

To:	Scott MacCallum	From:	Maureen Matthew, M.Sc., P.Geo.
	Kearney Lake Developments Limited Partnership		Stantec Consulting Ltd.
Project/File:	121624268	Date:	January 13, 2023

Reference: 209 Kearney Lake Road - Rockfall Analysis – Revision 1

At the request of Kearney Lake Developments Limited Partnership (KLD), Stantec Consulting Ltd. (Stantec) is providing ongoing geotechnical consultation in support of the planning and design of a potential residential development at 209 Kearney Lake Road, Halifax, NS (the Property). As part of a broader geotechnical review of the bedrock cut slopes that bound the property, Stantec has carried out a rockfall catchment analysis to assess the easement currently proposed in the site grading plan. This memo presents the results of this analysis with commentary on the rockfall catchment zone and currently proposed site layout.

Background

The Property is a 23-acre lot located on the north side of Kearney Lake. It is bounded by Kearney Lake Rd to the southwest, Bicentennial Highway to the northeast, and by undeveloped properties to the northwest and southeast (PID 40092421 and PID 00289207, respectively). The site was formerly operated as a quarry by circa 1966 – 1994, with abandoned quarried sidewalls and highwalls forming most of the northwest, southeast, and southwest perimeters, after which it was owned by Municipal Group of Companies (Municipal) and used primarily as storage/laydown for Eastern Traffic Services.

We understand that the currently proposed development is in the planning and design phase and will consist of multi-unit residential buildings with associated parking/roadway infrastructure and landscaped areas. Grading is proposed to be at or near the current pit floor with the quarry highwalls/sidewalls left largely as-is without significant regrading. A proposed grading/site plan with cross-sections was provided to Stantec by KLD on October 19, 2022, to support this work.

The analysis presented herein builds on an earlier review of geotechnical slope conditions carried out by Stantec in October 2018 (Stantec, 2018). As part of that review, Stantec carried out a site visit, limited to a visual walk-over, with preliminary comments and recommendations for general site development related to the old quarry highwalls and sidewalls. KLD has requested further analysis to validate their currently proposed site layout, which denotes a “no-go” zone (easement) at the toe of the quarry slopes to act as a potential rockfall catchment area, defined by a large earthen landscape berm that would separate the easement from the developed areas of the Property (Figures 121624268-GE-01 to GE-11). The berm is currently planned to have a crest elevation of +52.0 m, crest width of 6 m, a backslope of 2H:1V (towards the bedrock cuts) and a foreslope of 3H:1V (towards the development).

Analysis

Rockfall analyses were carried out on ten (10) cross-sections distributed across the northwest sidewall, northeast highwall, and southeast sidewall. The analyses were performed using Rocscience Suite software RocFall (Version 6.0), a 2-dimensional statistical analysis program that can calculate energy, velocity, bounce height, and maximum roll-out distance of rockfall events. The cross-sections were imported to the

Reference: 209 Kearney Lake Road - Rockfall Analysis – Revision 1

software, scaled, and assigned slope and ground material properties to approximate the actual condition of the rock slopes and catchment areas on the site.

Potential source zones of rockfall material (estimated worst-case scenario locations) were denoted on the slope sections as seeder lines, from which 1,000 rocks of varying size were released in the program and their travel path, energy, and maximum roll-out distance were modeled. Source zones, block sizes, and material properties were selected based on observations made during Stantec's earlier 2018 site visit. Block sizes ranging from an average of 200 – 1,000 kg in a lognormal distribution were modelled.

A location plan of the cross-sections as well as the modelled results (travel paths) of each RocFall analysis are included in the attachments (Drawing 121624268-GE-01 to GE-11). The results show that in all scenarios, the modelled rockfall events are contained either within the allocated catchment zone or come to rest on the backslope (i.e., closest to the highwalls) of the proposed landscape berm that will define the “no-go” catchment area at the base of the bedrock slopes.

Slopes extending eastward beyond Sections 1 and 10 were excluded from the present rockfall analysis given low overall slope heights and correspondingly lower risk for rock fall impacts. Further assessment of this area will be undertaken during detailed design to ensure effective tie-in of the landscape berm with the lower slopes.

Comments

The rockfall catchment analysis suggests that discrete rockfall events, which are anticipated due to ongoing natural erosion of the quarry walls, are likely to be contained within the currently proposed “no-go” easement on the property and that the proposed landscape berm should act as an appropriate earthen barrier to ensure potential rockfall detritus does not reach the developed areas of the site. As design progresses and further analyses are carried out to evaluate other slope failure modes, supplementary barriers, as needed, may include localized fencing and/or bio-engineered barriers (tree stands). Signage at the toe and crest of the bedrock slopes remains essential to alert the public to the risk and limit recreational access to any areas in proximity to the slopes. Signage, optimization of restricted access zones, and barriers, including potential upgrades to existing fencing on site, will be incorporated into a safety plan to be developed during the detailed design phase.

It is important to note that this analysis focuses solely on discrete rockfall events caused by natural weathering and erosion and is intended to evaluate the suitability of the proposed easement and landscape berm for rockfall catchment to support the planning and design phase of the Property development. This work does not include an assessment of large-scale failure potential (i.e., large rockfall, structural slope failure) and potential requirement for slope stabilization measures, which will be carried out in support of the detailed design. Stantec will provide ongoing geotechnical support throughout the design phase to determine further recommendations and offer the required on-site inspection and monitoring during site development.

Reference: 209 Kearney Lake Road - Rockfall Analysis – Revision 1

Closure

We trust this document meets your present requirements and we appreciate the opportunity to continue serving you on this project. If you have any questions or concerns related to the information in this analysis, please do not hesitate to contact the undersigned at your convenience.

Respectfully,

STANTEC CONSULTING LTD.

Original Signed

Maureen Matthew, MSc., P.Geo.

Engineering Geologist

Phone: (902) 292-3405

Maureen.Matthew@stantec.com

Attachment: Drawings 121624268-GE-01 (Location Plan) and GE-02 to GE-11 (Rockfall Analysis Sections)

V:\1216\active\121624XXX\121624268\8_deliverables\rev_1\mem_209_kearney_lake_road_rockfall_final.docx



v:\1216\ACTIVE\12162264\DRAWINGS\



Project No.:

121624268

Client:

West Bedford Holdings Ltd.

Project:

Rockfall Catchment Area Analysis
209 Kearney Lake Road, Halifax, NS

Drawing Title:

Rockfall Section Location Plan

Scale:

NTS

Drawn:

MCM

Approved:

MW

Date:

11/25/2022

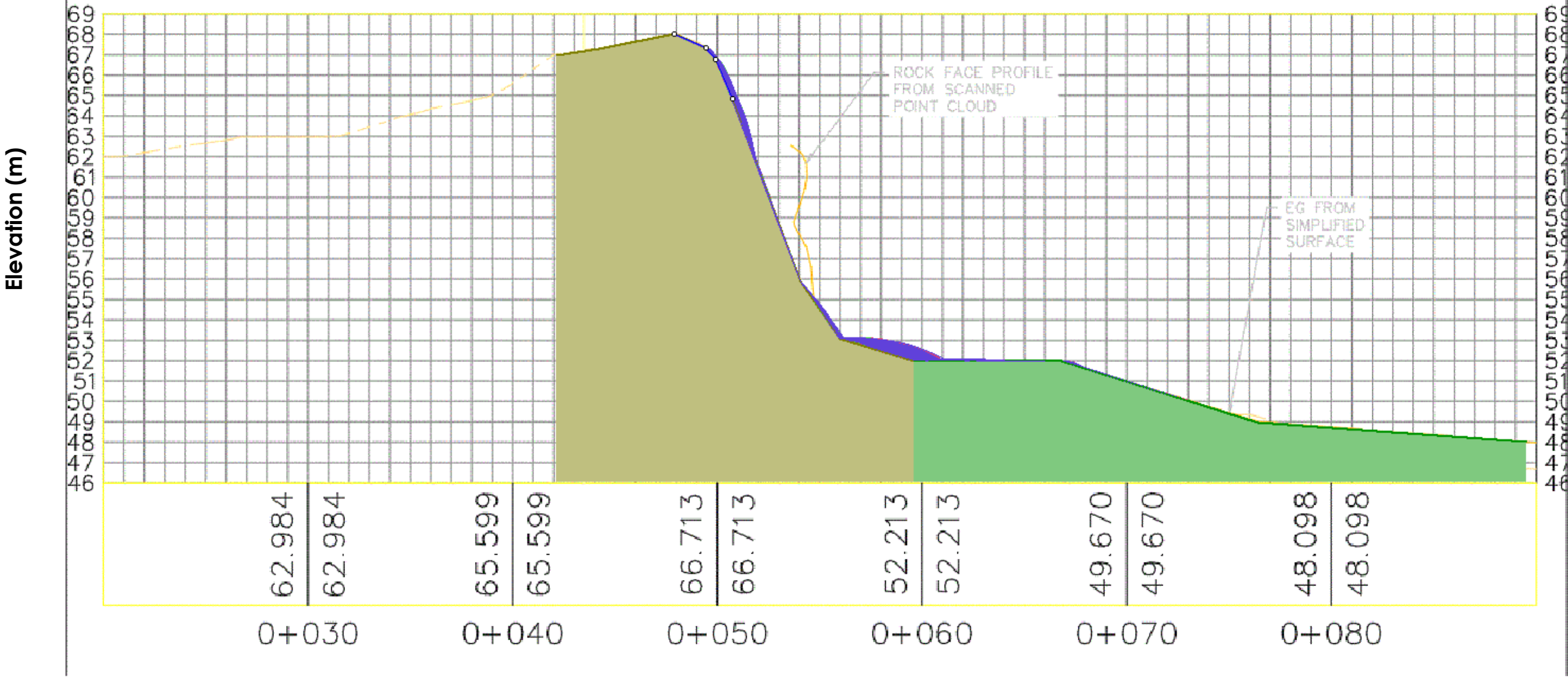
Drawing No.:

121624268-GE-01
Sheet 01



- Rockfall Trajectories**
- Rocks avg. 200 kg
 - Rocks avg. 500 kg
 - Rocks avg. 1,000 kg

SECTION 1 PROFILE



v:\1216\ACTIVE\121622264\DRAWINGS\



Project No.:

121624268

Client:

West Bedford Holdings Ltd.

Project:

Rockfall Catchment Area Analysis
209 Kearney Lake Road, Halifax, NS

Drawing Title:

Rockfall Section 1

Scale:

NTS

Drawn:

MCM

Approved:

MW

Date:

11/25/2022

Drawing No.:

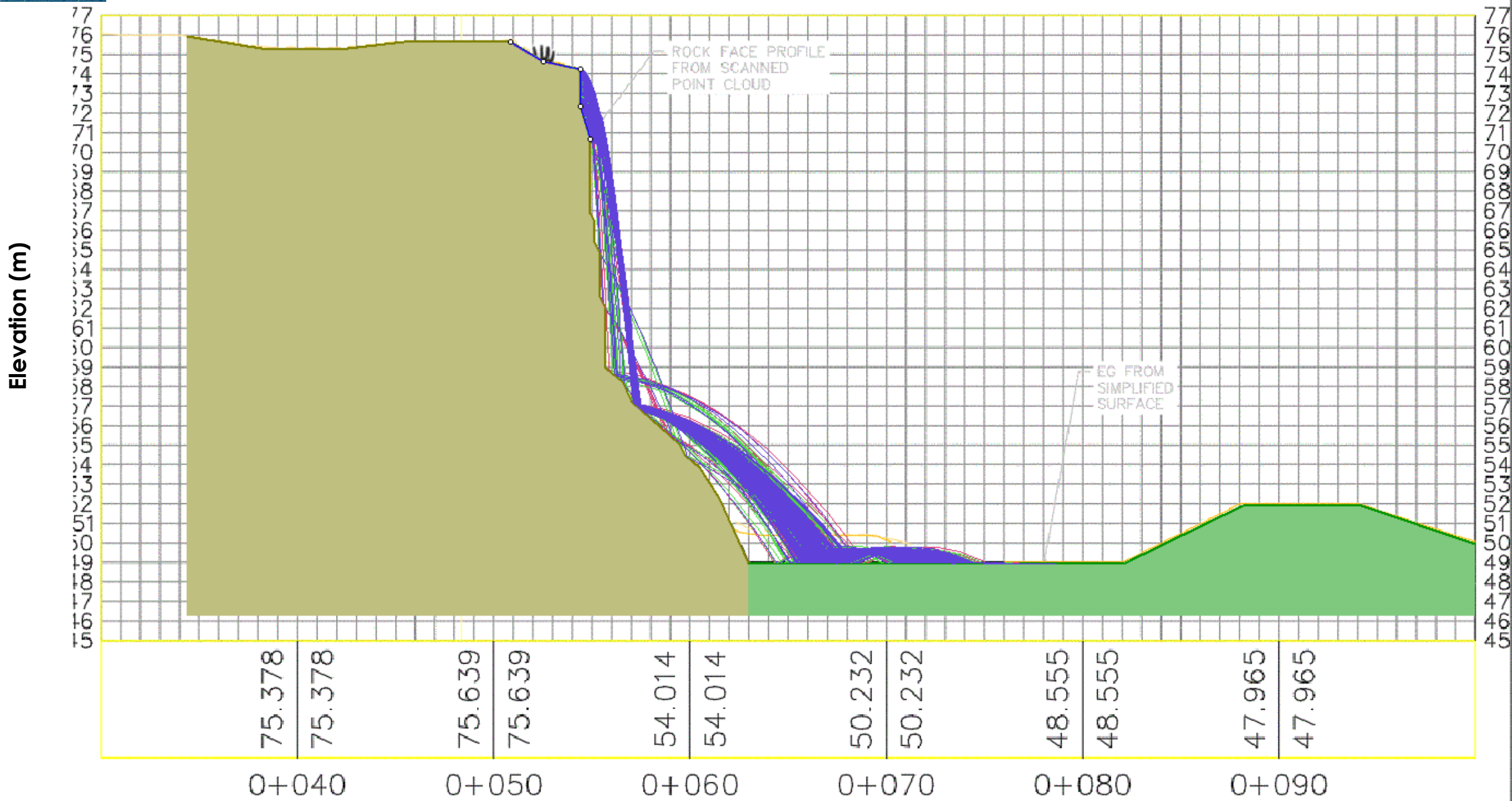
121624268-GE-02



Rockfall Trajectories

- Rocks avg. 200 kg
- Rocks avg. 500 kg
- Rocks avg. 1,000 kg

SECTION 2 PROFILE



v:\1216\ACTIVE\12162264\DRAWINGS\



Project No.:

121624268

Client:

West Bedford Holdings Ltd.

Project:

Rockfall Catchment Area Analysis
209 Kearney Lake Road, Halifax, NS

Drawing Title:

Rockfall Section 2

Scale:

NTS

Drawn:

MCM

Approved:

MW

Date:

11/25/2022

Drawing No.:

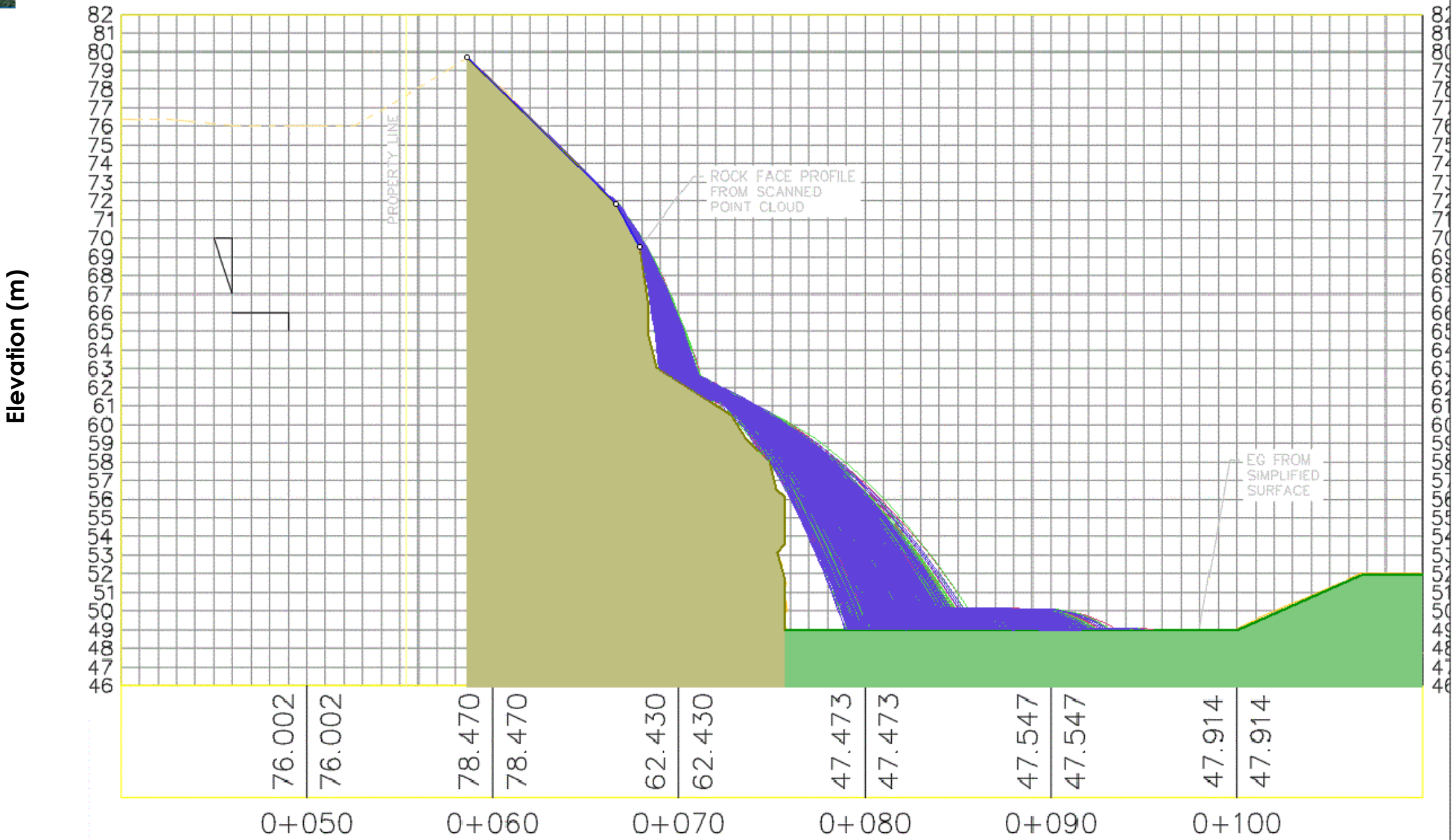
121624268-GE-03



Rockfall Trajectories

- Rocks avg. 200 kg
- Rocks avg. 500 kg
- Rocks avg. 1,000 kg

SECTION 3 PROFILE



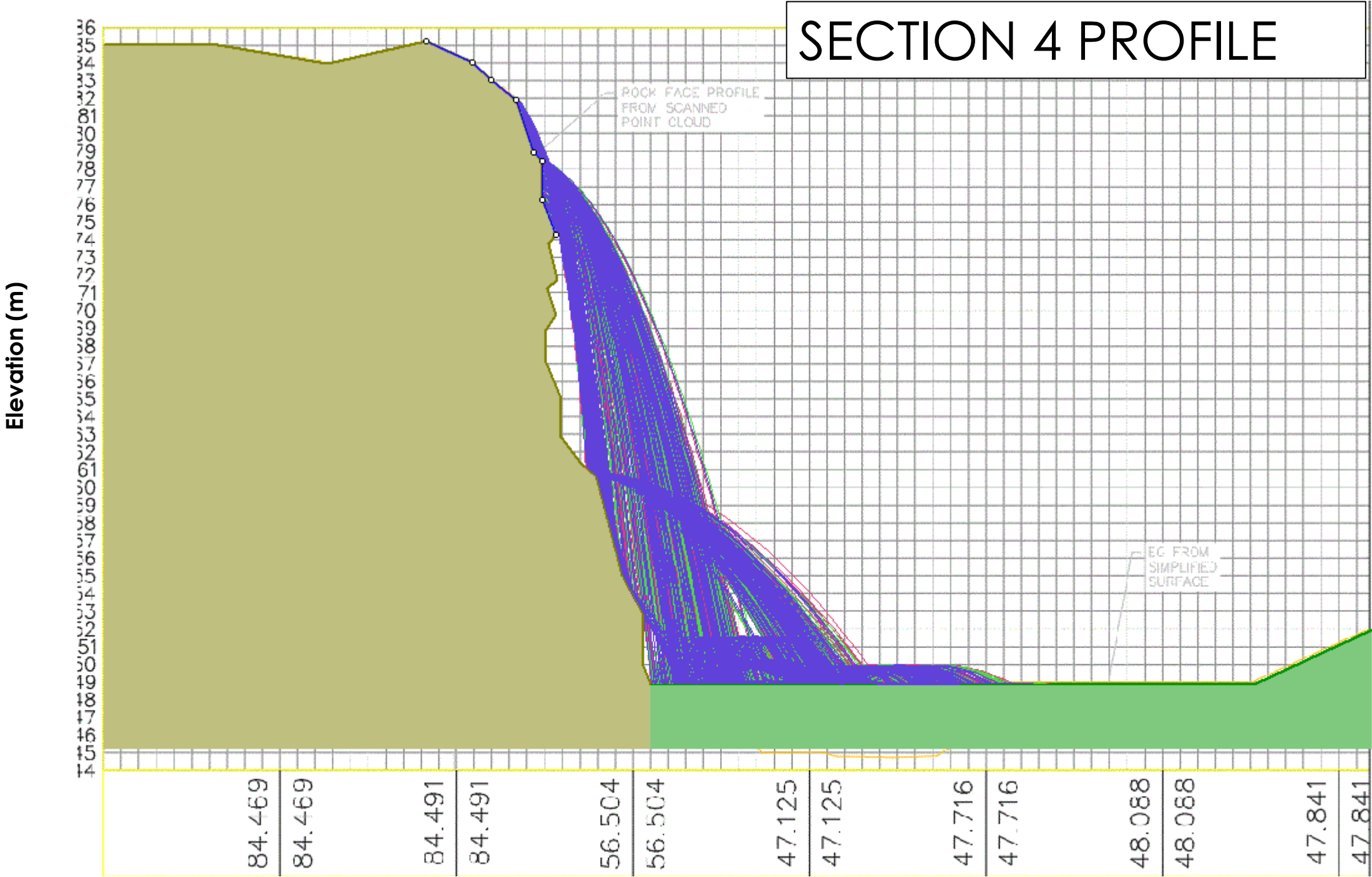
v:\1216\ACTIVE\12162264\DRAWINGS\

	Project No.:	Client:	Project:	Drawing Title:	Scale:	Drawing No.:
	121624268	West Bedford Holdings Ltd.	Rockfall Catchment Area Analysis 209 Kearney Lake Road, Halifax, NS	Rockfall Section 3	NTS	
					Drawn: MCM	
					Approved: MW	
					Date: 11/25/2022	

121624268-GE-04



- Rockfall Trajectories**
- Rocks avg. 200 kg
 - Rocks avg. 500 kg
 - Rocks avg. 1,000 kg



v:\1216\ACTIVE\121622264\DRAWINGS\

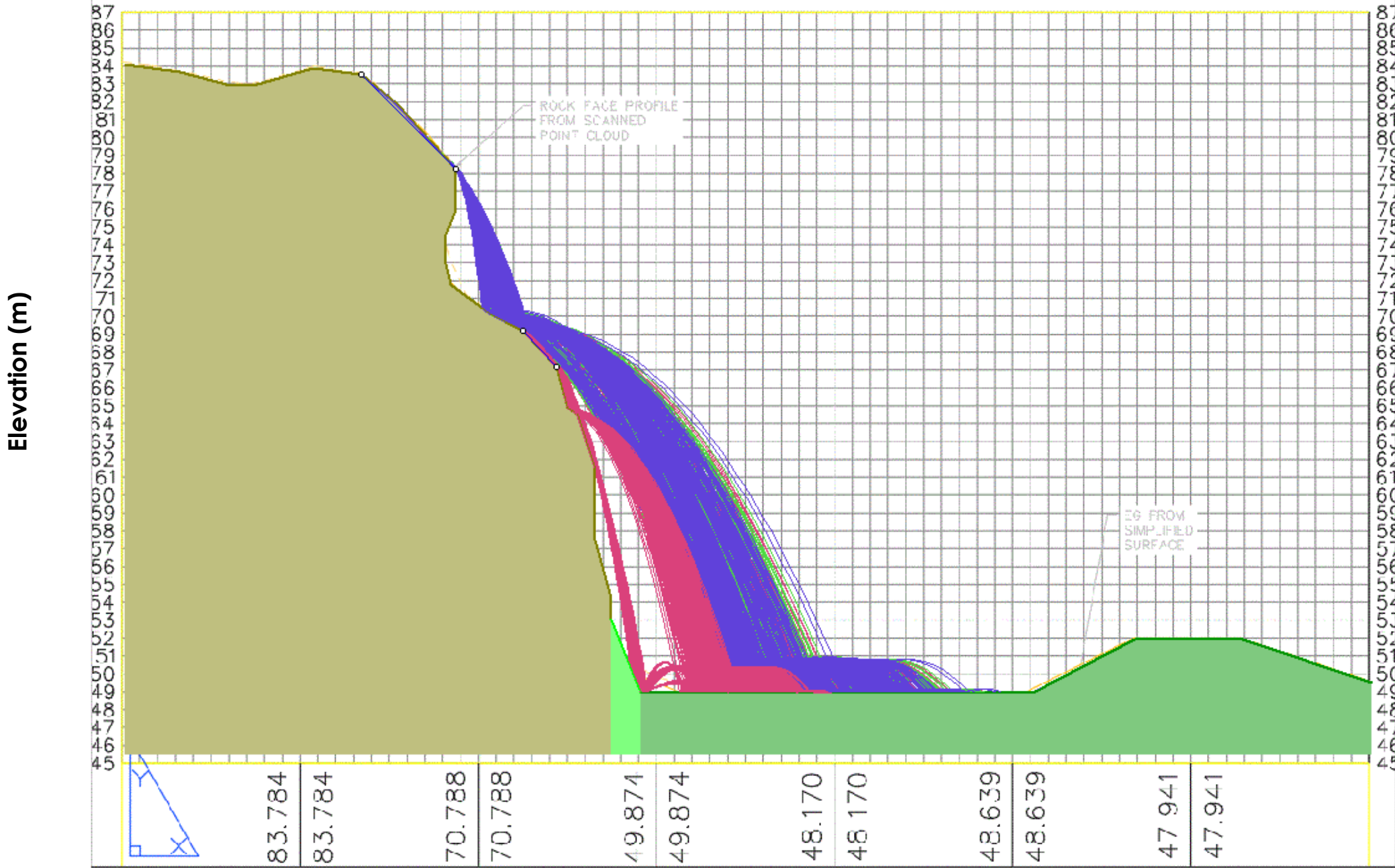
	Project No.:	Client:	Project:	Drawing Title:	Scale:	Drawing No.:
	121624268	West Bedford Holdings Ltd.	Rockfall Catchment Area Analysis 209 Kearney Lake Road, Halifax, NS	Rockfall Section 4	NTS	
					Drawn: MCM	
					Approved: MW	
					Date: 11/25/2022	



Rockfall Trajectories

- Rocks avg. 200 kg
- Rocks avg. 500 kg
- Rocks avg. 1,000 kg

SECTION 5 PROFILE



v:\1216\ACTIVE\121622264\DRAWINGS\

	Project No.:	Client:	Project:	Drawing Title:	Scale:	Drawing No.:
	121624268	West Bedford Holdings Ltd.	Rockfall Catchment Area Analysis 209 Kearney Lake Road, Halifax, NS	Rockfall Section 5	NTS	
					Drawn: MCM	
					Approved: MW	
					Date: 11/25/2022	

121624268-GE-06

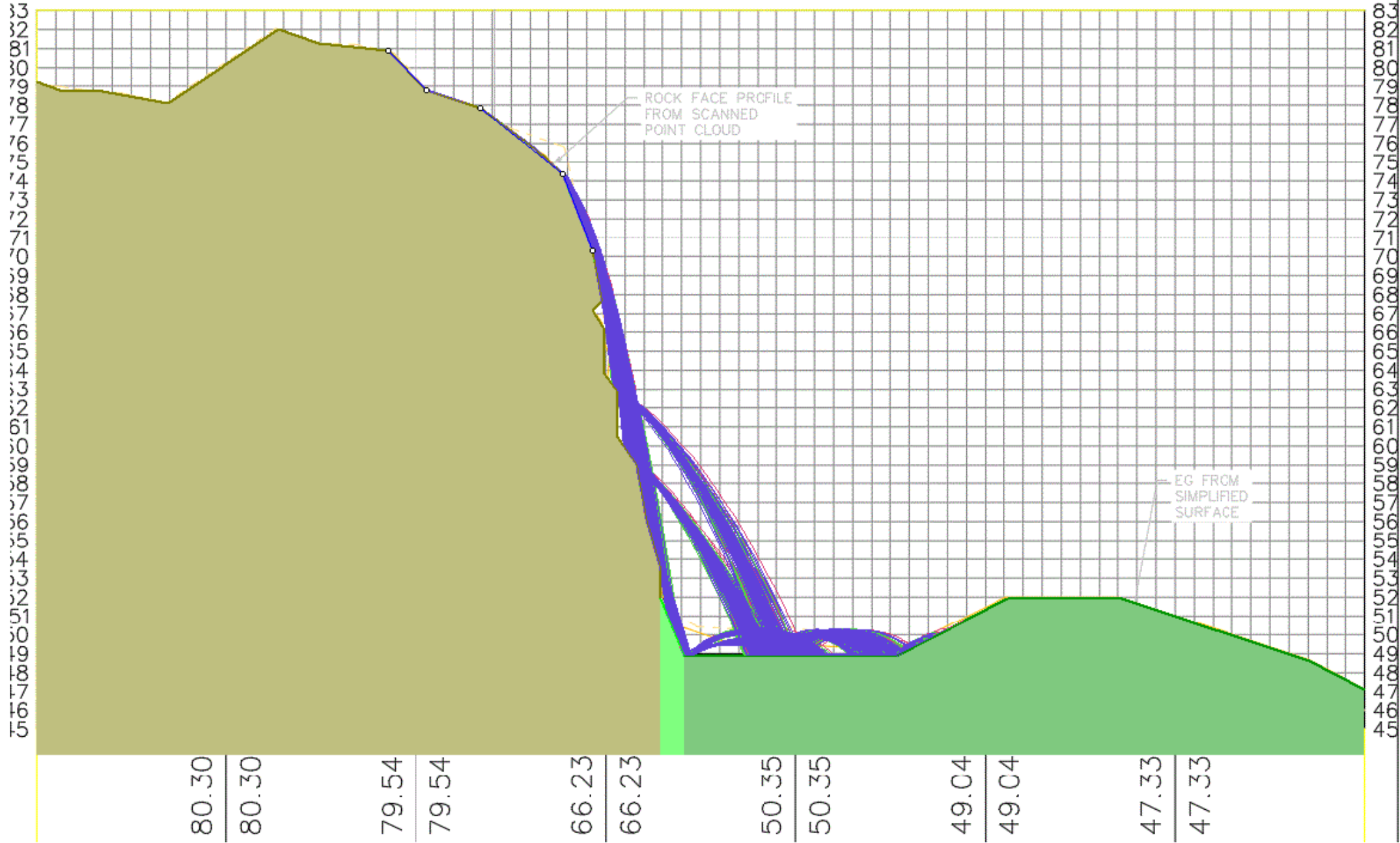


Rockfall Trajectories

- Rocks avg. 200 kg
- Rocks avg. 500 kg
- Rocks avg. 1,000 kg

SECTION 6 PROFILE

Elevation (m)



v:\1216\ACTIVE\12162264\DRAWINGS\



Project No.:

121624268

Client:

West Bedford Holdings Ltd.

Project:

Rockfall Catchment Area Analysis
209 Kearney Lake Road, Halifax, NS

Drawing Title:

Rockfall Section 6

Scale:

NTS

Drawn:

MCM

Approved:

MW

Date:

11/25/2022

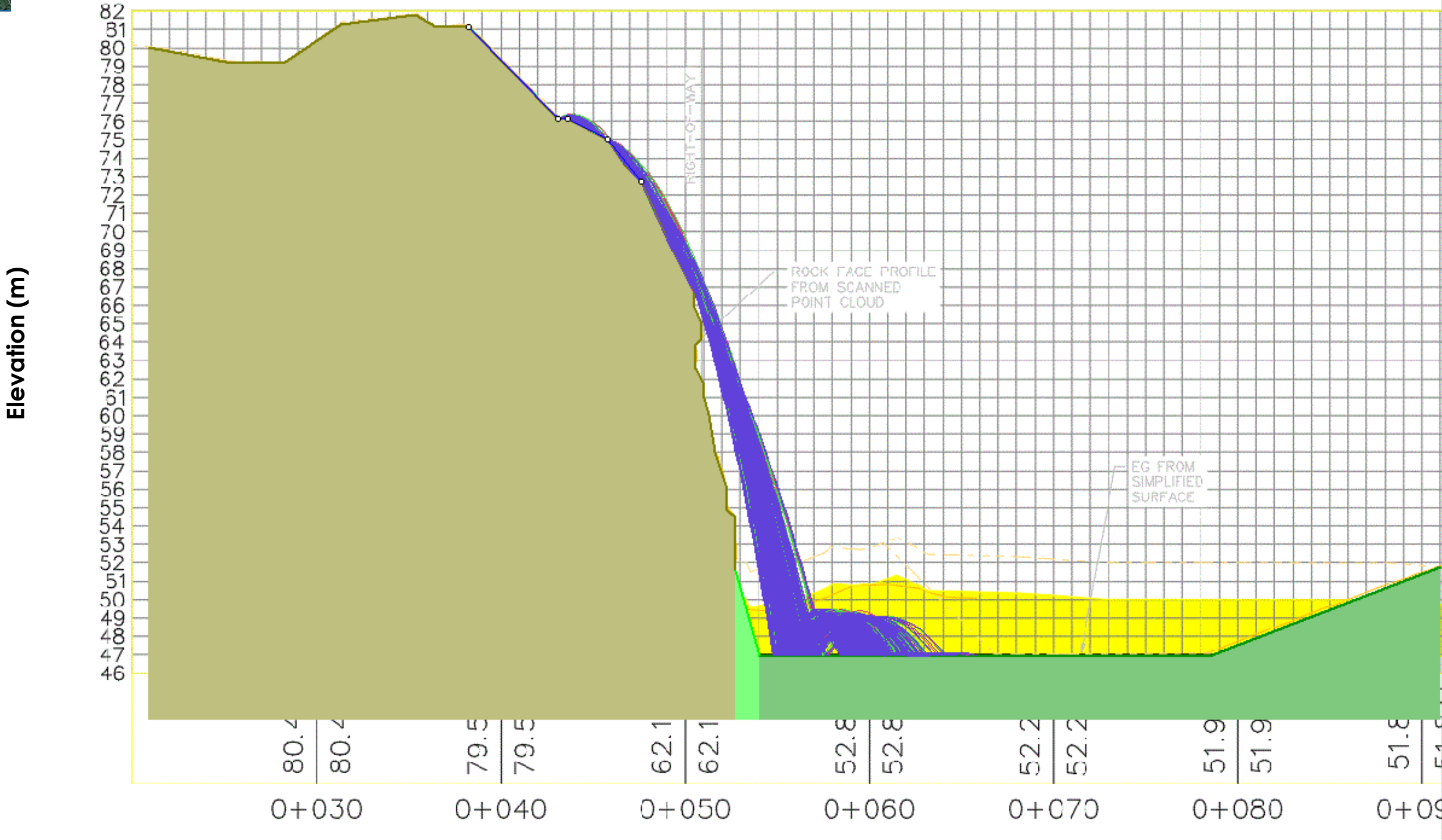
Drawing No.:

121624268-GE-07



- Rockfall Trajectories**
- Rocks avg. 200 kg
 - Rocks avg. 500 kg
 - Rocks avg. 1,000 kg

SECTION 7 PROFILE



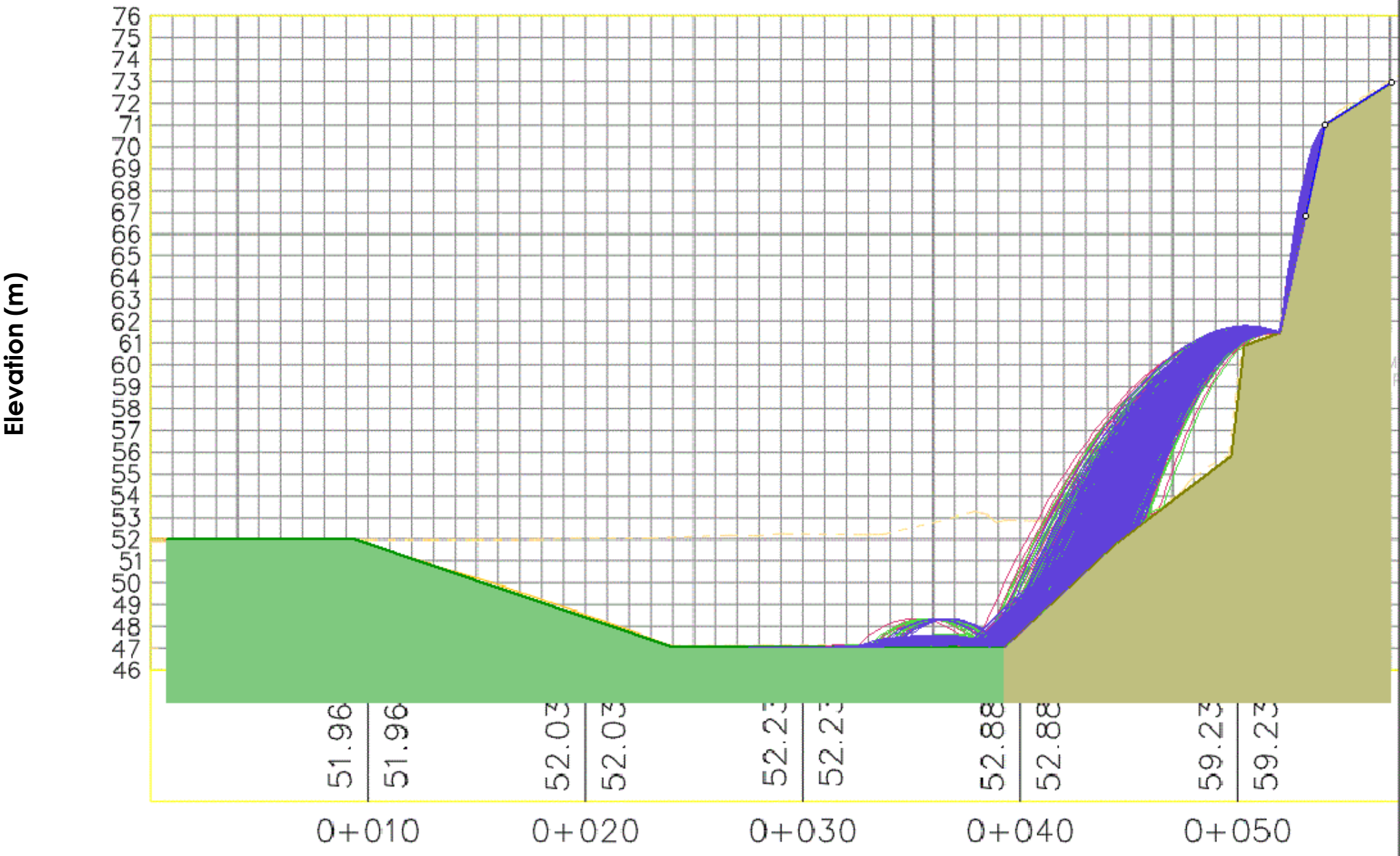
v:\1216\ACTIVE\12162264\DRAWINGS\

	Project No.:	Client:	Project:	Drawing Title:	Scale:	Drawing No.:
	121624268	West Bedford Holdings Ltd.	Rockfall Catchment Area Analysis 209 Kearney Lake Road, Halifax, NS	Rockfall Section 7	NTS	
					Drawn: MCM	
					Approved: MW	
					Date: 11/25/2022	



- Rockfall Trajectories**
- Rocks avg. 200 kg
 - Rocks avg. 500 kg
 - Rocks avg. 1,000 kg

SECTION 8 PROFILE



v:\1216\ACTIVE\12162264\DRAWINGS\



Project No.:

121624268

Client:

West Bedford Holdings Ltd.

Project:

Rockfall Catchment Area Analysis
209 Kearney Lake Road, Halifax, NS

Drawing Title:

Rockfall Section 8

Scale:

NTS

Drawn:

MCM

Approved:

MW

Date:

11/25/2022

Drawing No.:

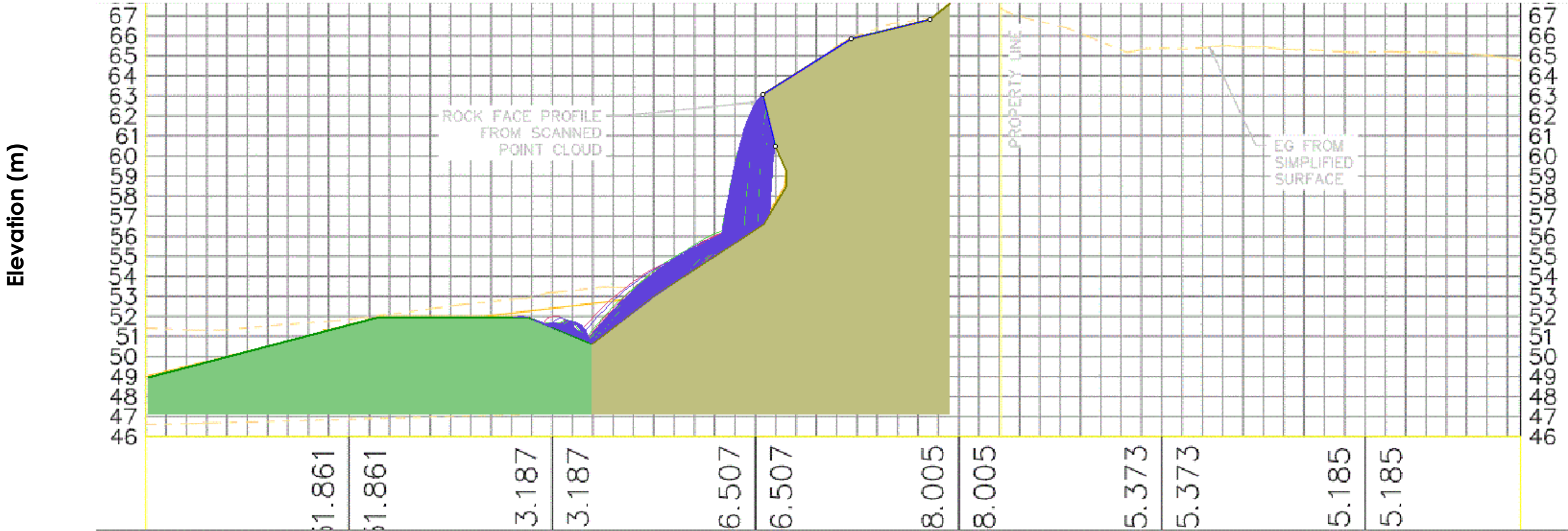
121624268-GE-09



Rockfall Trajectories

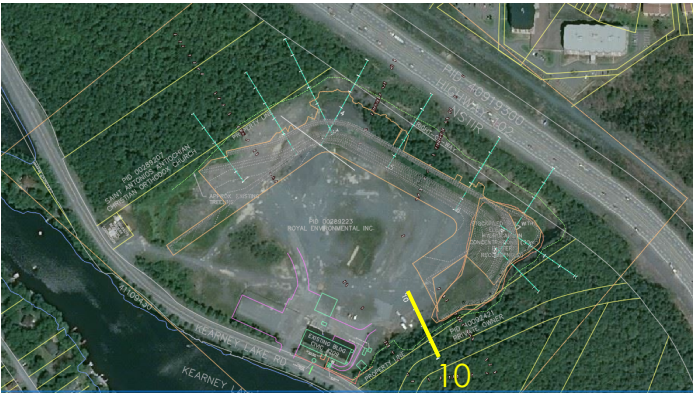
- Rocks avg. 200 kg
- Rocks avg. 500 kg
- Rocks avg. 1,000 kg

SECTION 9 PROFILE

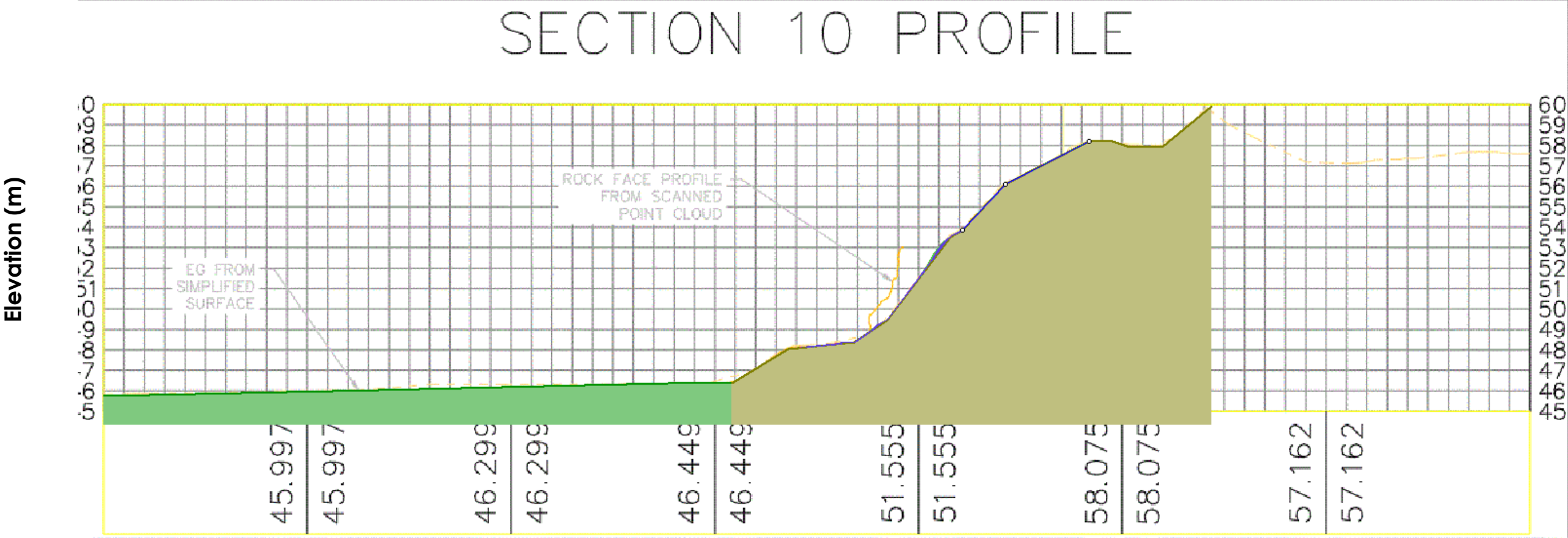


v:\1216\ACTIVE\121622264\DRAWINGS\

	Project No.:	Client:	Project:	Drawing Title:	Scale:	Drawing No.:
	121624268	West Bedford Holdings Ltd.	Rockfall Catchment Area Analysis 209 Kearney Lake Road, Halifax, NS	Rockfall Section 9	NTS	
					Drawn: MCM	
					Approved: MW	
					Date: 11/25/2022	121624268-GE-10



- Rockfall Trajectories**
- Rocks avg. 200 kg
 - Rocks avg. 500 kg
 - Rocks avg. 1,000 kg



v:\1216\ACTIVE\12162264\DRAWINGS\



Project No.:

121624268

Client:

West Bedford Holdings Ltd.

Project:

Rockfall Catchment Area Analysis
209 Kearney Lake Road, Halifax, NS

Drawing Title:

Rockfall Section 10

Scale:

NTS

Drawn:

MCM

Approved:

MW

Date:

11/25/2022

Drawing No.:

121624268-GE-11