TECHNICAL MEMO

Oxford Street Assessment

Prepared by: L. He, P. Eng., Project Engineer
Reviewed by: R. Choy, P. Eng., Manager of Engineering
Approved by: J. Gordon, P. Eng., Director of
Engineering & Operations Department
877 Keil Street
White Rock, BC V4B 4V6
OPERATIONS@WHITEROCKCITY.CA

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Executive Summary

An accident occurred on May 24, 2021, where a northbound truck on Oxford Street lost control and slid back into a private property. The homeowner and community members expressed concern about the safety of the road. Staff investigated existing safety measures and explored potential improvements.

Oxford Street follows a natural topography. The average grade on Oxford Street between Oxenham Avenue and Gordon Avenue is approximately 20% although some sections have been measured at up to 25%. New roadways with a similar classification in the Lower Mainland are designed to 12%, but there are much steeper sections of older streets such as Oak Street south of 6th Avenue in Vancouver. Several Streets in San Francisco and Los Angles have grades between 30% and 35%.

An option of regrading Oxford Street to flatten the grades is explored in this report but involves closing the adjoining streets and possibly driveway accesses as well. A second option of converting Oxford Street to one way southbound is also investigated but would reduce access to the City road network. A further detailed investigation would be needed to see if the challenges for either of these options can be mitigated to the extent that they are feasible.

Immediate improvements to the existing safety measures and warning signs are identified in this report and scheduled to be implemented. The road surface traction can be improved with High Friction Surface Treatment (HFST), which can be integrated into the City's capital program as medium-term actions.

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1. Background

On May 24, 2021, a pickup truck could not climb up Oxford Street hill during a heavy rain event, lost control between Roper Avenue and Prospect Avenue, reversed into the garage of an adjacent property and caused damages.

2. Existing Conditions

2.1 Road classification and configurations

Oxford Street is classified as a primary connector in the City's transportation network. It connects City's waterfront to the regional major road network (King George Boulevard and Highway 99.

Oxford Street is a two-way street with a 3.5 m wide travel lane for each direction. There is a 1.5 m wide sidewalk on the east side of the street. The posted speed is 30 km/h from Thrift Avenue to Marine Drive, and trucks over 5400 kg are not permitted from Thrift Avenue to Marine Drive. Transit buses also run along Oxford Street between North Bluff Road and Thrift Avenue.

Street parking is allowed on the east side of the street from North Bluff Street to Thrift Avenue. The City provides paid parking on the east side of the street from Marine Drive to Buena Vista Avenue.

The City's GIS shows a 20-meter ROW for Oxford Street. There are six side roads, two lanes, and approximately ten driveways connecting to Oxford Street from Thrift Avenue to Buena Vista Avenue.

Following the natural topography, Oxford Street has steep slopes within the corridor. The overall grade is approximately 20% from Oxenham Avenue to Gordon Avenue, and some sections exceed 25%. A topographical survey is required to identify the accurate slope of the subject corridor for further actions.

2.2 Utilities

There are storm sewers, sanitary sewers, and water mains along the street.
Hydro poles are on the east side of the street and streetlights on the west side of the street.

2.3 Safety features and devices

The following safety measures are provided on Oxford Street (See Appendix 1 for details):

- ✓ Warning signs;
- ✓ Raised concrete medians and traffic circles;
- ✓ W-beam guardrail;
- ✓ Concrete barrier;
- ✓ Barrier curb; and
- ✓ Laddered sidewalk with handrails.

3. Design Guidelines

3.1 Transportation Association of Canada (TAC)

Geometric Design Guide for Canadian Roads from TAC provides the design guide for highway and roadway design throughout Canada. According to the Design Guide, the maximum grade of an UCU (Urban Collector Undivided) is 12% as shown in the following table:

Table 3.3.1: Maximum Gradients[56]

Design Speed (km/h)	30/40/50		60		70		80		90		100		110		120/130	
Topography	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M
RLU	7	11	7	11	6	9	6	8	5	7	5	7	-	-	-	-
RCU	-	-	6	10	6	9	5	8	5	7	5	7	-	-	-	-
RCD	-	-	-	-	6	9	5	8	5	7	5	7	-	-	-	-
RAU	-	-	-	-	-	-	4	7	4	6	3	6	3	6	3	5
RAD	-	-	-	-	-	-	4	7	4	6	3	6	3	5	3	5
RFD	-	-	-	-	-	-	-	-	-	-	3	5	3	5	3	5
ULU-Residential	8	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ULU-Industrial-Commercial	6	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UCU- Residential	8	12	7	11	7	10	-	-	-	-	-	-	-	-	-	-
UCU-Industrial-Commercial	6	12	6	11	6	9	6	8	-	-	-	-	-	-	-	-
UCD	6	10	6	9	5	8	5	7	-	-	-	-	-	-	-	-
UAU	6	10	6	6	5	8	5	7	-	-	-	-	-	-	-	-
UAD	-	-	3	6	3	6	3	6	3	6	3	5	-	-	-	-
UED	-	-	-	-	-	-	5	6	4	5	4	5	4	5	3	5
UFD	-	-	-	-	-	-	-	-	4	5	3	5	3	5	3	5

Notes:
1. Short grades less than 150 m in length, and one-way downgrades may be 1% higher on urban roads, and 2% higher on low volume rural roads
2. R refers to rolling topography
3. M refers to mountainous topography.

3.2 Practices of other municipalities in Lower Mainland

A grade of 12% is specified as the maximum for city roads in the design criteria by the City of Surrey, Burnaby and Vancouver.

4. Discussion of Oxford Street Improvements

In response to the safety concern on Oxford Street, we are preparing the following options for consideration:

4.1 Potential immediate actions

Road closure

Adding to the current policy of road closure on snowy days, the City could expand road closure in bad weather including heavy rain events. However, the action can hardly be implemented effectively in a timely manner due to the difficulty in the consensus of “bad weather” or “heavy rain” mostly based on personal preference and driving skills, the unpredictability of when rain events will start and stop, and the costs and practicality of having a labourer on standby to close and open the roadway given the frequency of rain event.

Traffic signs

A warning sign “steep slope” is recommended to be installed before the intersection at Buena Vista Avenue for northbound uphill traffic although the steep signs are normally installed for downslope traffic.

This warning sign will remind drivers of a steep slope ahead and give them a chance to turn right into Buena Vista Avenue instead of heading up the steep slope.
For a better visibility, relocate the existing warning sign “steep slope“ ahead of the intersection at Thrift Avenue for the southbound traffic. Also, the advanced warning information would remind drivers of a steep slope ahead and give them a chance to make a left turn into Thrift Avenue instead of heading down the steep slope.

4.2 Potential medium-term actions

Speed bumps/humps

Speed bumps/humps have been suggested for Oxford Street Improvements.

According to *Urban Street Design Guide*, “Speed humps are parabolic vertical traffic calming devices intended to slow traffic speeds on low volume, low-speed roads”. “Speed humps should be designed to the criteria that slopes should not exceed 1:10 (10%) or be less steep than 1:25 (4%)”.

Given the steep slope along Oxford Street and the maximum slope for speed bumps, speed bumps are not suitable for the situation. Instead, the speed bumps may cause the southbound vehicles down the street to lose control; on the other hand, they also add extra difficulty for northbound vehicles to climb up the hill. Speed bumps will create more risks for vehicles up/down Oxford Street and for the adjacent properties. Additionally, the speed bumps will slow emergency vehicle responses, and increase noise and pollution within the subject corridor.

In terms of traffic calming, the existing curved road edge/curb line, and the raised concrete median are measures to control and slow down the traffic speed. Please refer to Appendix 1 for details.

High Friction Surface Treatments (HFST)

Oxford street was treated with transverse grooving in the asphalt pavement in the past to increase traction. The recent accident implicated that the previous treatment didn’t work well. Oxford Street could be improved with a new High Friction Surface Treatment (HFST).

HFST is a pavement surfacing system with exceptional skid-resistance properties. It involves the application of very high-quality aggregate to the pavement using a polymer binder to restore and/or maintain pavement friction at existing or potential highly crash areas. The higher pavement friction helps motorists maintain better control in both dry and wet driving conditions. The average expected life of HFST is 5-7 years under heavy traffic.

According to Federal Highway Administration (FHA), HFST provides a significant increase in friction for spot application to counter pavement friction reduction due to wet conditions, or high friction demand due to vehicle speed and/or roadway geometrics. Research published by FHWA shows HFST is estimated to reduce wet crashes by 83% and total crashes by 57%. In BC, the Ministry of Transportation and Highways also issued a Technical Bulletin dated September 12, 2018, to guide the application of HFST. According to Ministry’s application of HFST in the Lower Mainland, the Oxford Street improvements will require approximately $100,000 for installation of HFST for 800 m^2 at a unit price of $100/$m^2$ (including contingency) plus additional consulting services for design/tender and testing if required.

4.3 Potential long-term options

The essence of the improvements on Oxford Street is to reduce the grades. The following two options are for discussion:

Re-grading Oxford Street

There are noticeable humps along Oxford Street between Oxenham Avenue to Buena Vista Avenue. These humps resulted mostly by creating a flat landing area for the intersections connecting side roads. The grades can be ameliorated between Hardie Avenue and Buena Vista Avenue by removing these humps. Adding to this removal, the grades can be effectively improved by further excavation supported with retaining walls. To enable this improvement, as shown in the following Figure 1, this option requires closing a few side roads to Oxford Street, including Roper Avenue, MacDonald Avenue, Prospect Lane, Prospect Avenue, and Gordon Avenue. These side roads can be accessed either by Anderson Street from Marin Drive or by Everall Street from Buena Vista Avenue.

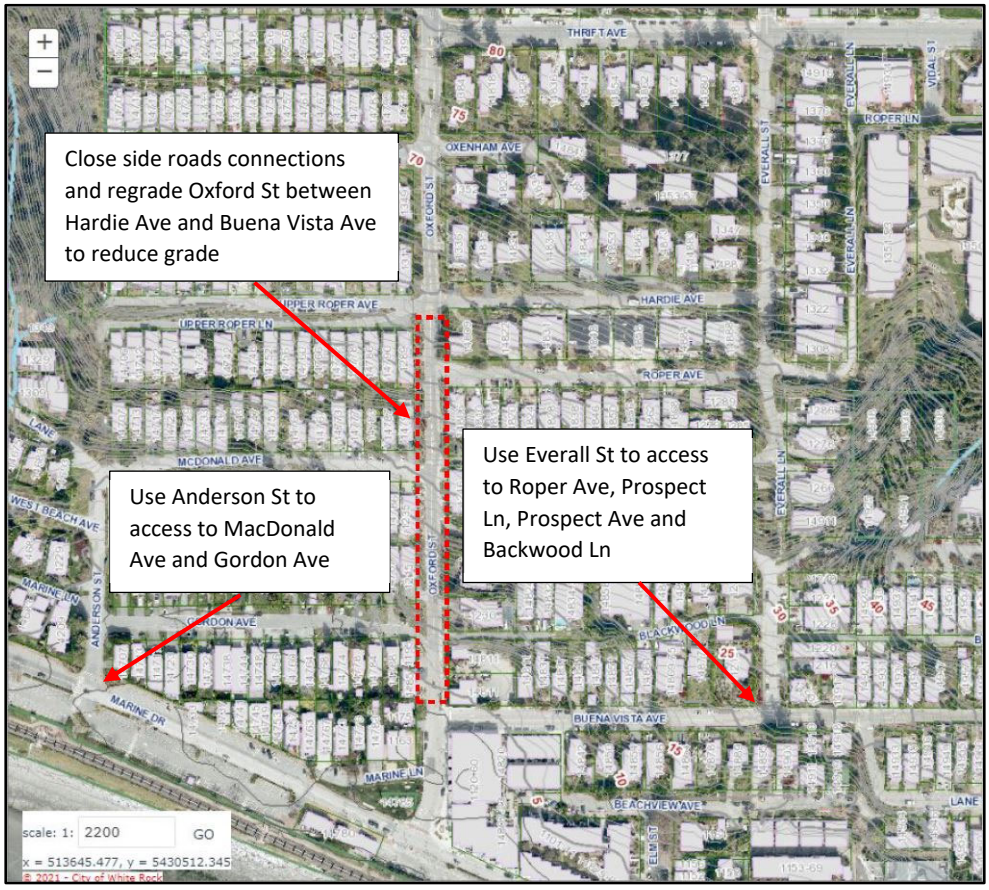

Figure 1-Regrading Oxford Street

The major challenge of this option is the driveway regrading and driveway tie-ins. It may not be possible to regrade the road and maintain driveway access to a number of properties at the same time. Emergency access for fire, police, and ambulance may also be affected. A further study is required to determine the feasibility.

One-way southbound scenic drive

This option converts Oxford Street into a one-way street for the southbound traffic only. The conversion will narrow Oxford Street down to one travel lane, and the one-lane Oxford Street will meander within the 20 m wide road ROW to stretch the length of the street and accordingly reduce the grade. The closed northbound lane can be used to upgrade the sidewalk amenities such as adding a treed boulevard with street furniture and viewpoints for ocean view. This option could create a scenic drive of Oxford Street as exemplified in Figure 2.

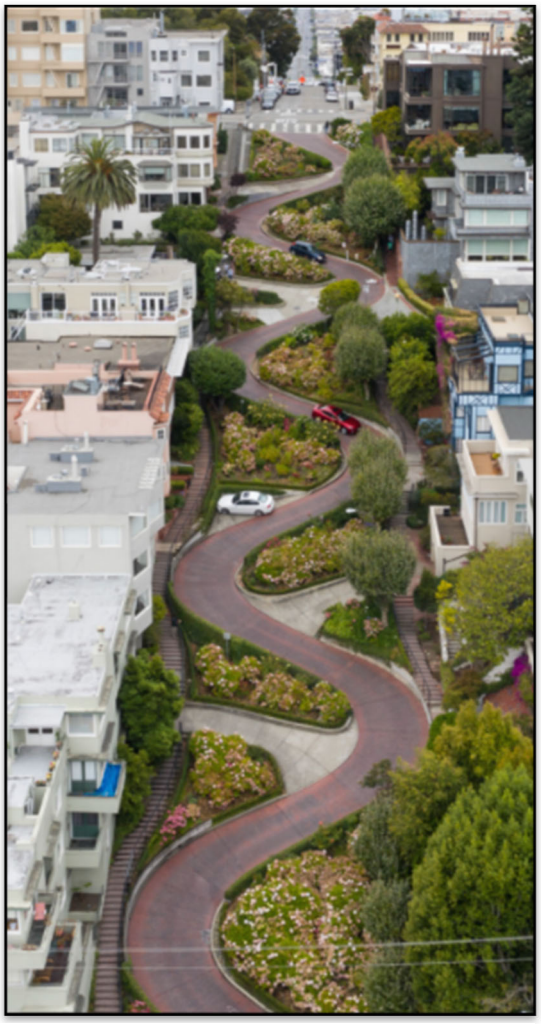

Figure 2-Meandering Scenic Drive (San Francisco Lombard Street from en.wikipedia.org)

As a result, the City's transportation network will lose a direct connection for northbound traffic from City's waterfront to the regional transportation major road network. Consequently, the northbound traffic has to take an eastbound detour along Marine Drive and get back to the regional transportation network (King George Boulevard and Highway 99) through Stayte Street; Marine Drive would be busy with more eastbound traffic while Stayte Street would be filled with more northbound traffic.

To mitigate the impacts, a further study is required to identify an alternative route to divert the northbound traffic on Oxford Street from City's waterfront to the regional transportation major road network. For example, Johnston Road (152 Street) can be extended through to the City's Waterfront, or Finlay Street (156 Street) can be upgraded to accommodate a northbound traffic.

5. Conclusions

In this report, the following options have been considered and evaluated in an order of ease of implementation:

Traffic signs installation;

Expanding road closure in bad weather;

Highway Friction Surface Treatments;

Re-grading Oxford Street; and

One-way southbound scenic drive.

For the time being, traffic signs installation is recommended for the action.

Appendix 1: Existing Safety Features and Devices

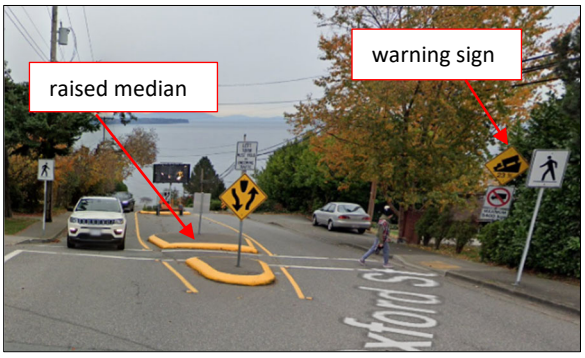

Figure 1-1 Raised median & warning sign

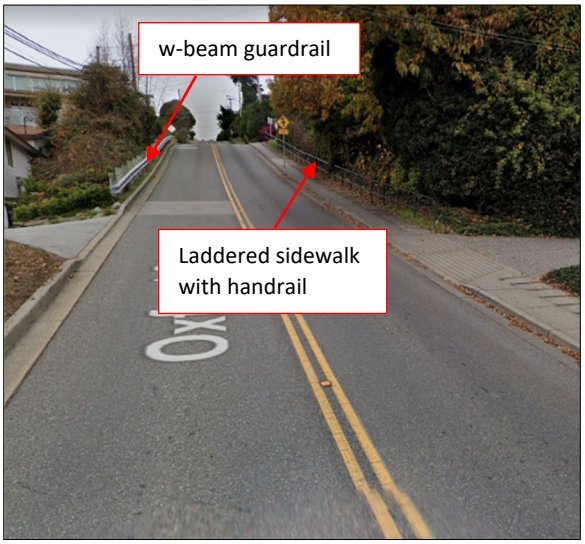

Figure 1-2 W-beam guardrail & laddered sidewalk c/w handrail

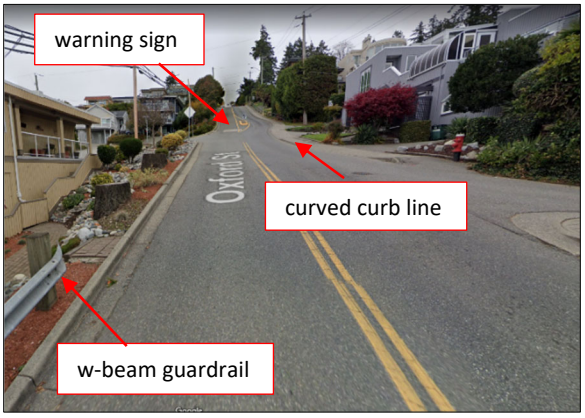

Figure 1-3 W-beam guardrail and curved curb line

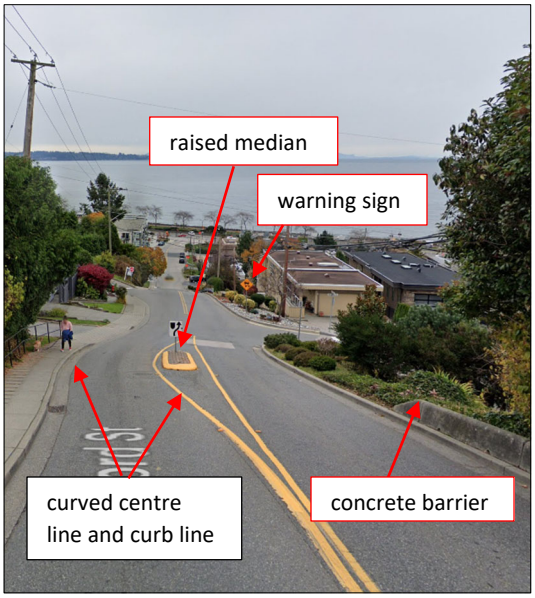

Figure 1-4 Raised median & warning sign

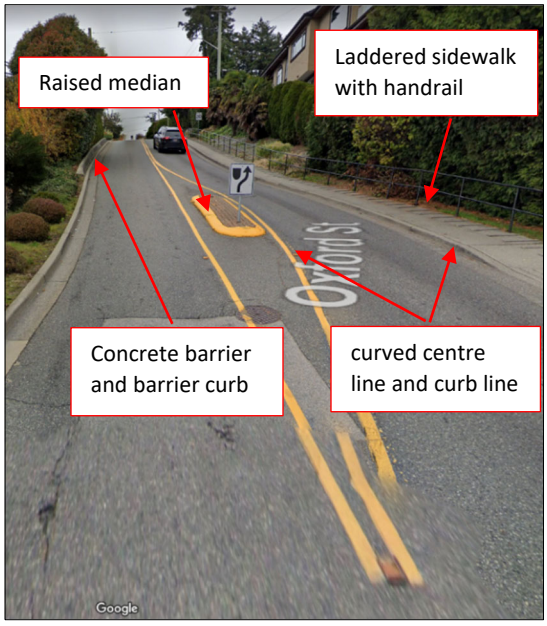

Figure 1-5 Concrete barrier & curved curb line