Pre-Feasibility Study:

Escarpment Extension Geotechnical Assessment

3 July 2025

Version 1.1

BATHURST
RESOURCES LIMITED

REVISION HISTORY:

Date	Version No.	Lead Author	Contributing Authors
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July 2025	1.1	Josh Holmes	

Version No.	Detail / Changes
1.0	Draft
1.1	Updates to address Andrew Smith peer review comments and modified pit shell

TITLE:	PLANNED REVIEW:
PFS – Escarpment Extension Geotechnical Assessment	

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1.0 Executive Summary

As part of the Buller Plateaux Continuation Project (BPCP), Bathurst Resources Ltd propose to develop an extension of the existing Escarpment Mine, located approximately 13 km east of the Westport township and directly west of the existing Escarpment mine development and infrastructure.

The proposed Escarpment Extension (ESE) forms one large opencast pit with two small auxiliary pits which will aid stormwater management and provide aggregates for onsite roading and infrastructure development. An ex-pit Engineered Landform (ELF) and several in-pit ELFs will be developed during mining to form a rehabilitated final landform. The economic coal seams at the site are host within the Brunner Coal Measures which have been a significant source of coal for the region and have been mined by both underground and opencast extraction methods for over 100 years. Access to the ESE site will be achieved via Denniston Road as well as a proposed haul road which will link ESE to the existing Stockton mining operations to the northeast.

This Pre-Feasibility level geotechnical assessment report forms part of Bathurst Resources Limited's Pre-Feasibility Study (PFS).

The objectives of this PFS geotechnical assessment report are:

- To collate and present geotechnical data collected to date and identify any gaps in the dataset;
- Use the dataset to review and update the geological and geotechnical model of the site using Maptek Vulcan software.
- To identify geotechnical hazards associated with the proposed opencast mine design and associated Engineered Landforms by means of geotechnical analysis, including static and seismic 2-dimensional limit equilibrium slope stability and sensitivity analysis, conducted using GeoStudio SlopeW software;
- Use the outcomes of the geotechnical analysis to make a preliminary evaluation of the key areas of geotechnical risk associated with the proposed designs and where necessary provide design recommendations and engineering solutions to eliminate these risks.
- To provide effective risk mitigation measures where a geotechnical risk cannot be eliminated through design or engineering solutions;
- To recommend a programme of further geotechnical work / investigations to ensure an effective feasibility level geotechnical assessment can be made.

The scope of this PFS includes geotechnical assessment of the mine design for:

- Overburden stripping and coal mining at Escarpment Extension (ESE);
- Construction of ELFs to produce a final landform.

A number of slope stability hazards have been considered as part of this pre-feasibility level report and some of these have been mitigated during the mine design phase when variables such as orientation of high walls relative to discontinuities have been considered. Where an unreasonable risk of instability developing was identified during design, the highwall design has been revised to excavate behind or step away from the discontinuity, reducing the risk of instability developing. Other slope instability hazards will require further assessment as identified in the report and other stability hazards can be managed during the mining stage through ongoing geological mapping and geotechnical assessment and risk mitigation measures.

In summary, we note the following points in relation to the residual hazard profile associated with the proposed Escarpment Extension mine design and mining sequence:

1. Geotechnical strength values for this assessment are estimates or have been derived from the same lithologies elsewhere on the Buller Coalfield. No recent site-specific geotechnical laboratory testing has been conducted.
2. Global / large scale highwall failure is very unlikely, the likelihood increases if the azimuth of bedding geometry aligns with highwall orientation and on unfavourably oriented faults structures.
3. Bench scale highwall failure is possible but very unlikely, if basic geotechnical risk control measures are not in place (such as mapping or exposed structures and ground truthing of bedding contacts) the likelihood increases.
4. Rockfall from cut slopes presents a potential hazard. This hazard can be effectively managed by:
    - Regular catch benches;
    - Effective planning and design to minimize blast damage of interim and final highwalls;
    - Highwall scaling;
    - Effective management of surface and groundwater flows through maintenance of graded drainage benches and sufficient understanding of the hydrological model.

The following key conclusions can be made:

- Based on the information available, outcomes of the geotechnical analysis show that the Escarpment Extension mine design meets the adopted design criteria and is therefore deemed geotechnically feasible in terms of construction and long-term stability;
- Analysis indicates that small to moderate instability has the potential develop as a result of unfavourable, steeply dipping bedding planes and discontinuities within the rock mass such as faults, jointing or collapse structures associated with HUW’s. Ongoing geological mapping should be carried out, ensuring critical areas of the design are identified and that differences from the assessed geological and groundwater model are recorded / mapped and used to refine the design where required to avoid

instability developing;

- Slope stability analysis of the proposed ELF / final landform indicates it meets the key slope design standards and is therefore considered geotechnically stable;
- Review of the geotechnical data gathered to date has identified the below gaps / areas of low confidence that will need to be addressed at feasibility level:
  - Insufficient monitoring of and gaps in the piezometric network;
  - Additional review of drill hole core, downhole geophysical data and engineering geology field mapping is required to aid kinematic analysis;
  - Site specific laboratory geotechnical testing of core samples is required to confirm and / or update material parameters used in this analysis are applicable to the ESE site.

2.0 Introduction

The Escarpment Extension (ESE) lies within the elevated Deniston Plateau in the Denniston Sector of the Buller Coalfield, approximately 8.0 km southwest of the neighbouring Stockton opencast mine, owned and operated by BRL (Figure 1). The proposed Escarpment Extension area covers approximately 300 hectares and encompasses part of the existing Escarpment Mine (ESC) and adjacent mining permits MP51279 and MPA60138, and the Sullivan Coal Mining License (CML 37161).

The economic coal seams at the site are hosted in the Brunner Coal Measures which have been a significant source of coal for the region and have been mined by both underground and opencast extraction methods for over 100 years. The proposed opencast mine will produce semi-hard coking coal for the export market using conventional truck and excavator extraction methods, supported by a range of ancillary / support equipment and infrastructure. Access to the site is currently achieved via the existing public road network and coal will be transported via a proposed coal haul road from the Escarpment site to the existing Stockton infrastructure for handling and processing. Geotechnical review of the proposed coal haul road has not been considered for this report.

This review presents a summary of preliminary geotechnical analyses and stability assessment of the proposed ESE cut wall stability, summary of the in-pit and ex-pit backfill stages and stability assessment of the associated Engineered Landforms (ELF) to create a final landform. The ESE will comprise of a series of cutbacks from the south to the north and northwest to form a 'ultimate pit' and asmall satellite pit which will act as an ex-pit seal as shown in (Figure 2). The geotechnical modelling reported below provides the data inputs, and modelling results for the proposed ESE.

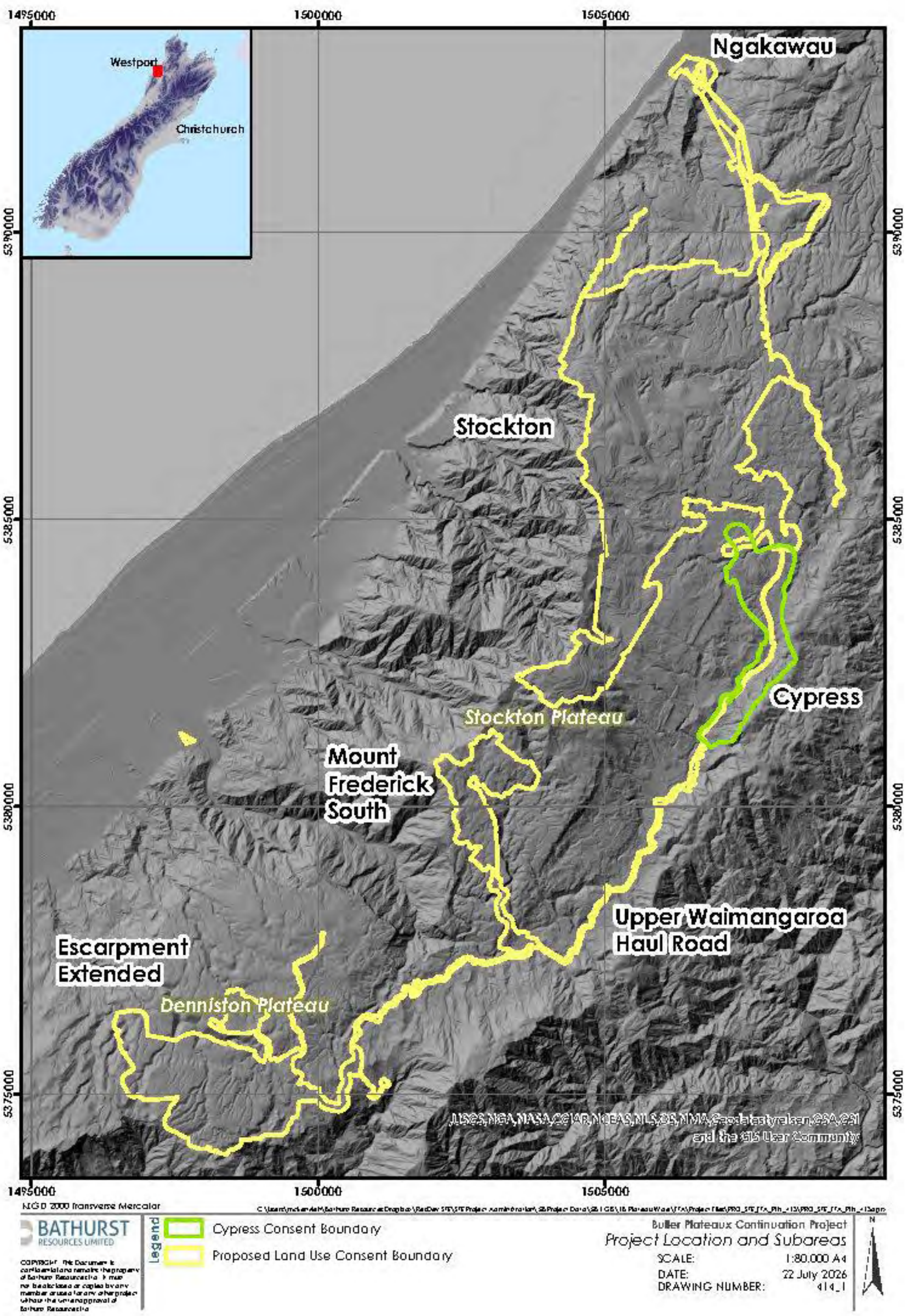


Figure 1. Overview of BRL Buller Plateaux Continuation Project.

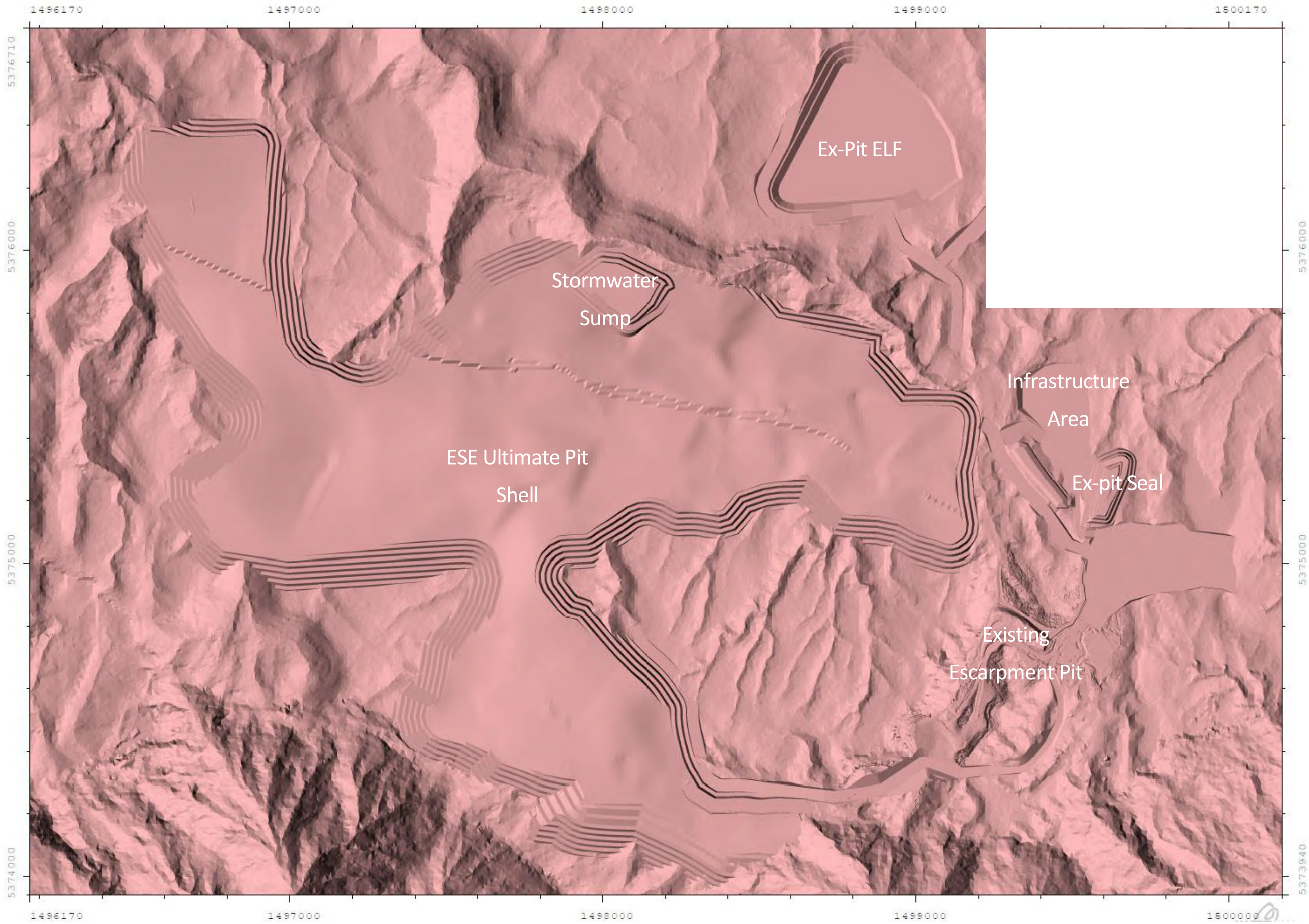


Figure 2. Proposed topographic surface of the ESE ultimate pit shell (without backfill), satellite pit, infrastructure area and ex-pit ELF.

3.0 Previous Work

There is a long history of successful development for slope design and geological modelling at BRL's neighbouring Stockton, Cascade and Escarpment mine sites involving inhouse experts and external consultants (e.g., Golder Associates Ltd). Some of this work is directly relatable to the ESE as the coal deposit is hosted by similar structures and geologic formations.

These directly relevant reports are:

- Golder Associates, 2010. Escarpment Mine – Geotechnical Feasibility Study: Geotechnical Assessment of the Escarpment Mining Area, Denniston Sector, Buller Coalfield, New Zealand. Report produced for Bathurst Resources Ltd by Golder Associates (NZ) Ltd. Report number 003_1078310148, July 2010.
- Golder Associates, 2012. Gravel Pit North Block – Northern High Wall Geotechnical Investigation and Design. Report produced for Cascade Coal Ltd Denniston by Golder Associates (NZ) Ltd. Report number 030_R087831816.
- Golder Associates, 2013. South Buller Mine Project – South Buller Integrated Mine Plan Interim Technical Report. Report produced for Bathurst Resources Ltd by Golder Associates (NZ) Ltd. Report number 1378301143-008-R-Rev0
- Golder Associates, 2017. Escarpment Mine – Pre-Feasibility Study for the Escarpment Extended Project, Buller Coal Project, New Zealand. Report produced for Bathurst Resources Ltd by Golder Associates (NZ) Ltd. Report number 1743471-005-R-Rev0, 14 July 2017

4.0 Design Standards

The proposed Escarpment Extension pit and ELF are designed in accordance with best practice and where appropriate specific design standards. Table 1 provides brief details of the key design standards.

Table 1: Key Slope Design Standards

Parameter		Standard
Design Life (final landform)		>100 years
Importance Level (AS/NZS 1170.0:2002 Table 3.1)		1
Slope Stability	Design Groundwater Conditions	Factor of Safety (FoS) ≥ 1.2
	Elevated Groundwater Conditions	FoS ≥ 1.1
	Final Landform	FoS ≥ 1.3
Seismic Stability	Serviceability Limit State (SLS)	1 in 100 AEP, FoS > 1 or if FoS < 1 displacement < 0.01m
	Ultimate Limit State (ULS)	1 in 250 AEP, FoS > 1 or if FoS < 1 displacement < 0.1m

5.0 Geological / Geotechnical Database

BRL has a database of over 240 drill holes for the Escarpment and Escarpment Extension area. Drill hole information, geotechnical laboratory testing and downhole geophysical logging combined with geological mapping of outcrops and existing pit wall exposures has provided a sound level of geological and geotechnical understanding resulting in good control around lithological contacts and fault interpretations.

The geotechnical model for the Escarpment Extension area was developed from geological cross-sections through a 3-dimensional Geology Model of the site and historical mine development plans. This model has built upon previous geological and engineering geology interpretations with the most recent update completed in February 2024 by BRL.

Piezometric monitoring data and previous assumptions on groundwater behaviour from adjacent and nearby existing cut pit slopes have been used in the groundwater interpretation in the context of geotechnical stability. These assumptions are consistent with field observations regarding the presence or absence of seepages on the pit walls at the existing Escarpment mine development. Material parameters have been adopted based on historical and recent data and recommendations from previous geotechnical reports for the Escarpment area. The parameters are similar to those used at the existing Escarpment mine development.

6.0 Geology

The Escarpment Extension area forms part of the Denniston Sector of the Buller Coalfield, the geology in the mining area is dominated by the upper Eocene Brunner Coal Measures (BCM) sediments and the dominant basement lithology is the Berlins Quartz Porphyry (BQP) of the Greenland Group formation.

The BCM are separated from the BQP basement lithologies by a regional unconformity (Figure 3), paleosols are often observed at this contact which comprise of carbonaceous sand, silt and clay up to half of a metre thick which often form Bedding Plane Shears (BPS). Typically, the BCM coal seams thin onto the margins of the basement paleo highs, thicken to the south and west and split in the vicinity of rare, massive, fine to coarse channel fill basal conglomerates. Overlying the basal conglomerates is a thin sequence of sandstone, siltstone and interbedded carbonaceous mudstone (Figure 4) followed by the main Brunner Coal Measures coal seam (M1). The main coal seam splits, interfingering with beds of coal and very carbonaceous mudstone. Above the main coal seam is an alternating, upward thinning succession of very coarse, cross bedded sandstone, medium to very fine laminated sandstone and less frequent siltstone, mudstone and some thin discontinuous coal seams. Laterally these units are highly variable in thickness and continuity. South of the Escarpment Fault (Figure 4) and within the vicinity of the Mt Rochfort the coal measures unit thickens to in excess of 350 metres.

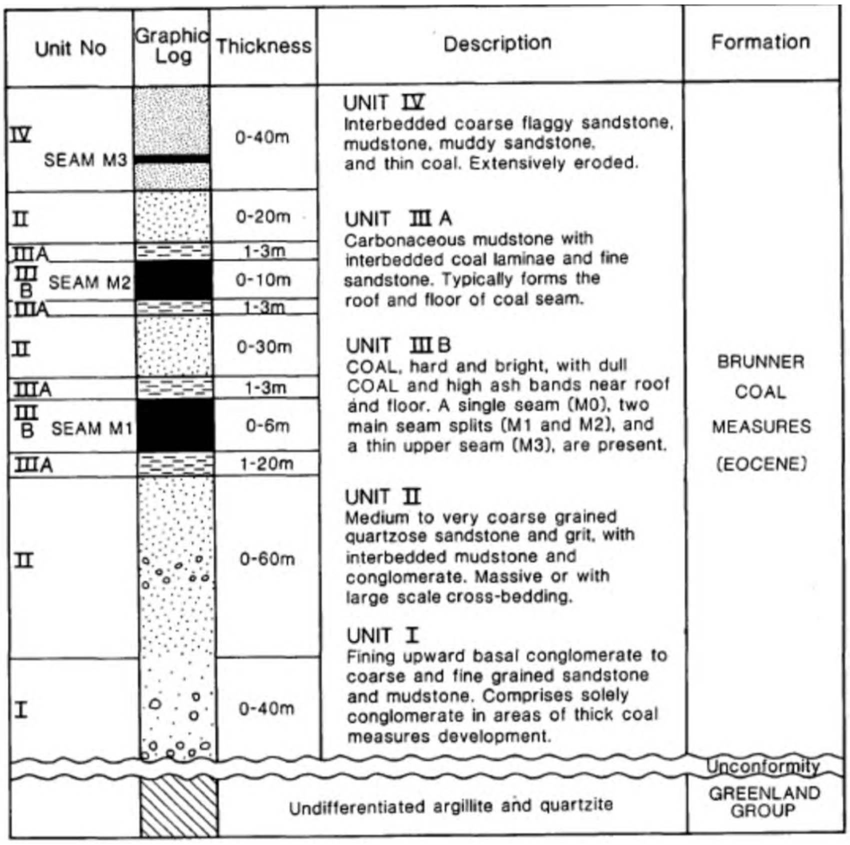


Figure 3. Generalized stratigraphic column of the Escarpment mine area (Todd, 1989).

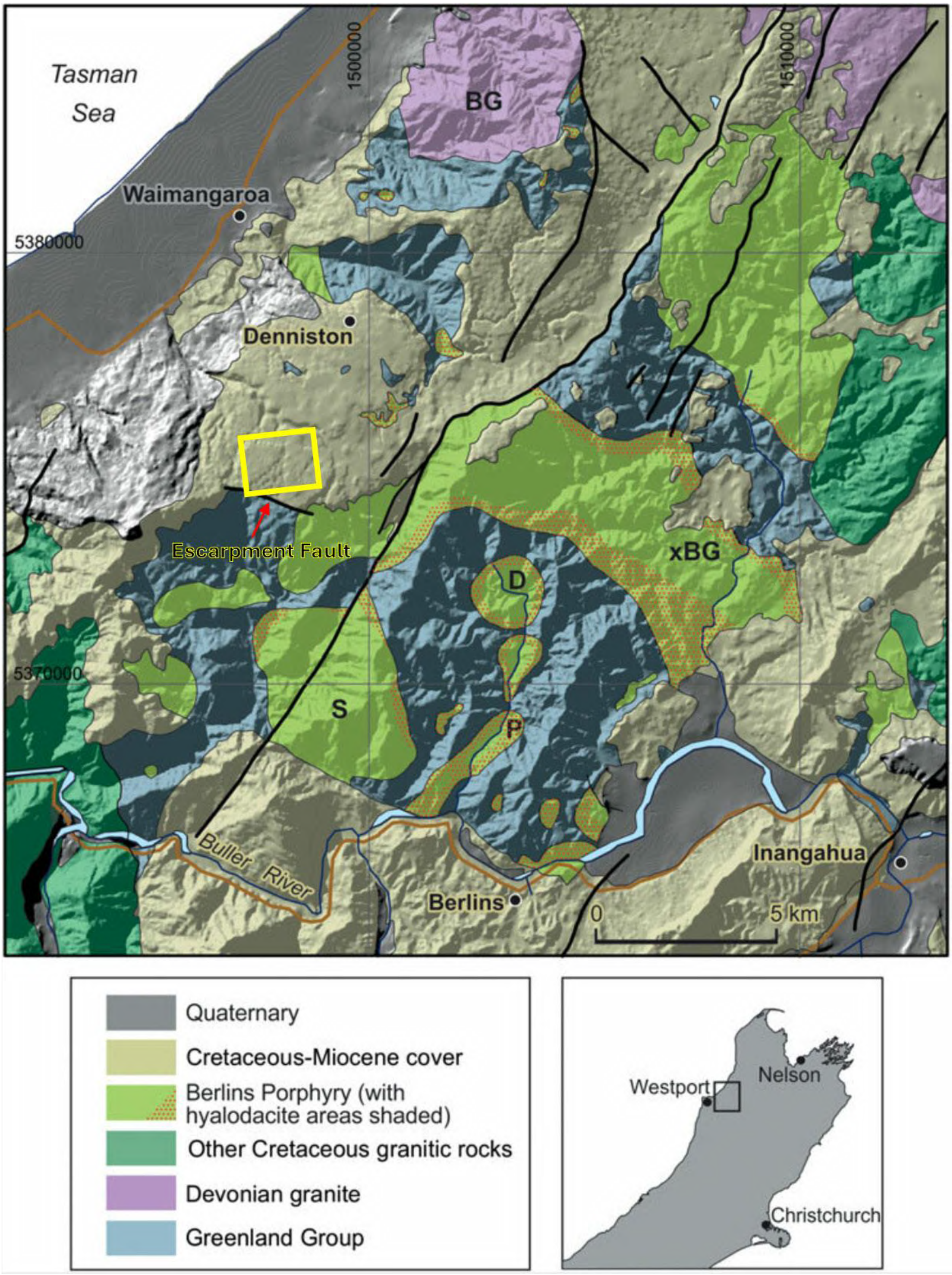
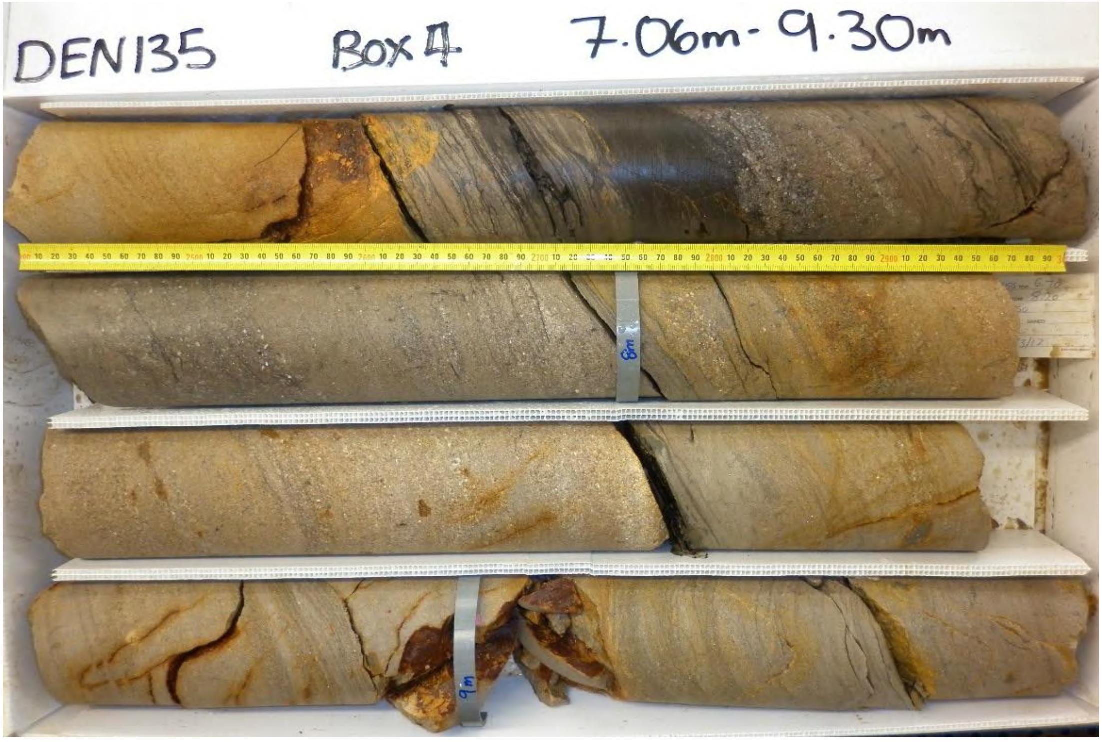


Figure 4. Surface geological map of the eastern Westport area (Nathan, 2014). Yellow rectangle outlines the approximate Escarpment Extension site.

(A)



(B)

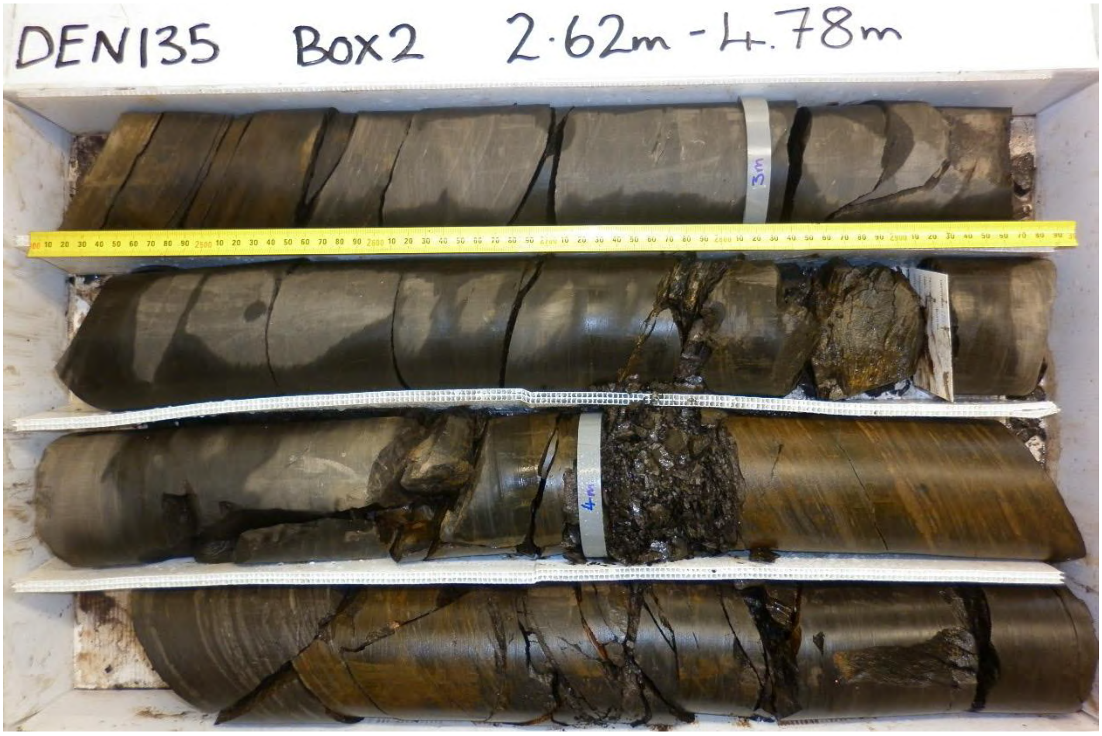


Figure 5. Drill core examples through Brunner Coal Measures sediments from bore hole DEN135. A) Fine – coarse grained sandstone, representative of the typical overburden found at the site. B) Fine sandstone and mudstone with minor carbonations bands, less frequent at the site.

7.0 Structure

The Mt William Fault is a prominent feature within the Buller Coalfield and forms the eastern limit to the Denniston Plateau. With a low to moderate angled east dipping displacement, it extends for more than 10km (Titheridge, 1992). Locally, the Denniston area is host to two distinct structural domains, structural domain west and structural domain east. Structural domain west is bound by the normal motion Escarpment fault to the south and the Whareatea River to the north / northeast. Localized fault drag associated with the Escarpment fault is noted within 70m of the hangingwall and bedding dips are observed to exceed 25 degrees unfavourably out of the slope (NNE) (Figure 7). The domain is characterized by a gently inclined bedding dip slope which is dissected by a series of small normal and reverse faults with vertical displacements of 4-8m (Golder Associates, 2010). The structural domain east is bound to the west by the Whareatea River which has formed parallel to small strike slip-faulting, to the south by outcropping coal and the north to northeast by compressional reverse faulting superimposed over earlier small-scale normal faulting. Bedding dips within the eastern structural domain are highly variable with north to south fold structures. Both domains contain extensive underground workings and associated voids from the historic Escarpment, Whareatea and Coalbrookdale Mines.

The Escarpment Extension pit is located within the structural domain west, where the southern highwall of the proposed pit exposes the Escarpment fault trace (Figure 6). The normal motion Escarpment fault footwall exposes blocky granitic basement BQP which has been displaced in the order of hundreds of metres. There are a number of minor faults that can be seen as surface expressions where the Kaiata Formation has been eroded off leaving the more resistant Brunner Coal Measures surface (Figure 6). In general, fault displacement and associated damage zone thickness scales with the fault length or strike dimension (Gudmundsson et al., 2013) so these minor faults are not expected to have large rock mass damage zones. In terms of stability, faults act as planes of weakness and where they intersect other structures (e.g., faults, bedding and/or joint/fracture sets) or are unfavourably orientated relative to the pit walls can cause structurally controlled failures (e.g., wedge or planar failures). Drilling near and within the Escarpment fault has identified an approximate 10-metre-wide damage zone within the Basement BQP, south of the Escarpment fault trace (Figure 13). Where applicable, a fault gouge and associated 10-metre-wide fault damage zone have been applied to the slope stability sections and are depicted in Figure 7 below. Minor low displacement faults that run at a high angle or perpendicular to the Escarpment fault are expected to be exposed during excavation of the proposed pit with vertical offsets on the order of several metres.

Bedding within the coal measures sequence in western structural domain / Escarpment Extension pit is shallow dipping (5°-12°) to the northeast but is folded by a series of northeast plunging anticlines and synclines. Structural contours define a gentle anticline between the historic Sullivan and Whareatea mines that appears to be associated with a basement high. In DH 6208 the Brunner Coal Measures are only 11m thick. Bedding is also inferred to locally bend adjacent to fault structures (Figure 7). Low strength bedding shear surfaces / 'seat earths' have been identified as the critical features influencing slope stability. Bedding parallel shears are known to exist within the mudstone units of the coal measures and along the roof and floor contacts of the coal seams. Bedding shear surfaces have very low shear strength (at or very near residual strength) and are typically laterally continuous unless offset by faulting. The orientation of these low strength features relative to the pit walls are the main control on the slope design angle and orientation and have been considered in the slope stability analysis for the Escarpment Extension pit and ELF's. In most cases, when the weak contact dips unfavourably out of the slope the material needs to be either excavated back to the structure or to a location where a more favourable orientation is encountered to ensure adequate slope stability.

Figure 6. Aerial image of the ESE area depicting the known faults in blue , note the Escarpment fault trace in foreground.

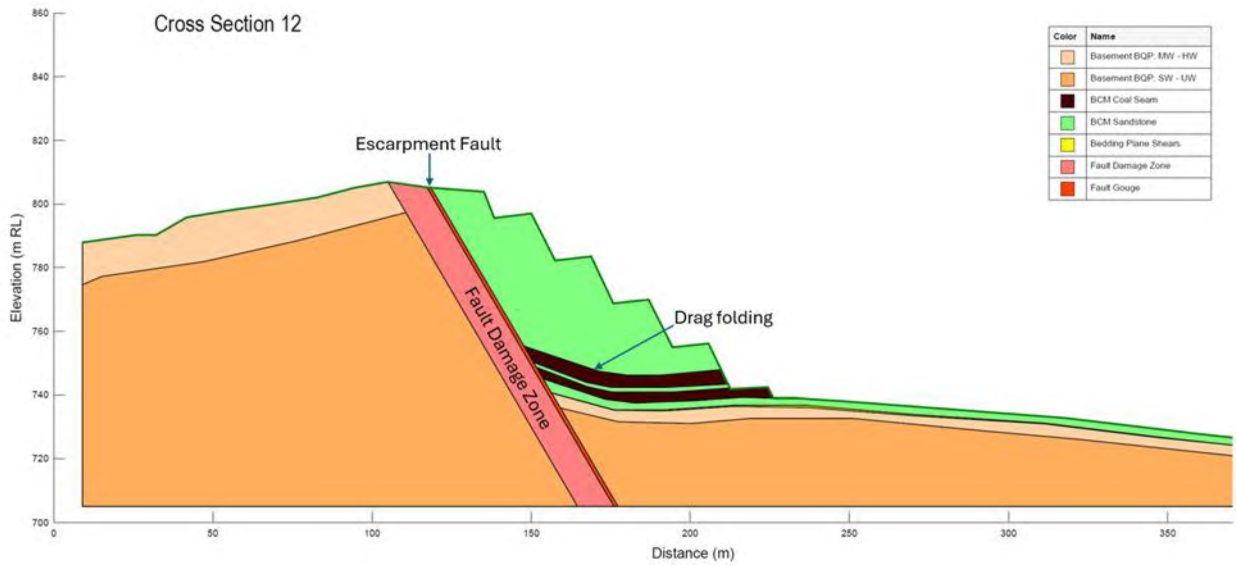


Figure 7. Geologic cross section through the Escarpment fault trace and proposed southern highwall. Note the drag folding within the hanging wall associated with the deformation from the Escarpment fault.

7.1 Groundwater

Limited up to date quantitative groundwater data is available for the ESE prospect but groundwater levels are generally well defined based on the monitoring of the piezometric network (Figure 8) as well as site observations and experience with the local geology. In general groundwater levels rise and fall with topography although differing groundwater pressures can also reflect the influence of permeability variation between the different units and it is expected that different hydraulic conditions exist within the sedimentary overburden units and the intrusive igneous basement.

The hydrogeological regime within the ESE prospect is likely to be influenced by remnant historic underground mine workings where they exist. Groundwater pressures, flow paths and drawdown response within the rock mass around any open pit may be controlled to some degree by the effect of open flow paths and underground storage in the old tunnel networks, a result of water level drawdown at topographic highs and 'ponding' in areas of topographic lows or synform depressions.

Two piezometric surfaces have been defined for this stability analysis which are named 'design groundwater conditions' and 'elevated groundwater conditions'. For the design groundwater conditions, a gradient of 1V:5H from the base of the coal seam into the slope has been adopted. In the elevated groundwater conditions scenario, a gradient of 1V:3H from the base of the coal seam into the slope has been adopted. Temporary elevated groundwater pressures have the potential to develop behind the cut face if slope drainage and the associated piezometric pressures lag behind excavation rates. Therefore, uncertainty in the groundwater profiles has been accounted for by adopting a standard deviation of five metres on the groundwater profiles as presented in Appendix A.

[redacted]

Figure 8. Location of actively monitored piezometers within or near the proposed ESE pit.

8.0 Historic Underground Workings

8.1 General

The remnants of three underground coal mines are located in the vicinity of ESE, largely confined to the eastern pit limits. Historic records show the mining in these areas comprised of first worked, second worked and pillared workings as well as isolated areas that were subject to hydro-mining method.

Review of Lidar surfaces and field mapping did not note any evidence of underground workings which have collapsed through to the surface within the proposed pit footprint, nor was any evidence of crown holes observed.

At the design stage, the main hazard with underground workings is reduced rock mass strengths in rock mass directly above the voids. The proposed design takes into account the reduced strength from the underground workings. Given some of the uncertainty in deformation associated with underground workings, empirical calculations have been carried out which take into account the thickness of the extracted material (coal) and the bulking of roof material (Bell & Stacey, 1992) to calculate the theoretical height of collapse. Results of these calculations have been adopted in the slope stability models and have conservatively allowed for a 10 m thick layer of reduced rock mass strength above the underground workings (where applicable).

8.2 Potential Void Migration

Collapse of the underground workings can lead to the upward propagation of voids breaking through to the surface. Voids breaking through to the surface may form some type of discontinuous subsidence such as crown holes / troughs or chimney caving (Figures 9c, d).

Voids will propagate upward until arrested by:

- The formation of a new stable self-supporting arch;
- A more competent roof layer is intercepted (Fig 9a);
- Bulking of roof debris (Fig 9b); or,
- Migration to the surface forming either a crown hole / trough (Fig 9c) or a chimney (Fig 9d).

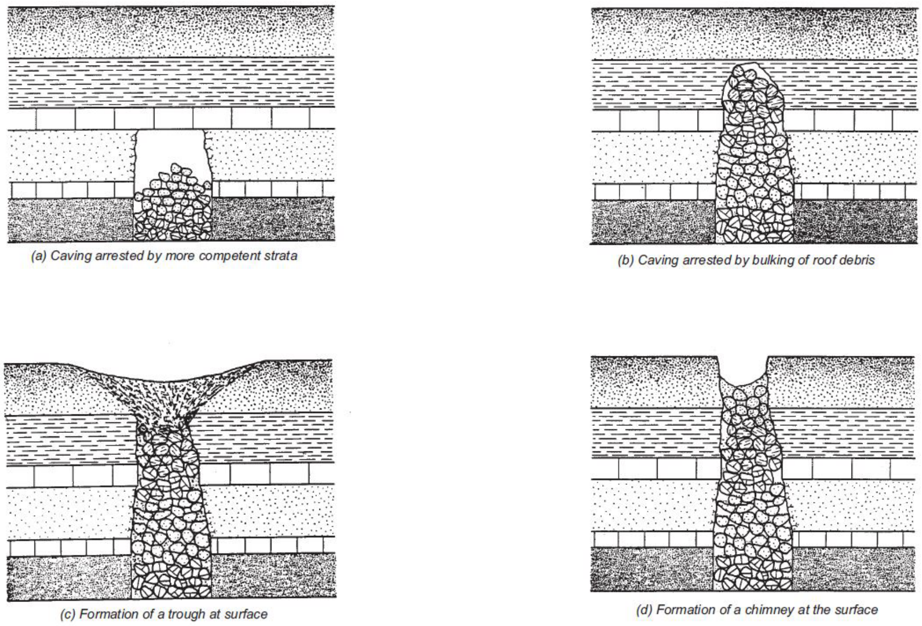


Figure 9. Schematic cross-sections depicting formation of voids above mine workings (Karfakis, 1993).

Simple equations have been developed between the height of collapse, the thickness of the extracted material and the bulking of the roof material (Figure 9, Bell & Stacey 1992). These bulking equations can be used to predict whether caving with a given geometry would reach the ground surface before a void is choked (choked void indicated in Fig 9b).

The bulking factor parameter is used to describe an increase in volume that may occur when a block of rock breaks up to form rubble or when a mass of material is excavated.

Bulking is the phenomenon of volume increase that occurs when solid rock is broken (Nelson, 1965). The volume of broken rock may increase relative to the original volume because the broken rock pieces typically do not fit together perfectly, which results in an increase in void space included with the rock solids.

Published bulking factors for coal measures strata are typically in the range from 1.30 to 1.50 (Bell & de Bruyn, 1999, Ofoegbu et al., 2008). Site field observations would suggest the more conservative lower bound bulking factor is more appropriate to adopt for Brunner Measures overburden due to the joint spacing observed within the fine – course sandstone units.

Based on the height of the underground workings (~3m) it would be possible for voids depending on the shape of collapse (e.g., rectangular, wedge or conical) to migrate up to 10m for a bulking factor of 1.30 (Figure 10B). Complete void choking should occur at the top level of migration.

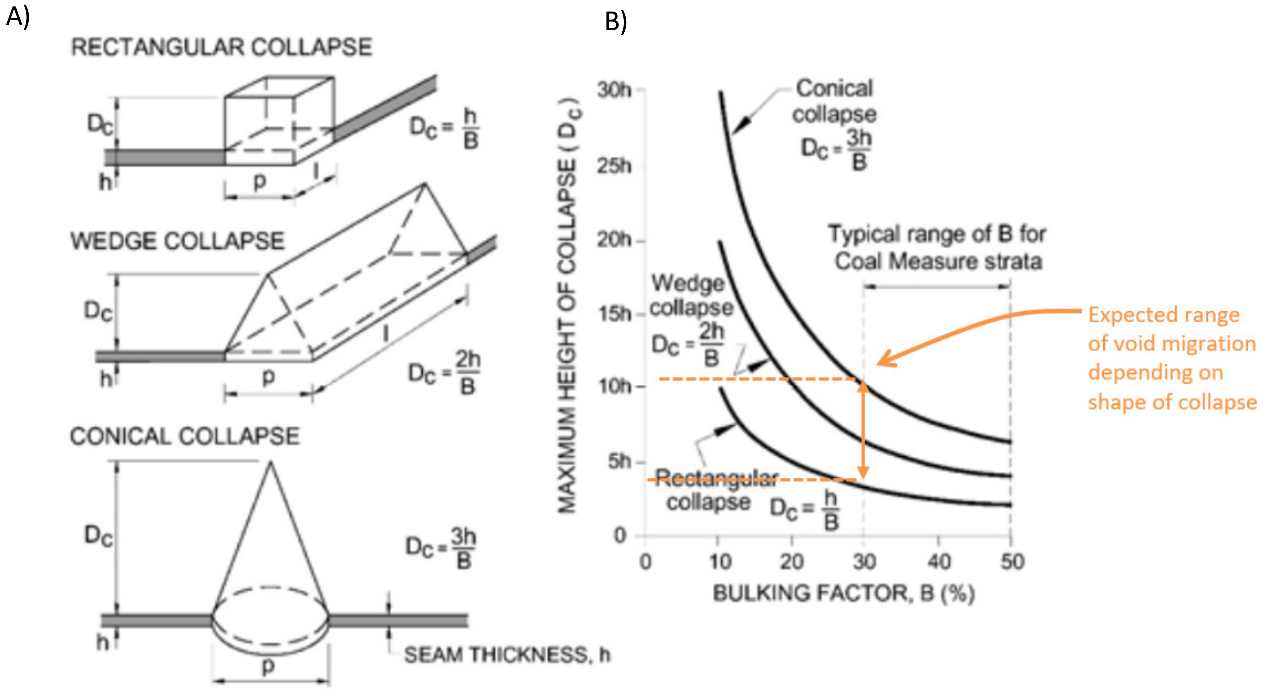


Figure 10. Diagram showing notation relating to maximum height of collapse geometry. B) Postulated variation in maximum height of collapse for different modes of failure. Potential range of void migration for ESE site annotated

8.2.1 Other Considerations

- If chimney development were to occur and a perched water layer was intersected, it has the potential to depressurize the overlying lithology;
- Regional dip and moderate permeability of overburden may keep HUW's in a drained state, but ponding should be expected in areas of topographic lows;
- Drawdown of the groundwater profile in response to mining and associated draining of flooded voids (if any) may reduce the support available to voids in flooded areas, potentially inducing void collapse.

8.3 Void Hazard

As a result of stress redistribution and ground movements above open voids associated with underground workings, the rock mass above the old workings has most likely relaxed (Bell & Stacey, 1992). Loading of the areas above open voids during construction of the proposed ELFs / waste dumps has the potential to induce further relaxing of the rock mass, induce void migration and remnant pillar collapse. Using the potential void migration range as calculated in Section 8.2, any areas with less than 10 metres of cover from the surface to the HUW are considered void hazard areas. The below heat map has been produced to depict the depth of in-situ cover above HUW's within the ELF footprint (Figure 11).

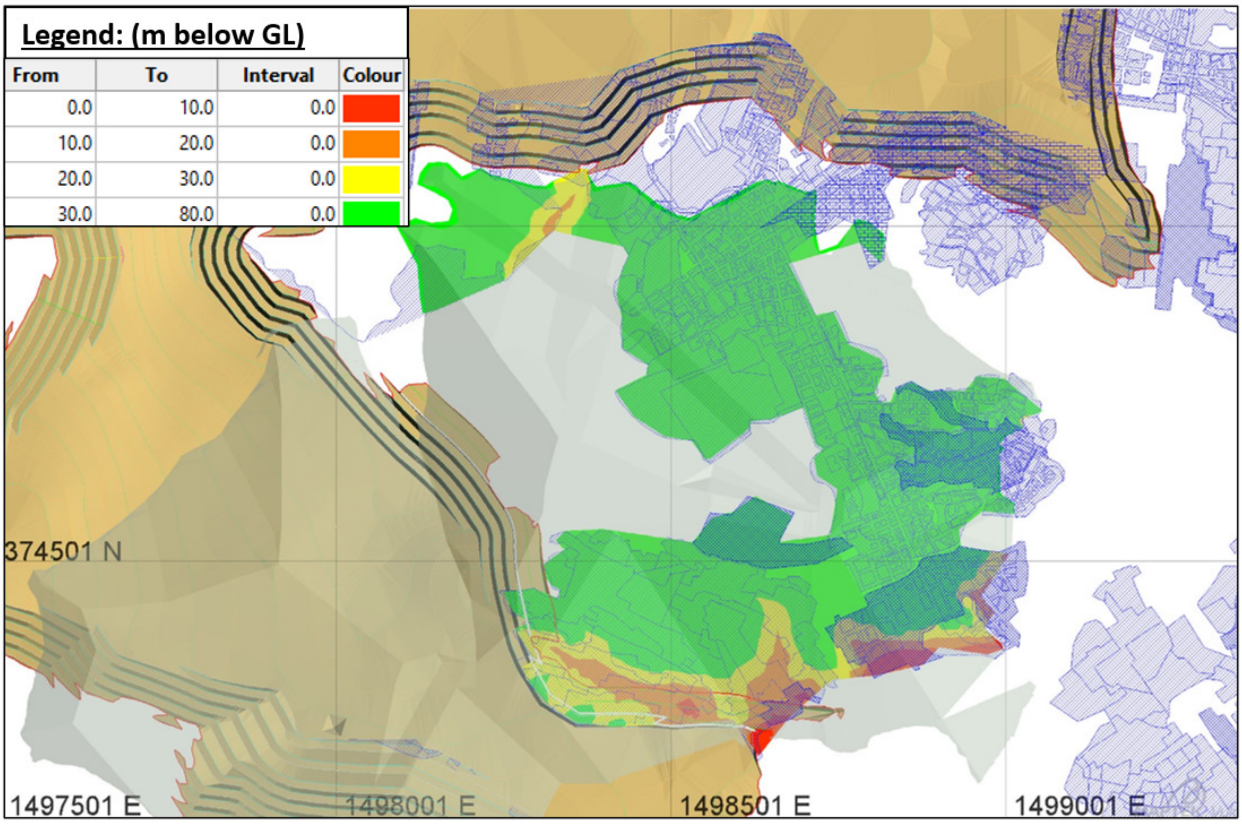


Figure 11. Heat map depicting depth of in-situ cover to HUW's within proposed ex-pit ELF footprint. Areas highlighted by red indicate <10m of in-situ cover and are identified void hazard areas.

8.4 Ex-pit Seal of Historic Underground Workings

An ex-pit seal is required to be constructed during the development phase to stop potentially contaminated water from progressing outside of the mining area via the mine workings and drainage adit (Figure 12). The seal will exist in two parts, an excavation which intersects a portion of first worked HUW's, and a seal created by filling a single adit from a surface drillhole.

The ex-pit seal excavation will extend from the ground surface to the floor of the HUW's. The exposed HUW's will then be sealed and backfilled with engineered fill to achieve a pre-determined permeability. Particular care is required to adequately prepare the low permeability layer contact with the seam floor to ensure an competent seal is created. The second seal will be formed by drilling a bore hole from the surface to intersect the drainage adit, the bore hole will provide access for a cement bentonite seal to be developed within the adit, cutting off the water flow path.

Detailed engineering design and installation methodology of the seals is yet to be undertaken but such designs will need to be in accordance with the Worksafe NZ Health and Safety at Opencast Mines, Alluvial Mines and Quarries good practice guidelines (June 2025) and should utilize case studies from similar works at the neighbouring Stockton mine.

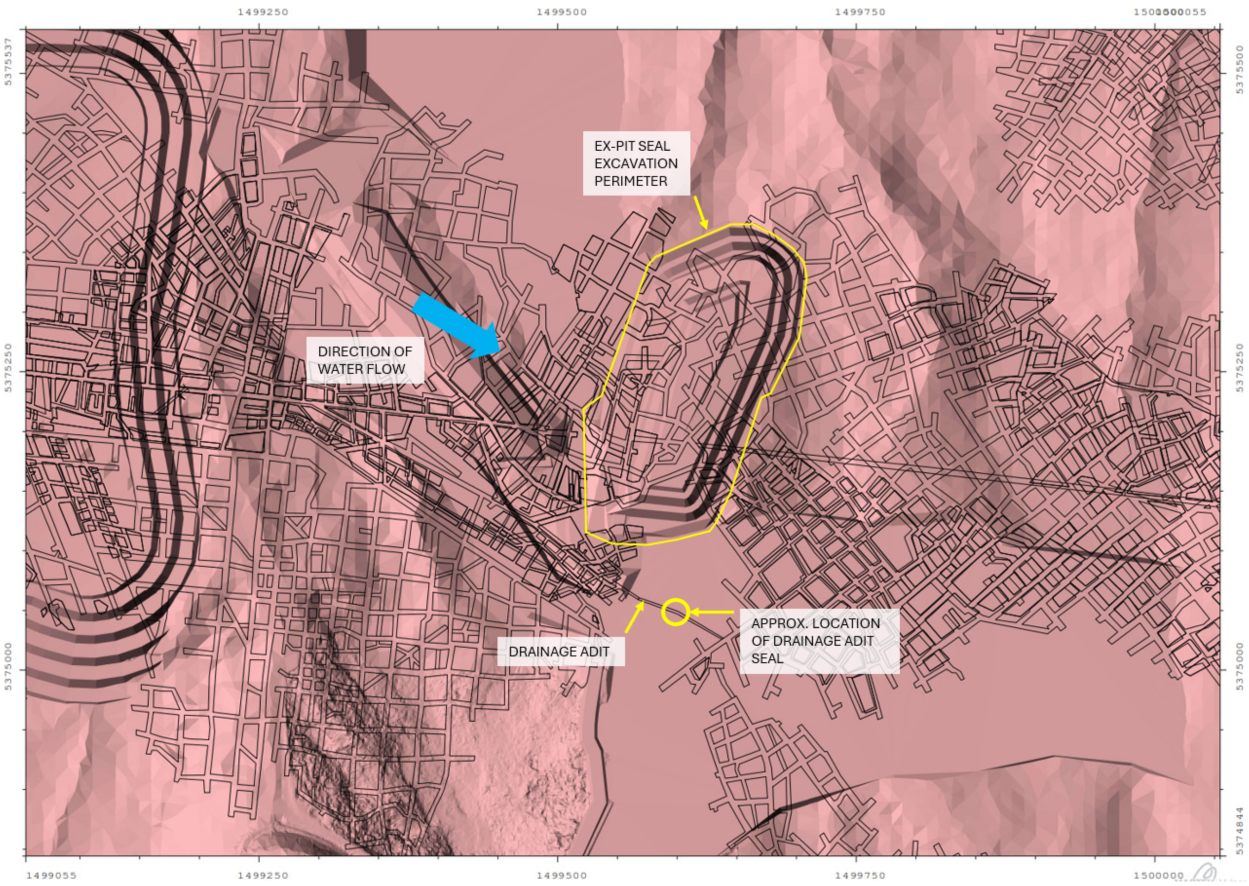


Figure 12. Topographic surface (pink) with outline of HUW's superimposed in black. Ex-pit seal locations are annotated.

9.0 Recent Investigations

9.1 Drilling

The most recent phase of exploration drilling in the Escarpment area was undertaken between 2011 to 2014, followed by a 6-hole program in 2019 to increase data resolution on geological contacts, coal quality, rock mass conditions and bedding orientation. The 2011 – 2014 exploration program included a targeted geotechnical drilling and geophysical logging exercise to fill gaps in the geotechnical model along the Escarpment fault trace. Analyses of the data have informed the overall pit design.

9.2 Groundwater

Ten open standpipe piezometers are actively monitored within the study area to confirm groundwater assumptions. (Figure 8). These piezometers will also be used to monitor the groundwater drawdown profile of the proposed pit during mining. The open standpipe piezometers have a 3.0m long 50mm diameter slotted PVC screen positioned at the base of the BCM coal seam. Data has been recorded intermittently since the piezometer installations and ongoing review of groundwater data will continue.

In summary, data indicates hydraulic conditions within the BCM are similar across the site with reasonably low water levels (Table 2), the historic underground workings and regional dip keep the BCM lithology in a relatively drained state. There is currently no groundwater data for the Berlins Quartz Porphyry basement.

Table 2. Summary of Piezometer Measurements from 1 July, 2025.

Drill Hole No.	Hole Collar RL (m)	Groundwater Depth BGL (m)	Groundwater Level RL (m)
6186	668.88	54.5	641.88
6189	633.62	28.6	605.02
6196	654.49	44.7	609.79
6203	648.98	43.9	605.08
6740	638.48	32.2	606.28
6538	663.95	48.8	615.15
DEN26	748.46	39.2	709.26
DEN115	709.09	9.3	700.06
DEN205	747.13	6.9	740.23
DEN248	724.13	13.0	711.13

9.3 Geophysical Logging

Geophysical logging, including Acoustic Televiewer (ATV), Sonic Velocity and Density has been carried out intermittently over previous geotechnical investigations, with the most recent phase carried out in 2012 by Subsurface Imaging Ltd on drill holes DEN134 and DEN135. This intercepted the Escarpment fault gouge and associated fault damage zone, the dipmeter log from DEN135 is presented in Figure 13 below. Where available, data from geophysical logging has been used to update the geology model, interpretation of the major fault structures and bedding at the site.

To summarize the DEN134 and DEN135 drill holes, the dominant structural orientation of the BCM within the vicinity of the DEN134 and 135 drill holes is perpendicular to the SE striking Escarpment fault structure. Bedding was sub-horizontal to moderately dipping (~30°) to the NE and the coal seam expressed the same orientation, dipping to the N/NE confirming the assumption that the BCM has been subject to fault drag associated with deformation along the normal motion Escarpment fault. The dominant cleat orientation in the coal is subvertical and NE striking, reflecting deformation from the fault

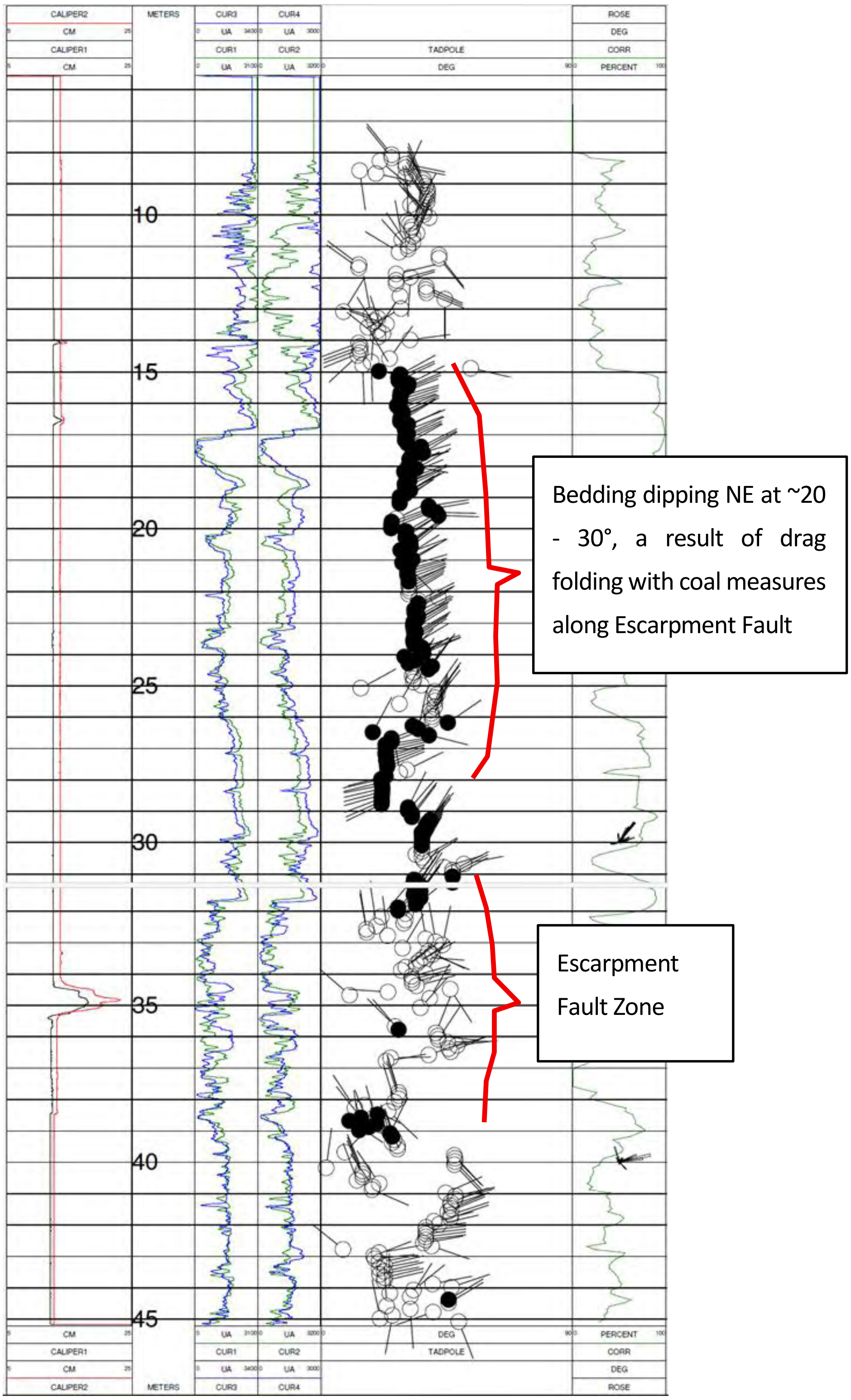


Figure 13. ATV dipmeter log output from drill hole DEN135. Tadpoles indicate strike and dip direction of bedding.

10.0 Existing Slope Performance

Several years of successful opencast development and mining have been conducted within the existing Escarpment opencast pit (Figure 2), Stockton and nearby Cascade mines. The performance of highwalls at these sites has provided a good opportunity to confirm material parameters and view the effect that unfavourably orientated fault structures, defects and weathering have on cut wall stability. The height of final walls proposed at the Escarpment Extension pit will be higher than any previously constructed at Escarpment (maximum overall height is 120m, average slope height is 68m) and the locations of the major fault zones within the pit walls as well as rock mass defects will be critical for wall design stability.

Review of Lidar surfaces from the proposed Escarpment pit area does not show any signs of recent instability and slope gradients generally range between 18 to 22 degrees. Two large, incised gully systems are noted directly NW and NE or the proposed pit and have slope angles up to 70 degrees. These incised gully systems do not exhibit any signs of large-scale instability. Several small to moderate slip head scarps are noted outside of the proposed development area, south of the Escarpment fault running out toward the south, this instability is related the steeply dipping topography and ESC fault damage zone and will not have any effect on the proposed pit development.

Historic aerial photographs of the Denniston Plateau mining area from 1943, 1946 and 1974 were reviewed as part of this assessment and no notable signs of instability within or near the proposed Escarpment pit were observed.

11.0 Mine Design

11.1 Mining Direction

Weak pre-sheared bedding plane surfaces within the Brunner Coal Measures require that consideration be given to the direction of pit wall advance to ensure that highwall instability does not occur. Highwall instability developing along bedding plane shears is most likely to occur when mining direction is advancing up-dip or when mining is advancing down dip leaving an unsupported, unfavourably dipping highwall behind. Historic performance and back analysis indicate that for Brunner Coal Measures, bedding plane shear instability is more likely to occur when bedding dips 10 - 15° out of the wall (unfavourable). Development of the mine plan has taken this into account and where bedding dip exceeds 10° unfavourably, mining is scheduled to advance across or down (favourably) the bedding plane dip where practical and backfill buttressing will follow in a timely manner.

Translational bedding plane failure along drag folding associated with normal faulting has also been considered in the mine design, particularly where a highwall runs parallel / oblique to a fault traces (Figure 6). Where an unreasonable risk of instability developing along this drag folding was identified, the highwall cut has been revised to excavate behind or step away from the fault, reducing the risk of bedding shear developing. As mining advances, most highwall cuts will be backfilled against or 'buttressed' with the construction of in pit ELFs.

11.2 Other Works

A 45m deep (maximum) sump will be cut into the pit floor in the central northern area of the ESE pit (Figure 2) for stormwater management and water treatment purposes, the sump will passively overflow at RL 593.6 m to the north into the Whareatea catchment.

11.3 Slope Design Parameters

The recommended cut slope design parameters for the Escarpment Extension pit, stormwater sump, andex-pit seal are given in Table 3 below. These recommended cut slope and backfill design parameters are based on geotechnical analysis (see Appendix A).

A 10-metre-wide fault damage zone has been applied to the Basement BQP along the Escarpment fault gouge, the slope batter angles have been reduced where the fault trace and associated fault damage zone outcrop in the proposed wall.

Table 3. Slope Design Parameters.

Geological Unit	Maximum Overall Slope	Maximum Batter Slope	Minimum Bench Width	Maximum Batter Height
Brunner Coal Measures Sandstone	39° (1V:1.2H)	65° (1V:0.46H)	11.5m	15m
Brunner Coal Measures Coal Seam	39° (1V:1.2H)	65° (1V:0.46H)	11.5m	15m
Basement (Berlins Quartz Porphyry)	39° (1V:1.2H)	65° (1V:0.46H)	11.5m	15m
Escarpment Fault Damage Zone	28° (1V:1.8H)	36° (1V:1.3H)	11.5m	15m
Interim Backfill Slope	26° (1V:2H)	33° (1V:1.5H)	7.5m	15m
Final Landform Slope	16° (1V:3.3H)	18° (1V:3H)	7.5m	

11.4 Material Parameters

A summary of the material parameters / rock mass strength parameters adopted for this slope stability review is given Table 4 below. Material parameters have been developed based on historical data, field engineering geological mapping, laboratory testing for the local area and previous investigation reports (Golder etcetera). A significant library of geotechnical laboratory testing data is available for the neighbouring Stockton mine and this has been used as a cross reference when confirming rock mass and bedding shear material parameters for this Pre-Feasibility Level report.

Information gathered from field mapping, drill core samples and laboratory testing indicate the upper 10 – 15 metres of the BQP Basement has been subject to chemical alteration / weathering. This upper basement horizon has been deemed moderately – highly weathered (MW – HW) and has been classified separately.

As the in-situ overburden will be subject to heavy production drill and blasting to fracture the rock mass prior to excavation, a blast disturbance factor of 1.0 (D = 1) has been used to develop generalized Hoek-Brown material parameters where applicable. A disturbance factor of 1.0 represents the level of disturbance the in-situ rock mass has experienced and therefore, causes a reduction in material strength.

The effective stress shear strength parameters used in the stability analyses have been derived from a combination of laboratory tests and Geological Strength Index (GSI) methods (Hoek-Brown Technique).

Table 4: Rock Mass Strength Parameters used in Slope Stability Analysis.

Geologic Unit	Model	Bulk Density (t/m3)	c' (Cohesion kPa) (St. Dev. in parentheses)	ϕ' (Phi °) (St. Dev. in parentheses)	UCS (mPa)	GSI	m_i
Brunner Coal Measures Sandstone	Mohr-Coulomb	2.4	50 (10)	35 (3)			
Brunner Coal Measures Damage Zone	Mohr-Coulomb	2.1	40 (10)	32 (3)			
Brunner Coal Measures Coal Seam	Mohr-Coulomb	1.1	80 (8)	33 (3)			
Bedding Plane Shears (Carb MST)	Mohr-Coulomb	2.4	0	20(2)			
Escarpment Fault Damage Zone	Mohr-Coulomb	2.1	5 (1)	20(2)			
Escarpment Fault Gouge	Mohr-Coulomb	2.1	0	15(2)			
Basement BQP: SW to UW	Hoek-Brown	2.6			25	63	28
Basement BQP: MW to HW	Hoek-Brown	2.6			18	55	28
General Backfill	Mohr-Coulomb	1.8	0	32 (3)			
Controlled Backfill	Mohr-Coulomb	1.9	2 (1)	35 (3)			

12.0 Final Landform / Engineered Landform

12.1 General

The elevated natural slopes of the Denniston Plateau surrounding the mine comprise a combination of gently to moderately sloping open areas of exposed sandstone (pavement) and low rolling hills with typical slopes between 1V:3H and 1V:5H, and localised steeper gully areas up. The elevation difference across the site is ~250 m extending from the Escarpment fault ridge in the south at RL ~850 m down to the NW near the Whareatea Steam at RL ~600 m.

The final pit is planned to be progressively backfilled from the south toward the north-east and north-west with overburden waste to form the final landform (Figure 15). The final landform batters are designed to resemble the surrounding gently to moderately sloping natural topography and provide a landform that meets long term slope stability criteria. The stormwater sump in the central northern portion of the pit will remain for stormwater control and treatment (Figure 15).

12.2 Design Considerations

The in-pit and ex-pit ELFs will be constructed from the excavated Brunner Coal Measures sandstones and rear mudstone. These excavated materials are generally coarse grained in nature and therefore considered free draining, meaning there is very little risk of elevated piezometric pressures developing within the elevated ELFs resulting in a low liquefaction risk under seismic loading.

In order to create a suitable foundation to form the ELF / final landforms upon, foundation preparation will be required which includes removal of topsoil and any other unsuitable material (high organic content), along with benching and / or ripping of the foundation floor in areas where the floor dips in excess of 5-degrees unfavourably. Under drainage will be required to be installed below the backfill where groundwater discharges are noted or when filling against historic underground workings that have the potential to discharge water.

12.3 Engineering Properties of Excavated Material

The excavated material at the site will largely comprise of Brunner Coal Measures sandstone and rare mudstone as these units are dominant overburden lithology at the site. End tipped, loose excavated material will stand at ~37 degrees in interim dump designs however interim batter angles are set at 33° and final landform (ELF) maximum batter angles are set at 18° to create a stable landform and reduce surface water runoff induced erosion.

Mohr-Coulomb derived parameters of loose dumped / end tipped BCM sandstone are typically c' = 0 Phi' = 35, based on observations of waste dumps in the existing Escarpment and Stockton Mines. Based on previous experience with BCM sediments it is expected that if the loose lift thickness is reduced, strength parameters of c' = 2 Phi' = 45 are achievable.

13.0 Slope Stability

13.1 General

Slopes were analysed using Geostudios SlopeW limit equilibrium software with the Morgernstern Price method with optimised failure surfaces reported. Potential slip surfaces were assessed with auto locate, block search and fully specified methods. The analysis compares driving and resisting forces within a slope and determines a ratio (or Factor of Safety) where values greater than 1 are increasingly more stable (Failure is assumed to occur when the factor of safety is less than 1). The lowest factor of safety (FoS) was assessed by either searching through potential failure surfaces and/or analysing a fully specified failure surface. The results of each analysis case are presented in Section 13.4 below. The outputs from the SlopeW analysis are attached in Appendix A.

13.2 Design Criteria

13.2.1 General

Pit wall and final landform slopes have been designed to achieve suitable levels of stability in terms of Factor of Safety (FoS) along with managing uncertainties in the designs for which sensitivity analyses are undertaken. A sensitivity analysis allows determination of the 'sensitivity' of the safety factor to variation in the input data variables (material strength parameters and groundwater pressure) which may be critical to the assessment of slope stability.

13.2.2 Static

Guidance on selection of structure importance levels and appropriate return periods for a particular facility is given NZS 1170.0 Structural Design Actions, Table 3.1, 3.2 and 3.3. For the site a design life of 100 years has been adopted, for Structure Importance Level 1. For Structure Importance Level 1 (IL1), it is expected there are low consequences for loss of human life or small to moderate economic, social, or environmental consequences, i.e. includes minor structures where failure not likely to endanger human life.

Groundwater response to mining excavation has been identified as a potential risk factor for design in previous studies. Therefore, two groundwater cases are considered as part of the cut wall stability assessment. These include a less favourable elevated groundwater and the expected design groundwater scenario. Slope stability analysis has also allowed for a standard deviation of 5.0 metre on the groundwater profiles. For the final landform, assuming the rehabilitated land will be returned to native vegetation a design FoS of 1.3 for static and 1.1 for elevated groundwater cases has been adopted. Table 6 below summarises the adopted design criteria. These criteria for low-risk areas are in general accordance with suggested limit equilibrium criteria accepted in other regions[1].

13.2.3 Seismic (Pseudo-static)

The mine site is located in an area of moderate to high seismicity compared to other regions of New Zealand in terms of Peak Ground Acceleration (PGA). According to the GNS Active Faults Database the closest active known fault to the site is the Lower Buller Fault, located approximately 5km due west. This fault has a very low

[1] Auckland Council – Code of Practice for Land Development and Subdivision – Section 2 Earthworks and Geotechnical Requirements. Version 1.6, 24 September 2013. Table 2.C.1 Factors of Safety.

recurrence interval reported (>5000 years).

Under NZS 1170.0, for structures presenting a low degree of hazard to life and other property and low consequence (IL1) for a 100-year design life earthquake motions with a return period of 250 years are used for the ultimate limit state (ULS). For IL1 structures the serviceability limit state (SLS) is not required. However, for this assessment for 100-year design life earthquake motions with a return period of 100 years are used for the SLS condition.

The ground motion estimates for the SLS events and ULS events described above are based on Table A1, ID 81 (Westport) of the Module 1 Earthquake Engineering Practice (NZGS/MBIE, 2021) and an effective earthquake magnitude of 6.0 suitable for the Escarpment area. Table 4 below is a summary of Seismic Hazard Parameters used in the analysis.

Table 5. Summary of Seismic Hazard

Parameter	Standard
Design Life	**>100 years**
Importance Level (AS/NZS 1170.0:2002 Table 3.1)	**1**
Seismic Stability Serviceability Limit State (SLS)	**1 in 100 AEP**
Ultimate Limit State (ULS)	**1 in 250 AEP**
Earthquake Magnitude (Mw)	**6.0**
PGA (SLS)	**0.28 g**
PGA (ULS)	**0.41 g**

An earthquake event was analysed using a pseudo-static approach, in which a horizontal load (PGA) is applied to the model to simulate the seismic loading.

Estimates of permanent displacements from seismic loadings were assessed using simplified empirical model (Newmark sliding-block analysis) from Jibson (2007). In this type of approach, the yield acceleration (k_y: threshold ground acceleration necessary to overcome basal sliding resistance and initiate permanent slope movement) of a sliding mass is estimated by finding the average horizontal acceleration that results in a factor of safety of 1.0. The ratio of the average yield acceleration to the maximum seismic acceleration (k_y/k_{max}) is then used to estimate the displacement. Sliding block analysis was conducted using the United States Geological Survey (USGS) SLAMMER program.

To assess the implications of the degree of displacement (D) that may occur during seismic induced slope instability, Table 22 from Bray and Travasarou (2007) can be utilized (refer to Table 6 below). A maximum displacement (D) of <10 cm and a performance level of 'Minor' has been deemed suitable for the Escarpment site given its seismic setting; these parameters have been utilized for the slope stability design criteria.

Table 6. Seismic displacement thresholds (Bray and Travasarou (2007)).

Displacement (D)	Performance Level	Implication
D < 1 cm	Stable	Negligible, no structural impact
1cm ≤ D <10 cm	Minor	Small permanent displacement, minor cracking or settlement
10 cm ≤ D < 100 cm	Moderate	Noticeable deformation, potential loss of functionality of infrastructure
D > 100 cm	Severe / Failure	Large displacements, slope failure likely, major damage to structures

Table 7. Slope Stability Design Criteria.

Design Groundwater Conditions	Elevated Groundwater Conditions	Final Landform	Seismic Stability	
			Pseudo-Static	
			SLS	ULS
Groundwater conditions expected within design life.	Groundwater conditions associated with heavy and prolonged rainfall event.	Groundwater conditions expected within design life.	Design Ground Acceleration of 0.28 g based on a 1:100 Annual Exceedance Probability.	Design Ground Acceleration of 0.41 g based on a 1:250 Annual Exceedance Probability.
FoS ≥ 1.2	FoS ≥ 1.1	FoS ≥ 1.3	FoS ≥ 1.0 or displacement < 10cm[B]	FoS ≥ 1.0 or displacement < 10cm[B]
[B] Displacement method of Jibson (2007) using critical acceleration ratio (K_y/K_{max}) and magnitude.				

13.3 Failure Mechanisms

The stability models assess the potential for instability through different failure mechanisms applicable to the pit walls and final landform to determine those with the lowest level of stability. These include:

- Planar failure along low strength bedding shear surfaces and associated structures within the *in situ* sedimentary sequence (e.g., shear seams at the upper and lower contacts of the BCM coal seams, carbonaceous mudstone lenses within the BCM, and unconformity between the lower BCM with the basement rock);
- Complex non-circular failure through in situ rock mass;
- Bi-wedge or multi wedge failure (e.g., Hegan and Read, 1988);
- Circular failure of engineered landform backfill;

If instability develops on the walls, the primary mechanism for failure would likely be wedge or planar sliding failures on the identified shear seams and / or fault zones.

13.4 Slope Stability Results

The locations of twelve cross-sections (Cross-Section 1 to 12) have been used to assess the ESE cut wall slope stability. The locations of the cross-sections are illustrated on Figure 14. Stability analysis outputs for Cross Sections 1 to 12 are presented in Appendix A and summarised in Table 8.

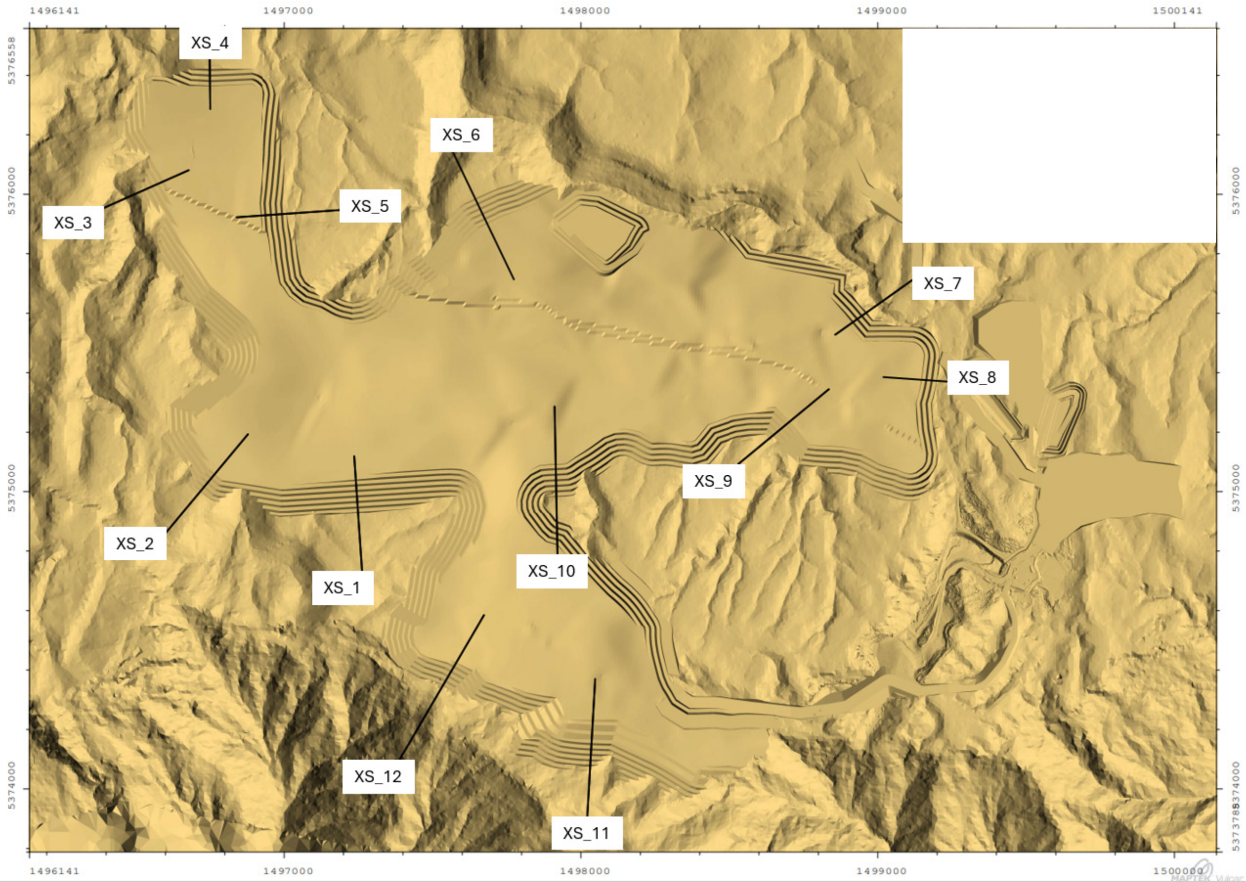


Figure 14. Location of geotechnical cross-sections used for slope stability analysis of the ESE cut walls.

13.4.1 Static case

Overall, slope analysis results indicate satisfactory levels of stability for the pit walls under expected groundwater conditions. The minimum calculated FoS was >1.2. The slopes meet the adopted design criteria.

13.4.2 Elevated Groundwater Case

The effects of elevated groundwater pressure in the cut slopes of the pit walls were undertaken by steepening the gradient of the piezometric line affecting both the BCM and basement. In the elevated groundwater scenarios, where there is potential for higher piezometric pressures behind freshly cut faces Factor of Safety (FoS) values below 1.3 could be expected until depressurization occurs, but slopes are expected to perform satisfactorily.

13.4.3 Seismic Case

The effects of a seismic load have been assessed for the long-term stability of the proposed pit walls. The analysis results indicate that displacements could occur during the design earthquake (FoS < 1.0) and so an assessment of the seismic yield acceleration (Ky, the acceleration at which a FoS of 1.0 is calculated) and has been undertaken for use in a displacement assessment. This assessment indicates displacement up to 2.9cm could be expected for the 250-year event design earthquake. This level of displacement meets the adopted design criteria set out in Table 7 and the expected performance is considered to be suitable for the proposed end land use of a nature reserve.

13.4.4 Sensitivity Analyses

Results of sensitivity analyses demonstrate for the possible range of input parameters the calculated FoS values can vary by ± 0.2. The most critical geotechnical model parameters from a wall stability perspective are:

- Elevated piezometric groundwater pressures;
- Residual strength of Bedding Plane Shears;
- Unfavourable bedding dip.

Table 8. Factors of Safety for the Escarpment Extension pit.

Cross - Section	Factor of Safety					
	Design Scenario					
	Design Groundwater Pressures	Elevated groundwater pressures	Pseudo Static[A] Serviceability Limit State (1/100yr 0.28g)	Displacement[B]	Pseudo Static[A] Ultimate Limit State) (1/250yr 0.41g)	Displacement[B]
XS_1	1.59	1.52	1.03		0.90 (K_y = 0.29g)	<1.0 cm
XS_2	1.50	1.41	0.92 (K_y = 0.21g)	0 cm	0.76 (K_y = 0.19g)	<1.0 cm
XS_3	1.20	1.15	0.83 (K_y = 0.19g)	<1.0 cm	0.54 (K_y = 0.20g)	<1.0 cm
XS_4	1.91	1.80	1.18		1.00	
XS_5	1.79	1.71	1.12		0.95 (K_y = 0.35g)	0 cm
XS_6	1.45	1.43	0.92 (Ky = 0.20g)	< 1.0 cm	0.77 (K_y = 0.20g)	< 1.0 cm
XS_7	1.61	1.60	1.04		0.89 (K_y = 0.29g)	< 1.0 cm
XS_8	1.87	1.87	1.22		0.97 (Ky = 0.390	0 cm
XS_9	1.58	1.48	0.99 (K_y = 0.27g)	0 cm	0.83 (K_y = 0.3g)	< 1.0 cm
XS_10	1.29	1.27	0.82 (K_y = 0.21g)	0 cm	0.68 (K_y = 0.2g)	< 1.0 cm
XS_11	2.36	1.49	0.71 (K_y = 0.13g)	<1.0 cm	0.56 (K_y = 0.10g)	2.9 cm
XS_12	1.29	1.27	0.81 (K_y = 0.14g)	<1.0 cm	0.68 (K_y = 0.13g)	1.5 cm

A Any movement will be negligible (overall stability maintained)
B Displacement method of Jibson (2007) using critical acceleration ratio (Ky/Kmax) and magnitude.

13.4.5 Stability of Final Landform

The locations of four cross-sections (Cross-Section A to D) have been used to assess the final landform slope stability. The locations of the cross sections are illustrated on Figure 15. Stability analysis outputs for Cross-Sections A to D are presented in Appendix A and summarised in Table 9.

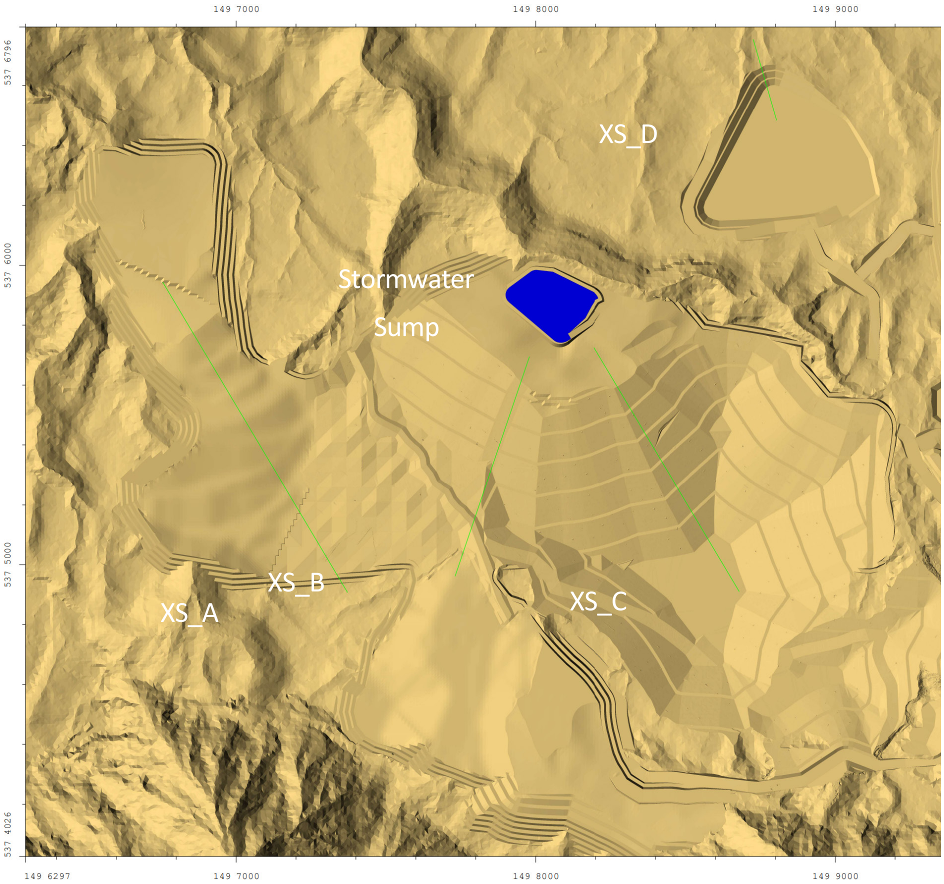


Figure 15. Proposed final landform surface and location of geotechnical cross-sections used for slope stability analysis of the ELF.

13.4.5.1 Static Case

Overall, slope analysis results indicate satisfactory levels of stability for the engineered landform slopes under design and elevated groundwater conditions (Table 8). The engineered landform does meet the adopted design criteria.

13.4.5.2 Seismic Case

The effects of a seismic load have been assessed for the long-term stability of the engineered landform. The analysis results indicate that displacements could occur on some of the slopes during the design earthquake (FoS < 1.0) and so an assessment of the seismic yield acceleration (Ky, the acceleration at which a FoS of 1.0 is calculated) has been undertaken for use in a displacement assessment. This assessment indicates displacements less than 1.0 cm could be expected for the 250-year event design earthquake. This level of displacement meets the adopted design criteria set out in Table 7 and the expected performance is therefore considered to be suitable.

Table 9. Factors of Safety for the Escarpment ELF

Cross - Section	Factor of Safety					
	Design Scenario					
	Design Groundwater Pressures	Elevated groundwater pressures	Pseudo Static[A] Serviceability Limit State (1/100yr 0.28g)	Displacement	Pseudo Static[A] Ultimate Limit State (1/250yr 0.41g)	Displacement
XS_A	2.54	2.46	1.18	0 cm	0.93 (K_y = 0.37g)	< 1.0 cm
XS_B	2.10	2.10	1.08	0 cm	0.85 (K_y = 0.30g)	< 1.0 cm
XS_C	2.10	2.10	1.00	0 cm	0.78 (K_y = 0.28g)	< 1.0 cm
XS_D	1.97	1.97	0.97 (K_y = 0.26g)	0 cm	0.80 (K_y = 0.26g)	< 1.0 cm

[A] K_y (g) = Critical (yield) acceleration calculated from horizontal acceleration that results in a factor of safety of 1.0
[B] Displacement method of Jibson (2007) using critical acceleration ratio and magnitude.

14.0 Key Areas of Geotechnical Risk / Uncertainty

Based on the analyses undertaken the following areas of residual geotechnical risk have been identified.

- **Bedding Shear Geometry:** The main residual risk item is the geometry of the underlying shear seam contacts on the base and top of the coal seam and the BCM / Basement contact. An unfavourable variation of dip in the order of several degrees on these surfaces into the pit will likely cause a reduction in the stability of the slope.
- **Fault Structures:** The relative locations of the main Escarpment fault structure and associated minor faults (forming parallel and/or as conjugates) and non-associated minor fault structures relative to the orientation of the pit walls also remains a risk. The location of the Escarpment Fault is reasonably well defined by drilling, review of historic underground mine plans and geological modelling but there may be additional unknown fault structures.
- **Minor faults**: These faults forming parallel and/or as conjugates to the main fault structures relative to the orientation of the pit walls also remains a risk in terms of wedge and planar failures if unfavourable orientations occur. Mapping and updating of geology and structure model as the cut is exposed to compare with original design assumptions will be required to minimise the risk.

- **Underground Workings:** The thickness of the disturbed rock mass zone (if any) overlying underground workings remains a risk. A conservative approach has been adopted in the design where historic underground workings are present by adopting lower material strength parameters in the 10 metres directly above the previously worked coal seam.
- **Uncertainty in Groundwater Levels:** Uncertainty in groundwater levels / piezometric pressures remains a risk to the performance of the proposed pit wall cuts. Slope stability analysis has allowed for a standard deviation of 5.0 metre on the groundwater profiles but there is a risk that the groundwater profiles fall outside of the 5.0 metre standard deviation. In which case Factor of Safety's may differ from those outlined in the slope stability analysis.
- **Uncertainty in Groundwater Response:** The uncertainty in response of groundwater to mining remains a risk to the performance of the proposed ESE pit. Analyses have allowed for some long-term groundwater drawdown into the pit floor. Drawdown may be slow to occur in the short term within the relatively low permeability rock with potential elevated groundwater pressures developed behind the cut slopes as groundwater drawdown lags behind excavation. In the short term FoS values below 1.3 could be expected until depressurisation occurs, but slopes are expected to perform satisfactorily.
- **Consequence of Failure:** Historically, any slope movements in the area have developed slowly and the Health and Safety risks of slope movement (if occurring) at the ESE pit will be manageable within the Bathurst Resources operating procedures. These risks can be further reduced by adoption of one or more of the risk mitigation measures outlined below.

15.0 Risk Mitigation Processes

During the mining phase risk mitigation measures should be undertaken to reduce the likelihood or consequence of the residual risks outlined above. Risk mitigation measures should include a combination of:

- **Geological Mapping:** The geological model should be 'ground truthed' during excavation. This is to ensure the critical areas of the design are identified (location and orientation of faults, and orientation of bedding), and that differences from the assessed geological and groundwater model are recorded / mapped and used to refine the design where required.
- **Geotechnical Inspections:** During excavation, the cut slopes need to be assessed for performance, rock mass conditions and for structural orientation of bedding parallel defects and faults relative to the design walls. This will allow for early recognition of structures that may be more favourably and/or unfavourably orientated than allowed for in the design.
- **Slope Monitoring:** Potential areas of instability need to be detected prior to them becoming hazardous, and the appropriate trigger-action response plans (TARP) initiated when ground movements are detected. Ground movements can be monitored using aerial drone surveys, real-time robotic total

stations and slope deformation radar / laser scanners. Slope movement monitoring is only effective where a competent and appropriately experienced person is interpreting the monitoring data.

- **Contingency Plan:** Contingency plans can be developed for at risk areas that provide options to reprofile, unload, install shear keys or buttress the cut slopes in the event of adverse geology and/or slope deformations are observed during excavation.

16.0 Recommendations for Further Work

Recommendations for further geotechnical investigations to be included in a further work plan are outlined below:

- The existing piezometric network should be monitored at least monthly and after high rainfall events so groundwater response to heavy / prolonged rainfall can be observed and seasonal groundwater fluctuations can be established.
- A targeted geotechnical drilling program is required during the mining phase to provide information on areas of low confidence, especially around the small – moderate displacement faults to confirm the scale of localized fault drag / bedding plane draping. Piezometers should be installed in these bore holes to provide further information, building confidence in the hydrological regime of the site.
- Install vibrating wire piezometers into the south wall to confirm ground water pressures in the hanging wall and footwall of Escarpment fault. This will also provide an opportunity to review material strengths of fault damage zone / gouge.
- Further downhole geophysical survey and engineering geology field mapping should be carried out to aid kinematic analysis prior to mining. Slope stability analysis has identified discontinuities as one of the largest hazards to slope stability and further information is required to appropriately assess the likelihood of wedge, planar and toppling failure.
- Laboratory testing of drill core sample within the vicinity of the proposed pit walls should be carried out to confirm the applicability of the material parameters used for this slope stability analysis and aid development of material parameters for future slope stability analysis and highwall design.
- Infill drilling should be carried out at consistent intervals to confirm bedding geometry, coal seam thickness and voids associated with historic underground workings prior to mining.

17.0 Conclusion

A geotechnical review of the proposed Escarpment Extension open pit and conceptual final landform design has been completed. The purpose of the review is to consider the feasibility of the proposed designs, likely stability and potential environmental effects related to geotechnical performance.

The slope stability analyses undertaken for the proposed ESE open pit design demonstrates that using the best available data, for the expected geology and groundwater conditions that the design slopes of the pit should remain stable. Critical stability exists at the BCM Sandstone / BCM Coal Seam interface and around the Escarpment fault zone. Risk mitigation measures such as geological mapping, geotechnical inspections, slope and groundwater monitoring, and stabilisation options can be adopted to manage the risks associated with areas of uncertainty.

Backfilling of the pit progressively during mining and upon completion with overburden material and construction of the ELF's will provide a stable long-term final landform for the expected land uses. We consider there is a low risk of instability for the proposed pit and ELF's assuming the adopted design geometries and stability criteria are implemented.

Overall, we consider that the proposed pit and final landform is geotechnically feasible and that slope instability risks can be managed by good design, mining practices, monitoring programmes and suitable setbacks from areas of high ecological values. Accordingly, we consider that the environmental effects relating to geotechnical performance are negligeable.

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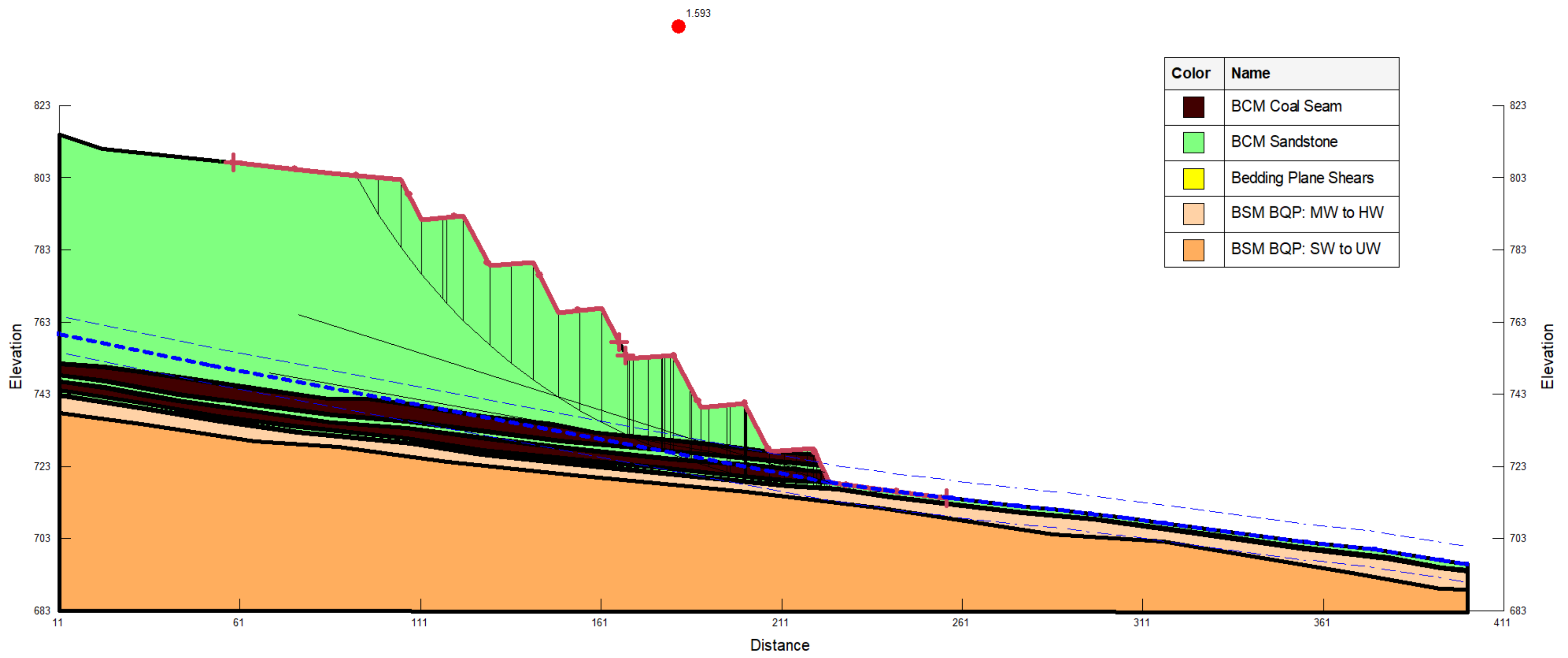
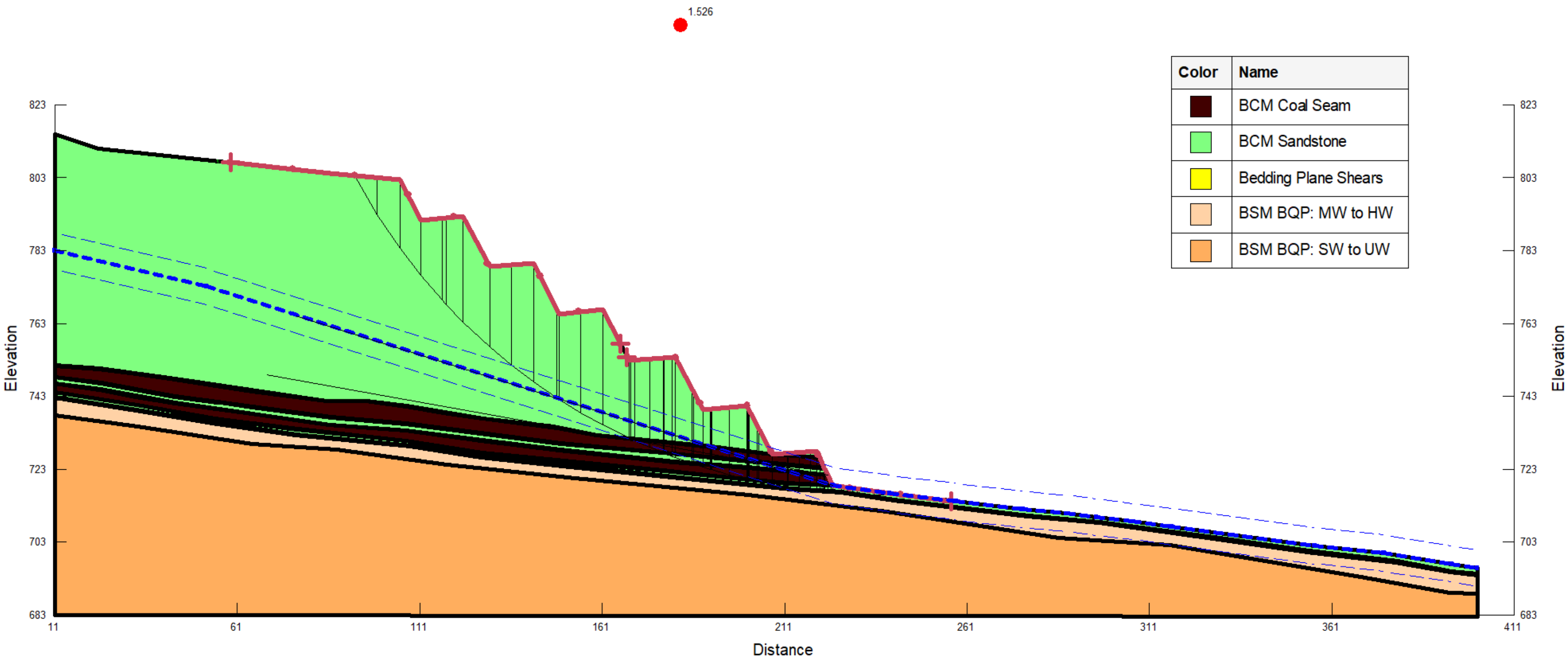
19.0 Appendix A – Slope Stability Analysis



Name: XS1 Design Groundwater Pressures



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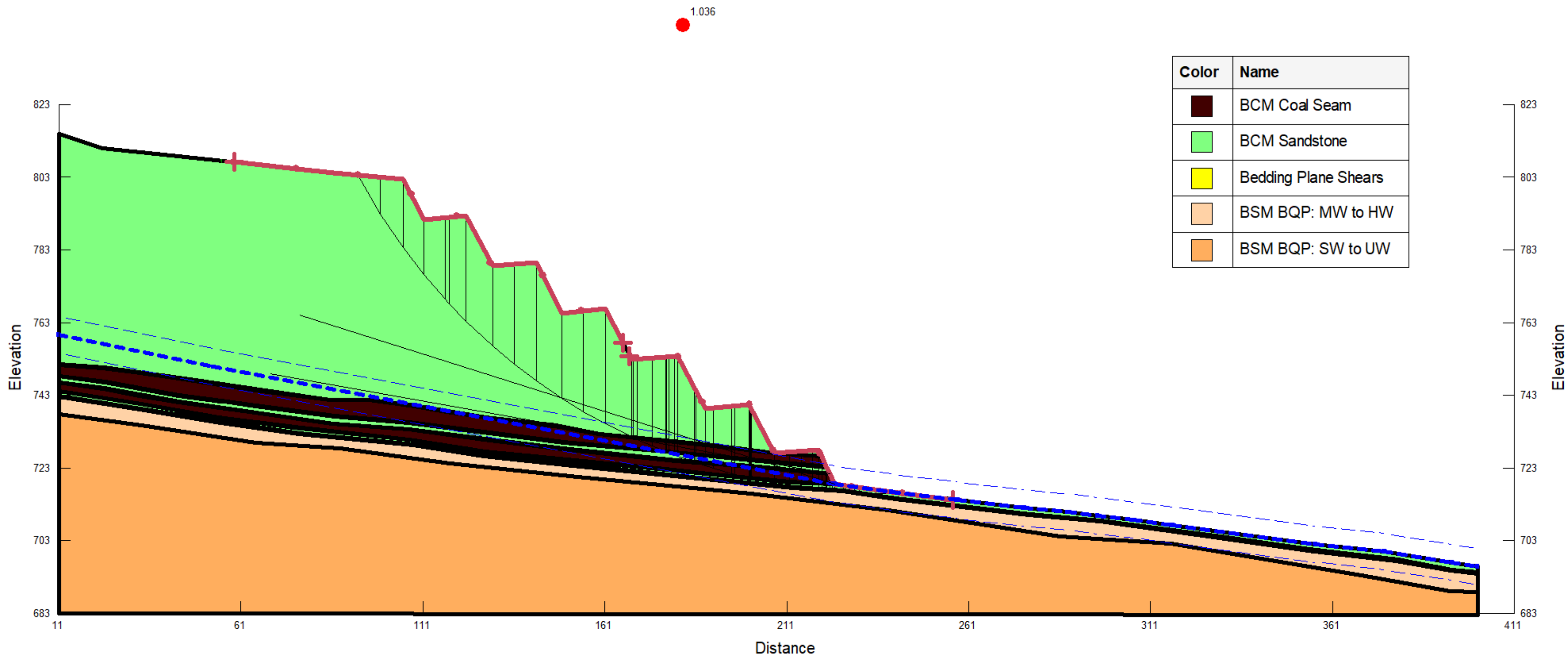

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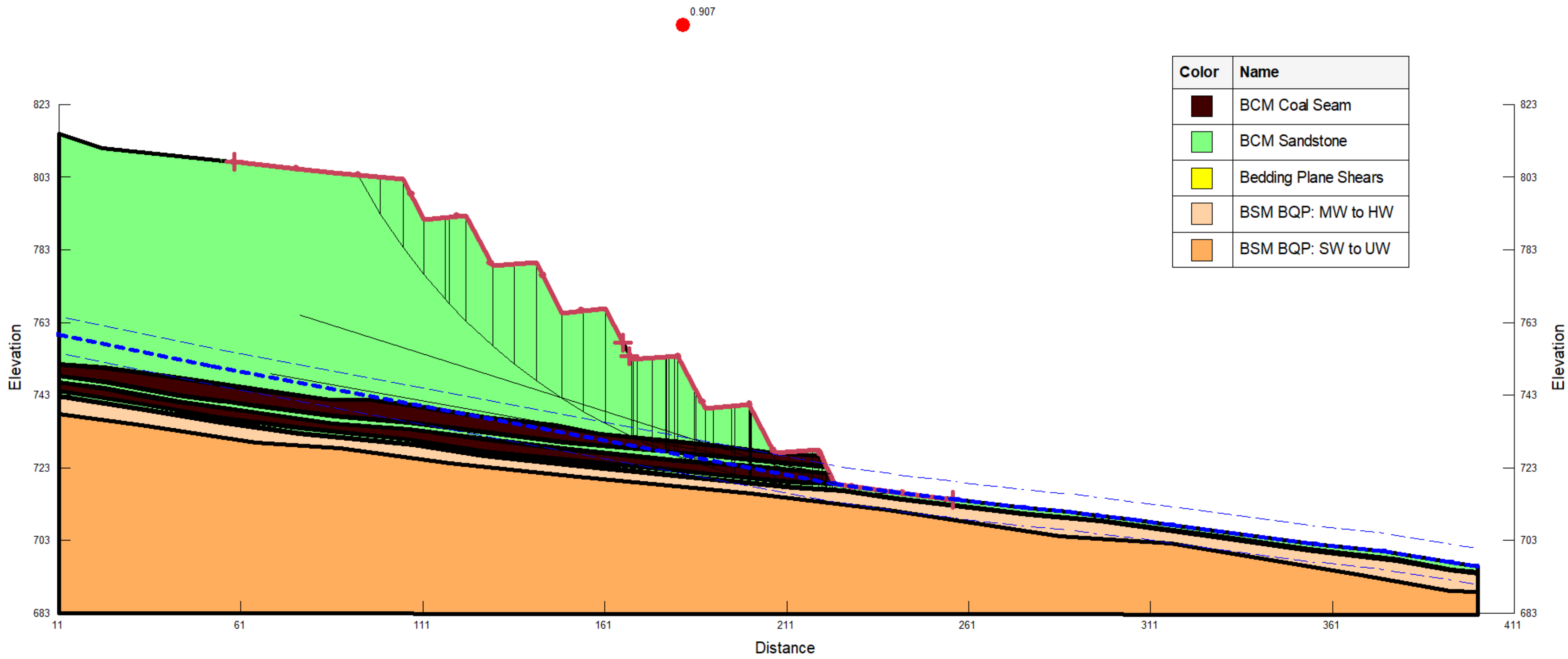

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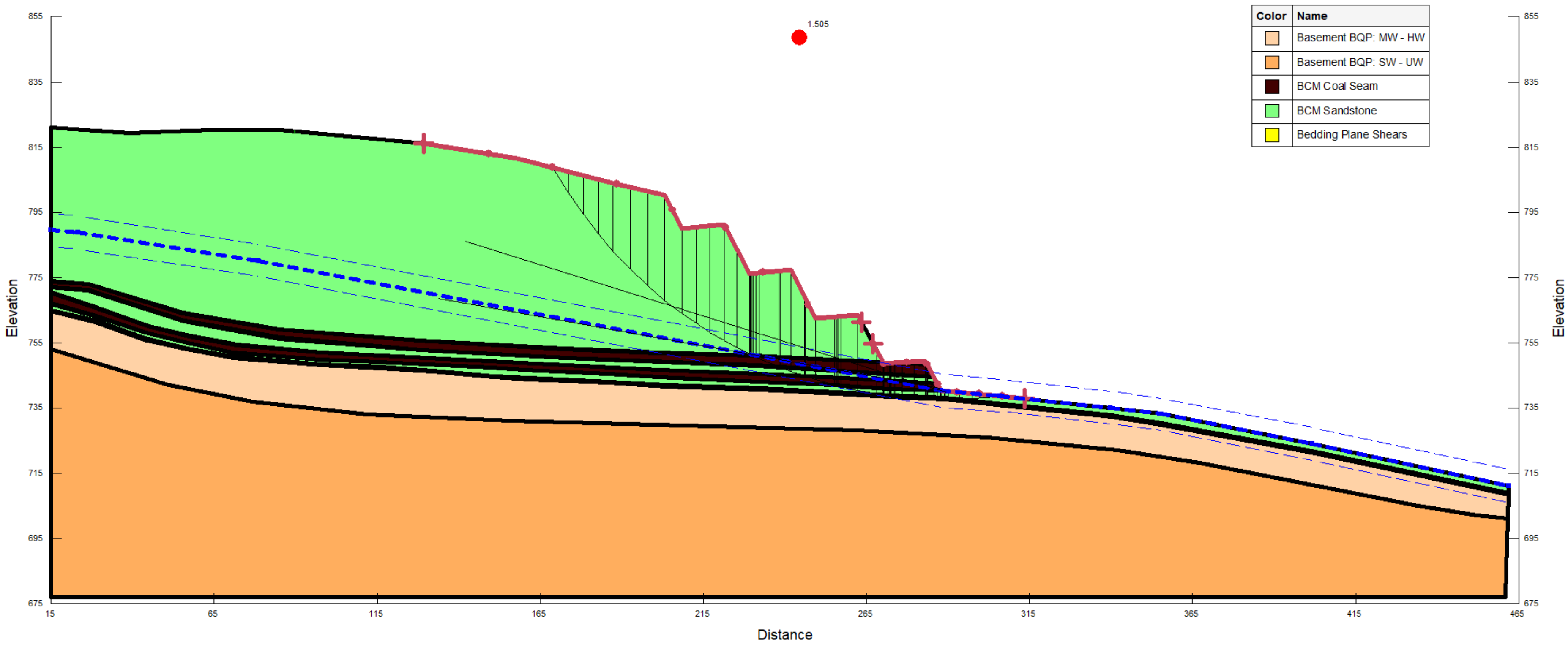

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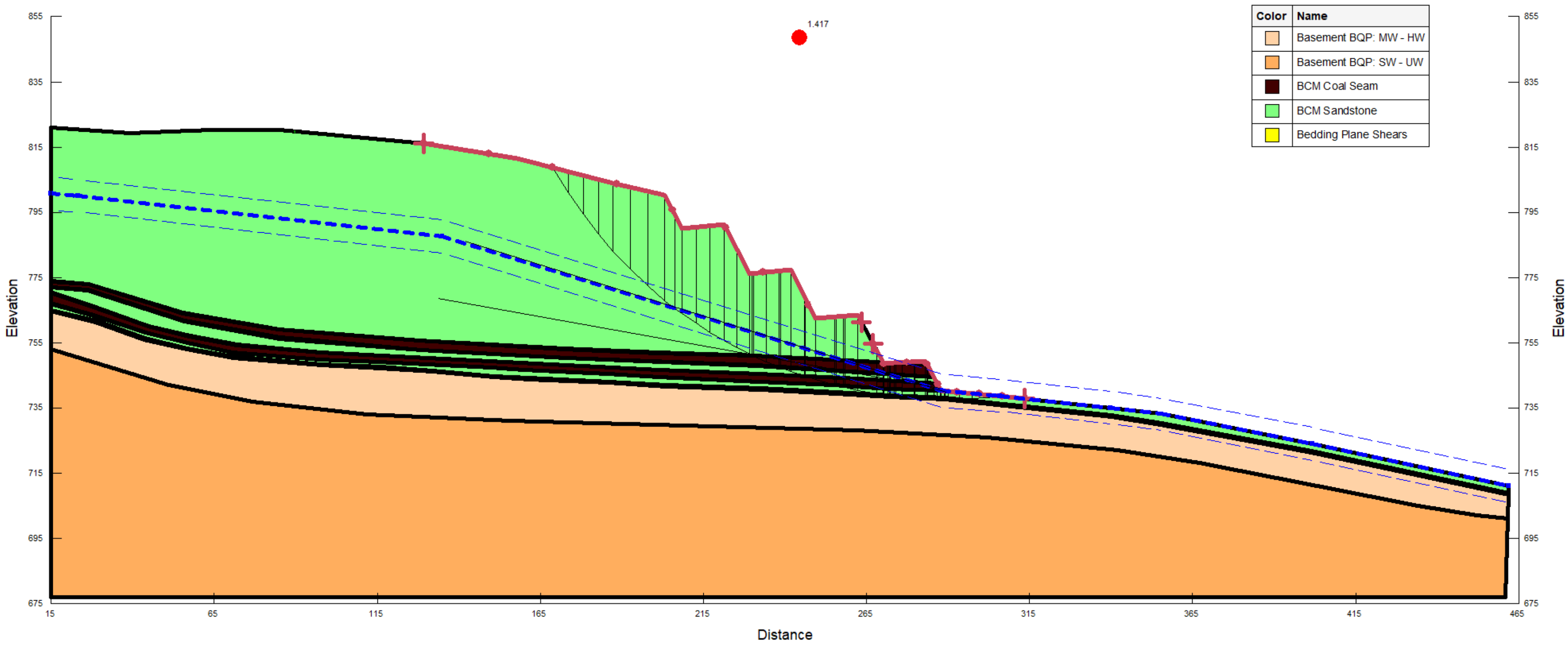

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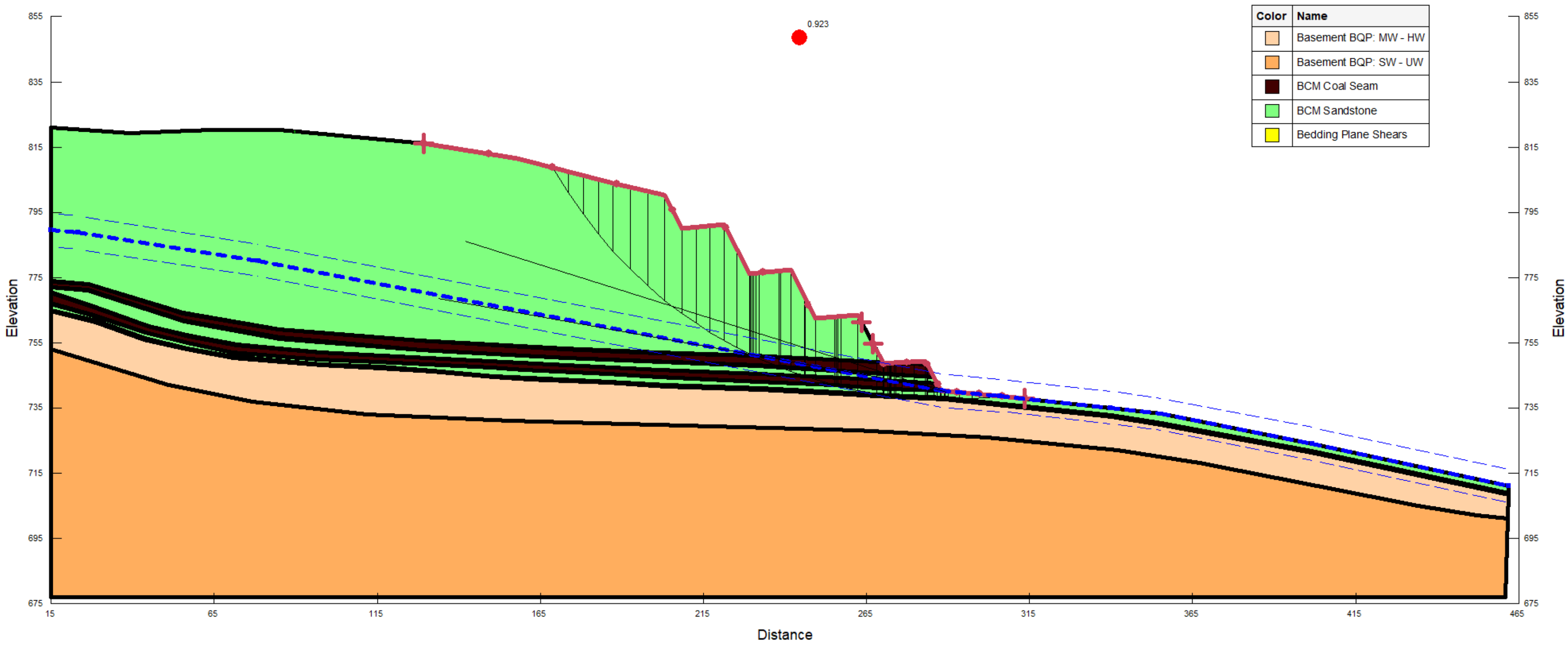

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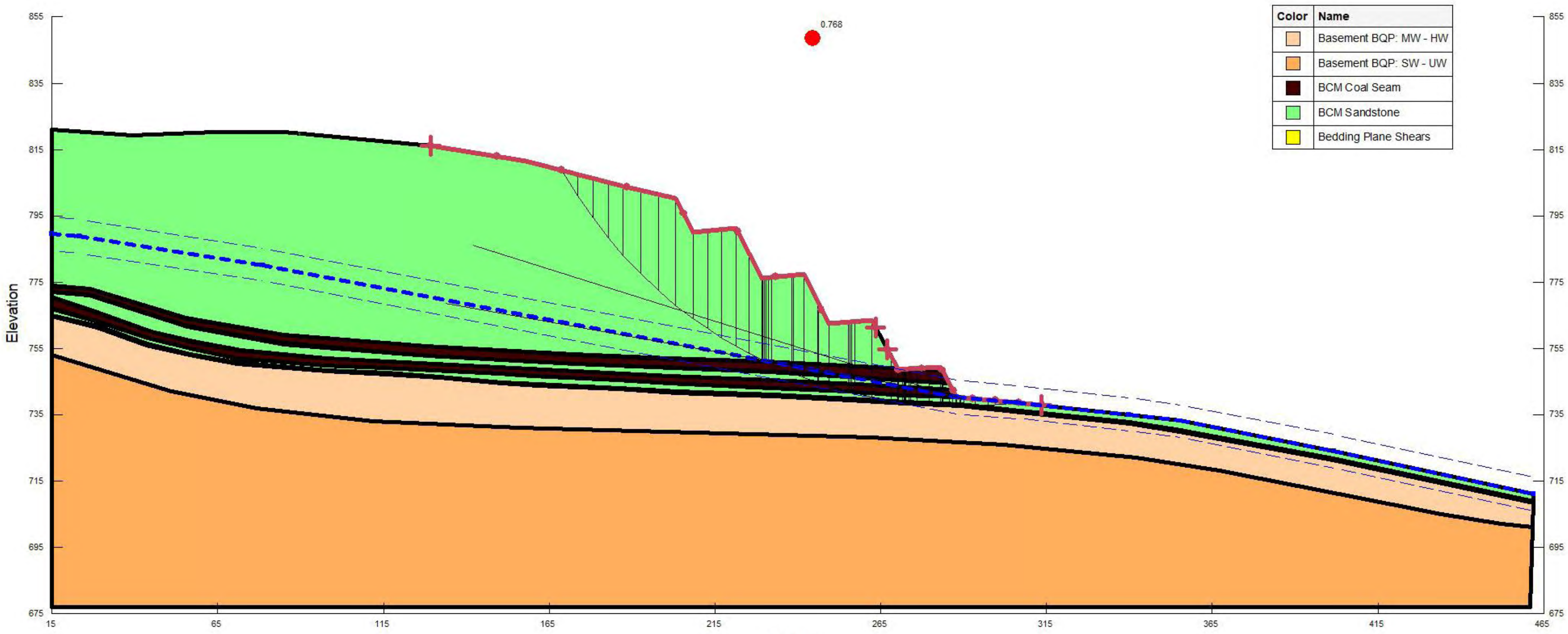

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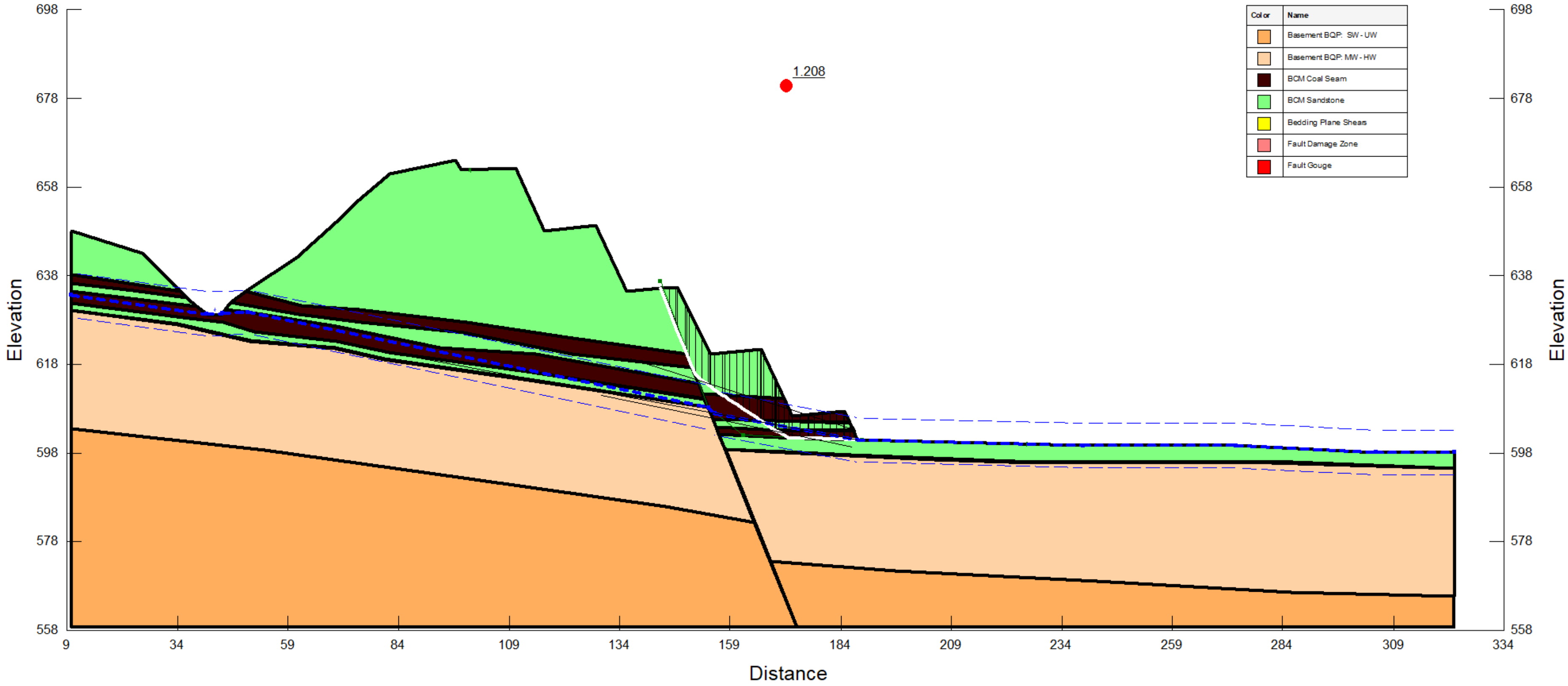

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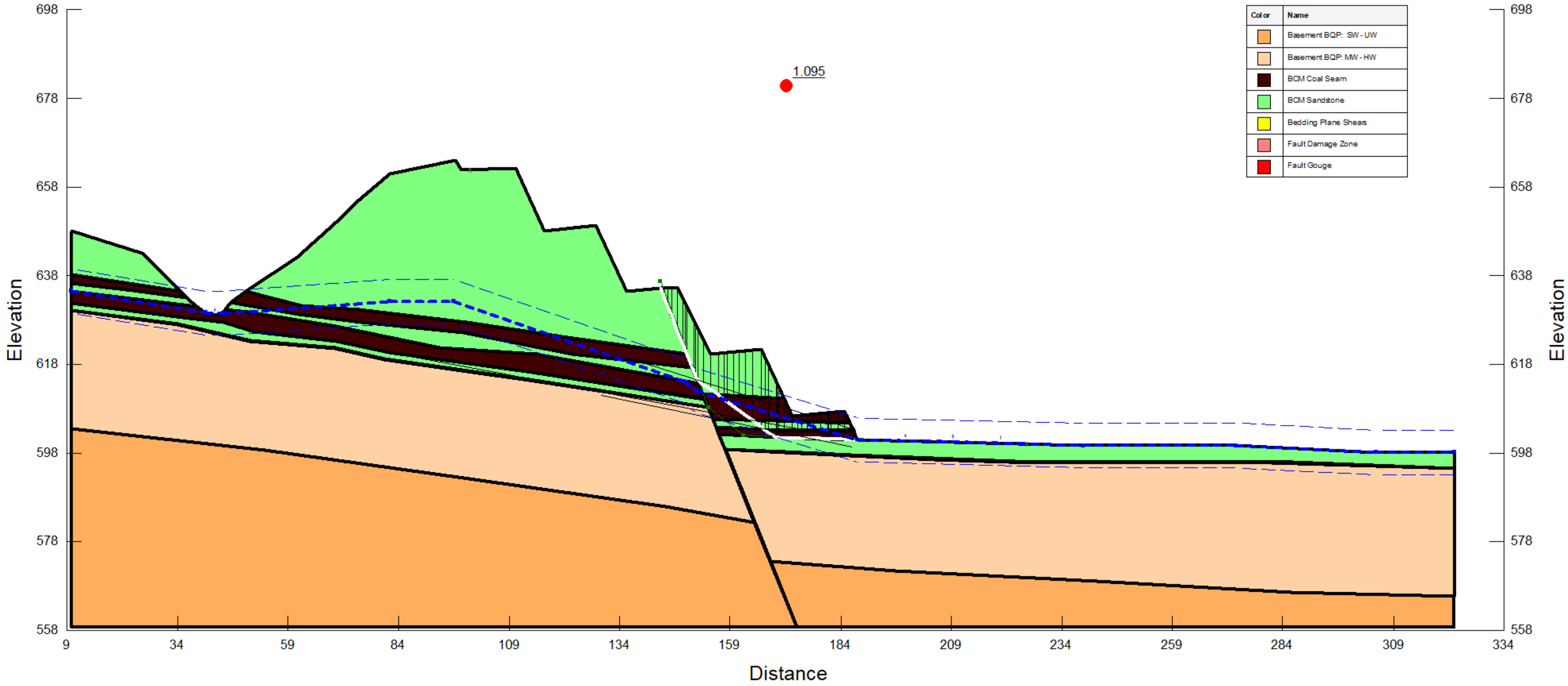

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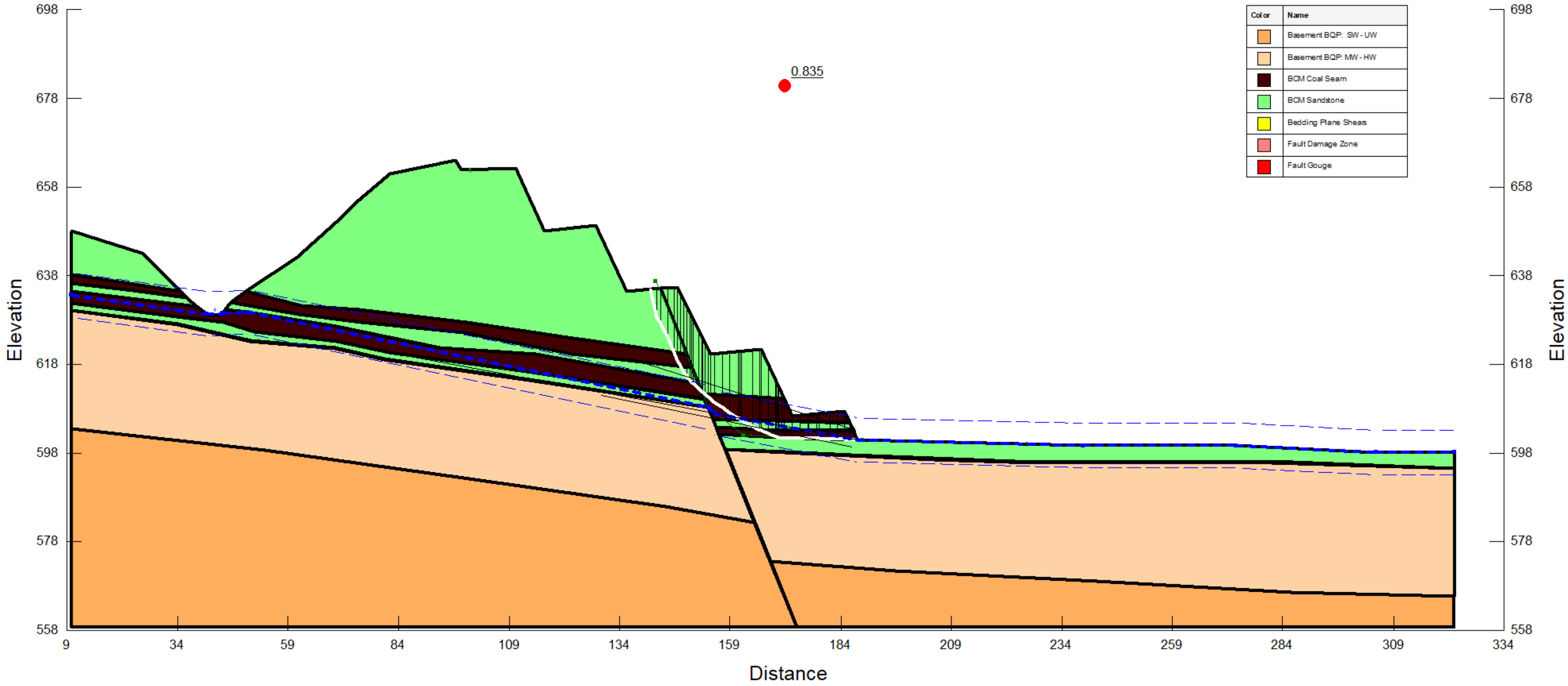

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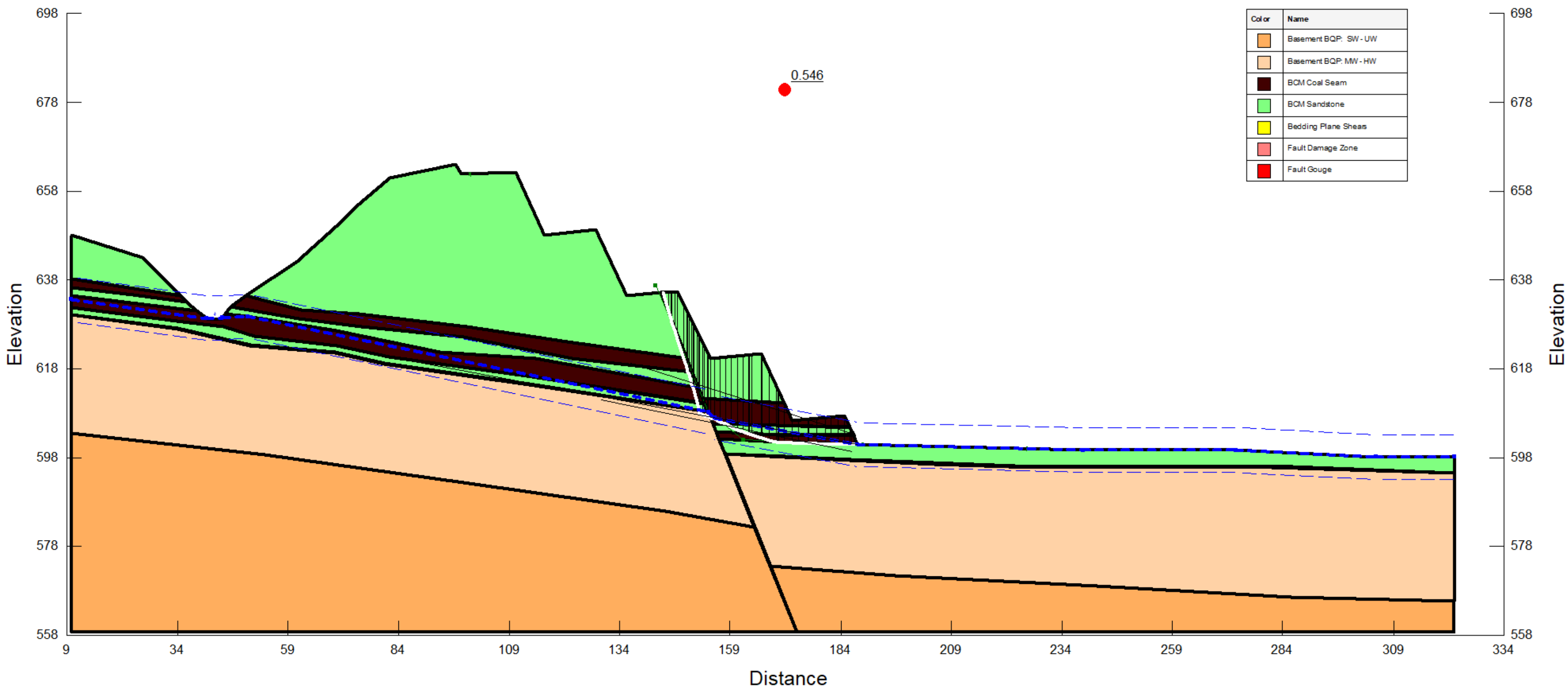

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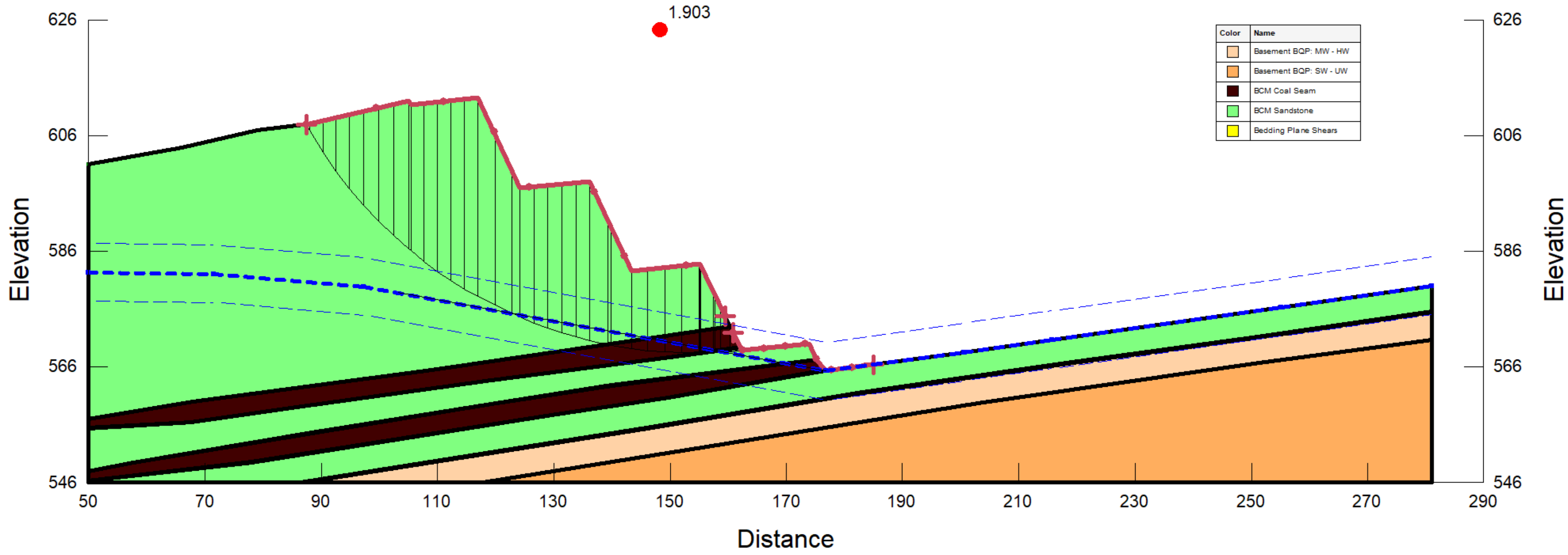

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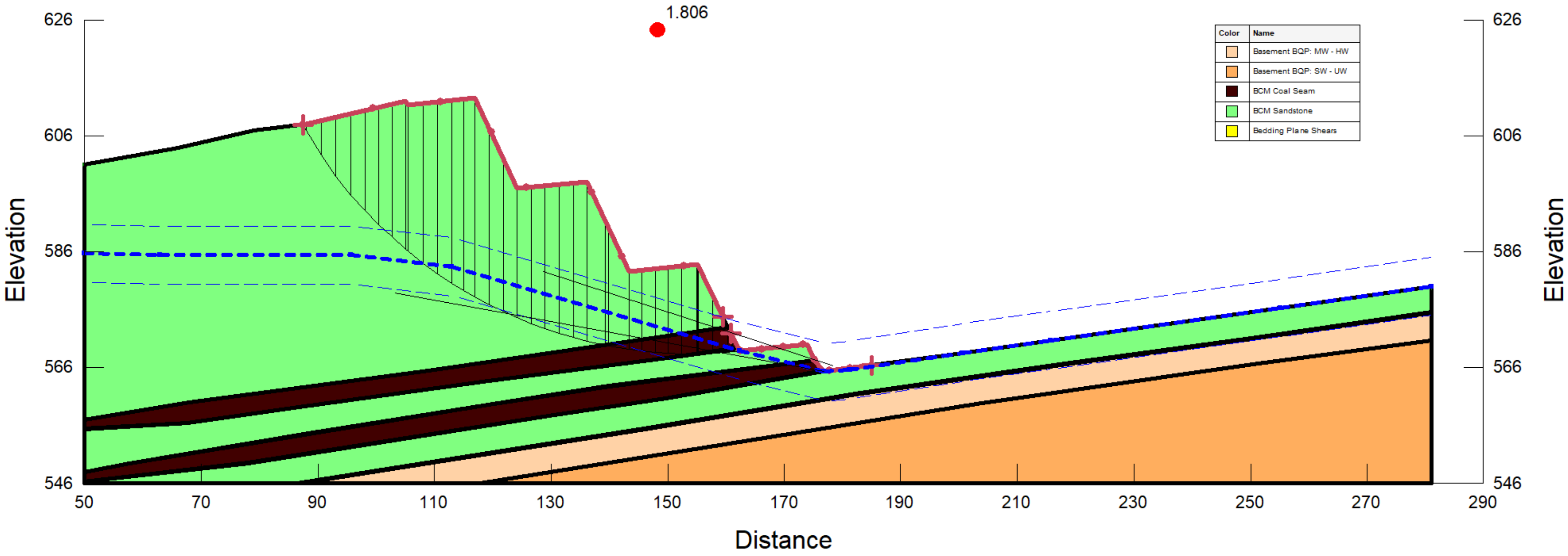

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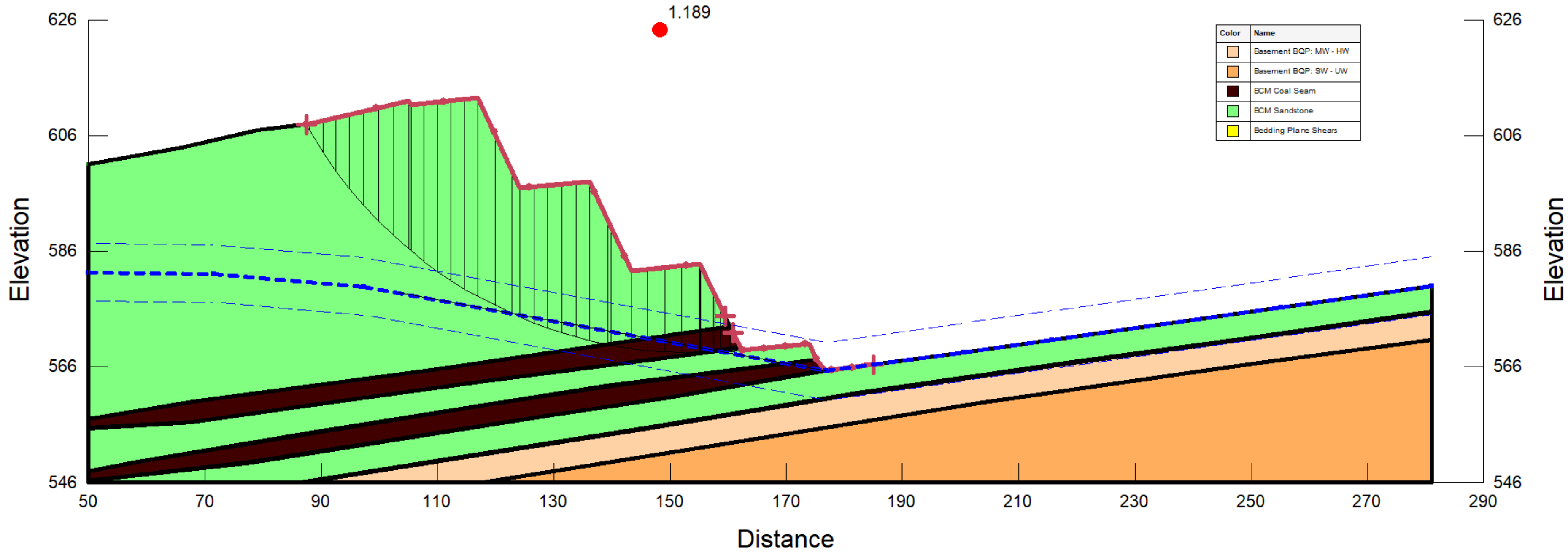

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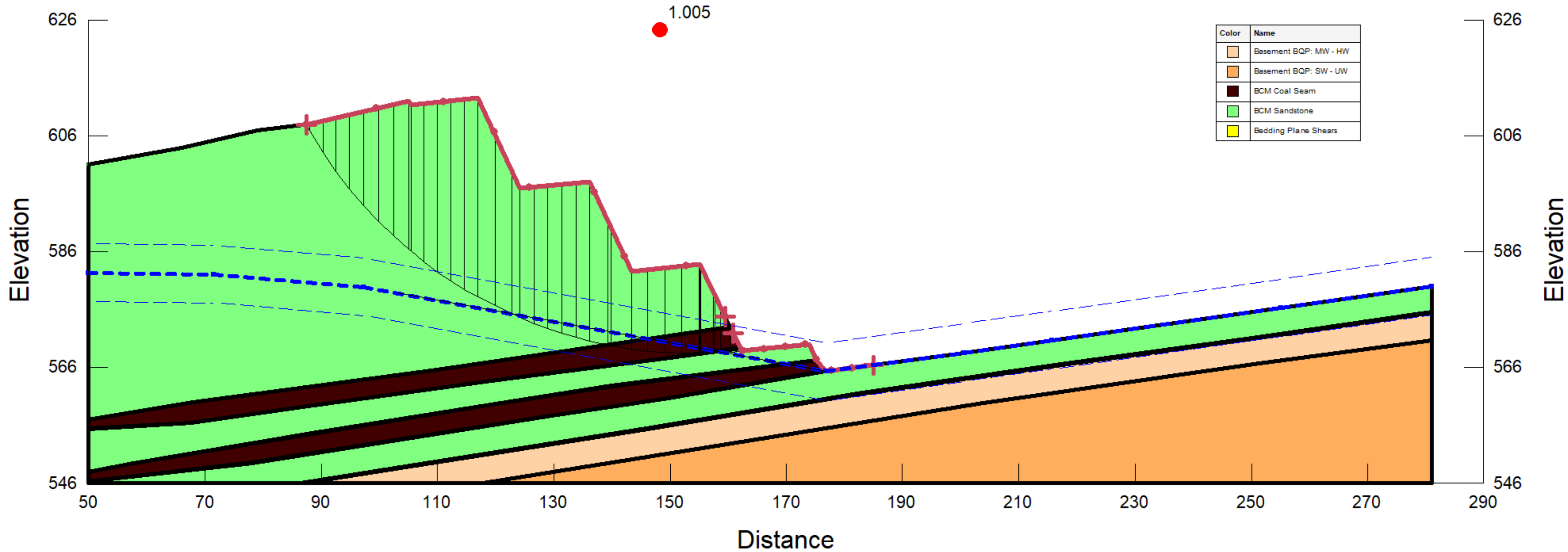

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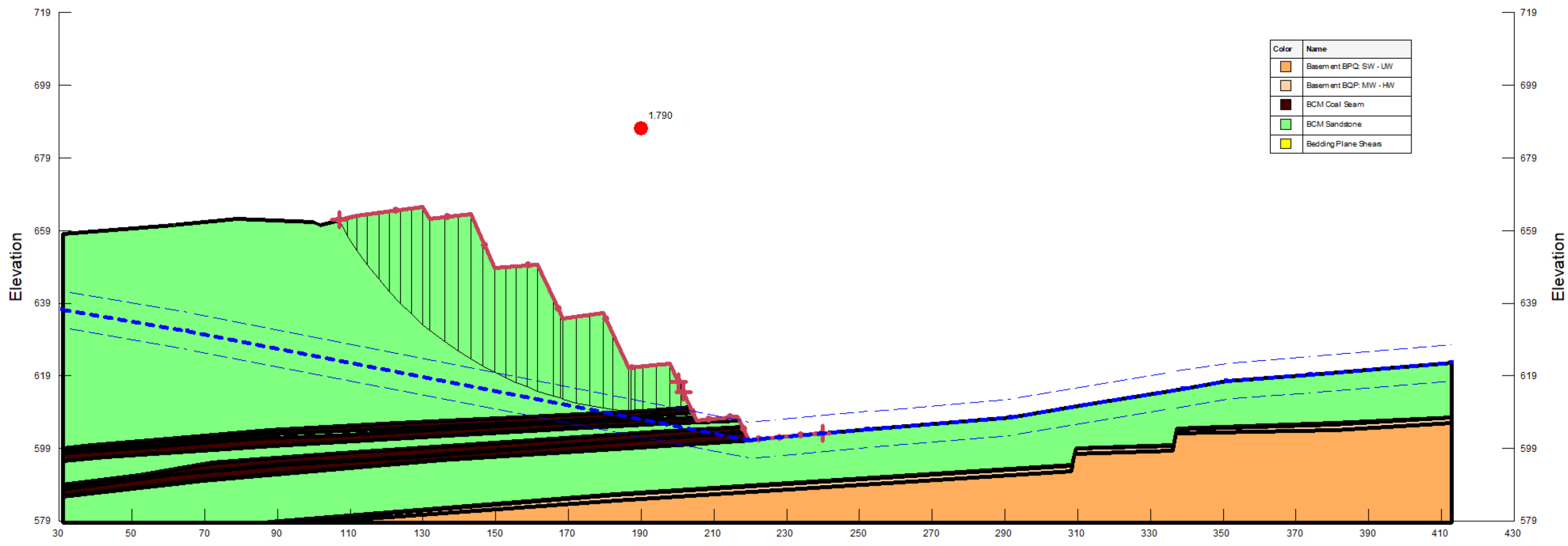

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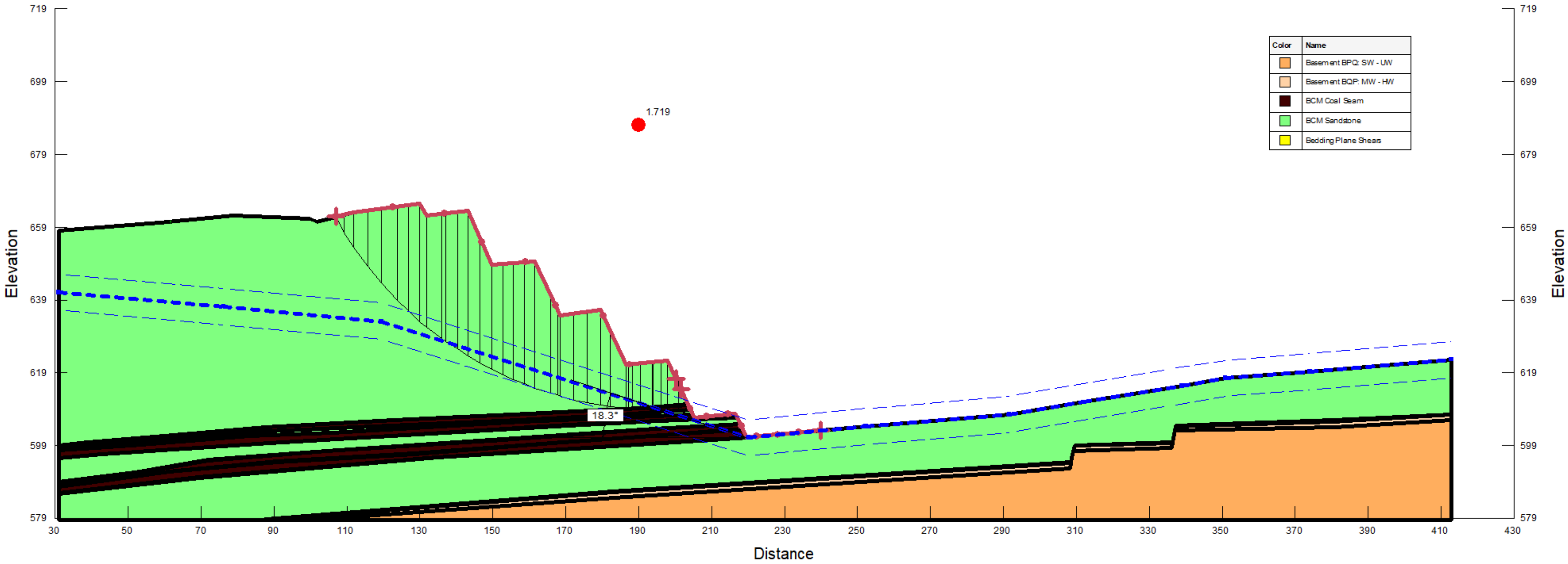

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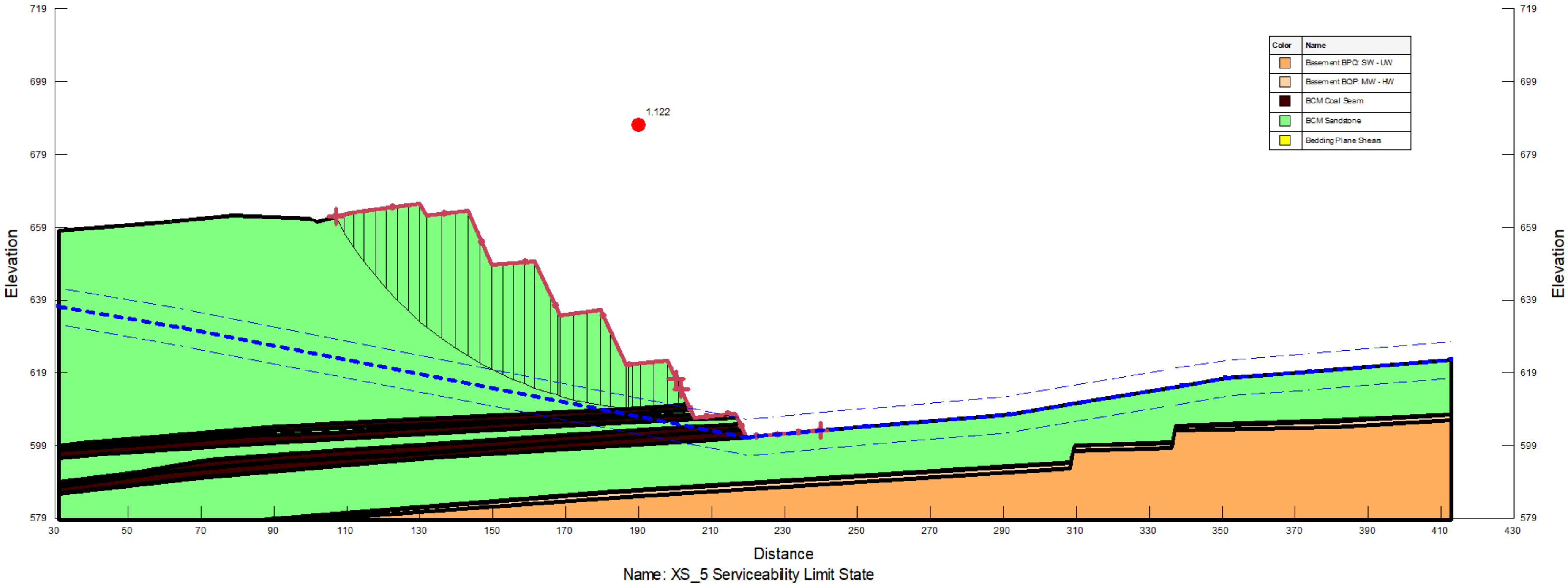
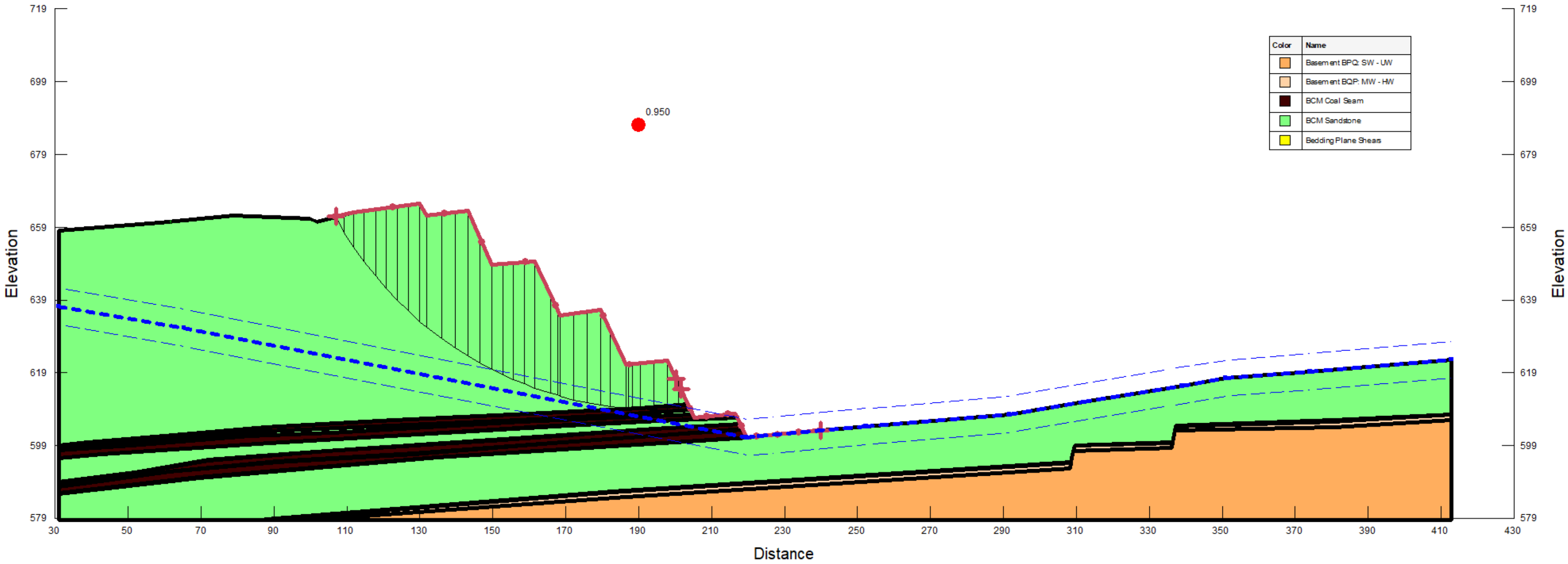
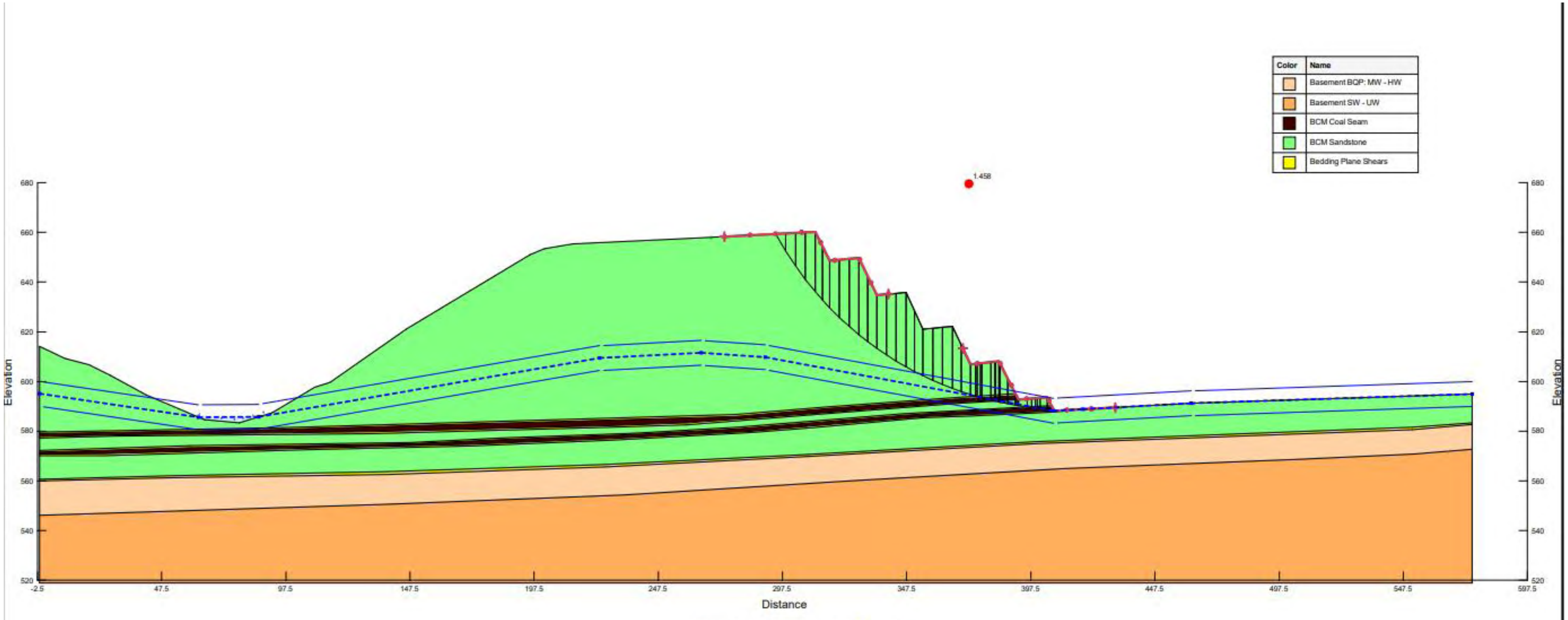

719
699
679
659
639
619
599
579
Elevation
1.122
Color
Name
Basement BPQ: SW - UW
Basement BQP: MW - HW
BCM Coal Seam
BCM Sandstone
Bedding Plane Shears
30
50
70
90
110
130
150
170
190
210
230
250
270
290
310
330
350
370
390
410
430
Distance
Name: XS_5 Serviceability Limit State



Name: XS_5 Ultimate Limit State



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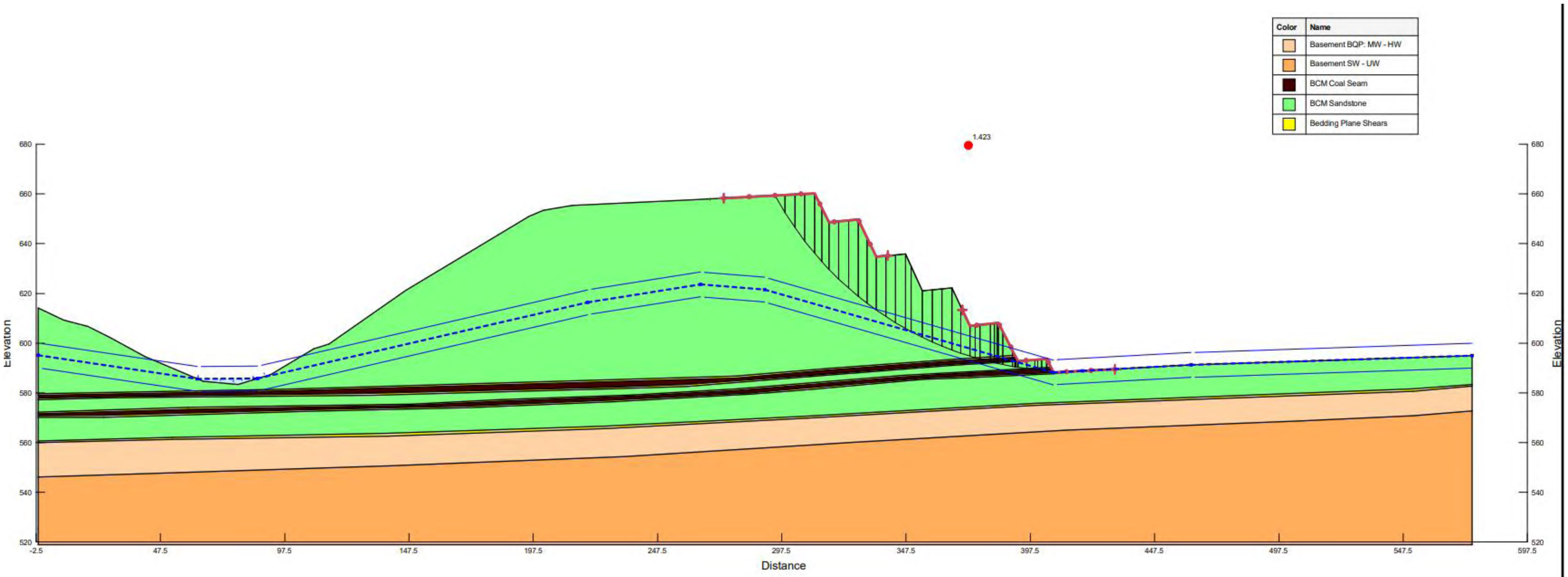
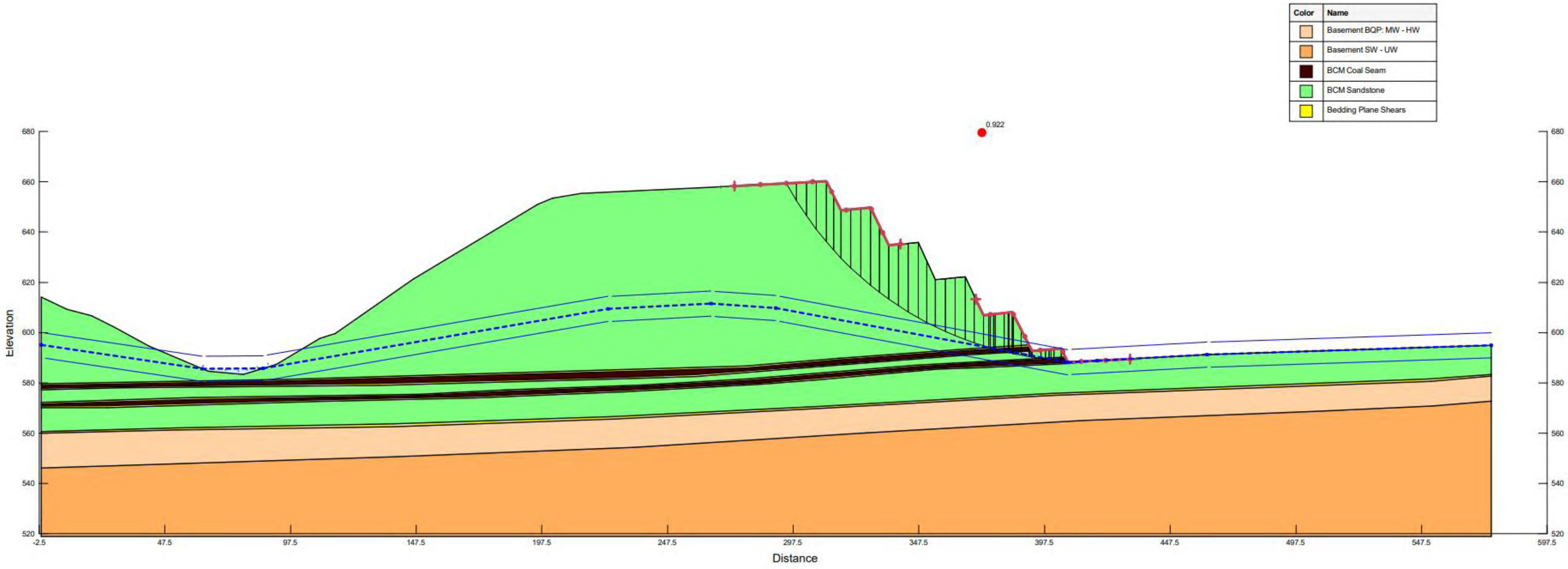
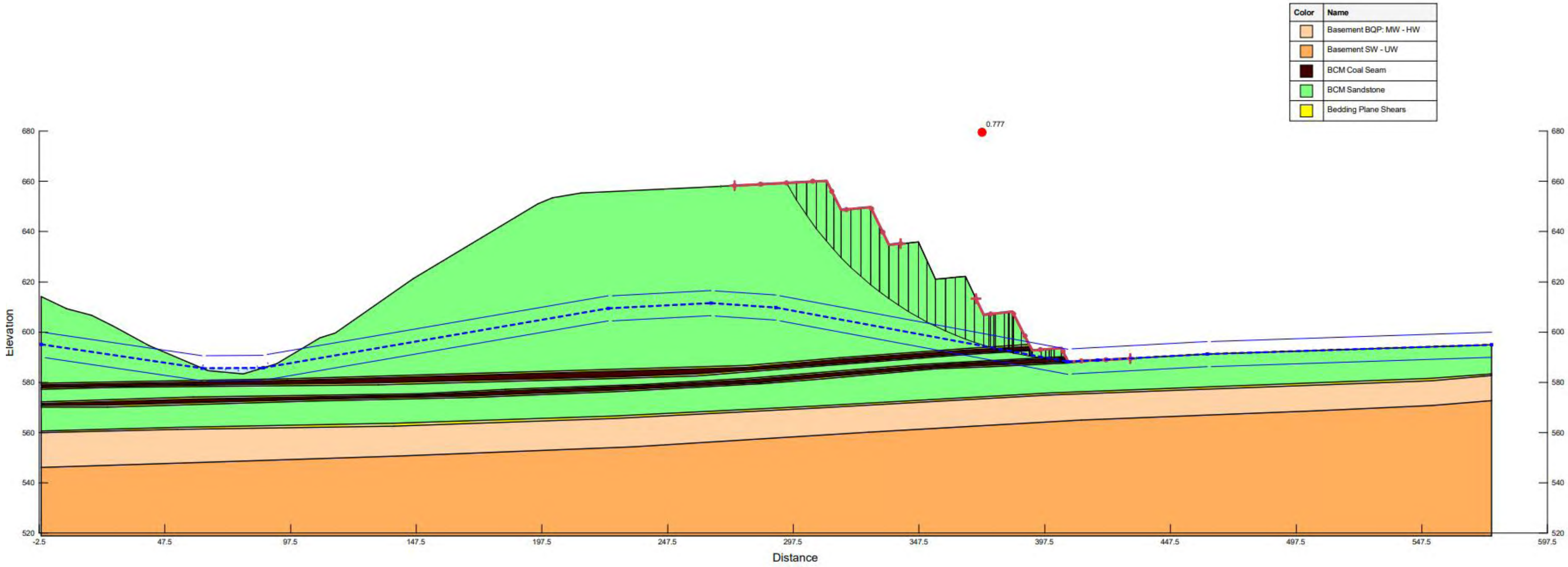


Name: XS_6 Elevatred Groundwater Pressures

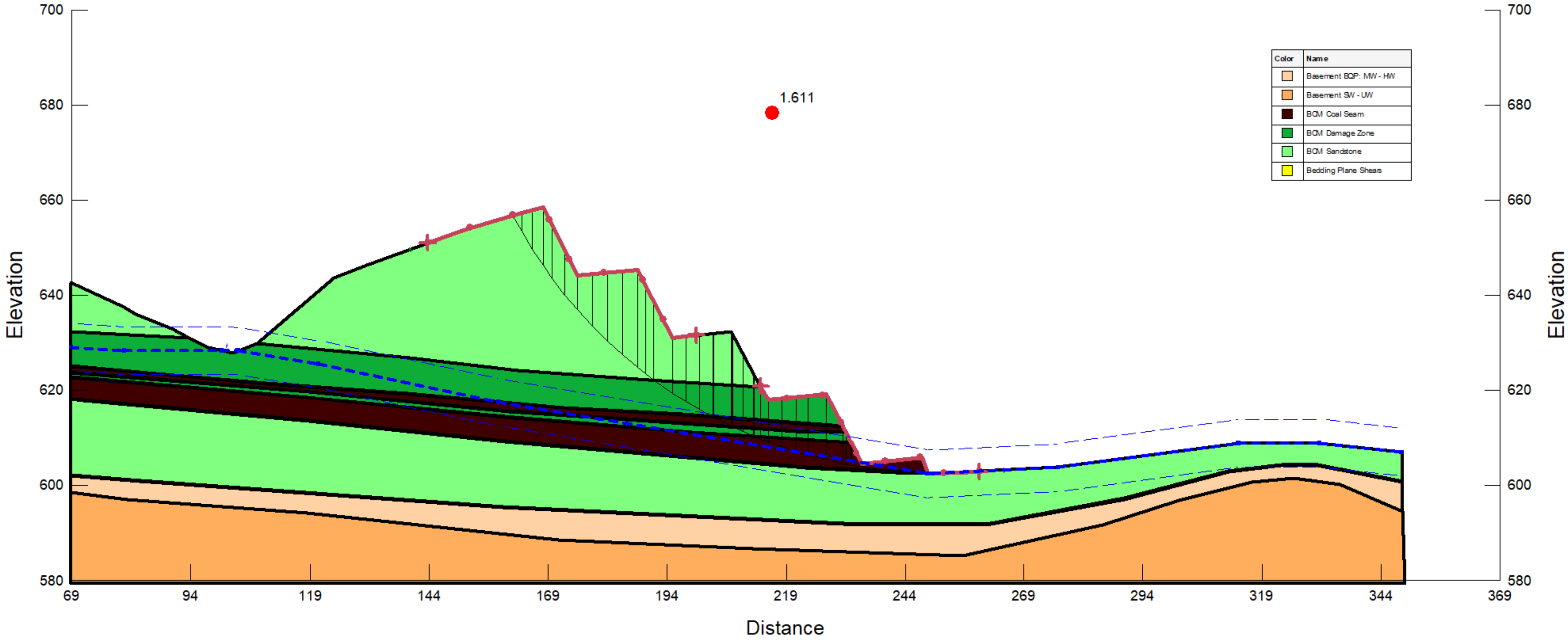


Color
Name
Basement BQP: MW - HW
Basement SW - UW
BCM Coal Seam
BCM Sandstone
Bedding Plane Shears
0.922
Elevation
Distance
-2.5
47.5
97.5
147.5
197.5
247.5
297.5
347.5
397.5
447.5
497.5
547.5
597.5
520
540
560
580
600
620
640
660
680

Name: XS_6 SLS


Color
Name
Basement BQP: MW - HW
Basement SW - UW
BCM Coal Seam
BCM Sandstone
Bedding Plane Shears
0.777
Elevation
Distance
680
660
640
620
600
580
560
540
520
-2.5
47.5
97.5
147.5
197.5
247.5
297.5
347.5
397.5
447.5
497.5
547.5
597.5

Name: XS_6 ULS



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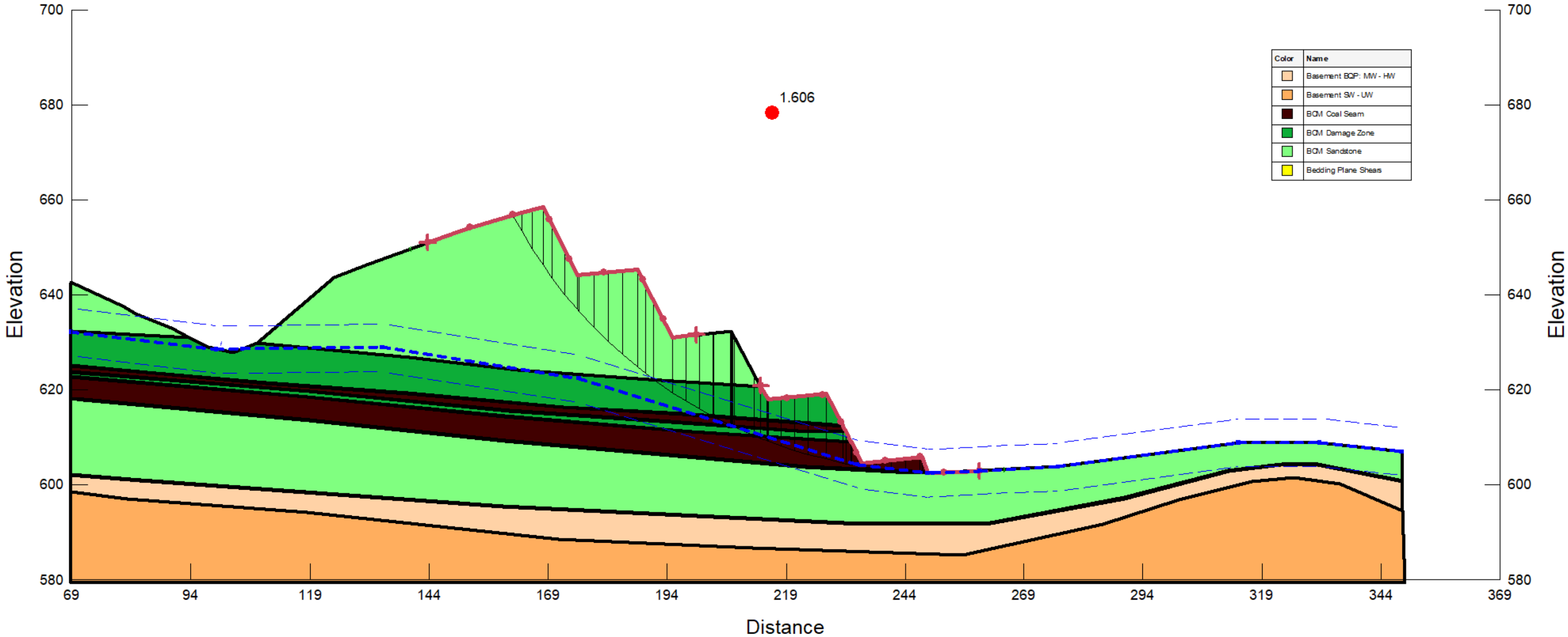

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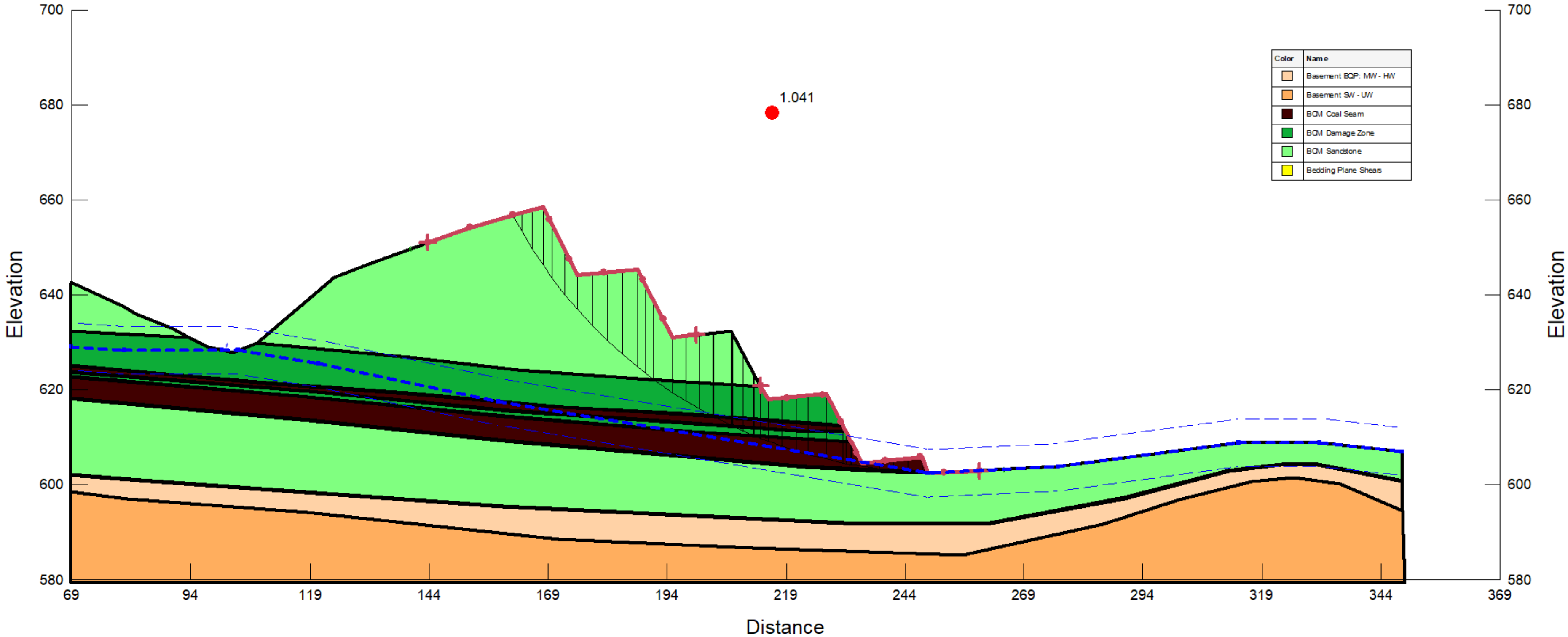
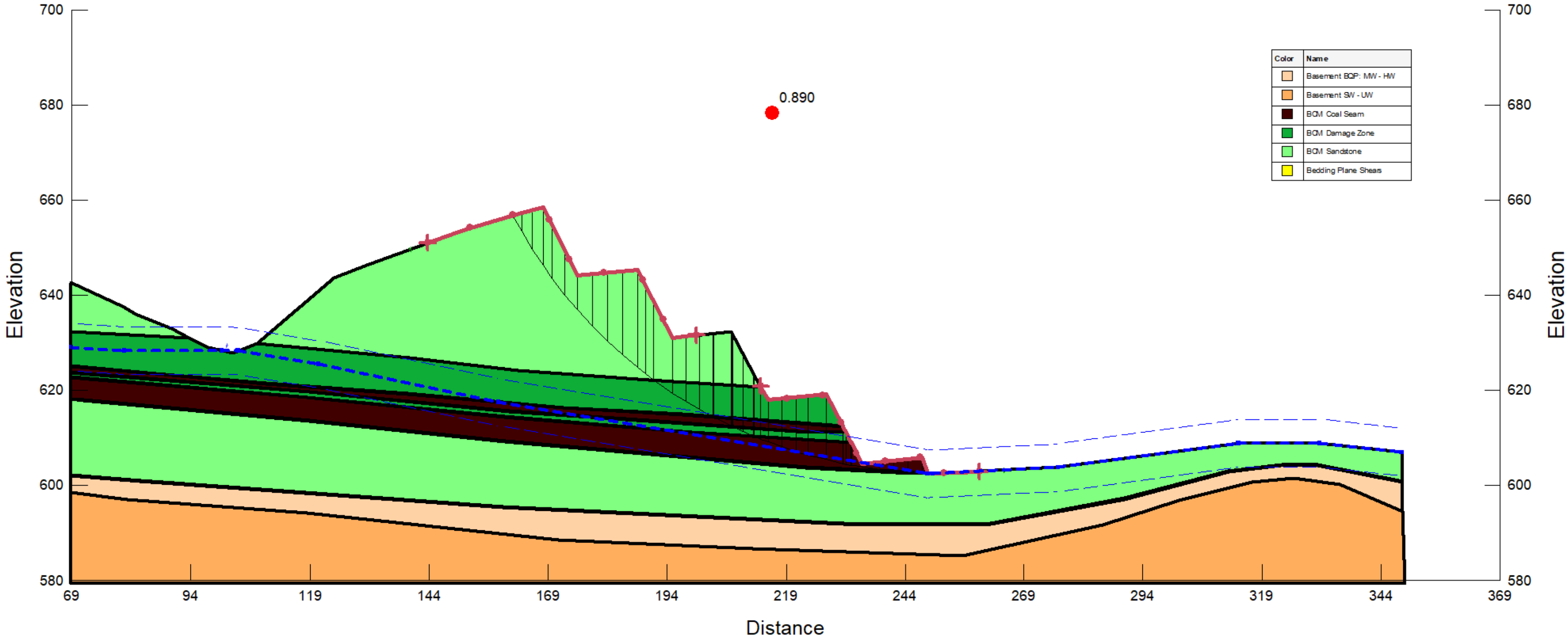


Name: XS_7 Servicibility Limit State



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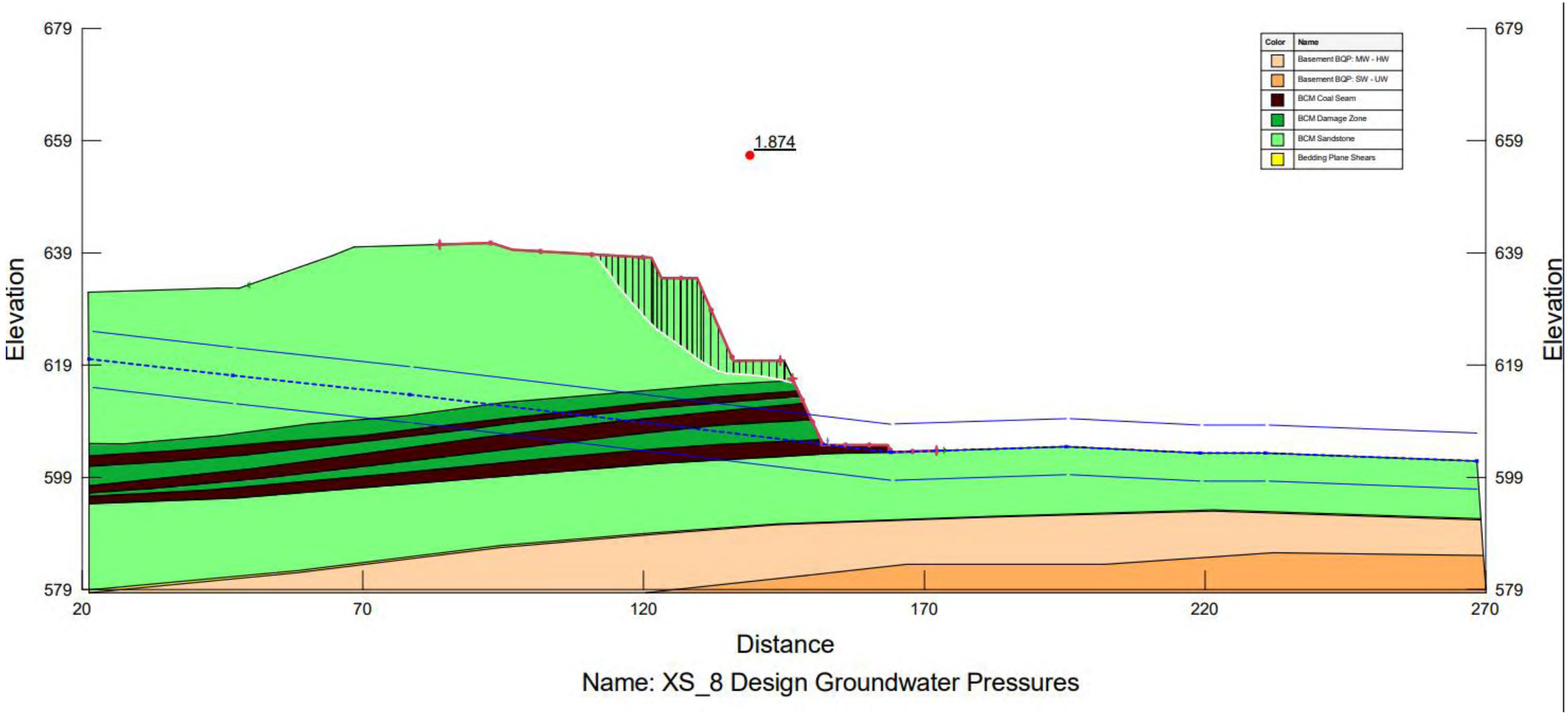
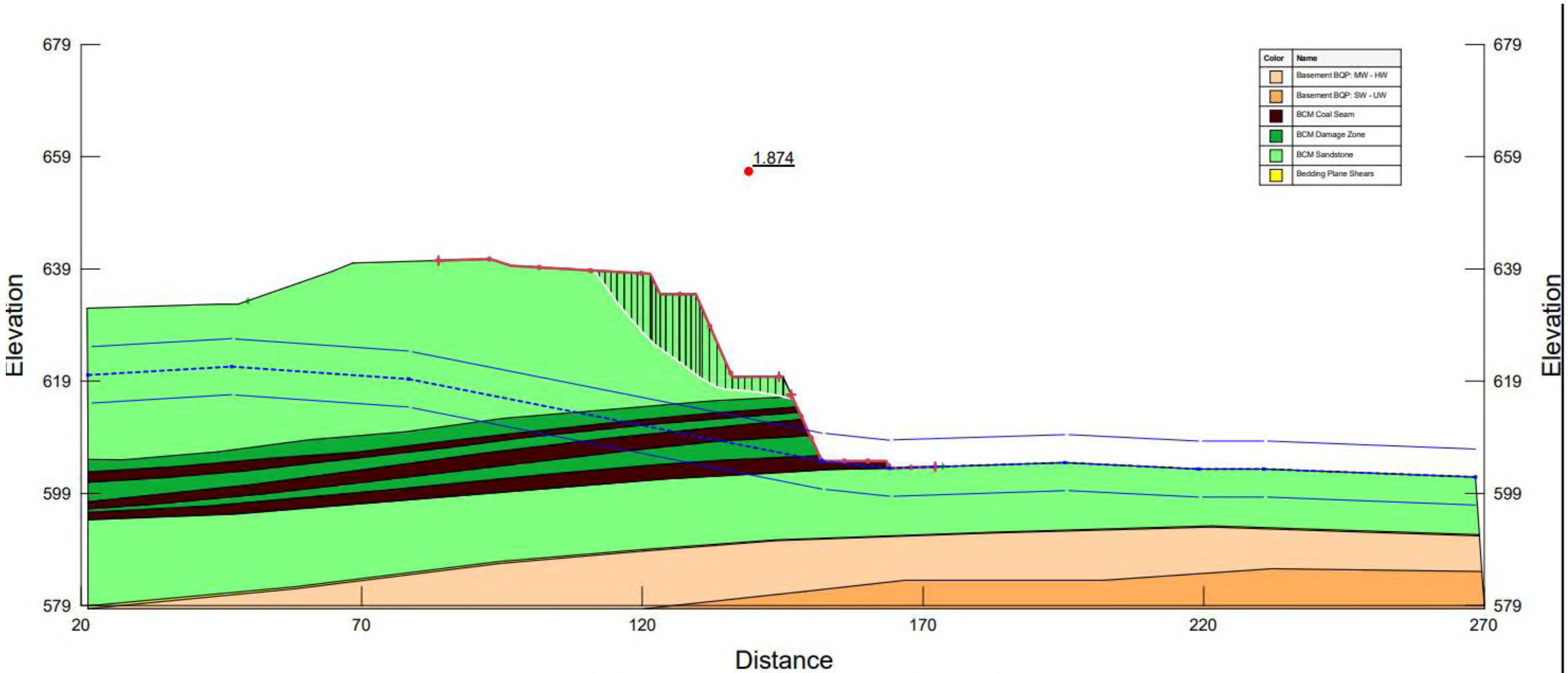

679
659
639
619
599
579
Elevation
1.874
Color
Name
Basement BQP: MW - HW
Basement BQP: SW - UW
BCM Coal Seam
BCM Damage Zone
BCM Sandstone
Bedding Plane Shears
20
70
120
170
220
270
Distance
Name: XS_8 Design Groundwater Pressures



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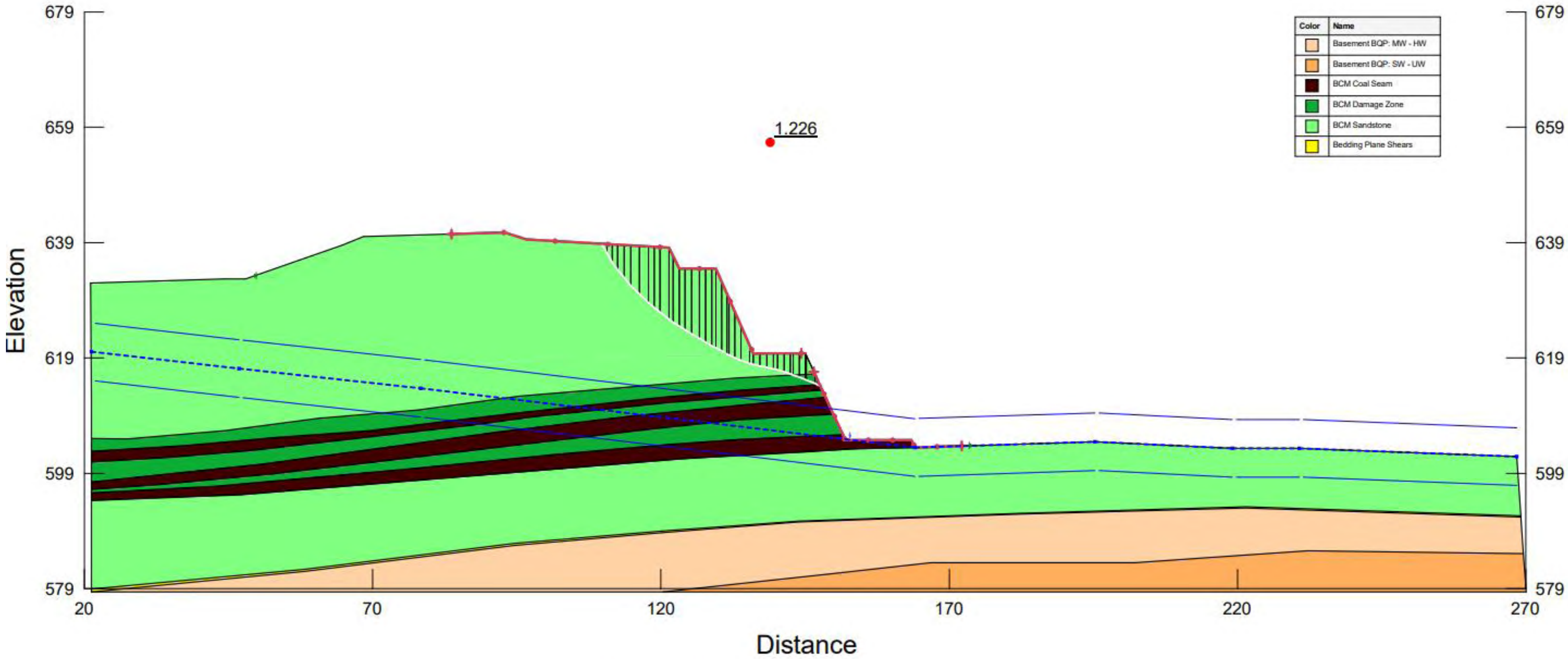
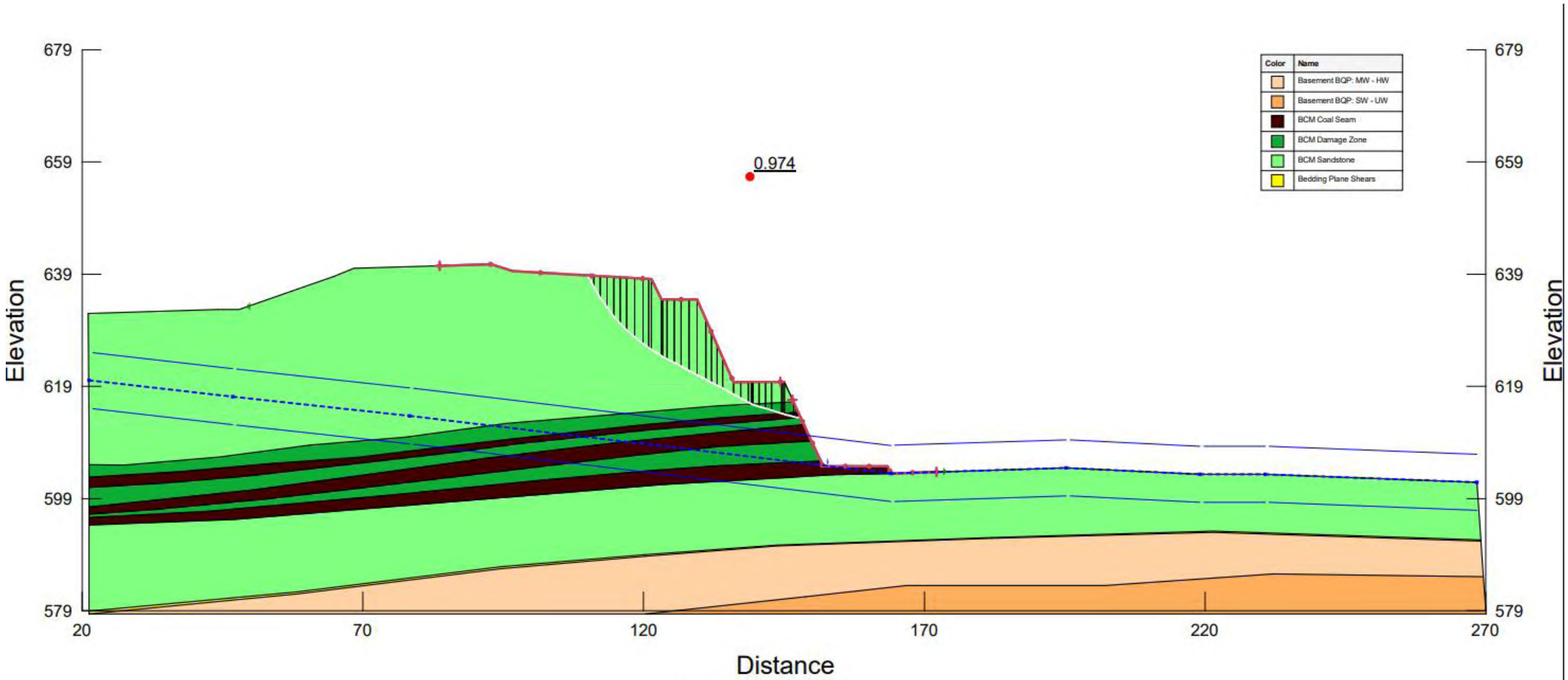
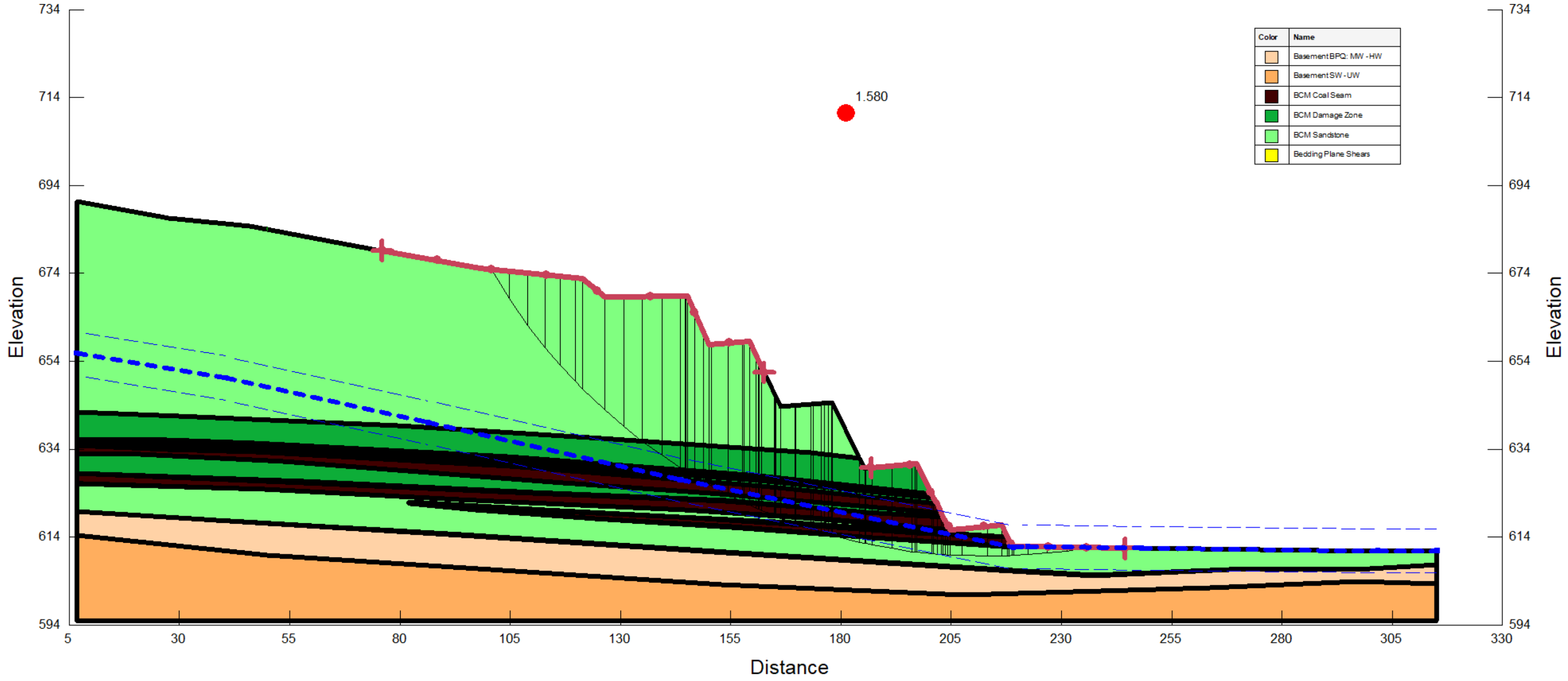

679
659
639
619
599
579
Elevation
1.226
Color
Name
Basement BQP: MW - HW
Basement BQP: SW - UW
BCM Coal Seam
BCM Damage Zone
BCM Sandstone
Bedding Plane Shears
20
70
120
170
220
270
Distance

Name: XS_8 SLS



679
659
639
619
599
579
Elevation
20
70
120
170
220
270
Distance
0.974
Color
Name
Basement BQP: MW - HW
Basement BQP: SW - UW
BCM Coal Seam
BCM Damage Zone
BCM Sandstone
Bedding Plane Shears

Name: XS_8 ULS



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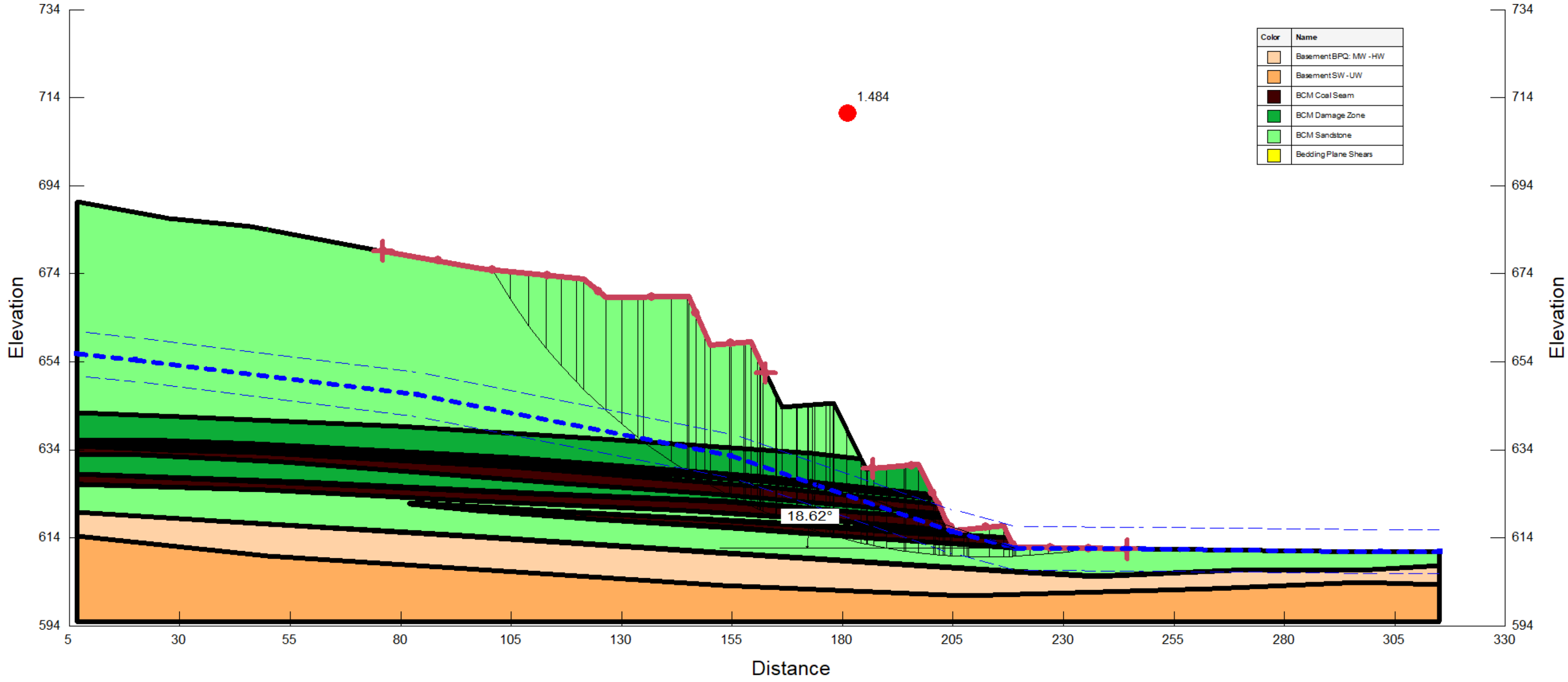
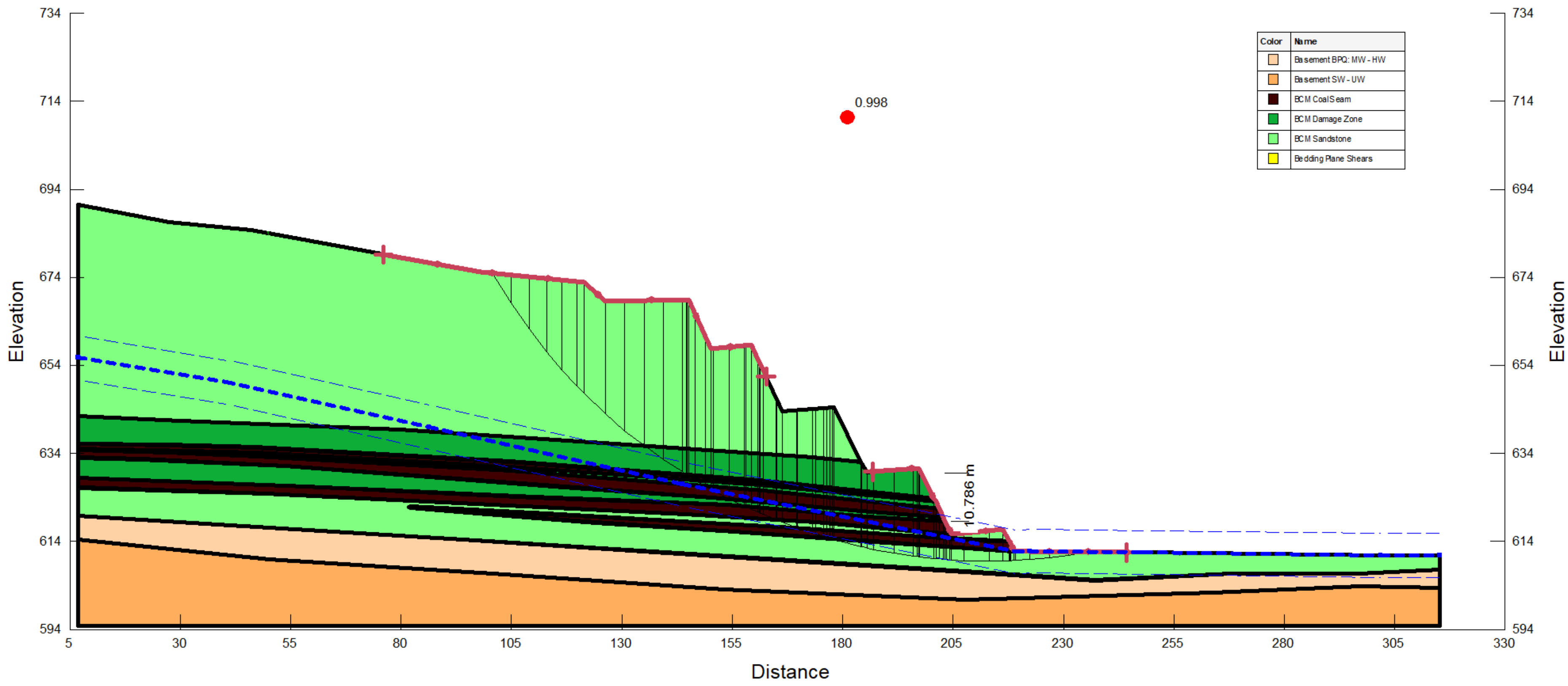
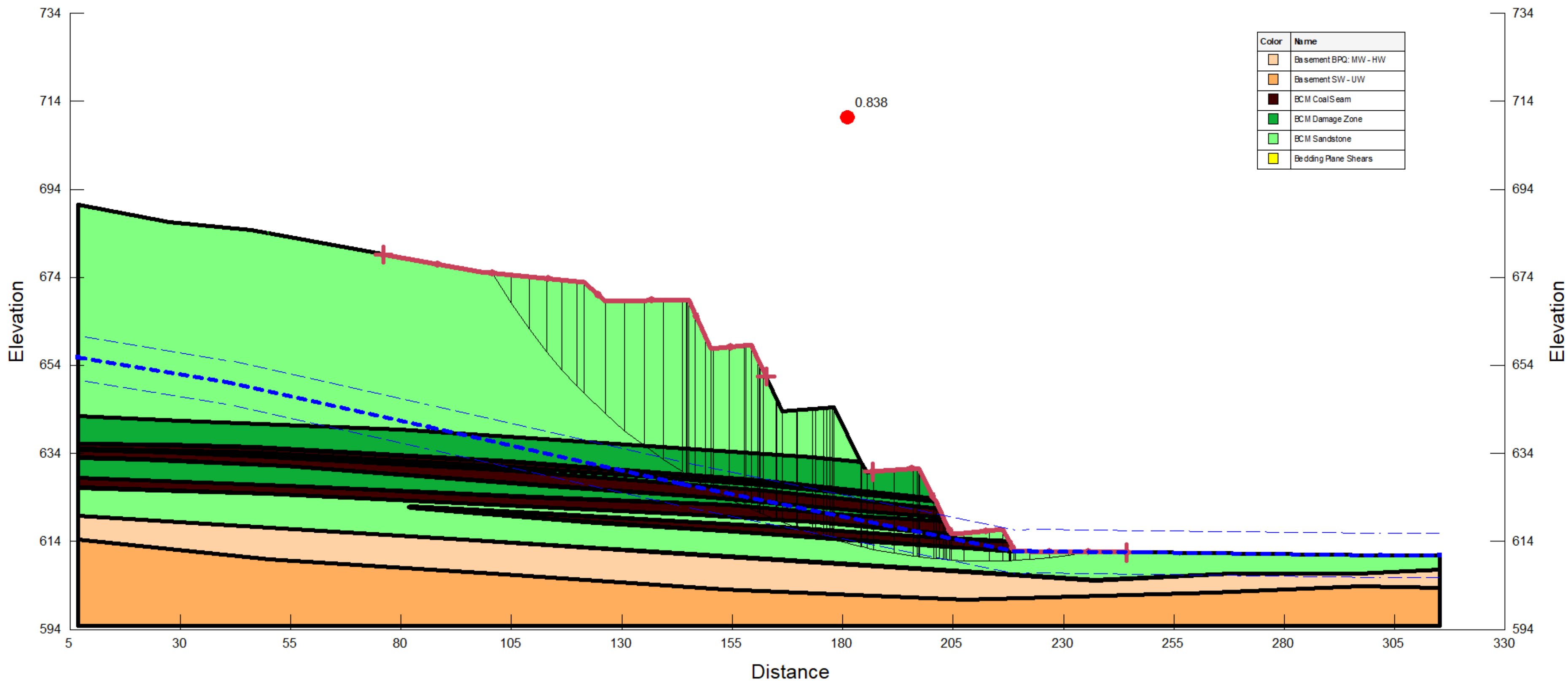


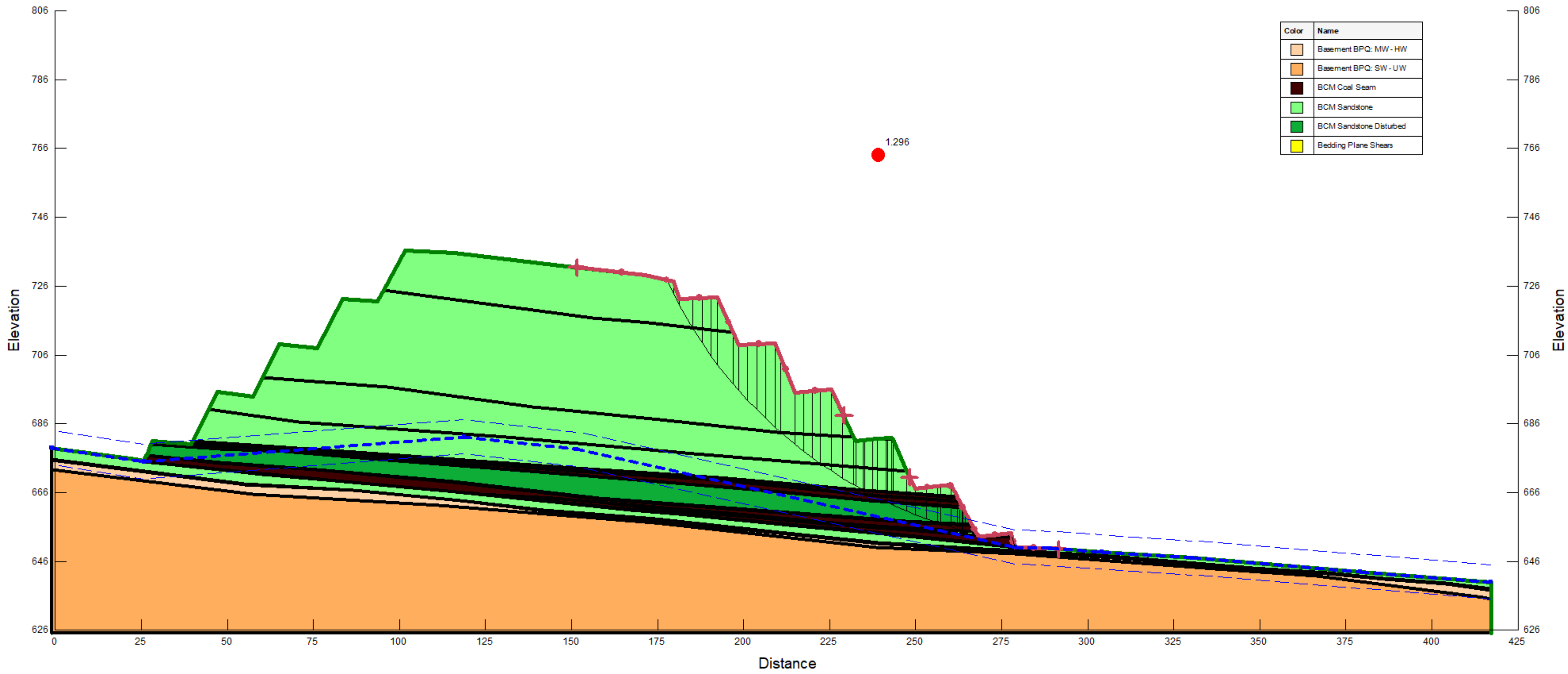
Name: XS_9 Elevated Groundwater Pressures



Name: XS_9 Serviceability Limit State



Name: XS_9 Ultimate Limit State



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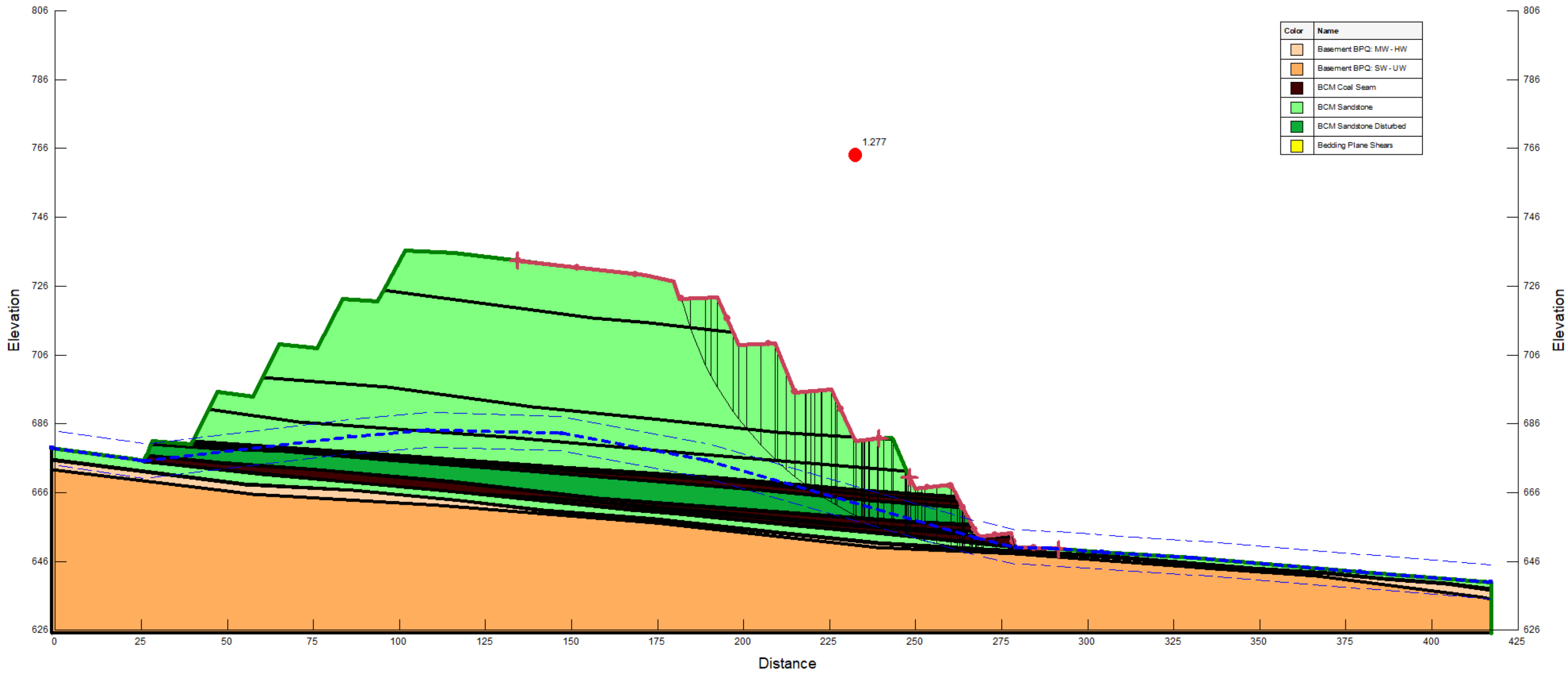
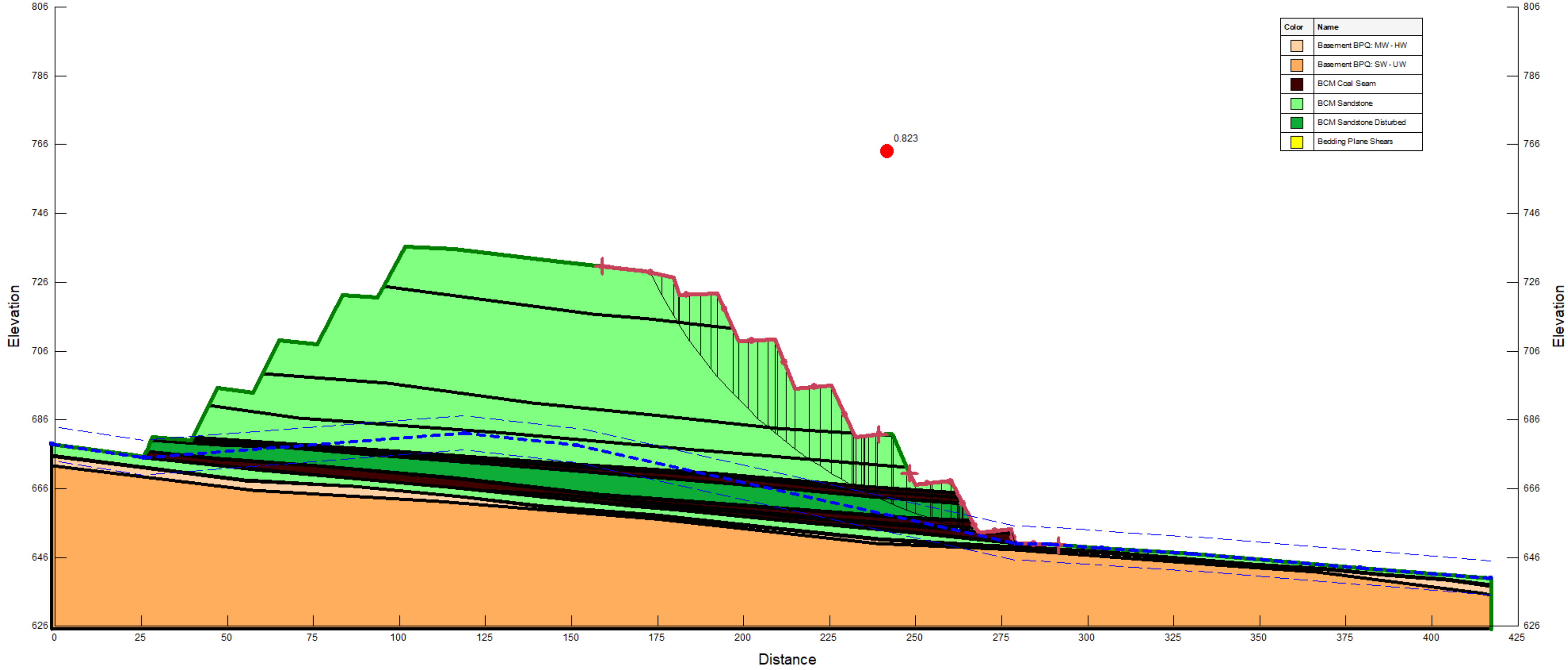


Name: XS_10 Elevated Groundwater Pressures



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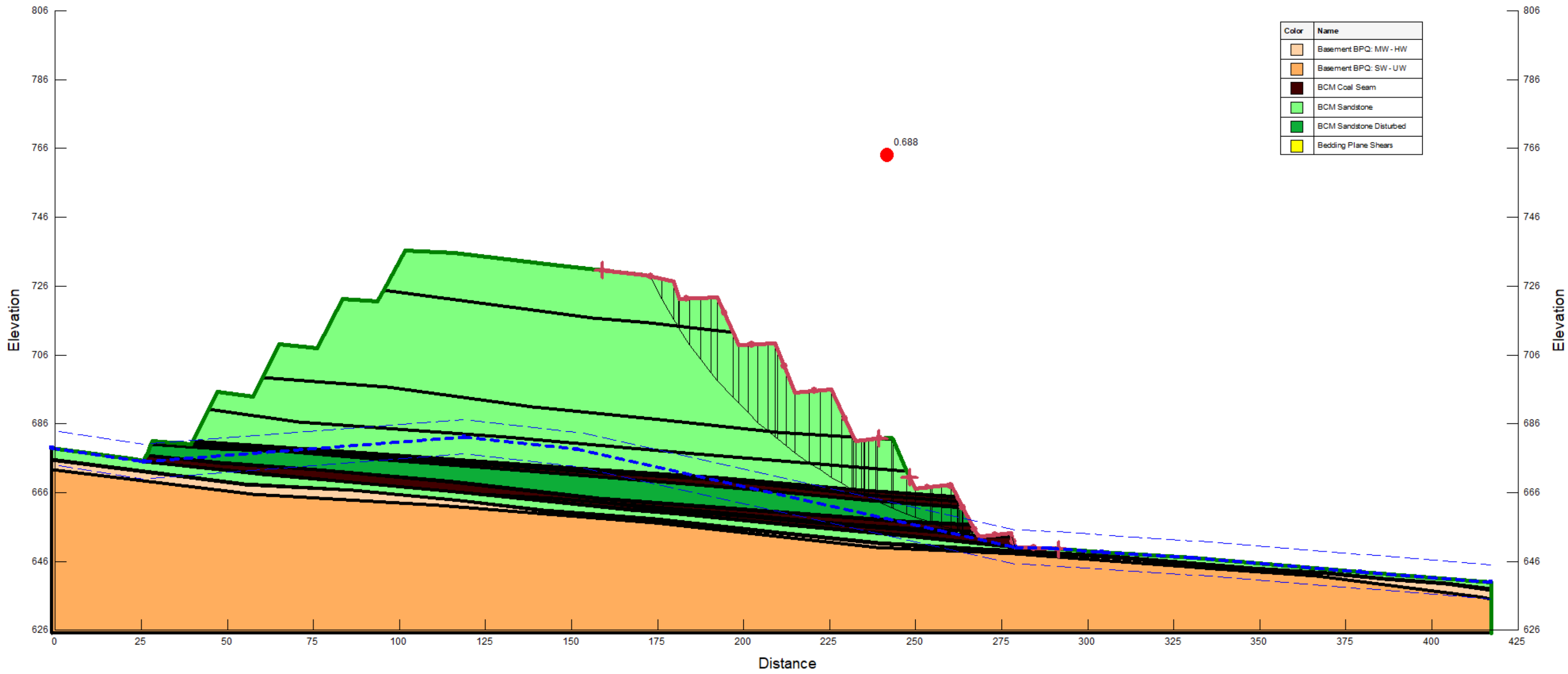

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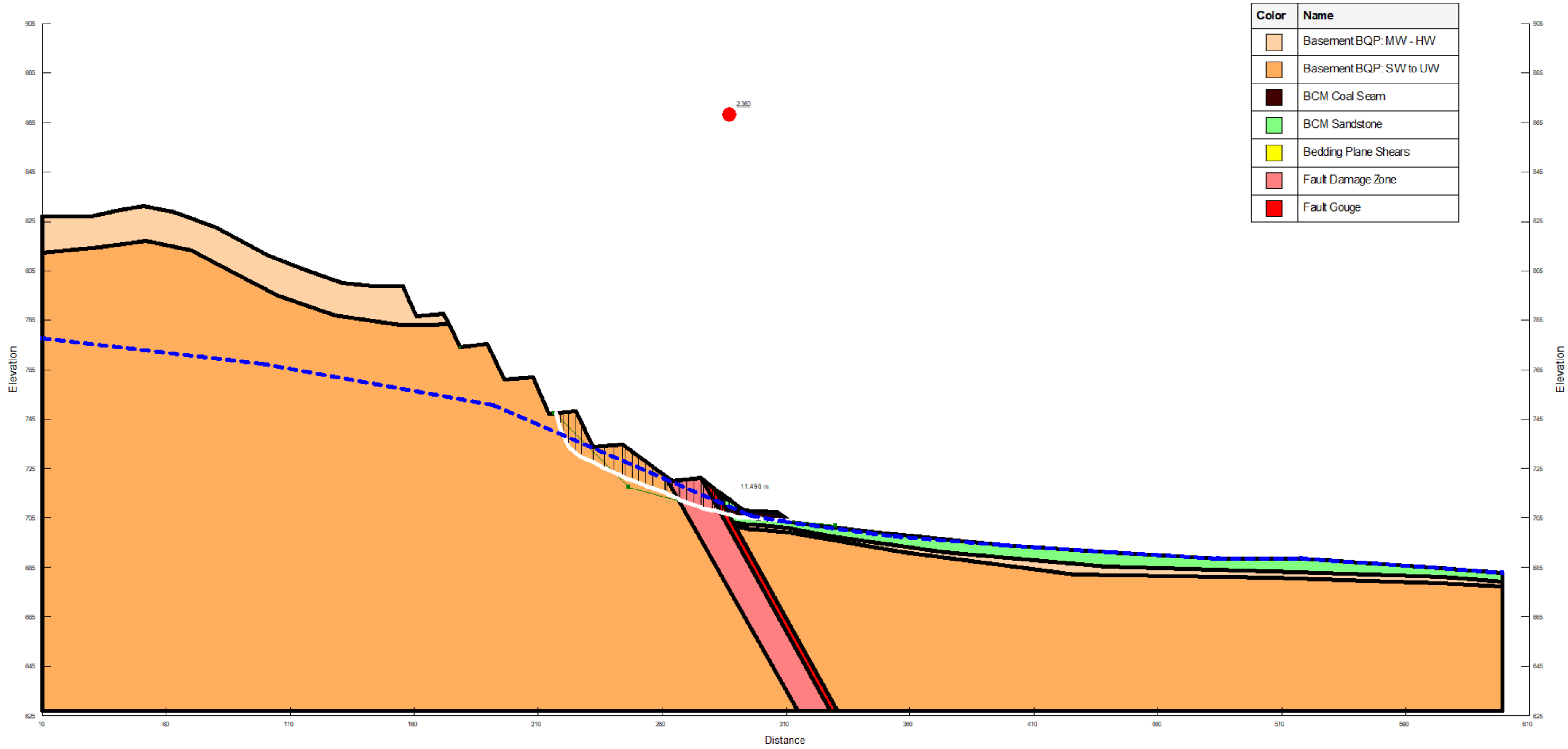

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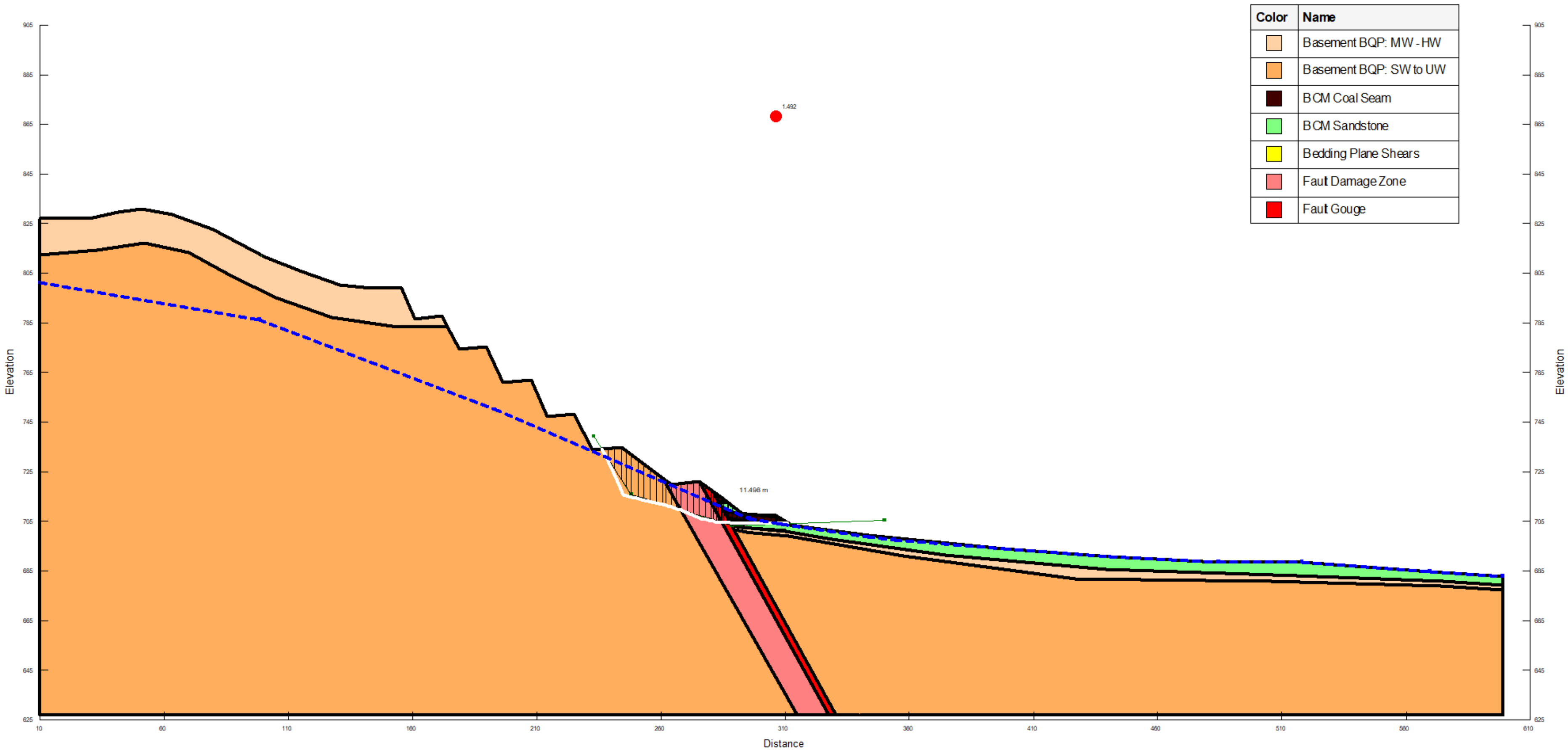

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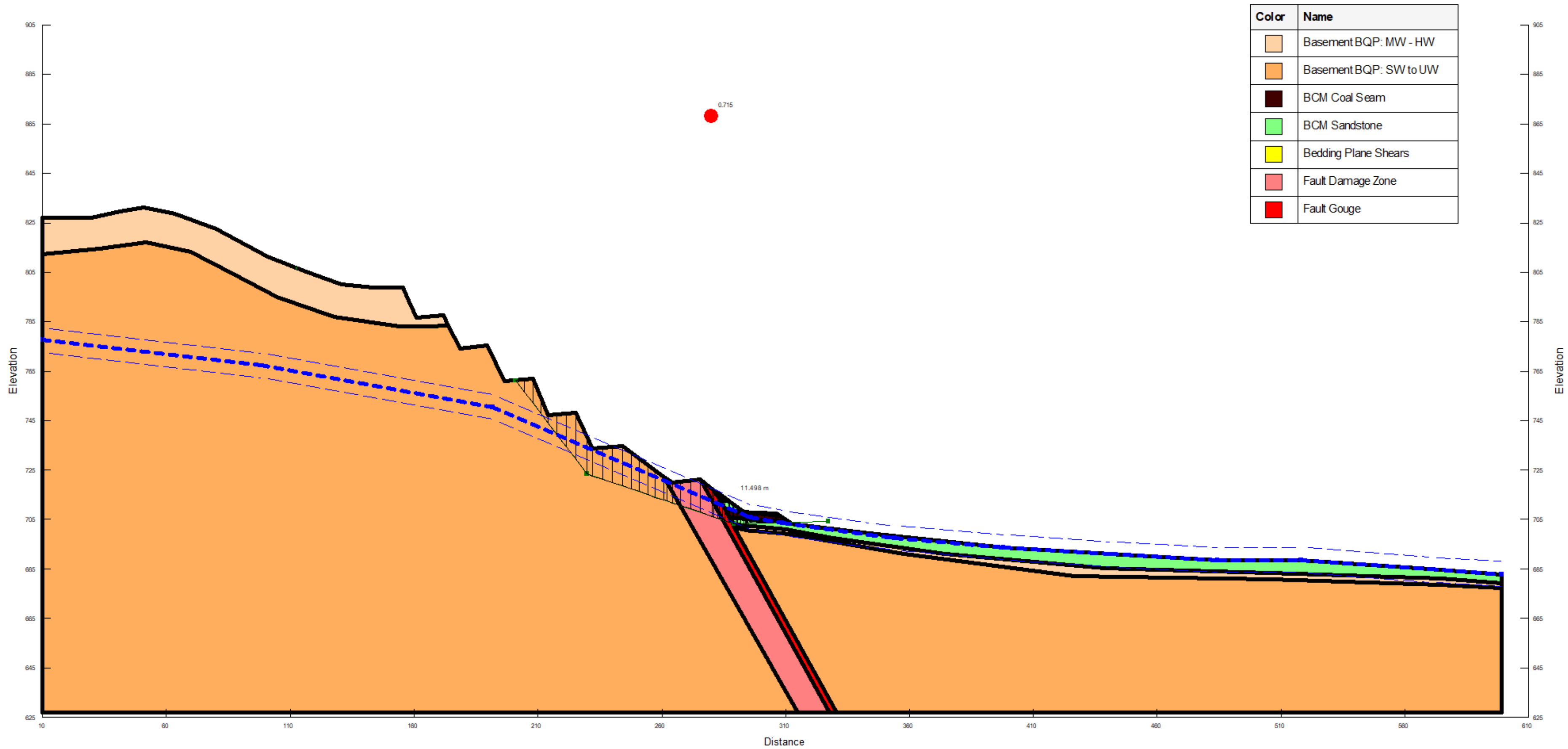

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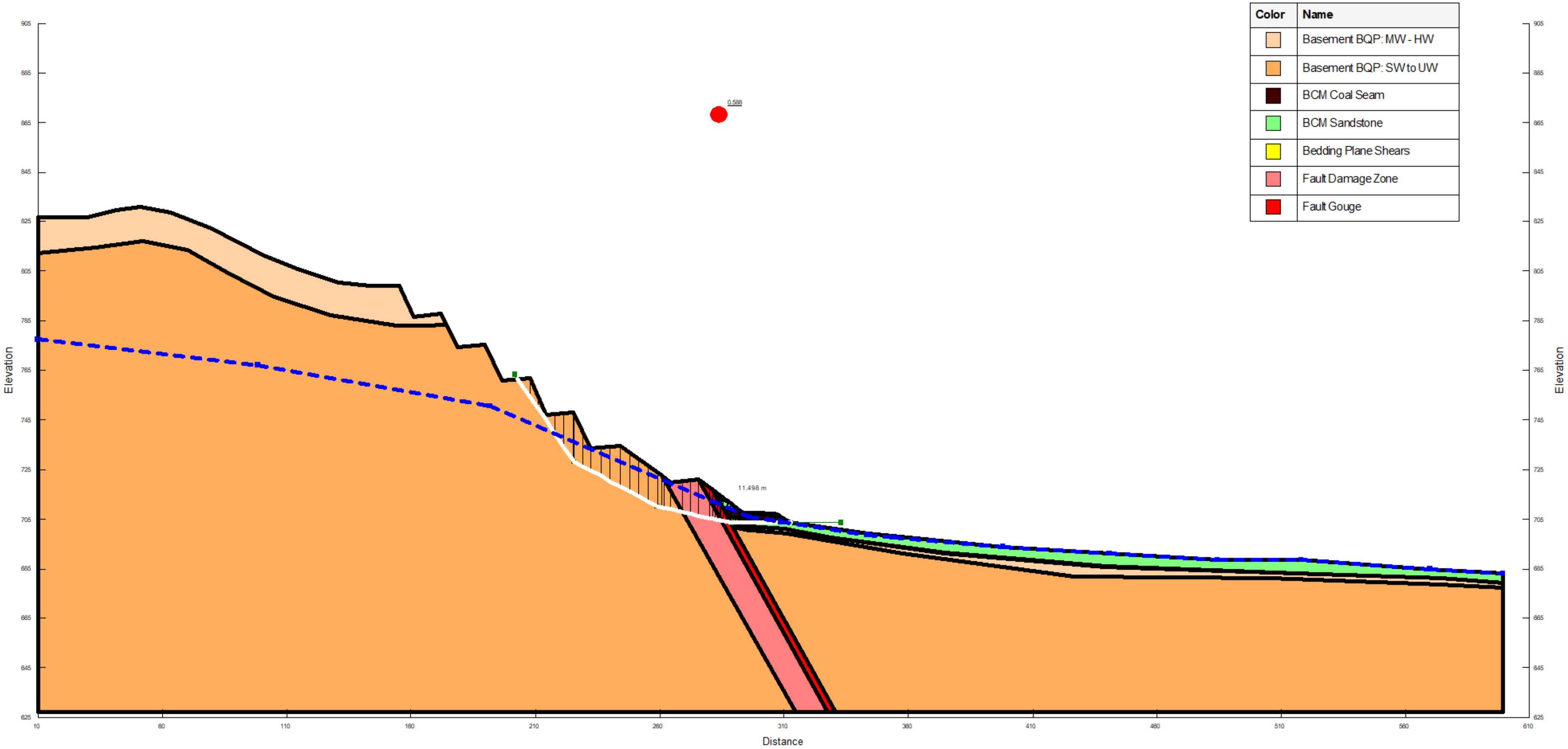

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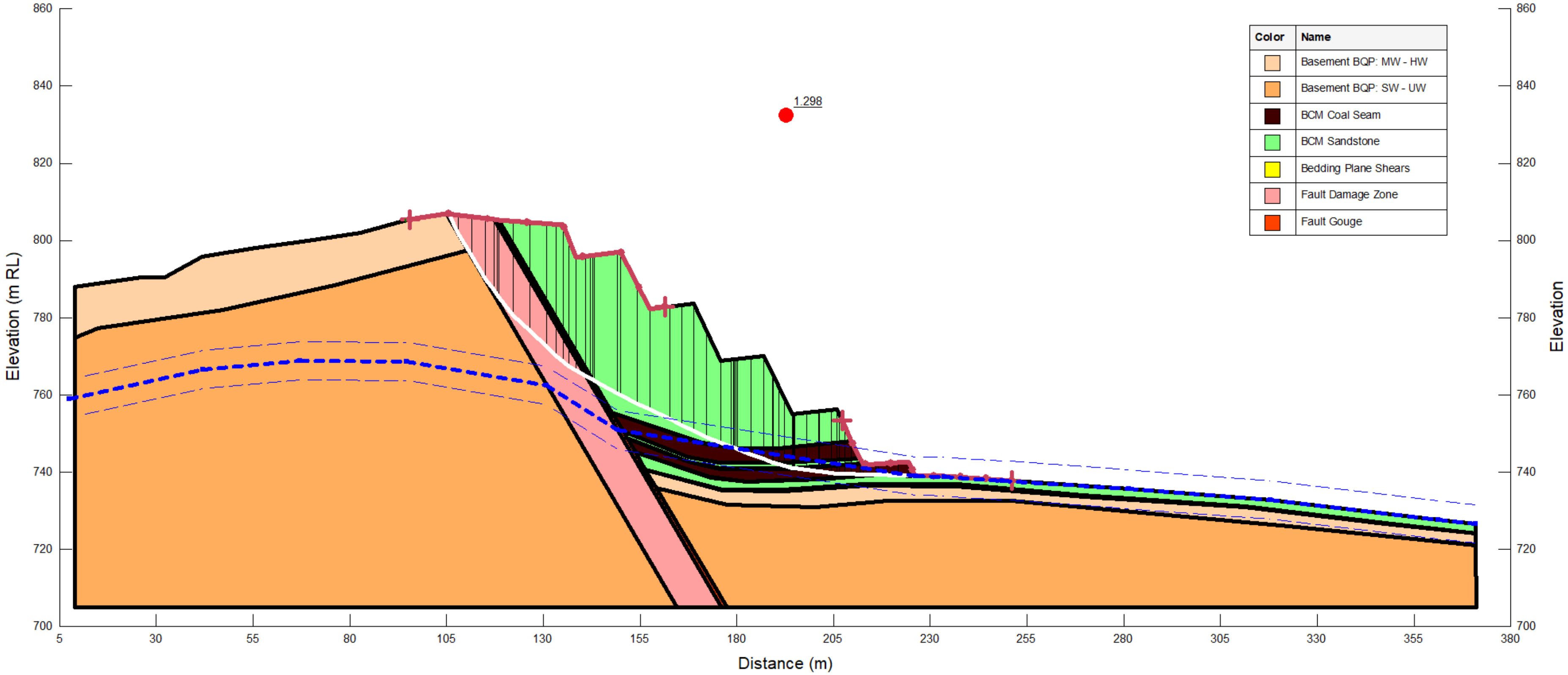

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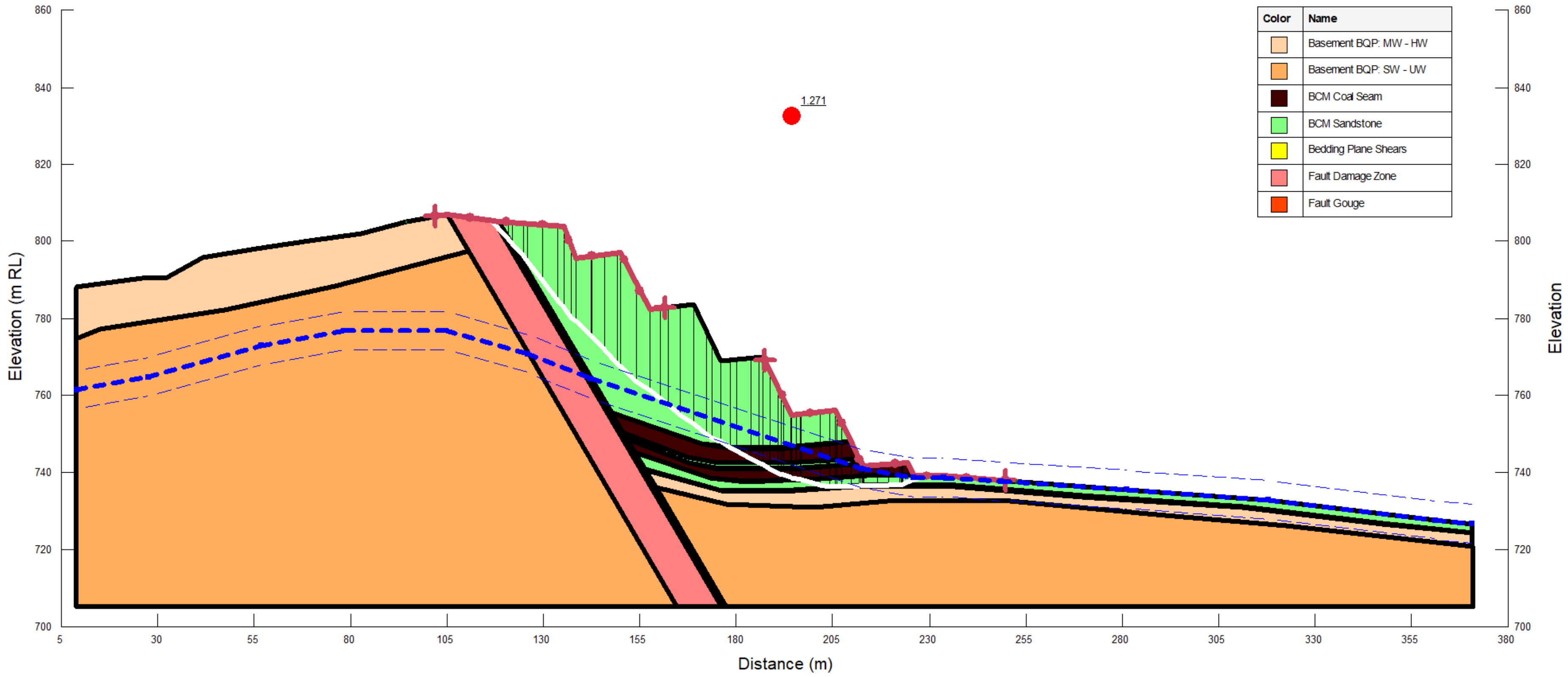

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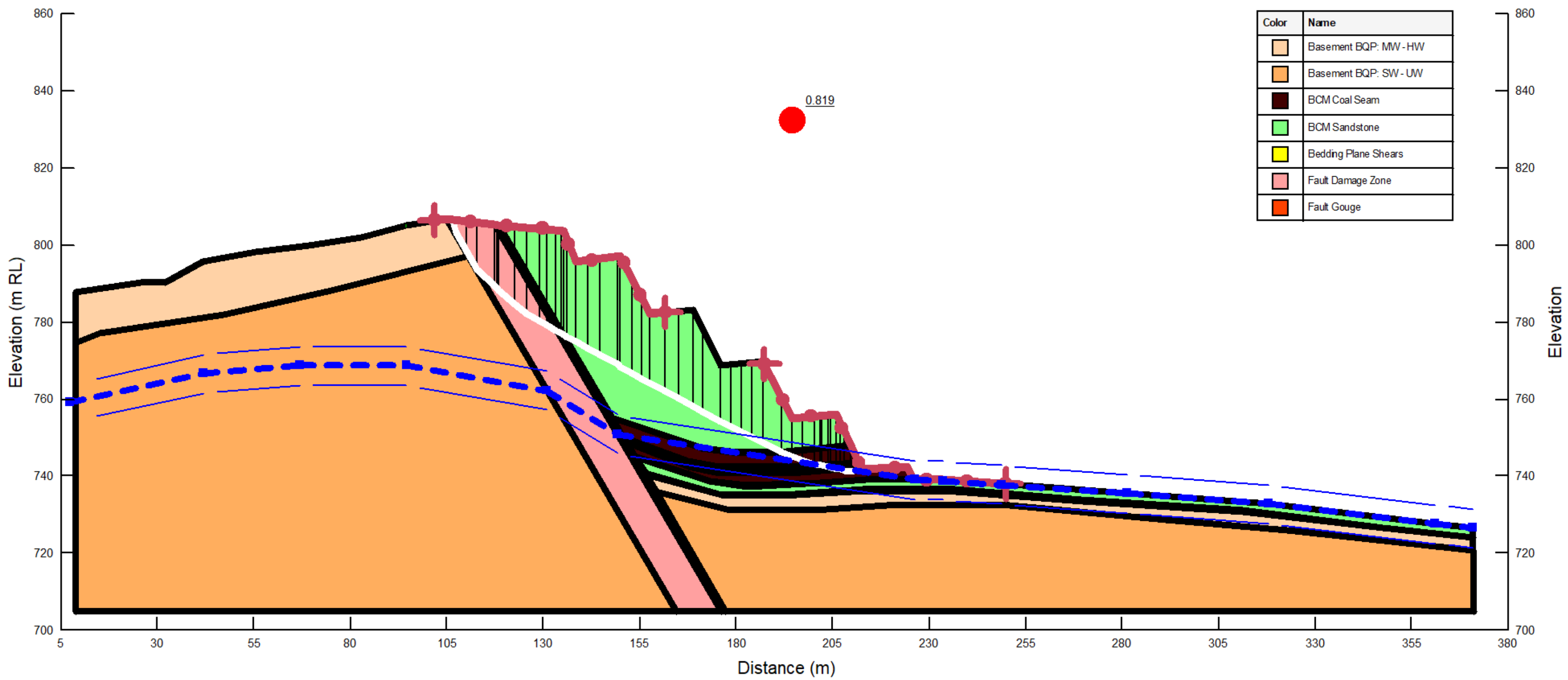
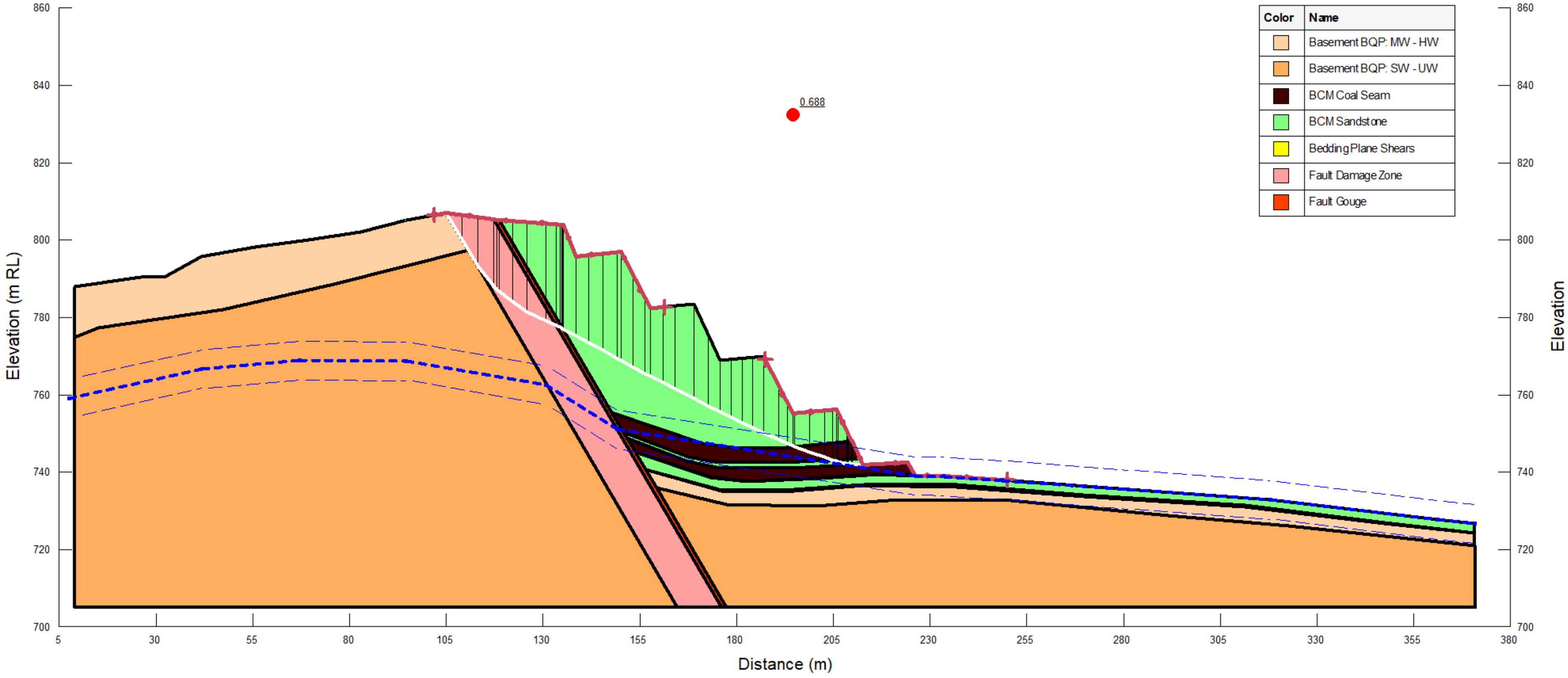


Name: XS_12 Serviceability limit State



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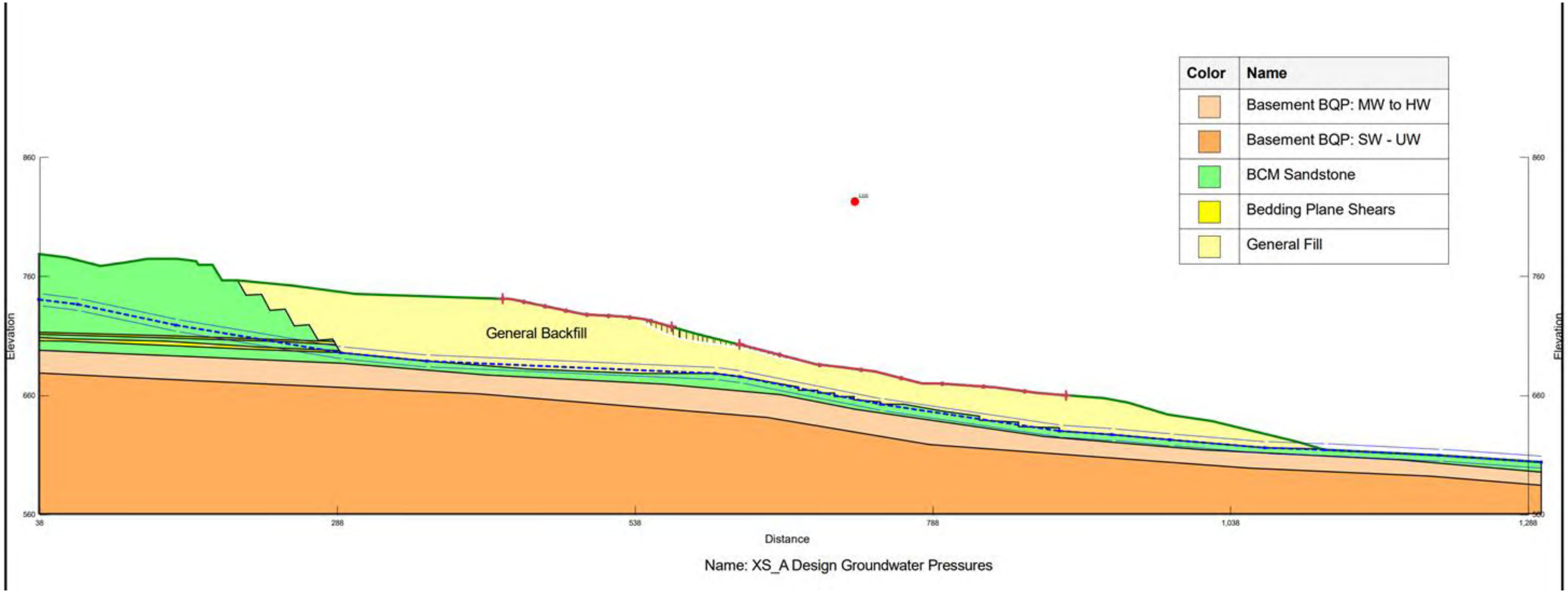

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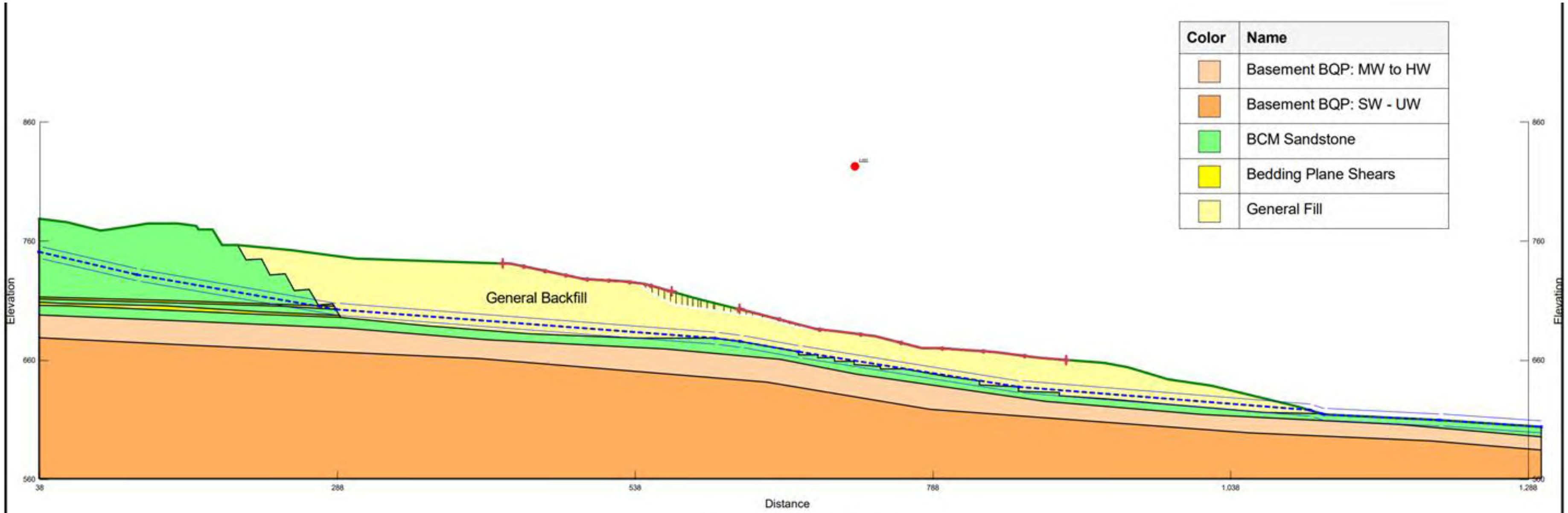
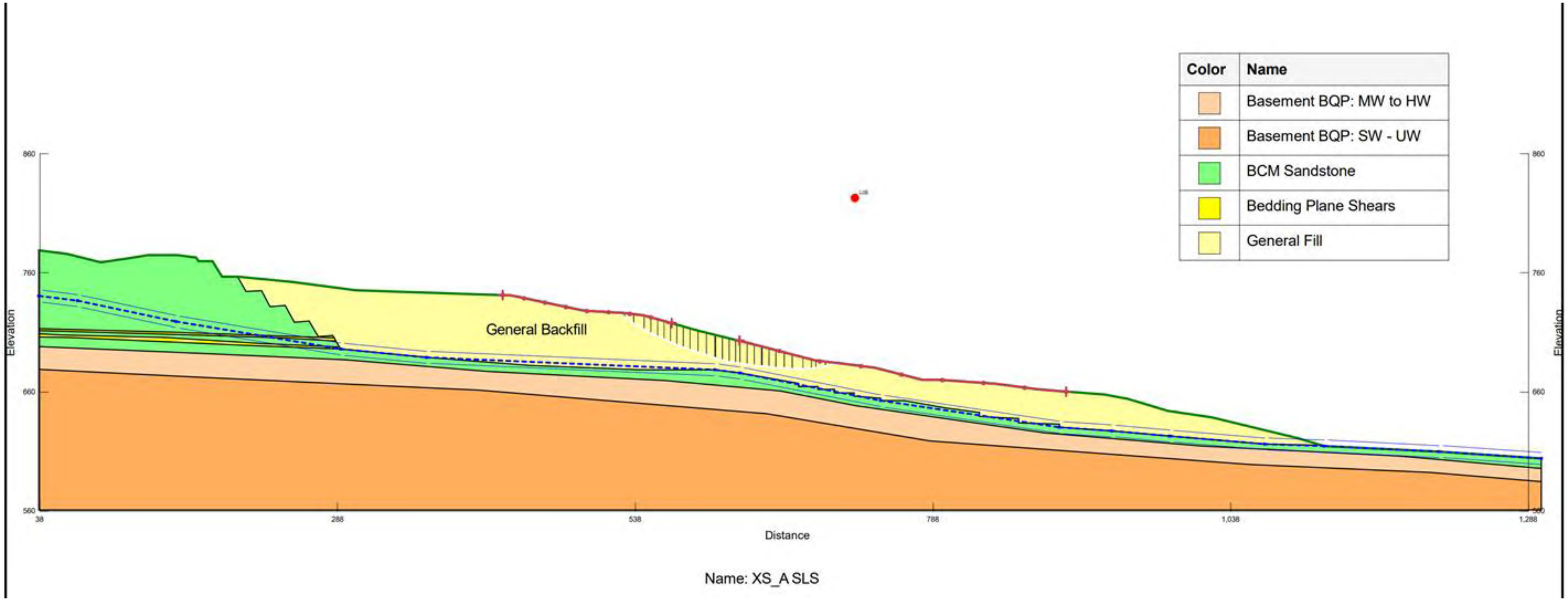
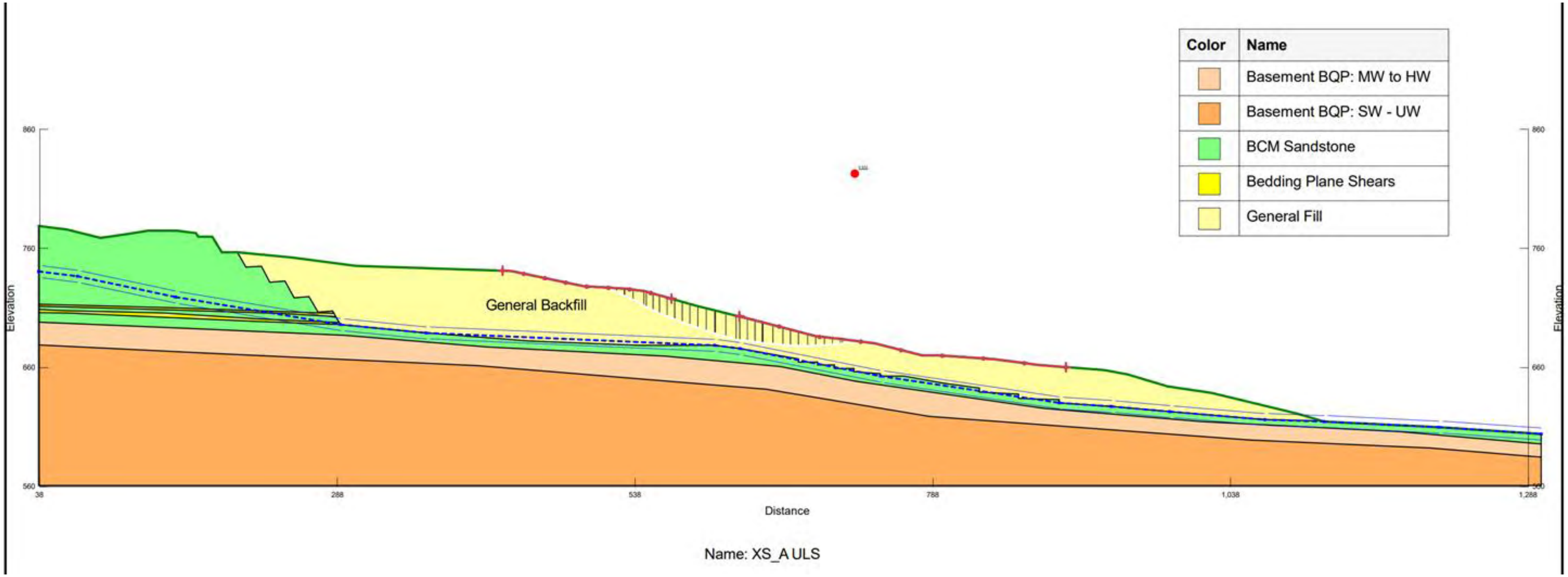


Name: XS_A Elevated Groundwater Pressures

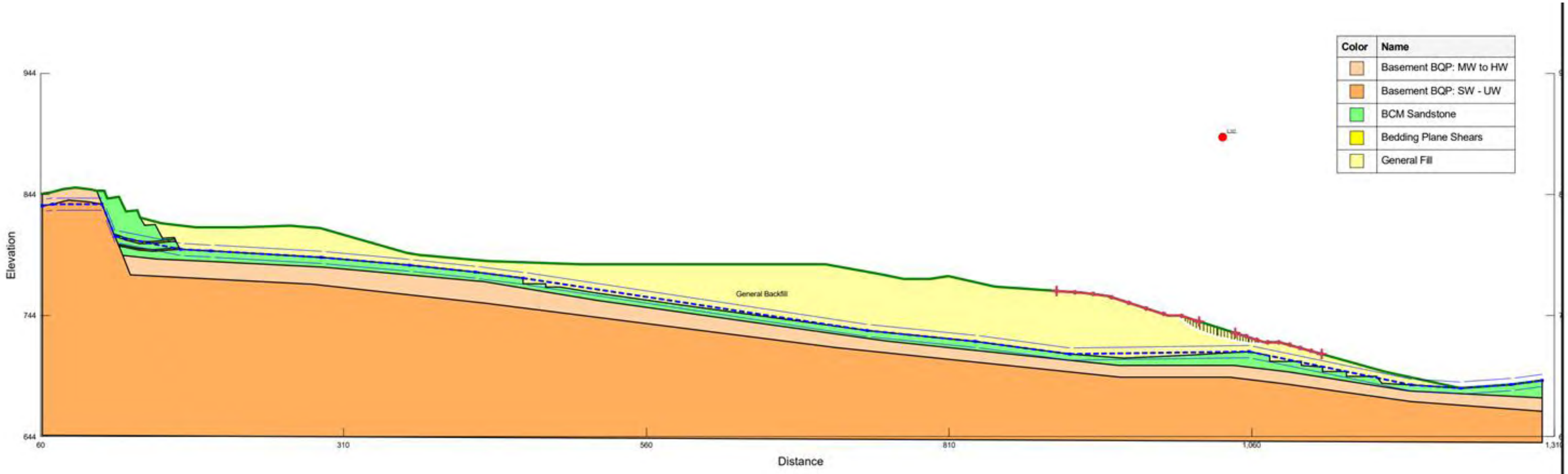

Color
Name
Basement BQP: MW to HW
Basement BQP: SW - UW
BCM Sandstone
Bedding Plane Shears
General Fill
General Backfill
Elevation
Distance
860
760
660
560
38
288
538
788
1,038
1,288

Name: XS_A SLS



Color
Name
Basement BQP: MW to HW
Basement BQP: SW - UW
BCM Sandstone
Bedding Plane Shears
General Fill
General Backfill
Elevation
Distance

Name: XS_A ULS



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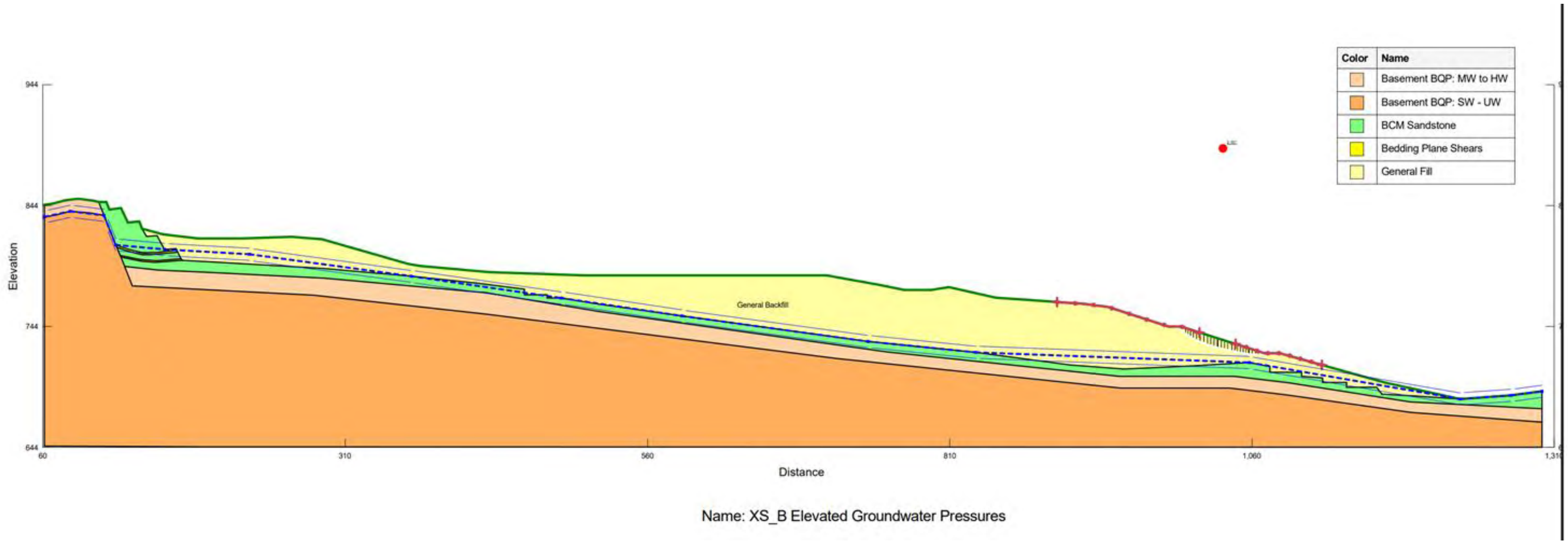
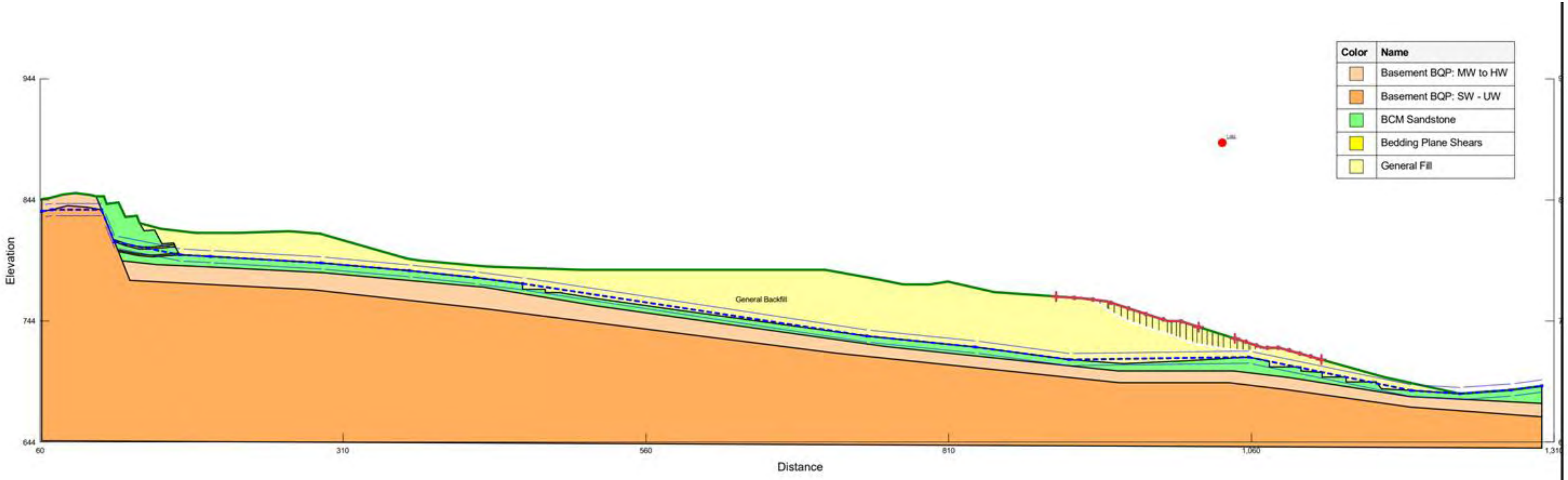
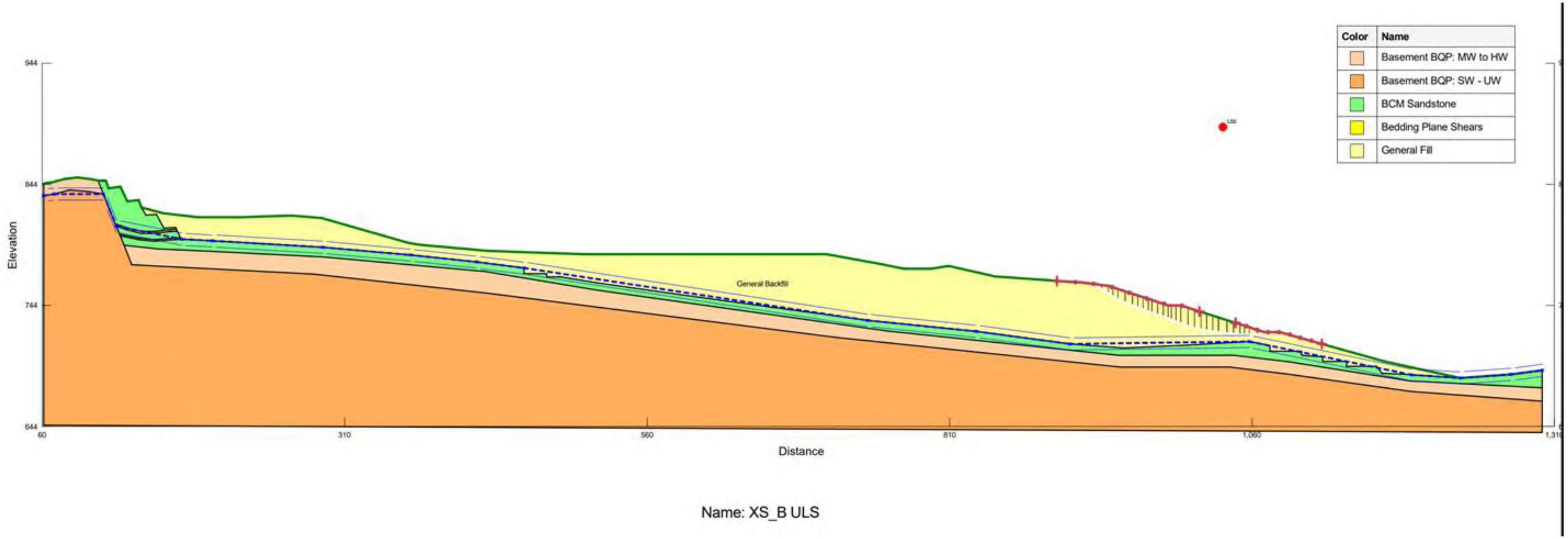


Name: XS_B Elevated Groundwater Pressures



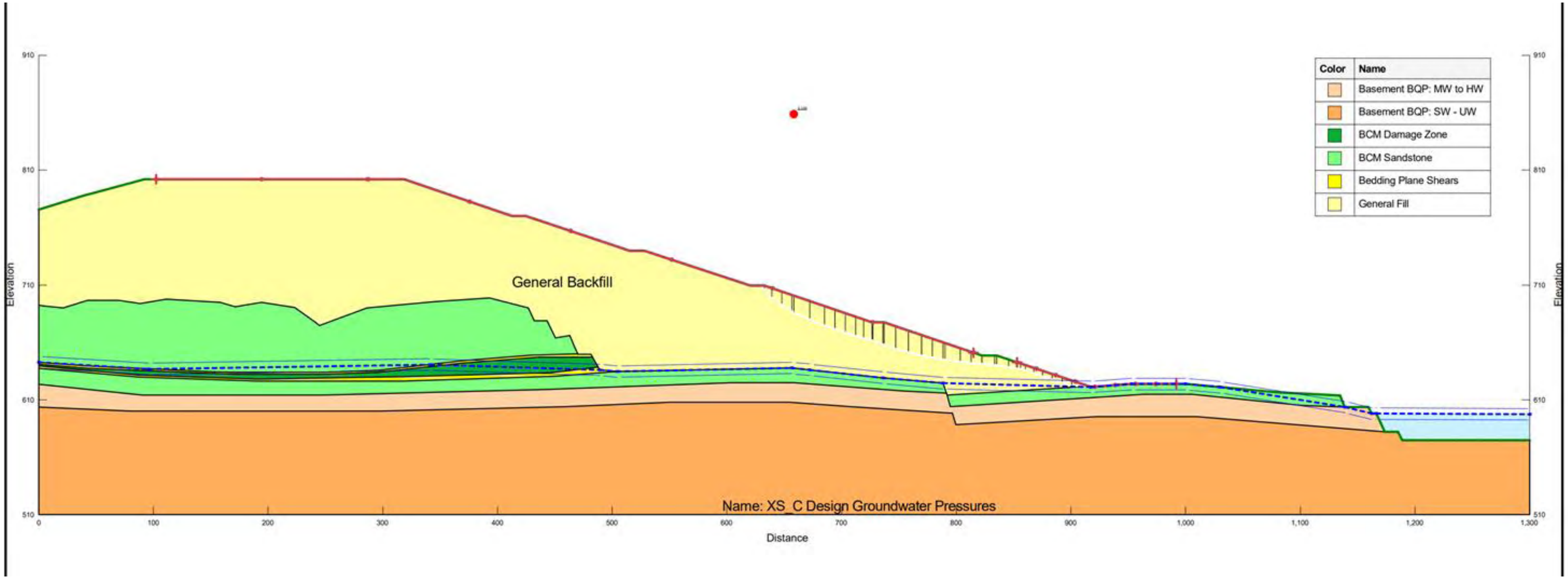
Color
Name
Basement BQP: MW to HW
Basement BQP: SW - UW
BCM Sandstone
Bedding Plane Shears
General Fill
General Backfill
Elevation
944
844
744
644
Distance
60
310
560
810
1,060
1,310

Name: XS_B SLS

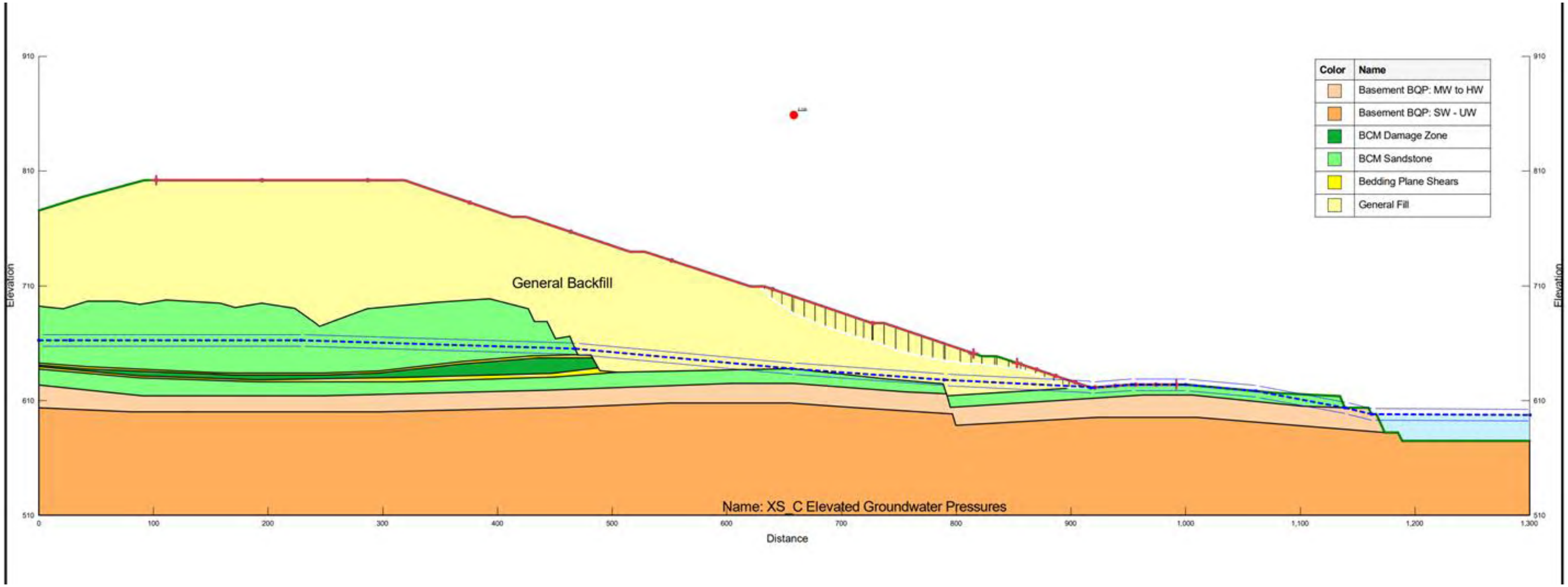


Color
Name
Basement BQP: MW to HW
Basement BQP: SW - UW
BCM Sandstone
Bedding Plane Shears
General Fill
944
844
744
644
Elevation
General Backfill
60
310
560
810
1,060
Distance

Name: XS_B ULS



Color
Name
Basement BQP: MW to HW
Basement BQP: SW - UW
BCM Damage Zone
BCM Sandstone
Bedding Plane Shears
General Fill
General Backfill
Name: XS_C Design Groundwater Pressures
Elevation
Distance
910
810
710
610
510
0
100
200
300
400
500
600
700
800
900
1,000
1,100
1,200
1,300



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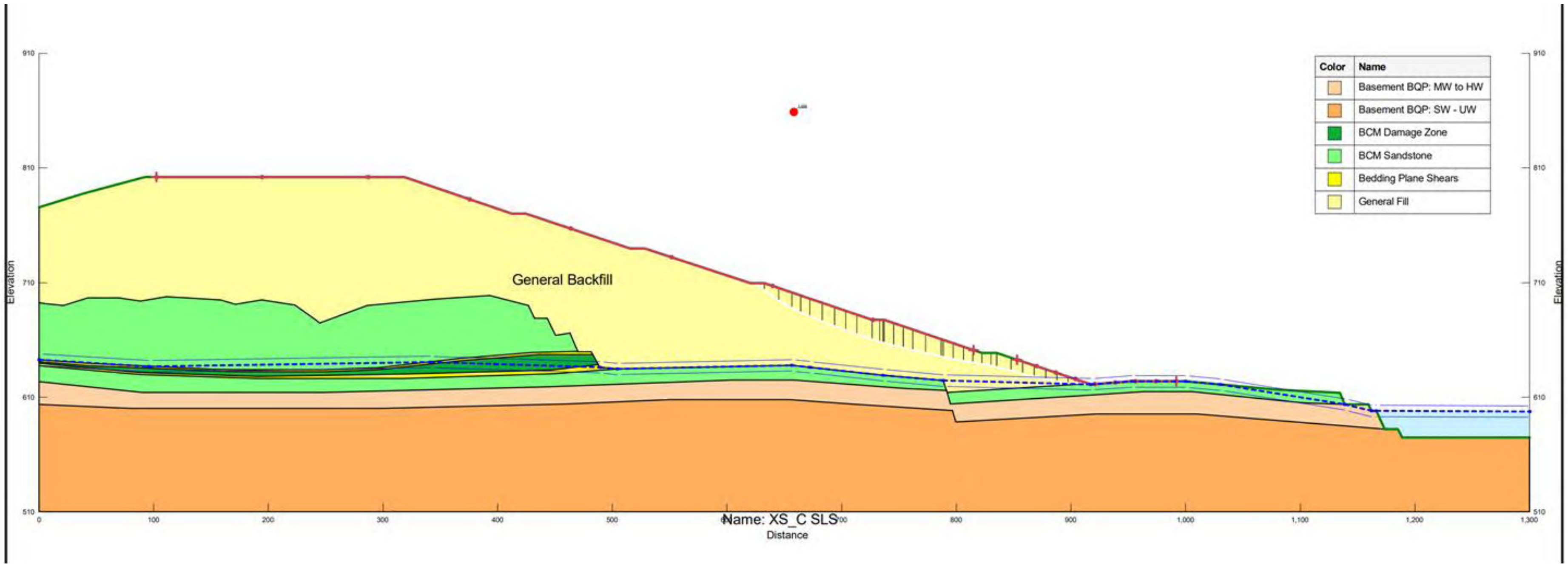
Basement BQP: SW - UW
BCM Damage Zone
BCM Sandstone
Bedding Plane Shears
General Fill
General Backfill
Name: XS_C Elevated Groundwater Pressures
Elevation
Distance
910
810
710
610
510
0
100
200
300
400
500
600
700
800
900
1,000
1,100
1,200
1,300



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Basement BQP: SW - UW
BCM Damage Zone
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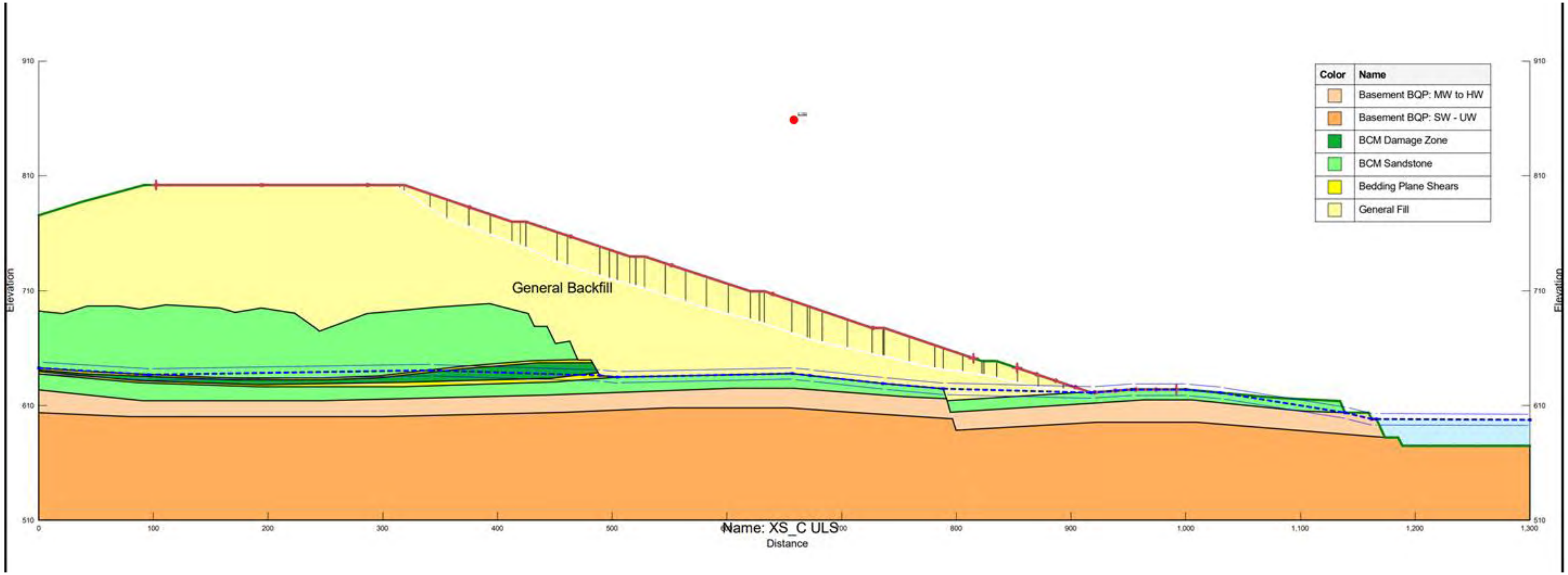
Bedding Plane Shears
General Fill
General Backfill
Elevation
Name: XS_C SLS
Distance



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Name
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Basement BQP: SW - UW
BCM Damage Zone
BCM Sandstone
Bedding Plane Shears
General Fill
General Backfill
Elevation
Distance
910
810
710
610
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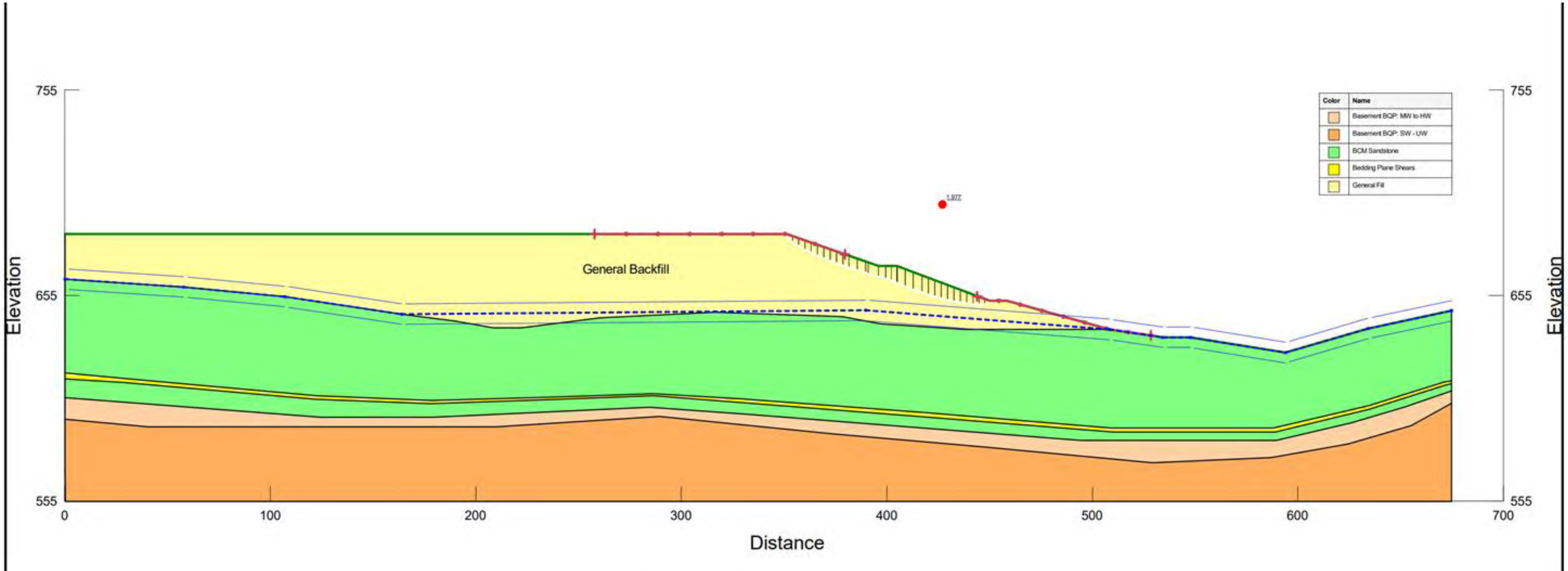
800
900
1,000
1,100
1,200
1,300

Name: XS_C ULS



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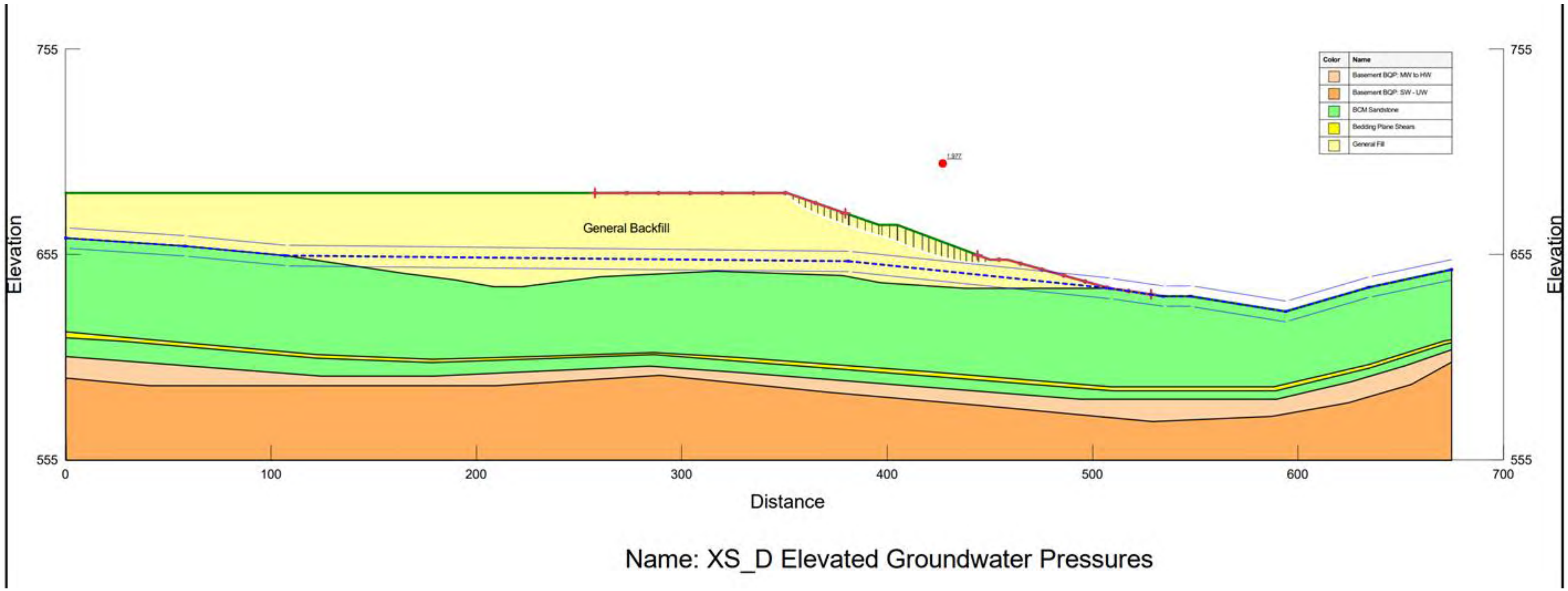

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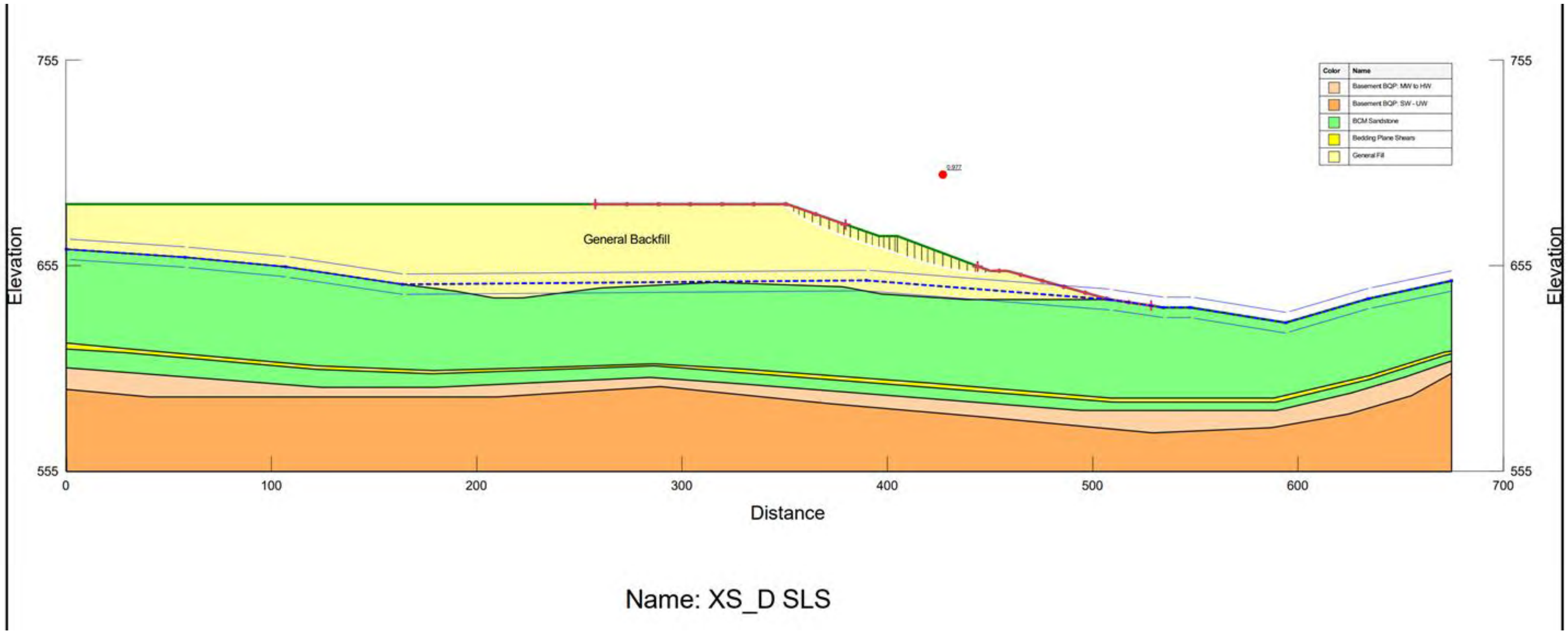
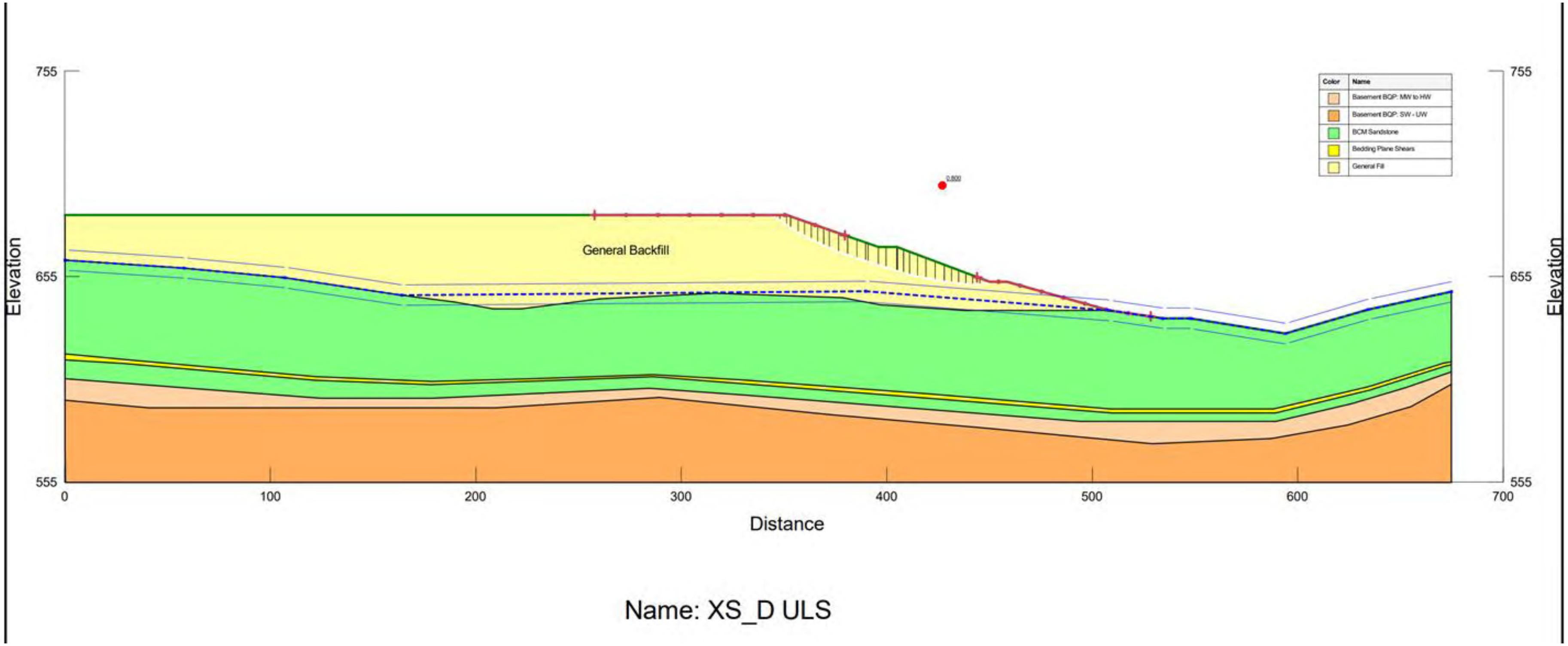


755
655
555
Elevation
0
100
200
300
400
500
600
700
Distance
General Backfill
Color
Name
Basement BQP: MW to HW
Basement BQP: SW - UW
BCM Sandstone
Bedding Plane Shears
General Fill

Name: XS_D SLS



Color
Name
Basement BQP: MW to HW
Basement BQP: SW - UW
BCM Sandstone
Bedding Plane Shears
General Fill
General Backfill
755
655
555
Elevation
0
100
200
300
400
500
600
700
Distance

Name: XS_D ULS

BATHURST
RESOURCES LIMITED

Addendum to Technical Report

Pre-Feasibility Study: Escarpment Extension Geotechnical Assessment

2 June 2026

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1.0 Purpose

The purpose of this supplementary addendum is to provide additional detail to the report titled Pre-Feasibility Study: Escarpment Extension Geotechnical Assessment. 3 July 2025, Version 1.1.

Since the completion of the Report, additional information has been obtained and a groundwater monitoring program has been established to address some of the recommendations for further work, outlined in Section 16 of the Report (BT Mining Ltd, 2025), and to provide further information to assist feasibility level assessments and construction drawings. The additional work carried out to date and data collected is presented in Section 2.0.

The Report outlined the below recommendations for further geotechnical investigations to be included in a further work plan:

- The existing piezometric network should be monitored at least monthly and after high rainfall events so groundwater response to heavy / prolonged rainfall can be observed and seasonal groundwater fluctuations can be established.
- A targeted geotechnical drilling programme is required during the mining phase to provide information on areas of low confidence, especially around the small – moderate displacement faults to confirm the scale of localized fault drag / bedding plane draping. Piezometers should be installed in these bore holes to provide further information, building confidence in the hydrological regime of the site.
- Install vibrating wire piezometers into the south wall to confirm ground water pressures in the hanging wall and footwall of Escarpment fault. This will also provide an opportunity to review material strengths of fault damage zone / gouge.
- Further downhole geophysical survey and engineering geology field mapping should be carried out to aid kinematic analysis prior to mining. Slope stability analysis has identified discontinuities as one of the largest hazards to slope stability and further information is required to appropriately assess the likelihood of wedge, planar and toppling failure.
- Laboratory testing of drill core sample within the vicinity of the proposed pit walls should be carried out to confirm the applicability of the material parameters used for this slope stability analysis and aid development of material parameters for future slope stability analysis and highwall design.
- Infill drilling should be carried out at consistent intervals to confirm bedding geometry, coal seam thickness and voids associated with historic underground workings prior to mining.

2.0 Summary of additional work

A monitoring programme of the existing piezometric network within the proposed Escarpment Extension (ESE) sub-area footprint has been established and water levels within the piezometers have been manually measured monthly by BT Mining Ltd staff. Locations of these piezometers are shown in Figure 1 below.

Results from previous geotechnical laboratory testing of Brunner Coal Measures lithologies from numerous drill holes within the proposed ESE development were located within the BT Mining Limited database, the location of each drill hole is depicted on Figure 1 and the results of this geotechnical laboratory testing are presented in Table 1.

3.0 Conclusion

The additional information gathered to date through the establishment of the groundwater monitoring programme and the geotechnical testing dataset have improved the understanding of the hydrological and geotechnical conditions within the ESE sub-area footprint and addresses some of the recommendations for further work, proposed in Section 16 of the Pre-Feasibility Study: Escarpment Extension Geotechnical Assessment. 3 July 2025, Version 1.1 Report.

The geotechnical testing dataset provided sufficient data to enable statistical assessment of the laboratory testing results, confirming the rock mass parameters and slope design criteria adopted in the Report are appropriate for the site-specific geotechnical conditions.

The establishment of the groundwater monitoring programme provides a measured dataset for future geotechnical assessments to utilize, and continued monitoring will increase the resolution of this data providing the opportunity for seasonal fluctuations and groundwater response to rainfall to be observed.

[redacted]

Figure 1. Aerial image of the proposed ESE development footprint depicting drill hole and piezometer locations.

Table 1: Description of geotechnical samples and laboratory testing results.

Sample No.	Drillhole ID	Sample RL (corrected)	Lithology	Density (t/m3)	Moisture content (%)	UCS (Mpa)	E (Gpa) 2nd	Poisson's ratio	P wave velocity (m/s) @ 1MPa	P wave Travel Time (µS/ft)
GT-6180-01	DH 6180	649.87	MST	2.512	0.6	60.4	20.4	0.31	3652	83.5
GT-6180-02	DH 6180	647.27	ZSS	2.493	1.1	74.3	23.2	0.18	3493	87.3
GT-6180-03	DH 6180	645.52	ZSS	2.536	0.8	86.2	29.6	0.19	3871	78.7
GT-6180-04	DH 6180	642.36	MST	2.505	1.1	49.4	17	0.32	3656	83.4
GT-6180-05	DH 6180	632.09	CSS	2.424	0.8	47.5	24.9	0.23	2614	116.6
GT-6180-06	DH 6180	625.89	CSS	2.46	0.5	58.9	32.3	0.13	3584	85.1
GT-6182-01	DH 6182	664.30	VCSS	2.393	1.3	30.9	16.7		2902	105
GT-6182-02	DH 6182	643.75	VFSS	2.416	1.6	37.9	13	0.24	2812	108.4
GT-6182-03	DH 6182	641.55	ZSS	2.537	1	66	27.7	0.23	3655	83.4
GT-6182-04	DH 6182	640.26	VFSS	2.332	2.9	29.5	14.1	0.34	2224	137.1
GT-6182-05	DH 6182	636.50	MST	2.397	0.7	54.3	20.9	0.26	2619	116.4
GT-6182-06	DH 6182	669.50	ZSS	2.618	0.6	49.1	20.5	0.18	2837	107.4
GT-6184-01	DH 6184	621.27	MST	2.587	0.7	12.6	14.8	0.16	3540	86.1
GT-6184-02	DH 6184	630.61	MSS	2.507	1.2	32	10.2	0.2	2273	134.1
GT-6184-03	DH 6184	634.77	VCSS	2.422	0.1	50.4	28.2	0.18		
GT-6184-04	DH 6184	640.88	ZSS	2.673	0.8	76.6	18.2	0.3	3958	77
GT-6184-05	DH 6184	644.11	VCSS	2.382	1.5	53.4	17.3	0.26	2557	119.2
GT-6186-01	DH 6186	625.74	MST	2.608	0.4	76.3	22.1	0.26	3530	86.4
GT-6186-02	DH 6186	630.65	VCSS	2.482	0.3	24.5	14.5		2677	113.9
GT-6186-03	DH 6186	633.12	FSS	2.498	1.1	45.4	17.4	0.19	2742	111.2
GT-6189-01	DH 6189	629.88	VCSS	2.282	1.1	26.7	15.2		2596	117.4
GT-6189-02	DH 6189	623.69	VCSS	2.372	2.8	27.8	15		3392	89.9
GT-6189-03	DH 6189	619.39	CSS	2.569	1.5	20.5	5.57	0.23	2510	121.4
GT-6189-04	DH 6189	616.86	CSS	2.432	2.2	18.5	12	0.46	2634	115.7
GT-6189-05	DH 6189	610.22	MST	2.652	0.5	54.3	18.2	0.37	3619	84.2
GT-6189-06	DH 6189	606.15	MST	2.58	0.6	44.5	21	0.24	3710	82.2
GT-6191-01	DH 6191	638.93	CSS	2.261	0.1	22.1	16.2		2755	110.7
GT-6191-02	DH 6191	633.84	FSS	2.407	1.7	21.1	5.83	0.24	2377	128.3
GT-6191-03	DH 6191	632.03	ZSS	2.581	0.5	77.3	17.5	0.22	3278	93
GT-6193-01	DH 6193	621.26	MSS	2.316	0.8	24.2	13	0.39	2812	108.4
GT-6194-01	DH 6194	620.01	FSS	2.534	0.8	64.5	19.5	0.2	2450	124.4
GT-6194-03	DH 6194	624.91	MST	2.56	0.4	72.2	19.8	0.26	3462	88
GT-6194-04	DH 6194	604.20	MSS	2.472	0.4	58.8	46.5	0.22	4015	75.9
GT-6194-05	DH 6194	600.79	MST	2.593	0.4	61.8	43.3	0.27	4344	70.2
GT-6195-01	DH 6195	642.68	LZSS	2.618	0.3	91.5	31.7	0.23	3506	86.9
GT-6195-02	DH 6195	633.73	MSS	2.389	0.7	51	25.6	0.27	3423	89
GT-6195-03	DH 6195	618.70	MST	2.629	0.4	73	27.5	0.29	3961	77
GT-6204-01	DH 6204	652.35	ZSS	2.57	0.3	48.1	25.1	0.27	3567	85.5
GT-6204-02	DH 6204	630.23	MSS	2.337	2.5	34.8	20.4	0.5	3093	98.5
GT-6204-03	DH 6204	634.02	VFSS	2.594	0.5	75.1	35	0.26	4073	74.8
GT-6204-04	DH 6204	626.44	ZSS	2.494	0.3	57.3	31.7	0.25	4046	75.3

GT-6207-01	DH 6207	660.34	MST	2.612	0.4	60.1	24.3	0.25	3594	84.8
GT-6207-02	DH 6207	653.29	ZSS	2.594	0.06	76.7	31.1	0.24	4079	74.7
GT-6207-03	DH 6207	643.00	CSS	2.426	2.3	43.2	18.1	0.24	2769	110.1
GT-6209-01	DH 6209	644.23	ZSS	2.494	1.2	36.6	9.23	0.13	2152	141.7
GT-6209-02	DH 6209	631.15	MSS	2.483	1.7	35.8	12.8	0.22	2640	115.5
GT-6209-03	DH 6209	616.31	MST	2.431	0.7	47.9	14.1	0.29	3245	93.9
GT-6527-01	DH 6527	594.45	ZSS	2.592	0.8	61.2	20.6	0.2	3174	96
GT-6527-03	DH 6527	571.45	FSS	2.523	1.3	58.6	20.4	0.19	3078	99
GT-6529-01	DH 6529	592.66	VCSS	2.405	0.1	37.1	22.7			
GT-6529-03	DH 6529	589.47	VFSS	2.591	0.5	71.2	29.9	0.21	3567	85.5
GT-6533-01	DH 6533	593.59	MST	2.519	0.7	29.8	11.1	0.08	2585	117.9
GT-6533-02	DH 6533	590.16	ZSS	2.585	0.6	26.1	15.9	0.17	2627	116
GT-6533-03	DH 6533	581.61	VCSS	2.368	2.8	34.6	20.5	0.29	3073	99.2

4.0 References

BT Mining Limited. 2025, July 3. Pre-Feasibility Study: Escarpment Extension geotechnical assessment, Version 1.1.