TECHNICAL MEMORANDUM

DATE June 12, 2025 **Reference No.** 25175 ge mem TARP 0

TO Trudi McClelland, P.Eng.
Urban Systems Ltd.

CC Alex Badea

FROM Ben Dorsey, P.Eng. **EMAIL ben.dorsey@wsp.com**

BASTIN ROAD AT BASTIN HILL EROSION – TRIGGER ACTION RESPONSE PLAN

1.0 INTRODUCTION

Realignment of Bastin Road along with regrading of the slope above the road is proposed to mitigate the risk from ongoing landsliding above and below the road at Bastin Hill (the Site). This Trigger Action Response Plan (TARP) is to supplement the Schedule 3 contract document, which was developed for MOTT Project No. 25175, Bastin Road at Bastin Hill Erosion, and is to be followed throughout project construction. Information regarding the monitoring point installation requirements is provided in the Schedule 3 document.

The TARP outlines the roles and responsibilities of the various parties involved in the Bastin Hill monitoring program and provides trigger values for the locations identified in the monitoring program and a plan outlining actions to be taken at different displacement trigger values.

2.0 TRIGGER ACTION RESPONSE PLAN

This TARP outlines a monitoring and response strategy designed to ensure a safe work environment for personnel operating on or near slopes considered potentially hazardous. It details recommended monitoring methods – such as visual inspections and survey measurements to be used throughout the construction phase. Additionally, the TARP defines specific threshold levels that, if exceeded, will initiate corresponding response actions.

2.1 Monitoring Methods, Trigger Thresholds, and Roles and Responsibilities

Monitoring methods, trigger thresholds for each monitoring method, and responses associated with each trigger threshold are described in Table 1 below. Construction activities can generally proceed in the identified areas under the strict implementation of this TARP.

WSP Canada Inc.
Suite 700 - Landmark 6, 1631 Dickson Avenue, Kelowna, BC
V1Y 0B5V1Y 0B5 Canada
T: (250) 980-5500

Table 1: Bastin Hill Slide Monitoring Program Trigger Action Response Plan (TARP)

Monitoring Method	Trigger Threshold	Response
Daily Visual Inspection **by Ministry Representative and Contractor**	▪ Limited to no visible signs of slope movement or instability	▪ Construction can proceed with no limitations
	▪ Surficial slide resulting in material coming down the slope. ▪ Tension cracking, bulging, disturbance or loss of vegetation along the slope, changed surface drainage patterns.	▪ **Ministry Representative to** immediately pause work activities and block off the area so workers cannot enter. ▪ The **Geotechnical EOR will** complete a site visit immediately following the event to review slope conditions and assess next steps. Increased slope monitoring will be required to determine if the slope has stabilized following a slide event.
Visual Inspection **by the Geotechnical EOR** on a monthly basis	▪ Limited to no visible signs of slope movement or instability.	▪ Construction can proceed with no limitations.
	▪ Tension cracking along the upper part of the slope ▪ Surficial sloughing or bulging ▪ Minor loss or disturbance of vegetation ▪ Water seepage from the slope or changes to surface drainage patterns	▪ Ministry Representative will be informed **by the Geotechnical EOR** that the work activities should be temporarily halted in the impacted area. ▪ The **Geotechnical EOR will** visually monitor the slope on consecutive days to determine if there are any clear signs of ongoing movement that would require an extended closure of the impacted area ▪ **Contractor to complete** additional monitoring surveys **as directed by the Geotechnical EOR and Ministry Representative**. VWP and SI readings **by WSP** should be collected twice daily during the temporary pause to determine if there are any indications of downslope movement or an increase in pore water pressure. ▪ Construction activities can commence in the impacted area if survey readings and visual observations indicate conditions have stabilized. If conditions do not appear to have stabilized, increased visual monitoring, surveys, and VWP/SI readings should be continues until conditions stabilize.
VWP/SI Readings **by Geotechnical EOR Representative**	▪ No increase, or marginal increases in-line with seasonal or average meteorological events, in pore water pressure readings ▪ No movement or less than 2mm displacement observed in SI data	▪ Construction can proceed with no limitations.
	▪ Increases in pore water pressure readings ▪ Slope displacement greater than 2 mm observed in inclinometer data	▪ If the **Geotechnical EOR identifies** a concerning spike in VWP readings or movement in SI readings, they will inform the **Ministry Representative, who will** temporarily pause work activities.

Monitoring Method	Trigger Threshold	Response
		▪ The **Geotechnical EOR will** conduct a site visit within 24 hours of the temporary halt to inspect the slope for any signs of slope instability. ▪ **Additional contractor survey**, **VWP and SI readings by WSP** should be taken twice daily until it is determined that site conditions have started to stabilize. ▪ Based on follow-up survey readings and visual observations, if there are no signs of slope movement, clearance can be provided to continue work activities ▪ The **Geotechnical EOR may** recommend increasing the frequency of survey readings and site visits to monitor the impacted slopes more closely following the temporary pause.
Total-Station Survey-Based Movement Monitoring System **by Contractor**	▪ Negligible slope movements recorded (within error range of 1-2 mm)	▪ Construction can proceed with no limitations.
	▪ Slope movements of greater than 5 mm downslope	▪ The **Geotechnical EOR will** inform the Ministry Representative, who will pause work activities below the specific slope sections ▪ **Contractor will** complete another survey to confirm if the movement was due to error. VWP and SI readings should be collected **by WSP**. ▪ If, after two or more days of readings, conditions appear to have stabilized, work activities can proceed in the affected area. ▪ Survey readings **by the Contractor** should continue to be taken twice daily.
Forecasted Rainfall exceeding pre-determined threshold limits monitored **by Ministry Representative**	▪ Weather forecast from nearest station calling for precipitation that exceeds either 15 mm over a period of 24 hours, or 25 mm over a period of 48 hours	▪ **Ministry Representative to** pause work activities in the vicinity of the slopes in advance of forecasted rain events that exceed target thresholds ▪ **Geotechnical EOR** to visit the site within 24 hours of completion of the precipitation event to review the site slopes for any indications of instability ▪ Additional survey readings **by the Contractor** and two sets of VWP and SI readings **by WSP** should be taken within the 24-hour period following completion of the forecasted rain event. If there are no signs of instability, site activities can resume in the impacted area.
Heavy Rainfall Events monitored **by Ministry Representative**	▪ Heavy on-site rainfall leading to the saturation of the ground and surface water build-up and/or ponding	▪ Pause work activities. **Ministry Representative to** contact the Geotechnical EOR to have them or a qualified member of the geotechnical engineering team travel to site to observe slope conditions.

Monitoring Method	Trigger Threshold	Response
	▪ Ongoing precipitation of greater than 15 mm over a period of 24 hours, or greater than 25 mm over a period of 48 hours resulting in ground saturation and surface water build-up and/or ponding	Work activities can resume if there are no signs of slope instability. ▪ Survey readings **by Contractor** may continue to be read twice daily. It is recommended for **WSP to complete** VWP and SI readings every 12 hours for 1 week following a heavy rainfall event to more closely monitor slope conditions. ▪ VWP and SI reading frequency **by WSP** can be reduced to normal readings after 1 week if there is no evidence of slope movement.
Rain on Snow Events and Spring Freshet monitored **by Geotechnical EOR, Contractor, and Ministry Representative**	▪ Rainfall on site while snow is still on the ground ▪ Spring thaw and freshet	▪ The site slopes should be reviewed **by the Geotechnical EOR** before re-starting construction following winter shutdown. Multiple survey monitoring readings **by the Contractor**, VWP and SI readings **by WSP**, should be taken before site activities occur following a winter shutdown. The **Geotechnical EOR will** provide the go ahead to re-start construction activities base on the outcome of the site visit and readings. ▪ Remedial recommendations may be provided should there be any signs of instability that need to be addressed prior to work commencing. ▪ If there is still snow on the ground once construction commences, work should be paused **by the Ministry Representative and the Geotechnical EOR** should be contacted following rain on snow event. The **Geotechnical EOR will** visit the site to observe. Survey monitoring **by the Contractor**, VWP and SI readings **by WSP**, will be taken to determine if there are any signs of instability. If there are no signs of instability, site activities can commence in the impacted area.

2.2 Slide Monitoring

Ongoing monitoring of the identified slopes during construction is proposed to consist of the following:

1) Visual review of the slopes. Daily inspections should be carried out by the contractor and Ministry Representative, while a more comprehensive assessment will be completed by the Geotechnical Engineer-of-Record (EOR), or a qualified representative, on a monthly basis. An initial site review involving both the EOR and Ministry Representatives is recommended to identify any areas of concern and discuss possible indicators of slope instability. If evidence of slope movement is detected, the EOR may increase the frequency of site visits to allow for closer observations and assessment of the affected areas.

2) VWP and Slope Inclinometer (SI) readings will be taken on a monthly basis by WSP.

3) Slope monitoring via total station survey-based movement monitoring system. The monitoring points will consist of reflective survey markers attached to 1.5 m long (minimum), 25 mm by 25 mm pointed angle iron stakes driven approximately 1 m into the soil. Monitoring points will be installed along the crest of the slide area above Bastin Road, along the flanks of the slide area as well as along the crest of the excavation. The monitoring points shall be installed at 10 m increments along the slope edge of the existing alignment from STA 106+40 to STA 112+00. Monitoring points shall be approved by the Ministry Representative. Other considerations for the surveying include:

   - Total station instrument must be located outside of the active slide area and securely affixed to a stable monitoring platform with a clear line of site to all monitoring points.
   - The contractor shall provide the daily survey monitoring point data (northing, easting, elevation) to the EOR and Ministry Representative in Excel (.csv) format.
   - Initial baseline readings of the monitoring points must be completed one week before excavation. Each monitoring point must be surveyed twice per day by the Contractor and compared to the baseline survey.
   - During excavation and fill placement, survey readings must be collected a minimum of twice daily within the slide boundaries at the start and end of each shift of work by the Contractor.
   - End of previous shift and start of shift readings are to be provided by the Contractor to the Ministry Representative and EOR by 09:00. The EOR will respond with the results by 11:00.
   - During seasonal shutdown, each monitoring point shall be surveyed once every two weeks by the Contractor.

4) Daily monitoring of the Quesnel Hydraulic weather station and weather forecasts. Intense rainfall from thunderstorms, extended wet periods, or rain-on-snow events can elevate porewater pressures, promote erosion, and compromise slope stability. Note that such weather conditions were contributing factors to the landslides that prompted the development of the Cariboo Road Recovery Projects. Precipitation monitoring will involve:

   - Closely monitor the weather forecasts for the closest weather station to determine if work in and around the potentially impacted slopes needs to be suspended until the inclement weather passes.
   - Actively monitor weather conditions at the site, specifically during heavy rain events (e.g. thunderstorms) and significant ongoing rain that leads to saturation of the ground surface and accumulation of surface water.
   - If a seasonal shutdown occurs, rain on snow events in the spring should be monitoring closely, and monitoring site conditions during and following the freshet should occur prior to and during re-commencement of work activities.

3.0 LIMITATIONS

This document should be read in conjunction with the “Important Information and Limitations of this Report” which is provided following the text of this memorandum. The reader’s attention is specifically drawn to this information as it is essential for the proper use and interpretation of this report. Further to these limitations, this report also provides written consent to the British Columbia Ministry of Transportation and Transit, the contractors bidding on the Bastin Hill Erosion Project and the successful construction contractor for the Bastin Hill Erosion Project (the “Authorized Users”) as outlined in the 268 CS 1825 Contract H0461d form, to rely on this report under the same terms and conditions as WSP has with its Client for the strict purposes of the Project design, only conditional upon and governed by the Authorized User’s acceptance of the conditions presented following the text of this memo.

4.0 CLOSURE

This memo was prepared for the exclusive use of Urban Systems Ltd. and the BC Ministry of Transportation and Transit for the specific application to the project area described herein. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. WSP Canada Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. It has been prepared in accordance with generally accepted soil and foundations engineering practices. No other warranty expressed or implied, is made.

WSP Canada Inc.

Ben Dorsey, P.Eng.
Lead Geotechnical Engineer

Glen Rutherford, P.Eng.
Director, Ground Engineering

BD/GR/lih

WSP Canada Inc.
Engineers & Geoscientists BC
Permit# 1000200

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IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: WSP Canada Inc. (WSP) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to WSP by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. WSP can not be responsible for use of this report, or portions thereof, unless WSP is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without WSP's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, WSP may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to WSP. The report, all plans, data, drawings and other documents as well as all electronic media prepared by WSP are considered its professional work product and shall remain the copyright property of WSP, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of WSP. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client cannot rely upon the electronic media versions of WSP's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to WSP by the Client, communications between WSP and the Client, and to any other reports prepared by WSP for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. WSP can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, WSP does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions

that WSP interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. **The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report.** The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: WSP will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of WSP's report. WSP should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of WSP's report.

During construction, WSP should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of WSP's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in WSP's report. Adequate field review, observation and testing during construction are necessary for WSP to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, WSP's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that WSP be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that WSP be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. WSP takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.