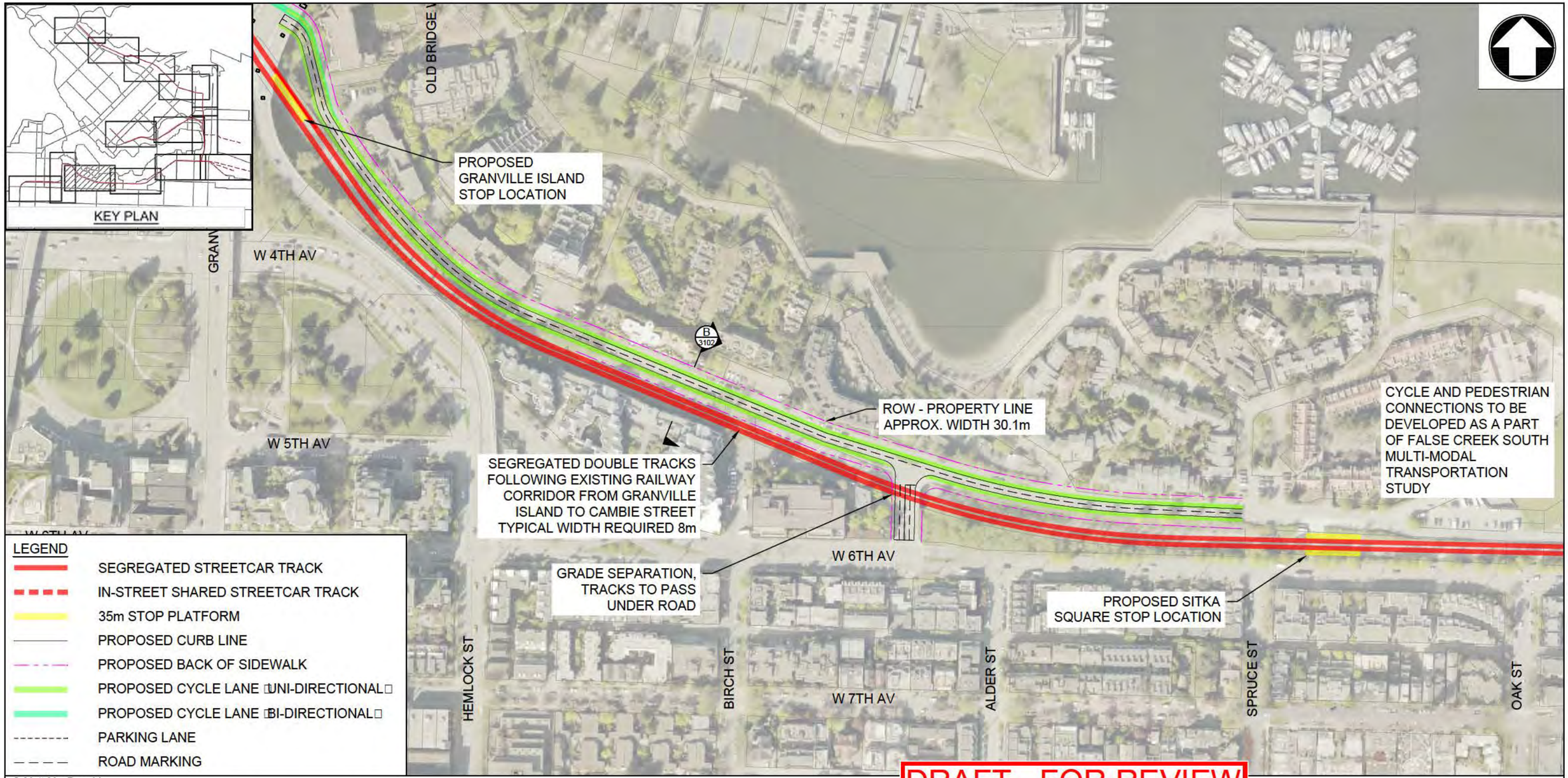

DRAFT - FOR REVIEW

20 m 0 1:2500 100 m

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Rev	Date	Drawn	Description	Ch'k'd	App'd
A	2018-10-04	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
B	2018-10-15	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 1 - FALSE CREEK SOUTH
SHEET 7 OF 41

Drawn	L. ANDERSON	18-10-04
Checked	K. MILLER	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:2500

Drawing Number
388583-MMD-00-P0-DR-TR-1102

Security	Status	Rev
STD	PRE	D

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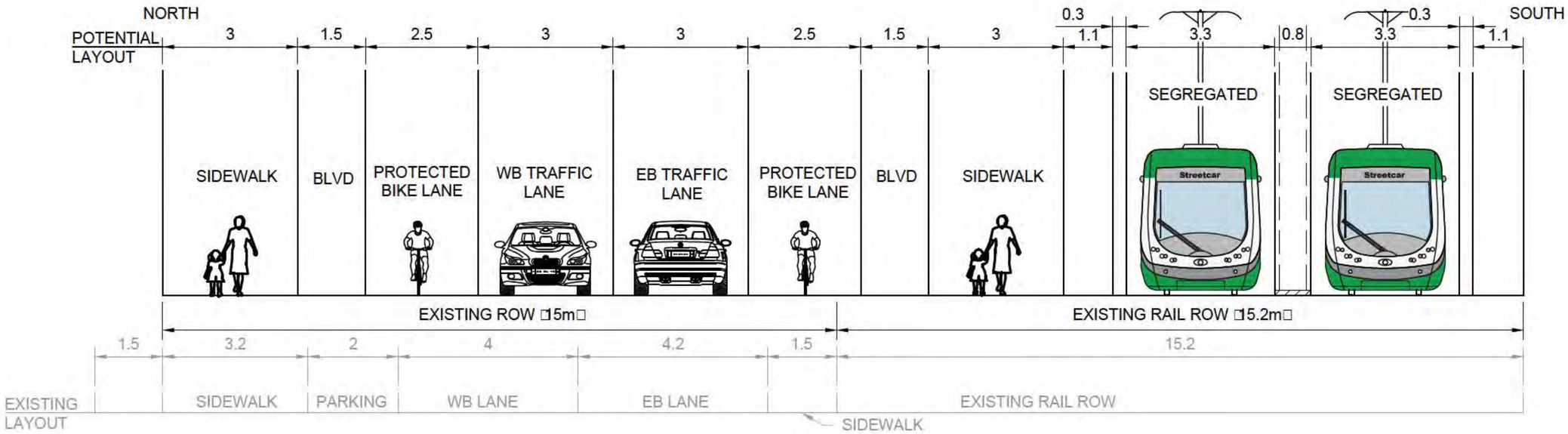

SECTION B - OPTION 1

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C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
SECTION B
SHEET 8 OF 41

Drawn	K. MILLER	18-10-04
Checked	L. ANDERSON	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:100

Drawing Number
388583-MMD-00-P0-DR-TR-3102

Security	Status	Rev
STD	PRE	D

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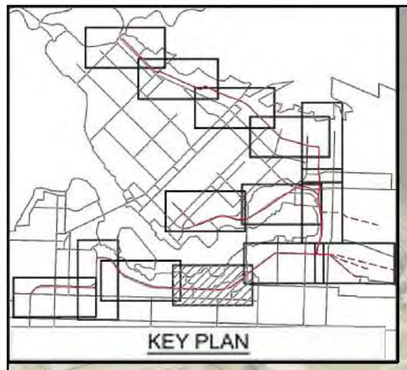

CYCLE AND PEDESTRIAN CONNECTIONS TO BE DEVELOPED AS A PART OF FALSE CREEK SOUTH MULTI-MODAL TRANSPORTATION STUDY

PROPOSED CAMBIE STREET STOP LOCATION

CAMBIE BRIDGE

W 2ND AV

CHARLESON

C 3103

W 6TH AV

W 6TH AV

SEGREGATED DOUBLE TRACKS FOLLOWING EXISTING RAILWAY CORRIDOR FROM GRANVILLE ISLAND TO CAMBIE STREET TYPICAL WIDTH REQUIRED 8m

ROW - PROPERTY LINE APPROX. WIDTH 15.2m

W 7TH AV

WILLOW ST

HEATHER ST

ASH ST

CAMBIE ST

LEGEND

- SEGREGATED STREETCAR TRACK
- IN-STREET SHARED STREETCAR TRACK
- 35m STOP PLATFORM
- PROPOSED CURB LINE
- PROPOSED BACK OF SIDEWALK
- PROPOSED CYCLE LANE □UNI-DIRECTIONAL□
- PROPOSED CYCLE LANE □BI-DIRECTIONAL□
- PARKING LANE
- ROAD MARKING
- APPROXIMATE COLUMN LOCATIONS

DRAFT - FOR REVIEW

20 m 0 1:2500 100 m

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A	2018-10-04	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
B	2018-10-15	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	20 9-1	SMV	ISSUED R N VIEW		G

Title

CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 1 - FALSE CREEK SOUTH
SHEET 9 OF 41

Drawn	L. ANDERSON	18-10-04
Checked	K. MILLER	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:2500

Drawing Number
388583-MMD-00-P0-DR-TR-1103

Security	Status	Rev
STD	PRE	D

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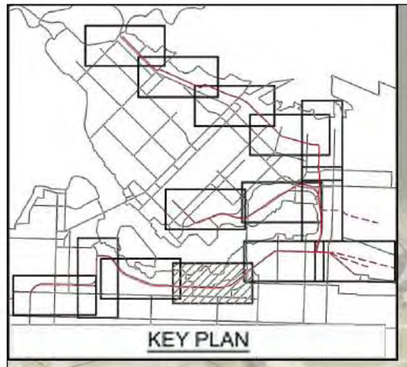

CYCLE AND PEDESTRIAN CONNECTIONS TO BE DEVELOPED AS A PART OF FALSE CREEK SOUTH MULTI-MODAL TRANSPORTATION STUDY

PROPOSED CAMBIE STREET STOP LOCATION

CAMBIE BRIDGE

W 2ND AV

CHARLESON

W 6TH AV

W 6TH AV

SEGREGATED DOUBLE TRACKS FOLLOWING EXISTING RAILWAY CORRIDOR FROM GRANVILLE ISLAND TO CAMBIE STREET TYPICAL WIDTH REQUIRED 8m

ROW - PROPERTY LINE APPROX. WIDTH 15.2m

W 7TH AV

WILLOW ST

HEATHER ST

ASH ST

CAMBIE ST

LEGEND

- SEGREGATED STREETCAR TRACK
- IN-STREET SHARED STREETCAR TRACK
- 35m STOP PLATFORM
- PROPOSED CURB LINE
- PROPOSED BACK OF SIDEWALK
- PROPOSED CYCLE LANE □UNI-DIRECTIONAL□
- PROPOSED CYCLE LANE □BI-DIRECTIONAL□
- PARKING LANE
- ROAD MARKING
- APPROXIMATE COLUMN LOCATIONS

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Rev	Date	Drawn	Description	Ch'k'd	App'd
A	2018-10-04	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
B	2018-10-15	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
C	018-12 21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title

CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 2 - FALSE CREEK SOUTH
SHEET 10 OF 41

Drawn	L. ANDERSON	18-10-04
Checked	K. MILLER	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:2500

Drawing Number
388583-MMD-00-P0-DR-TR-1203

Security	Status	Rev
STD	PRE	D

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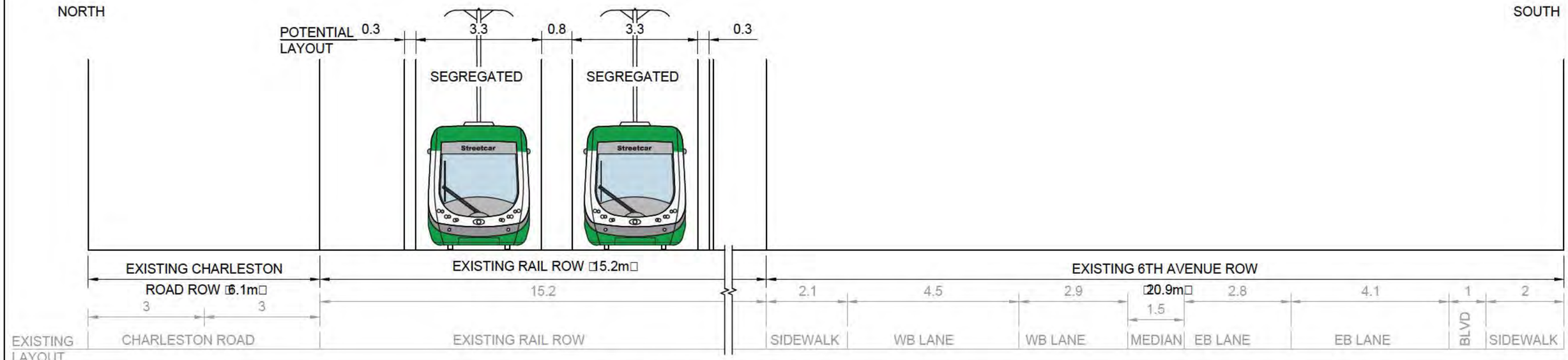

SECTION C - OPTION 1

DRAFT - FOR REVIEW

1 m 0 1:100 5 m

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Rev	Date	Drawn	Description	Ch'k'd	App'd
A	2018-10-04	KHM	ISSUED FOR DISCUSSION - DRAFT	LJA	GBF
B	2018-10-15	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
SECTION C
SHEET 11 OF 41

Drawn	K. MILLER	18-10-04
Checked	L. ANDERSON	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:100

Drawing Number
388583-MMD-00-P0-DR-TR-3103

Security	Status	Rev
STD	PRE	D

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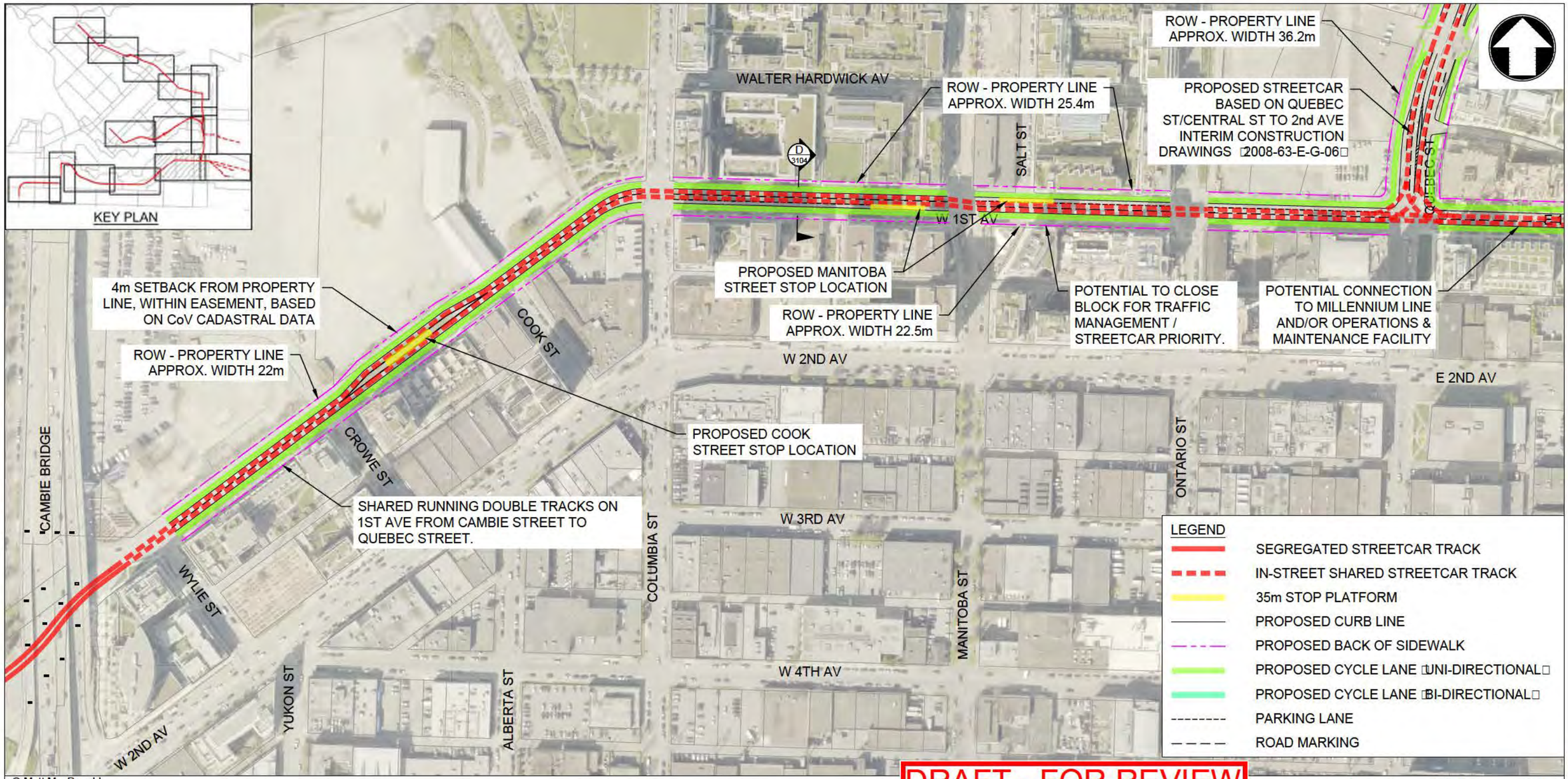

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20 m 0 1:2500 100 m

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Rev	Date	Drawn	Description	Ch'k'd	App'd
A	2018-10-04	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
B	2018-10-15	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 1 - SEFC
SHEET 12 OF 41

Drawn	L. ANDERSON	18-10-04
Checked	K. MILLER	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:2500

Drawing Number
388583-MMD-00-P0-DR-TR-1104

Security	Status	Rev
STD	PRE	D

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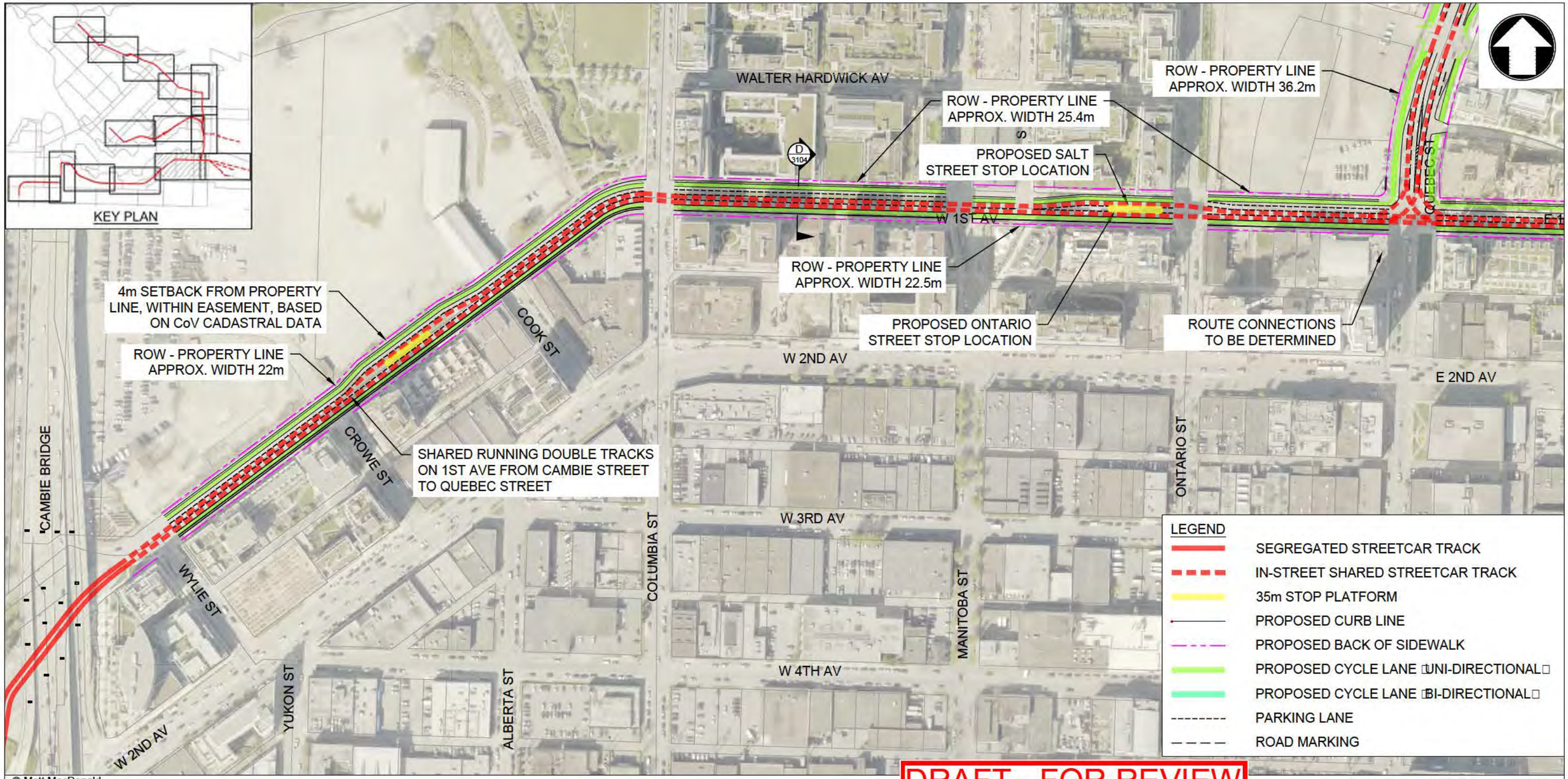

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20 m 0 1:2500 100 m

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Rev	Date	Drawn	Description	Ch'k'd	App'd
A	2019-10-23	RAH	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 2 - SEFC
SHEET 13 OF 41

Drawn	R. HAY	19-10-23
Checked	K. MILLER	19-10-23
Approved	G. FARMER	19-10-23

Scale at ANSI B
1:2500

Drawing Number
388583-MMD-00-P0-DR-TR-1204

Security	Status	Rev
STD	PRE	A

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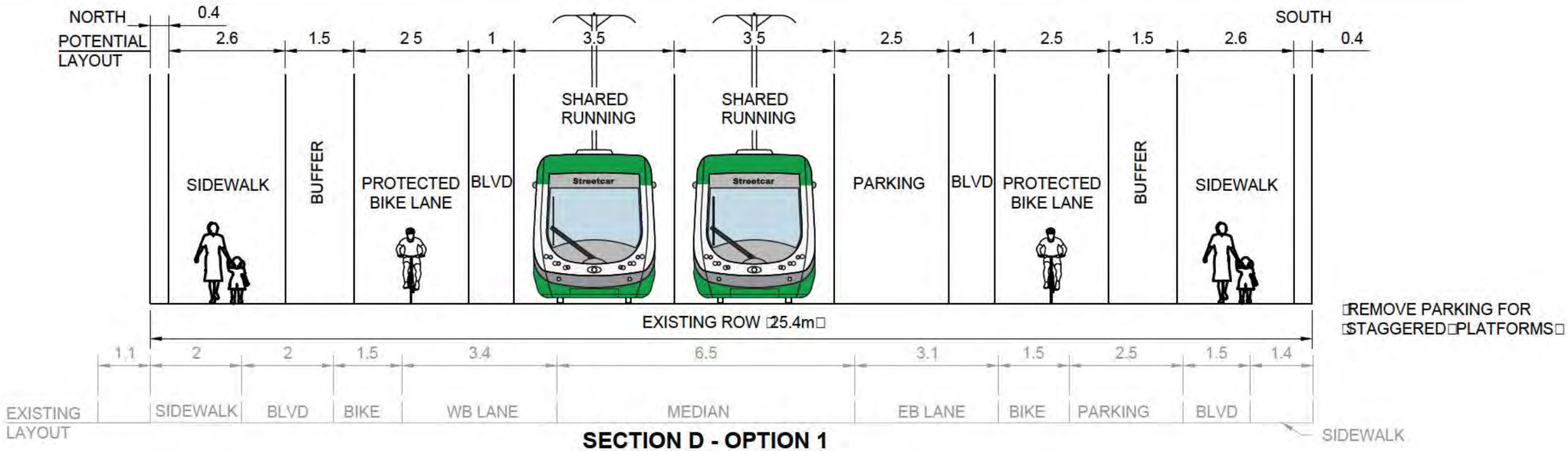
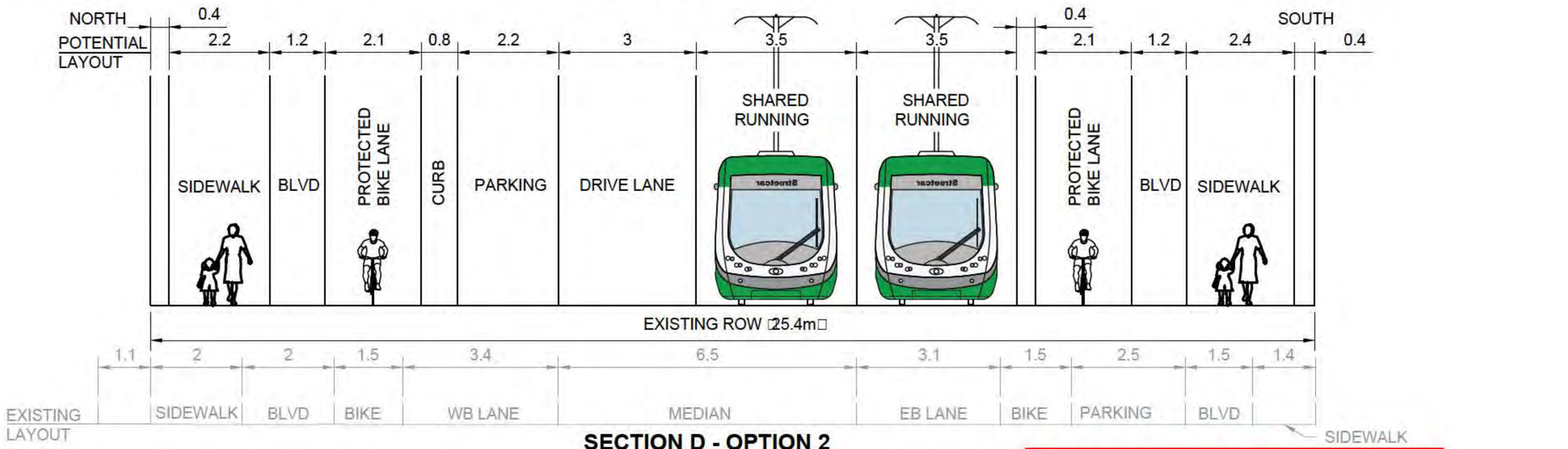


SECTION D - OPTION 1



SECTION D - OPTION 2

DRAFT - FOR REVIEW

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A	2018-10-04	KHM	ISSUED FOR DISCUSSION - DRAFT	LJA	GBF
B	2018-10-15	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	RAH	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
SECTION D
SHEET 14 OF 41

Drawn	K. MILLER	18-10-04
Checked	L. ANDERSON	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:100

Drawing Number
388583-MMD-00-P0-DR-TR-3104

Security	Status	Rev
STD	PRE	D

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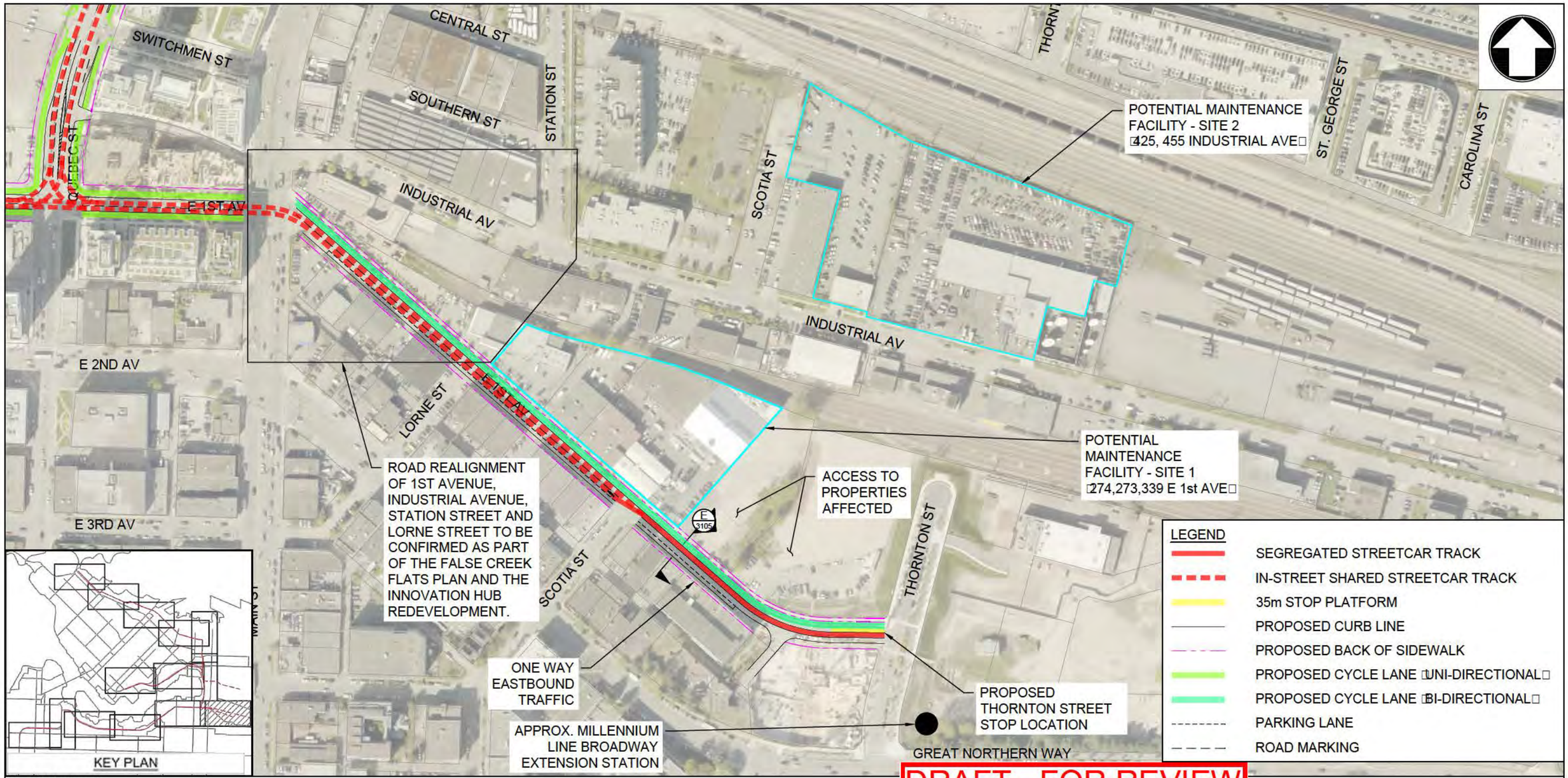

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B	2018-10-15	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-03-19	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
E	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 1 - FALSE CREEK FLATS
SHEET 15 OF 41

Drawn	L. ANDERSON	18-10-04
Checked	K. MILLER	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:2500

Drawing Number
388583-MMD-00-P0-DR-TR-1105

Security	Status	Rev
STD	PRE	E

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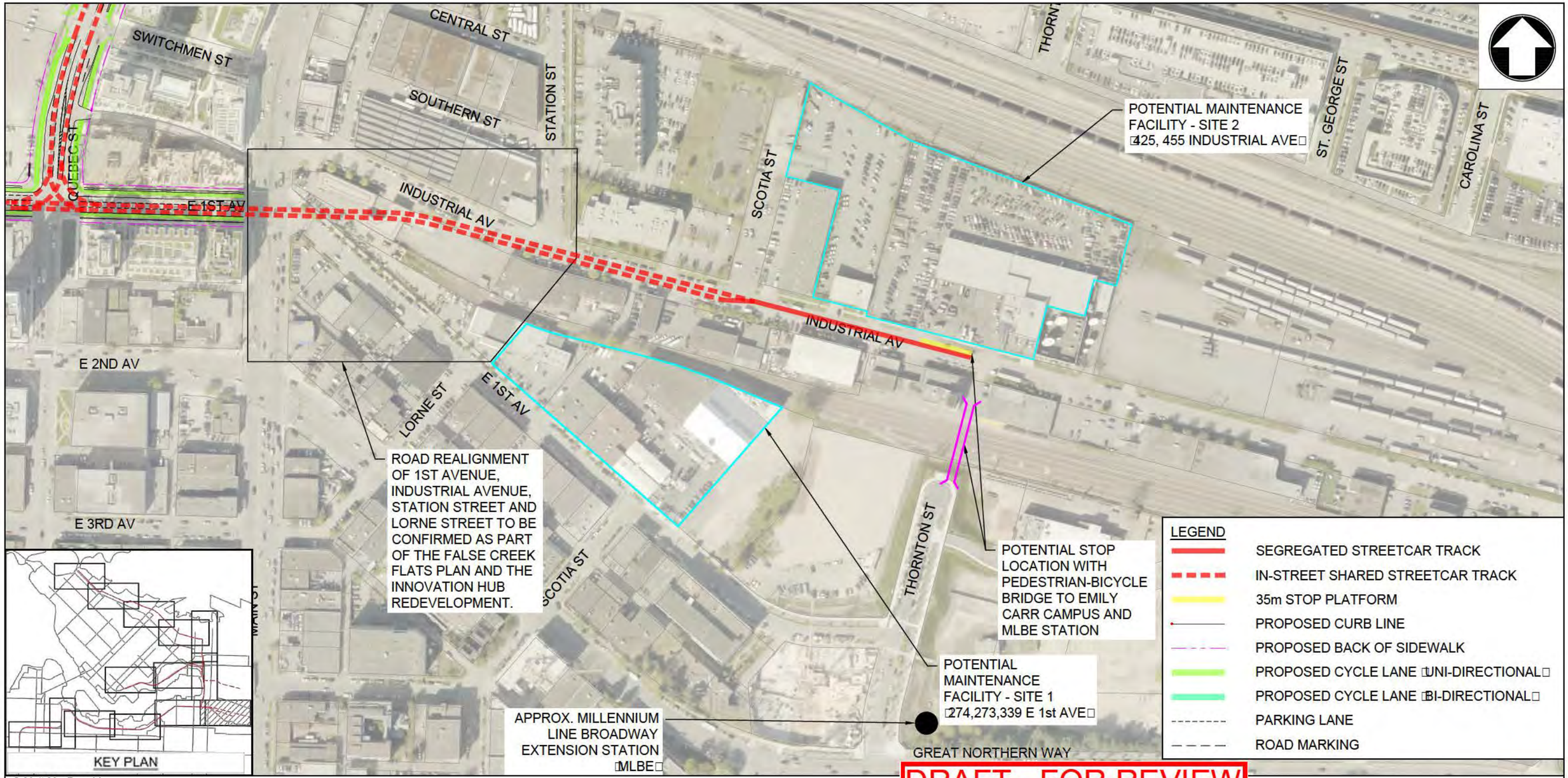

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20 m 0 1:2500 100 m

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D	2019-03-19	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
E	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 2 - FALSE CREEK FLATS
SHEET 16 OF 41

Drawn	L. ANDERSON	18-10-04
Checked	K. MILLER	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:2500

Drawing Number
388583-MMD-00-P0-DR-TR-1205

Security	Status	Rev
STD	PRE	E

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NOTE: ROAD AND TRACK DESIGN AS PER WATERFRONT HUB STUDY

CENTRAL ST
SOUTHERN ST
STATION ST
QUEBEC ST
E 1ST AV
INDUSTRIAL AV
SCOTIA ST
THORNTON ST
ST. GEORGE ST
CAROLINA ST
E 2ND AV
LORNE ST
E 3RD AV
MAIN ST

POTENTIAL MAINTENANCE FACILITY - SITE 2
425, 455 INDUSTRIAL AVE

POTENTIAL MAINTENANCE FACILITY - SITE 1
274,273,339 E 1st AVE

ROAD REALIGNMENT OF 1ST AVENUE, INDUSTRIAL AVENUE, STATION STREET AND LORNE STREET TO BE CONFIRMED AS PART OF THE FALSE CREEK FLATS PLAN AND THE INNOVATION HUB REDEVELOPMENT.

PROPOSED THORNTON STREET STOP LOCATION

APPROX. MILLENNIUM LINE BROADWAY EXTENSION STATION

GREAT NORTHERN WAY

LEGEND
- SEGREGATED STREETCAR TRACK
- IN-STREET SHARED STREETCAR TRACK
- 35m STOP PLATFORM
- PROPOSED CURB LINE
- PROPOSED BACK OF SIDEWALK
- PROPOSED CYCLE LANE UNI-DIRECTIONAL
- PROPOSED CYCLE LANE BI-DIRECTIONAL
- PARKING LANE
- ROAD MARKING

KEY PLAN

DRAFT - FOR REVIEW

20 m 0 1:2500 100 m

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Vancouver, BC
V5Y 1V4

Rev	Date	Drawn	Description	Ch'k'd	App'd
A	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
B	2019-03-19	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
C	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 3 - FALSE CREEK FLATS
SHEET 17 OF 41

Drawn	L. ANDERSON	18-12-21
Checked	K. MILLER	18-12-21
Approved	G. FARMER	18-12-21

Scale at ANSI B
1:2500

Drawing Number
388583-MMD-00-P0-DR-TR-1305

Security	Status	Rev
STD	PRE	C

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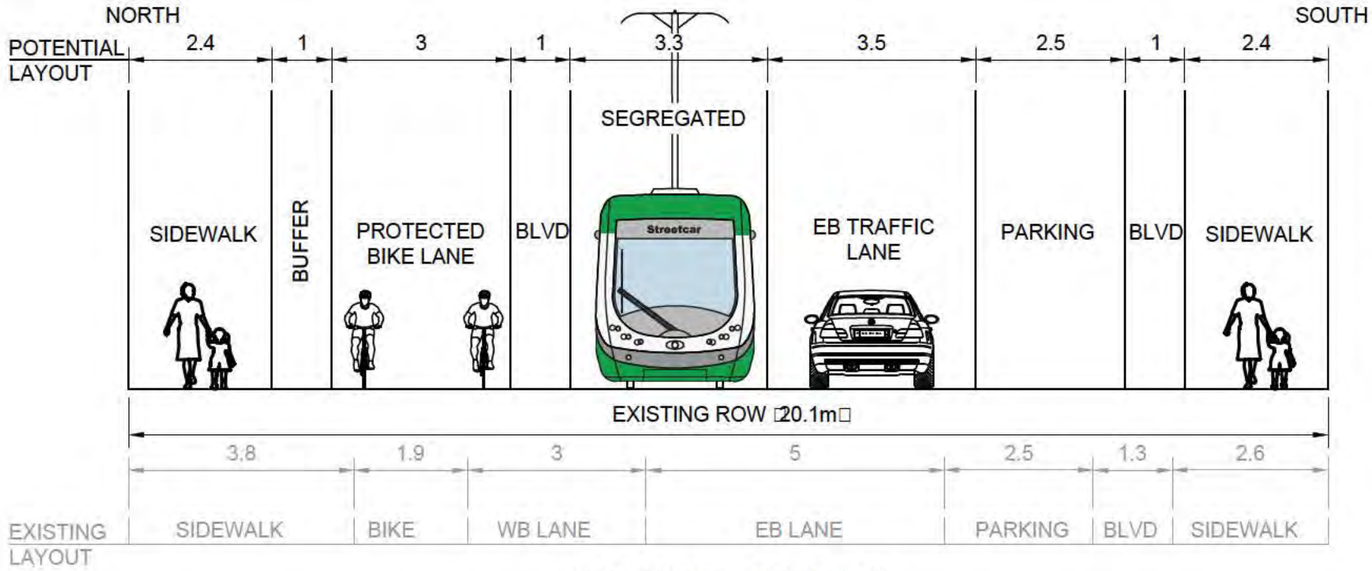

SECTION E - OPTION 1

DRAFT - FOR REVIEW

1 m 0 1:100 5 m

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Vancouver, BC
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C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
SECTION E
SHEET 18 OF 41

Drawn	K. MILLER	18-10-04
Checked	L. ANDERSON	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:100

Drawing Number
388583-MMD-00-P0-DR-TR-3105

Security	Status	Rev
STD	PRE	D

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NOTE: ROAD AND TRACK DESIGN AS PER NEFC DESIGN

ROW - PROPERTY LINE APPROX. WIDTH 36.2m

EXTENT OF NEFC TRACK DESIGN

PROPOSED PACIFIC BOULEVARD STOP LOCATIONS

ROW - PROPERTY LINE APPROX. WIDTH 18.2m

ADVANCED STREETCAR SIGNAL REQUIRED

EXTENT OF NEFC TRACK DESIGN

PROPOSED SCIENCE WORLD STOP LOCATION

POTENTIAL MAINTENANCE FACILITY - SITE 4
701 NATIONAL AVE

KEY PLAN

LEGEND

- SEGREGATED STREETCAR TRACK
- IN-STREET SHARED STREETCAR TRACK
- 35m STOP PLATFORM
- PROPOSED CURB LINE
- PROPOSED BACK OF SIDEWALK
- PROPOSED CYCLE LANE UNI-DIRECTIONAL
- PROPOSED CYCLE LANE BI-DIRECTIONAL
- PARKING LANE
- ROAD MARKING

DRAFT - FOR REVIEW

20 m 0 1:2500 100 m

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Rev	Date	Drawn	Description	Ch'k'd	App'd
A	2018-10-04	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
B	2018-10-15	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 1 - FALSE CREEK FLATS
SHEET 19 OF 41

Drawn	L. ANDERSON	18-10-04
Checked	K. MILLER	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:2500

Drawing Number
388583-MMD-00-P0-DR-TR-1106

Security	Status	Rev
STD	PRE	D

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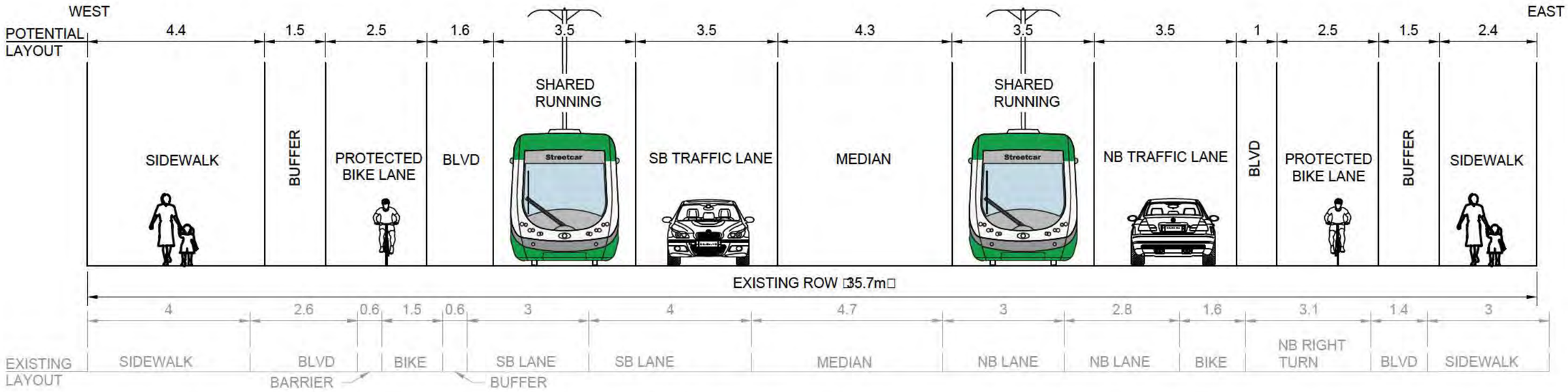

SECTION F - OPTION 1

DRAFT - FOR REVIEW

1 m 0 1:100 5 m

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Rev	Date	Drawn	Description	Ch'k'd	App'd
A	2018-10-04	KHM	ISSUED FOR DISCUSSION - DRAFT	LJA	GBF
B	2018-10-15	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
SECTION F
SHEET 20 OF 41

Drawn	K. MILLER	18-10-04
Checked	L. ANDERSON	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:100

Drawing Number
388583-MMD-00-P0-DR-TR-3106

Security	Status	Rev
STD	PRE	D

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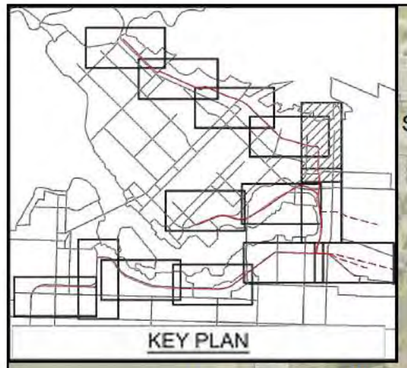

ST

CARRALL ST

CARRALL ST

EASTBOUND TRACK FOR SHARED USE ON NORTH SIDE OF CORDOVA STREET.

WESTBOUND TRACK FOR SHARED USE ON POWELL STREET & WATER STREET.

ROW - PROPERTY LINE APPROX. WIDTH 18.2m

ROW - PROPERTY LINE APPROX. WIDTH 20.2m

G 3107

COLUMBIA ST

UEBEC ST

COLUMBIA ST

POWELL ST

ALEXANDER ST

ROW - PROPERTY LINE APPROX. WIDTH 20.2m

PROPOSED HASTINGS STREET STOP LOCATION

ADVANCED STREETCAR SIGNAL REQUIRED

SHARED TRACK FROM PRIOR STREET TO CORDOVA STREET. EASTERN AND WESTERN PARKING MAINTAINED THROUGH OUT.

KEEFER ST

E PENDER ST

MAIN ST

E HASTINGS ST

E CORDOVA ST

ALEXANDER ST

LEGEND

- SEGREGATED STREETCAR TRACK
- IN-STREET SHARED STREETCAR TRACK
- 35m STOP PLATFORM
- PROPOSED CURB LINE
- PROPOSED BACK OF SIDEWALK
- PROPOSED CYCLE LANE (UNI-DIRECTIONAL)
- PROPOSED CYCLE LANE (BI-DIRECTIONAL)
- PARKING LANE
- ROAD MARKING

DRAFT - FOR REVIEW

20 m 0 1:2500 100 m

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CITY OF VANCOUVER

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C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title

CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 1 - GASTOWN
SHEET 21 OF 41

Drawn	L. ANDERSON	18-10-04
Checked	K. MILLER	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:2500

Drawing Number
388583-MMD-00-P0-DR-TR-1107

Security	Status	Rev
STD	PRE	D

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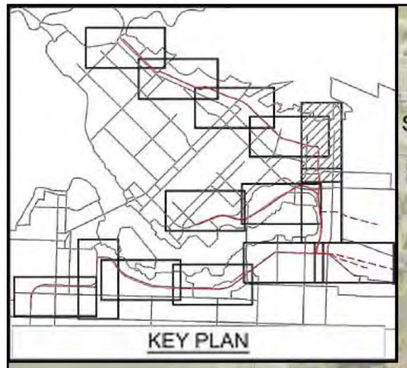

CARRALL ST

WESTBOUND TRACK SEGREGATED ON NORTH SIDE. EASTBOUND TRACK SHARED ON SOUTH SIDE OF CORDOVA STREET.

CARRALL ST

ROW - PROPERTY LINE APPROX. WIDTH 20.2m

G 3107

COLUMBIA ST

QUEBEC ST

COLUMBIA ST

POWELL ST

ALEXANDER ST

PROPOSED HASTINGS STREET STOP LOCATION

SHARED TRACKS FROM PRIOR STREET TO CORDOVA STREET.

KEEFER ST

E PENDER ST

MAIN ST

E HASTINGS ST

E CORDOVA ST

ALEXANDER ST

LEGEND

- SEGREGATED STREETCAR TRACK
- IN-STREET SHARED STREETCAR TRACK
- 35m STOP PLATFORM
- PROPOSED CURB LINE
- PROPOSED BACK OF SIDEWALK
- PROPOSED CYCLE LANE (UNI-DIRECTIONAL)
- PROPOSED CYCLE LANE (BI-DIRECTIONAL)
- PARKING LANE
- ROAD MARKING

DRAFT - FOR REVIEW

20 m 0 1:2500 100 m

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B	2018-10-15	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title

CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 2 - GASTOWN
SHEET 22 OF 41

Drawn	L. ANDERSON	18-10-04
Checked	K. MILLER	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:2500

Drawing Number
388583-MMD-00-P0-DR-TR-1207

Security	Status	Rev
STD	PRE	D

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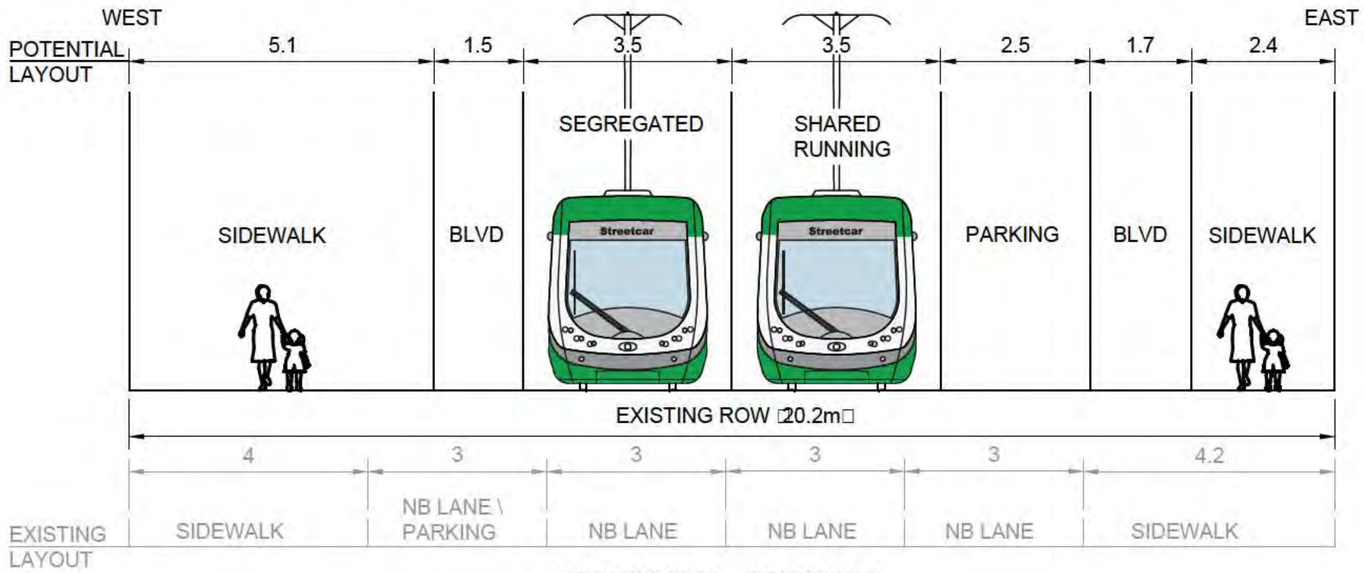

SECTION G - OPTION 1

DRAFT - FOR REVIEW

1 m 0 1:100 5 m

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B	2018-10-15	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
SECTION G
SHEET 23 OF 41

Drawn	K. MILLER	18-10-04
Checked	L. ANDERSON	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:100

Drawing Number
388583-MMD-00-P0-DR-TR-3107

Security	Status	Rev
STD	PRE	D

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NOTE: ROAD AND TRACK DESIGN AS PER WATERFRONT HUB STUDY

ROW - PROPERTY LINE WIDTH APPROX. 26.6m

PROPOSED WATERFRONT STOP LOCATION - POSSIBLE INTERIM TERMINUS

WESTBOUND TRACK FOR SHARED USE ON POWELL STREET & WATER STREET.

PROPOSED ABBOTT STREET WB STOP LOCATION

ROW - PROPERTY LINE APPROX. WIDTH 20.1m

PROPOSED ABBOTT STREET EB STOP LOCATION

EASTBOUND TRACK FOR SHARED USE ON NORTH SIDE OF CORDOVA STREET.

ADVANCED STREETCAR SIGNAL REQUIRED

GRANVILLE

SEYMOUR ST

RICHARDS ST

WATER ST

W CORDOVA ST

HOMER ST

W HASTINGS ST

CAMBIE ST

ABBOTT ST

W PENDER ST

ALEXANDER ST

POWELL ST

CARRALL ST

COLUMBIA ST

H 3108

J 3109

KEY PLAN

LEGEND

- SEGREGATED STREETCAR TRACK
- IN-STREET SHARED STREETCAR TRACK
- 35m STOP PLATFORM
- PROPOSED CURB LINE
- PROPOSED BACK OF SIDEWALK
- PROPOSED CYCLE LANE (UNI-DIRECTIONAL)
- PROPOSED CYCLE LANE (BI-DIRECTIONAL)
- PARKING LANE
- ROAD MARKING

DRAFT - FOR REVIEW

20 m 0 1:2500 100 m

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C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 1 - GASTOWN
SHEET 24 OF 41

Drawn	L. ANDERSON	18-10-04
Checked	K. MILLER	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:2500

Drawing Number
388583-MMD-00-P0-DR-TR-1108

Security	Status	Rev
STD	PRE	D

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NOTE: ROAD AND TRACK DESIGN AS PER WATERFRONT HUB STUDY

ROW - PROPERTY LINE WIDTH APPROX. 26.6m

PROPOSED WATERFRONT STOP LOCATION

ROW - PROPERTY LINE APPROX. WIDTH 20.1m

PROPOSED ABBOTT STREET STOP LOCATION

WESTBOUND TRACK SEGREGATED ON NORTH SIDE. EASTBOUND TRACK SHARED ON SOUTH SIDE OF CORDOVA STREET.

GRANVILLE

SEYMOUR ST

RICHARDS ST

WATER ST

W HASTINGS ST

HOMER ST

W CORDOVA ST

CAMBIE ST

W PENDER ST

ABBOTT

CARRALL ST

ALEXANDER ST

POWELL ST

COLUMBIA ST

J 3109

KEY PLAN

LEGEND

- SEGREGATED STREETCAR TRACK
- IN-STREET SHARED STREETCAR TRACK
- 35m STOP PLATFORM
- PROPOSED CURB LINE
- PROPOSED BACK OF SIDEWALK
- PROPOSED CYCLE LANE (UNI-DIRECTIONAL)
- PROPOSED CYCLE LANE (BI-DIRECTIONAL)
- PARKING LANE
- ROAD MARKING

DRAFT - FOR REVIEW

20 m 0 1:2500 100 m

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B	2018-10-15	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 2 - GASTOWN
SHEET 25 OF 41

Drawn	L. ANDERSON	18-10-04
Checked	K. MILLER	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:2500

Drawing Number
388583-MMD-00-P0-DR-TR-1208

Security	Status	Rev
STD	PRE	D

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NOTE: ROAD AND TRACK DESIGN AS PER WATERFRONT HUB STUDY

ROW - PROPERTY LINE WIDTH APPROX. 26.6m

PROPOSED WATERFRONT STOP LOCATION

ADVANCED STREETCAR SIGNAL REQUIRED

PROPOSED ABBOTT STREET STOP LOCATION

WESTBOUND TRACK FOR SHARED USE ON NORTH SIDE. EASTBOUND TRACK FOR SHARED USED ON SOUTH SIDE OF OF HASTINGS STREET.

ROW - PROPERTY LINE APPROX. WIDTH 24.4m

ROW - PROPERTY LINE APPROX. WIDTH 30.2m

GRANVILLE ST

SEYMOUR ST

RICHARDS ST

WATER ST

HOMER ST

W HASTINGS ST

W CORDOVA ST

ALEXANDER ST

POWELL ST

CARRALL ST

COLUMBIA ST

CAMBIE ST

ABBOTT ST

W PENDER ST

K 3110

KEY PLAN

LEGEND

- SEGREGATED STREETCAR TRACK
- IN-STREET SHARED STREETCAR TRACK
- 35m STOP PLATFORM
- PROPOSED CURB LINE
- PROPOSED BACK OF SIDEWALK
- PROPOSED CYCLE LANE (UNI-DIRECTIONAL)
- PROPOSED CYCLE LANE (BI-DIRECTIONAL)
- PARKING LANE
- ROAD MARKING

DRAFT - FOR REVIEW

20 m 0 1:2500 100 m

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B	2018-10-15	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title

CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 3 - GASTOWN
SHEET 26 OF 41

Drawn	L. ANDERSON	18-10-04
Checked	K. MILLER	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:2500

Drawing Number
388583-MMD-00-P0-DR-TR-1308

Security	Status	Rev
STD	PRE	D

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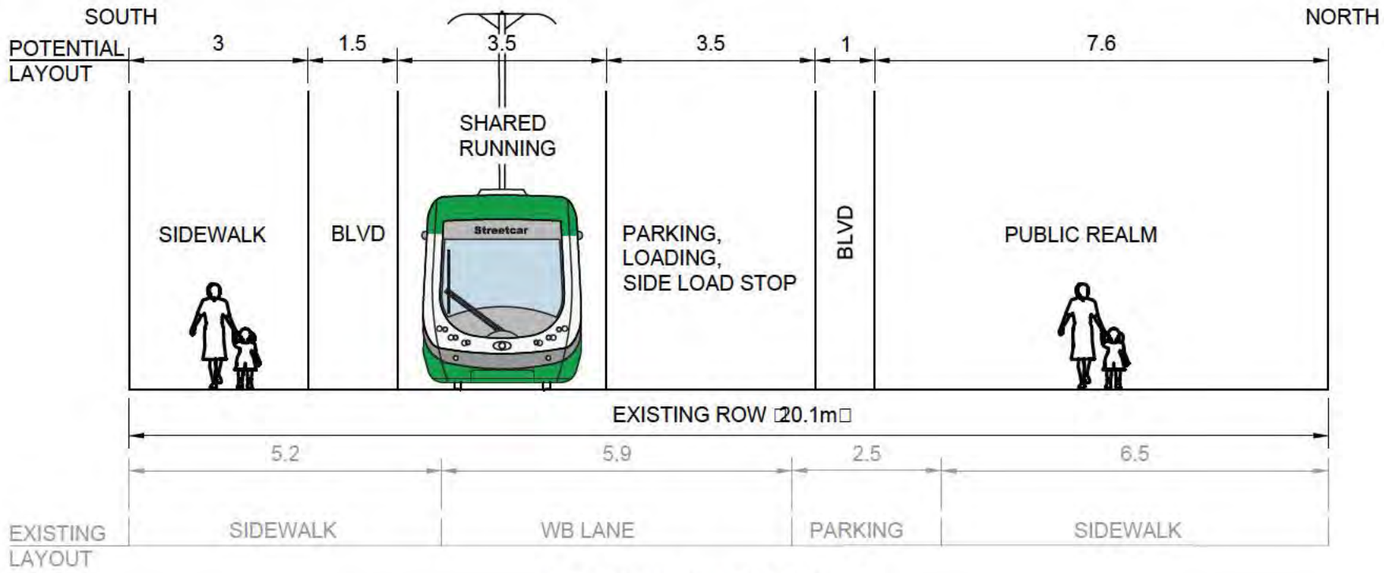

SECTION H - OPTION 1

DRAFT - FOR REVIEW

1 m 0 1:100 5 m

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Rev	Date	Drawn	Description	Ch'k'd	App'd
A	2018-10-04	KHM	ISSUED FOR DISCUSSION - DRAFT	LJA	GBF
B	2018-10-15	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
SECTION H
SHEET 27 OF 41

Drawn	K. MILLER	18-10-04
Checked	L. ANDERSON	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:100

Drawing Number
388583-MMD-00-P0-DR-TR-3108

Security	Status	Rev
STD	PRE	D

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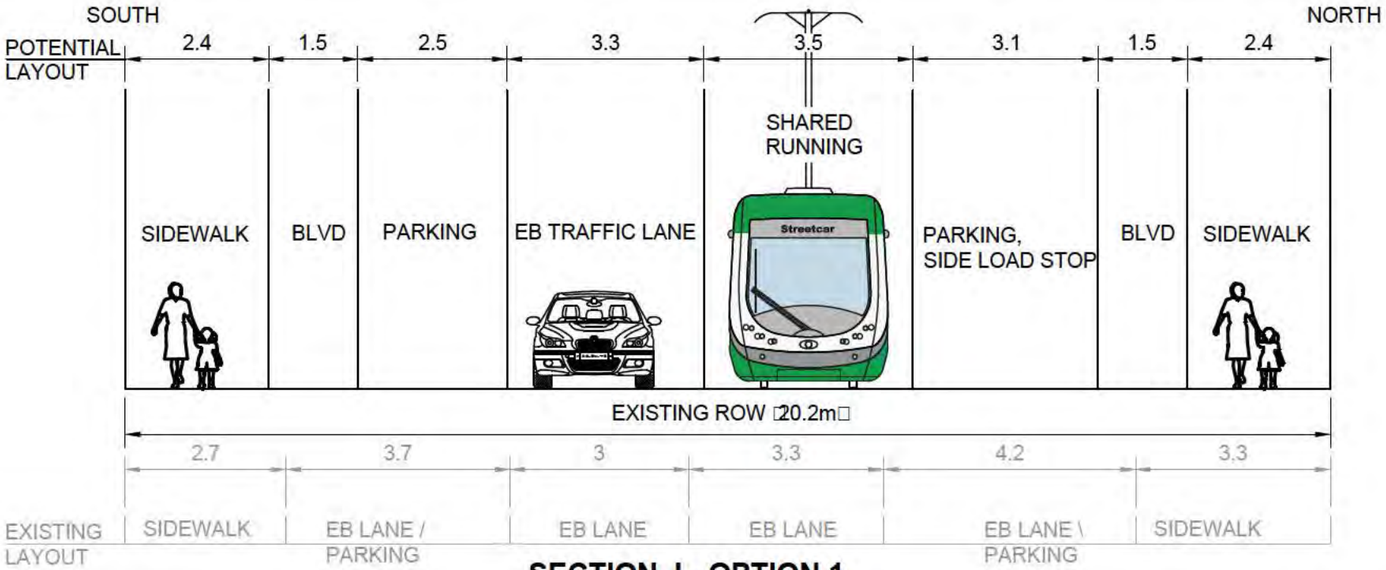
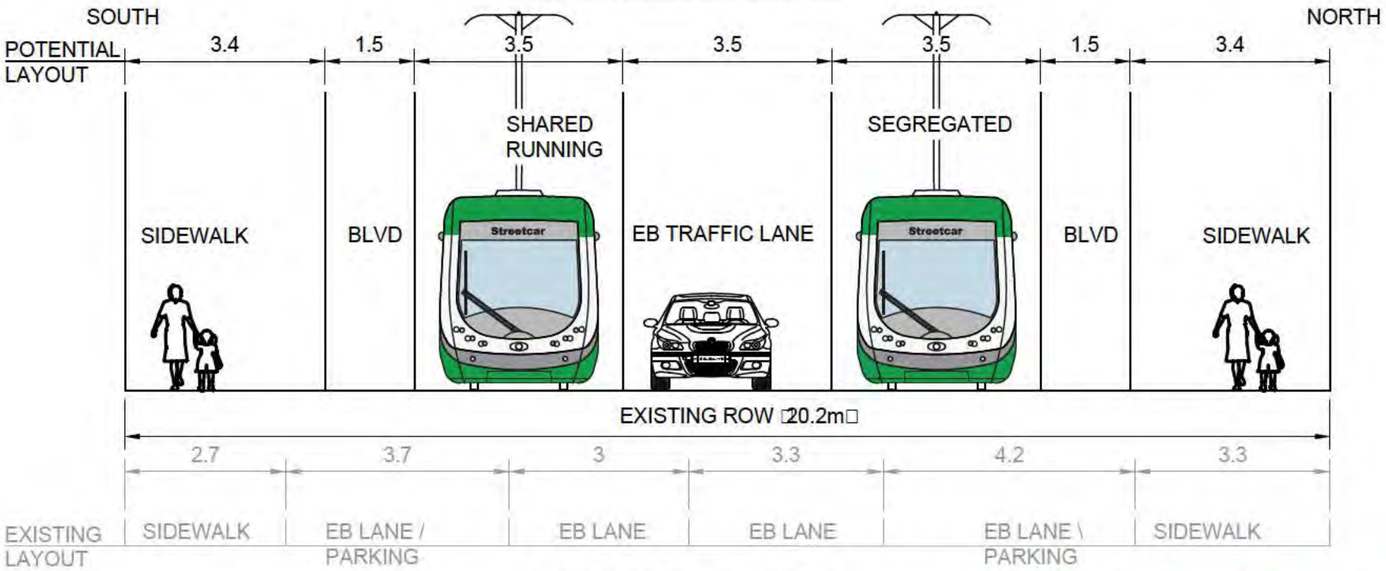


SECTION J - OPTION 1



SECTION J - OPTION 2

DRAFT - FOR REVIEW

1 m 0 1:100 5 m

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C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
SECTION J
SHEET 28 OF 41

Drawn	K. MILLER	18-10-04
Checked	L. ANDERSON	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:100

Drawing Number
388583-MMD-00-P0-DR-TR-3109

Security	Status	Rev
STD	PRE	D

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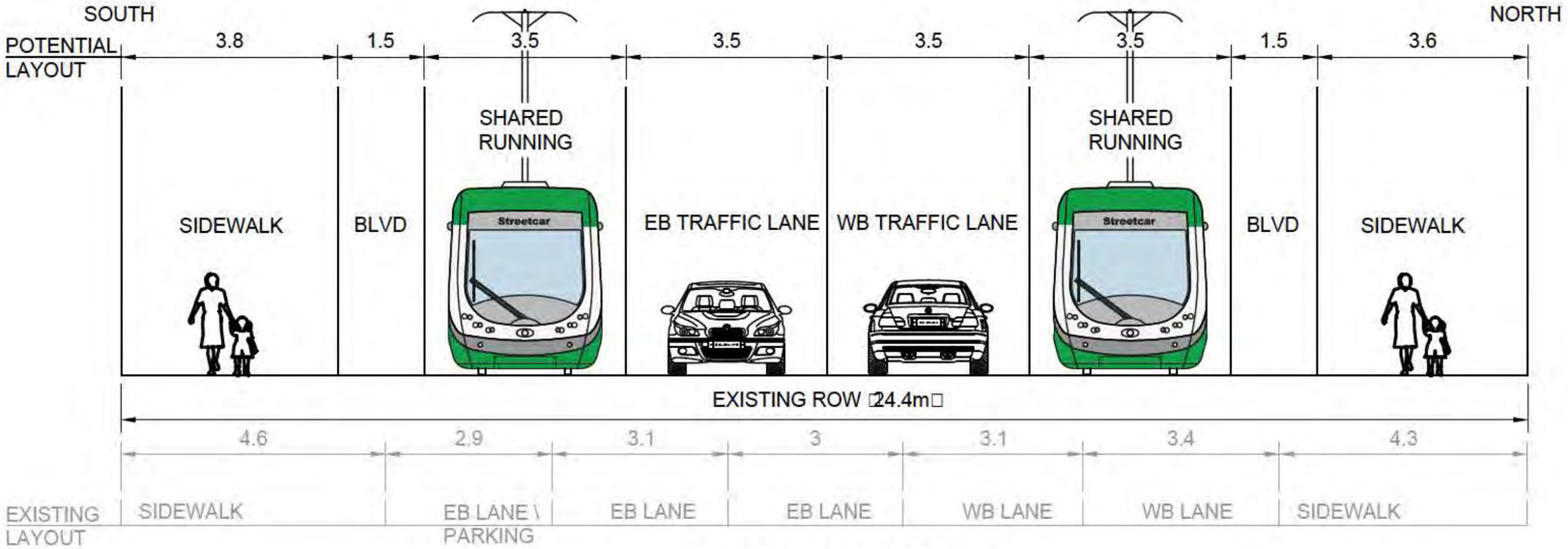

SECTION K - OPTION 3

DRAFT - FOR REVIEW

1 m 0 1:100 5 m

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C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
SECTION K
SHEET 29 OF 41

Drawn	K. MILLER	18-10-04
Checked	L. ANDERSON	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:100

Drawing Number
388583-MMD-00-P0-DR-TR-3110

Security	Status	Rev
STD	PRE	D

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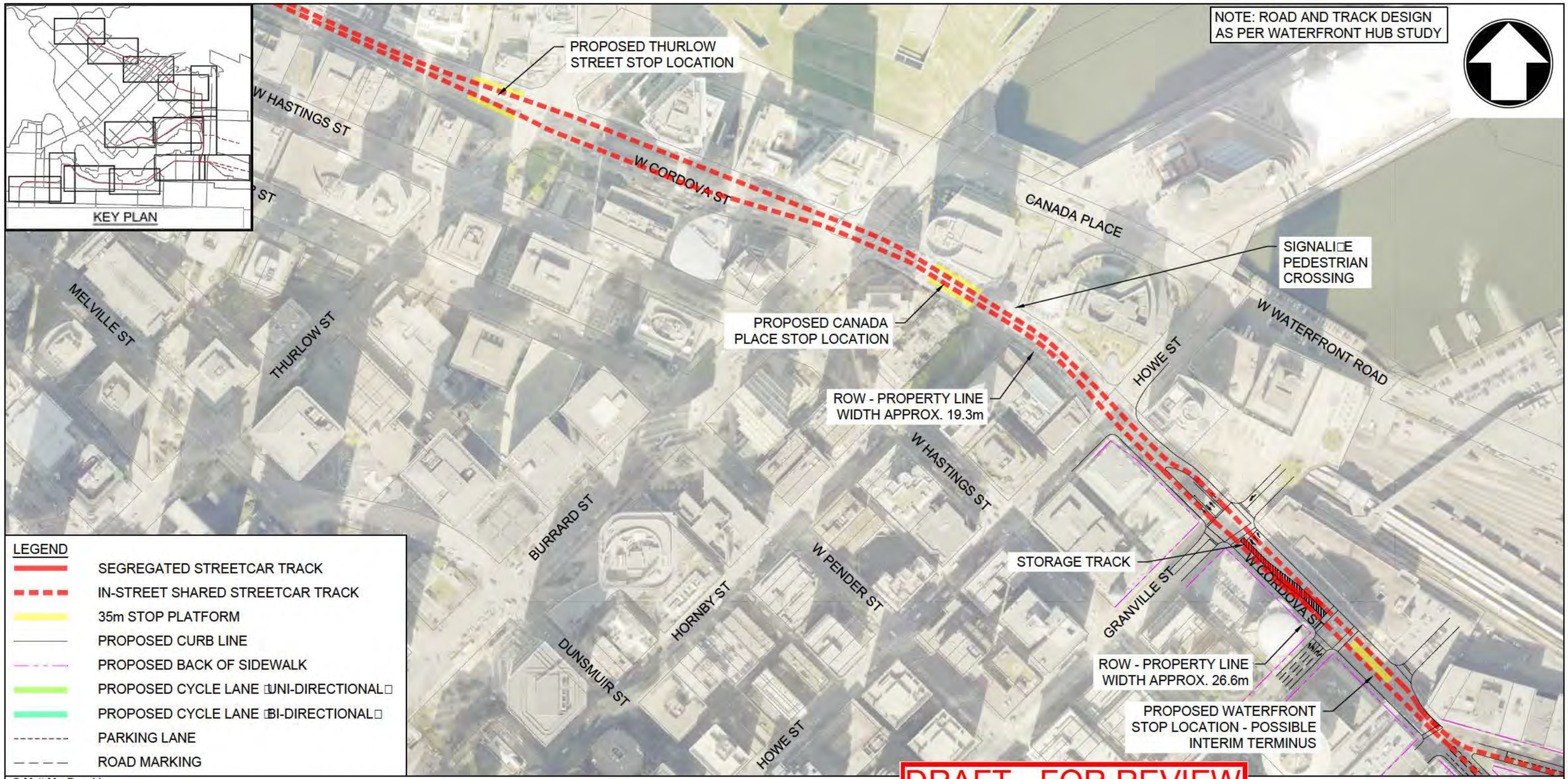

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V5Y 1V4

Rev	Date	Drawn	Description	Ch'k'd	App'd
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B	2018-10-15	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 1 - CANADA PLACE
SHEET 30 OF 41

Drawn	L. ANDERSON	18-10-04
Checked	K. MILLER	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:2500

Drawing Number
388583-MMD-00-P0-DR-TR-1109

Security	Status	Rev
STD	PRE	D

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A	2018-10-04	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
B	2018-10-15	LJA	ISSUED FOR DISCUSSION - DRAFT	KHM	GBF
C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 1 - COAL HARBOUR
SHEET 31 OF 41

Drawn	L. ANDERSON	18-10-04
Checked	K. MILLER	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:2500

Drawing Number	Security	Status	Rev
388583-MMD-00-P0-DR-TR-1110	STD	PRE	D

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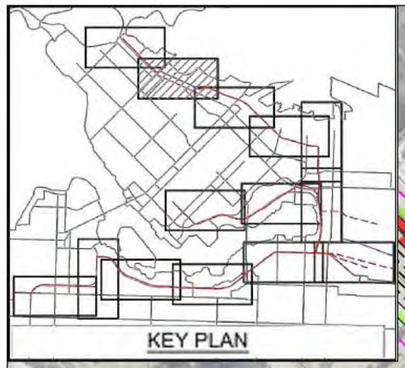

PROPOSED SWITCH TO HAVE WESTBOUND STREETCAR MERGE INTO SHARE BUS LANE

ADVANCED INTEGRATED TRAFFIC AND STREETCAR SIGNALING REQUIRED TO NAVIGATE CARDERO STREET

PROPOSED BIKE LANE CROSSING LOCATION

GREEN CORRIDOR ALLOCATED FOR STREETCAR EXPANSION

PROPOSED SWITCH TO SHIFT TO SINGLE TRACK SECTION

PROPOSED CARDERO STREET STOP LOCATION

ROW - PROPERTY LINE WIDTH APPROX. 20.1M

COAL HARBOUR QUAY

W HASTINGS ST

W CORDOVA ST

W PENDER ST

ROBSON ST

CARDER

NICOLA ST

BROUGHTON ST

W GEORGIA ST

JERVIS ST

BUTE ST

L 3111

LEGEND

- SEGREGATED STREETCAR TRACK
- IN-STREET SHARED STREETCAR TRACK
- 35m STOP PLATFORM
- PROPOSED CURB LINE
- PROPOSED BACK OF SIDEWALK
- PROPOSED CYCLE LANE (UNI-DIRECTIONAL)
- PROPOSED CYCLE LANE (BI-DIRECTIONAL)
- PARKING LANE
- ROAD MARKING

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A	2019-10-23	RAH	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 2 - COAL HARBOUR
SHEET 32 OF 41

Drawn	R. HAY	19-10-23
Checked	K. MILLER	19-10-23
Approved	G. FARMER	19-10-23

Scale at ANSI B
1:2500

Drawing Number	Security	Status	Rev
388583-MMD-00-P0-DR-TR-1210	STD	PRE	A

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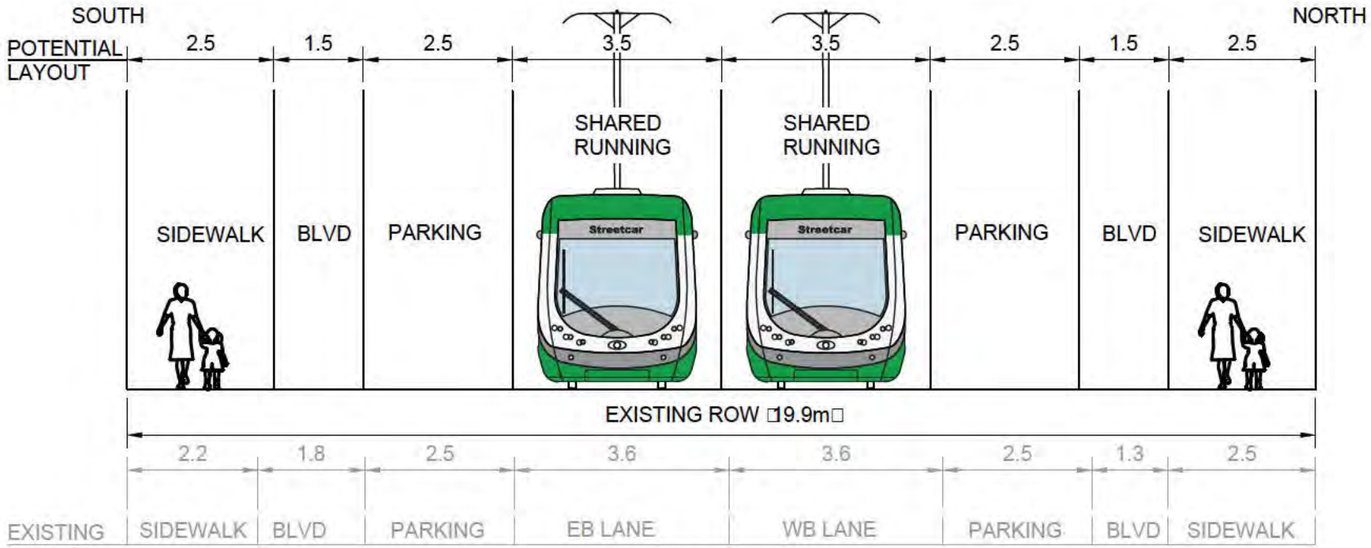

SECTION L

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C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
SECTION L
SHEET 33 OF 41

Drawn	K. MILLER	18-10-04
Checked	L. ANDERSON	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:100

Drawing Number
388583-MMD-00-P0-DR-TR-3111

Security	Status	Rev
STD	PRE	D

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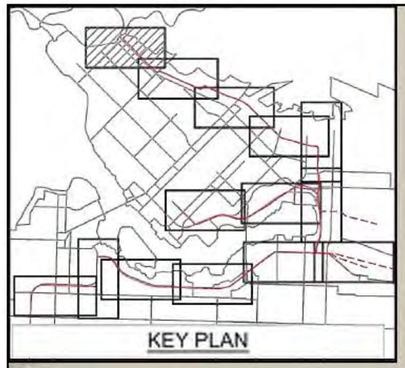

PROPOSED TERMINUS STOP LOCATION, CHILCO STREET

GREEN SPACE ALLOCATED FOR STREETCAR ON NORTH SIDE OF WEST GEORGIA STREET

PROPOSED DENMAN STREET STOP LOCATION

PROPOSED BIKE LANE CROSSING LOCATION

BI-DIRECTIONAL TRACK

W GEORGIA ST

LAGOON DRIVE

CHILCO ST

HARO ST

GILFORD ST

ROBSON ST

ALBERNI ST

DENMAN ST

M 3114

LEGEND

- SEGREGATED STREETCAR TRACK
- IN-STREET SHARED STREETCAR TRACK
- 35m STOP PLATFORM
- PROPOSED CURB LINE
- PROPOSED BACK OF SIDEWALK
- PROPOSED CYCLE LANE □UNI-DIRECTIONAL□
- PROPOSED CYCLE LANE □BI-DIRECTIONAL□
- PARKING LANE
- ROAD MARKING

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C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	RAH	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title

CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 1 - COAL HARBOUR
SHEET 34 OF 41

Drawn	L. ANDERSON	18-10-04
Checked	K. MILLER	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:2500

Drawing Number
388583-MMD-00-P0-DR-TR-1111

Security	Status	Rev
STD	PRE	D

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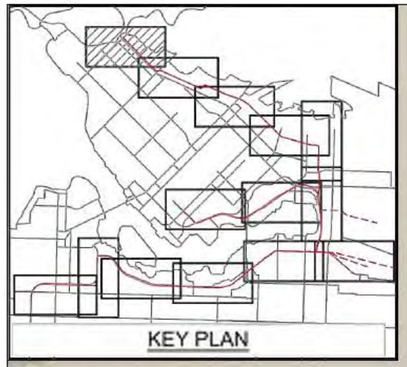

PROPOSED TERMINUS STOP LOCATION, CHILCO STREET

GREEN SPACE ALLOCATED FOR STREETCAR ON NORTH SIDE OF WEST GEORGIA STREET

PROPOSED DENMAN STREET STOP LOCATION

PROPOSED BIKE LANE CROSSING LOCATION

SEGREGATED EASTBOUND TRACK

WEST GEORGIA ST

LAGOON DRIVE

CHILCO ST

HARO ST

GILFORD ST

ROBSON ST

ALBERNI ST

DENMAN ST

M 3114

LEGEND

- SEGREGATED STREETCAR TRACK
- IN-STREET SHARED STREETCAR TRACK
- 35m STOP PLATFORM
- PROPOSED CURB LINE
- PROPOSED BACK OF SIDEWALK
- PROPOSED CYCLE LANE □UNI-DIRECTIONAL□
- PROPOSED CYCLE LANE □BI-DIRECTIONAL□
- PARKING LANE
- ROAD MARKING

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Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 2 - COAL HARBOUR
SHEET 35 OF 41

Drawn	R. HAY	19-10-23
Checked	K. MILLER	19-10-23
Approved	G. FARMER	19-10-23

Scale at ANSI B
1:2500

Drawing Number
388583-MMD-00-P0-DR-TR-1211

Security	Status	Rev
STD	PRE	A

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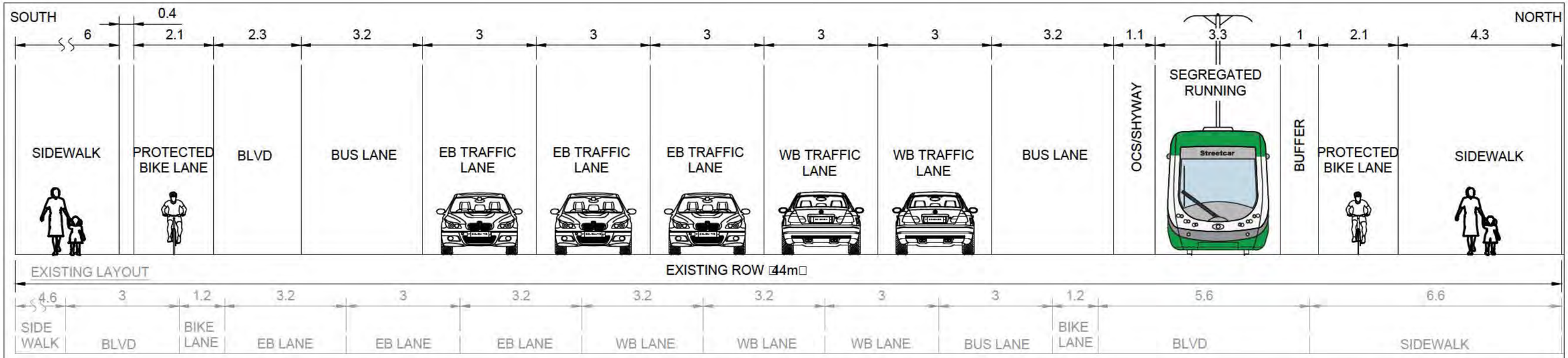
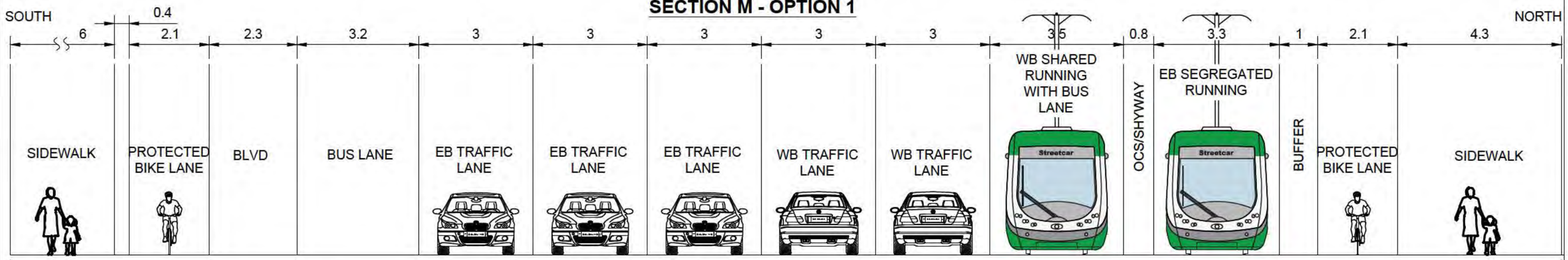


SECTION M - OPTION 1



SECTION M - OPTION 2

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A	2019-10-23	RAH	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
SECTION M
SHEET 36 OF 41

Drawn	R. HAY	19-10-23
Checked	K. MILLER	19-10-23
Approved	G. FARMER	19-10-23

Scale at ANSI B
1:100

Drawing Number
388583-MMD-00-P0-DR-TR-3114

Security	Status	Rev
STD	PRE	A

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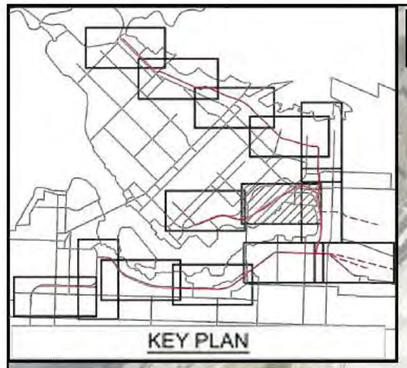

NOTE: ROAD AND TRACK DESIGN AS PER NEFC DESIGN

EXPO BOULEVARD

ABBOTT ST

ORIGINALLY PROPOSED STOP LOCATION RE-LOCACATED EAST

GEORGIA VIADUCT

PACIFIC BOULEVARD

PROPOSED PACIFIC BOULEVARD STOP LOCATION

PROPOSED EXPO BOULEVARD STOP LOCATION

PROPOSED BC PLACE STOP LOCATION

EXPO BOULEVARD

SMITHE ST

CAMBIE BRIDGE

PROPOSED CAMBIE STREET STOP LOCATION

QUEBEC ST

LEGEND

- SEGREGATED STREETCAR TRACK
- IN-STREET SHARED STREETCAR TRACK
- 35m STOP PLATFORM
- PROPOSED CURB LINE
- PROPOSED BACK OF SIDEWALK
- PROPOSED CYCLE LANE (UNI-DIRECTIONAL)
- PROPOSED CYCLE LANE (BI-DIRECTIONAL)
- PARKING LANE
- ROAD MARKING

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C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title

CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 1 - NEFC
SHEET 37 OF 41

Drawn	L. ANDERSON	18-10-04
Checked	K. MILLER	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:2500

Drawing Number
388583-MMD-00-P0-DR-TR-1112

Security	Status	Rev
STD	PRE	D

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NOTE: ROAD AND TRACK DESIGN AS PER NEFC DESIGN

LEGEND

- SEGREGATED STREETCAR TRACK
- IN-STREET SHARED STREETCAR TRACK
- 35m STOP PLATFORM
- PROPOSED CURB LINE
- PROPOSED BACK OF SIDEWALK
- PROPOSED CYCLE LANE (UNI-DIRECTIONAL)
- PROPOSED CYCLE LANE (BI-DIRECTIONAL)
- PARKING LANE
- ROAD MARKING

PROPOSED GRANVILLE STREET STOP LOCATION

BLOCK CLOSED TO VEHICULAR TRAFFIC

PROPOSED ROUNDHOUSE STOP LOCATION

EXTENT OF NEFC TRACK DESIGN

ROW - PROPERTY LINE APPROX. WIDTH 20.0m

ROW - PROPERTY LINE APPROX. WIDTH 37.7m

GRANVILLE ST
SEYMOUR ST
HELMCKEN ST
RICHARDS ST
DAVIE ST
HOMER ST
HAMILTON ST
MAINLAND ST
NELSON ST
CAPU BOULEVARD
PACIFIC ST
PACIFIC BOULEVARD
DRAKE ST

P 3113
N 3112

KEY PLAN

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C	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF
D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 1 - YALETOWN
SHEET 38 OF 41

Drawn	L. ANDERSON	18-10-04
Checked	K. MILLER	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:2500

Drawing Number
388583-MMD-00-P0-DR-TR-1113

Security	Status	Rev
STD	PRE	D

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NOTE: ROAD AND TRACK DESIGN AS PER NEFC DESIGN

LEGEND
- SEGREGATED STREETCAR TRACK
- IN-STREET SHARED STREETCAR TRACK
- 35m STOP PLATFORM
- PROPOSED CURB LINE
- PROPOSED BACK OF SIDEWALK
- PROPOSED CYCLE LANE (UNI-DIRECTIONAL)
- PROPOSED CYCLE LANE (BI-DIRECTIONAL)
- PARKING LANE
- ROAD MARKING

PROPOSED GRANVILLE STREET STOP LOCATION

BLOCK CLOSED TO VEHICULAR TRAFFIC

PROPOSED ROUNDHOUSE STOP LOCATION

EXTENT OF NEFC TRACK DESIGN

ROW - PROPERTY LINE APPROX. WIDTH 20.0m

ROW - PROPERTY LINE APPROX. WIDTH 37.7m

GRANVILLE ST
SEYMOUR ST
HELMCKEN ST
RICHARDS ST
DAVIE ST
HOMER ST
HAMILTON ST
MAINLAND ST
NELSON ST
PACIFIC ST
PACIFIC BOULEVARD
DRAKE ST

P 3113
N 3112

KEY PLAN

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B	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
OPTION 2 - YALETOWN
SHEET 39 OF 41

Drawn	L. ANDERSON	18-12-21
Checked	K. MILLER	18-12-21
Approved	G. FARMER	18-12-21

Scale at ANSI B
1:2500

Drawing Number	Security	Status	Rev
388583-MMD-00-P0-DR-TR-1213	STD	PRE	B

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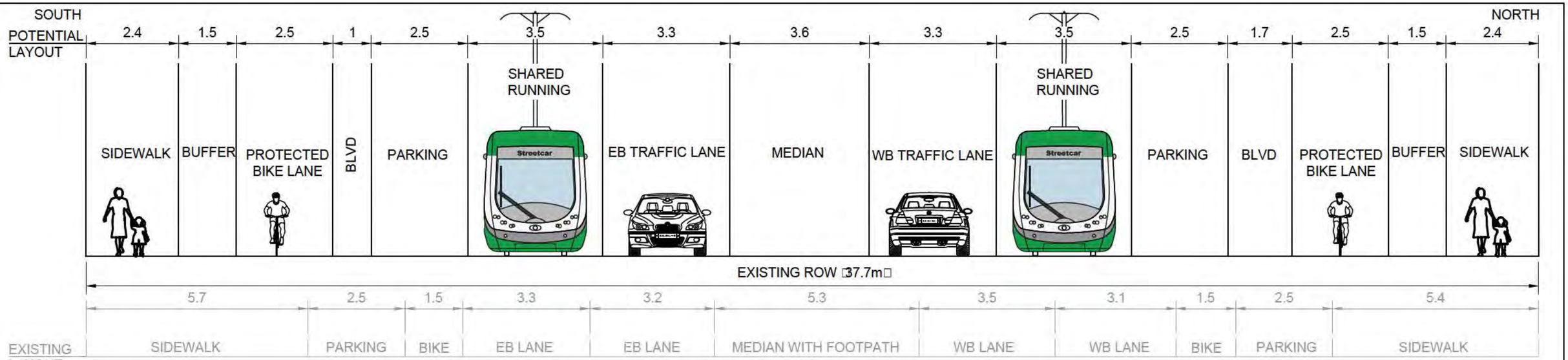
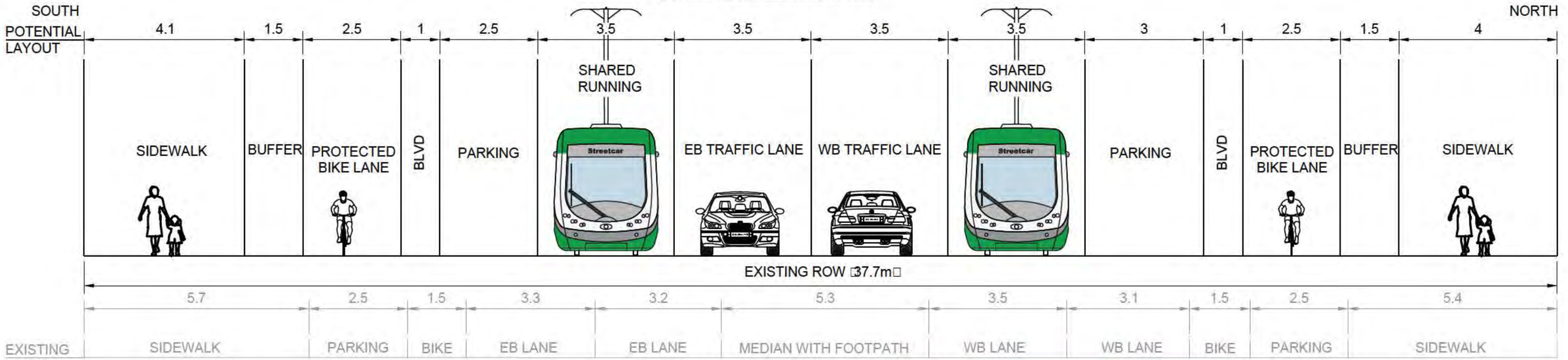


SECTION N - OPTION 1



SECTION N - OPTION 2

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D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
SECTION N
SHEET 40 OF 41

Drawn	K. MILLER	18-10-04
Checked	L. ANDERSON	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:100

Drawing Number
388583-MMD-00-P0-DR-TR-3112

Security	Status	Rev
STD	PRE	D

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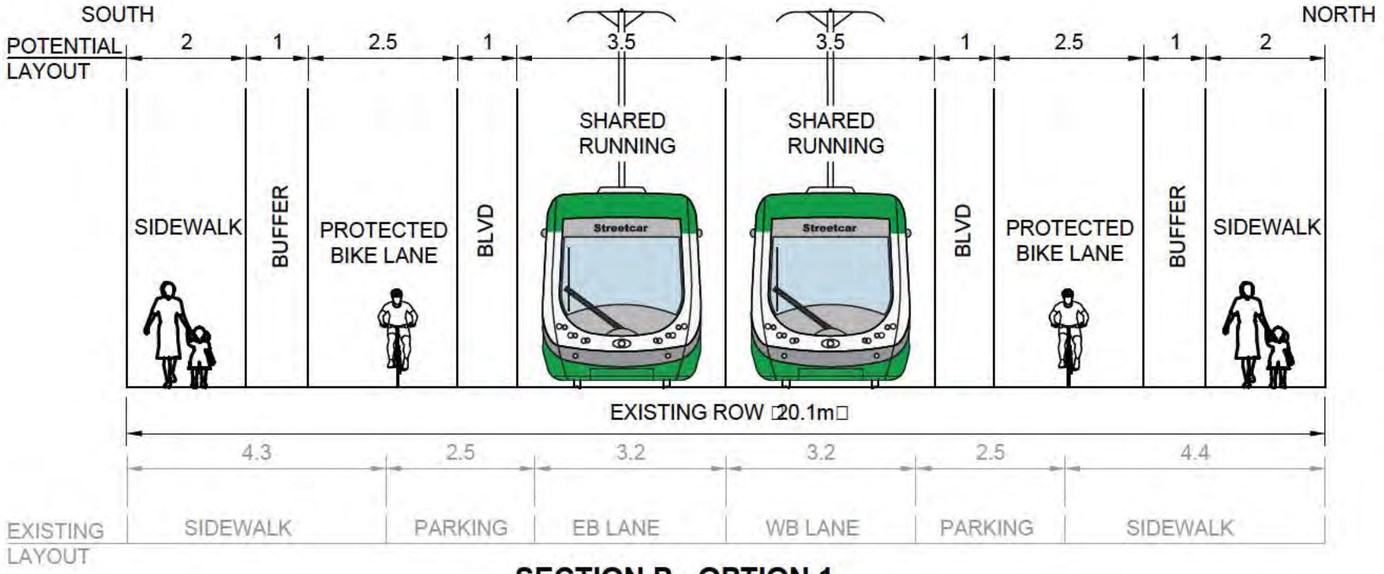

SECTION P - OPTION 1

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D	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED ROUTING
SECTION P
SHEET 41 OF 41

Drawn	L. ANDERSON	18-10-04
Checked	K. MILLER	18-10-04
Approved	G. FARMER	18-10-04

Scale at ANSI B
1:100

Drawing Number
388583-MMD-00-P0-DR-TR-3113

Security	Status	Rev
STD	PRE	D

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C. 388583-MMD-00-P0-MO-TR-0002 – Operations and Maintenance Facility Sizing Information Memo

Memorandum

[1]**Subject**	Operations and Maintenance Facility Sizing Information
To	City of Vancouver Project Team
From	Mott MacDonald Canada Limited – Prepared by Rob Evans and Dennis Wu Checked by Katherine Miller and Reviewed by Gary Farmer
Our reference	388583-MMD-00-P0-MO-TR-0002
Date	December 21, 2018 – Rev B

The City of Vancouver has engaged Mott MacDonald to build upon the wealth of previous work, and to imagine Vancouver's streetcar future by incorporating the latest technology trends, planning visions for different areas and City policies into a feasibility study. The Feasibility Study will involve reviewing and updating the streetcar routing, incorporating additional technical detail, developing a high-level ridership forecast, preparing capital cost estimate, benchmarking typical operating costs, and outlining potential funding mechanisms, business case requirements and project next steps. The study will be used by the City as a planning tool to continue to secure space for a future streetcar, identify constraints and inform network design.

The City has grown and developed over the past couple decades and the property that was previously identified to house the maintenance facility, 800 Quebec Street, is now slated to be developed as part of the Northeast False Creek (NEFC) project. Additionally, the planning vision and area plans for NEFC and the False Creek Flats area have gone through significant changes. Thus, it is necessary to identify a new maintenance facility location, and to update the size requirements to be based on the latest industry best practices and the latest fleet size estimation for the streetcar network.

The following technical memo has been produced as a guide to advise on the potential size and requirements to be factored in when determining a site location for a new operations and maintenance facility (OMF). The memo has been produced to inform the feasibility study for the City of Vancouver Streetcar project.

To determine the land requirements for the OMF the following have been considered:

- Number of storage tracks
- Number of maintenance bays
- Other facility elements:
  - Wash plant
  - Crew facilities
  - Control room
  - Staff parking

1 Number of Storage Tracks

Based on the current proposed streetcar network, including the all of the Arbutus Greenway, and high-level estimation of speed and run-time, the assumed fleet size at present is 22 vehicles, each 30 m long and 2.65 m wide. Simple run time calculations for each of the potential network routes was done and summarized below with detailed calculations appended.

	Length of Routes (m)	Journey Time	Roundtrip Journey Time	Average speed (kph)	# of vehicles in operation	10% Vehicles out of service for planned maintenance	5% Vehicles out of service for emergency maintenance	Total Fleet Size
West Broadway – Chilco Street	8,846	00:33:05	01:12:10	16.05	10	1	1	12
Thornton Street – Granville Street	3,551	00:14:30	00:35:00	14.69	5	1	1	7
Downtown Streetcar Network (2 routes combined)	**12,397**				**15**	**2**	**1**	**18**
Ultimate build-out Milton Street – Chilco Street	16,216	00:52:40	1:51:19	18.48	14	1	1	16
Total fleet size for ultimate build-out (2 routes combined)	**19,767**				**19**	**2**	**1**	**22**

The number of storage positions that could be required as a minimum may be taken as 20 or 21 on the assumption that at least one streetcar will be in the workshop undergoing preventative maintenance.

However, given the stage of design it is not recommended to work on this minimum allowance. The approach for feasibility design should consider the storage of all 22 cars with an additional empty track that can be used for bypassing storage or as a location to store cars during movements when all storage bays are occupied. The number and length of storage tracks that would be required to accommodate these 22 cars can vary depending on whether they are single ended or double ended.

Single-Ended / Stub-Ended Storage Tracks

For a single-ended scenario, the number of storage tracks that would provide for an ideal situation would be seven tracks with an additional track or location on site to cater for reversing movements, for instance from the storage tracks to the workshop or vice versa. This would provide three cars per track requiring a maximum of two cars to be moved clear to get the last car out. This is seen as the maximum number of non-essential moves that will not impact unduly on general OMF operations. Anything more than this on a single-ended track would be seen as over complicating site operations.

Double-Ended Storage Tracks

For a double-ended scenario the number of storage bays per track can be increased to an optimum maximum of six cars per track. This would require four tracks (three and a half occupied) within the storage yard, assuming all storage tracks are the same length although it is most likely that each track will be a different length.

Space for Storage Tracks

The space requirements for these options can be estimated at this initial feasibility stage as follows:

The separation between the cars within the storage area can be anything up to 2 m in width between car bodies. This range of distances allows for anything from two cars adjacent to each other with no infrastructure between them (so a very small gap) to locating a platform between the cars for car access (assuming high floor cars as low floor would not need step access). The separation between tracks and allowance for walkways can often be determined by the level of pre-service inspection that needs to be carried out before the cars enter service. At this feasibility stage, as this is not known it is assumed that a full walk around the car will be required and so walkways are to be provided on both sides. It would be recommended to use a 2 m separation which can be refined at a later stage. The clearance between cars longitudinally would need to allow for parking clearance and a walkway for staff. This can be taken as 3 m, which would provide a nominal 1 m wide walkway and the remainder as a visual stopping distance to the walkway. Taking these into account the space for a streetcar can be taken as 153.5 m^2 and so a fleet of 22 would equate to an area of 3,682.8 m^2, which also includes an allowance for a bypass/movement track to assist with moving cars around during times of full storage. For the site arrangement an allowance will also need to be provided for the trackwork leading to and from the storage tracks. For a single-ended storage arrangement this could be up to 50% on top of the car storage requiring a total storage area of 5,525 m^2. For double-ended track, the leading trackwork area could need the same size required as the stabling, meaning the total storage area required is 7,365 m^2.

2 Number of Maintenance Bays

The maintenance workshop needs to take account of preventative and corrective maintenance. This will require all possible access to the vehicles full exterior and interior via the use of pits and working platforms. For a fleet size of 22 – 100% low floor cars the recommended number of maintenance bays would be three. These three bays would be made up of two light maintenance bays used for underframe and roof access primarily to gain access to car mounted equipment for maintenance, while the third bay would be used for heavy lifting purposes to remove car bogies.

Spacing between the cars within the workshop would need to take into account the circulation of both staff and equipment such as forklift trucks. A recommended distance between cars, at this stage of design without knowing the chosen car, would be 4 m between bodysides and a distance of 2 m between bodyside and workshop building. Adjacent to the workshop there will also need to be a number of rooms to provide office and welfare facilities for the maintenance staff. As a minimum, a 7 m width for this space would be recommended if only one level is to be provided. If an upper floor is to be included then the width would need to increase to allow for a corridor linking the rooms on the upper floor. This would require a width of approximately 10 m. Using the larger width of 10 m to provide the maximum amount of office and welfare space within the facility, a workshop building width of 30 m would be adequate for this application. The length of the workshop would need to take into account the car length (assumed to be 30 m), the step access to the pit and workshop floor level surface for circulation and locating removed car equipment. Together this provides a length of 42 m for the workshop, thus providing an overall building area of 1,260 m^2. As with the storage sidings there will need to be an element of trackwork leading to the workshop (and potentially from the workshop if it was to be designed double ended). An allowance of 50% should be included; thus the total area required for the maintenance bays is 1,890 m^2.

As part of the preventative maintenance activities undertaken at an OMF site, the maintenance of wheelsets is of high importance. For a fleet size of 22 cars it is recommended to purchase a wheel lathe to complete the wheel turning in house. Two types of lathe are available for purchase. These are an in-floor lathe over which the car would traverse to the correct position for wheel turning, or a mobile lathe which would pass under a lifted car to the correct position to perform the wheel turning operation. Both of these have benefits and limitations with the main difference being the space requirements for them. An underfloor wheel lathe would require its own bay ideally with sufficient space to allow the full car to be wheel turned whilst under cover, however a mobile lathe could share a bay with the heavy maintenance activities. An indicative size for an extension to the workshop to cater for the mobile wheel lathe would be 66.5 m^2 where as an underfloor wheel lathe would require approximately 1,066 m^2.

Considering the possible expansion of the fleet of streetcars there would be a limitation of the utilization of a workshop containing only 3 maintenance bays. This would be expected to be in the region of 30 cars before an additional maintenance bay would be required to be built.

Within the storage tracks or leading to the workshop there will need to be a provision for a delivery track so that the streetcars can be delivered to the OMF site via road transport. This track would need to start by hard standing to allow the road vehicle to approach it and install ramps from the delivery vehicle to the trackwork to offload the streetcar vehicle. There would be no need for overhead cables in this location as the delivered car will be unpowered. As a rule of thumb, you would generally allow for two car lengths for the road vehicles and the offloaded car, which would equate to approximately 348 m^2.

3 Other Facility Elements

Wash plant

Daily washing of the streetcars may be introduced as a requirement to keep the cars presentable all year round and so a wash plant would be required on site. These can vary in length depending on the level of washing required. This ranges from just washing the sides of the cars to washing the sides, front, and rear end. It is assumed at this stage that only the sides of the cars would need to be washed with the front and rear washing being completed manually. A minimum size of wash plant to be accommodated would be approximately 20 m in length and 6 m in width providing an area of 120 m^2. The wash plant would also have an accompanying plant room which contains the pumps and cleaning fluid storage and dispensing systems. A typical plant room would be 10 m by 5 m giving 50 m^2, and the total space requirement of the wash plant would be 170 m^2.

Substation

Depending on how the OMF site and the portion of the mainline that leads to the OMF are fed with traction power, a substation may need to be located within the OMF site. A typical size could be 200 m^2.

Crew Facilities and Storage

Within the workshop allowance detailed above, there is an allocation for office and welfare space to the side of the workshop portion which measures 10 m wide by 42 m. If this is included over two floors then this will provide 840 m^2. In comparison with an existing facility in the UK with a similar fleet size, the office/welfare and stores space is approximately 3,000 m^2 over two floors. This space includes additional auxiliary workshop space for metal working and welding activities. It is assumed at this stage that the level of metal working activities would not be as high as the older OMF comparison in the UK and so a reduced area would be feasible.

The allocation of office and welfare space noted would be sufficient for the maintenance and driving staff at the site but additional space is likely to be required for storage. At this feasibility stage, an assumed requirement for storage would be in the region of 300 m^2 but some storage on an upper floor would also be included.

Control Room

For the overall running of the network a control room will be required. This control room however does not necessarily need to be located at the OMF and could be located off site somewhere. The benefit of having it on the same site is that all the operations staff are together. For similar facilities a control room size of up to 150 m^2 is typically utilized; this would provide space for a large video screen and individual desks for operators and a supervisor.

Staff Parking

Parking provision would need to be provided for staff working at the OMF site but not for all staff identified below due to shift patterns, and the fact that staff who do not need to be onsite prior to the service running would likely use the system to get to and from work thus reducing the need for parking on site and promoting sustainability.

Staffing Level

An assumed staffing level at this feasibility stage consists of the following, which would be refined or adjusted as the project progresses.

- General Manager and PA - 2
- Admin - 2
- Finance - 2
- Operations Manager - 1
- Operations team - 10
- Drivers - 84
- Engineering Manager - 1
- Maintenance Staff - 42
- Infrastructure Manager - 1
- Infrastructure Staff - 40
- Car Cleaners - 20
- Infrastructure Cleaners - 10
- Safety Manager - 1

This allocation would provide a full staff compliment of 216 as an initial high level figure to be reviewed further as the project progresses.

A recommended allocation of parking at this stage of feasibility design could consist of:

- Drivers - 25 (with allowance for shift changeovers)
- General Staff - 4
- Operations Staff - 5
- Maintenance Staff - 20

4 General Site Commentary

The site location for the maintenance facility would benefit from the following attributes:

- Land for additional OMF extension past the current fleet of 22 projected
- The ability to provide a mainline connection that allows for movement in both directions to and from the main line.
- Good road network access.
- Minimal surrounding residential properties.
- Sufficient size to allow for all operational movements to be completed within the boundary of the site and not affect the mainline.
- Ability to turn the streetcars around so that wheel wear when running on the network is even. This is only really required if there is nowhere on the system that allows the cars to turn around.

Given land availability, there is also a possibility of creating an overbuild development on top of the OMF site. This type of construction does come with its limitations however in that the footprint of the site is likely to increase given the additional structural supports that would be required to support the overbuild development, limited ability to expand in the future, blocking out of natural light and less flexibility in terms of track layout and curves.

Covered storage facilities are also a possibility for additional protection of the cars overnight and when not in service. This type of storage can then lead to a smaller development over the top such as car parking.

5 Split Site Facilities

The preference for OMF sites is to contain all facilities required to run the network in one location to provide a single collaborative working location. However, this is not always possible due to land availability and locations of sites. In this case, a split site may be required which could be done in the following ways:

	Site 1	Site 2
Option 1	Full maintenance workshop	Stabling
Option 2	Light maintenance workshop and stabling	Heavy maintenance workshop and stabling
Option 3	Full maintenance workshop and stabling	Small amount of stabling *(potential to place around the system)*

For a fleet size of 22 cars, a recommended split would be to house the workshop in one location with some stabling capacity and the remainder of the stabling at a second location (option 1). The distance the sites are apart would also need to be considered for service running and ensuring that no unnecessarily long empty runs are required. Split site operation can also lead to duplication of facilities such as wash plant (daily servicing) and security presence.

As the fleet grows from the initial size of 22 cars a second OMF site may be preferred as it makes the system start-up and shutdown more efficient with less deadhead kilometres as the vehicles are stored overnight spread throughout the system. However, if a split site was required at this early stage the split could be for the workshop and stabling of up to 4 cars to be located on one site, and the remaining 17 cars to be stored at a second site.

6 Operations and Maintenance Facility Sizing Calculations

The following table provides a summary of the areas laid out in previous sections.

Table 6-1 OMF Sizing Calculations

	Single MOF Site (m^2)				Split OMF Site (m^2)					
					Workshop and stabling for 4 vehicles				Stabling for 17 vehicles	
	In-floor wheel lathe		Mobile wheel lathe		In-floor wheel lathe		Mobile wheel lathe			
	Dead end storage	Double end storage	Dead end storage	Double end storage	Dead end storage	Double end storage	Dead end storage	Double end storage	Dead end storage	Double end storage
Workshop	2,325	2,955	1,325	1,955	2,325	2,955	1,325	1,955	0	0
Storage/Stabling	5,525	7,365	5,525	7,365	920	1,535	920	1,535	4,605	6,140
Delivery track	350	350	350	350	350	350	350	350	0	0
Wash Plant and plant room	170	170	170	170	170	170	170	170	170	170
Stores	300	300	300	300	300	300	300	300	0	0
Control Room	150	150	150	150	150	150	150	150	0	0
Parking	1,245	1,245	1,245	1,245	1,035	1,035	1,035	1,035	205	205
Substation	200	200	200	200	200	200	200	200	200	200
Circulation Space 20%	2,055	2,545	1,855	2,345	1,090	1,340	890	1,140	1,035	1,345
Total (m^2)	**12,320**	**15,280**	**11,120**	**14,080**	**6,540**	**8,035**	**5,340**	**6,835**	**6,215**	**8,060**
Average area per vehicle (m^2)	587	728	530	670	1635	2009	1335	1709	366	474

7 Existing Maintenance and Storage Facilities

As mentioned, a single maintenance and storage location is ideal. However, without sufficient land availability or with a need to accommodate a large fleet size, such as in Seattle and Toronto, respectively, multiple facilities may be required.

The majority of streetcars are typically not under cover when stored overnight as maintenance buildings can only offer covered storage for a very limited number of cars. Portland and Atlanta have constructed the maintenance and storage facility under an elevated section of their interstate highways to provide cover for their cars which is advantageous but not always necessary.

Below are examples of maintenance and storage facilities for light rail and streetcar systems in the UK and North America. These facilities can be used for relative size comparison as well as facility layout examples.

Table 7-1 Example OMF Sizes on Other Systems

Location	Number of vehicles stored	Vehicle Dimensions		Depot Size (m^2)	Average area per vehicle (m^2)
		Length (m)	Width (m)		
Gosforth Depot, Newcastle	90	27.40	2.65	59,000	656
Nunnery Depot, Sheffield	32	34.8 (25 vehicles) 37.2 (7 vehicles)	2.65	23,600	738
Gogar Depot, Edinburgh	27	42.08	2.65	68,500	2,537
Wednesbury Depot, Birmingham	21 (30+ potential)	33.00	2.65	40,000	1,905 (1,333)
Therapia Lane Depot, Croydon	34	30.10 (24 vehicles) 32.37 (10 vehicles)	2.65	28,500	838
Trafford Depot, Manchester	95	28.40	2.65	64,000	674
Starr Gate Depot, Blackpool	18	32.23	2.65	13,250	736
Wilkinson Street Depot, Nottingham	37	33.00 (15 vehicles) 32.00 (22 vehicles)	2.40	31,000	838
Portland Streetcar Depot, Oregon	15	20.13	2.46	8,500	567
Seattle Streetcar Depot, Washington South Lake Union	11	20.13	2.46	3,350	305

Location	Number of vehicles stored	Vehicle Dimensions		Depot Size (m^2)	Average area per vehicle (m^2)
		Length (m)	Width (m)		
Seattle Streetcar Depot, Washington Chinatown - International District	8	20.13	2.46	3,200	400
Toronto Streetcar Depot, Ontario Roncesvalles Carhouse	60	30.18	2.55	18,200	303
Toronto Streetcar Depot, Ontario Russel Carhouse	40	30.18	2.55	16,500	413
Toronto Streetcar Depot, Ontario Leslie Barns	164	30.18	2.55	65,000	396
Tucson Streetcar Depot, Arizona	9	20.13	2.46	5,300	589
Atlanta Streetcar Depot, Georgia	6	24.11	2.65	10,000	1,667

8 Conclusions

Laid out in this memorandum is a conservative estimation of OMF sizing. This aims to aid in the initial search for sites, but it should be noted that trackwork geometry may have an impact on the sizing requirements depending on the types of turnouts used.

As a sense check, the average areas per vehicle laid for the different OMF layout scenarios in Table 6-1 can be compared against the average areas per vehicle of existing OMFs in Table 7-1. In comparison, the OMF areas in Table *6-1* do fall within the typical range of the existing OMF examples. The single OMF site has a similar area per vehicle to those with similar vehicles sizes and storage capacities. While the split OMF site does have a larger average area per vehicle as some OMF infrastructure may be duplicated.

Overall, the average size of an OMF is highly dependent on several factors including property availability and constraints (i.e. size, shape, etc.), and the operational requirements. A larger fleet size accommodated on one site typically has a lower average area per vehicle as the infrastructure is not duplicated and layout efficiencies can be realized.

In conclusion, the sizing requirements should be used as an initial guide only for further development as design work commences. They are based on best practices for maintenance and stabling facilities. The requirements for the Vancouver streetcar network may be adjusted as the project develops and more clarity on how it will be operated and maintained, and by whom, is achieved. Additionally, the shape of the site is also very important when trying to achieve a useable layout. Triangular and rectangular sites tend to lend themselves to more efficient operational layouts rather than long thin or square sites.

Project	City of Vancouver Streetcar Feasibility Study							
Calculations for	Fleet size calulation for Arbutus Street at West Broadway to Chilco Street	Divn/Dept	CND - Vancouver	JobNr/FileNr	388583		/	
		Calculated by	KHM	Date	8/8/2018		Sheet Nr	
		Checked by	GBF	Date	8/8/2018		1 of 1	

Parameters

Overall			Stops			Reduced Speed Sections			Fleet size		
Route length =	8.846	km	Intermediate stop dwell time =	20	s	Reduced speed =	20	kph	% in planned maintenance =	10	%
Average route speed between stops, junctions and other reduced speed sections =	50	kph	Terminus stop dwell time	3	Mins	No. of sections =	0	No.	% in emergency maintenance =	5	%
Headway =	8	Mins	No. of Intermediate Stops =	16	No.	Length over which reduced speed applies. =	0	m			
Acceleration =	0.9		**Junctions (see note 2)**								
Deceleration =	0.8	m/s^2	Junction stop time =	10	s						
			No. of junctions =	29	No.						

Notes

1. Stops, junctions and reduced speed sections are evenly spaced.
2. RT vehilce has full priority at all juncitons, except for the number listed.

Stop Parameters								Junction Parameters								Reduced Speed Section Parameters								Route Parameters					
Deceleration Parameters		Acceleration Parameters		Total Parameters per stop		Total Parameters		Deceleration Parameters		Acceleration Parameters		Total Parameters per junction		Total Parameters		Deceleration Parameters		Acceleration Parameters		Total Parameters per reduced speed section		Total Parameters							
Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Average Stop Spacing (km)	Journey Time With no Delays (hours mins secs)	Length at Route Speed (km)	Time at Route Speed (hours mins secs)	Journey Time (hours mins secs)	Average speed (kph)
00:00:17	0.12	00:00:15	0.11	00:00:53	0 23	00:14:05	3.64	00:00:17	0.12	00 00:15	0.11	00:00:43	0.23	00:20:41	6.60	00:00:10	0.10	00:00:09	0.09	00:00:20	0.19	00:00:00	0.00	0 52	00:10:37	-1.40	##########	00:33:05	16.05

Fleet Size				
Round Trip Journey Time	No. of vehicles in operation	Vehicles our of Service (planned maintenance) 10 %	Vehicles our of Service (emergency maintenance) 5 %	Total
01:12:10	10	1	1	12

Project	City of Vancouver Streetcar Feasibility Study						
Calculations for	Fleet size calulation for East 1st Avenue at Thornton Street to Drake Street at Granville Street	Divn/Dept	CND - Vancouver	JobNr/FileNr	388583	/	
		Calculated by	KHM	Date	8/8/2018	Sheet Nr	
		Checked by	GBF	Date	8/8/2018	1 of 1	

Parameters

Overall				Stops				Reduced Speed Sections				Fleet size			
Route length	=	3.551	km	Intermediate stop dwell time	=	20	s	Reduced speed	=	20	kph	% in planned maintenance	=	10	%
Average route speed between stops, junctions and other reduced speed sections	=	50	kph	Terminus stop dwell time		3	Mins	No. of sections	=	0	No.	% in emergency maintenance	=	5	%
Headway	=	8	Mins	No. of Intermediate Stops	=	6	No.	Length over which reduced speed applies.	=	0	m				
Acceleration	=	0.9		**Junctions (see note 2)**											
Deceleration	=	0.8	m/s^2	Junction stop time	=	10	s								
				No. of junctions	=	15	No.								

Notes

1	Stops, junctions and reduced speed sections are evenly spaced.
2	RT vehilce has full priority at all juncitons, except for the number listed.

Stop Parameters								Junction Parameters								Reduced Speed Section Parameters								Route Parameters					
Deceleration Parameters		Acceleration Parameters		Total Parameters per stop		Total Parameters		Deceleration Parameters		Acceleration Parameters		Total Parameters per junction		Total Parameters		Deceleration Parameters		Acceleration Parameters		Total Parameters per reduced speed section		Total Parameters							
Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Average Stop Spacing (km)	Journey Time With no Delays (hours mins secs)	Length at Route Speed (km)	Time at Route Speed (hours mins secs)	Journey Time (hours mins secs)	Average speed (kph)
00 00:17	0.12	00:00:15	0.11	00:00 53	0.23	00:05:17	1.37	00:00:17	0.12	00 00:15	0.11	00:00:43	0.23	00:10:42	3.42	00 00:10	0.10	00:00:09	0.09	00:00 20	0.19	00:00:00	0.00	0.51	00:04:16	-1.23	##########	00:14:30	14.69

Fleet Size

Round Trip Journey Time	No. of vehicles in operation	Vehicles our of Service (planned maintenance) 10 %	Vehicles our of Service (emergency maintenance) 5 %	Total
00 35:00	5	1	1	7

Project	City of Vancouver Streetcar Feasibility Study							
Calculations for	Fleet size calulation for Arbutus Greenway at Milton Street to Chilco Street	Divn/Dept	CND - Vancouver	JobNr/FileNr	388583		/	
		Calculated by	KHM	Date	8/1/2018		Sheet Nr	
		Checked by	GBF	Date	8/1/2018	1	of	1

Parameters

Overall				Stops				Reduced Speed Sections				Fleet size			
Route length	=	16.216	km	Intermediate stop dwell time	=	20	s	Reduced speed	=	20	kph	% in planned maintenance	=	10	%
Average route speed between stops, junctions and other reduced speed sections	=	50	kph	Terminus stop dwell time		3	Mins	No. of sections	=	0	No.	% in emergency maintenance	=	5	%
Headway	=	8	Mins	No. of Intermediate Stops	=	25	No.	Length over which reduced speed applies.	=	0	m				
Acceleration	=	0.9		**Junctions (see note 2)**											
Deceleration	=	0.8	m/s^2	Junction stop time	=	10	s								
				No. of junctions	=	41	No.								

Notes

1	Stops, junctions and reduced speed sections are evenly spaced.
2	RT vehilce has full priority at all juncitons, except for the number listed.

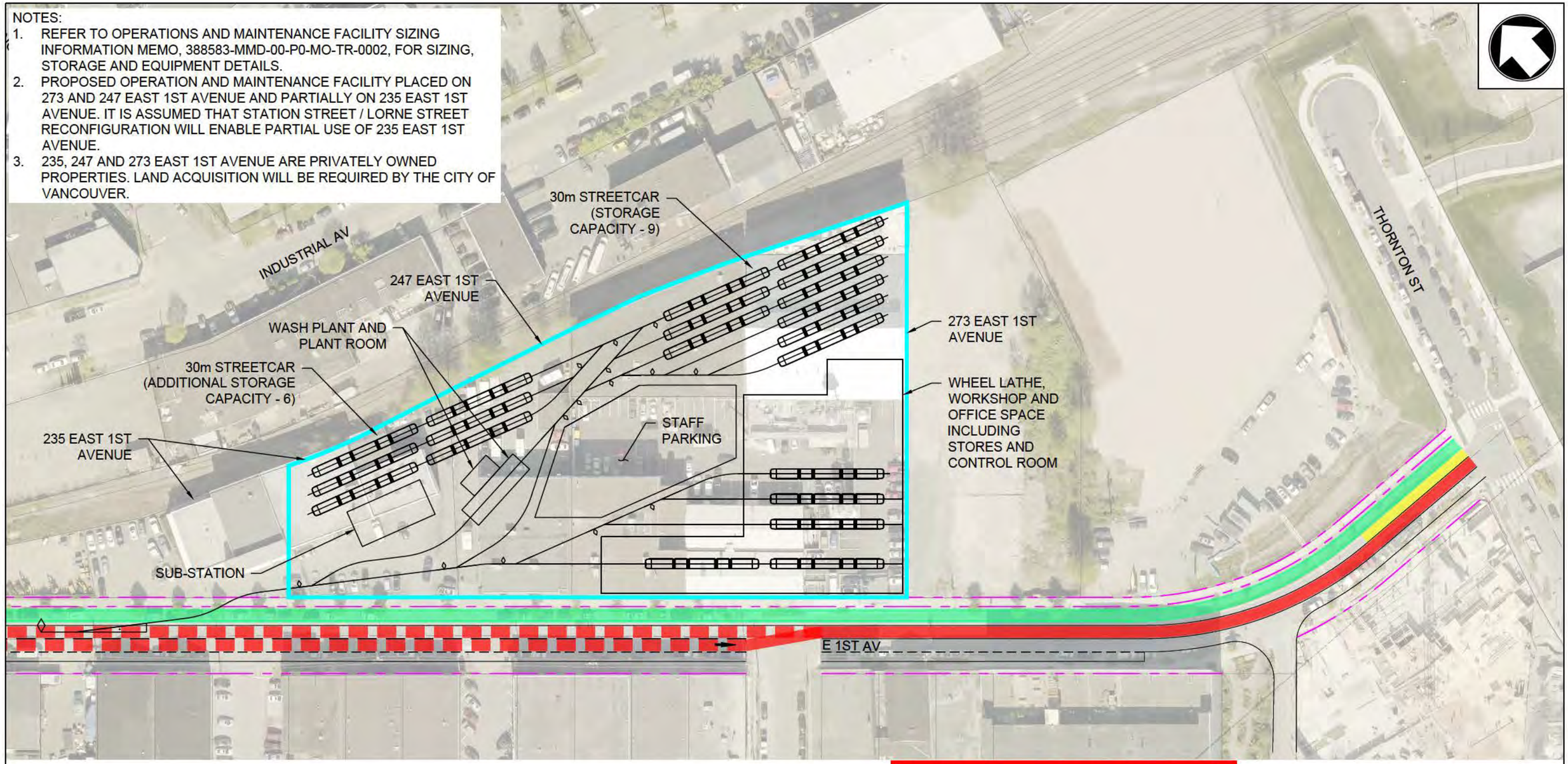
Stop Parameters								Junction Parameters								Reduced Speed Section Parameters								Route Parameters					
Deceleration Parameters		Acceleration Parameters		Total Parameters per stop		Total Parameters		Deceleration Parameters		Acceleration Parameters		Total Parameters per junction		Total Parameters		Deceleration Parameters		Acceleration Parameters		Total Parameters per reduced speed section		Total Parameters							
Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Time (hours mins secs)	Distance (km)	Average Stop Spacing (km)	Journey Time With no Delays (hours mins secs)	Length at Route Speed (km)	Time at Route Speed (hours mins secs)	Journey Time (hours mins secs)	Average speed (kph)
00 00:17	0.12	00:00:15	0.11	00:00 53	0.23	00:22:00	5.69	00:00:17	0.12	00 00:15	0.11	00:00:43	0.23	00:29:15	9.34	00 00:10	0.10	00:00:09	0.09	00:00 20	0.19	00:00:00	0.00	0.62	00:19:28	1.19	00:01:25	00:52:40	18.48

Fleet Size

Round Trip Journey Time	No. of vehicles in operation	Vehicles our of Service (planned maintenance) 10 %	Vehicles our of Service (emergency maintenance) 5 %	Total
01 51:19	14	1	1	16

D. 388583-MMD-00-P0-DR-TR-4101 and -4102 – OMF Site 1 Layout

NOTES:
1. REFER TO OPERATIONS AND MAINTENANCE FACILITY SIZING INFORMATION MEMO, 388583-MMD-00-P0-MO-TR-0002, FOR SIZING, STORAGE AND EQUIPMENT DETAILS.
2. PROPOSED OPERATION AND MAINTENANCE FACILITY PLACED ON 273 AND 247 EAST 1ST AVENUE AND PARTIALLY ON 235 EAST 1ST AVENUE. IT IS ASSUMED THAT STATION STREET / LORNE STREET RECONFIGURATION WILL ENABLE PARTIAL USE OF 235 EAST 1ST AVENUE.
3. 235, 247 AND 273 EAST 1ST AVENUE ARE PRIVATELY OWNED PROPERTIES. LAND ACQUISITION WILL BE REQUIRED BY THE CITY OF VANCOUVER.



DRAFT - FOR REVIEW

10 m 0 1:1000 50 m

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Rev	Date	Drawn	Description	Ch'k'd	App'd
A	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title: CITY OF VANCOUVER STREETCAR STUDY OPERATIONS AND MAINTENANCE FACILITY - SITE 1 PROPOSED LAYOUT - OPTION A

Drawn	L. ANDERSON	18-12-21
Checked	K. MILLER	18-12-21
Approved	G. FARMER	18-12-21

Scale at ANSI B: 1:1000

Drawing Number: 388583-MMD-00-P0-DR-TR-4101

Security	Status	Rev
STD	PRE	A

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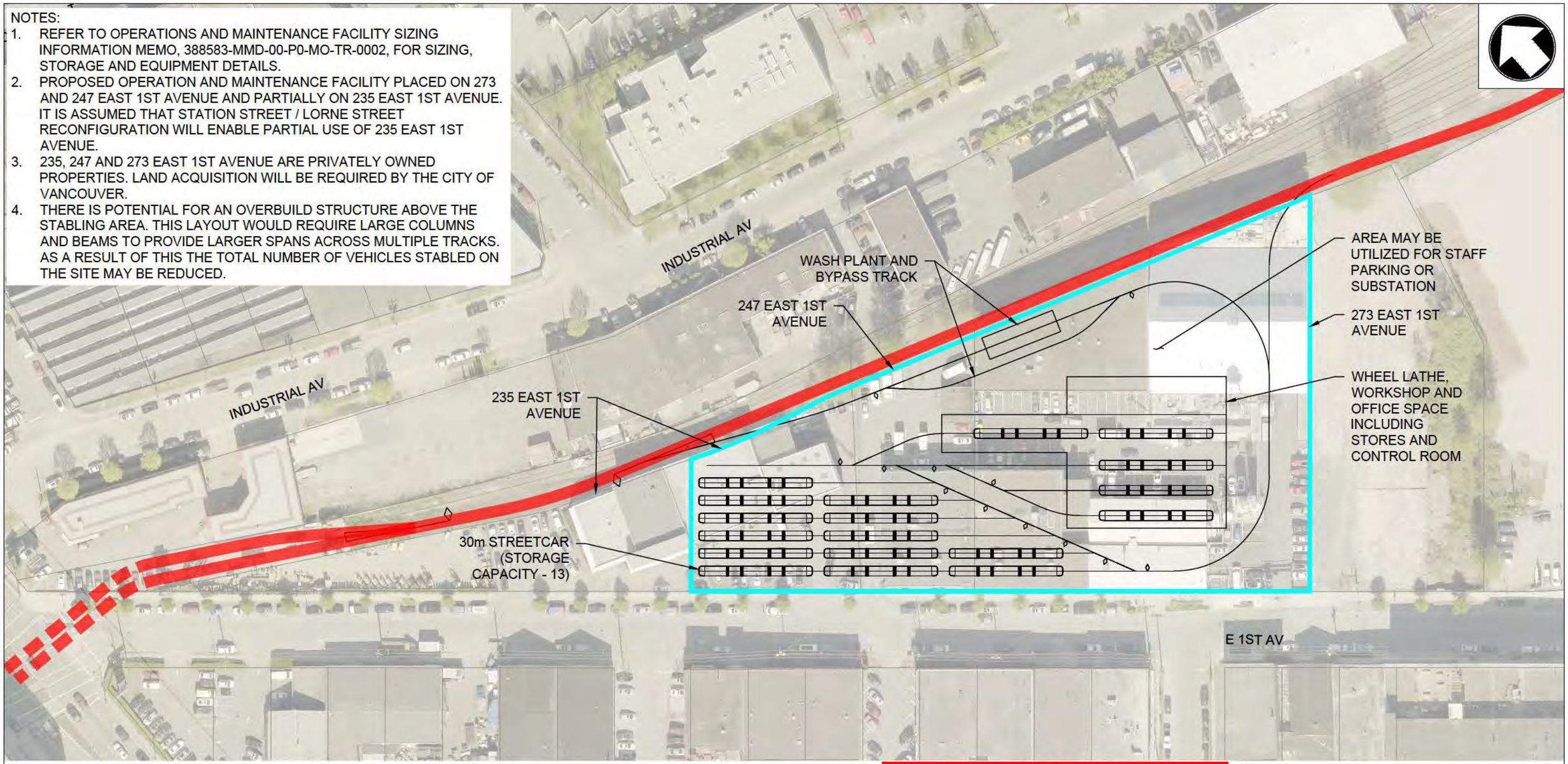
NOTES:

1. REFER TO OPERATIONS AND MAINTENANCE FACILITY SIZING INFORMATION MEMO, 388583-MMD-00-P0-MO-TR-0002, FOR SIZING, STORAGE AND EQUIPMENT DETAILS.
2. PROPOSED OPERATION AND MAINTENANCE FACILITY PLACED ON 273 AND 247 EAST 1ST AVENUE AND PARTIALLY ON 235 EAST 1ST AVENUE. IT IS ASSUMED THAT STATION STREET / LORNE STREET RECONFIGURATION WILL ENABLE PARTIAL USE OF 235 EAST 1ST AVENUE.
3. 235, 247 AND 273 EAST 1ST AVENUE ARE PRIVATELY OWNED PROPERTIES. LAND ACQUISITION WILL BE REQUIRED BY THE CITY OF VANCOUVER.
4. THERE IS POTENTIAL FOR AN OVERBUILD STRUCTURE ABOVE THE STABLING AREA. THIS LAYOUT WOULD REQUIRE LARGE COLUMNS AND BEAMS TO PROVIDE LARGER SPANS ACROSS MULTIPLE TRACKS. AS A RESULT OF THIS THE TOTAL NUMBER OF VEHICLES STABLED ON THE SITE MAY BE REDUCED.



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A	2018-12-21	LJA	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title

CITY OF VANCOUVER
STREETCAR STUDY
OPERATIONS AND MAINTENANCE FACILITY - SITE 1
PROPOSED LAYOUT - OPTION B

Drawn	L. ANDERSON	18-12-21
Checked	K. MILLER	18-12-21
Approved	G. FARMER	18-12-21

Scale at ANSI B
1:1000

Drawing Number
388583-MMD-00-P0-DR-TR-4102

Security	Status	Rev
STD	PRE	A

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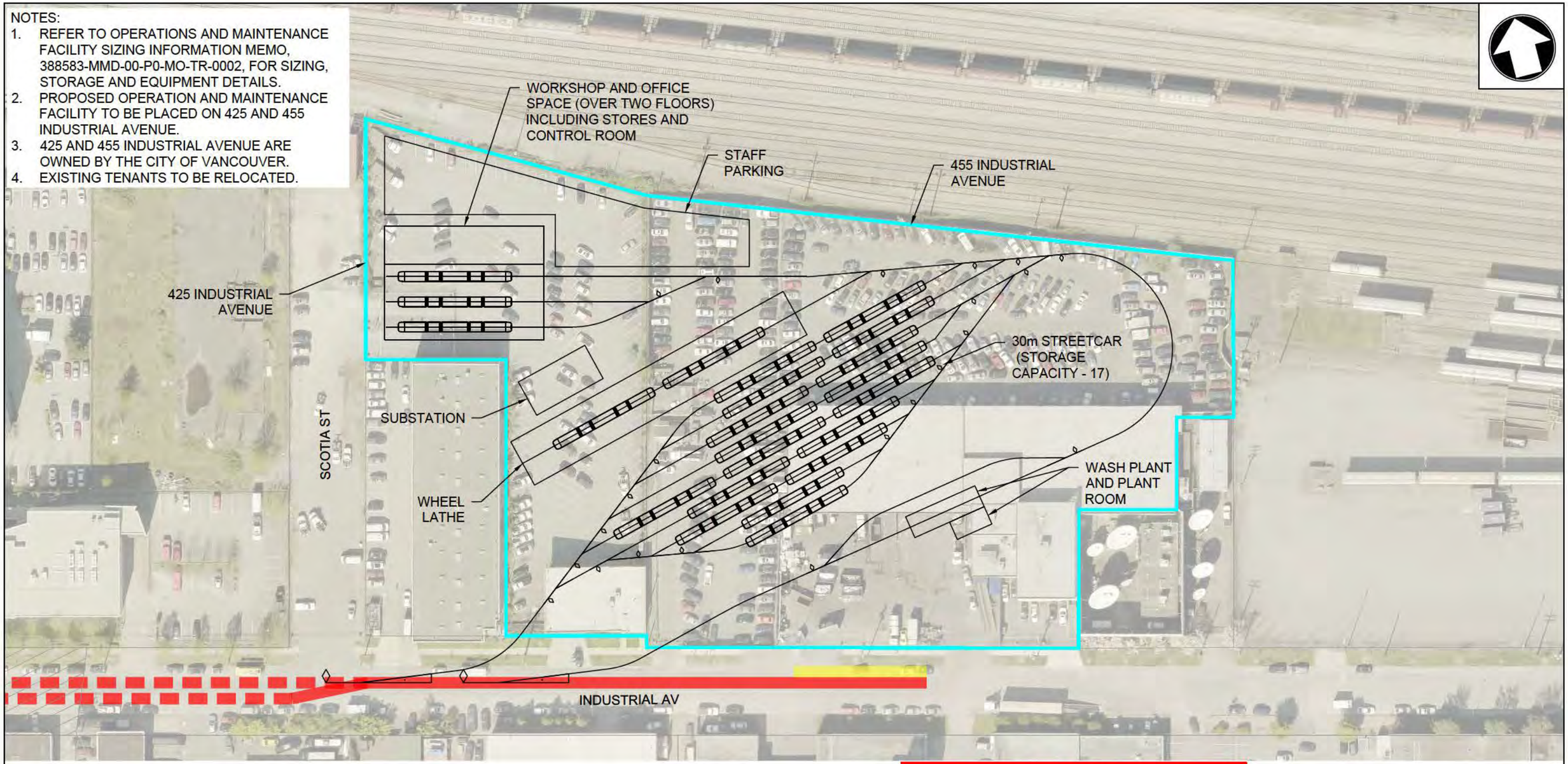
E. 388583-MMD-00-P0-DR-TR-4201 and -4202 – OMF Site 2 Layout

NOTES:
1. REFER TO OPERATIONS AND MAINTENANCE FACILITY SIZING INFORMATION MEMO, 388583-MMD-00-P0-MO-TR-0002, FOR SIZING, STORAGE AND EQUIPMENT DETAILS.
2. PROPOSED OPERATION AND MAINTENANCE FACILITY TO BE PLACED ON 425 AND 455 INDUSTRIAL AVENUE.
3. 425 AND 455 INDUSTRIAL AVENUE ARE OWNED BY THE CITY OF VANCOUVER.
4. EXISTING TENANTS TO BE RELOCATED.



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10 m 0 1:1000 50 m

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Title

CITY OF VANCOUVER
STREETCAR STUDY
OPERATIONS AND MAINTENANCE FACILITY - SITE 2
PROPOSED LAYOUT - OPTION 1

Drawn	L. ANDERSON	18-12-21
Checked	K. MILLER	18-12-21
Approved	G. FARMER	18-12-21

Scale at ANSI B
1:1000

Drawing Number
388583-MMD-00-P0-DR-TR-4201

Security	Status	Rev
STD	PRE	A

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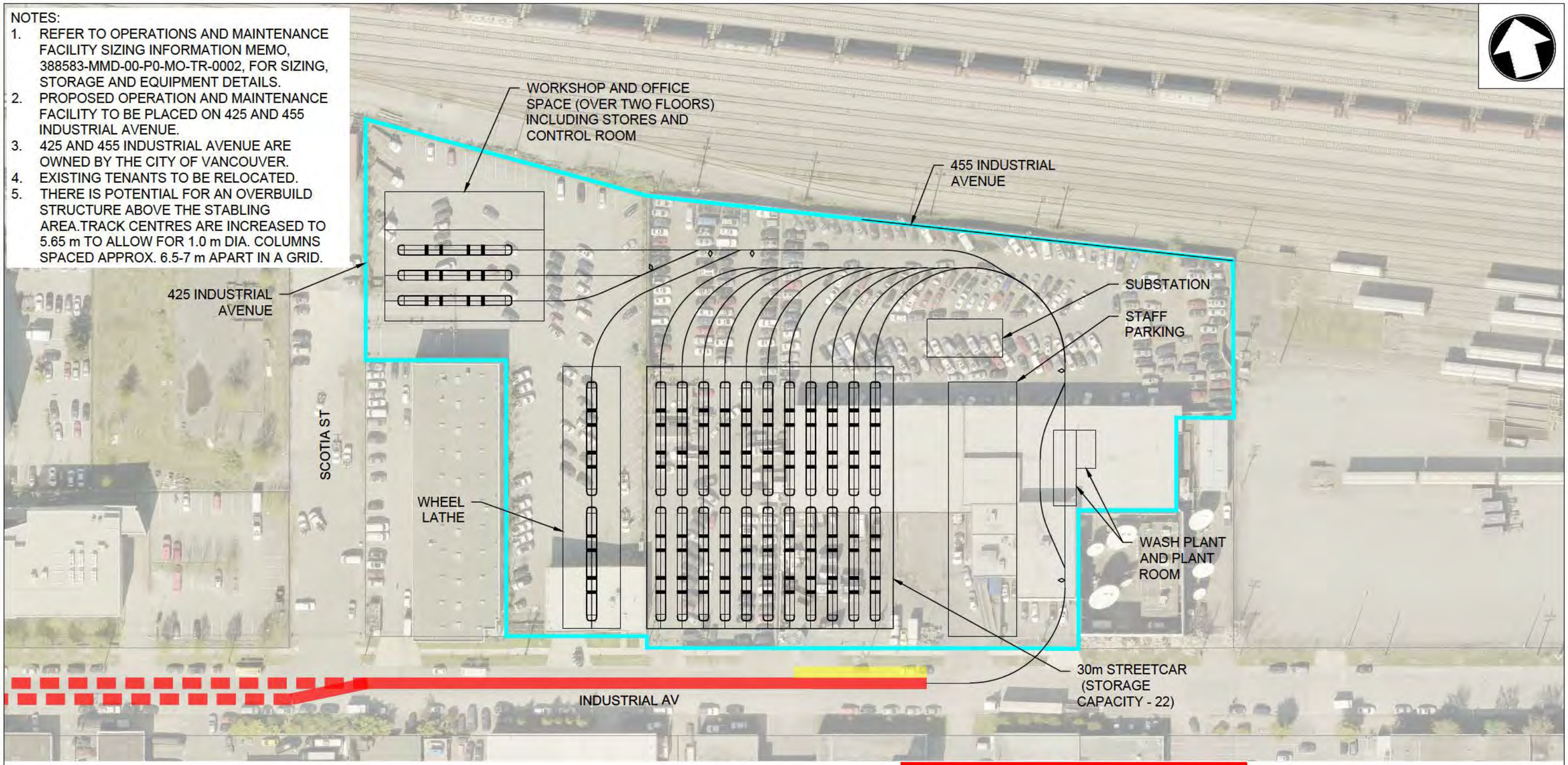
NOTES:
1. REFER TO OPERATIONS AND MAINTENANCE FACILITY SIZING INFORMATION MEMO, 388583-MMD-00-P0-MO-TR-0002, FOR SIZING, STORAGE AND EQUIPMENT DETAILS.
2. PROPOSED OPERATION AND MAINTENANCE FACILITY TO BE PLACED ON 425 AND 455 INDUSTRIAL AVENUE.
3. 425 AND 455 INDUSTRIAL AVENUE ARE OWNED BY THE CITY OF VANCOUVER.
4. EXISTING TENANTS TO BE RELOCATED.
5. THERE IS POTENTIAL FOR AN OVERBUILD STRUCTURE ABOVE THE STABLING AREA.TRACK CENTRES ARE INCREASED TO 5.65 m TO ALLOW FOR 1.0 m DIA. COLUMNS SPACED APPROX. 6.5-7 m APART IN A GRID.



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10 m 0 1:1000 50 m

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Title

CITY OF VANCOUVER
STREETCAR STUDY
OPERATIONS AND MAINTENANCE FACILITY - SITE 2
PROPOSED LAYOUT - OPTION B

Drawn	L. ANDERSON	18-12-21
Checked	K. MILLER	18-12-21
Approved	G. FARMER	18-12-21

Scale at ANSI B
1:1000

Drawing Number
388583-MMD-00-P0-DR-TR-4202

Security	Status	Rev
STD	PRE	A

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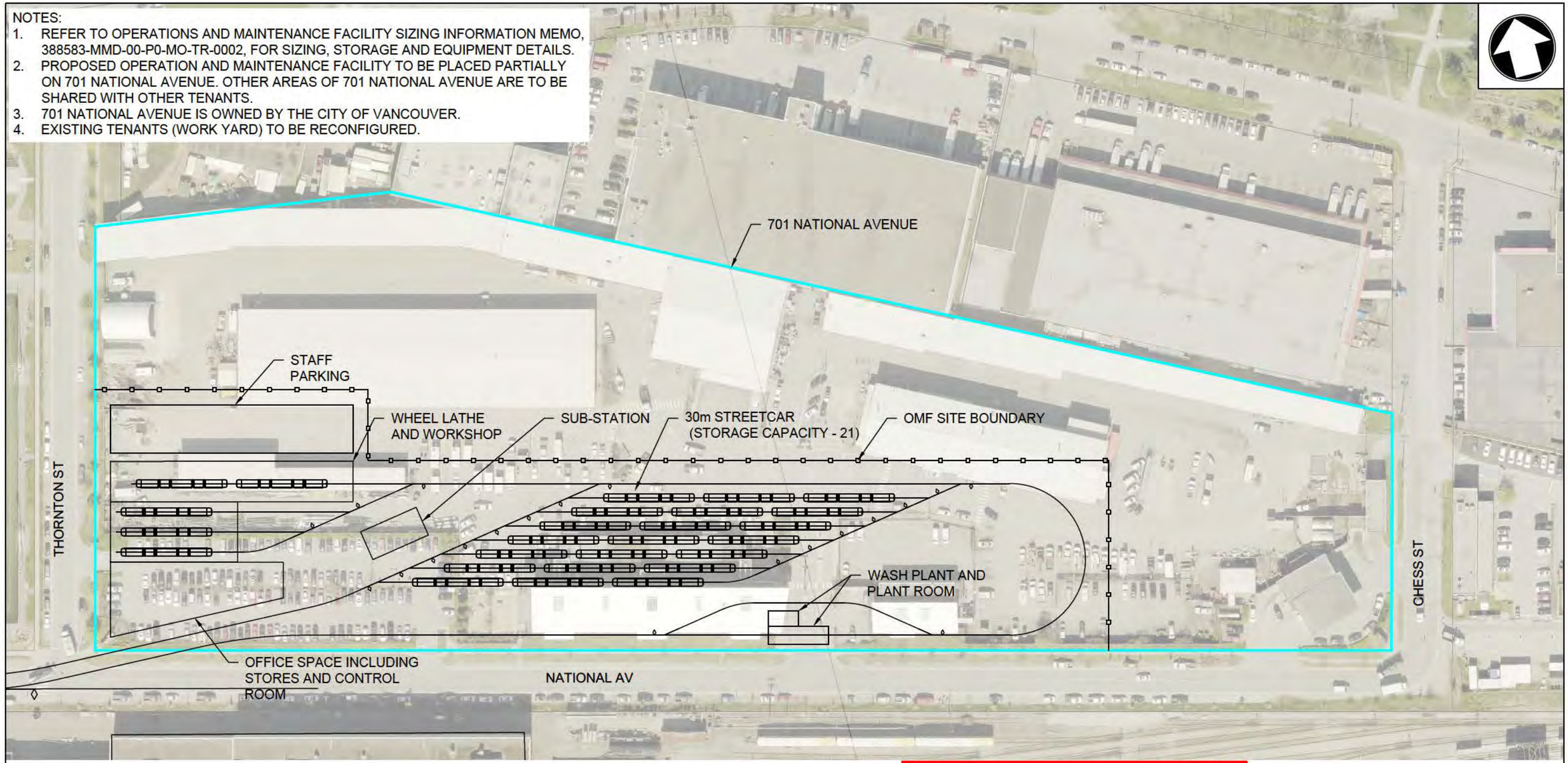
F. 388583-MMD-00-P0-DR-TR-4301 – OMF Site 4 Layout

NOTES:
1. REFER TO OPERATIONS AND MAINTENANCE FACILITY SIZING INFORMATION MEMO, 388583-MMD-00-P0-MO-TR-0002, FOR SIZING, STORAGE AND EQUIPMENT DETAILS.
2. PROPOSED OPERATION AND MAINTENANCE FACILITY TO BE PLACED PARTIALLY ON 701 NATIONAL AVENUE. OTHER AREAS OF 701 NATIONAL AVENUE ARE TO BE SHARED WITH OTHER TENANTS.
3. 701 NATIONAL AVENUE IS OWNED BY THE CITY OF VANCOUVER.
4. EXISTING TENANTS (WORK YARD) TO BE RECONFIGURED.



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Title

CITY OF VANCOUVER
STREETCAR STUDY
OPERATIONS AND MAINTENANCE FACILITY - SITE 4
PROPOSED LAYOUT

Drawn	L. ANDERSON	18-12-21
Checked	K. MILLER	18-12-21
Approved	G. FARMER	18-12-21

Scale at ANSI B
1:1250

Drawing Number
388583-MMD-00-P0-DR-TR-4301

Security	Status	Rev
STD	PRE	A

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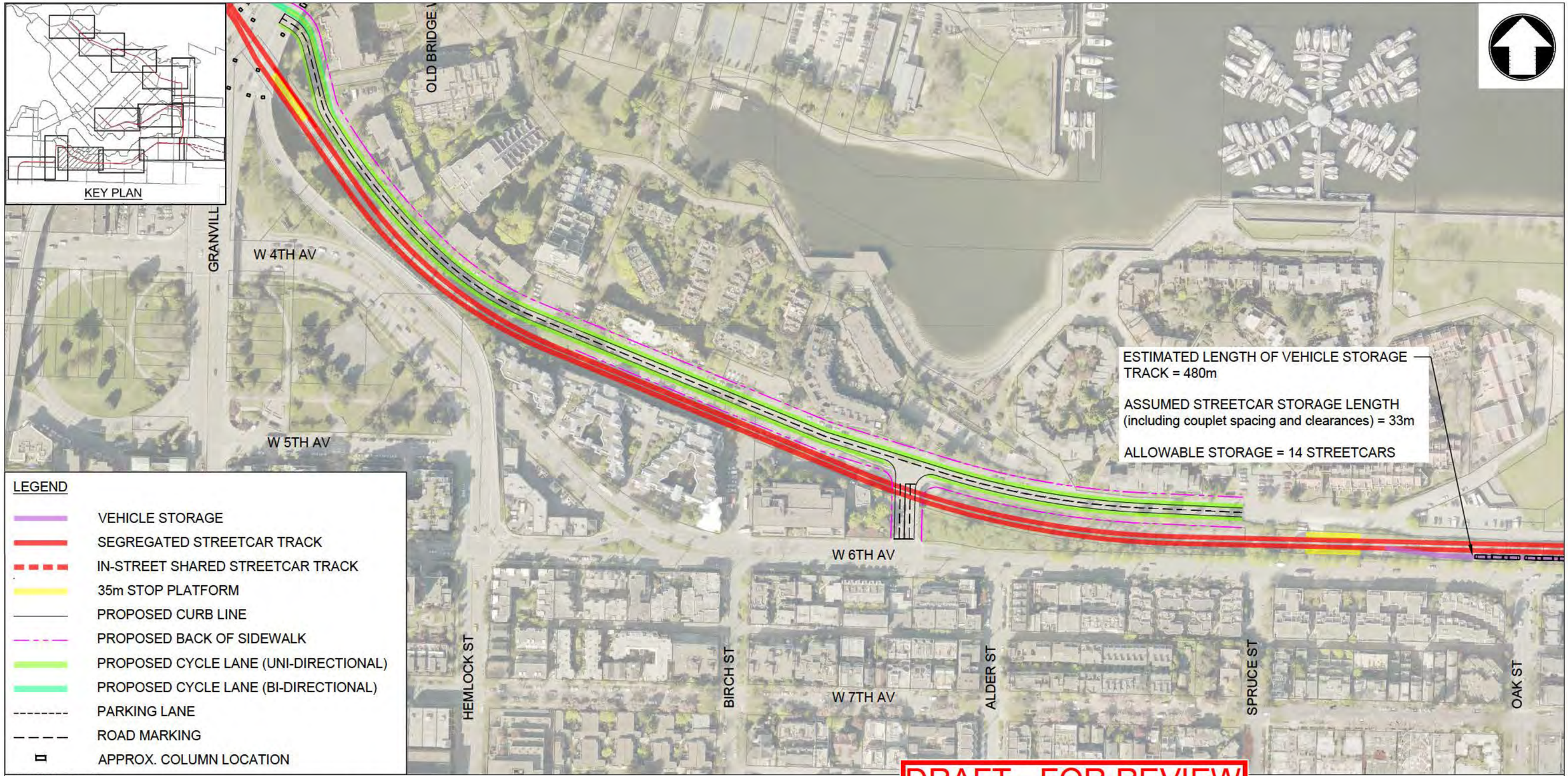
G. 388583-MMD-00-P0-SK-TR-4401 and -4402 – Vehicle Storage Track



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20 m 0 1:2500 100 m

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Rev	Date	Drawn	Description	Ch'k'd	App'd
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Title
CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED LOCATION
VEHICLE STORAGE TRACK
OPTION 1

Drawn	S. VIAJE	19-10-23
Checked	K. MILLER	19-10-23
Approved	G. FARMER	19-10-23

Scale at ANSI B
1:2500

Drawing Number	Security	Status	Rev
388583-MMD-00-P0-SK-TR-4401	STD	PRE	A

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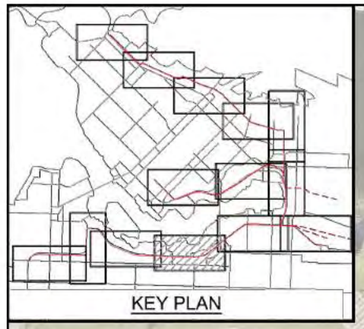

ESTIMATED LENGTH OF VEHICLE STORAGE TRACK = 285m

ASSUMED STREETCAR STORAGE LENGTH
(including couplet spacing and clearances) = 33m

ALLOWABLE STORAGE = 8 STREETCARS

ESTIMATED LENGTH OF VEHICLE STORAGE TRACK = 480m

ASSUMED STREETCAR STORAGE LENGTH
(including couplet spacing and clearances) = 33m

ALLOWABLE STORAGE = 14 STREETCARS

CROSS-OVER LOCATION

CAMBIE BRIDGE

W 2ND AV

CHARLESON

W 6TH AV

W 6TH AV

OAK ST

W 7TH AV

W 7TH AV

LAUREL ST

WILLOW ST

ASH ST

LEGEND

- VEHICLE STORAGE
- SEGREGATED STREETCAR TRACK
- IN-STREET SHARED STREETCAR TRACK
- 35m STOP PLATFORM
- PROPOSED CURB LINE
- PROPOSED BACK OF SIDEWALK
- PROPOSED CYCLE LANE (UNI-DIRECTIONAL)
- PROPOSED CYCLE LANE (BI-DIRECTIONAL)
- PARKING LANE
- ROAD MARKING
- APPROX. COLUMN LOCATION

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20 m 0 1:2500 100 m

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CITY OF VANCOUVER

Rev	Date	Drawn	Description	Ch'k'd	App'd
A	2019-10-23	SMV	ISSUED FOR CLIENT REVIEW	KHM	GBF

Title

CITY OF VANCOUVER
STREETCAR STUDY
PROPOSED LOCATION
VEHICLE STORAGE TRACK
OPTION 2

Drawn	S. VIAJE	19-10-23
Checked	K. MILLER	19-10-23
Approved	G. FARMER	19-10-23

Scale at ANSI B
1:2500

Drawing Number
388583-MMD-00-P0-SK-TR-4402

Security	Status	Rev
STD	PRE	A

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H. Land Use

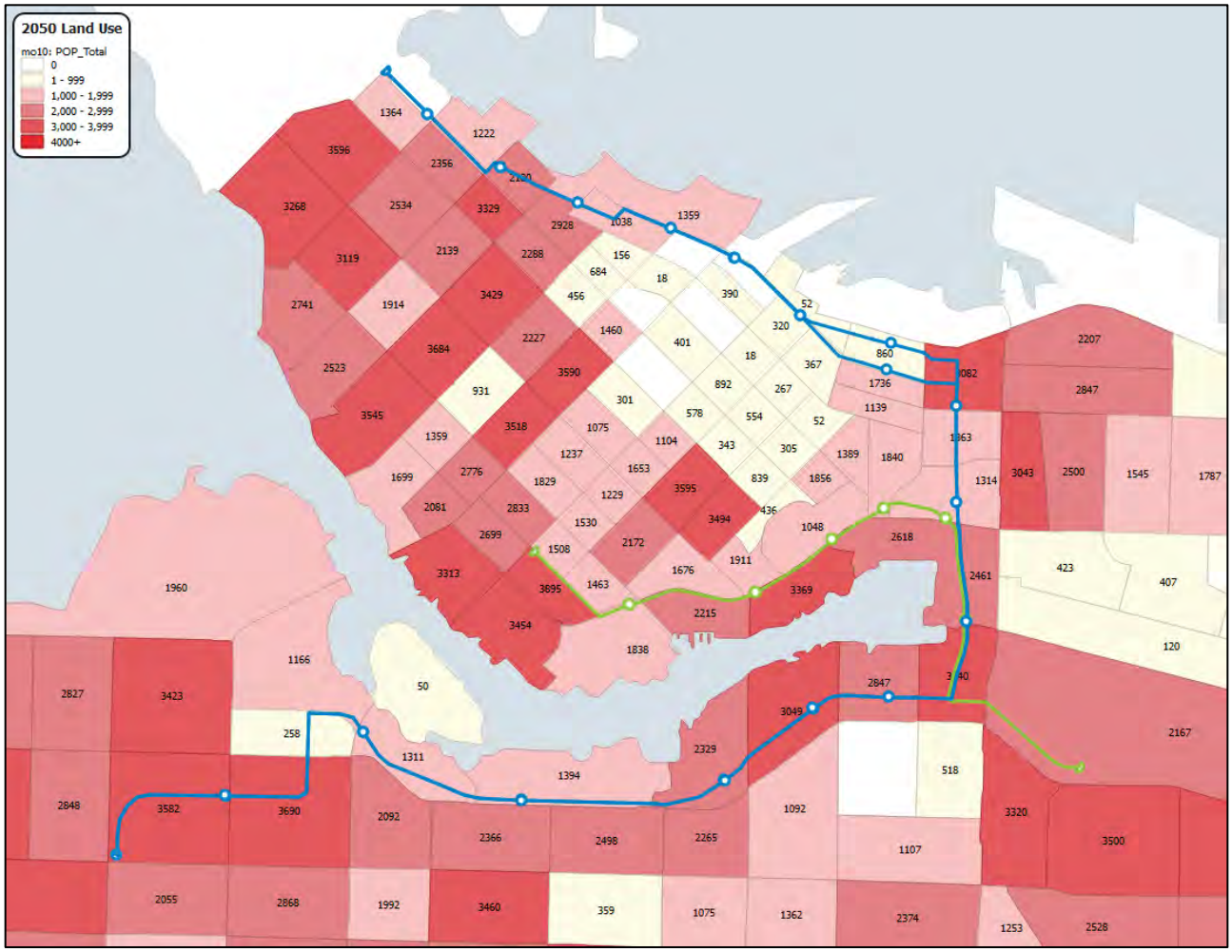


Figure H-1 2050 Population

Source: TransLink RTM Phase 3.2

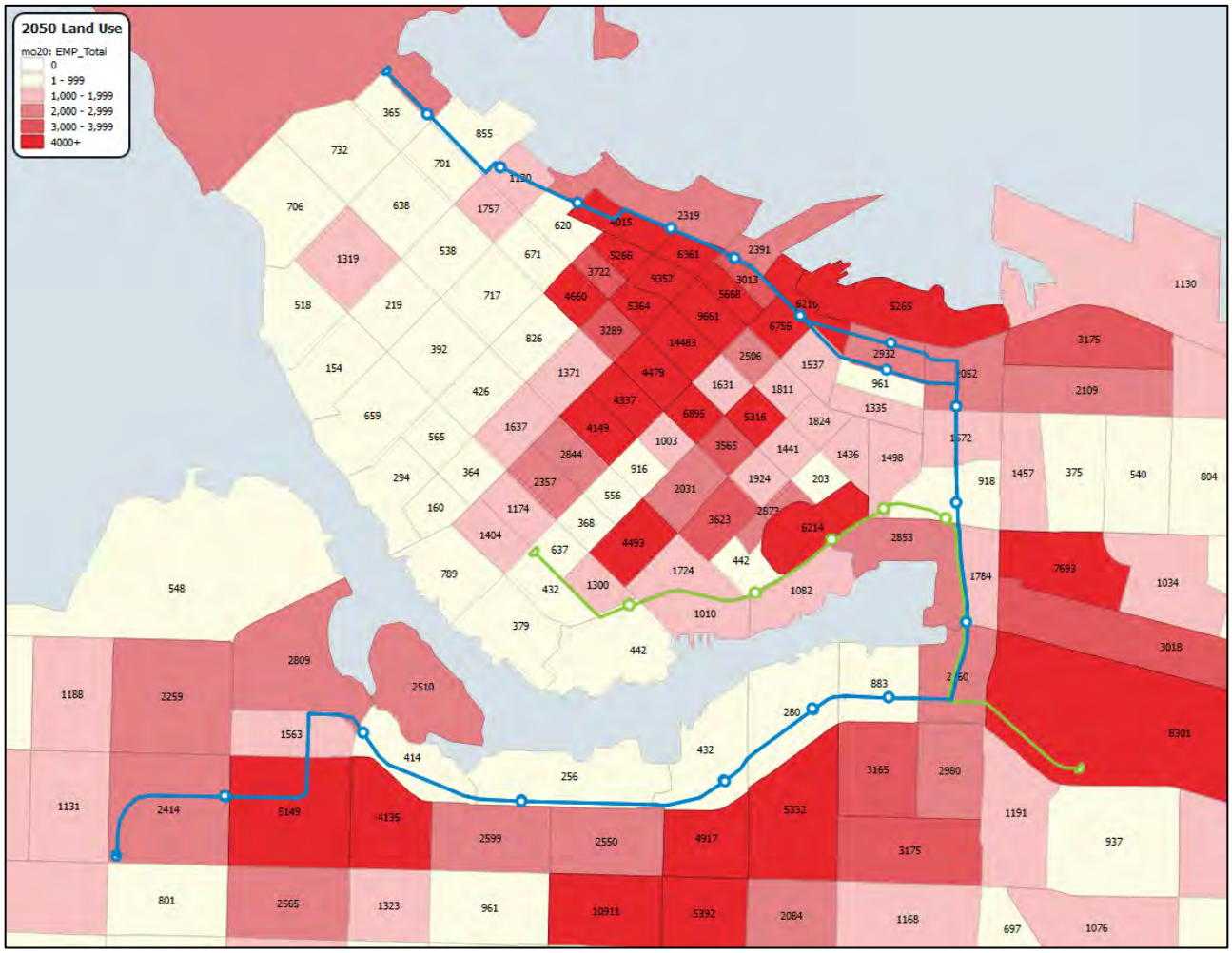


Figure H-2 2050 Employment

Source: TransLink RTM Phase 3.2

I. Employment and Population Catchment Analysis

Proposed Alignment - 400 m Catchment By Line - No Overlap

Line	2011 Pop	2011 Emp	2016 Pop	2016 Emp	2030 Pop	2030 Emp	2045 Pop	2045 Emp
Pacific Blvd	29,973	28,170	34,204	32,125	49,735	37,962	52,282	39,919
Phase 0	15,136	25,634	20,464	30,188	28,771	31,813	31,989	33,560
Phase 1	12,476	22,284	14,230	24,294	19,641	26,970	20,770	28,454
Stanley Park	19,020	75,997	20,831	83,038	24,731	91,521	25,866	96,550
Total	**76,606**	**152,085**	**89,729**	**169,645**	**122,878**	**188,266**	**130,908**	**198,484**

Proposed Alignment - 400 m Catchment By Stop - With Overlap

Stop Name	2011 Pop	2011 Emp	2016 Pop	2016 Emp	2030 Pop	2030 Emp	2045 Pop	2045 Emp
Chilco St	3,643	1,178	3,819	1,264	3,990	1,153	4,049	1,216
Denman St	5,945	2,297	6,149	2,457	7,230	2,324	7,484	2,451
Cardero St	9,075	5,575	9,556	5,965	13,261	5,610	14,017	5,916
Jervis St	9,201	17,396	10,128	18,967	11,490	19,828	12,051	20,916
Thurlow St	2,657	37,361	3,095	41,280	3,470	43,873	3,641	46,284
Canada Pl	1,021	39,357	1,070	43,519	1,562	49,338	1,638	52,049
Waterfront Station	1,620	28,893	2,183	31,018	2,299	38,618	2,409	40,746
Gastown/Abbott WB	5,040	13,347	6,220	14,368	6,252	13,859	6,606	14,618
Gastown/Abbott EB	6,321	14,200	7,665	15,452	7,771	15,588	8,211	16,444
Hastings St	7,141	9,261	8,083	9,932	9,994	9,176	10,569	9,677
Prior St SB	3,685	4,138	3,912	4,617	8,304	7,356	8,790	7,764
Granville St	12,169	9,237	14,624	10,068	20,176	9,627	21,427	10,154
Davie St	10,583	8,511	11,649	9,499	12,391	8,283	12,922	8,734
Nelson St	5,919	7,128	6,243	8,375	11,611	11,077	11,989	11,558
W Georgia St	4,365	6,216	5,252	7,609	10,174	12,124	10,600	12,689
Pat Quinn Way	4,909	5,262	5,956	6,545	9,873	8,609	10,385	9,045
Science World	2,570	2,775	4,541	4,476	7,253	6,398	7,678	6,757
Manitoba St	1,258	3,730	4,705	5,675	6,499	5,096	6,912	5,378
Cook St	1,749	3,376	4,063	4,234	5,768	4,022	6,205	4,240
Cambie St	3,510	6,604	4,107	7,426	5,352	6,885	6,283	7,262
Sitka Square	3,969	4,418	4,301	4,733	4,171	4,308	5,083	4,543
Granville Island	2,660	5,999	2,855	6,403	3,076	6,011	3,469	6,338
TOTAL	**109,011**	**236,258**	**130,176**	**263,880**	**171,967**	**289,163**	**182,416**	**304,777**

Original Alignment - 400 m Catchment By Line - No Overlap

Line	2011 Pop	2011 Emp	2016 Pop	2016 Emp	2030 Pop	2030 Emp	2045 Pop	2045 Emp
Pacific Blvd	28,665	27,002	32,640	30,662	48,169	36,448	50,627	38,321
Phase 0	15,248	26,110	20,616	30,810	29,071	32,523	32,304	34,311
Phase 1	13,239	27,908	15,152	30,306	20,769	34,906	21,954	36,831
Stanley Park	19,020	75,997	20,831	83,038	24,731	91,521	25,866	96,550
Total	**76,172**	**157,017**	**89,239**	**174,816**	**122,740**	**195,398**	**130,751**	**206,013**

Original Alignment - 400 m Catchment By Stop - With Overlap

Stop Name	2011 Pop	2011 Emp	2016 Pop	2016 Emp	2030 Pop	2030 Emp	2045 Pop	2045 Emp
Chilco St	3,643	1,178	3,819	1,264	3,990	1,153	4,049	1,216
Denman St	5,945	2,297	6,149	2,457	7,230	2,324	7,484	2,451
Cardero St	9,075	5,575	9,556	5,965	13,261	5,610	14,017	5,916
Jervis St	9,201	17,396	10,128	18,967	11,490	19,828	12,051	20,916
Thurlow St	2,657	37,361	3,095	41,280	3,470	43,873	3,641	46,284
Canada Pl	1,021	39,357	1,070	43,519	1,562	49,338	1,638	52,049
Waterfront Station	1,620	28,893	2,183	31,018	2,299	38,618	2,409	40,746
Storyeum/Cambie St WB	4,257	15,761	5,435	16,936	5,360	17,632	5,656	18,602
Carrall St WB	6,120	11,192	7,197	12,017	7,416	10,877	7,838	11,473
Cambie St EB	5,217	18,488	6,618	20,039	6,473	22,492	6,828	23,733
Carrall St EB	7,446	10,827	8,687	11,721	9,303	10,672	9,834	11,257
Hastings St	7,141	9,261	8,083	9,932	9,994	9,176	10,569	9,677
Keefer St	6,087	6,672	6,713	7,205	10,920	7,223	11,554	7,616
Granville St	12,169	9,237	14,624	10,068	20,176	9,627	21,427	10,154
Drake St	10,583	8,511	11,649	9,499	12,391	8,283	12,922	8,734
Nelson St	5,919	7,128	6,243	8,375	11,611	11,077	11,989	11,558
W Georgia St	4,365	6,216	5,252	7,609	10,174	12,124	10,600	12,689
Prior St SB	3,685	4,138	3,912	4,617	8,304	7,356	8,790	7,764
Science World	2,570	2,775	4,541	4,476	7,253	6,398	7,678	6,757
Ontario St	1,213	3,785	4,895	6,190	6,939	5,736	7,354	6,053
Columbia St	1,418	3,215	4,399	4,425	5,921	4,018	6,327	4,239
Cambie St	3,510	6,604	4,107	7,426	5,352	6,885	6,283	7,262
Sitka Square	3,969	4,418	4,301	4,733	4,171	4,308	5,083	4,543
Granville Island	2,660	5,999	2,855	6,403	3,076	6,011	3,469	6,338
TOTAL	**121,490**	**266,282**	**145,511**	**296,139**	**188,137**	**320,640**	**199,488**	**338,024**

Proposed Alignment - 600 m Catchment By Line - No Overlap

Line	2011 Pop	2011 Emp	2016 Pop	2016 Emp	2030 Pop	2030 Emp	2045 Pop	2045 Emp
Pacific Blvd	48,303	50,990	56,265	58,435	78,756	69,999	82,904	73,732
Phase 0	29,155	53,307	35,962	61,473	49,547	68,731	55,318	72,391
Phase 1	18,593	40,191	22,328	44,683	30,421	57,470	32,084	60,613
Stanley Park	30,332	108,689	33,239	119,442	39,198	129,936	40,955	137,075
Total	**126,383**	**253,177**	**147,793**	**284,033**	**197,922**	**326,135**	**211,261**	**343,811**

Proposed Alignment - 600 m Catchment By Stop - With Overlap

Stop Name	2011 Pop	2011 Emp	2016 Pop	2016 Emp	2030 Pop	2030 Emp	2045 Pop	2045 Emp
Chilco St	8,573	2,991	8,882	3,203	9,668	2,970	9,921	3,131
Denman St	12,578	5,762	13,165	6,171	16,454	5,748	17,192	6,061
Cardero St	18,152	13,856	19,136	15,050	22,847	14,806	23,995	15,617
Jervis St	15,751	41,548	16,859	46,098	20,753	46,380	21,797	48,924
Thurlow St	7,247	71,346	8,011	78,938	9,747	83,721	10,125	88,314
Canada Pl	2,733	74,314	3,470	81,426	4,372	89,966	4,603	94,906
Waterfront Station	4,787	65,478	6,143	71,683	7,314	82,035	7,701	86,549
Gastown/Abbott WB	10,036	30,094	11,853	32,617	12,346	37,009	13,021	39,050
Gastown/Abbott EB	11,473	30,579	13,669	33,227	14,853	38,266	15,668	40,380
Hastings St	13,154	18,670	14,997	20,495	19,023	19,664	20,117	20,741
Prior St SB	8,829	9,559	10,705	11,660	18,565	18,853	19,590	19,866
Granville St	24,205	22,398	27,488	25,039	36,512	23,087	38,589	24,349
Davie St	22,103	16,164	24,437	18,264	28,886	16,723	30,318	17,615
Nelson St	14,360	16,569	16,747	19,155	23,913	23,254	24,932	24,402
W Georgia St	11,280	17,642	13,541	20,576	22,585	28,568	23,633	30,018
Pat Quinn Way	11,599	16,819	13,511	19,225	21,275	27,027	22,342	28,429
Science World	4,302	6,257	7,956	9,170	13,554	16,598	14,328	17,515
Manitoba St	2,976	8,980	7,409	12,242	13,123	12,841	13,922	13,489
Cook St	5,249	9,365	8,775	11,666	13,252	12,135	14,104	12,695
Cambie St	6,110	14,820	7,380	16,939	9,512	15,579	11,359	16,432
Sitka Square	8,684	13,303	9,389	14,249	9,200	13,501	11,168	14,241
Granville Island	5,690	12,840	6,187	13,710	6,851	13,021	7,947	13,730
TOTAL	**229,873**	**519,354**	**269,710**	**580,802**	**354,608**	**641,752**	**376,372**	**676,454**

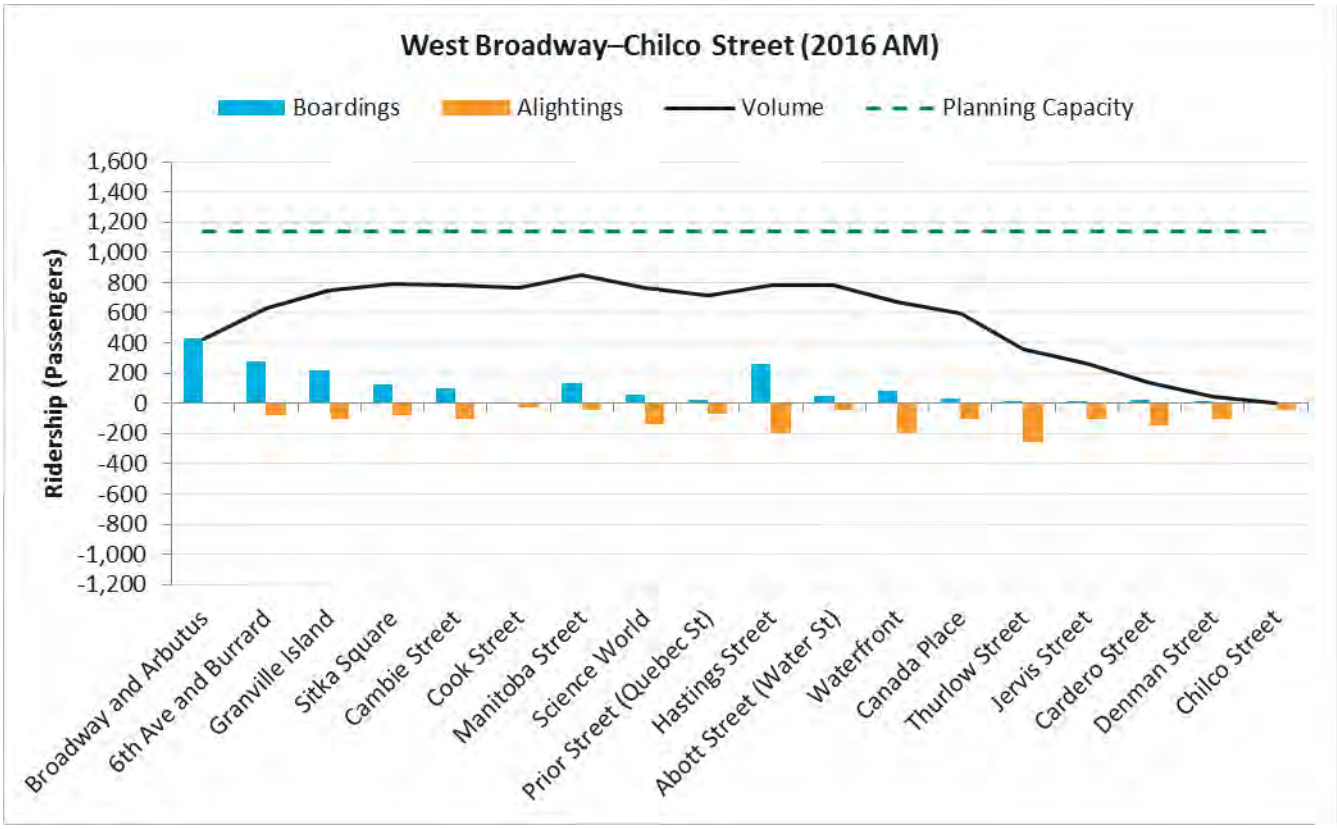
Original Alignment - 600 m Catchment By Line - No Overlap

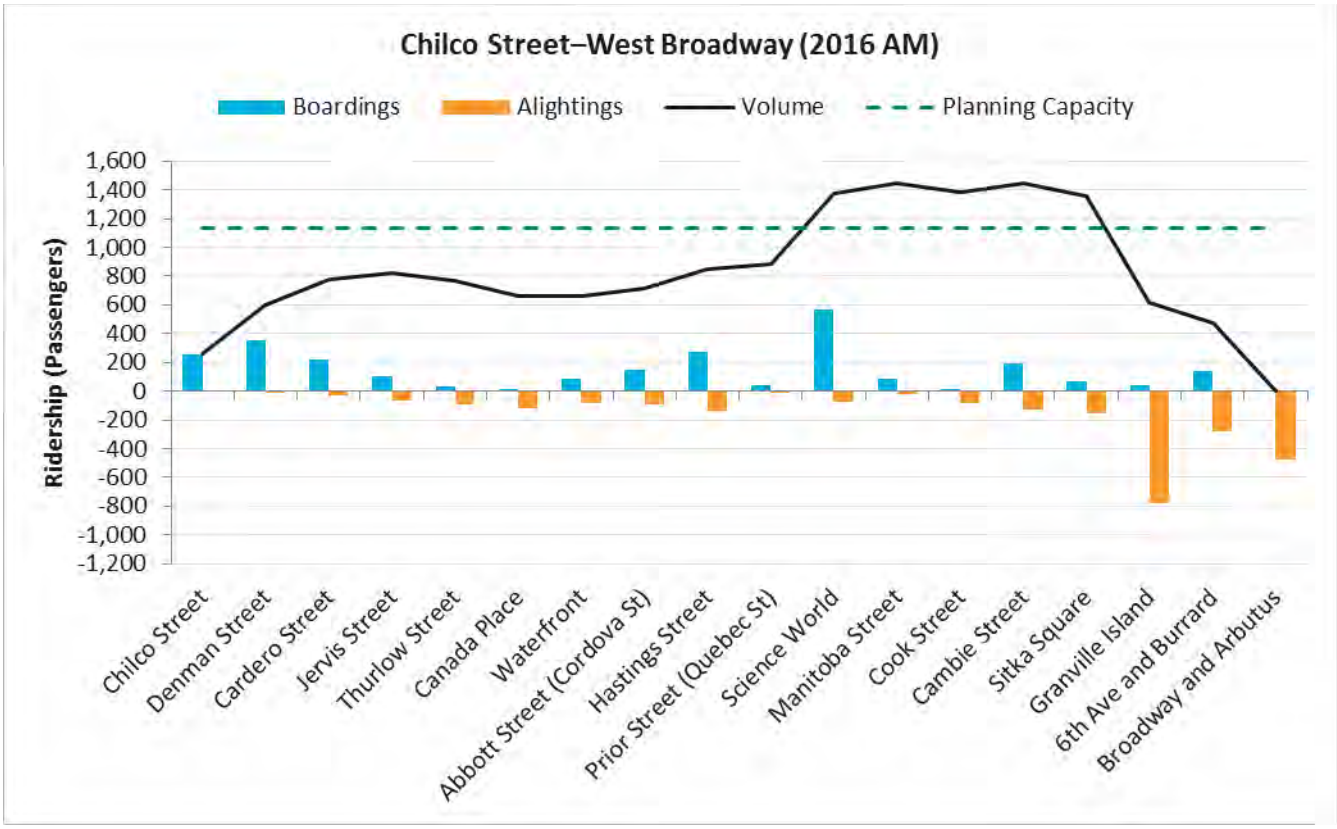
Line	2011 Pop	2011 Emp	2016 Pop	2016 Emp	2030 Pop	2030 Emp	2045 Pop	2045 Emp
Pacific Blvd	46,680	48,997	54,167	56,242	76,636	67,723	80,663	71,331
Phase 0	29,162	53,676	36,075	61,837	49,821	69,280	55,626	72,965
Phase 1	19,457	49,036	23,220	54,165	31,694	70,237	33,428	74,086
Stanley Park	30,332	108,689	33,239	119,442	39,198	129,936	40,955	137,075
Total	**125,631**	**260,398**	**146,701**	**291,687**	**197,349**	**337,176**	**210,671**	**355,458**

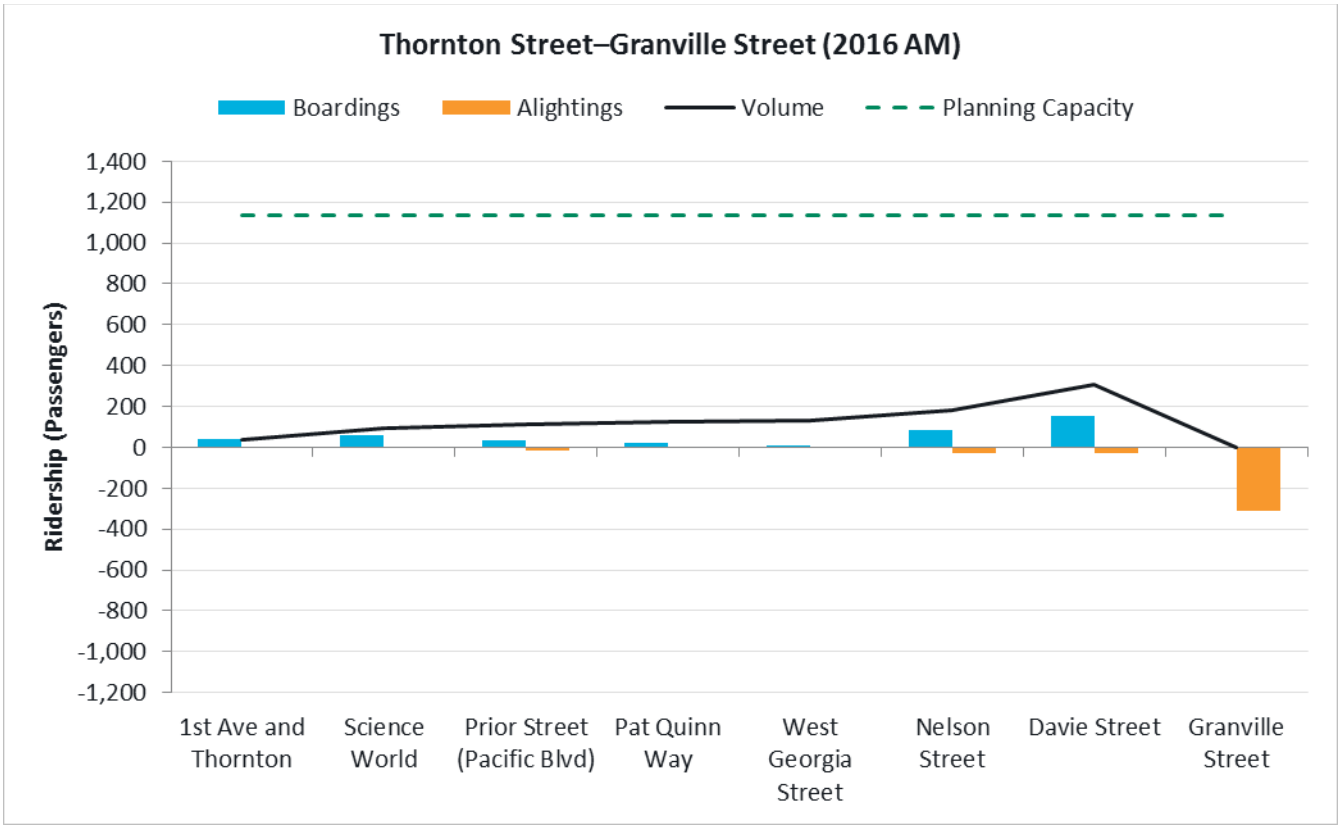
Original Alignment - 600 m Catchment By Stop - With Overlap

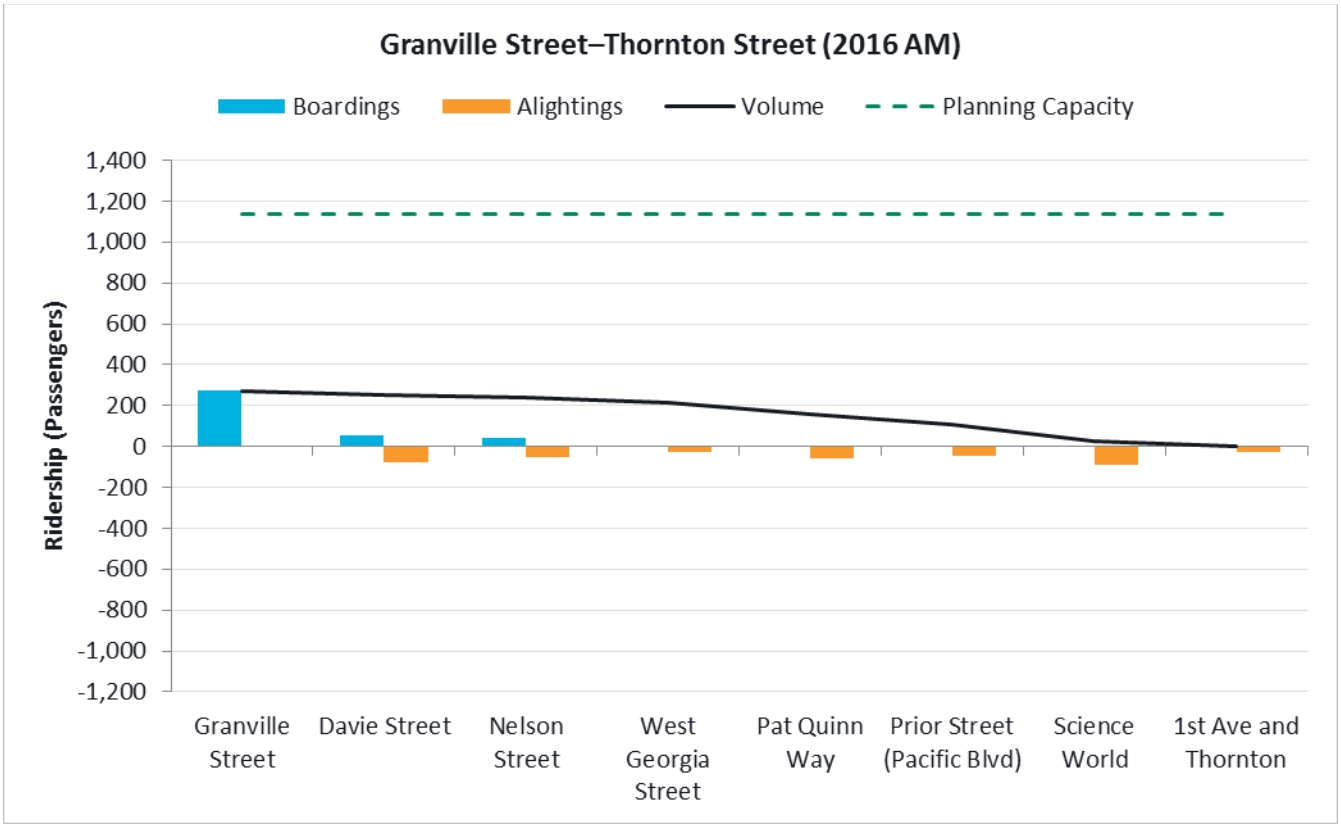
Stop Name	2011 Pop	2011 Emp	2016 Pop	2016 Emp	2030 Pop	2030 Emp	2045 Pop	2045 Emp
Chilco St	8,573	2,991	8,882	3,203	9,668	2,970	9,921	3,131
Denman St	12,578	5,762	13,165	6,171	16,454	5,748	17,192	6,061
Cardero St	18,152	13,856	19,136	15,050	22,847	14,806	23,995	15,617
Jervis St	15,751	41,548	16,859	46,098	20,753	46,380	21,797	48,924
Thurlow St	7,247	71,346	8,011	78,938	9,747	83,721	10,125	88,314
Canada Pl	2,733	74,314	3,470	81,426	4,372	89,966	4,603	94,906
Waterfront Station	4,787	65,478	6,143	71,683	7,314	82,035	7,701	86,549
Storyeum/Cambie St WB	9,387	35,068	11,126	37,959	11,544	45,384	12,170	47,888
Carrall St WB	10,272	22,876	11,996	24,889	13,494	25,589	14,257	26,996
Cambie St EB	11,130	38,731	13,322	41,994	14,135	50,089	14,901	52,856
Carrall St EB	11,743	22,122	13,747	24,191	16,393	24,768	17,328	26,129
Hastings St	13,154	18,670	14,997	20,495	19,023	19,664	20,117	20,741
Keefer St	14,805	15,371	16,624	17,246	22,418	20,899	23,710	22,052
Granville St	24,205	22,398	27,488	25,039	36,512	23,087	38,589	24,349
Drake St	22,103	16,164	24,437	18,264	28,886	16,723	30,318	17,615
Nelson St	14,360	16,569	16,747	19,155	23,913	23,254	24,932	24,402
W Georgia St	11,280	17,642	13,541	20,576	22,585	28,568	23,633	30,018
Prior St SB	8,829	9,559	10,705	11,660	18,565	18,853	19,590	19,866
Science World	4,302	6,257	7,956	9,170	13,554	16,598	14,328	17,515
Ontario St	3,369	8,865	7,651	12,226	11,988	12,814	12,741	13,510
Columbia St	3,811	8,809	8,018	11,701	14,193	12,492	14,986	13,055
Cambie St	6,110	14,820	7,380	16,939	9,512	15,579	11,359	16,432
Sitka Square	8,684	13,303	9,389	14,249	9,200	13,501	11,168	14,241
Granville Island	5,690	12,840	6,187	13,710	6,851	13,021	7,947	13,730
TOTAL	**253,056**	**575,359**	**296,976**	**642,031**	**383,925**	**706,509**	**407,407**	**744,899**

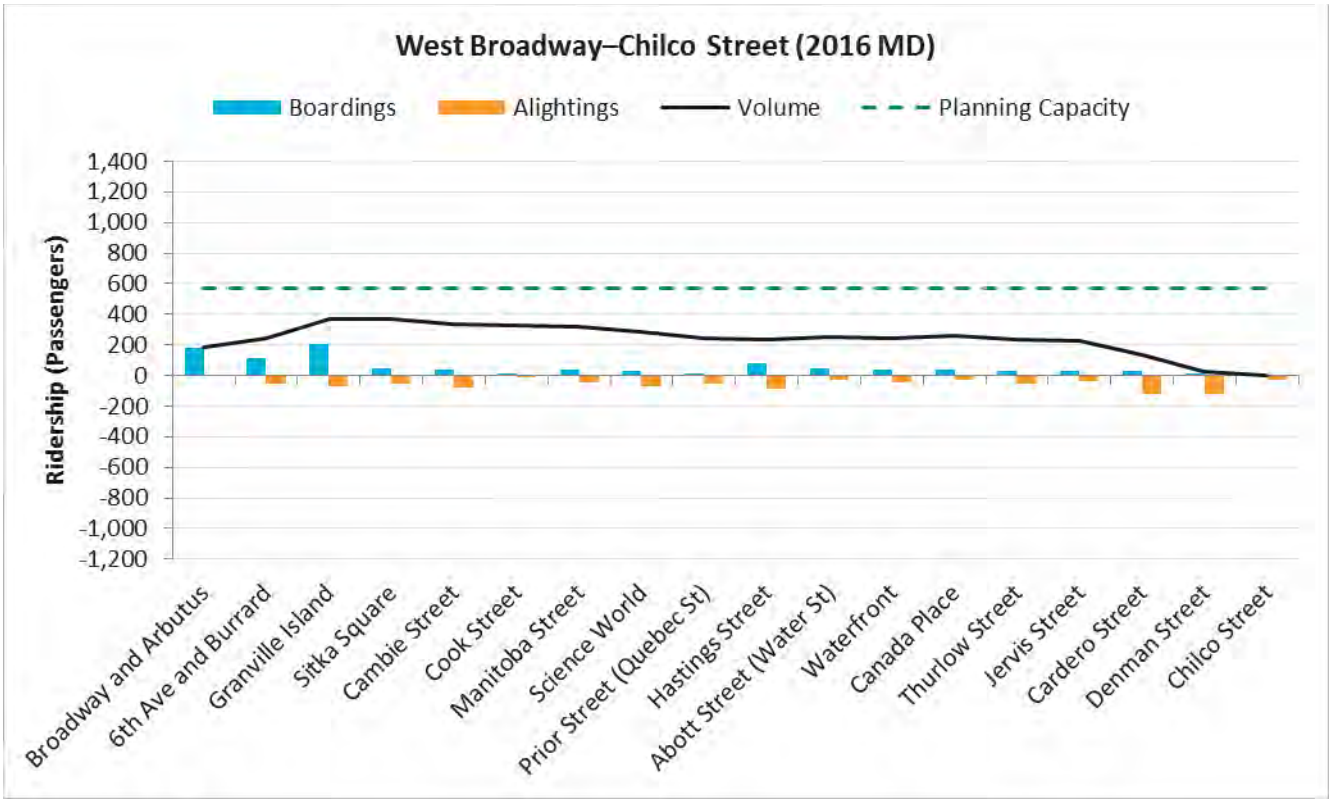
J. 2016 AM and Midday Hourly Ridership

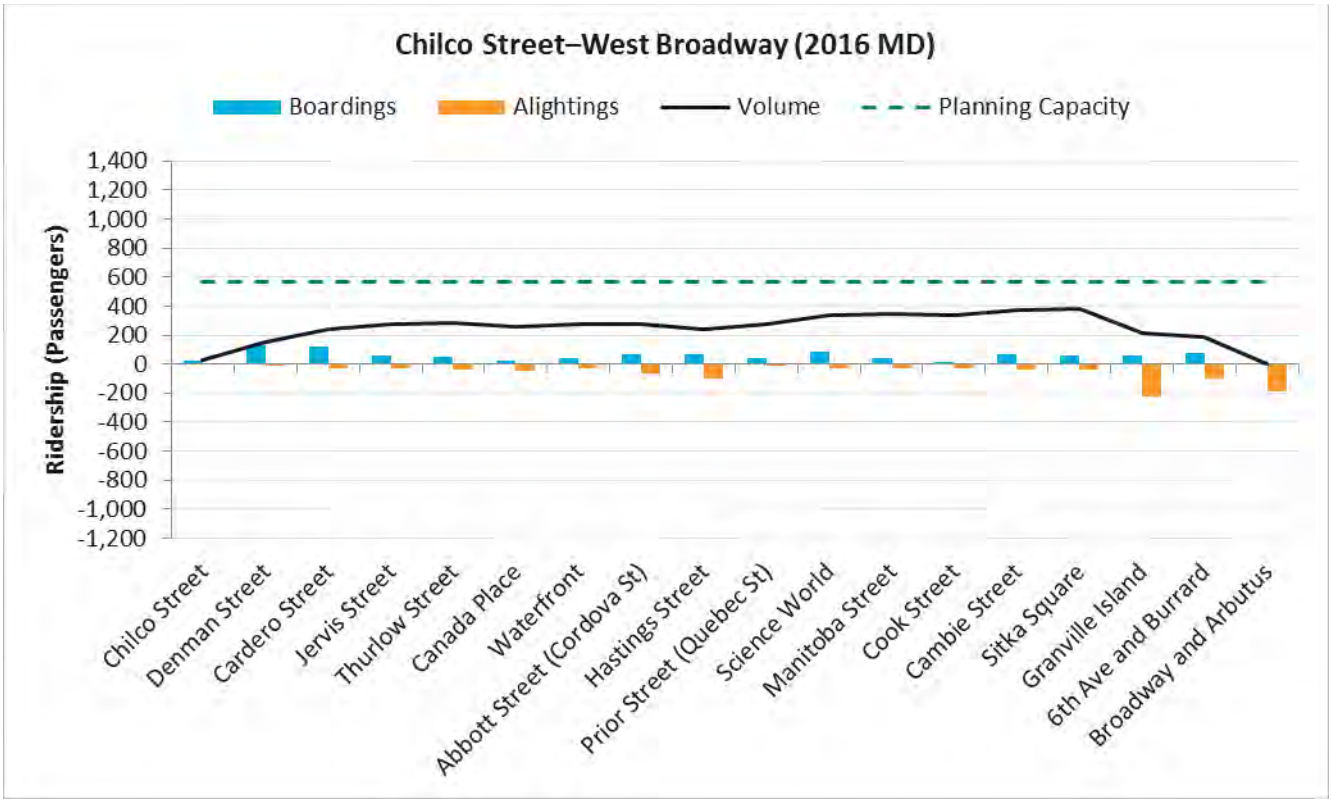


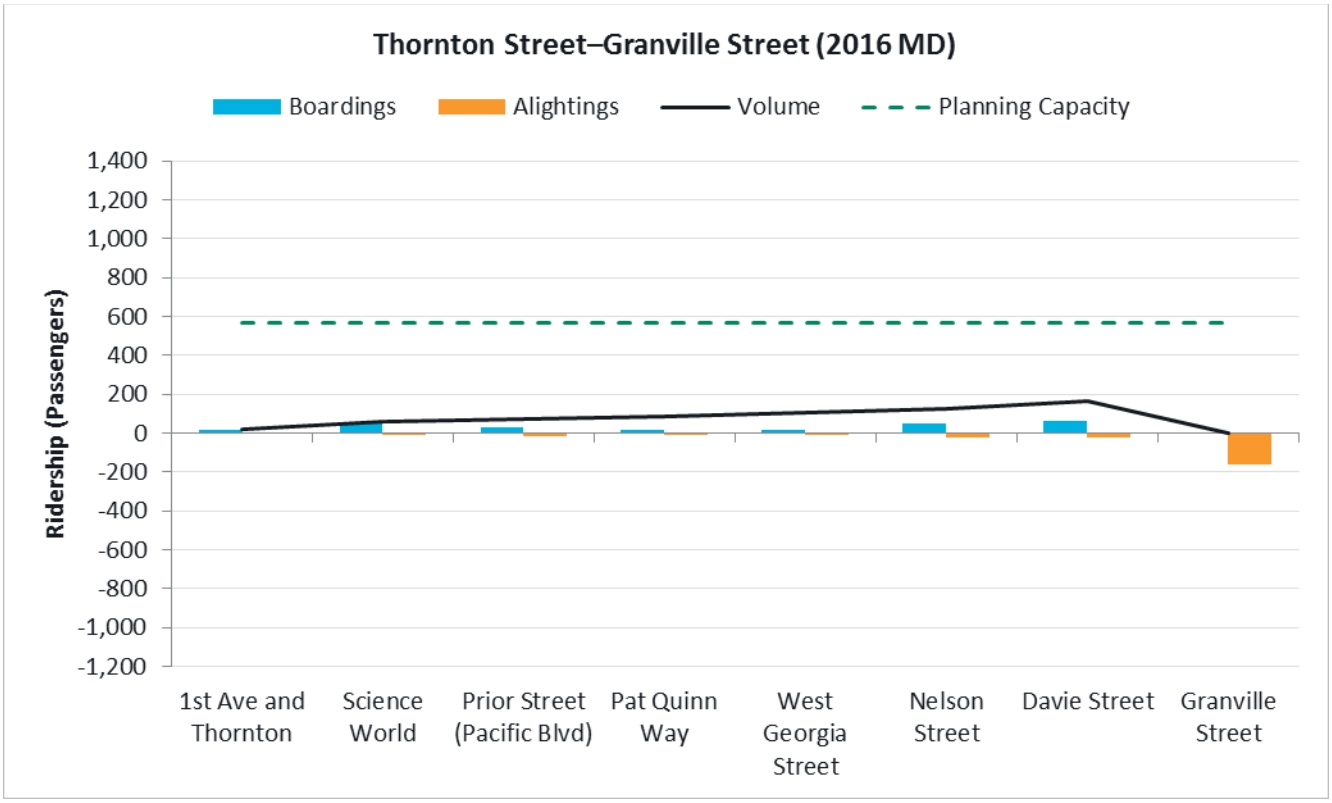

Chilco Street–West Broadway (2016 AM)
Boardings
Alightings
Volume
Planning Capacity
Ridership (Passengers)
1,600
1,400
1,200
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
-1,200
Chilco Street
Denman Street
Cardero Street
Jervis Street
Thurlow Street
Canada Place
Waterfront
Abbott Street (Cordova St)
Hastings Street
Prior Street (Quebec St)
Science World
Manitoba Street
Cook Street
Cambie Street
Sitka Square
Granville Island
6th Ave and Burrard
Broadway and Arbutus

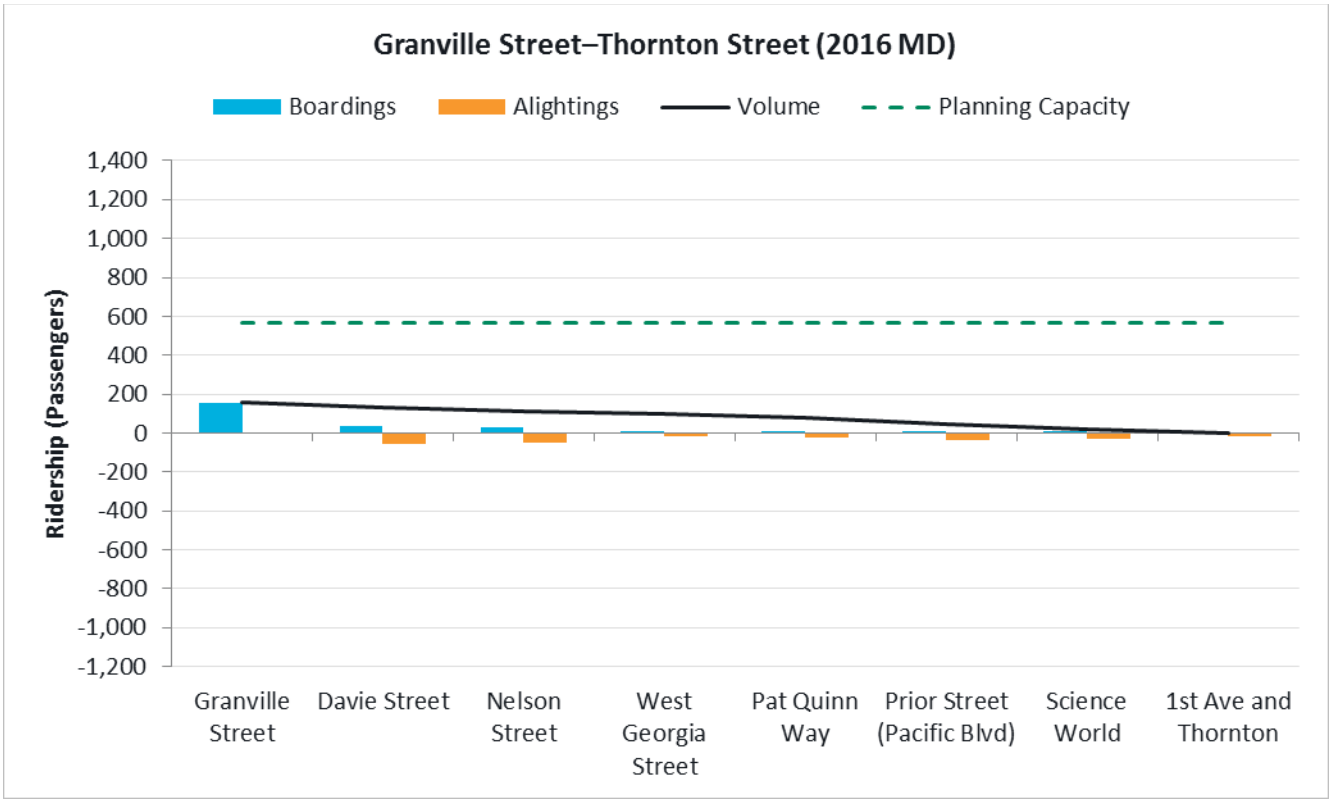

Thornton Street–Granville Street (2016 AM)
Boardings
Alightings
Volume
Planning Capacity
Ridership (Passengers)
1,400
1,200
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
-1,200
1st Ave and Thornton
Science World
Prior Street (Pacific Blvd)
Pat Quinn Way
West Georgia Street
Nelson Street
Davie Street
Granville Street


Granville Street–Thornton Street (2016 AM)
Boardings
Alightings
Volume
Planning Capacity
Ridership (Passengers)
1,400
1,200
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
-1,200
Granville Street
Davie Street
Nelson Street
West Georgia Street
Pat Quinn Way
Prior Street (Pacific Blvd)
Science World
1st Ave and Thornton

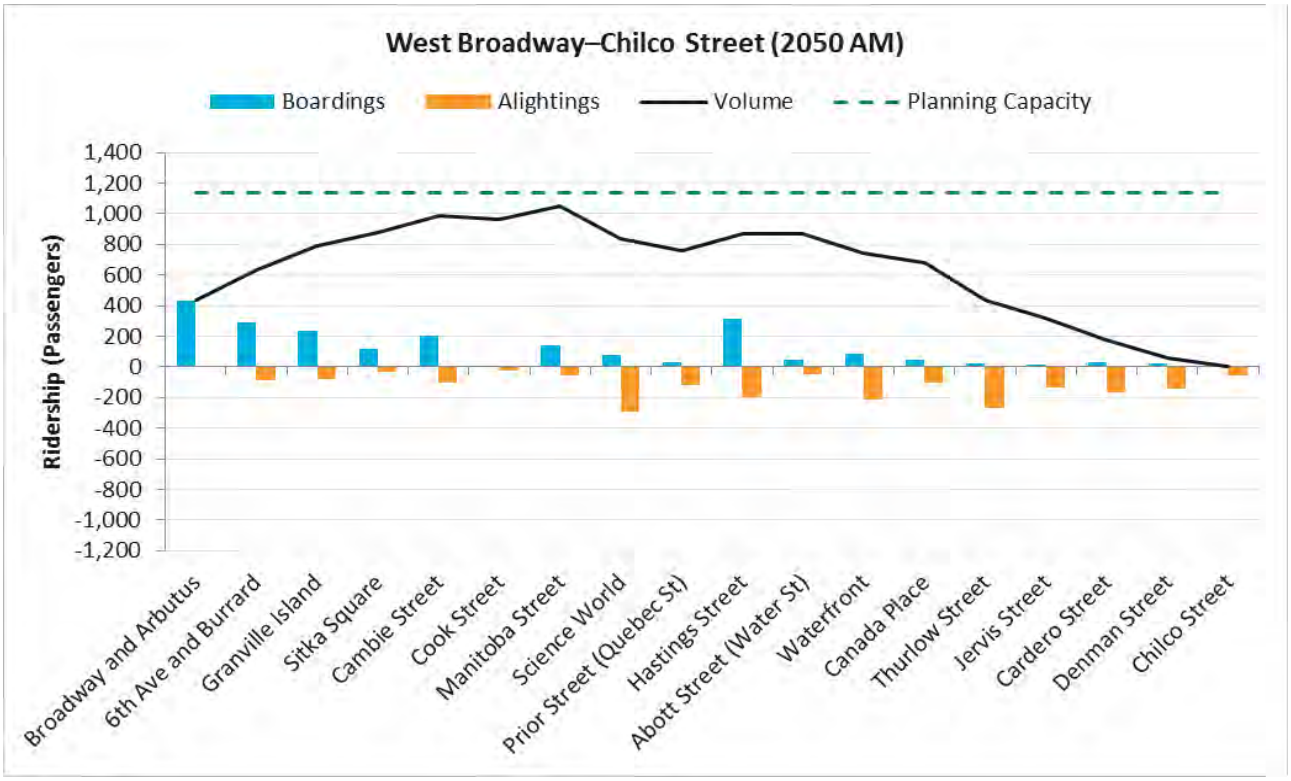

West Broadway–Chilco Street (2016 MD)
Boardings
Alightings
Volume
Planning Capacity
Ridership (Passengers)
1,400
1,200
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
-1,200
Broadway and Arbutus
6th Ave and Burrard
Granville Island
Sitka Square
Cambie Street
Cook Street
Manitoba Street
Science World
Prior Street (Quebec St)
Hastings Street
Abott Street (Water St)
Waterfront
Canada Place
Thurlow Street
Jervis Street
Cardero Street
Denman Street
Chilco Street

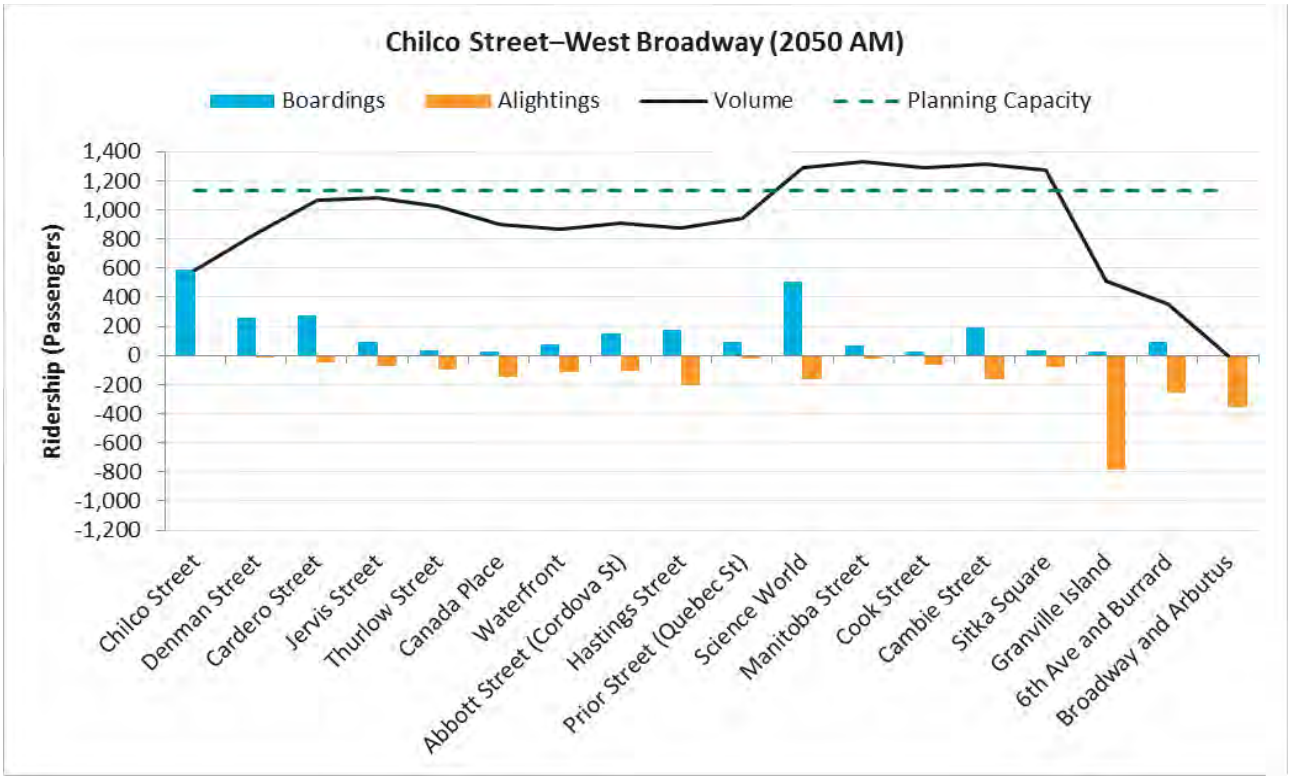

Chilco Street–West Broadway (2016 MD)
Boardings
Alightings
Volume
Planning Capacity
Ridership (Passengers)
1,400
1,200
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
-1,200
Chilco Street
Denman Street
Cardero Street
Jervis Street
Thurlow Street
Canada Place
Waterfront
Abbott Street (Cordova St)
Hastings Street
Prior Street (Quebec St)
Science World
Manitoba Street
Cook Street
Cambie Street
Sitka Square
Granville Island
6th Ave and Burrard
Broadway and Arbutus

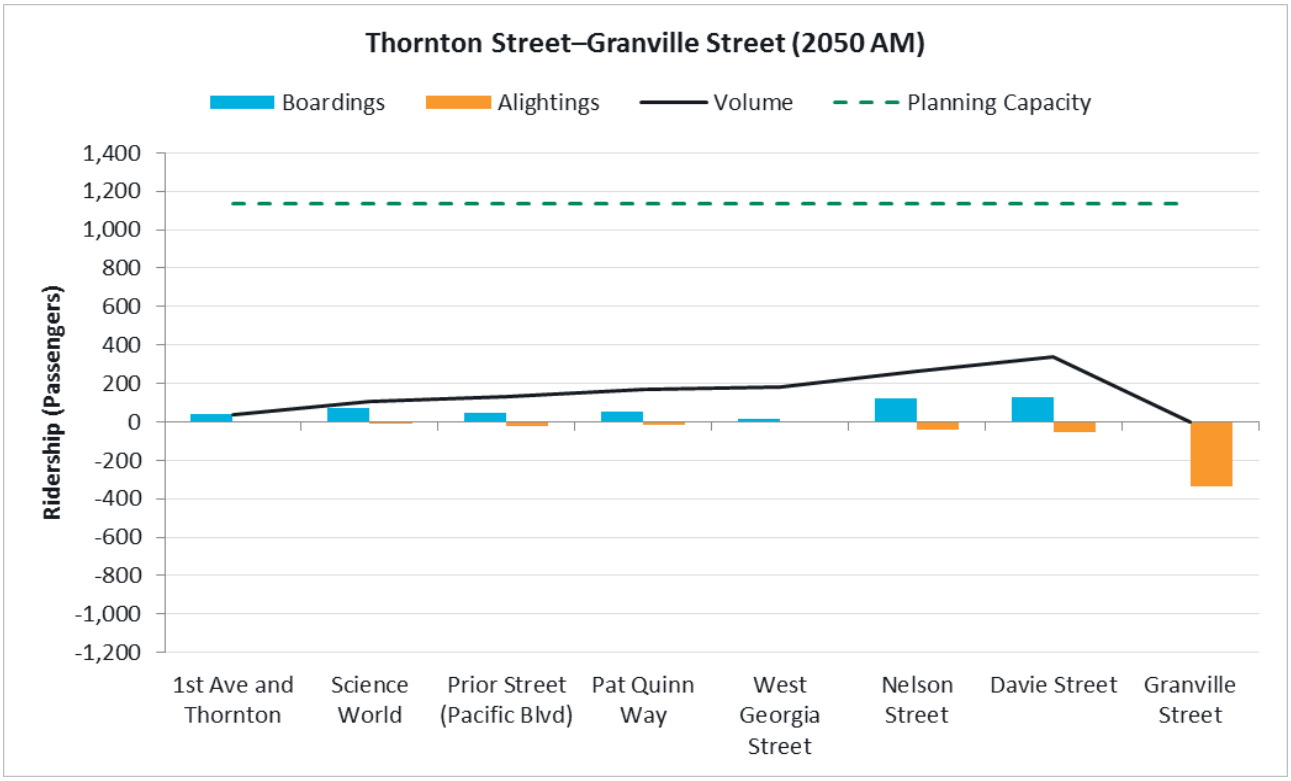

Thornton Street–Granville Street (2016 MD)
Boardings
Alightings
Volume
Planning Capacity
Ridership (Passengers)
1,400
1,200
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
-1,200
1st Ave and Thornton
Science World
Prior Street (Pacific Blvd)
Pat Quinn Way
West Georgia Street
Nelson Street
Davie Street
Granville Street

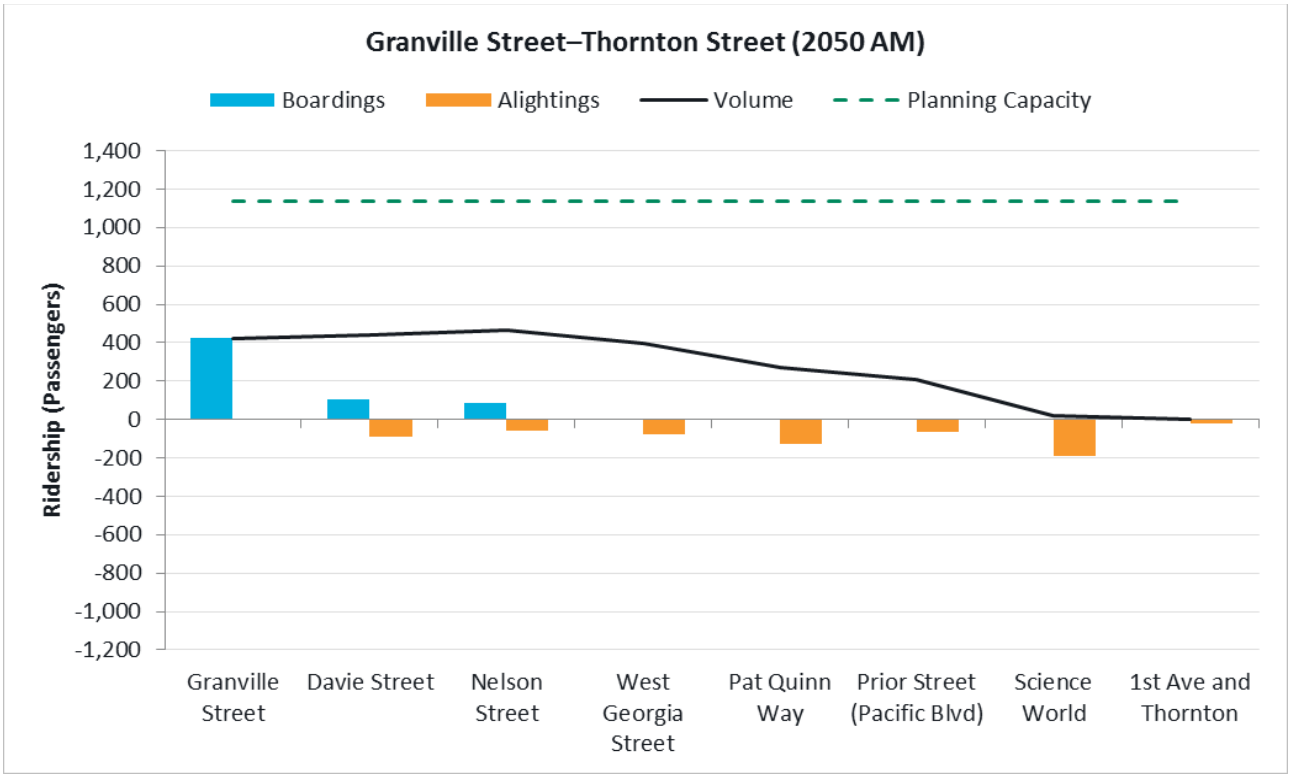

Granville Street–Thornton Street (2016 MD)
Boardings
Alightings
Volume
Planning Capacity
Ridership (Passengers)
1,400
1,200
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
-1,200
Granville Street
Davie Street
Nelson Street
West Georgia Street
Pat Quinn Way
Prior Street (Pacific Blvd)
Science World
1st Ave and Thornton

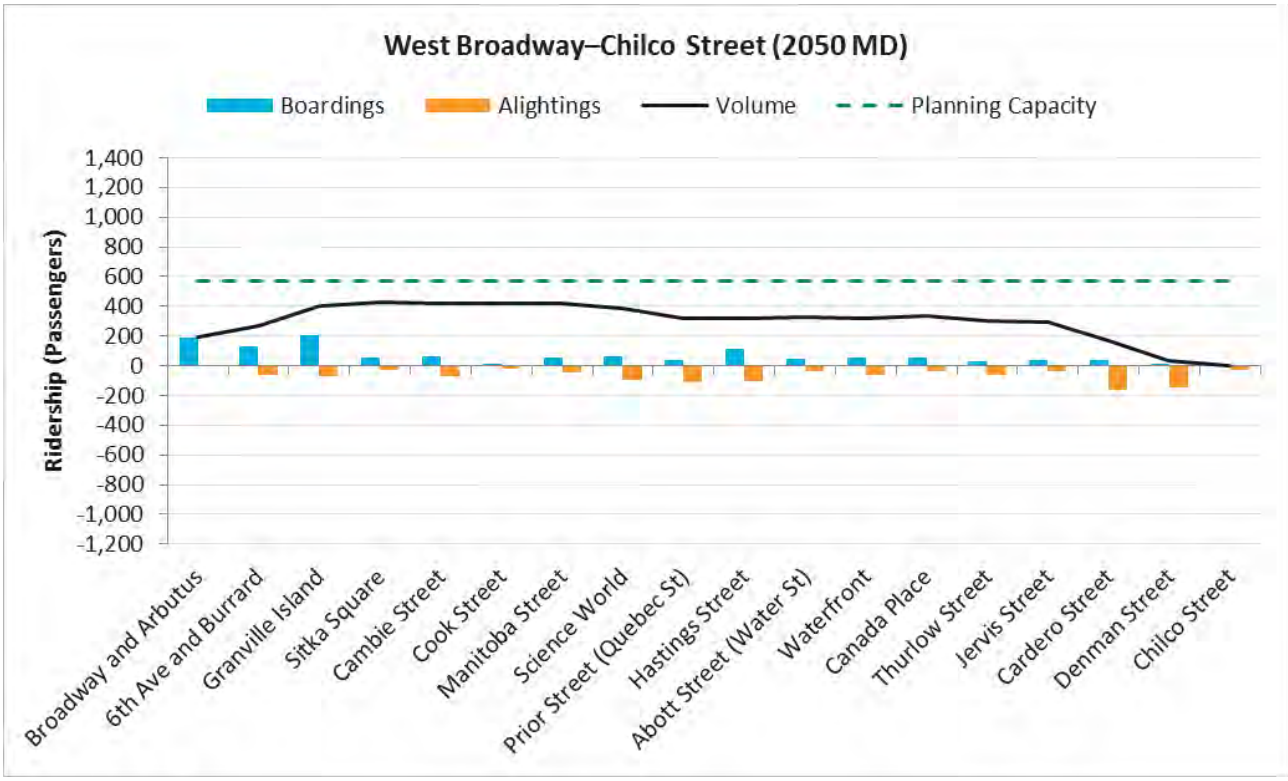
K. 2050 AM and Midday Hourly Ridership



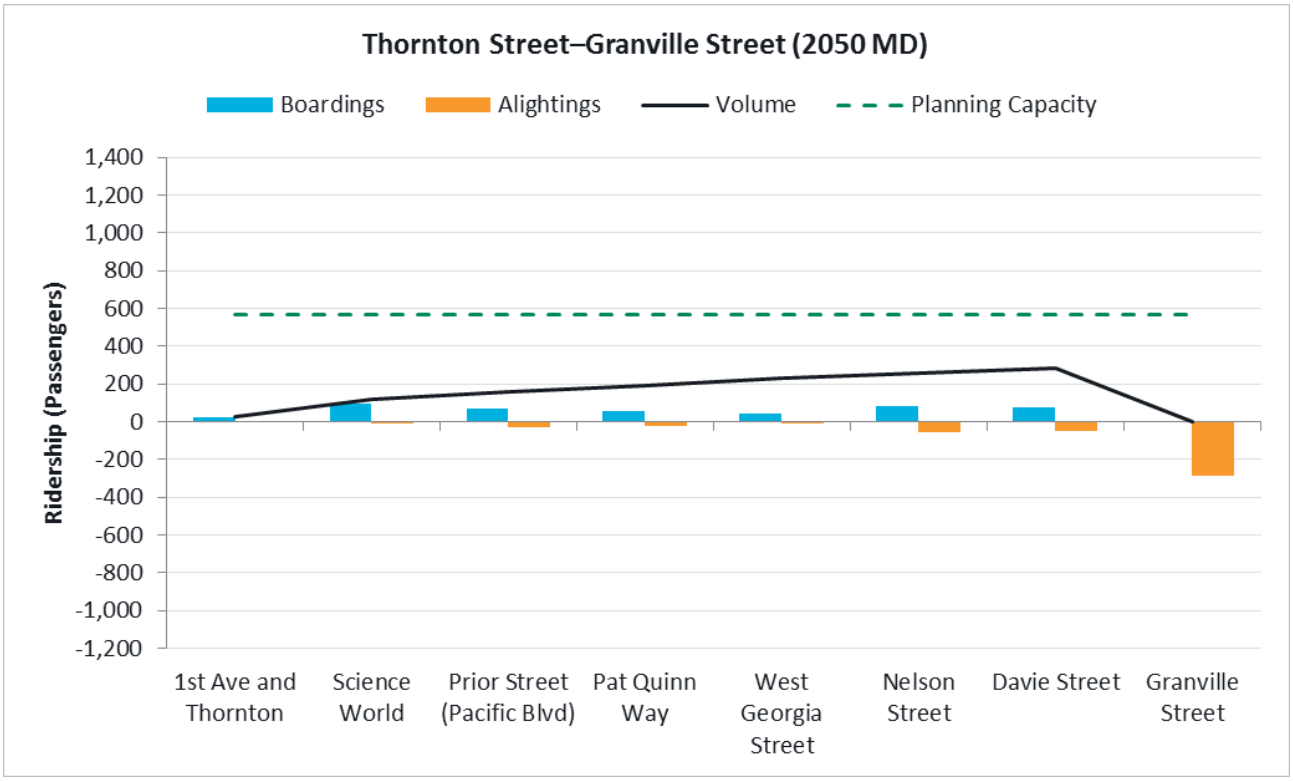

Chilco Street–West Broadway (2050 AM)
Boardings
Alightings
Volume
Planning Capacity
Ridership (Passengers)
1,400
1,200
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
-1,200
Chilco Street
Denman Street
Cardero Street
Jervis Street
Thurlow Street
Canada Place
Waterfront
Abbott Street (Cordova St)
Hastings Street
Prior Street (Quebec St)
Science World
Manitoba Street
Cook Street
Cambie Street
Sitka Square
Granville Island
6th Ave and Burrard
Broadway and Arbutus

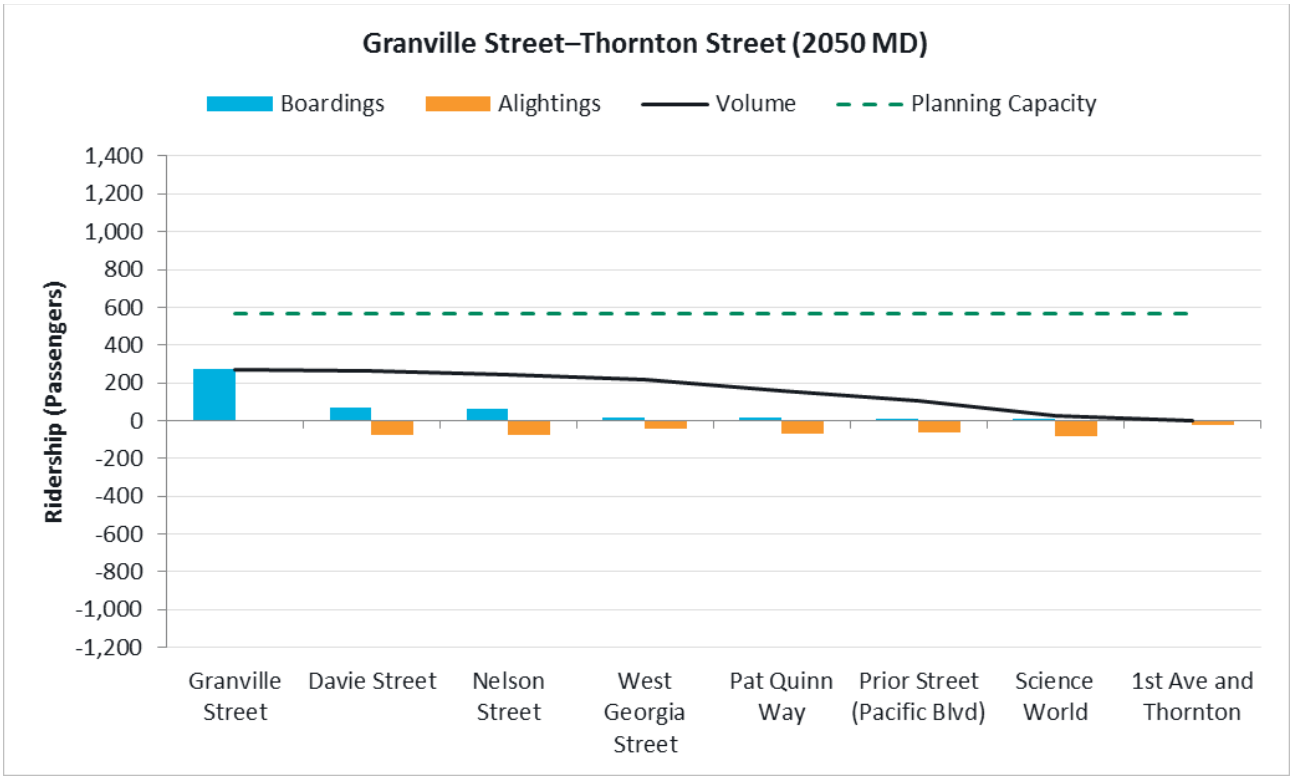

Thornton Street–Granville Street (2050 AM)
Boardings
Alightings
Volume
Planning Capacity
Ridership (Passengers)
1,400
1,200
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
-1,200
1st Ave and Thornton
Science World
Prior Street (Pacific Blvd)
Pat Quinn Way
West Georgia Street
Nelson Street
Davie Street
Granville Street


Granville Street–Thornton Street (2050 AM)
Boardings
Alightings
Volume
Planning Capacity
Ridership (Passengers)
1,400
1,200
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
-1,200
Granville Street
Davie Street
Nelson Street
West Georgia Street
Pat Quinn Way
Prior Street (Pacific Blvd)
Science World
1st Ave and Thornton


West Broadway–Chilco Street (2050 MD)
Boardings
Alightings
Volume
Planning Capacity
Ridership (Passengers)
1,400
1,200
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
-1,200
Broadway and Arbutus
6th Ave and Burrard
Granville Island
Sitka Square
Cambie Street
Cook Street
Manitoba Street
Science World
Prior Street (Quebec St)
Hastings Street
Abott Street (Water St)
Waterfront
Canada Place
Thurlow Street
Jervis Street
Cardero Street
Denman Street
Chilco Street


Chilco Street–West Broadway (2050 MD)
Boardings
Alightings
Volume
Planning Capacity
Ridership (Passengers)
1,400
1,200
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
-1,200
Chilco Street
Denman Street
Cardero Street
Jervis Street
Thurlow Street
Canada Place
Waterfront
Abbott Street (Cordova St)
Hastings Street
Prior Street (Quebec St)
Science World
Manitoba Street
Cook Street
Cambie Street
Sitka Square
Granville Island
6th Ave and Burrard
Broadway and Arbutus


Thornton Street–Granville Street (2050 MD)
Boardings
Alightings
Volume
Planning Capacity
Ridership (Passengers)
1,400
1,200
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
-1,200
1st Ave and Thornton
Science World
Prior Street (Pacific Blvd)
Pat Quinn Way
West Georgia Street
Nelson Street
Davie Street
Granville Street


Granville Street–Thornton Street (2050 MD)
Boardings
Alightings
Volume
Planning Capacity
Ridership (Passengers)
1,400
1,200
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
-1,200
Granville Street
Davie Street
Nelson Street
West Georgia Street
Pat Quinn Way
Prior Street (Pacific Blvd)
Science World
1st Ave and Thornton

L. Basis of Estimate

Note: Basis of Estimate was produced with the assumption that 22 vehicles would be purchased for the Vancouver Streetcar network. Only 15 vehicles are required to service the two lines (Arbutus/Broadway to Chilco Street and East 1st Avenue/Thornton Street to Granville Street/Drake Street) and an additional 15% required for spares taking the total number vehicles required to 18. This number has been taken into consideration for the Cost Estimate in Section 5.

CITY OF VANCOUVER STREET CAR

FEASIBILITY STUDY

CONCEPTUAL DESIGN ESTIMATE

14th January 2019

INTRODUCTION

The Basis and Scope of the City of Vancouver Feasibility Study Conceptual Design Estimate, describes the work included in the estimates necessary to design, construct, and implement the Vancouver Street Car Project. The estimates are provided for three alignments, the overall scope of which are described in this Feasibility Study Report.

The estimates are conceptual and prepared in advance of preliminary or detailed design, but are all prepared on the same basis, to provide a direct comparison of costs. This document sets out the basis and assumptions included within the estimates, and the basis of the costs used.

It is understood that it is not likely that the work will be carried out in the immediate future, and although the estimates represent the costs as if the project was commenced in early 2019, these costs will need to be up-dated to reflect the actual commencement date. This up-date will reflect inflation, changes in bye-laws, changes in environmental requirements, the market conditions at the time of project implementation, and the current building codes at the time it is intended to proceed with the project.

An estimate for a City of Vancouver Street Car was prepared in June 2005, which set out a lower estimate for this project. The increases between the 2005 and this estimate include the following:

- Inflation of between 55% and 65%
- The length is 2.5 times longer than previously
- The number of vehicles previously included were 6, this estimate includes 22
- The vehicles were semi-low floor of a basic simple design, the current vehicle assumption is full low floor, with a more modern design.
- The utility relocation estimate has increased considerably due to current trends of utility companies requiring extensive relocation work, and the work becoming more complex
- The maintenance facility was assumed to be a minimal facility to store 6 cars, less than 30% of the size included within the estimate
- Financing interest during construction has been increased from 3% to 4% to reflect current trends in financial forecasting
- The trend since 2005 for construction to be subject to stricter bye-laws, less tolerance for traffic impact, and increases in environmental requirements.

BASIS OF ESTIMATE

1. The alignments are based upon drawings, alignments, and concepts set out in the Feasibility Study.

2. The estimates have been prepared with the use of historical knowledge and current pricing levels.

3. The estimates are to cover all costs associated with the implementation of the project from the period commencing with the set-up of the project management group until the Street Car is ready for revenue service.

4. The construction prices are assuming the use of pricing obtained from competitive tenders, with minimal restrictions on construction methodology and without onerous contractual conditions which would be reflected in a contract price

5. The management for this project is anticipated to be a dedicated design, project, and construction management group to similar to that used on transit projects implemented in the Lower Mainland.

6. Procurement is assumed to be design, tender and procure, and build. As noted in the feasibility study there are other options including design build, design build and operate with the possibility of including finance. These options will change the risk profile, but the final cost may only change noticeably if the party implementing the project is permitted to use any design without restriction.

7. The schedule assumed for the construction and implementation of the project is based on the project commencing in early 2019 to the following schedule:

    - Design, engineering, and documentation – 15 months
    - Procurement including tender preparation and award – 6 months
    - Construction – 51 months

8. Inflation is included to cover the above schedule; but will need to be adjusted to cover the period between the date of this Feasibility Study and the date the project commences. This inflation adjustment will also include the other factors that may influence costs noted in the introduction.

9. The inflation levels assumed in the estimate for the above project implementation period is as follows:

Element	Prior to Contract Award	During Construction
Civil and Building Works	3.5% per annum	2.5% per annum
Systems	2.5% per annum	2.0% per annum

10. The estimate is based upon an opinion of cost that creates a preliminary estimate with assumptions and allowances covering work that cannot be quantified, which will need to be reviewed as the project becomes more clearly defined; and adjusted as necessary to reflect any changes in scope and levels of pricing.

11. The estimate excludes Property Costs, as noted below. These costs could be significant, especially related to the property purchase for the Operating and Maintenance Facility, and possibly to those costs associated with local disruption and partial property acquisition. It is not known what the property estimate would be, but it is conceivable the costs will be over $50 million, and could be perhaps be $150 million or even more, based on zoning and the property market at the time of project implementation. It is recommended that a Property Professional from within the City, or an independent consultant, is consulted to provide possible costs. It is also possible that high property costs may result in route changes, or design changes to the Operating and Maintenance Facility to reduce the effect of Property Costs.

12. The estimates exclude the following:

    a) All costs associated with managing and operating the Street Car Operating Organisation.
    b) Any major power up-grades to the existing B.C. Hydro power supply
    c) Fare collection, except for a tap on and off two fare card readers per vehicle
    d) Property costs
    e) Re-routing of existing transit services, either temporarily or permanently.
    f) Street works beyond the transit routes
    g) Physical barriers at street crossings
    h) Joint development costs or opportunities
    i) Studies prior to project commencement
    j) Park and ride facilities
    k) Bus loops or any other work that may be required to the existing transit facilities
    l) Vehicle mock-ups
    m) Operating spares
    n) Operating costs
    o) GST

SCOPE OF THE WORKS

1. Stations

A separated station area with a paved platform raised to allow for access to a low floor vehicle. The station platforms are all 35 metres long, with an access ramp to one end. The side platform stations include a 3 metre wide platform. The centre platform stations include for a 4 metre wide platform, except for a 6 metre wide platform to the end station at the Chilco Loop

Each station platform includes the following:

- Platform structure including foundations
- Wheel-chair ramp to one end of the platform
- A passenger shelter to each platform, similar to the design used on the Granville Island Winter Olympic LRT line
- Platform finishes, consisting of patterned concrete with a platform edge tile including a tactile strip for impaired access
- Platform drainage

- Lighting to the platform and access ramp
- Signage
- Four CCTV cameras per station
- Two dynamic train arrival signs per station
- Furniture, including seating, notice board, and garbage receptacles
- Service connections to the stations

2. Track and Track-bed

Site preparation necessary to construct the track-bed, removing existing street paving and trackwork where necessary, and contaminated material removal.

The reinforced concrete structure to support and operate the running system which includes the designed to take support the trackwork. The track-bed with be either segregated with kerbs to separate the track bed from the traffic; or finished at road surface level to allow for mixed transit and traffic use. In various areas, where appropriate a green track finish has been included.

Street trackwork comprises of insulated embedded track consisting of Ri 50 grooved rail set into the track-bed, together with turn-outs as required for the alignment.

3. Systems

The provision of the power supply and distribution system together with the signalling necessary to operate the Street Car, including the following

- Construction of ducting necessary for the power supply and signalling
- Single wire auto-tension overhead contact power supply system
- One megawatt traction power sub-station equipment packaged units at approximately 1.5 kilometre centres
- High voltage power connections between sub-stations
- Low voltage power distribution cables
- S.C.A.D.A. necessary to control and monitor power supply, security and train control systems
- Line of sight operation signalling system

4. Roadworks

The roadworks cover widening and alterations that are directly required to construct the transitway. The works includes the following:

- Removing the road surface, medians, and sidewalks as necessary to accommodate the LRT guideway
- Mill and re-surface all roads where work has been carried out to accommodate the LRT guideway
- Bike lanes and parking lanes
- Work to traffic intersections to accommodate the LRT line
- Additional traffic signals necessary to operate the Street Car system.

- Drainage improvements as necessary to accommodate additional drainage issues that may become apparent due to the construction of the LRT System.
- Traffic management

5. Utility Relocation

The estimate is an allowance based on other transit estimate details prepared for other transit projects within the Lower Mainland. This estimate will need to be reviewed and revised as knowledge of the utility impacts become better understood. This is a high risk element the overall estimate, which could lead to a review of the transit route in areas where utility impacts require a disproportionate quantity of work to relocate a utility.

6. Landscaping

A general allowance landscaping along the transitway

7. Vehicle Maintenance and Storage Facility

Each alignment option has a Vehicle Maintenance and Storage facility that varies in size as follows:

	Option 1	Option 2	Option 3
Area	11,750 m2	21,900 m2	23,000 m2
Track Length	1,325 metres	1,780 metres	2,190 metres
Work-shop, Office, and Storage Building	2,955 m2	2,744 m2	2,943 m2
Wash Plant	1	1	1
Sub-station	1	1	1
Parking Area	1,284 m2	1,472 m2	1,280 m2

The work-shop, office, and storage building is assumed to be an industrial type building with some minor architectural enhancement.

The estimate for the maintenance facility includes an allowance of $10,000,000 for maintenance equipment.

8. Testing and Commissioning

Testing and commissioning the complete system, including power for testing
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9. Management, Design and Engineering

Design of the complete system, including architectural, civil and system works both prior to construction commencing and providing design support through construction. The estimate is based upon an allowance of between 7% of construction costs. This service will need to be reviewed once the procurement strategy is finalised

10. Project Management

Project management services for the project that cover the general management by project staff and consultants for the duration of the project. This will include overall management, planning, procurement, systems integration, cost and schedule control, estimating, quality assurance, environmental control, offices, and operational costs. The estimate is based upon an allowance of 7.5% of construction costs

11. Construction management

Construction management services during the construction stage of the project. This includes overall management on behalf of the project, owner's representation, general supervision and co-ordination, contract management, safety monitoring, environmental monitoring, general administration, and offices for site based project staff. The estimate is based upon an allowance of 6.5% of construction costs. This service will need to be reviewed once the procurement strategy is finalised

12. Environmental

Environmental assessment and permitting, and First Nation co-ordination.

13. Operation Preparation

Planning of operations including general planning and training prior to opening. Setting up the operating entity, and the supply of uniforms and furniture.

14. Insurance and Bonding

Overall project insurance and bonding covering all construction and professional liability insurance together with bonding is included at 2% of the total costs

15. Vehicles

22 Low floor light rail transit vehicle 30 metres long

16. Contingencies

Contingencies are included as 25% of the construction, design, and management estimates to cover the following risks:

- Alignment refinement
- Design development
- Unforeseen ground conditions
- Co-ordination with third parties
- Commercial risk
- Procurement and tendering risk

- Contract reserve during construction
- Schedule delay

There is also a 5% contingency applied to the vehicle costs, as the actual price is dependant upon current vehicles orders at the time of procurement, regulatory changes, and rates of exchange.

17. IDC

IDC, interest during construction, is the financing interest on all capital expenditure over the project implementation period, a borrowing rate of 4% is assumed.

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