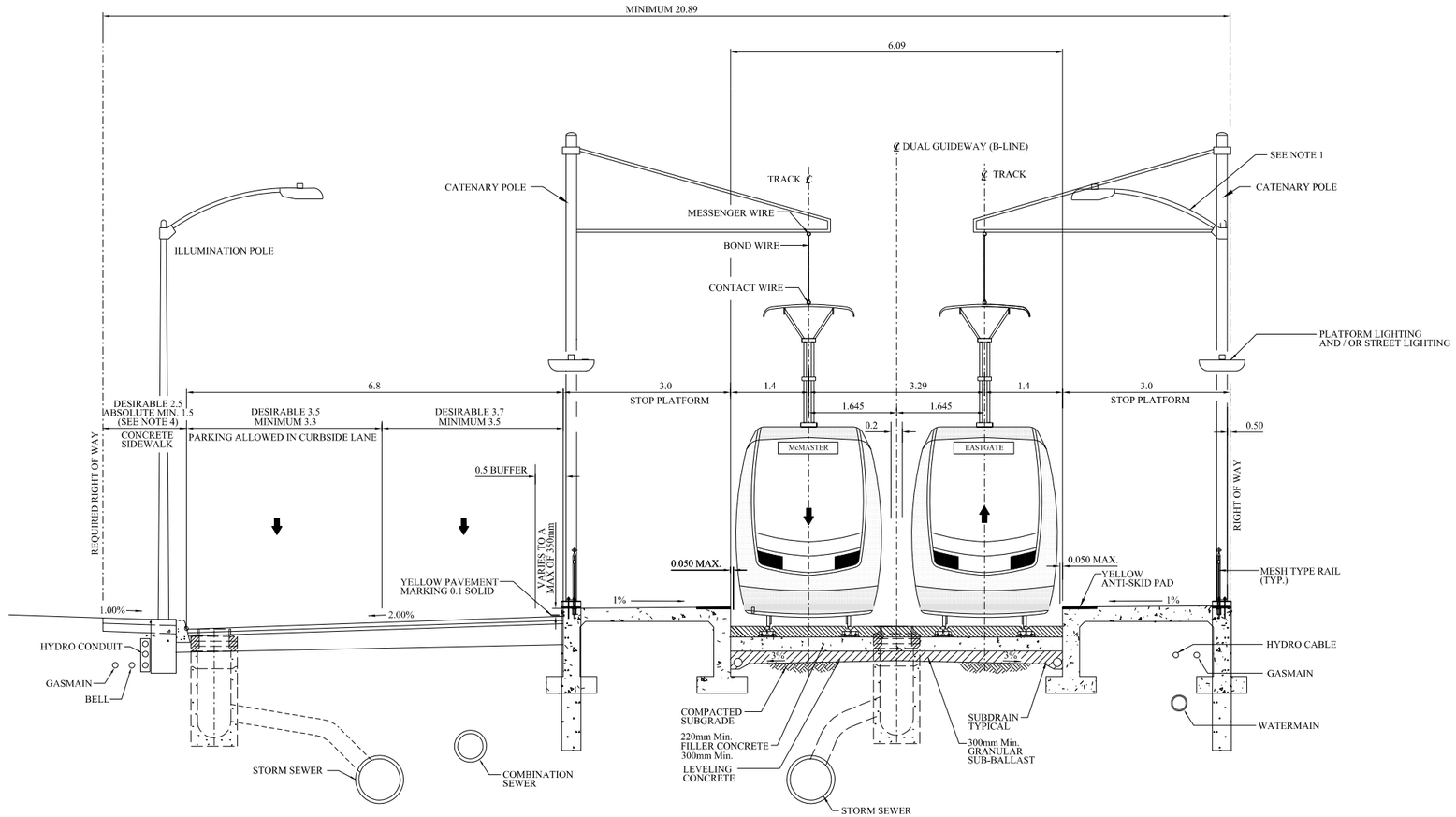
HAMILTON LRT 'B' LINE
Typical Dual Guideway Cross Section
GUIDEWAY ON CURBSIDE ON EXISTING ROADWAY
WITH DOUBLE AND/OR TRIPLE LANE OPTIONS
ON ONE SIDE ONLY

TYPICAL SECTION 013



TANGENT TRACK
TYPICAL DUAL GUIDEWAY CROSS - SECTION
GUIDEWAY WITH PARALLEL STOP PLATFORMS CURBSIDE LOCATION ON EXISTING ROADWAYS
WITH DOUBLE AND/OR TRIPLE TRAFFIC LANE OPTIONS ON ONE SIDE ONLY
TRACK CENTRES 3.29 m

NOTES:

1. LOCATION OF CABLE CONDUITS FOR LRT TO BE DETERMINED.
2. HEIGHT OF CATENARY SUPPORT POLES TO BE DETERMINED.
3. LOCATIONS AND DEPTHS OF UTILITIES SHOWN ARE TYPICAL /INDICATIVE ONLY.
4. WHERE SIDEWALK IS MODIFIED, A DESIRABLE WIDTH OF 2.5m, MINIMUM WIDTH OF 2m, AND ABSOLUTE MINIMUM WIDTH OF 1.5m WILL BE MAINTAINED.
5. LIGHT FIXTURE AND CATENARY TO BE COMBINED ON A POLE AS MUCH AS POSSIBLE.

PRELIMINARY

P:\503795\Trans\508-Typicals_Details\DGN\503795-2000-41DD-013.dgn
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No.	REVISIONS	INITIAL	DATE

DRAWN BY: initials | DATE:

REFERENCE MATERIAL:
Surveyed By : name
Sewer Plans :
Water Plans :
Survey Plan :

Geodetic Bench Mark Index Elevation=
Borehole Report -

SCALES
0 0.5m 1m 2m
HORIZONTAL 1:50

Project Manager (Design)
NAME
Manager of Design
NAME

SNC·LAVALIN | steer davies gleave | DIALOG

DRAWN JUAN C. ZAPATA
CHECKED ATI MINCHEV
APPROVED STEPHAN MEHR

Hamilton Public Works

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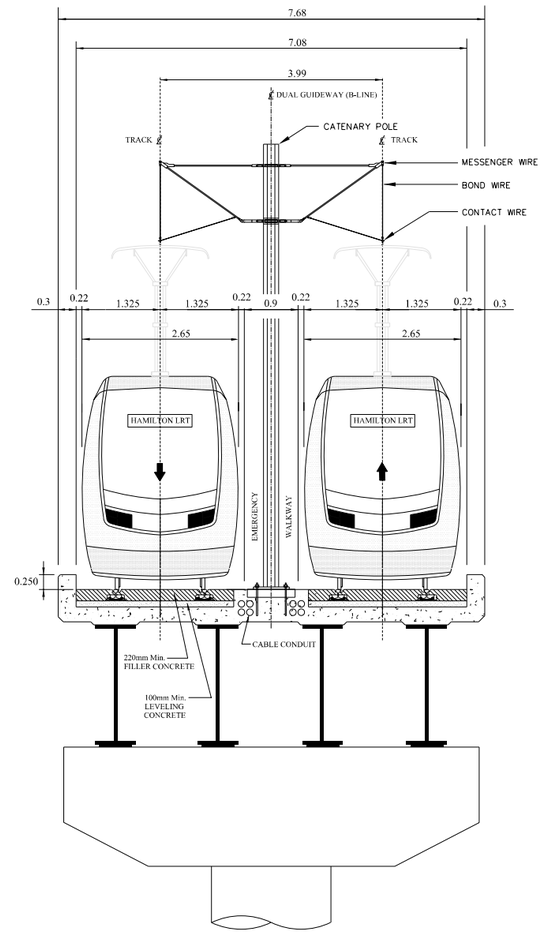
HAMILTON LRT 'B' LINE
Typical Dual Guideway Cross Section
GUIDEWAY WITH PARALLEL STOP PLATFORMS
CURBSIDE LOCATION ON EXISTING ROADWAYS
WITH DOUBLE AND/OR TRIPLE TRAFFIC LANE OPTIONS
ON ONE SIDE ONLY

DIMENSIONS SHOWN ON THIS PLAN ARE IN METRES UNLESS OTHERWISE NOTED

CONTRACT No.
DRAWING No. 503795-2000-41-DD-014
FILE No.

TYPICAL SECTION 014



TANGENT TRACK
TYPICAL HAMILTON LRT DUAL GUIDEWAY CROSS - SECTION OF THE PROPOSED B-LINE
GUIDEWAY ON NEW PROPOSED BRIDGE OVER HWY 403
WITH EMERGENCY WALKWAY
TRACK CENTRES 3.99 m

NOTES:
1. LOCATION OF CABLE CONDUITS FOR LRT TO BE DETERMINED.
2. HEIGHT OF CATENARY SUPPORT POLES TO BE DETERMINED.

PRELIMINARY

No.	REVISIONS	INITIAL	DATE

DRAWN BY: initials | DATE:

REFERENCE MATERIAL:
Surveyed By : name
Sewer Plans :
Water Plans :
Survey Plan :

Geodetic Bench Mark Index Elevation=
Borehole Report -

SCALES
0 0.5m 1m 2m
HORIZONTAL 1:50

Project Manager (Design)
NAME
Manager of Design
NAME

SNC·LAVALIN | steer davies gleave | DIALOG

DRAWN: JUAN C. ZAPATA
CHECKED: ATI MINCHEV
APPROVED: STEPHAN MEHR

Hamilton Public Works | RAPIDTransit moving HAMILTON forward | METROLINX An agency of the Government of Ontario

HAMILTON LRT 'B' LINE
Typical Dual Guideway Cross Section
ELEVATED GUIDEWAY
WITH CENTRAL CATENARY POLE
TRACK CENTRES 3.99 m

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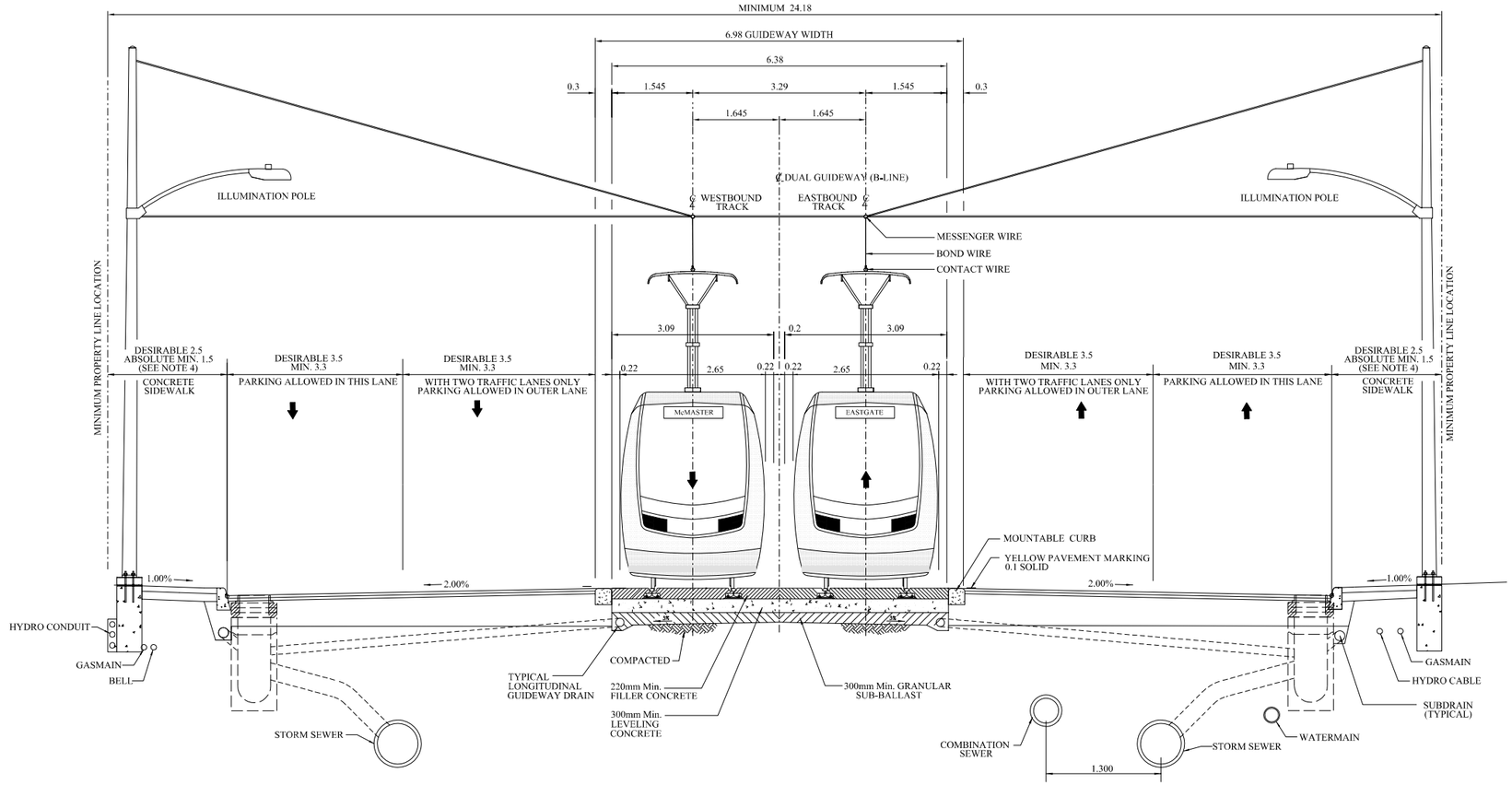
TYPICAL SECTION 015



TANGENT TRACK
TYPICAL DUAL GUIDEWAY CROSS - SECTION
GUIDEWAY IN CENTRE WITH SIDE CATENARY SUPPORT
TRACK CENTRES 3.29 m

NOTES:

1. LOCATION OF CABLE CONDUITS FOR LRT TO BE DETERMINED.
2. HEIGHT OF CATENARY SUPPORT POLES TO BE DETERMINED.
3. LOCATIONS AND DEPTHS OF UTILITIES SHOWN ARE TYPICAL /INDICATIVE ONLY.
4. WHERE SIDEWALK IS MODIFIED, A DESIRABLE WIDTH OF 2.5m, MINIMUM WIDTH OF 2m, AND ABSOLUTE MINIMUM WIDTH OF 1.5m WILL BE MAINTAINED.

PRELIMINARY

No.	REVISIONS	INITIAL	DATE

DRAWN BY: initials | DATE:

REFERENCE MATERIAL:
Surveyed By : name
Sewer Plans :
Water Plans :
Survey Plan :

Geodetic Bench Mark Index | Elevation=
Borehole Report -

SCALES
0 0.5m 1m 2m
HORIZONTAL 1:50

Project Manager (Design)
NAME
Manager of Design
NAME

steer davies gleave
SNC·LAVALIN DIALOG

DRAWN JUAN C. ZAPATA
CHECKED ATI MINCHEV
APPROVED STEPHAN MEHR

Hamilton Public Works
RAPIDTransit moving HAMILTON forward
METROLINX An agency of the Government of Ontario

HAMILTON LRT 'B' LINE
Typical Dual Guideway Cross Section
GUIDEWAY IN CENTRE WITH SIDE CATENARY SUPPORT
TRACK CENTRES 3.29 m

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Appendix B
Photographs of Typical LRT Sites and Related Impervious Area Impacts

1) Location with No Increase in Impervious Area

2) Location with 56m^2 Increased Impervious Area

3) Location with 367m^2 Increased Impervious Area

4) Location with 2109m^2 Increased Impervious Area

5) Location with 5626m^2 Increased Impervious Area

Appendix C

Bridge over Highway-403 Overpass:
Aerial Photo
Preliminary Design Plates and Existing Drainage Outlets

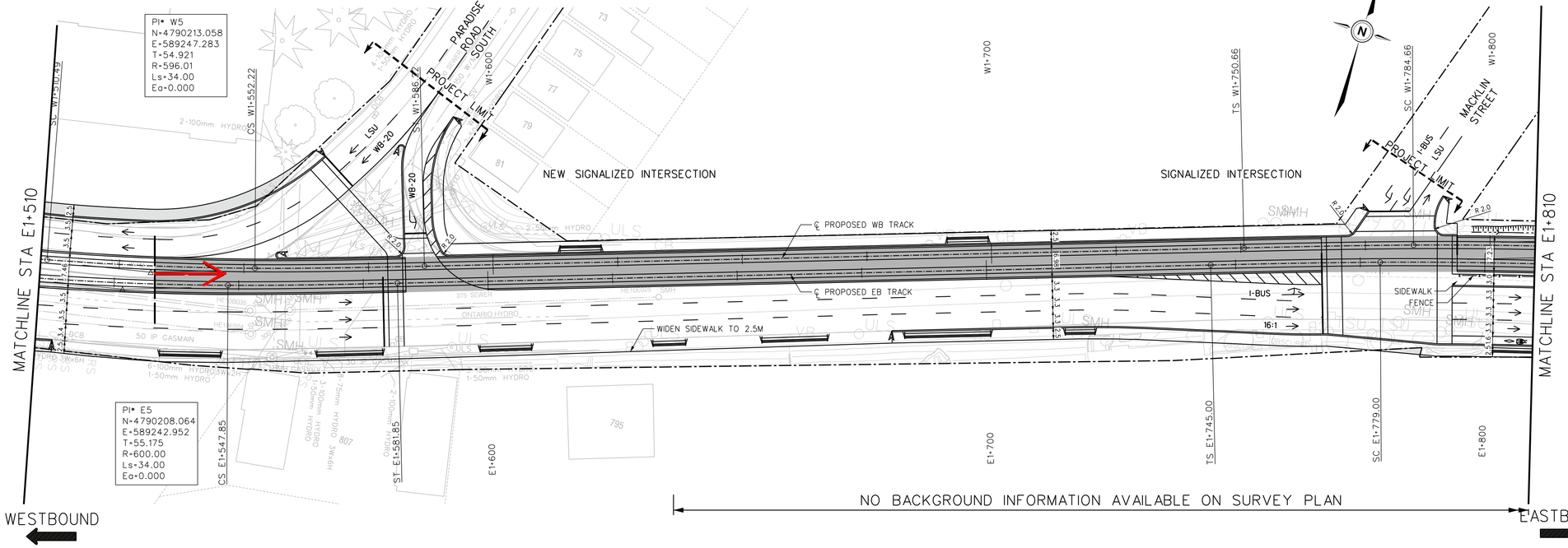

CHEDOKE CREEK
KING ST
TOPE CRESCENT
403
MAIN ST
SAG
N

MAIN STREET W

MAIN STREET W

FILE No.	CONTRACT No. C11-12-10	SHEET No. 8 OF 50

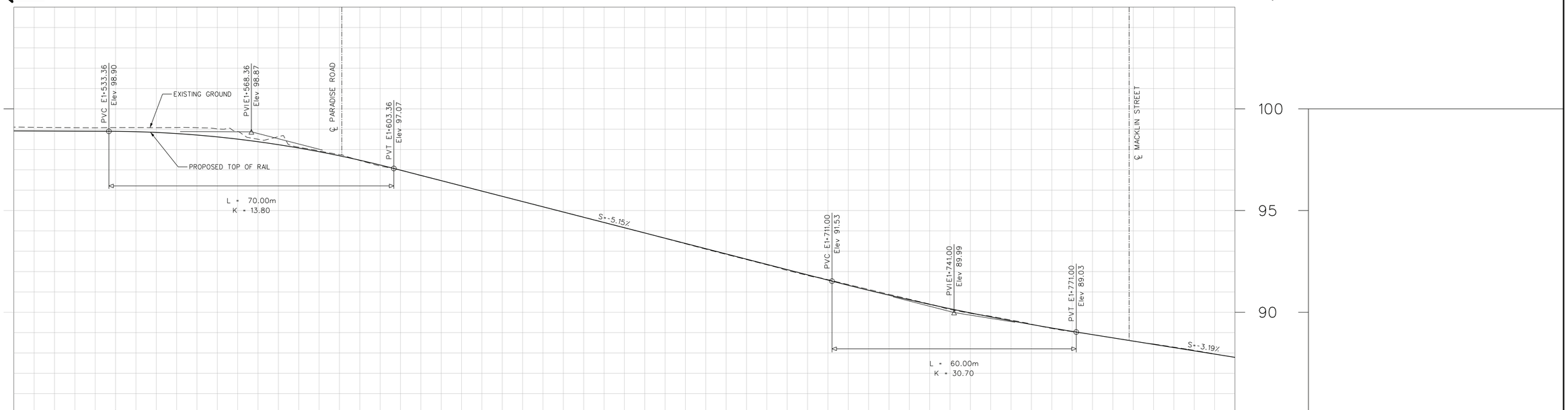
DIMENSIONS SHOWN ON THIS PLAN ARE IN METRES UNLESS OTHERWISE NOTED



LEGEND

- LRT TRACK CENTRELINE
- EXISTING PROPERTY LINE
- PROPOSED TOP OF RAIL (PROFILE)
- EXISTING GROUND LINE — EAST BOUND TRACK USED AS REFERENCE LINE
- E0+000.00 — STATIONING ON EB TRACK
- W0+000.00 — STATIONING ON WB TRACK
- PROPERTY REQUIRED
- MATCH EXISTING
- EXISTING DRIVEWAY
- WB-20 — DESIGN VEHICLE
- XX:1 — TAPER RATE
- TOP OF SLOPE
- BOTTOM OF SLOPE
- DITCH FLOW DIRECTION

NOT FOR CONSTRUCTION



99.074	99.081	98.631	97.182	95.952	94.676	93.367	92.056	90.883	89.804	88.903	88.127	*PROPOSED TOP OF RAIL PROFILE*
98.904	98.785	98.238	97.239	95.956	94.670	93.383	92.096	90.842	89.771	88.901	88.103	EXISTING GROUND ELEVATION
E1+525	E1+550	E1+575	E1+600	E1+625	E1+650	E1+675	E1+700	E1+725	E1+750	E1+775	E1+800	DESIGN ℄ CHAINAGE EASTBOUND TRACK

No.	REVISIONS	INITIAL	DATE
1	Modified lane configuration and profile	JU	09/26/11

REFERENCE MATERIAL:

Survey Plan : COMPILED FBS AND SURVEY LRT.dgn (MAY 19, 2011)
0937HAMI0002_ALL_v8.dgn (OCTOBER 7, 2010)
basemap2.dwg (MAY 19, 2011)
Sewer Plans :
Water Plans :

Geodetic Bench Mark Index — Elevation=
Borehole Report -

SCALES
HORIZONTAL 1:500 (0, 5m, 10m, 20m)
VERTICAL 1:100 (0, 1m, 2m, 4m)

Project Manager
NAME
Manager of Design
NAME

SNC·LAVALIN · steer davies gleave · DIALOG

DRAWN BELDEN KUNG / BRIAN KIM
CHECKED JUAN UMANA
APPROVED STEPHAN MEHR
DATE 2011/09/06

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HAMILTON LRT 'B' LINE
PRELIMINARY DESIGN
PLAN AND PROFILE
STA E1+510 TO STA E1+810

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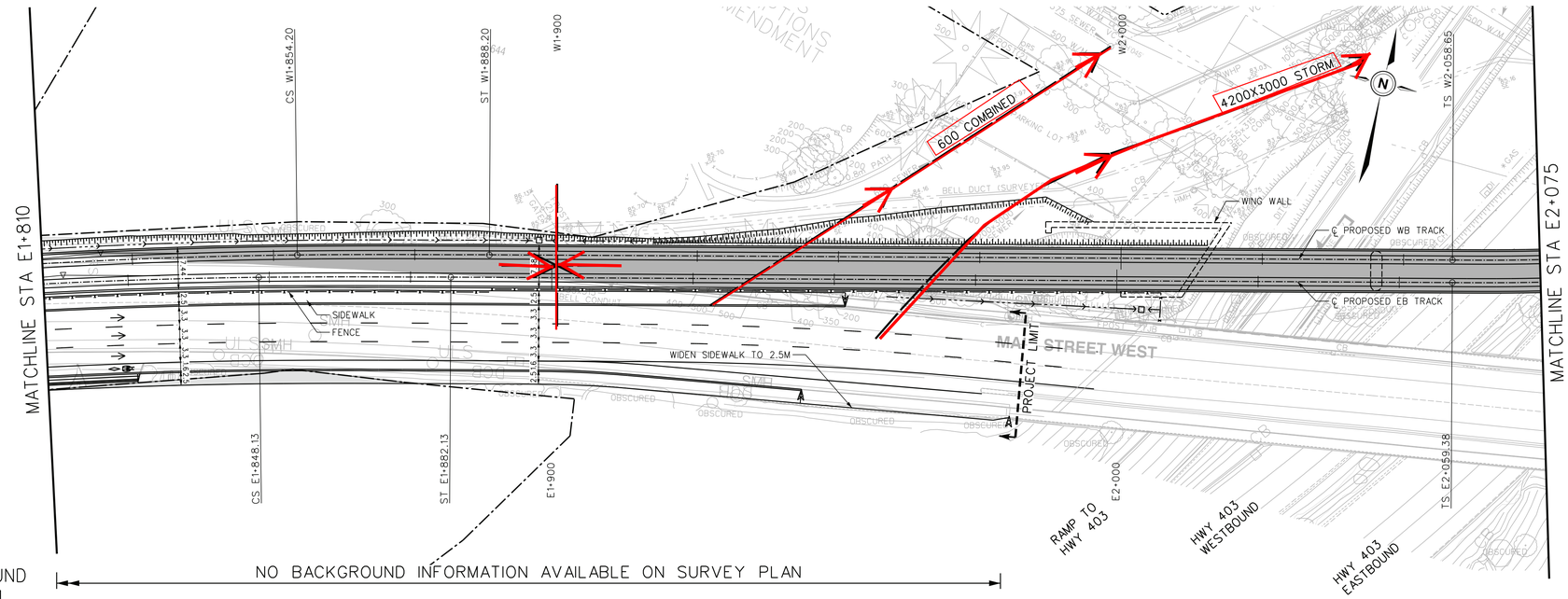
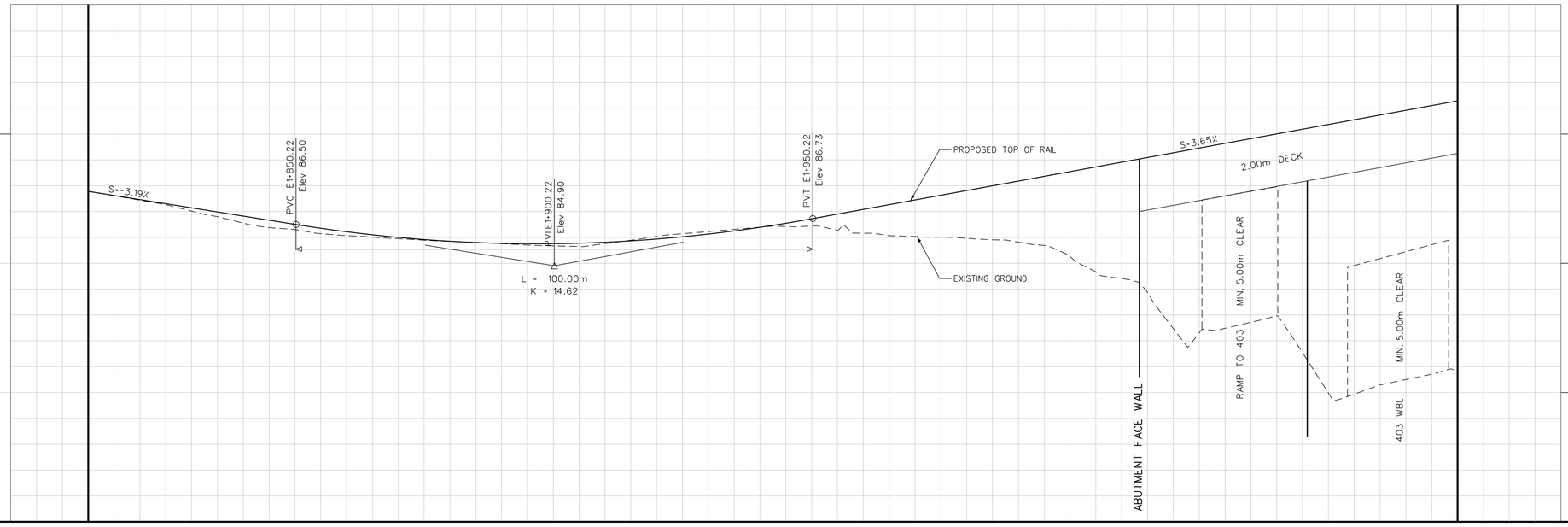
MAIN STREET W

MAIN STREET W



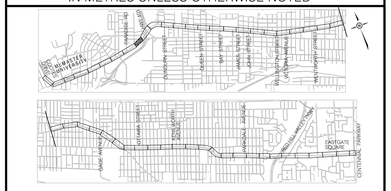


DRAFT

87.268	86.309	85.891	85.674	86.144	86.440	86.009	85.271	82.311	79.983	80.803	*PROPOSED TOP OF RAIL PROFILE*
87.305	86.507	85.919	85.758	86.026	86.721	87.633	88.545	89.458	90.370	91.282	EXISTING GROUND ELEVATION
E1+825	E1+850	E1+875	E1+900	E1+925	E1+950	E1+975	E2+000	E2+025	E2+050	E2+075	DESIGN ℄ CHAINAGE EASTBOUND TRACK

FILE No.	CONTRACT No. PW 00-00 (-)	SHEET No. 8 OF 48

DIMENSIONS SHOWN ON THIS PLAN ARE IN METRES UNLESS OTHERWISE NOTED



LEGEND

- LRT TRACK CENTRELINE
- EXISTING PROPERTY LINE
- PROPOSED TOP OF RAIL (PROFILE)
- EXISTING GROUND LINE EAST BOUND TRACK USED AS REFERENCE LINE
- E0+000.00 STATIONING ON EB TRACK
- W0+000.00 STATIONING ON WB TRACK
- PROPERTY REQUIRED
- MATCH EXISTING
- EXISTING DRIVEWAY
- WB-20 DESIGN VEHICLE
- XX:1 TAPER RATE
- TOP OF SLOPE
- BOTTOM OF SLOPE
- DITCH FLOW DIRECTION

No.	REVISIONS	INITIAL	DATE

REFERENCE MATERIAL:

Survey Plan : COMPILED FBS AND SURVEY LRT.dgn (MAY 19, 2011)
0937HAMI0002_ALL_v8.dgn (OCTOBER 7, 2010)
basemap2.dwg (MAY 19, 2011)
Sewer Plans :
Water Plans :

Geodetic Bench Mark Index Elevation=
Borehole Report -

SCALES
0 5m 10m 20m
HORIZONTAL 1:500
0 1m 2m 4m
VERTICAL 1:100

Project Manager
NAME
Manager of Design
NAME

steer davies gleave
SNC·LAVALIN DIALOG

DRAWN BELDEN KUNG / BRIAN KIM
CHECKED JUAN UMANA
APPROVED STEPHAN MEHR
DATE 2011/09/06

Hamilton Public Works
RAPIDTransit moving HAMILTON forward
METROLINX An agency of the Government of Ontario

HAMILTON LRT 'B' LINE
PRELIMINARY DESIGN
PLAN AND PLANE
STA E1+810 TO STA E2+075

09-H-00 (1)

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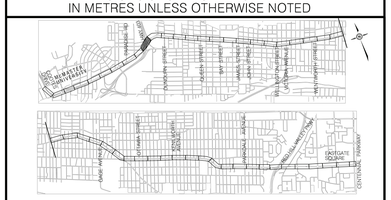
KIMBR 2011-09-22 11:04:35 AM

KING STREET W

FILE No.	CONTRACT No. PW 00-00 (-)	SHEET No. 9 OF 48

DIMENSIONS SHOWN ON THIS PLAN ARE IN METRES UNLESS OTHERWISE NOTED



LEGEND

- LRT TRACK CENTRELINE
- EXISTING PROPERTY LINE
- PROPOSED TOP OF RAIL (PROFILE)
- EXISTING GROUND LINE
  EAST BOUND TRACK USED AS REFERENCE LINE
- E0+000.00 STATIONING ON EB TRACK
- W0+000.00 STATIONING ON WB TRACK
- PROPERTY REQUIRED
- MATCH EXISTING
- EXISTING DRIVEWAY
- WB-20 DESIGN VEHICLE
- XX:1 TAPER RATE
- TOP OF SLOPE
- BOTTOM OF SLOPE
- DITCH FLOW DIRECTION

DRAFT

80.635	81.202	82.120	82.218	82.262	82.962	88.026	88.625	89.591	88.399	88.320	*PROPOSED TOP OF RAIL PROFILE*
91.282	92.195	93.107	94.020	94.851	95.351	95.504	95.350	95.150	94.950	94.750	EXISTING GROUND ELEVATION
E2+075	E2+100	E2+125	E2+150	E2+175	E2+200	E2+225	E2+250	E2+275	E2+300	E2+325	DESIGN ℄ CHAINAGE EASTBOUND TRACK

No.	REVISIONS	INITIAL	DATE

REFERENCE MATERIAL:

Survey Plan : COMPILED FBS AND SURVEY LRT.dgn (MAY 19, 2011)
0937HAMI0002_ALL_v8.dgn (OCTOBER 7, 2010)
basemap2.dwg (MAY 19, 2011)
Sewer Plans :
Water Plans :

Geodetic Bench Mark Index Elevation=
Borehole Report -

SCALES

0 5m 10m 20m
HORIZONTAL 1:500
0 1m 2m 4m
VERTICAL 1:100

Project Manager
NAME
Manager of Design
NAME

SNC·LAVALIN steer davies gleave DIALOG

DRAWN BELDEN KUNG / BRIAN KIM
CHECKED JUAN UMANA
APPROVED STEPHAN MEHR
DATE 2011/08/24

Hamilton Public Works

RAPIDTransit moving HAMILTON forward

METROLINX An agency of the Government of Ontario

HAMILTON LRT 'B' LINE

PRELIMINARY DESIGN

PLAN AND PROFILE
STA E2+075 TO STA E2+325

09-H-00 (1)

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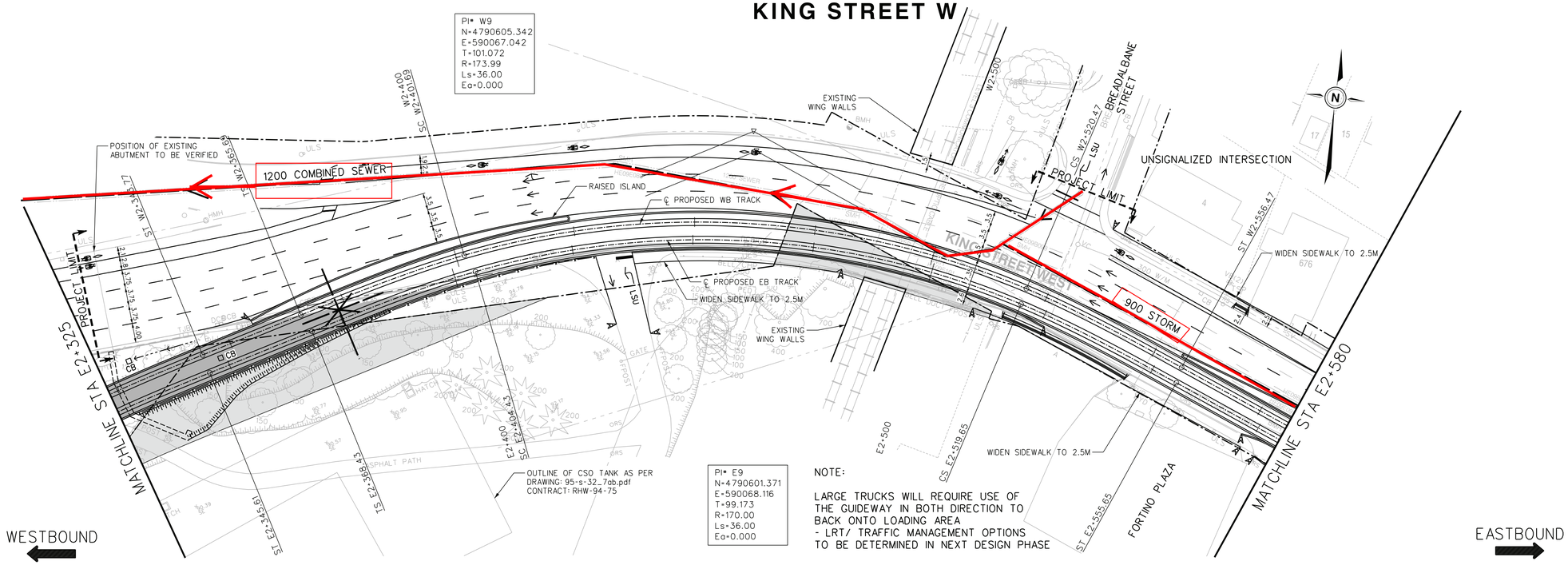
KIMBR 2011-09-22 10:58:13 AM

KING STREET W

FILE No.	CONTRACT No. PW 00-00 (-)	SHEET No. 11 OF 50

DIMENSIONS SHOWN ON THIS PLAN ARE IN METRES UNLESS OTHERWISE NOTED

KING STREET W



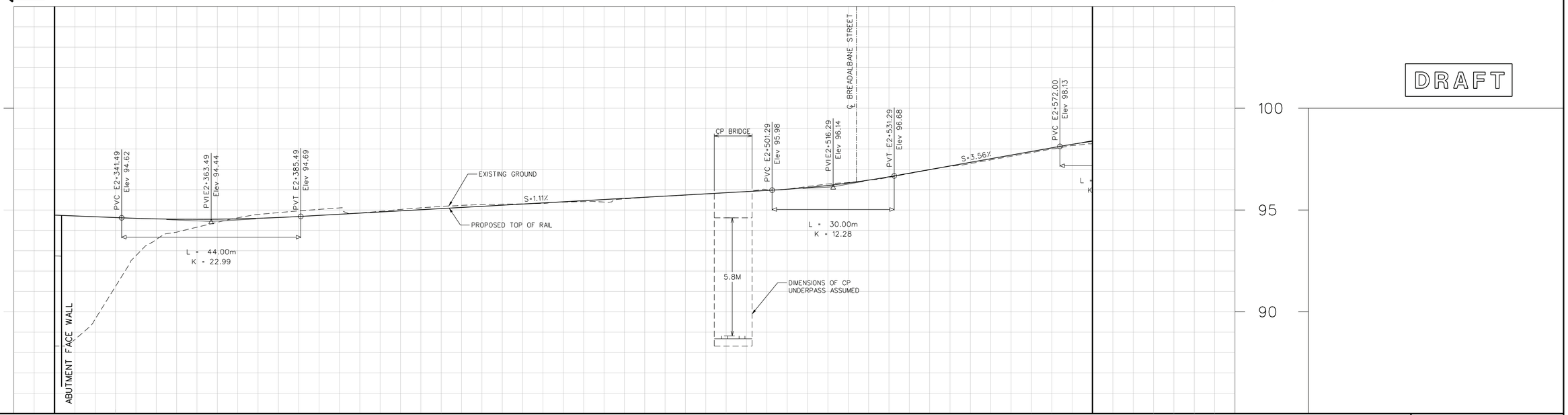
LEGEND

- LRT TRACK CENTRELINE
- EXISTING PROPERTY LINE
- PROPOSED TOP OF RAIL (PROFILE)
- EXISTING GROUND LINE EAST BOUND TRACK USED AS REFERENCE LINE
- E0+000.00 STATIONING ON EB TRACK
- W0+000.00 STATIONING ON WB TRACK
- PROPERTY REQUIRED
- MATCH EXISTING
- EXISTING DRIVEWAY
- WB-20 DESIGN VEHICLE
- XX:1 TAPER RATE
- TOP OF SLOPE
- BOTTOM OF SLOPE
- DITCH FLOW DIRECTION

NOTE

ASSESSMENT OF POSSIBILITY TO ELIMINATE DRIVEWAYS ON SOUTH SIDE SHALL BE UNDER TAKEN IN NEXT DESIGN PHASE.

DRAFT



88.320	93.520	94.786	94.857	95.231	95.391	95.681	95.995	96.466	97.285	98.167
94.750	94.566	94.594	94.848	95.127	95.405	95.684	95.962	96.469	97.343	98.228
E2+325	E2+350	E2+375	E2+400	E2+425	E2+450	E2+475	E2+500	E2+525	E2+550	E2+575

PROPOSED TOP OF RAIL PROFILE

EXISTING GROUND ELEVATION

DESIGN ℄ CHAINAGE EASTBOUND TRACK

No.	REVISIONS	INITIAL	DATE

REFERENCE MATERIAL:

Survey Plan : COMPILED FBS AND SURVEY LRT.dgn (MAY 19, 2011)
0937HAMI0002_ALL_v8.dgn (OCTOBER 7, 2010)
basemap2.dwg (MAY 19, 2011)
Sewer Plans :
Water Plans :

Geodetic Bench Mark Index Elevation=
Borehole Report -

SCALES

HORIZONTAL 1:500 (0, 5m, 10m, 20m)
VERTICAL 1:100 (0, 1m, 2m, 4m)

Project Manager
NAME
Manager of Design
NAME

SNC·LAVALIN steer davies gleave DIALOG

DRAWN BELDEN KUNG / BRIAN KIM
CHECKED JUAN UMANA
APPROVED STEPHAN MEHR
DATE 2011/08/24

Hamilton Public Works

RAPIDTransit moving HAMILTON forward

METROLINX An agency of the Government of Ontario

HAMILTON LRT 'B' LINE

PRELIMINARY DESIGN

PLAN AND PROFILE

STA E2+325 TO STA E2+580

09-H-00 (1)

P:\503795\Trans\2000-Temp\BHK\STORMWATER REPORT\NC11.dgn
KIMBR 2011-09-22 10:54:37 AM

Hamilton LRT

403 Bridge Drainage

Guideway width = 7.68 m

Rainfall IDF Parameters (Mount Hope Station):

	A	B	C
5 Year	1049.5	8	0.803
100 Year	2317.4	11	0.836

					DRAINAGE AREA					RUNOFF					
LOCATION	FROM		TO		A			CA	Cumul. CA	Tc	Intensity I 5-yr	Q 5yr (2.778*CIA)	Intensity I 100-yr	Q 100yr (2.778*CIA)	Design Flow
	Flow Node	Sta.	Flow Node	Sta.	(Ha)			Total		(min)	(mm/h)	(l/s)	(mm/h)	(l/s)	(l/s)
Main St.					0.40	0.65	0.90	a1*0.4+ a2*0.5+ a3*0.85							
					a1	a2	a3								
West Sag 1+900	1	1+536	2	1+850			0.241	0.217	0.217						
East Sag 1+900	3	2+225	2	1+850			0.288	0.259	0.476						
Total Sag 1+900									0.476	10.0	103.04	**136.3**	181.81	**240.4**	
King St West Sag 2+375	3	2+225	4	2+375			0.115	0.104	0.104	10.0	103.04	**29.8**	181.81	**52.5**	

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