GEOTECHNICAL REPORT

2024 Annual Report
Structural Geology Evaluation
Specification Aggregates Quarry

Martin Marietta Materials
Golden, Colorado

Schnabel Reference 23180001.000
February 6, 2024

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February 6, 2024

Mr. Phillip Courtney
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Subject: **2024 Annual Report, Structural Geology Evaluation**
Specifications Aggregate Quarry, Golden, Colorado
Schnabel Reference 23180001.000

Dear Mr. Courtney:

SCHNABEL ENGINEERING, LLC is pleased to submit our geological engineering report of the annual structural geologic evaluation for the Specification Aggregates Quarry located in Golden, Colorado. This report documents the results and conclusions of our 2023 field mapping effort and structural geology evaluation. This study was performed in accordance with our proposal dated February 27, 2023 and authorized by Jeff Lines on April 6, 2023.

We appreciate the opportunity to be of service for this project. Please call us if you have any questions regarding this report.

Sincerely,

SCHNABEL ENGINEERING, LLC

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2024 ANNUAL REPORT
STRUCTURAL GEOLOGY EVALUATION
SPECIFICATIONS AGGREGATE QUARRY
GOLDEN, COLORADO

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1.0 INTRODUCTION

Schnabel has prepared this independent annual structural geology evaluation for the Specification Aggregates (Spec Agg) Quarry located in Golden, Colorado for the 2024 reporting year. This study was conducted at the request of Martin Marietta Materials, Inc. (Martin Marietta), the owner of the quarry, as a requirement for the State of Colorado, Permit Number M-74-004. The structural geology evaluation presented herein includes observations and measurements from the quarry that have been obtained annually by Schnabel and Lachel & Associates, Inc. (Lachel) staff over the past 26 years (1997-2023), as well as results of the detailed geotechnical investigation conducted by Lachel in 2003.

2.0 PURPOSE AND SCOPE OF WORK

The purpose of the annual evaluation is to monitor the influence the bedrock structural geology has on pit wall stability as mining progresses. The data collected during this annual assessment was obtained during site visits in June 2023 and November 2023.

The scope of this study is as follows:

- Observe recent rock mass exposures for large-scale instability and collect geologic rock structure data.
- Document the orientation and character of rock mass discontinuities (e.g., joints, foliations, faults) where recent exposures are accessible to supplement the existing structural geology database.
- Document groundwater observations at mapped locations.
- Photograph significant findings at the mapped rock mass exposures and discontinuity conditions.
- Compare the new rock structure data collected during site visits in 2023 with the previously collected data to identify potential changes to the previously analyzed discontinuity sets and possible new sets that may need to be considered for the mine highwall structural discontinuity analysis.
- Based on the new rock structure data, update the rock structural discontinuity analyses for the final mine highwall slopes.
- Summarize the field observations, mapping data, and structural discontinuity analyses results in an Annual Report.

3.0 LOCATION AND GEOLOGIC SETTING

The Spec Agg Quarry is located north of Interstate 70 near Jackson Gulch on the east flank of the Rocky Mountain Front Range, approximately 3 miles south of downtown Golden, Colorado (**Figure 1**). The natural topography of the property increases significantly in elevation to the west, with elevations within the planned mining pit area that vary from approximately EL 6,425 feet (ft) along the mine's eastern boundary to EL 7,110 ft on the western boundary (**Figures 1 and 2**).

This region of the Rocky Mountain Front Range was deformed during the Laramide orogeny in the late Cretaceous and early Tertiary periods. The gneissic bedrock within the quarry is believed to have undergone two to three episodes of deformation during Precambrian time (Gable, 1968). During this time, the bedrock material was intruded by several distinct igneous bodies and dikes. The gneisses are mapped as a series of folds, which are oriented roughly east-west, and have been broken and displaced by faults believed to range in age from Precambrian to Tertiary.

The bedrock within the mined portions of the quarry is mapped as migmatitic quartzo-felspathic gneiss with intrusions of granitic pegmatite veins (Scott, 1972). The granitic gneiss found in the quarry is generally hard and relatively competent. The gneiss varies in color from grayish orange to dark gray, with occasional banding visible along the foliation of the rock. The term foliation refers to the realignment of minerals into a parallel orientation as a result of the intense heat and/or pressure of metamorphism. The rock mass tends to be weakest along the foliation planes, which ultimately results in a discontinuity set parallel to the orientation of the foliation. The foliation orientation is the most prominent discontinuity set identified in the quarry. The foliation undulates across rock exposures in some locations. The rock mass also exhibits several other joint sets that are locally prominent and varied with elevations as mining progress to lower elevation. However, the joints are generally not as regular or as laterally continuous as the foliation.

Two regional fault orientations, trending approximately east-west and north-south, have been mapped within the property by others (Gable, 1968; Scott, 1972), and multiple fault orientation measurements have been recorded in our site visits over the years, as shown in **Figure 3**.

An approximately east-west trending fault is mapped by Gable (1968) across the northern margin of the quarry. This fault is exposed in the northern portion of the main quarry pit (**Figure 3**).

A second approximately east-west trending fault was previously identified in Jackson Gulch (informally named the Jackson Gulch fault). However, this fault is not mapped due to the uncertainty in the orientation of the fault trace.

A mapped reverse fault trending roughly north-south is located within the quarry property and constitutes the boundary between the metamorphosed Precambrian bedrock to the west and the Pennsylvanian sedimentary rocks to the east (Smith, 1964; Scott, 1972). The quarry property straddles this boundary, with the majority of the processing plant and the entire asphalt plant located east of the fault (**Figure 3**). The bedrock material east of the fault is dominantly composed of upturned sandstones and shales of the Fountain Formation (Scott, 1972). West of this fault, the material is mapped as migmatitic quartzo-felspathic gneiss with intrusions of granitic pegmatite veins (Scott, 1972).

Two other approximately north-south trending faults have been exposed in the northern quarry walls, as shown on **Figure 3**, and discussed in our 2013 report (Lachel, 2013). They roughly parallel the Golden Fault, which is a major fault that forms the north-northwest trending hogback immediately east of the quarry property. These two faults remain unchanged since there are no mining activities in the Main Pit area.

In the Southern Expansion Area, Gable (1968) mapped a third fault that also trends roughly east-west (**Figure 3**). This fault was initially exposed during the 2006 investigation and was noted by a distinct pegmatite vein that was surrounded by decomposed weak biotite rich gneiss. The fault was exposed in temporary excavation walls along the southwestern and southern margin of the Southern Expansion Area during previous year site visits. Several fault and local shear zones were observed in this report year, and the most prominent fault exposures observed are shown in **Figure 3**. Other local fault and shear zones observed in the combined with previous fault measurements are shown in the stereonet presented in **Figure 4**.

4.0 MINING PLAN AND PROGRESS

Mining activities have typically been focused in two distinct areas: the Main Pit and the Southern Expansion Area (**Figure 2**). It is our understanding that minimal or no mining activity has occurred in the Main Pit Area since the last report with the exception of minimal pumping of the impounded water.

Significant mining activity has taken place in the Southern Expansion Area since our last Annual Report and between our June 2023 and November 2023 site visits. The mining is being accomplished with two active temporary benches with reclamation occurring in stages following excavation along permanent benches. The upper bench observed during the 2023 site visits exists near the southwestern margin of the Southern Expansion Area (see Stations 24-01, 24-02, and 24-03) and is at approximately EL 6,440 ft. The lowest bench observed during our site visit is in the vicinity of Stations 24-04 and 24-05 (**Figure 2**) and is at approximately EL 6,405 ft. Each bench is approximately 35 feet lower than the bench to its west. Bench elevations were provided on-site by Phillip Courtney with Martin Marietta at the time of the June and November 2023 inspections.

Based on the current mine plan developed by Martin Marietta (formerly Lafarge West, Inc.) in December 2003, and the current Colorado Division of Minerals and Geology mine plan, we understand that the mine will eventually be excavated to an approximate final mine floor elevation of EL 6,200 ft as approved in the permit. The orientations of the final planned highwalls are the basis for our rock structural discontinuity assessment, as discussed in Section 6.0.

On September 12, 2022, Martin Marietta received approval to expand the pit further south past the current ridge bounding the Southern Expansion Area. While mining activities have not begun in this area, Martin Marietta is tentatively planning to begin subsurface exploration of this area in 2024. Future inspections will consider discontinuity orientations within this area as mining progresses.

5.0 FIELD OBSERVATIONS

Field observations for the 2024 Annual Report consisted of rock structure mapping and the collection of information regarding areas of visible, large-scale instability; seepage; and mining activity. Observations for the current Annual Report were made during two site visits, which took place in June 2023 and November 2023.

During our visits, we performed rock structure mapping to collect representative discontinuity measurements from recently mined rock exposures in the Southern Expansion Areas (**Figures 2 and 3**; **Photos 1-4**). Orientation measurements (i.e., dip/dip direction) of joints, foliation, and faults were taken from the faces of advancing benches. Two methods were used to collect discontinuity orientation measurements. A geological compass was used to obtain discontinuity measurements by sighting along the discontinuity surfaces. Stereonet Mobile (Version 4.0.5), an App developed by Richard Allmendiger, was used in conjunction with the geological compass measurements to obtain discontinuity orientations. Stereonet Mobile works by reading mobile device orientations and converting it to strike and dip of planes while also taking GPS coordinate locations with every orientation measurement.

A total of 278 discontinuity measurements were collected in 2023 at five data collection points (**Figure 2**) and were added to the measurements from previous years. When combined with data collected from previous Annual Reports (1997-2002, 2004-2023) and with borehole geophysical data collected during the 2003 geotechnical investigation, a total of 4524 discontinuity orientation measurements have been obtained over the past 26 years. **Figure 5** shows the 278 discontinuity orientation measurements collected for this Annual Report overlain on a contour stereonet plot of the entire Spec Agg structural dataset.

Discontinuity orientations on the EL 6,440 ft bench were measured in the south, southwest, and west temporary excavation walls during our 2023 site visits. Along the south temporary excavation wall, a fault exposure was observed near Station 24-01 (**Photo 5**) as well as multiple small scale shear zones (**Photo 6**). During the November 2023 inspection, folding and foliation was also observed in the west temporary excavation wall of the EL 6,440 ft bench near Station 24-03 (**Photo 7**). Discontinuity orientations measured on the EL 6,405 ft bench walls only occurred during the November 2023 inspection, and were measured in the west, south, and east temporary excavation walls. A fault exposure was observed at a corner of the west temporary excavation wall near Station 24-04 (**Photo 8**). Rock in the northern portion of the west temporary excavation wall appeared to be more massive and became more fractured as measurements advanced further south (**Photo 9**). Metamorphic banding was also observed in the west temporary excavation wall. A localized small scale shear zone was observed near Station 24-05 in the northeast corner of the east temporary excavation wall at bench EL 6,405 ft (**Photo 10**). Shear zones observed during the 2023 inspections correspond to some previous shear and fault measurements observed in 2022, but appear to be localized. Previous fault and shear zone measurements along with those observed in the 2023 reporting year are shown in **Figure 3** and presented in the stereonet in **Figure 4**.

The quarry walls observed during the 2023 site visits appeared to be relatively dry; with the exception of minor seepage visible in the southwest corner of the Main Pit, which has been documented in the past. Other than minor seepage observed along the temporary access road to the Southern Expansion Areas, no major seepage was observed. Additionally, we observed impounded water in the Main Pit floor (**Photos 11 and 12**). It is our understanding that there has been intermittent pumping of the impounded water to maintain water level during the past year.

After planar failure along foliation planes in 1998 and 1999, the overall effective angle of the last three benches of the Northeast Wall 1 and the Northwest Wall were reduced to an overall angle of 35°, which is consistent with the 2003 Lachel geotechnical evaluation (Lachel, 2003). The failure surfaces (i.e., the surfaces along which movement has occurred) remain at a “residual strength” and therefore are less resistant to additional loading. Based on visual inspection from the access road and bottom of the pit, these slopes did not appear to show signs of additional movement during the site visits for this study (**Photos 13-16**). It is important to note that in the Spring of 2023, Spec Agg experienced significant amounts of rainfall that was evident in greener vegetation along the slopes of the Main Pit in the June 2023 inspection. In the November 2023 inspection, a stake was observed in the Main Pit noting where the high water elevation was observed (**Photo 17**). During the November 2023 inspection, access was given by Martin Marietta to visually assess the slopes from the top of the highwalls of the Main Pit in addition to visually assessing from the access road (**Photo 18**). From viewing the slopes at a higher perspective, no signs of significant movement were observed. Although the slope configuration is currently stable, the failure mechanism could potentially be reactivated, resulting in movement of additional material. The Northwest Wall, Northeast Wall 1, and Northeast Wall 3 as shown in **Figure 2** should continue to be visually monitored for indications of instability from the Main Pit access road and from the top of the Main Pit slopes when access is possible.

6.0 ANALYSIS OF STRUCTURAL DISCONTINUITIES

The stability of the rock mass that forms the quarry walls is primarily controlled by the presence of rock discontinuities, such as joints, foliation, and faults. Discontinuities can create surfaces for toppling, sliding, and the intersections of multiple discontinuities can define the boundaries of wedges or blocks that have the potential to slide. The orientations of discontinuity sets vary considerably throughout the quarry. Therefore, it is possible that discontinuity orientations in a specific location of the quarry could deviate from the discontinuity orientations assumed for the analyses presented in this report.

6.1 Evaluation of Discontinuity Measurements

Representative discontinuity orientations for the quarry walls are required to evaluate the stability of the rock mass that forms the mine walls. Representative orientations for each discontinuity set observed were developed by analyzing the thousands of measurements collected since the beginning of Lachel's involvement at the Spec Agg site. For the 2024 Annual Report, we evaluated how the data collected over the past year compares with the previous geologic structure dataset and the representative orientations of observed discontinuity sets previously selected for analysis. Using this approach, we assess possible emerging trends related to the shift in orientation of the various observed discontinuity sets as more of the rock mass is exposed during mining operations.

We analyzed the discontinuity orientation data using DIPS 8.025 (Rocscience, 2023). The program enables plotting of individual data points, and offers several methods of data analysis, including contouring and cluster analyses.

We plotted the individual data points collected during the June 2023 and November 2023 site visits over contours for the entire dataset (from all previous years), and alongside representative discontinuity orientations used for the previous 2023 Annual Report (**Figure 5**). We also plotted this year's individual data points over contours for just this year's data (**Figure 6**). These figures show that the latest data is generally consistent with the representative orientations of discontinuity sets observed in previous years. Foliation sets F-1 and F-2 were each measured once but remained unchanged based on the amount of data collected. A foliation set F-3 was identified in previous years (prior to 2013) but has not been observed in the past nine years. Joint Sets P-1 through P-4 were observed in the 2023 inspections and were shifted based on the emerging trends of measurements collected this year. Joint set P-5 was observed for the first time since 2019 during last year's site visits and continued to emerge more in the 2023 measurements. Joint set P-6 has emerged over more recent years and has been shifted based on the data collected during the 2023 site visits. Joint set P-7, identified in the 2013 report, was measured at multiple locations during the 2023 site visits. Joint set P-8 was a new joint set identified during last year's site visits and continued to emerge more based on the 2023 measurements. Two localized joint sets identified in last year's report as well as previous Annual Reports (2017-2022) were not observed during the 2023 site visits. Based on the data collected this year, however, other localized joint sets were observed. These joints may be localized and varied with elevation, and they will continue to be monitored in the next years' study. Generally, joint sets P-1, P-3, P-4, P-5, P-6, and P-8 were the dominant joint sets observed this year (**Figure 6**). Arrows shown in **Figure 6** indicate the shifts in representative orientations of the observed discontinuity sets based on our evaluation of the new data acquired during the 2023 report year. **Figure 7** shows the updated discontinuity orientations for the 2024 Annual Report with contours of the entire data set.

Ultimately, a total of 10 discontinuity sets (two foliation sets and eight joint sets) were identified and analyzed for this Annual Report's structural discontinuity analysis. The discontinuity orientations are summarized in **Table 1** below. Foliation set F-3 was not included in the kinematic analysis described in Section 6.4 since it has not been observed in the past eight years.

Table 1: Representative Discontinuity Orientations

Discontinuity Set	Representative Orientation (Dip/Dip Direction)		
	2022 Annual Report	2023 Annual Report	2024 Annual Report
F-1 (Foliation)	33°/171° (unchanged)	33°/171° (unchanged)	33°/171° (unchanged)
F-2 (Foliation)	22°/300° (unchanged)	22°/300° (unchanged)	22°/300° (unchanged)
F-3 (Foliation)	Not observed	Not observed	Not observed
P-1 (Joint)	72°/174°	67°/178°	74°/167°
P-2 (Joint)	58°/085°	62°/92°	62°/83°
P-3 (Joint)	68°/256° (unchanged)	65°/262°	70°/258°
P-4 (Joint)	74°/299°(unchanged)	74°/299°(unchanged)	76°/294°
P-5 (Joint)	Not Observed	68°/354° (unchanged)	70°/354°
P-6 (Joint)	63°/029° (unchanged)	68°/31°	67°/25°
P-7 (Joint)	61°/215° (unchanged)	61°/215° (unchanged)	57°/218°
P-8 (Joint)	N/A	11°/238° (new)	14°/259°

6.2 Slope Geometry

Wall orientations used in this report are based on the mine plan developed by Martin Marietta in December 2003 (**Figure 2**). The wall designations, slope angles, and slope dip directions used to represent the final quarry walls are presented in **Table 2**.

Table 2: Representative Quarry Wall Orientations

Wall Designation	Slope Angle(1)	Slope Direction of Wall(2)
East Wall 1	45°	242°
East Wall 2	45°	270°
Northeast Wall 1	35°	175°
Northeast Wall 2	45°	225°
Northeast Wall 3	45°	176°
Northwest Wall	35°	151°
West Wall 1	45°	091°
West Wall 2	45°	120°
West Wall 3	45°	091°
Southwest Wall 1	45°	016°
Southwest Wall 2	45°	036°
South Wall	45°	000°
Southeast Wall	45°	335°

Notes:
1 Slope angles are measured relative to the horizontal.
2 Slope orientations are presented as dip directions measured from true north (0°).

6.3 Friction Angle

A representative angle of friction ($\phi + i$) = 33° was used for our kinematic analysis, where "ϕ" is the basic friction angle and "*i*" is the surface roughness angle (Hoek and Bray, 1977). The surface roughness angle is the angle between the basic plane of the joint and the planes representing the surface of undulations on the joint surface. This value was based on the results of the direct shear testing performed as part of the 2003 geotechnical investigation (Lachel, 2003). The test results produced only a basic friction angle, ϕ, and results indicated that the basic friction angle of the discontinuities ranged from 13.7° to 49.3° with a mean value of 28°. These results do not include the two direct shear tests conducted on samples with clay material along the foliation plane, which produced an average friction angle of 5°. A generally accepted and conservative value of 5° was selected for the surface roughness angle, "*i*".

6.4 Kinematic Analysis

We performed kinematic structural discontinuity analyses for each of the representative quarry wall orientations presented in **Table 2**. The analyses were performed to evaluate potential rock slope failure modes controlled by planar rock mass discontinuities based exclusively on the geometric relationships of the discontinuities measured. Potential rock slope failure modes include sliding of wedges formed in the slope by the intersection of two discontinuity planes, sliding of rock blocks along a single planar discontinuity, and toppling rock blocks. The computer program DIPS 8.024 (Rocscience, 2023) was used for the kinematic stability analysis. Inputs for the analyses include the following:

1) Representative discontinuity orientations (dip and dip direction) determined from all previous years' data and updated utilizing data collected during the 2023 site visits (**Table 1**).
2) Mine Slope Orientations (dip and dip direction) as presented in **Table 2** and shown in **Figure 2**. A total of 13 slope orientations were considered.
3) Estimated Rock Mass Discontinuity Interface Friction Angle. A typical interface friction angle of 33 degrees was considered in all cases for the kinematic analysis, as discussed in Section 6.3.

The kinematic analysis stereonet plots are presented in **Figures 8** through **24**. Representative discontinuity orientations are shown as green lines. The orientation of the slope face for the considered wall is shown as an orange great circle. The friction circle used for planar failure analysis is shown as a black line. The limits of the critical zone for the planar failure analysis are defined by the area of overlap between the friction circle and the daylight envelope. The limits of the "critical zone" are defined by the area of overlap between the friction circle and the great circle representing the plane of the slope face and is shown as a light orange shaded area. Each kinematic analysis plot is evaluated based on where discontinuities plot in relation to the critical zone.

6.4.1 Potential Failure Modes

<u>**Planar Failure**</u>

The following four conditions, defined by Hoek & Bray (1977) and Wyllie & Mah (2004), must be met in order for planar failure to occur:

1) The plane on which sliding occurs must strike parallel or nearly parallel to the slope face. Typically, discontinuity planes with a dip direction within 30 degrees of the slope dip direction are considered.
2) The failure plane must “daylight” in the slope face (i.e., the dip of the failure plane must be smaller than the dip of the slope face).
3) The dip of the failure plane must be greater than the angle of friction of the plane.
4) Release surfaces, which provide negligible resistance to sliding, must be present in the rock mass to define the lateral boundaries of the slide.

On the stereonets, criteria for planar sliding are satisfied when the dip vector of a discontinuity plots within the critical zone (and the dip direction of the discontinuity plane is within 20 degrees of the slope dip direction).

Wedge Failure

Wedge failure is characterized by sliding that occurs along the line of intersection of two discontinuities (Hoek & Bray, 1977). According to the analysis method developed by Markland (1972), a wedge failure can occur when the following criteria are satisfied:

1) The plunge of the lines of intersection is less than the dip of the slope face.
2) The plunge of the lines of intersection exceeds the angle of friction.

On the stereonets, Markland’s criteria for wedge sliding are satisfied when the intersection of two discontinuities plot within the critical zone. It should be noted that in some instances, the intersection of the discontinuity sets fall barely outside of the critical zone. In these cases, the wedge failures may still be considered kinematically feasible since the orientations presented on the stereonets are the average of hundreds of measurements, as well as our interpretation of where the discontinuity measurements are trending based on recent measurements.

Toppling Failure

Toppling failures can occur where planes share a similar dip direction to the slope face and where they dip relatively steeply into the slope face. Rock blocks that would be prone to toppling at the site were noted in these and previous site visits to be small, of a size to be scaled during routine operation. In our opinion, toppling failure is not likely to be associated with large-scale instability on the scale of an entire mine highwall at the existing and currently-planned slopes. Therefore, our kinematic analyses of these potential toppling failures were not included as part of this report. Small-scale toppling failures are likely to occur locally in the temporary walls (vertical wall of each bench) since a majority of the joints exposed in this assessment are steeply inclined.

6.4.2 East Walls

For the 2024 Annual Report, two east wall orientations were analyzed based on the locations shown in **Figure 2** and **Table 2**: East Walls 1 and 2 correspond to the same wall location and orientation analyzed in the previous 2013-2023 Annual Reports (**Figure 2**). Mining activity near the East Walls is currently taking place near Station 24-05.

The stereonet plots for East Walls 1 and 2 each show one discontinuity intersection that falls within the critical zone for wedge failure, suggesting that wedge failure is kinematically possible for these slope orientations (**Figure 8 and 10**). The intersecting set that may result in wedge failure are joint sets P-5 and joint P-7. The development and size of these wedge failures will be controlled by the variability and limited lateral extent of the discontinuities. Based on the current and previous years' data sets, these two joint sets (P-5 and P-7) have weak signatures represented by relatively few measured orientations (**Figures 5 and 6**) relative to the entire data set. As excavation proceeds in the vicinity of the eastern walls, additional measurements are needed to refine the representative discontinuity orientations of these joint and foliation sets in this area to evaluate their potential to contribute to large-scale slope failure modes. The stereonet plots for East Wall 1 and 2 do not indicate the possibility of planar failure.

6.4.3 Northern Walls

For the 2024 Annual Report, four northern wall orientations were analyzed based on the locations shown in **Figure 2** and **Table 2**: Northeast Walls 1 through 3, and the Northwest Wall correspond to the same wall locations and orientations analyzed in the previous 2013-2023 Annual Reports (**Figure 2**). There is currently no mining activity in the northern walls area.

The stereonet plot for Northeast Wall 1 shows one discontinuity intersection that appears nearly within the critical zone for wedge failure (**Figure 12**). Kinematic analysis performed for the 2022 Annual Report shows this wedge intersection appeared within the critical zone, but it no longer appears in the critical zone due to discontinuity orientations shifting with the data collected for the 2023 and 2024 Annual Reports. The intersecting sets that appear near the critical zone for wedge failure include foliation F-1 and joint set P-3. As joint sets orientation have shifted this year, foliation F-1, and joint sets P-2 and P-7 all have intersections close to the critical zone for wedge failure in addition to F-1 and P-3. The stereonet plot for Northeast Wall 1 also indicates a potential planar failure mode along foliation F-1 for this slope orientation (**Figure 13**). This is the same foliation orientation that was believed to contribute to the 1998 slope instability.

The stereonet plot for Northeast Wall 2 shows one discontinuity intersection that appears nearly within the critical zone for wedge failure (**Figure 14**). Kinematic analysis performed for the 2022 Annual Report show this wedge intersection appeared within the critical zone, but it no longer appears in the critical zone due to discontinuity orientations shifting with the data collected for the past two Annual Reports. The intersecting sets that appear near the critical zone for wedge failure include foliation F-1 and joint set P-3. Currently there is no additional excavation planned near the northeastern wall. Planar failure is not indicated in the stereonet plot for Northeast Wall 2 (**Figure 15**).

The stereonet plot for Northeast Wall 3 shows 4 discontinuity sets that fall nearly within the critical zone for wedge failure (**Figure 16**). These intersecting sets include the intersection of F-1 with P-3, P-2, and P-7, as well as the intersection of P-2 and P-7. Intersecting discontinuity sets F-1 and P-2, and P-2 and P-7 fell within the critical zone last year, but no longer appear as critical intersections due to discontinuity orientations shifting with the data collected for this year's report. The development and size of these wedge failures will be controlled by the variability and limited lateral extent of the discontinuities. Based on the current and previous years' data sets, joint set P-7 has weak signatures represented by relatively few measured orientations representing these features (**Figures 5 and 6**). The Northeast Wall 3 was not accessible for direct measurements or observations during our site visits. The stereonet plot for Northeast Wall 3 also indicates a potential planar failure mode along foliation F-1 for this slope orientation (**Figure**

17). This is the same foliation orientation that was believed to contribute to the 1998 slope instability. Additional measurements and observations are needed to assess the potential for large scale planar sliding along foliation F-1 as excavation continues to extend below Northeast Wall 3 in the future (there is currently no mining activity in this area).

The stereonet plot for Northwest Wall shows four discontinuity sets that fall nearly within the critical zone for wedge failure (**Figure 18**). These intersecting sets include the intersection of F-1 with P-3, P-2, and P-7, as well as the intersection of P-2 and P-7. The development and size of these wedge failures will be controlled by the variability and limited lateral extent of the discontinuities. Kinematic analysis performed for the 2023 Annual Report show foliation F-1 and joint set P-2 formed a discontinuity intersection within the critical zone for wedge failure, however this intersection no longer appears in the critical zone due to discontinuity orientations shifting with the data collected for the 2024 Annual Report. The stereonet plot for the Northwest Wall also shows a potential planar failure along foliation F-1 for this slope orientation (**Figure 19**). Additional measurements and observations are needed to assess the potential for large scale planar sliding along foliation F-1 as excavation continues to extend below the Northwest Wall in the future (there is currently no mining activity in this area).

6.4.4 West Walls

For the 2023 Annual Report, we analyzed three west wall orientations based on the locations shown in **Figure 2** and **Table 2**: West Wall 1, West Wall 2, and West Wall 3. The wall locations and orientations correspond to the same wall locations and orientations analyzed in previous 2013-2023 Annual Reports (**Figure 2**). There is currently no mining activity in the west walls area except near West Wall 3 (Station 24-03).

Stereonets for West Wall 1 and 3 are shown in **Figures 20 and 21** on the same plot since they have the same wall orientation. West Wall 1 is located in the Main Pit and West Wall 3 is located in the Southern Expansion Area. The stereonet plot for West Wall 1 and 3 shows one discontinuity intersection that falls within the critical zone for wedge failure, suggesting that wedge failure is kinematically feasible for this slope orientation (**Figure 20**). The intersecting sets that may result in wedge failure are joint sets P-1 and P-6. The development and size of wedge failures will be controlled by the variability and limited lateral extent of the discontinuities. Based on the current and previous years' data sets, P-1, P-2, and P-3 are the dominant joint sets observed in the Southern Expansion Area in the recent years. Joint set P-6 has a relatively weaker signature than other joint sets P-1, P-2, and P-3 relative to the entire data set, but has shown reemergence in the past two Annual Reports. Planar failure is not indicated in the stereonet plot for West Wall 1 and 3 (**Figure 21**).

The stereonet plot for West Wall 2, adjacent to the access road in the Southern Expansion Area, shows four discontinuity intersections that fall nearly within the critical zone for wedge failure, suggesting that wedge failure is kinematically possible for this slope orientation (**Figure 22**). The intersecting sets that fall nearly within the critical zone include foliation F-1 with joint sets P-2 and P-7, joint sets P-2 and P-7, and P-1 and P-6. Kinematic analysis performed for the 2023 Annual Report show the intersections of joint sets P-1 and P-6, and foliation F-1 and joint set P-2 fall within the critical zone. These intersections no longer appear in the critical zone due to discontinuity orientations shifting for the 2024 Annual Report. The development and size of wedge failures will be controlled by the variability and limited lateral extent of the discontinuities. As excavation proceeds in the West Wall 2 area, additional measurements are needed to refine the representative discontinuity orientations of these joint and foliation sets to evaluate their potential contribute to large-scale slope failure modes. Planar failure is not indicated in the stereonet plot for West Wall 2 (**Figure 23**).

6.4.5 Southern Walls

For the 2023 annual Report, we analyzed four southern wall orientations based on the locations shown in **Figure 2** and **Table 2**: Southwest Walls 1 and 2, the South Wall, and the Southeast Wall. The wall locations and orientations for all four southern walls correspond to the same wall locations and orientations analyzed in previous 2013-2023 Annual Reports (**Figure 2**). Current mining activities are mainly in the southern walls area. The current temporary benches are being advanced to approximately EL 6,440 ft (**Figure 2**, Stations 24-01 through 24-03).

The stereonet plots for the Southwest Wall 1, Southwest Wall 2, South Wall, and Southeast Wall each show one discontinuity intersection that falls within the critical zone for wedge failure, suggesting that wedge sliding is kinematically feasible for this slope orientation (**Figures 24, 26, 28, and 30**). The intersecting sets that may result in wedge failure are joint sets P-2 and P-4. This joint intersection did not appear in the critical zone in last year's analyses, but did this year based on shifting discontinuity orientations with the data collected for the 2024 Annual Report. The development and size of wedge failures will be controlled by the variability and limited lateral extent of the discontinuities. As excavation proceeds in the Southern Walls area, additional measurements are needed to refine the representative discontinuity orientations of these joint sets to evaluate their potential contribute to large-scale slope failure modes. In the Southeast Wall, kinematic analysis performed for the 2023 Annual Report showed joint sets P-3 and P-6 formed a discontinuity intersection within the critical zone for wedge failure, however this intersection no longer appears in the critical zone due to discontinuity orientations shifting with the data collected for the 2024 Annual Report. The development and size of wedge failures will be controlled by the variability and limited lateral extent of the discontinuities. Planar failure is not indicated in the stereonet plot for these four walls (**Figures 25, 27, 29, and 31**).

7.0 CONCLUSIONS AND RECOMMENDATIONS

The results of the structural geologic evaluations and kinematic structural discontinuity analyses for the Spec Agg Quarry do not indicate any immediate concerns with respect to large-scale instabilities in the current final quarry wall faces based on our field observations and current rock mass assumptions. The stability of the slopes is enhanced by the absence of significant hydrostatic pressure, by current mining procedures, and by the current reclamation process being implemented by Martin Marietta at the site. While large-scale failures are not anticipated, the slopes will likely continue to experience minor raveling as a result of small-scale failures (planar or wedge failure), particularly in near-vertical temporary bench faces prior to reclamation.

For the 2024 Annual Report, kinematic analyses are based on discontinuity measurements derived principally from data collected from the historic dataset supplemented with data collected during the June 2023 and November 2023 site visits. The 2024 analysis is not intended to supersede results of analyses performed for prior years. Rather, they are meant to compliment previous years' analyses and enable monitoring of possible new trends in the data that could result in previously unconsidered failure modes.

The majority of joint and foliation orientations collected during the 2023 site visits fall within the windows for the representative discontinuity orientations established in previous reports. The kinematic analysis performed for the 2024 Annual Report showed some changes in wedge failure potential based on the shifting of discontinuity orientations from data collected in 2023. The discontinuity intersections that fell in the critical zone for wedge failure in previous reports should continue to be accounted for as mining operations progress.

Based on the 2024 kinematic analyses, wedge failures appear kinematically feasible on all wall orientations based on joint and foliation intersections falling within the critical zone of wedge failure or intersecting nearly within the critical zone. Additionally, the analysis for Northeast Walls 1 and 3 and Northwest Wall shows the potential for planar failure. The walls of the quarry in these areas should continue to be monitored closely as mining continues to assess the potential for the indicated failure modes to contribute to large-scale slope instability of a final mine highwall based on the properties, continuity, regularity, and variation in orientations of the discontinuities involved.

We also recommend that known faults are tracked and observed in new exposures to confirm orientation and character for supplemental stability analysis, as needed. We expect the southern fault identified by Gable (1968) and in previous years site visits (**Figure 3**) may be exposed in other locations as excavation continues in the Southern Expansion Area. As recommended in the previous reports, evaluations will be conducted during future investigations to assess whether or not any of the foliation sets (F-1 through F-3) are caused due to localized faulting that may have resulted in “structural regions” that have created areas in which the varying orientation of the foliation planes occur. These questions will continue to be addressed as more data is collected.

Localized raveling, especially along the south walls, is likely to continue. Continuation of the safety-minded policies already in place, which limit the height of the exposed highwalls as well as the reclamation of exposed highwalls as soon as possible following blasting and rock haulage, will aid in minimizing the potential for instabilities to occur. The quarry walls appear to be relatively dry and noticeably absent of any major seepage. However, any major changes in ground water seepage or hydrostatic conditions observed either from the quarry walls or during production drilling activities should be characterized and reported to Schnabel.

Lastly, the impounded water in the Main Pit creates no immediate concerns, but a rapid drawn-down of the water level could create a potential for slope instabilities. Any plans to pump the water out of the Main Pit causing rapid drawdown of water of more than half of the current water level should be relayed to Schnabel for an evaluation of the effects on the slopes’ stability.

8.0 REFERENCES

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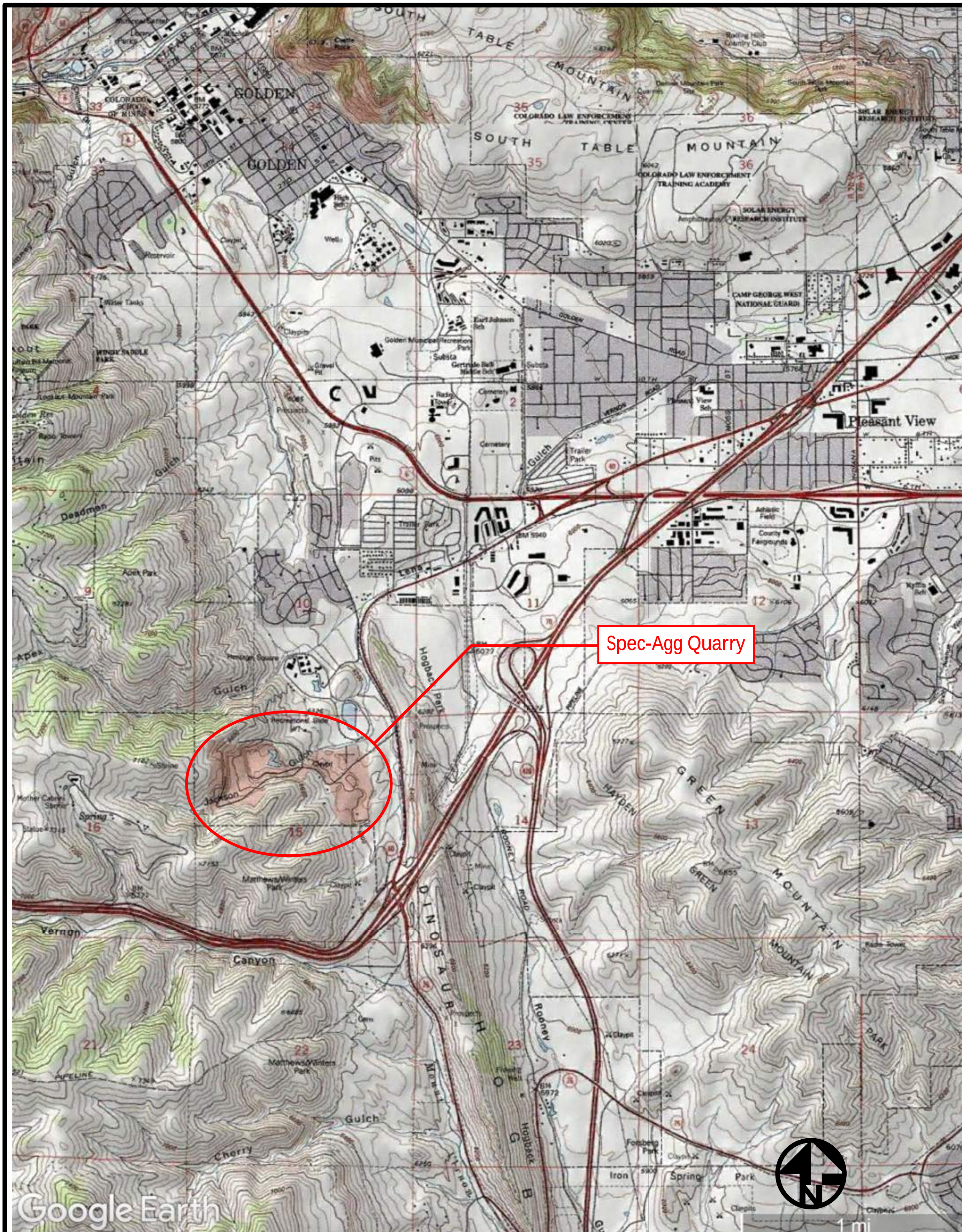
FIGURES



O:\DENVER\2023\23180001 - SPEC AGG 2024\03_SE_PRODUCTS\08-CAD\FIGURE_2_MAPPING LOCATIONS.DWG

Schnabel ENGINEERING	2024 SPEC-AGG QUARRY STRUCTURAL GEOLOGY EVALUATION MARTIN MARIETTA GOLDEN, COLORADO	SITE VICINITY MAP Figure 1

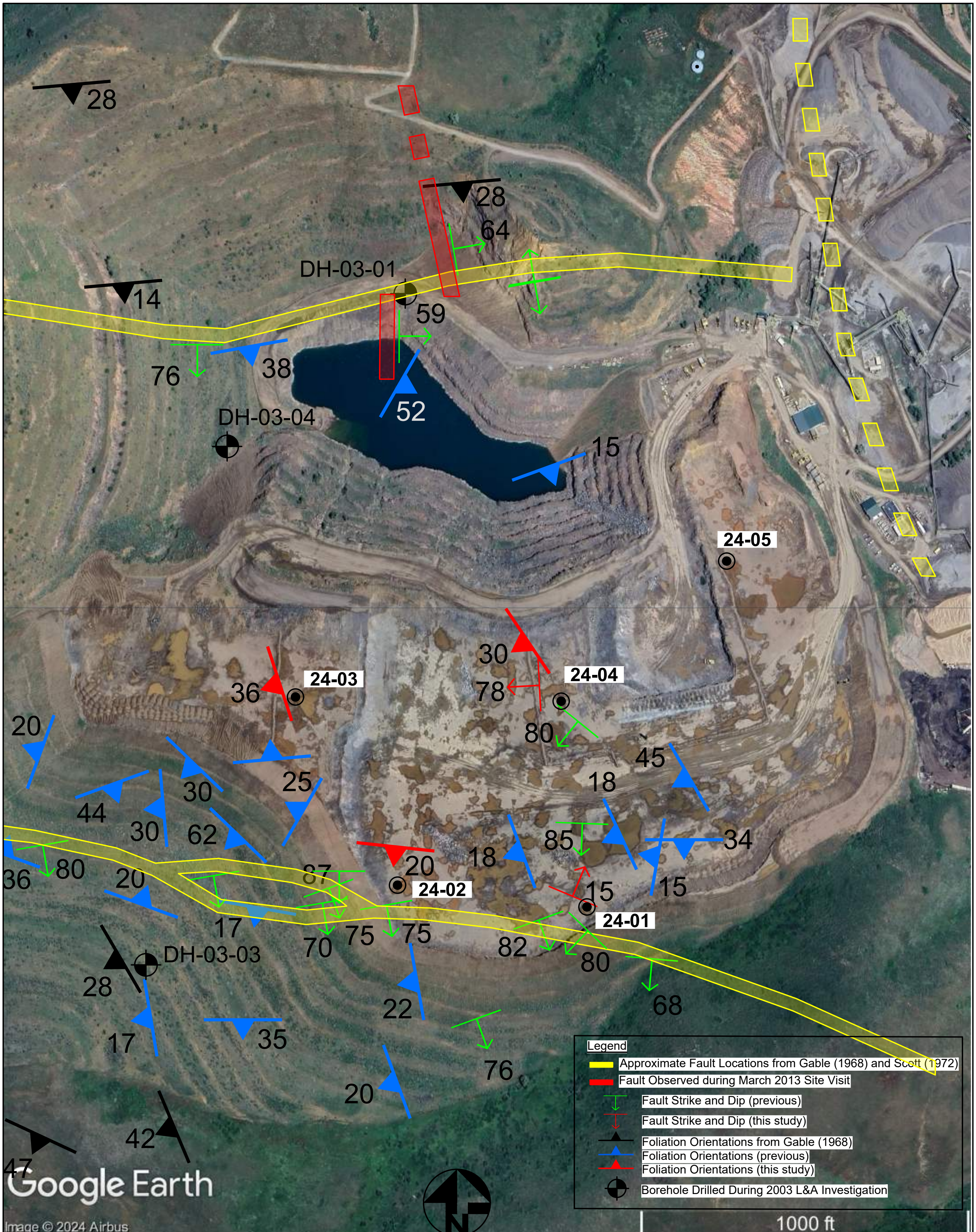
O:\DENVER\2023\23180001 - SPEC AGG 2024\03_SE_PRODUCTS\08-CAD\FIGURE_2_MAPPING LOCATIONS.DWG

Schnabel ENGINEERING

2024 SPEC-AGG QUARRY STRUCTURAL GEOLOGY EVALUATION
MARTIN MARIETTA
GOLDEN, COLORADO

MINING PLAN AND 2023 MAPPING LOCATIONS

Figure 2



Schnabel ENGINEERING	2024 SPEC-AGG QUARRY STRUCTURAL GEOLOGY EVALUATION MARTIN MARIETTA GOLDEN, COLORADO	FAULT AND FOLIATION MAP Figure 3

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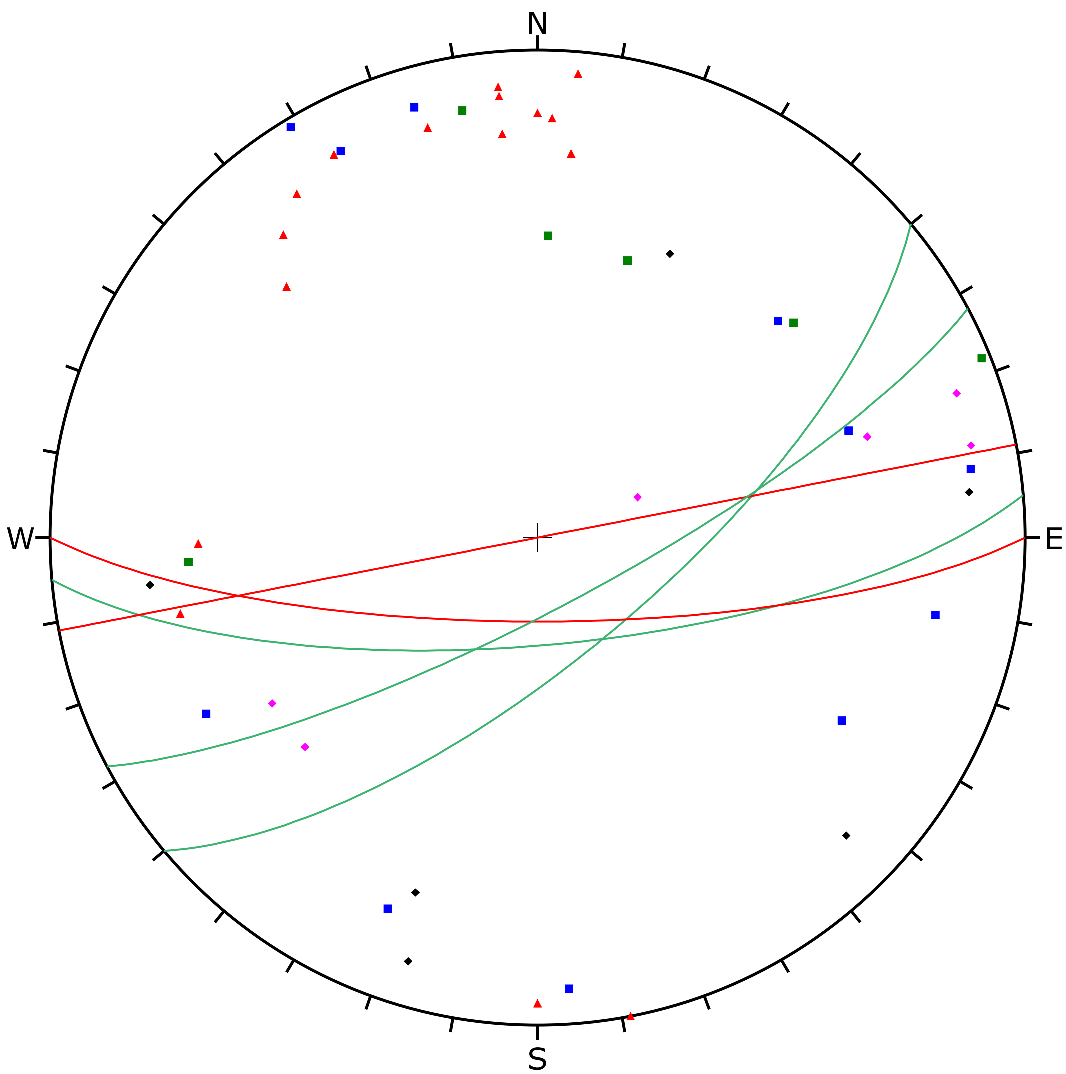
Figure 4



Symbol	POINT ID	Quantity
◆	2022 Fault Measurement	6
■	2022 Shear Zone Measurement	6
◆	2023 Fault Measurement	6
■	2023 Shear Measurement	11
▲	Previous Fault Measurement	16

	Color	Dip	Dip Direction	Label
User Planes				
1		70	140	South Gable
2		72	175	South Gable
4		90	349	North Gable
7		76	180	North Gable
8		78	152	South Gable

Plot Mode	Pole Vectors
Vector Count	45 (45 Entries)
Hemisphere	Lower
Projection	Equal Area

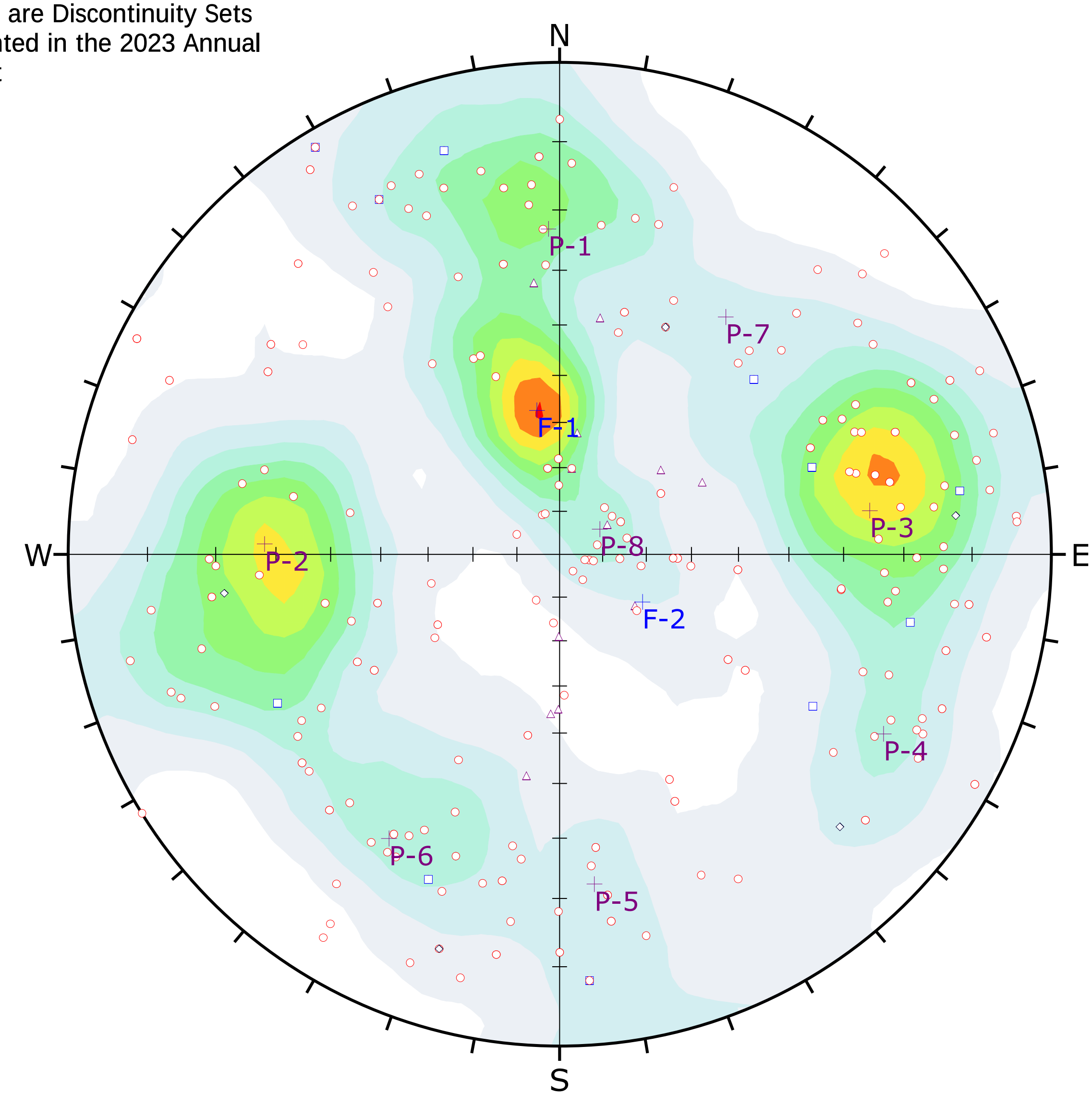
Schnabel ENGINEERING

DIPS 8.025

Project	2024 Spec Agg Quarry Structural Geology Evaluation
Analysis Description	Fault and Shear Zone Orientations
Drawn By	JDS
Client	Martin Marietta
Date	1/22/2024
File Name	Faults 1997-2023.dips8

Figure 5

Note: User Plane Pole Vectors shown are Discontinuity Sets presented in the 2023 Annual Report



Symbol	FEATURE TYPE	Quantity
◇	2023 Fault	6
△	2023 Foliation	12
○	2023 Joint	249
□	2023 Shear	11
	Others	4246

Color	Density Concentrations
	0.00 - 0.40
	0.40 - 0.80
	0.80 - 1.20
	1.20 - 1.60
	1.60 - 2.00
	2.00 - 2.40
	2.40 - 2.80
	2.80 - 3.20
	3.20 - 3.60
	3.60 - 4.00
Contour Data	Pole Vectors
Maximum Density	3.66%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
		User Planes		
3		67	178	P-1
4		62	92	P-2
5		65	262	P-3
6		74	299	P-4
7		68	354	P-5
8		68	31	P-6
9		61	215	P-7
10		11	238	P-8
12		33	171	F-1
11		22	300	F-2

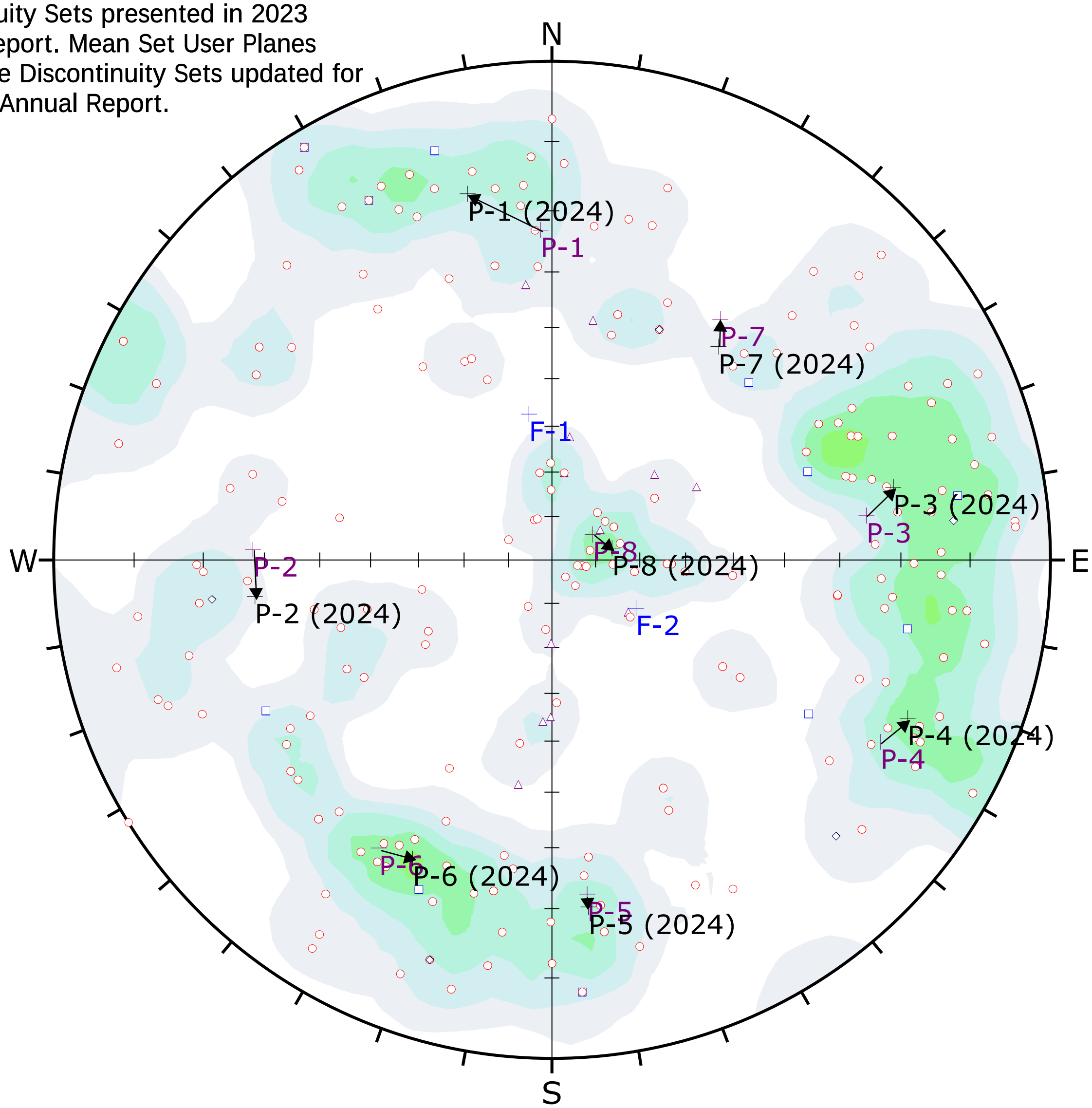
Plot Mode	Pole Vectors
Vector Count	4524 (4524 Entries)
Hemisphere	Lower
Projection	Equal Angle

Schnabel ENGINEERING

DIPS 8.025

Project	2024 Spec Agg Quarry Structural Geology Evaluation		
Analysis Description	Contour Plot of 1997-2023 Data with 2023 Data Pole Vectors		
Drawn By	JDS	*Client*	Martin Marietta
Date	1/22/2024	*File Name*	ALL DATA_Report2024_GlobalAdjustment_JDS.dips8

Note: User Plane Pole Vectors Shown are Discontinuity Sets presented in 2023 Annual Report. Mean Set User Planes Shown are Discontinuity Sets updated for the 2024 Annual Report.



Symbol	FEATURE TYPE	Quantity
◇	2023 Fault	6
△	2023 Foliation	12
○	2023 Joint	249
□	2023 Shear	11

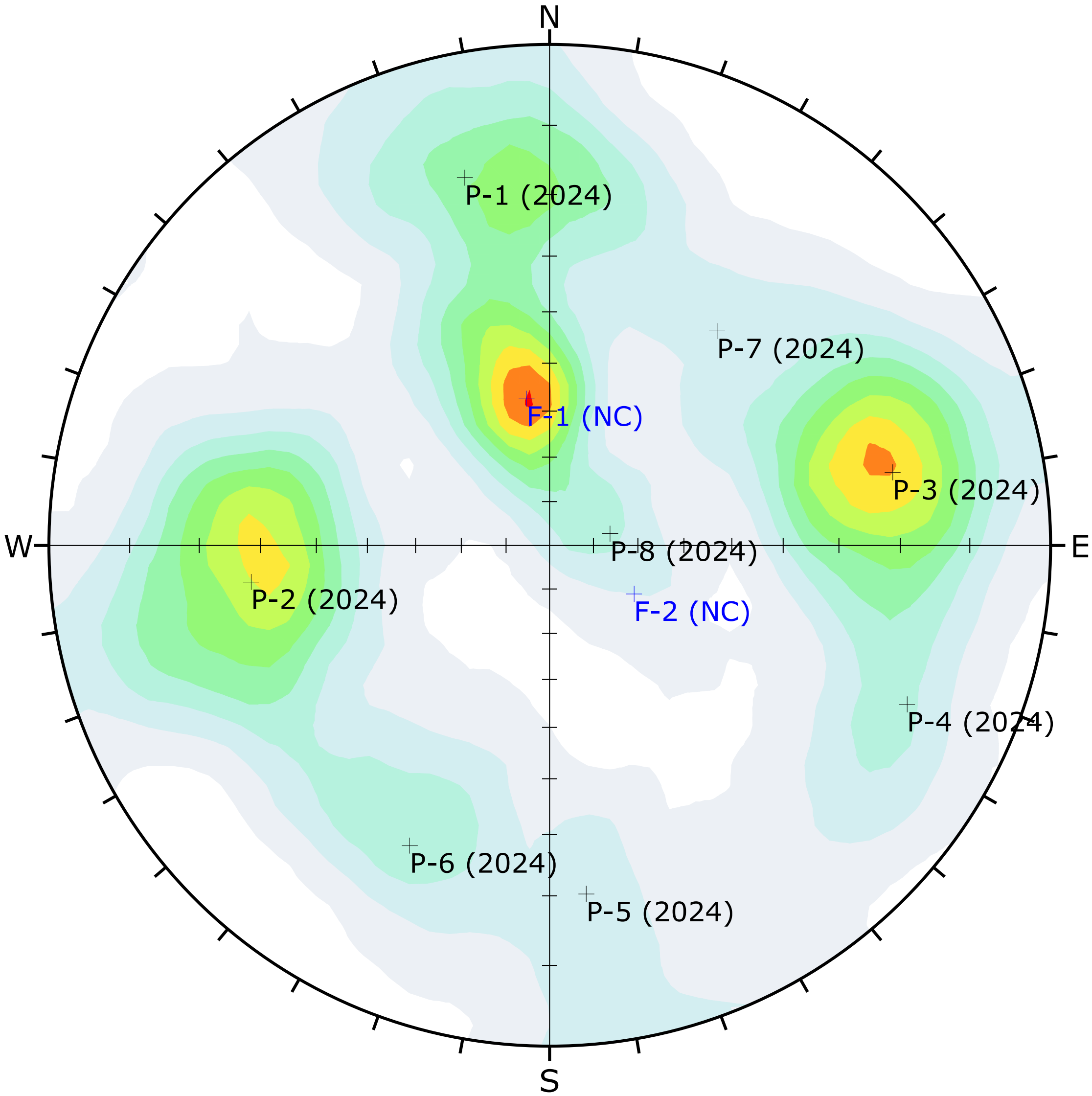
Color	Density Concentrations
	0.00 - 0.70
	0.70 - 1.40
	1.40 - 2.10
	2.10 - 2.80
	2.80 - 3.50
	3.50 - 4.20
	4.20 - 4.90
	4.90 - 5.60
	5.60 - 6.30
	6.30 <
Contour Data	Pole Vectors
Maximum Density	3.99%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
3		67	178	P-1
4		62	92	P-2
5		65	262	P-3
6		74	299	P-4
7		68	354	P-5
8		68	31	P-6
9		61	215	P-7
10		11	238	P-8
11		22	300	F-2
12		33	171	F-1
Mean Set Planes				
1m		74	167	P-1 (2024)
2m		62	83	P-2 (2024)
3m		70	258	P-3 (2024)
4m		76	294	P-4 (2024)
5m		70	354	P-5 (2024)
6m		67	25	P-6 (2024)
7m		57	218	P-7 (2024)
8m		14	259	P-8 (2024)
9m		N/A	N/A	F-1 (NC)
10m		N/A	N/A	F-2 (NC)

Plot Mode	Pole Vectors

Schnabel ENGINEERING	*Project* 2024 Spec Agg Quarry Structural Geology Evaluation		
	Analysis Description Contour Plot of 2023 Data with 2023 Data Pole Vectors		
	Drawn By JDS	*Client* Martin Marietta	
DIPS 8.025	*Date* 1/22/2024	*File Name* ALL DATA_Report2024_GlobalAdjustment_JDS.dips8	

Figure 7



Color	Density Concentrations
	0.00 - 0.40
	0.40 - 0.80
	0.80 - 1.20
	1.20 - 1.60
	1.60 - 2.00
	2.00 - 2.40
	2.40 - 2.80
	2.80 - 3.20
	3.20 - 3.60
	3.60 - 4.00
Contour Data	Pole Vectors
Maximum Density	3.66%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
3		74	167	P-1 (2024)
4		62	83	P-2 (2024)
5		70	258	P-3 (2024)
6		76	294	P-4 (2024)
7		70	354	P-5 (2024)
8		67	25	P-6 (2024)
9		57	218	P-7 (2024)
10		14	259	P-8 (2024)
12		33	171	F-1 (NC)
11		22	300	F-2 (NC)

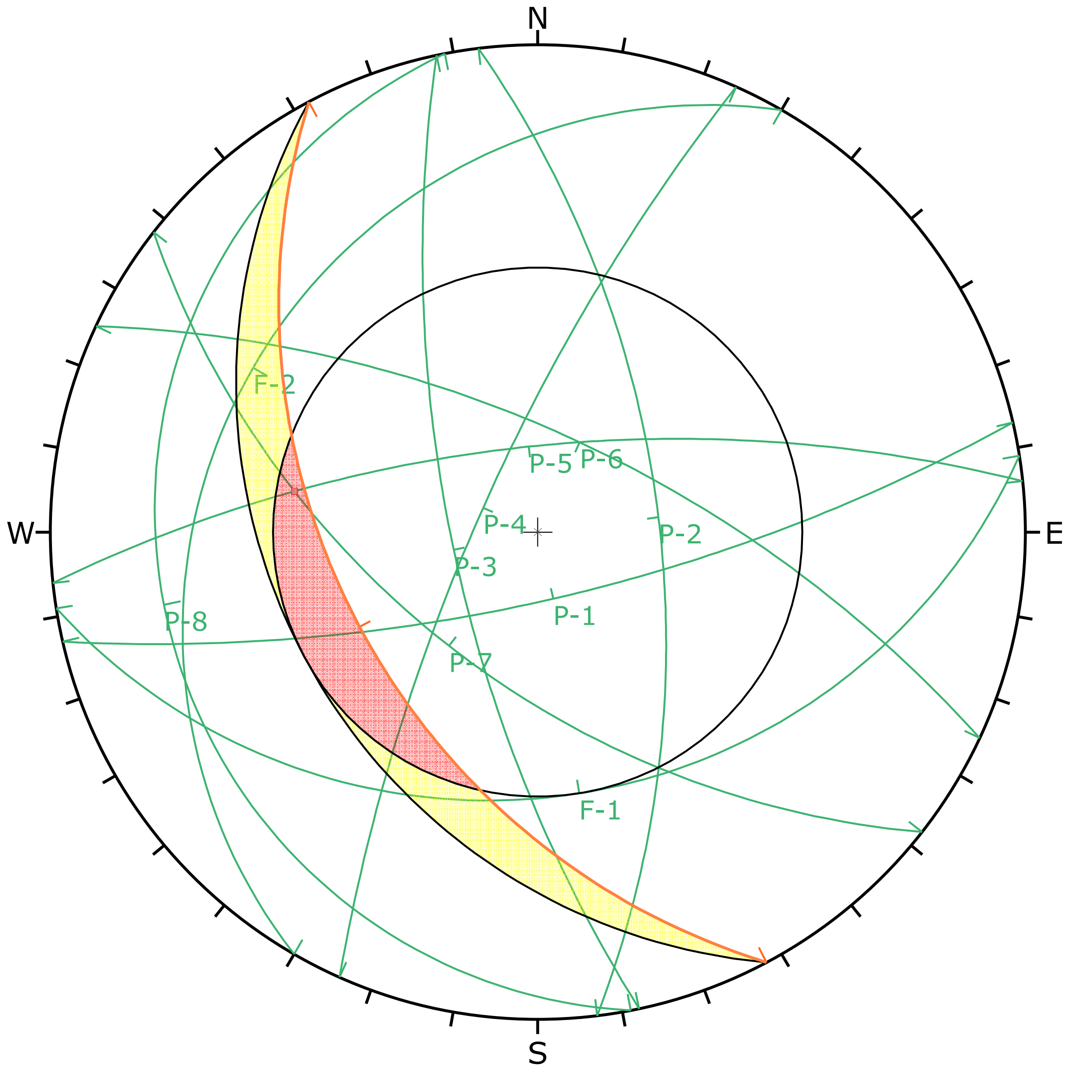
Plot Mode	Pole Vectors
Vector Count	4524 (4524 Entries)
Hemisphere	Lower
Projection	Equal Angle

Schnabel ENGINEERING

Project	2024 Spec Agg Quarry Structural Geology Evaluation		
Analysis Description	Contour Plot of 1997-2023 Data with 2024 Discontinuity Orientations		
Drawn By	JDS	*Client*	Martin Marietta
Date	1/23/2024	*File Name*	ALL DATA_Report2024_GlobalAdjustment_JDS_2024update.dips8

DIPS 8.025

Figure 8



Symbol	Feature
▪	Critical Intersection

Kinematic Analysis	Wedge Sliding		
Slope Dip	45		
Slope Dip Direction	242		
Friction Angle	33°		
	Critical	**Total**	**%**
Wedge Sliding	1	45	2.22%

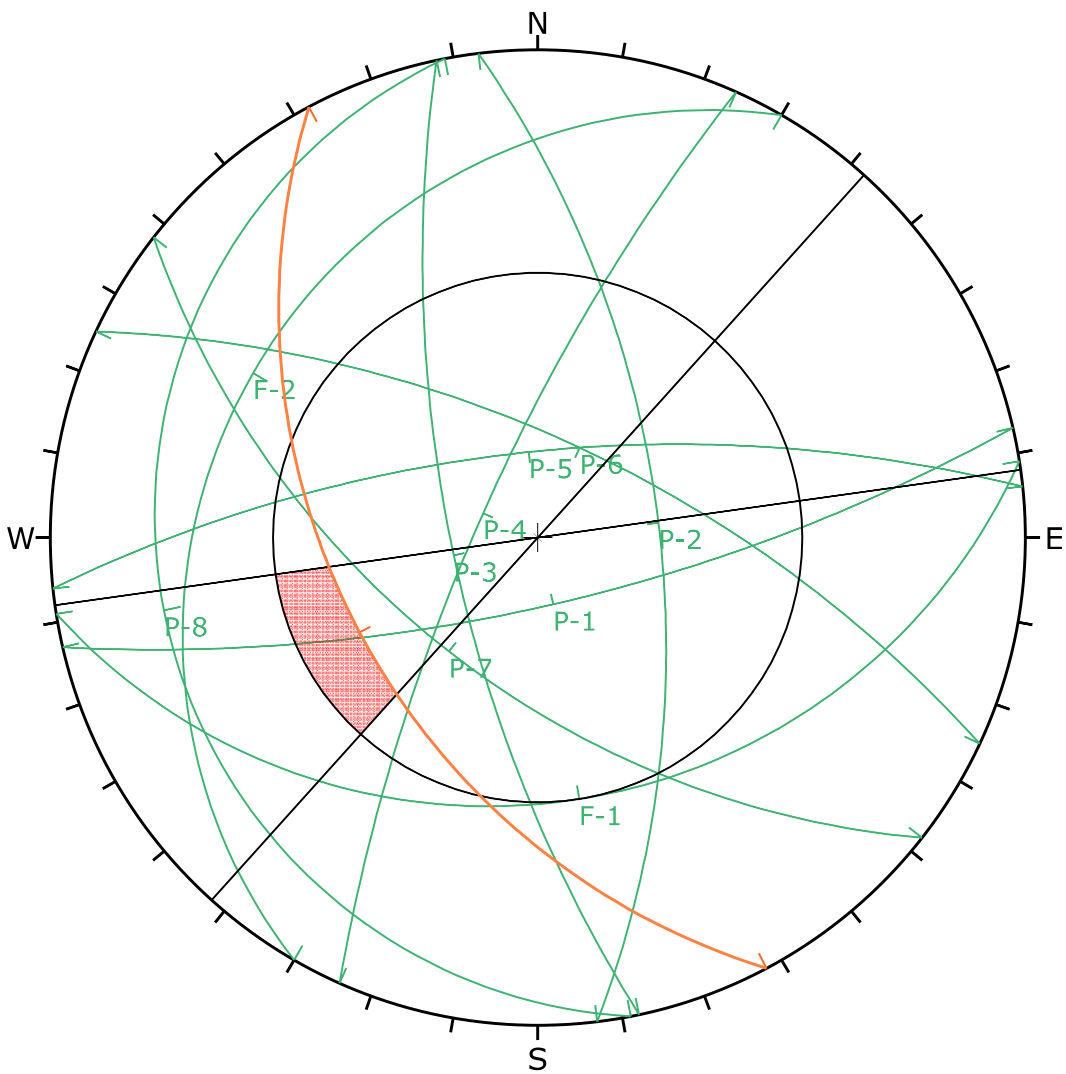
	Color	Dip	Dip Direction	Label
User Planes				
13		45	242	East Wall 1
12		33	171	F-1
11		22	300	F-2
3		74	167	P-1
4		62	83	P-2
5		70	258	P-3
6		76	294	P-4
7		70	354	P-5
8		67	25	P-6
9		57	218	P-7
10		14	259	P-8

Project	2024 Spec Agg Quarry Structural Geology Evaluation
Analysis Description	Kinematic Analysis - East Wall 1
Drawn By	JDS
Client	Martin Marietta
Date	1/23/2024
File Name	ALLDATA_Report2024_GlobAdjust_KA_EastWall1.dips8

Schnabel ENGINEERING

DIPS 8.025

Figure 9

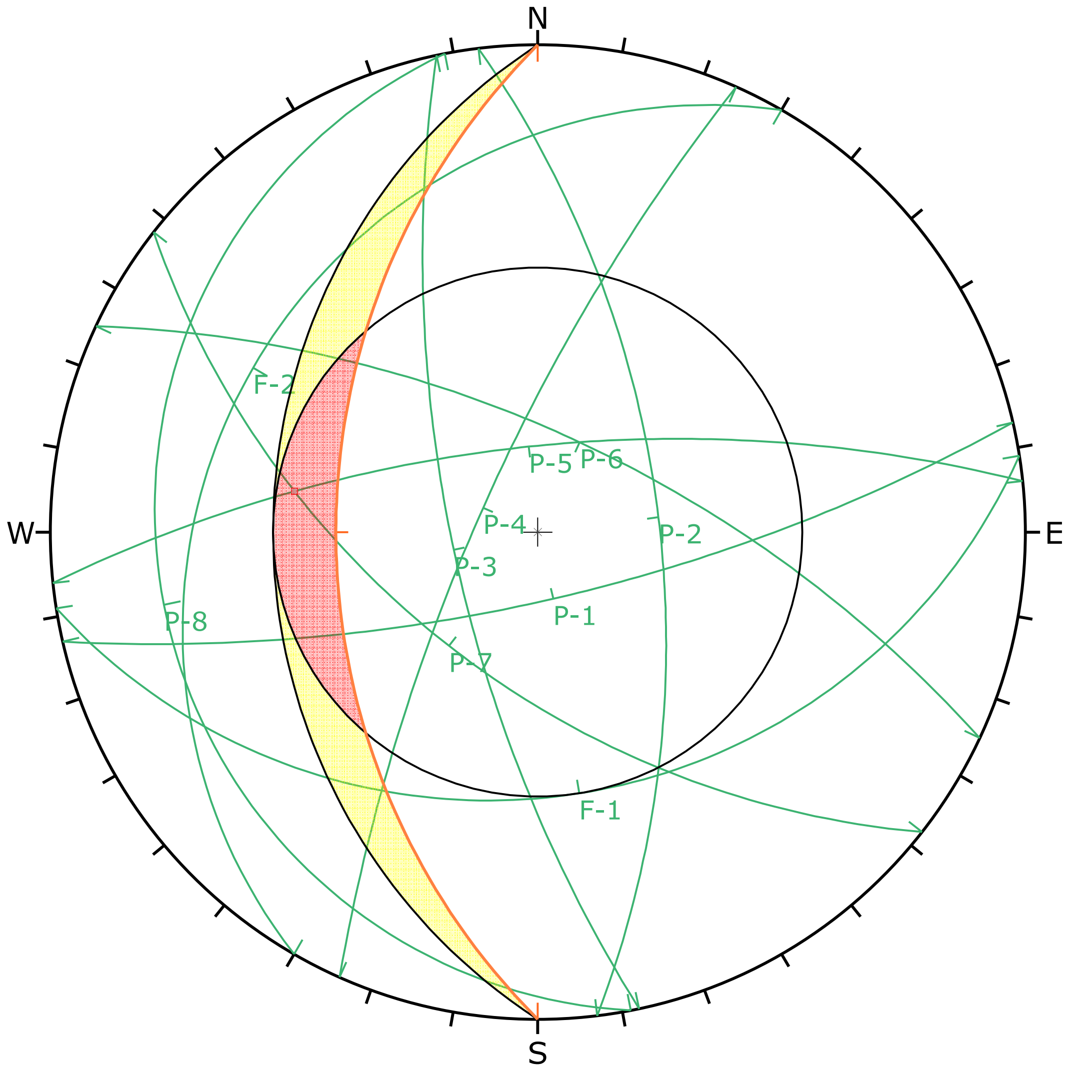


Kinematic Analysis	Planar Sliding			
Slope Dip	45			
Slope Dip Direction	242			
Friction Angle	33°			
Lateral Limits	20°			
		Critical	**Total**	**%**
Planar Sliding (All)		0	10	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
13		45	242	East Wall 1
12		33	171	F-1
11		22	300	F-2
3		74	167	P-1
4		62	83	P-2
5		70	258	P-3
6		76	294	P-4
7		70	354	P-5
8		67	25	P-6
9		57	218	P-7
10		14	259	P-8

Schnabel ENGINEERING	*Project*	2024 Spec Agg Quarry Structural Geology Evaluation	
	Analysis Description	Kinematic Analysis - East Wall 1	
	Drawn By JDS	*Client* Martin Marietta	
DIPS 8.025	*Date* 1/23/2024	*File Name* ALLDATA_Report2024_GlobAdjust_KA_EastWall1.dips8	

Figure 10



Symbol	Feature
▫	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	45
Slope Dip Direction	270
Friction Angle	33°

	Critical	Total	%
Wedge Sliding	1	45	2.22%

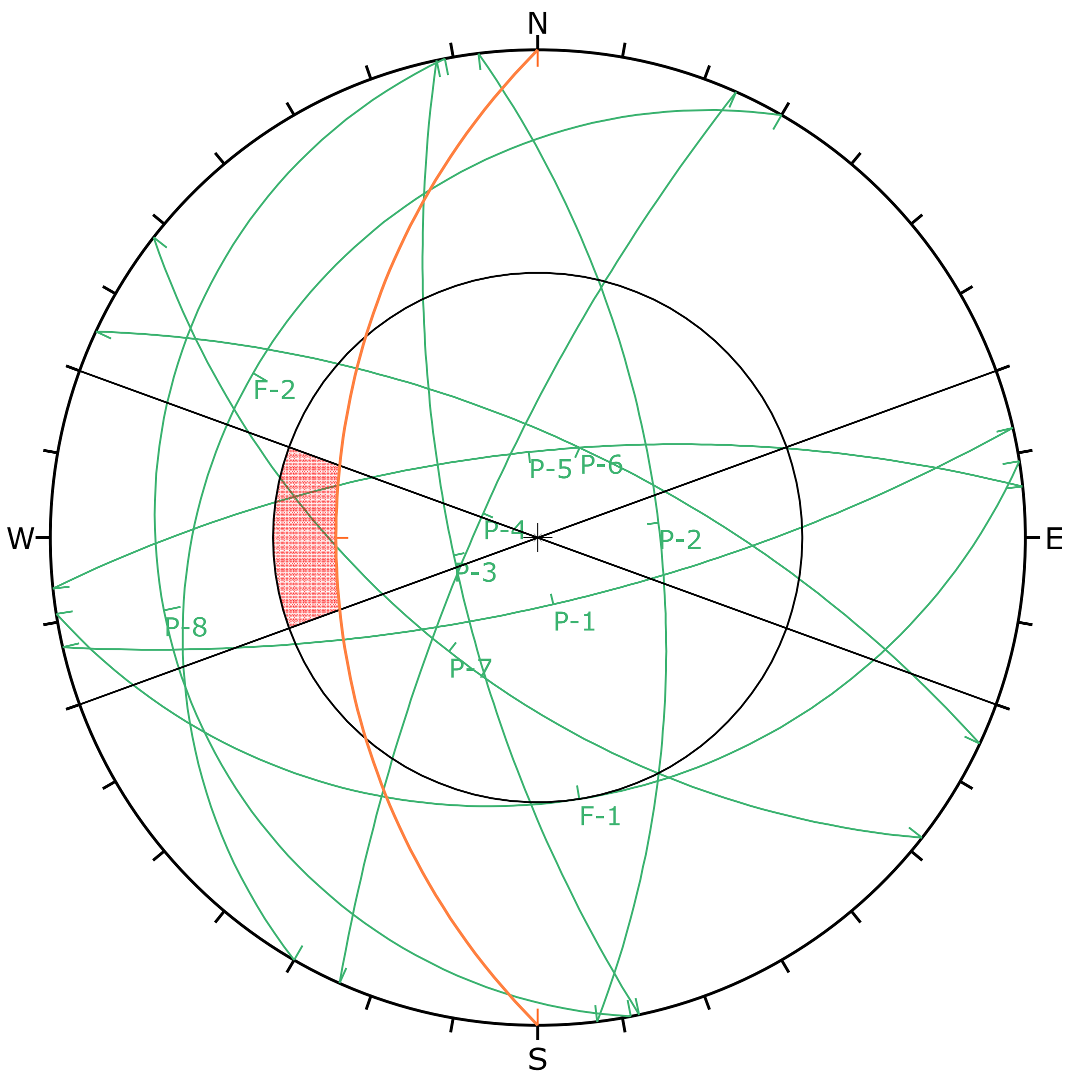
	Color	Dip	Dip Direction	Label
User Planes				
13		45	270	East Wall 2
12		33	171	F-1
11		22	300	F-2
3		74	167	P-1
4		62	83	P-2
5		70	258	P-3
6		76	294	P-4
7		70	354	P-5
8		67	25	P-6
9		57	218	P-7
10		14	259	P-8

Schnabel ENGINEERING

DIPS 8.025

Project	2024 Spec Agg Quarry Structural Geology Evaluation
Analysis Description	Kinematic Analysis - East Wall 2
Drawn By	JDS
Client	Martin Marietta
Date	1/23/2024
File Name	ALLDATA_Report2024_GlobAdjust_KA_EastWall2.dips8

Figure 11



Kinematic Analysis	Planar Sliding
Slope Dip	45
Slope Dip Direction	270
Friction Angle	33°
Lateral Limits	20°

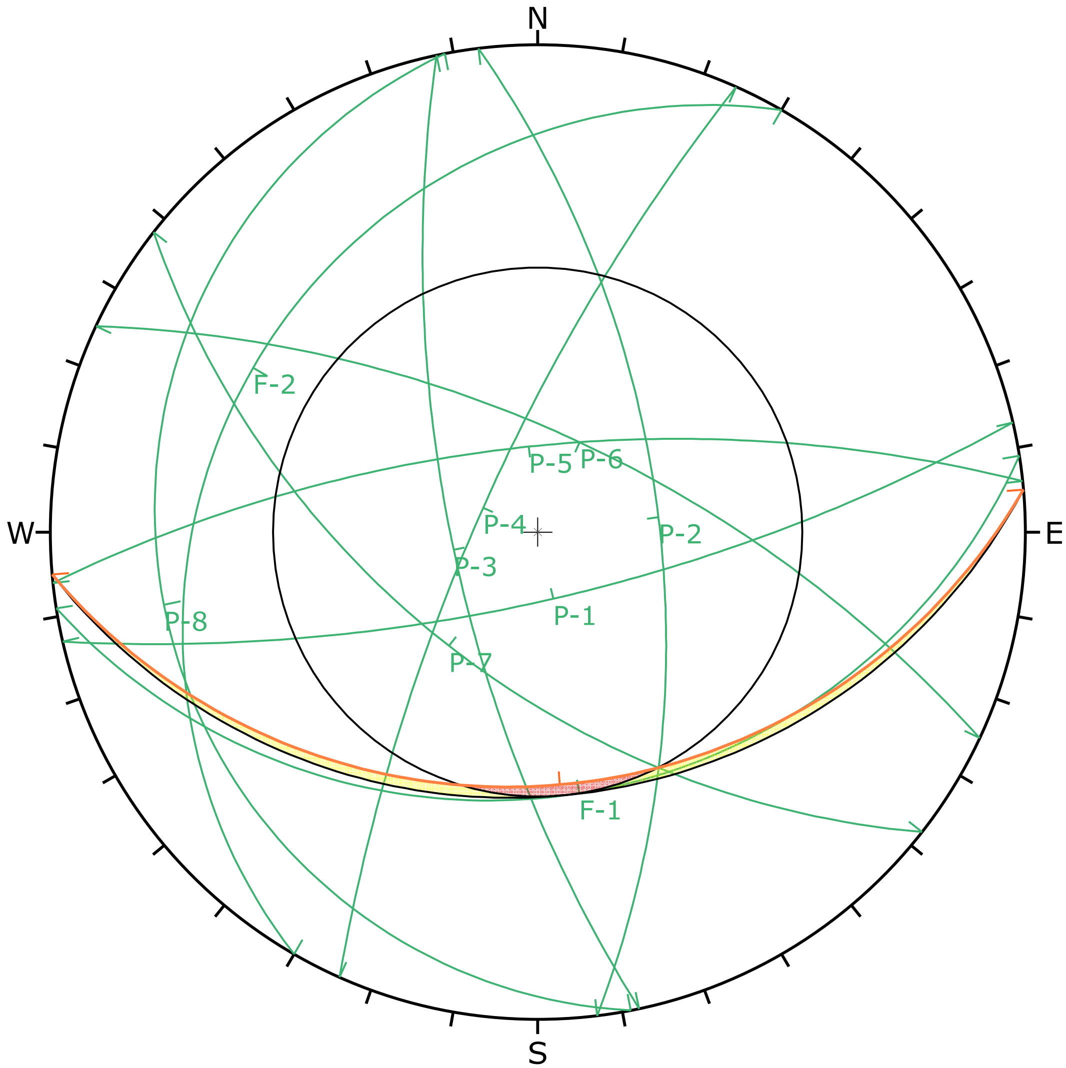
	Critical	**Total**	**%**
Planar Sliding (All)	0	10	0.00%

	Color	**Dip**	**Dip Direction**	**Label**
User Planes				
13	(orange)	45	270	East Wall 2
12	(green)	33	171	F-1
11	(green)	22	300	F-2
3	(green)	74	167	P-1
4	(green)	62	83	P-2
5	(green)	70	258	P-3
6	(green)	76	294	P-4
7	(green)	70	354	P-5
8	(green)	67	25	P-6
9	(green)	57	218	P-7
10	(green)	14	259	P-8

Project	2024 Spec Agg Quarry Structural Geology Evaluation
Analysis Description	Kinematic Analysis - East Wall 2
Drawn By	JDS
Client	Martin Marietta
Date	1/23/2024
File Name	ALLDATA_Report2024_GlobAdjust_KA_EastWall2.dips8

Schnabel ENGINEERING

DIPS 8.025



Symbol	Feature
▫	Critical Intersection

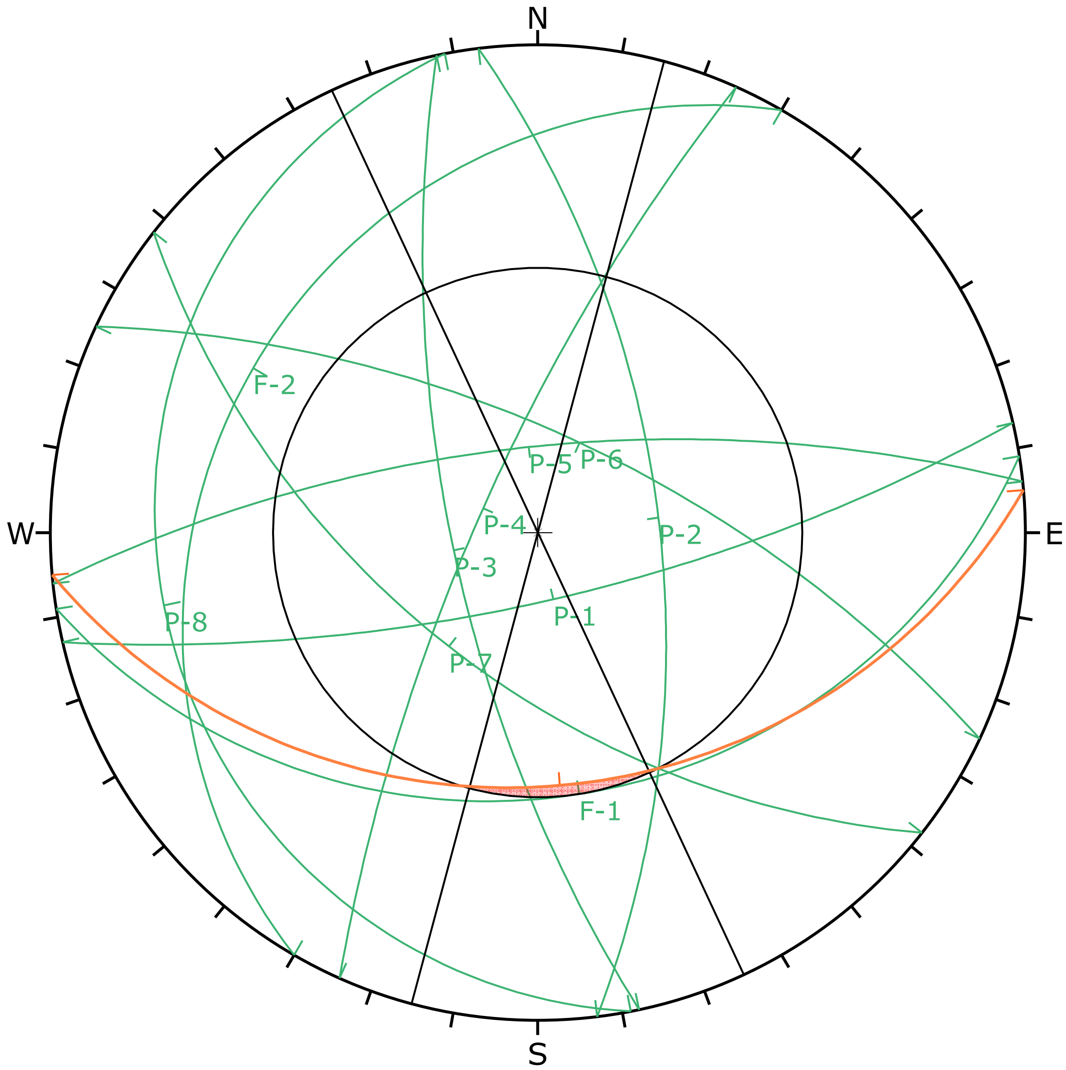
Kinematic Analysis	Wedge Sliding
Slope Dip	35
Slope Dip Direction	175
Friction Angle	33°

	Critical	Total	%
Wedge Sliding	0	45	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
13		35	175	NE Wall 1
12		33	171	F-1
11		22	300	F-2
3		74	167	P-1
4		62	83	P-2
5		70	258	P-3
6		76	294	P-4
7		70	354	P-5
8		67	25	P-6
9		57	218	P-7
10		14	259	P-8

Schnabel ENGINEERING	*Project* 2024 Spec Agg Quarry Structural Geology Evaluation		
	Analysis Description Kinematic Analysis - Northeast Wall 1		
	Drawn By JDS	*Client* Martin Marietta	
DIPS 8.025	*Date* 1/23/2024	*File Name* ALLDATA_Report2024_GlobAdjust_KA_Northeast Wall 1.dips8	

Figure 13



Kinematic Analysis	Planar Sliding
Slope Dip	35
Slope Dip Direction	175
Friction Angle	33°
Lateral Limits	20°

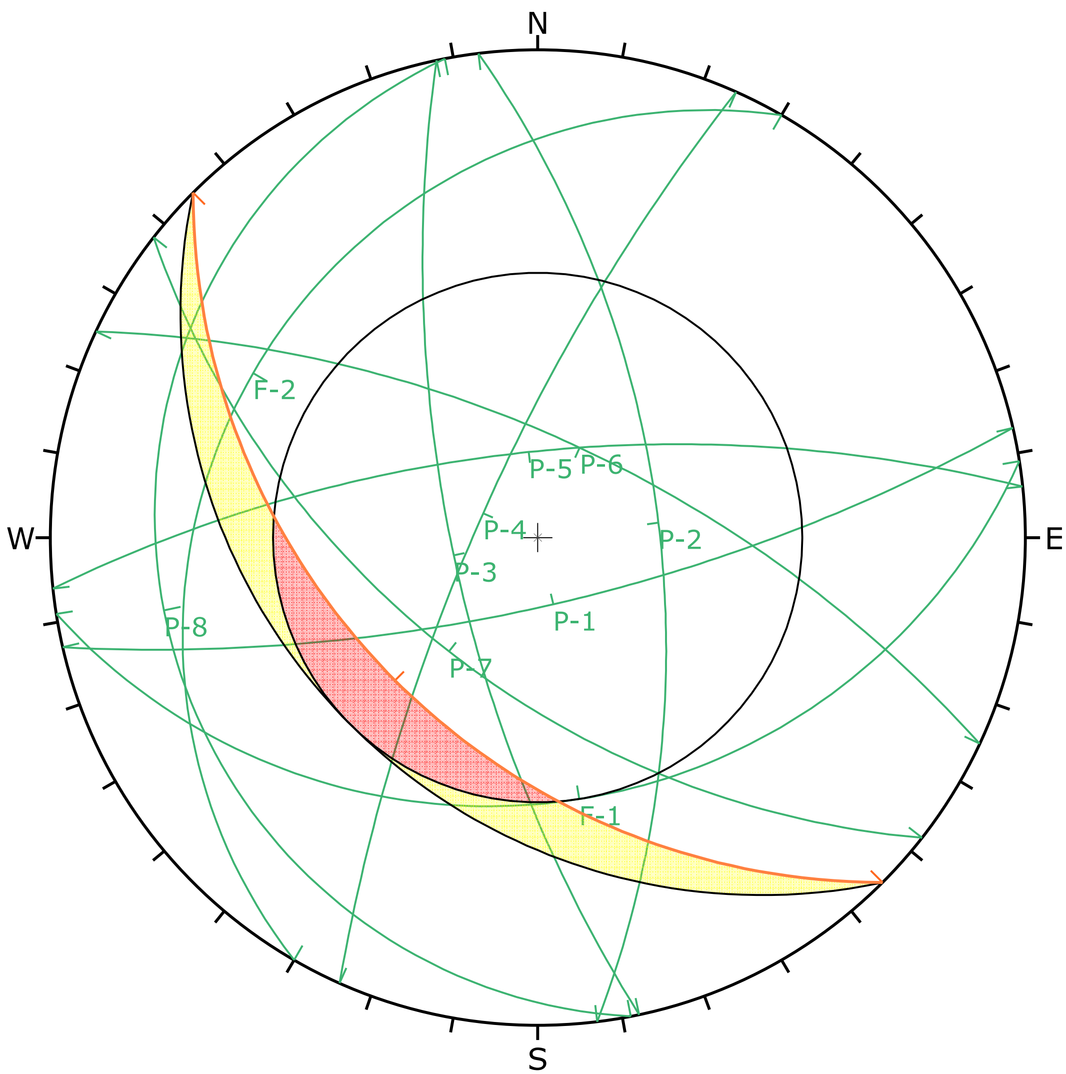
	Critical	Total	%
Planar Sliding (All)	1	10	10.00%

	Color	Dip	Dip Direction	Label
User Planes				
13	orange	35	175	NE Wall 1
12	green	33	171	F-1
11	green	22	300	F-2
3	green	74	167	P-1
4	green	62	83	P-2
5	green	70	258	P-3
6	green	76	294	P-4
7	green	70	354	P-5
8	green	67	25	P-6
9	green	57	218	P-7
10	green	14	259	P-8

Project	2024 Spec Agg Quarry Structural Geology Evaluation
Analysis Description	Kinematic Analysis - Northeast Wall 1
Drawn By JDS	*Client* Martin Marietta
Date 1/23/2024	*File Name* ALLDATA_Report2024_GlobAdjust_KA_Northeast Wall 1.dips8

Schnabel ENGINEERING

DIPS 8.025



Symbol	Feature
▫	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	45
Slope Dip Direction	225
Friction Angle	33°

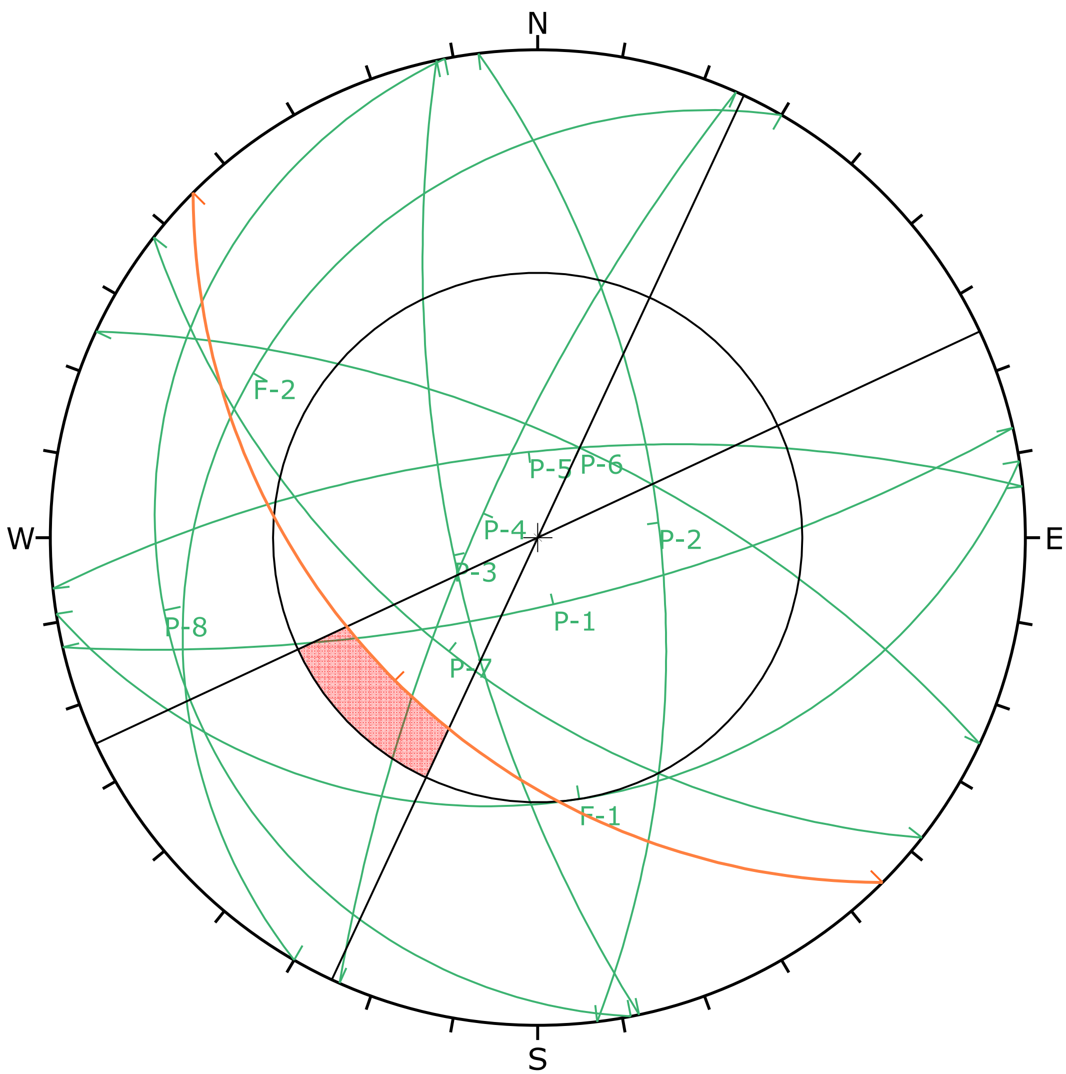
	Critical	Total	%
Wedge Sliding	0	45	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
13		45	225	NE Wall 2
12		33	171	F-1
11		22	300	F-2
3		74	167	P-1
4		62	83	P-2
5		70	258	P-3
6		76	294	P-4
7		70	354	P-5
8		67	25	P-6
9		57	218	P-7
10		14	259	P-8

Schnabel ENGINEERING

DIPS 8.025

Project	2024 Spec Agg Quarry Structural Geology Evaluation
Analysis Description	Kinematic Analysis - Northeast Wall 2
Drawn By	JDS
Client	Martin Marietta
Date	1/23/2024
File Name	ALLDATA_Report2024_GlobAdjust_KA_Northeast Wall 2.dips8



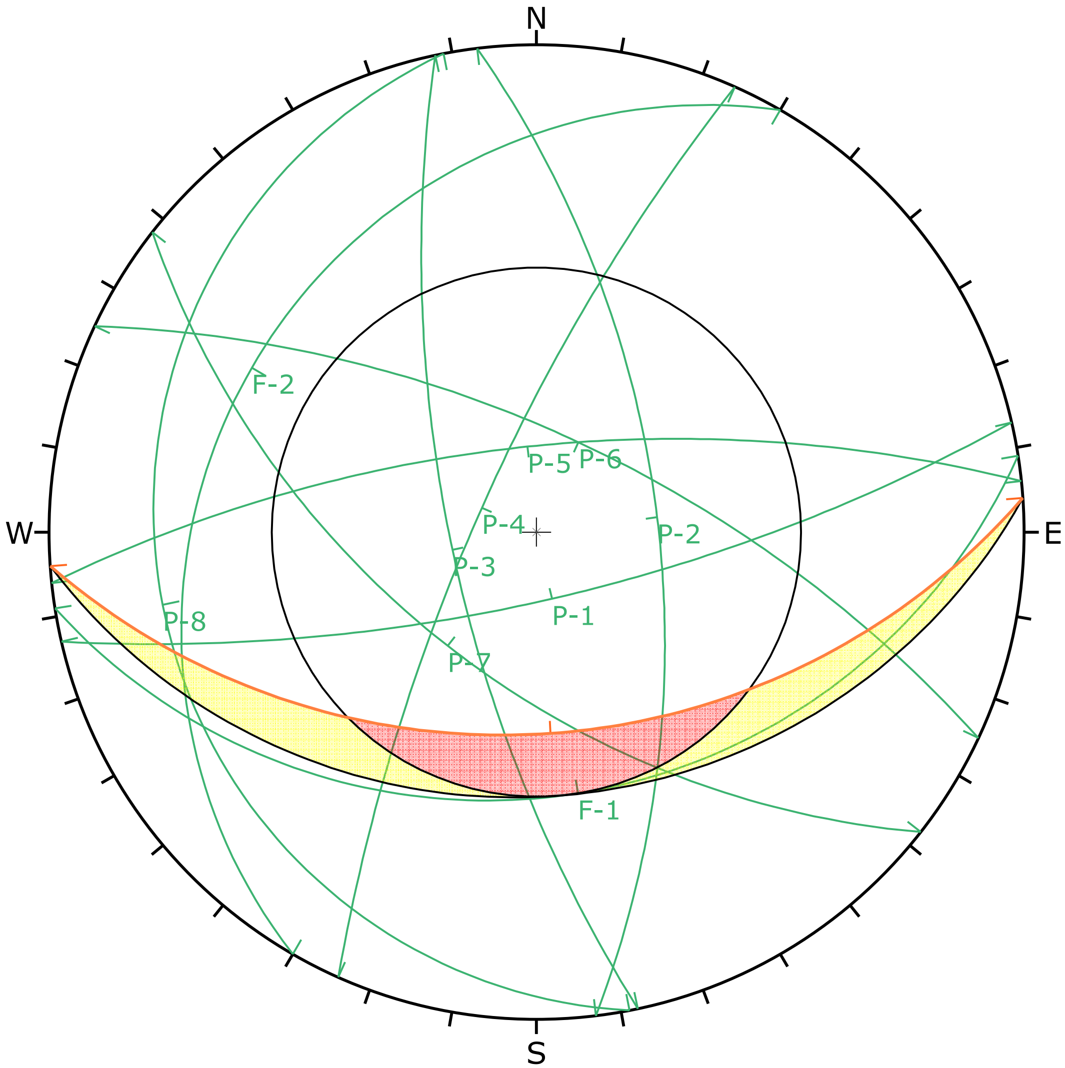
Kinematic Analysis	Planar Sliding			
Slope Dip	45			
Slope Dip Direction	225			
Friction Angle	33°			
Lateral Limits	20°			
		Critical	**Total**	**%**
Planar Sliding (All)		0	10	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
13		45	225	NE Wall 2
12		33	171	F-1
11		22	300	F-2
3		74	167	P-1
4		62	83	P-2
5		70	258	P-3
6		76	294	P-4
7		70	354	P-5
8		67	25	P-6
9		57	218	P-7
10		14	259	P-8

Schnabel ENGINEERING

DIPS 8.025

Project	2024 Spec Agg Quarry Structural Geology Evaluation
Analysis Description	Kinematic Analysis - Northeast Wall 2
Drawn By	JDS
Client	Martin Marietta
Date	1/23/2024
File Name	ALLDATA_Report2024_GlobAdjust_KA_Northeast Wall 2.dips8



Symbol	Feature
▫	Critical Intersection

Kinematic Analysis	Wedge Sliding		
Slope Dip	45		
Slope Dip Direction	176		
Friction Angle	33°		
	Critical	**Total**	**%**
Wedge Sliding	0	45	0.00%

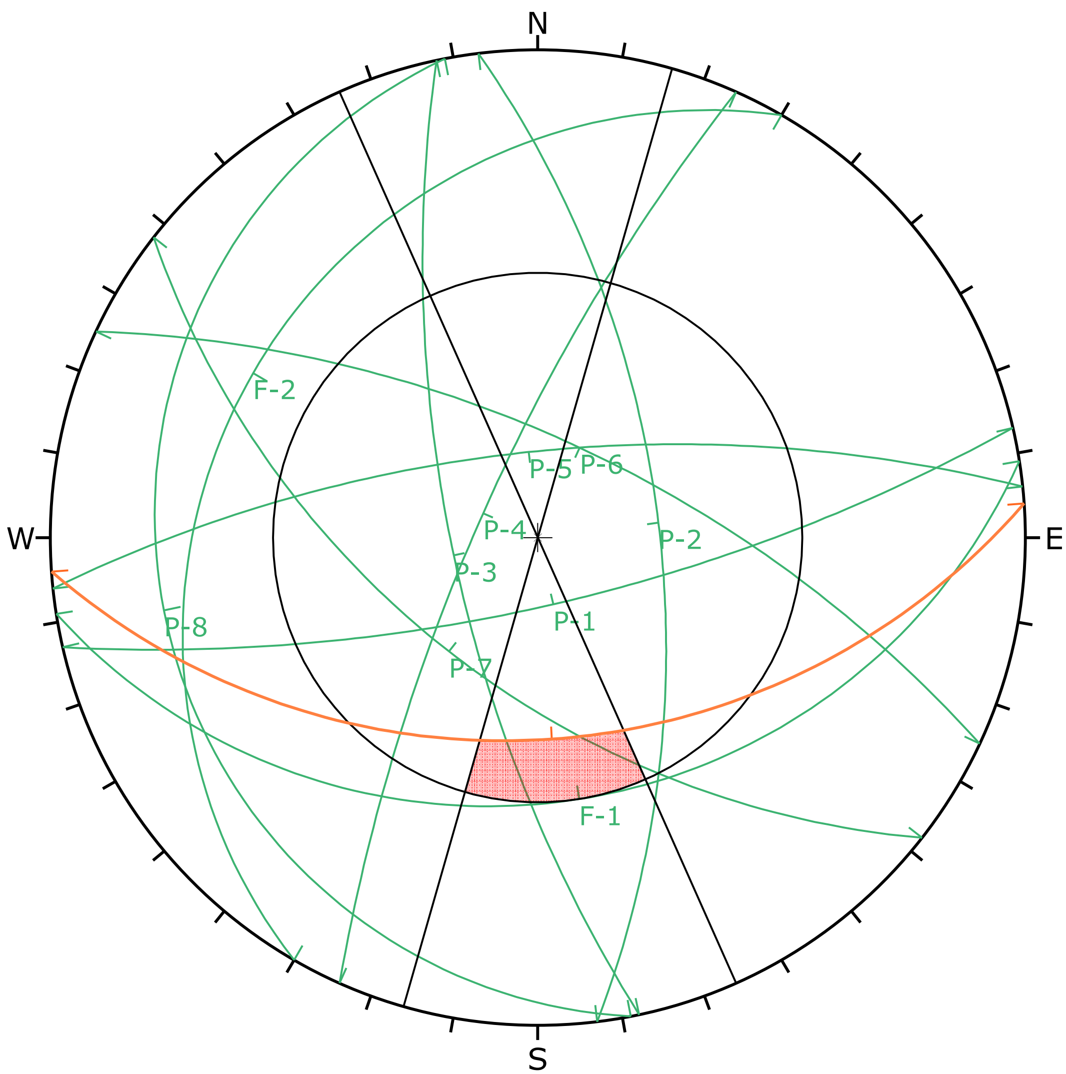
	Color	Dip	Dip Direction	Label
		User Planes		
13	Orange	45	176	NE Wall 3
12	Green	33	171	F-1
11	Green	22	300	F-2
3	Green	74	167	P-1
4	Green	62	83	P-2
5	Green	70	258	P-3
6	Green	76	294	P-4
7	Green	70	354	P-5
8	Green	67	25	P-6
9	Green	57	218	P-7
10	Green	14	259	P-8

Schnabel ENGINEERING

DIPS 8.025

Project	2024 Spec Agg Quarry Structural Geology Evaluation
Analysis Description	Kinematic Analysis - Northeast Wall 3
Drawn By	JDS
Client	Martin Marietta
Date	1/23/2024
File Name	ALLDATA_Report2024_GlobAdjust_KA_Northeast Wall 3.dips8

Figure 17



Kinematic Analysis	Planar Sliding
Slope Dip	45
Slope Dip Direction	176
Friction Angle	33°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	1	10	10.00%

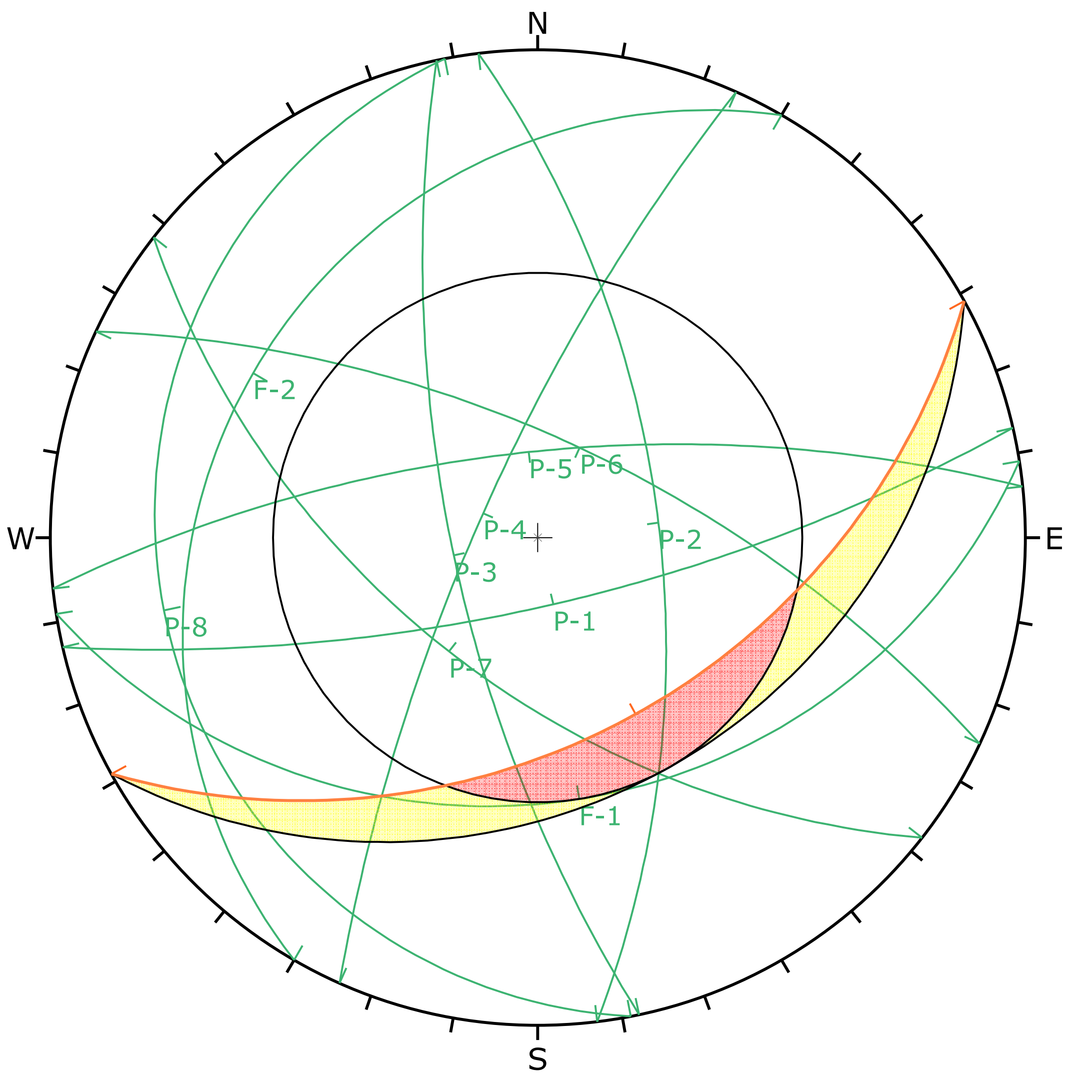
	Color	Dip	Dip Direction	Label
		User Planes		
13		45	176	NE Wall 3
12		33	171	F-1
11		22	300	F-2
3		74	167	P-1
4		62	83	P-2
5		70	258	P-3
6		76	294	P-4
7		70	354	P-5
8		67	25	P-6
9		57	218	P-7
10		14	259	P-8

Schnabel ENGINEERING

DIPS 8.025

Project	2024 Spec Agg Quarry Structural Geology Evaluation
Analysis Description	Kinematic Analysis - Northeast Wall 3
Drawn By	JDS
Client	Martin Marietta
Date	1/23/2024
File Name	ALLDATA_Report2024_GlobAdjust_KA_Northeast Wall 3.dips8

Figure 18



Symbol	Feature
▫	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	45
Slope Dip Direction	151
Friction Angle	33°

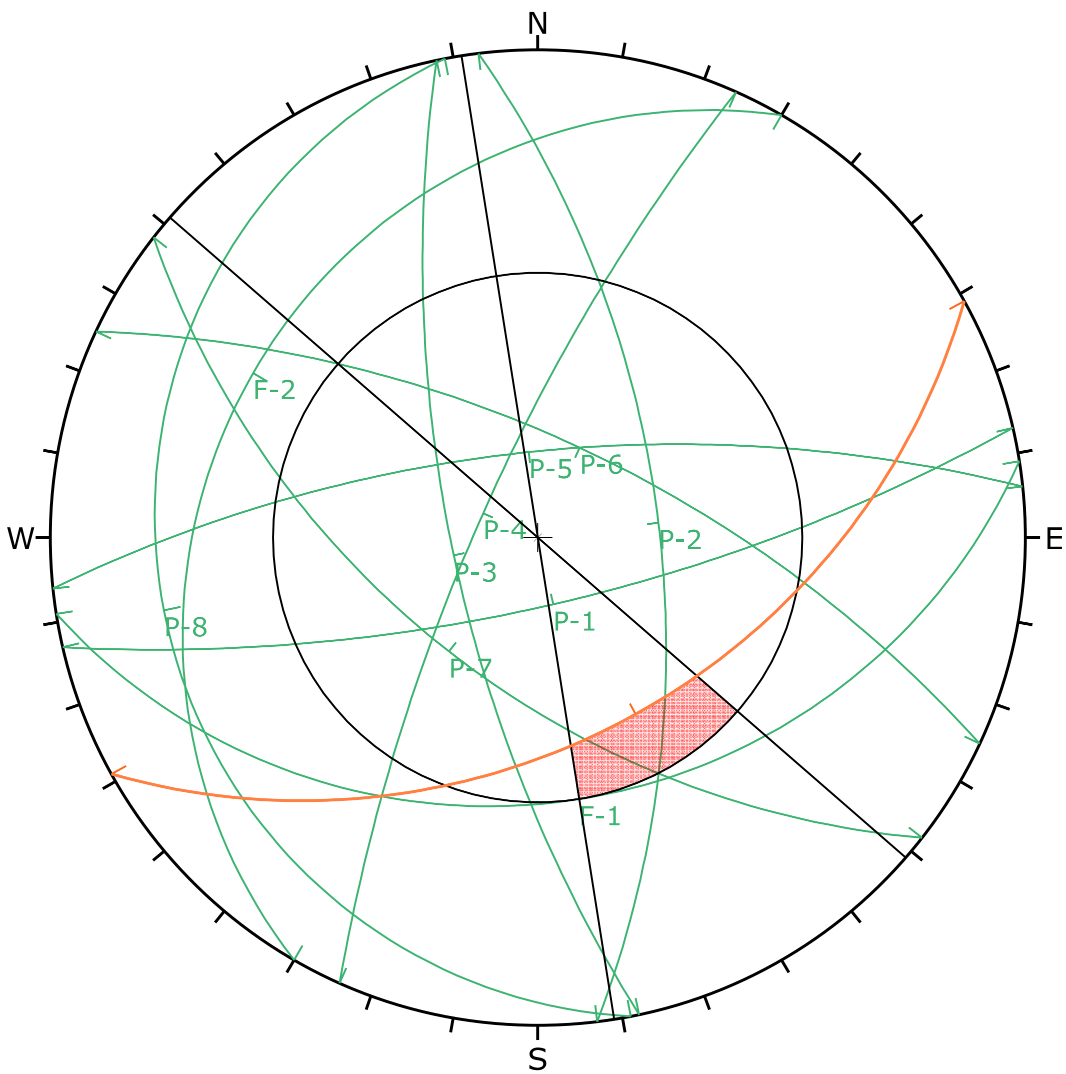
	Critical	Total	%
Wedge Sliding	0	45	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
13		45	151	NW Wall
12		33	171	F-1
11		22	300	F-2
3		74	167	P-1
4		62	83	P-2
5		70	258	P-3
6		76	294	P-4
7		70	354	P-5
8		67	25	P-6
9		57	218	P-7
10		14	259	P-8

Project	2024 Spec Agg Quarry Structural Geology Evaluation
Analysis Description	Kinematic Analysis - Northwest Wall
Drawn By	JDS
Client	Martin Marietta
Date	1/23/2024
File Name	ALLDATA_Report2024_GlobAdjust_KA_North West Wall.dips8

Schnabel ENGINEERING

DIPS 8.025

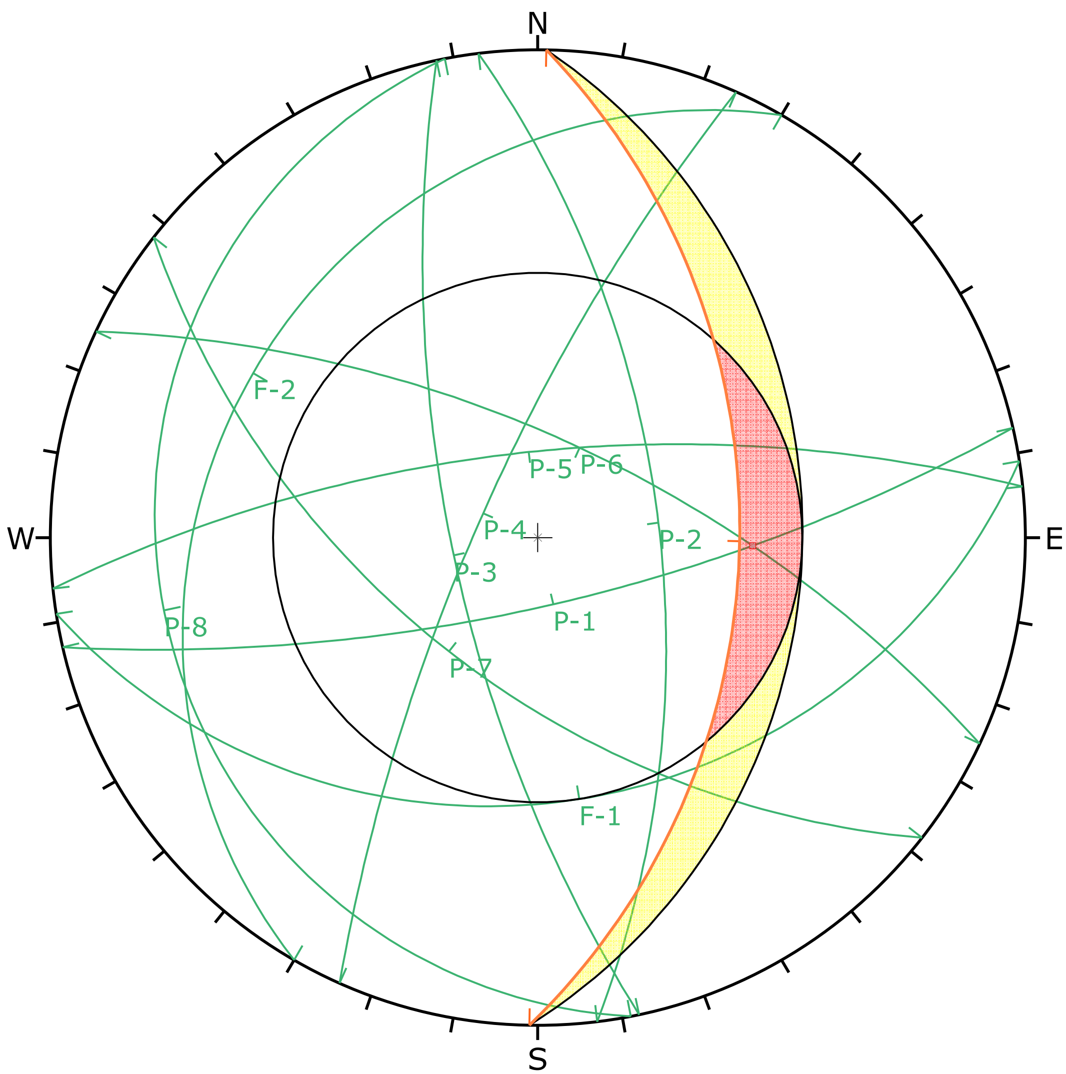


Kinematic Analysis	Planar Sliding
Slope Dip	45
Slope Dip Direction	151
Friction Angle	33°
Lateral Limits	20°

	Critical	**Total**	**%**
Planar Sliding (All)	1	10	10.00%

	Color	**Dip**	**Dip Direction**	**Label**
User Planes				
13	orange	45	151	NW Wall
12	green	33	171	F-1
11	green	22	300	F-2
3	green	74	167	P-1
4	green	62	83	P-2
5	green	70	258	P-3
6	green	76	294	P-4
7	green	70	354	P-5
8	green	67	25	P-6
9	green	57	218	P-7
10	green	14	259	P-8

Schnabel ENGINEERING	*Project* 2024 Spec Agg Quarry Structural Geology Evaluation	
	Analysis Description Kinematic Analysis - Northwest Wall	
	Drawn By JDS	*Client* Martin Marietta
DIPS 8.025	*Date* 1/23/2024	*File Name* ALLDATA_Report2024_GlobAdjust_KA_North West Wall.dips8

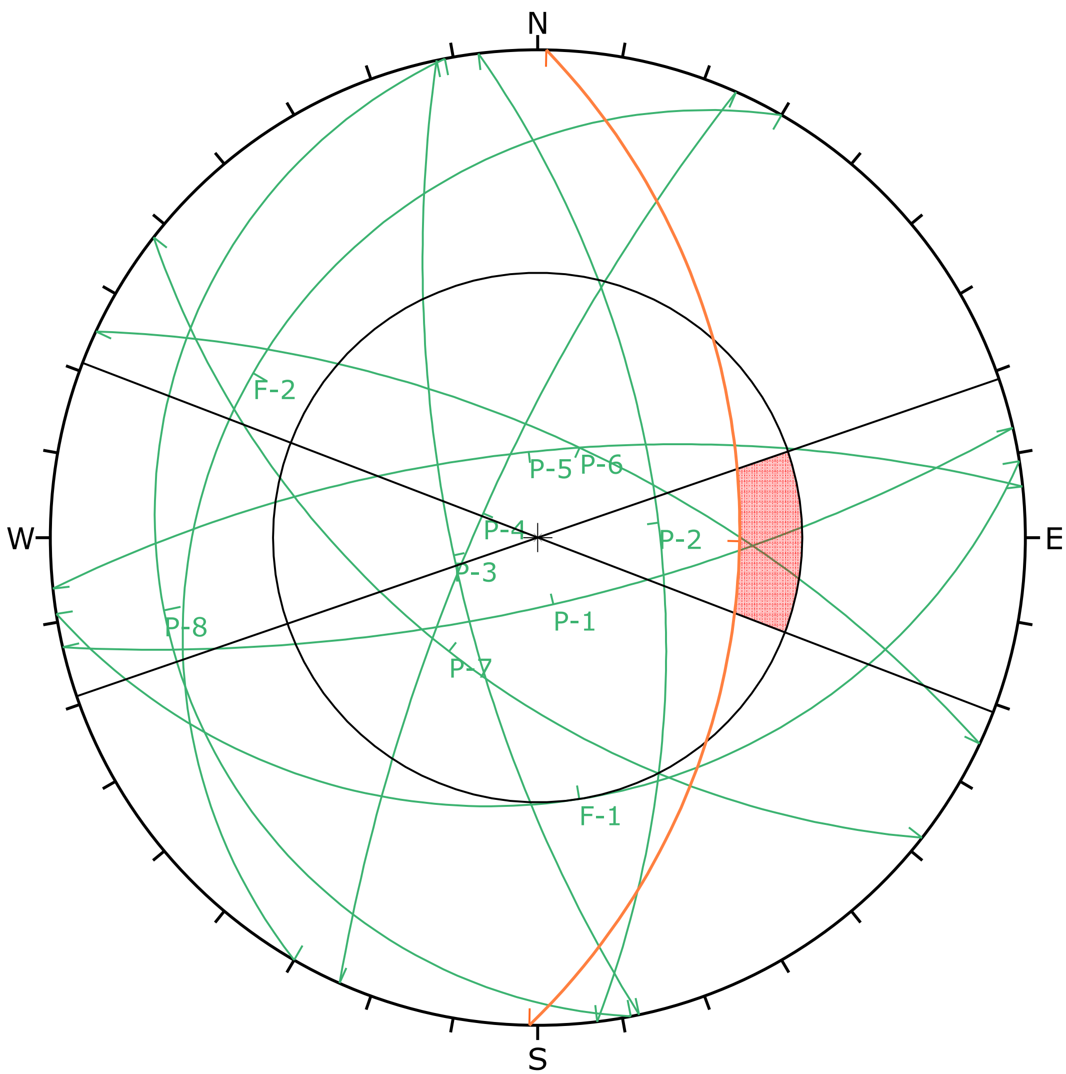


Symbol	Feature
▫	Critical Intersection

Kinematic Analysis	Wedge Sliding		
Slope Dip	45		
Slope Dip Direction	91		
Friction Angle	33°		
	Critical	Total	%
Wedge Sliding	1	45	2.22%

	Color	Dip	Dip Direction	Label
User Planes				
13		45	91	W Wall 1 & 3
12		33	171	F-1
11		22	300	F-2
3		74	167	P-1
4		62	83	P-2
5		70	258	P-3
6		76	294	P-4
7		70	354	P-5
8		67	25	P-6
9		57	218	P-7
10		14	259	P-8

Schnabel ENGINEERING	*Project* 2024 Spec Agg Quarry Structural Geology Evaluation		
	Analysis Description Kinematic Analysis - West Wall 1 and 3		
	Drawn By JDS	*Client* Martin Marietta	
DIPS 8.025	*Date* 1/23/2024	*File Name* ALLDATA_Report2024_GlobAdjust_KA_West Wall 1.dips8	



Kinematic Analysis	Planar Sliding
Slope Dip	45
Slope Dip Direction	91
Friction Angle	33°
Lateral Limits	20°

	Critical	Total	%
Planar Sliding (All)	0	10	0.00%

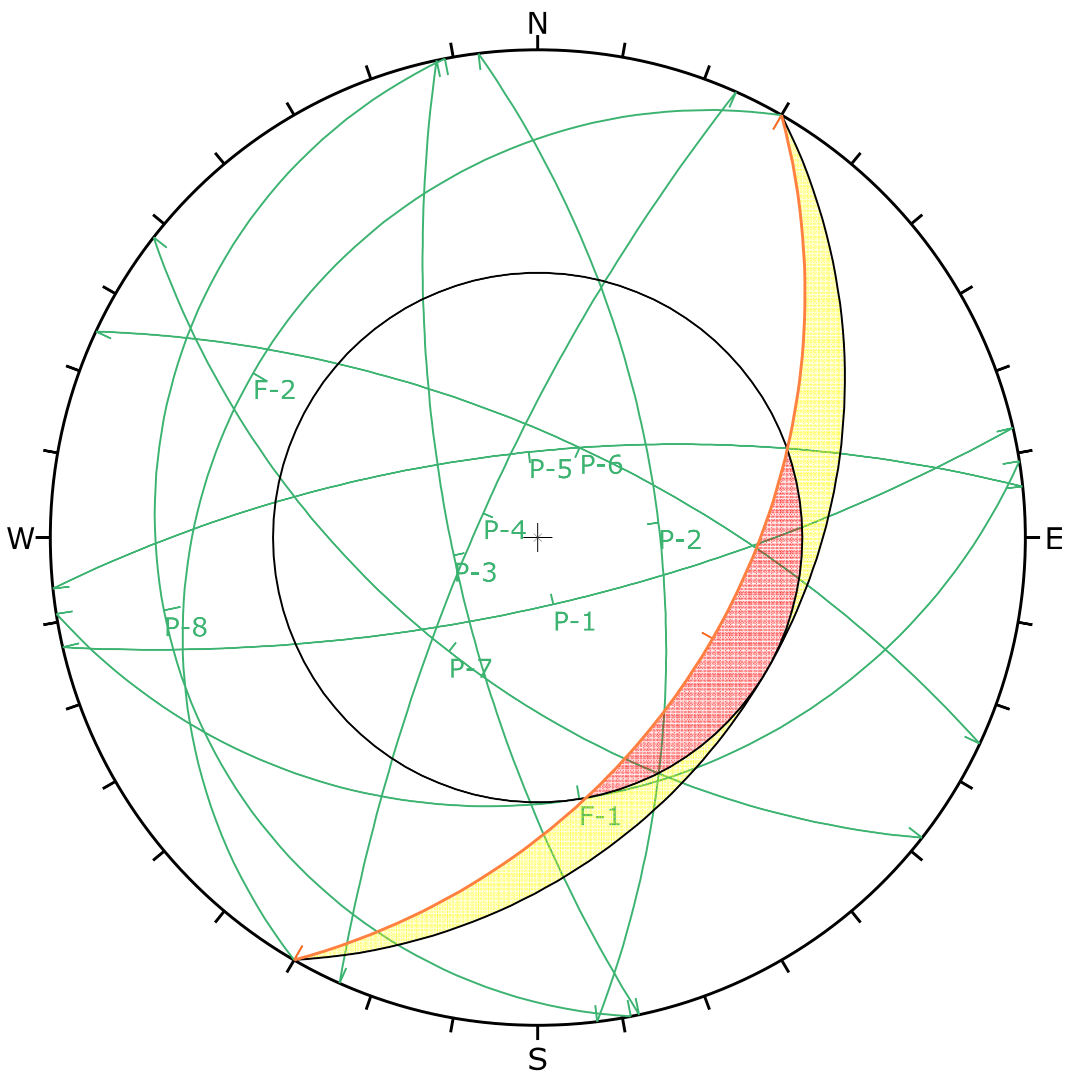
	Color	Dip	Dip Direction	Label
User Planes				
13		45	91	W Wall 1 & 3
12		33	171	F-1
11		22	300	F-2
3		74	167	P-1
4		62	83	P-2
5		70	258	P-3
6		76	294	P-4
7		70	354	P-5
8		67	25	P-6
9		57	218	P-7
10		14	259	P-8

Project	2024 Spec Agg Quarry Structural Geology Evaluation
Analysis Description	Kinematic Analysis - West Wall 1 and 3
Drawn By	JDS
Client	Martin Marietta
Date	1/23/2024
File Name	ALLDATA_Report2024_GlobAdjust_KA_West Wall 1.dips8

Schnabel ENGINEERING

DIPS 8.025

Figure 22



Symbol	Feature
▫	Critical Intersection

Kinematic Analysis	Wedge Sliding			
Slope Dip	45			
Slope Dip Direction	120			
Friction Angle	33°			
		Critical	**Total**	**%**
Wedge Sliding		0	45	0.00%

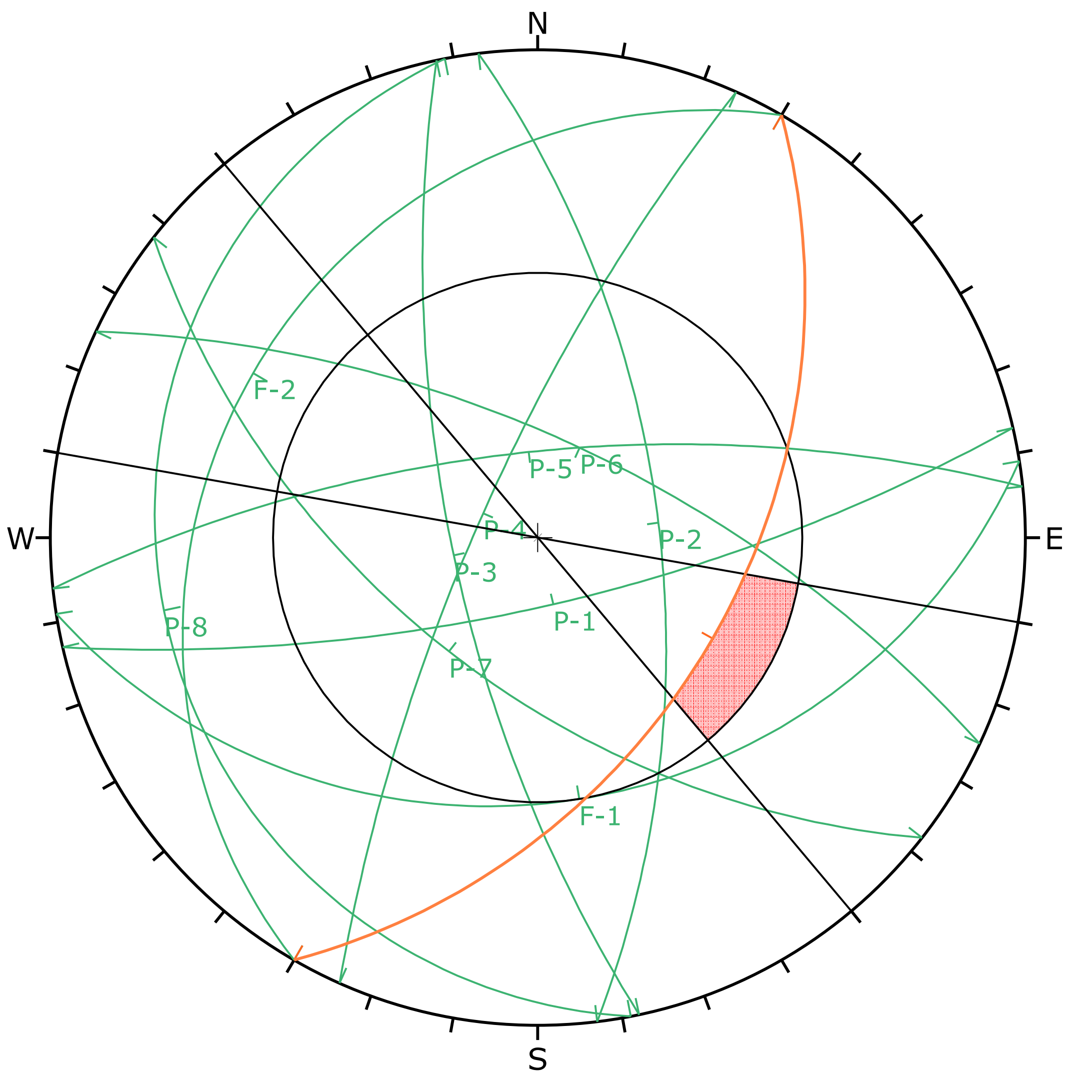
	Color	Dip	Dip Direction	Label
User Planes				
13		45	120	West Wall 2
12		33	171	F-1
11		22	300	F-2
3		74	167	P-1
4		62	83	P-2
5		70	258	P-3
6		76	294	P-4
7		70	354	P-5
8		67	25	P-6
9		57	218	P-7
10		14	259	P-8

Schnabel ENGINEERING

DIPS 8.025

Project	2024 Spec Agg Quarry Structural Geology Evaluation
Analysis Description	Kinematic Analysis - West Wall 2
Drawn By JDS	*Client* Martin Marietta
Date 1/23/2024	*File Name* ALLDATA_Report2024_GlobAdjust_KA_West Wall 2.dips8

Figure 23



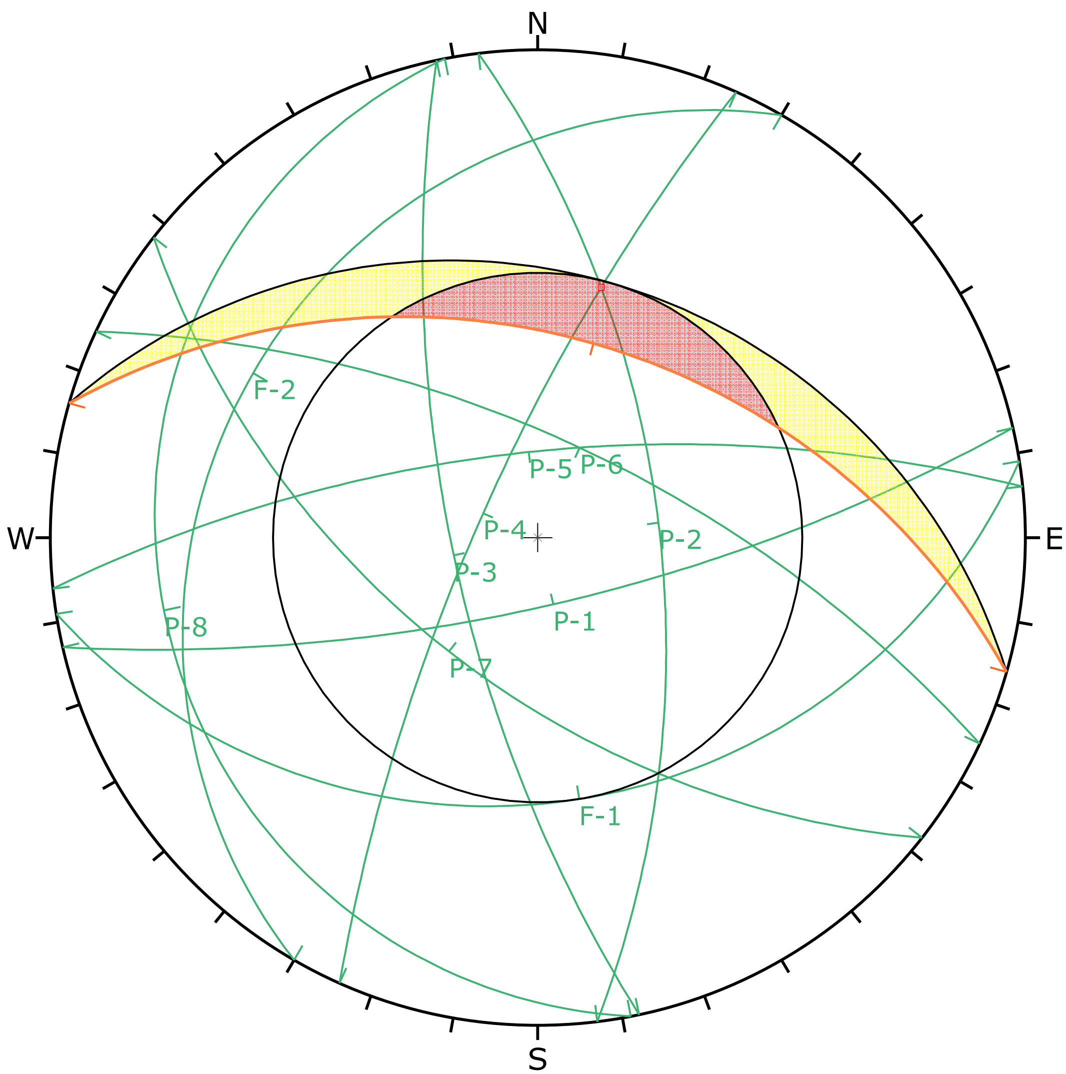
Kinematic Analysis	Planar Sliding		
Slope Dip	45		
Slope Dip Direction	120		
Friction Angle	33°		
Lateral Limits	20°		
	Critical	Total	%
Planar Sliding (All)	0	10	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
13		45	120	West Wall 2
12		33	171	F-1
11		22	300	F-2
3		74	167	P-1
4		62	83	P-2
5		70	258	P-3
6		76	294	P-4
7		70	354	P-5
8		67	25	P-6
9		57	218	P-7
10		14	259	P-8

Schnabel ENGINEERING

DIPS 8.025

Project	2024 Spec Agg Quarry Structural Geology Evaluation		
Analysis Description	Kinematic Analysis - West Wall 2		
Drawn By	JDS	*Client*	Martin Marietta
Date	1/23/2024	*File Name*	ALLDATA_Report2024_GlobAdjust_KA_West Wall 2.dips8



Symbol	Feature
▫	Critical Intersection

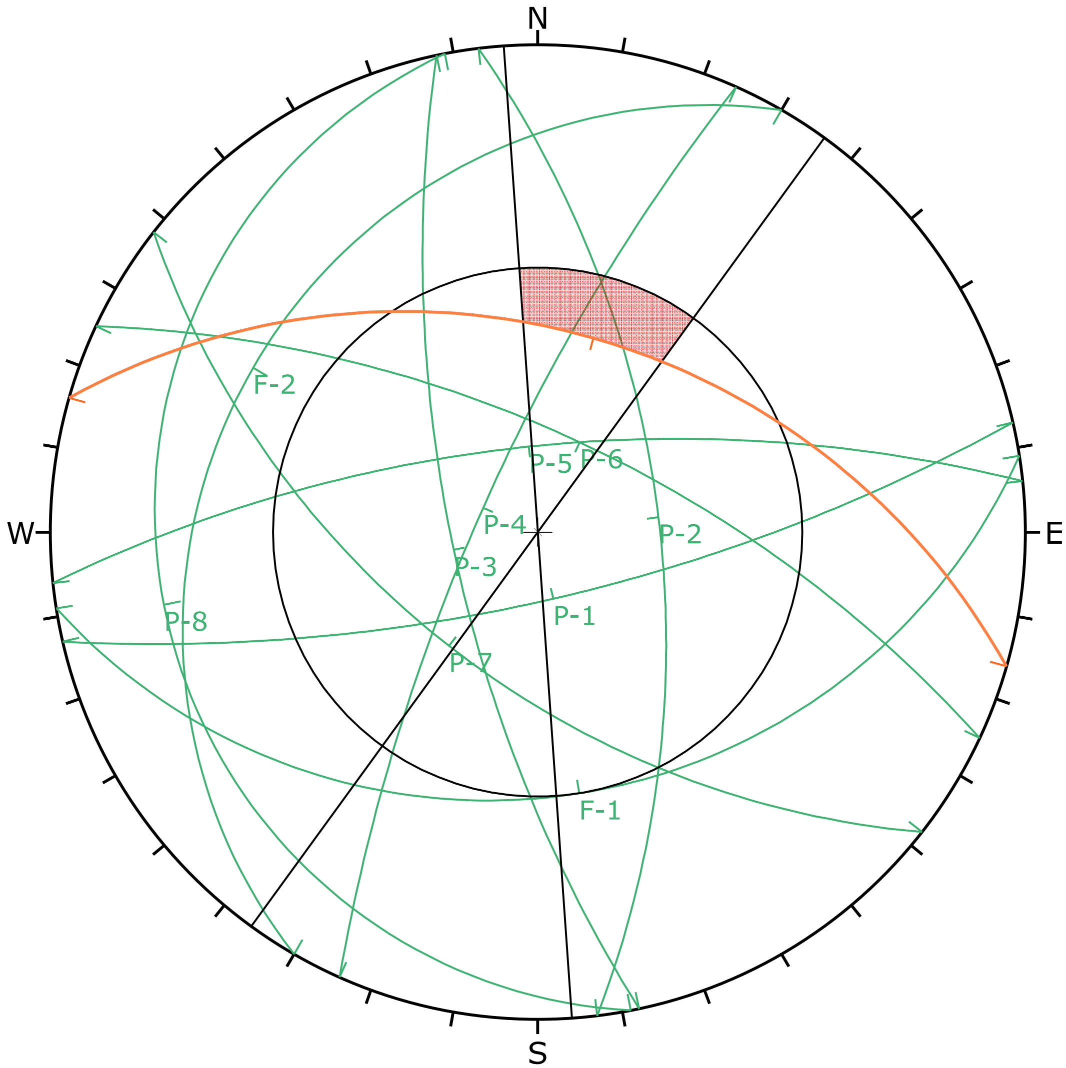
Kinematic Analysis	Wedge Sliding
Slope Dip	45
Slope Dip Direction	16
Friction Angle	33°

	Critical	Total	%
Wedge Sliding	1	45	2.22%

	Color	Dip	Dip Direction	Label
		User Planes		
13	■	45	16	SW Wall 1
12	■	33	171	F-1
11	■	22	300	F-2
3	■	74	167	P-1
4	■	62	83	P-2
5	■	70	258	P-3
6	■	76	294	P-4
7	■	70	354	P-5
8	■	67	25	P-6
9	■	57	218	P-7
10	■	14	259	P-8

Schnabel ENGINEERING	*Project* 2024 Spec Agg Quarry Structural Geology Evaluation		
	Analysis Description Kinematic Analysis - Southwest Wall 1		
	Drawn By JDS	*Client* Martin Marietta	
DIPS 8.025	*Date* 1/23/2024	*File Name* ALLDATA_Report2024_GlobAdjust_KA_Southwest Wall 1.dips8	

Figure 25



Kinematic Analysis	Planar Sliding		
Slope Dip	45		
Slope Dip Direction	16		
Friction Angle	33°		
Lateral Limits	20°		
	Critical	Total	%
Planar Sliding (All)	0	10	0.00%

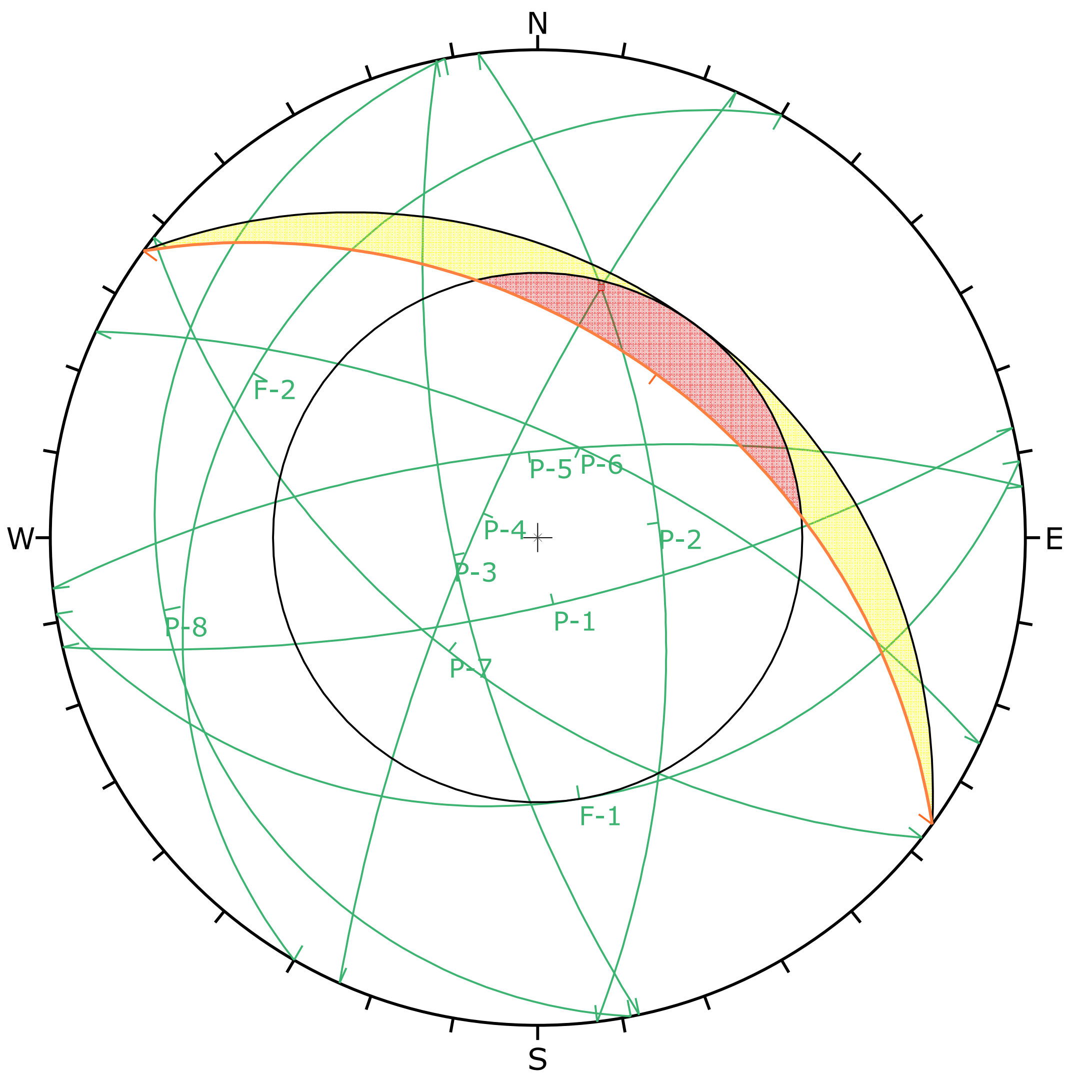
	Color	Dip	Dip Direction	Label
User Planes				
13		45	16	SW Wall 1
12		33	171	F-1
11		22	300	F-2
3		74	167	P-1
4		62	83	P-2
5		70	258	P-3
6		76	294	P-4
7		70	354	P-5
8		67	25	P-6
9		57	218	P-7
10		14	259	P-8

Schnabel ENGINEERING

Project	2024 Spec Agg Quarry Structural Geology Evaluation		
Analysis Description	Kinematic Analysis - Southwest Wall 1		
Drawn By	JDS	Client	Martin Marietta
Date	1/23/2024	File Name	ALLDATA_Report2024_GlobAdjust_KA_Southwest Wall 1.dips8

DIPS 8.025

Figure 26



Symbol	Feature
▪	Critical Intersection

Kinematic Analysis	Wedge Sliding			
Slope Dip	45			
Slope Dip Direction	36			
Friction Angle	33°			
		Critical	**Total**	**%**
Wedge Sliding		1	45	2.22%

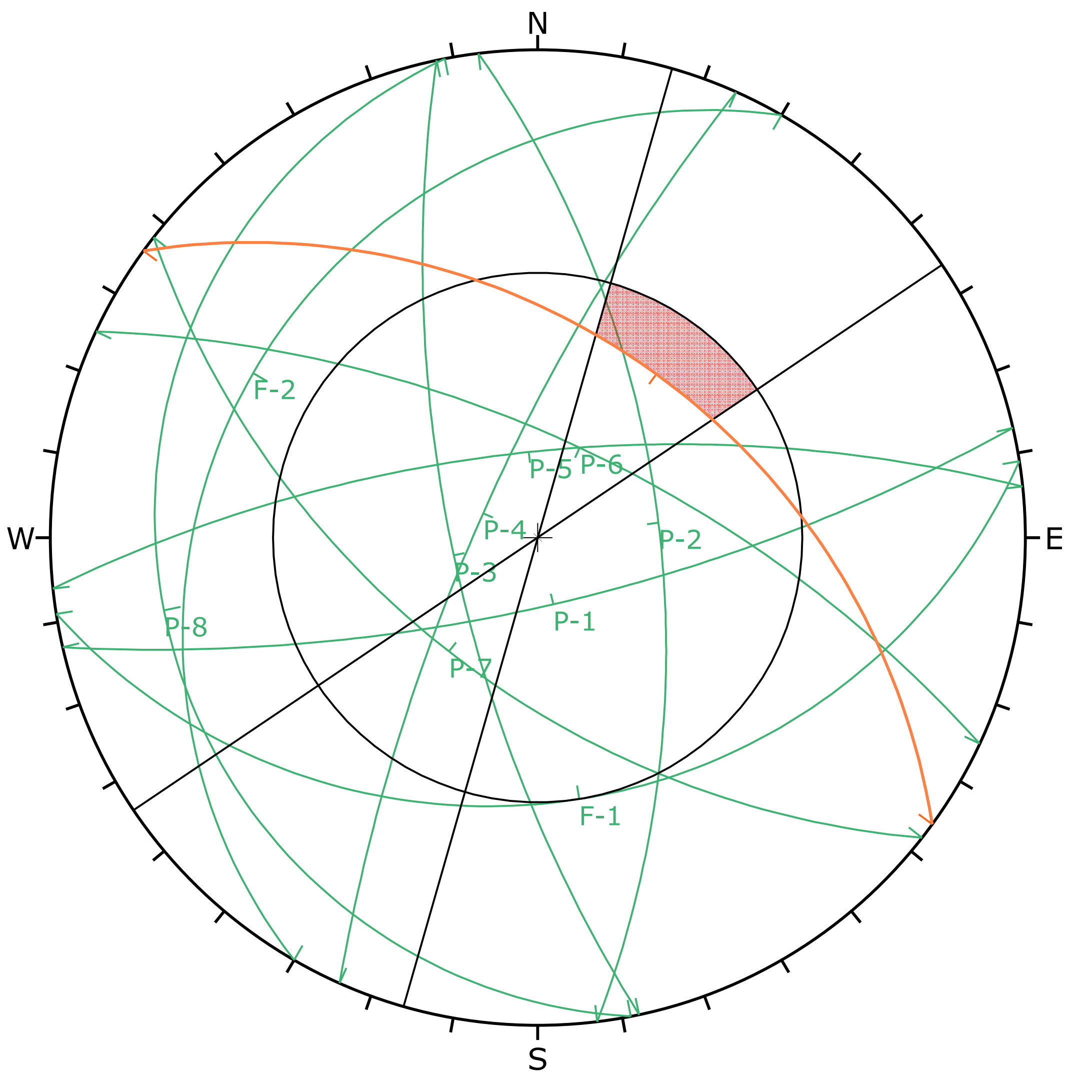
	Color	Dip	Dip Direction	Label
User Planes				
13		45	36	SW Wall 2
12		33	171	F-1
11		22	300	F-2
3		74	167	P-1
4		62	83	P-2
5		70	258	P-3
6		76	294	P-4
7		70	354	P-5
8		67	25	P-6
9		57	218	P-7
10		14	259	P-8

Schnabel ENGINEERING

DIPS 8.025

Project	2024 Spec Agg Quarry Structural Geology Evaluation
Analysis Description	Kinematic Analysis - Southwest Wall 2
Drawn By	JDS
Client	Martin Marietta
Date	1/23/2024
File Name	ALLDATA_Report2024_GlobAdjust_KA_Southwest Wall 2.dips8

Figure 27



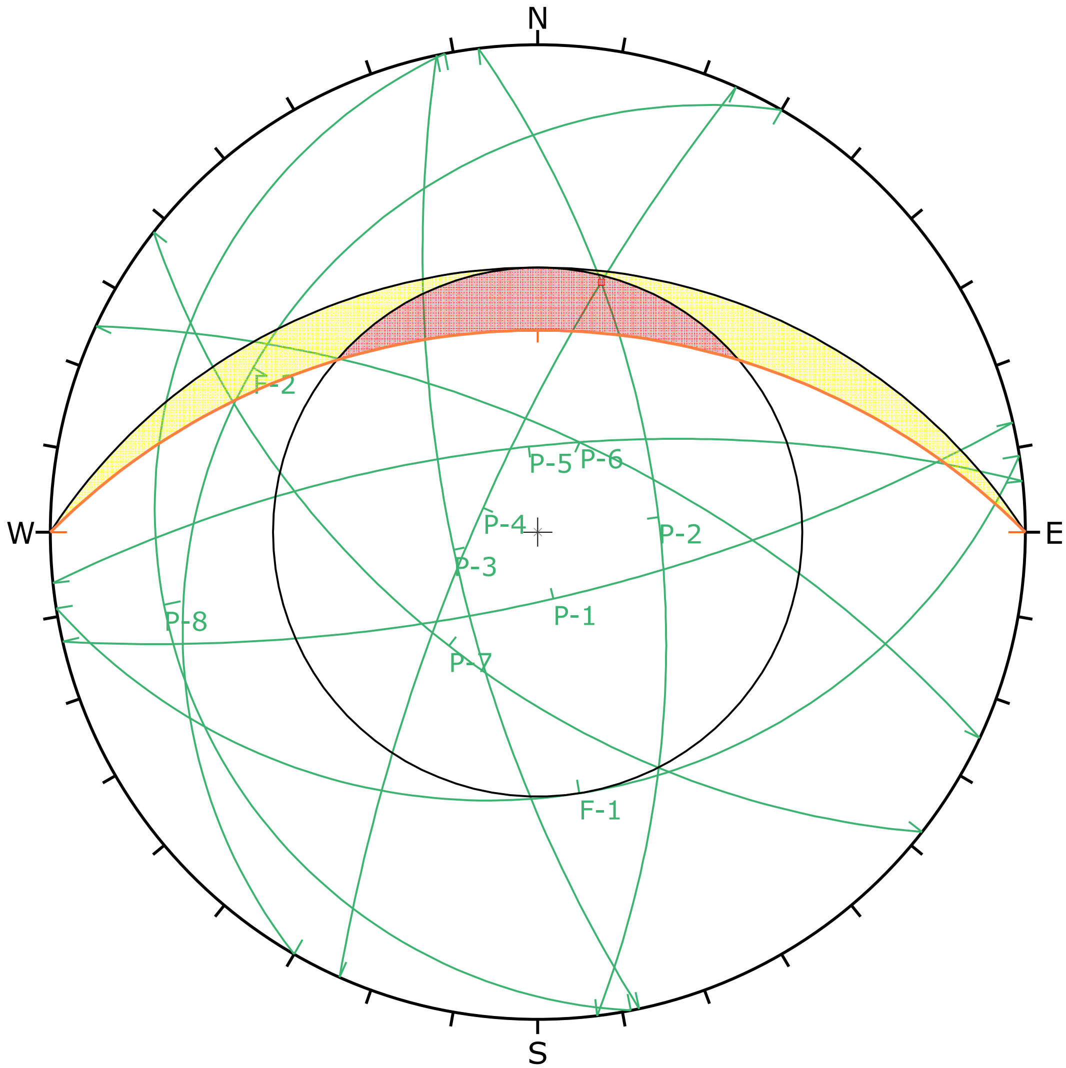
Kinematic Analysis	Planar Sliding			
Slope Dip	45			
Slope Dip Direction	36			
Friction Angle	33°			
Lateral Limits	20°			
		Critical	**Total**	**%**
Planar Sliding (All)		0	10	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
13		45	36	SW Wall 2
12		33	171	F-1
11		22	300	F-2
3		74	167	P-1
4		62	83	P-2
5		70	258	P-3
6		76	294	P-4
7		70	354	P-5
8		67	25	P-6
9		57	218	P-7
10		14	259	P-8

Schnabel ENGINEERING

DIPS 8.025

Project	2024 Spec Agg Quarry Structural Geology Evaluation
Analysis Description	Kinematic Analysis - Southwest Wall 2
Drawn By	JDS
Client	Martin Marietta
Date	1/23/2024
File Name	ALLDATA_Report2024_GlobAdjust_KA_Southwest Wall 2.dips8



Symbol	Feature
▪	Critical Intersection

Kinematic Analysis	Wedge Sliding
Slope Dip	45
Slope Dip Direction	0
Friction Angle	33°

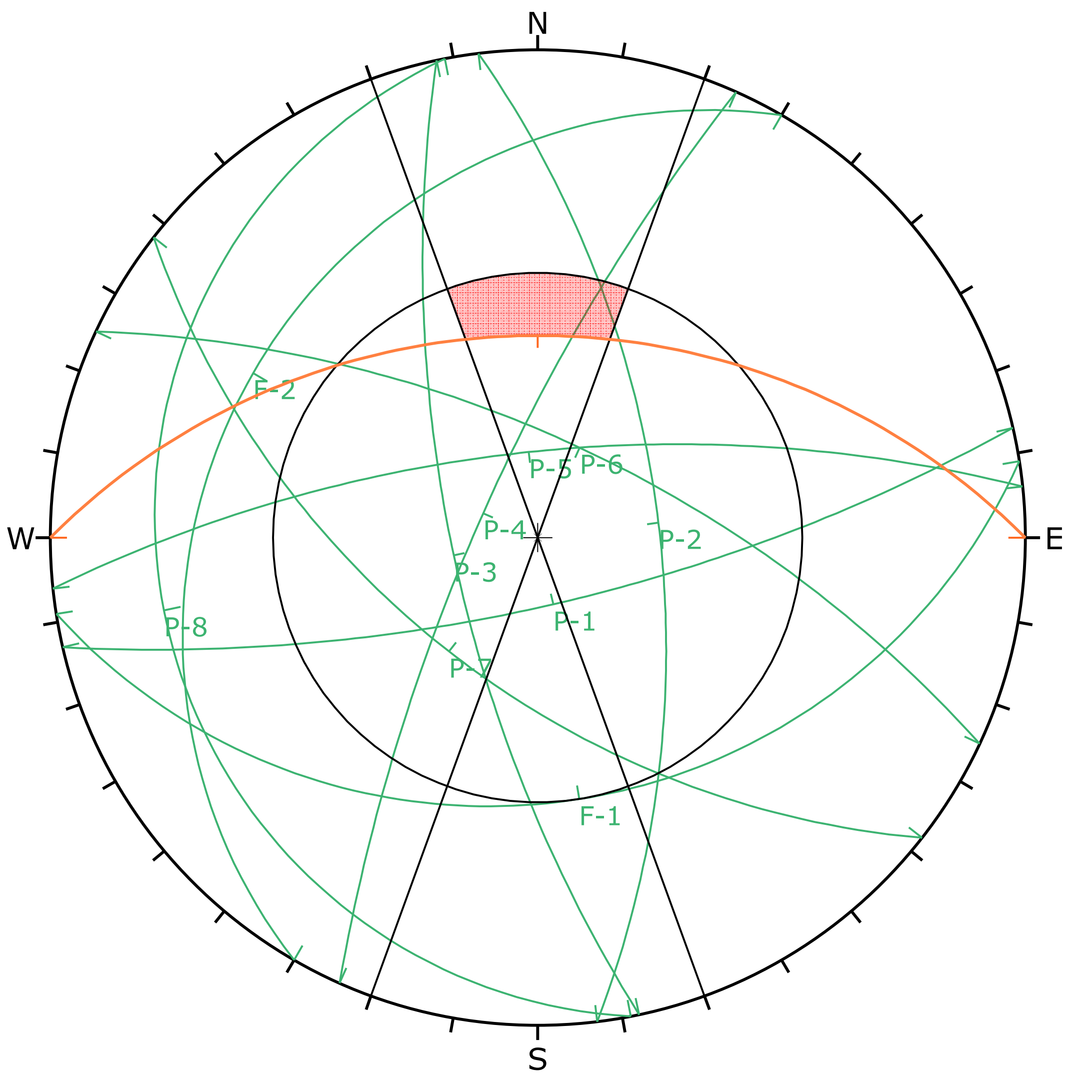
	Critical	Total	%
Wedge Sliding	1	45	2.22%

	Color	Dip	Dip Direction	Label
User Planes				
13		45	360	South Wall
12		33	171	F-1
11		22	300	F-2
3		74	167	P-1
4		62	83	P-2
5		70	258	P-3
6		76	294	P-4
7		70	354	P-5
8		67	25	P-6
9		57	218	P-7
10		14	259	P-8

Schnabel ENGINEERING

DIPS 8.025

Project	2024 Spec Agg Quarry Structural Geology Evaluation		
Analysis Description	Kinematic Analysis - South Wall		
Drawn By	JDS	*Client*	Martin Marietta
Date	1/23/2024	*File Name*	ALLDATA_Report2024_GlobAdjust_KA_South Wall.dips8



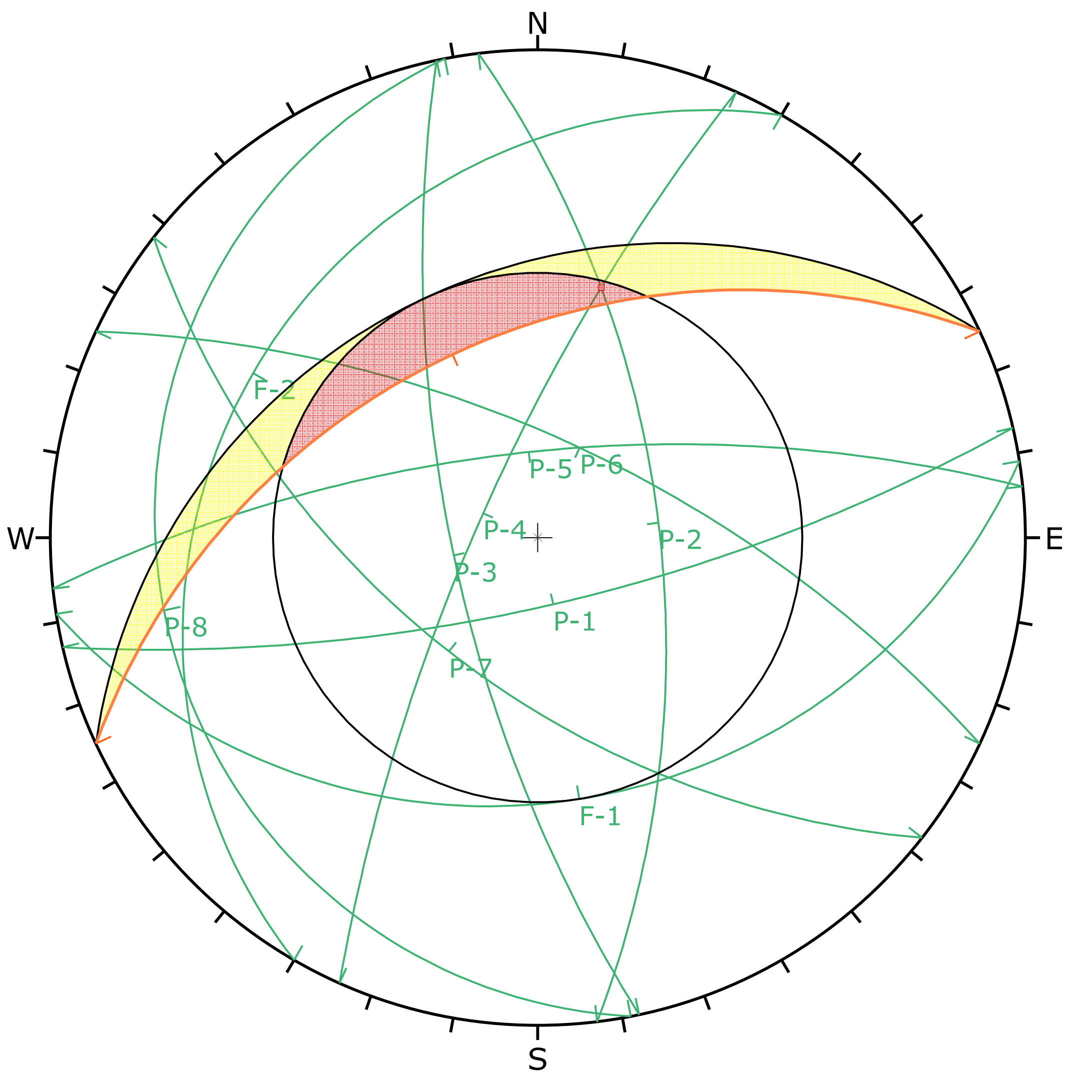
Kinematic Analysis	Planar Sliding
Slope Dip	45
Slope Dip Direction	0
Friction Angle	33°
Lateral Limits	20°

	Critical	**Total**	**%**
Planar Sliding (All)	0	10	0.00%

	Color	**Dip**	**Dip Direction**	**Label**
User Planes				
13		45	360	South Wall
12		33	171	F-1
11		22	300	F-2
3		74	167	P-1
4		62	83	P-2
5		70	258	P-3
6		76	294	P-4
7		70	354	P-5
8		67	25	P-6
9		57	218	P-7
10		14	259	P-8

Schnabel ENGINEERING	*Project* 2024 Spec Agg Quarry Structural Geology Evaluation		
	Analysis Description Kinematic Analysis - South Wall		
	Drawn By JDS	*Client* Martin Marietta	
DIPS 8.025	*Date* 1/23/2024	*File Name* ALLDATA_Report2024_GlobAdjust_KA_South Wall.dips8	

Figure 30



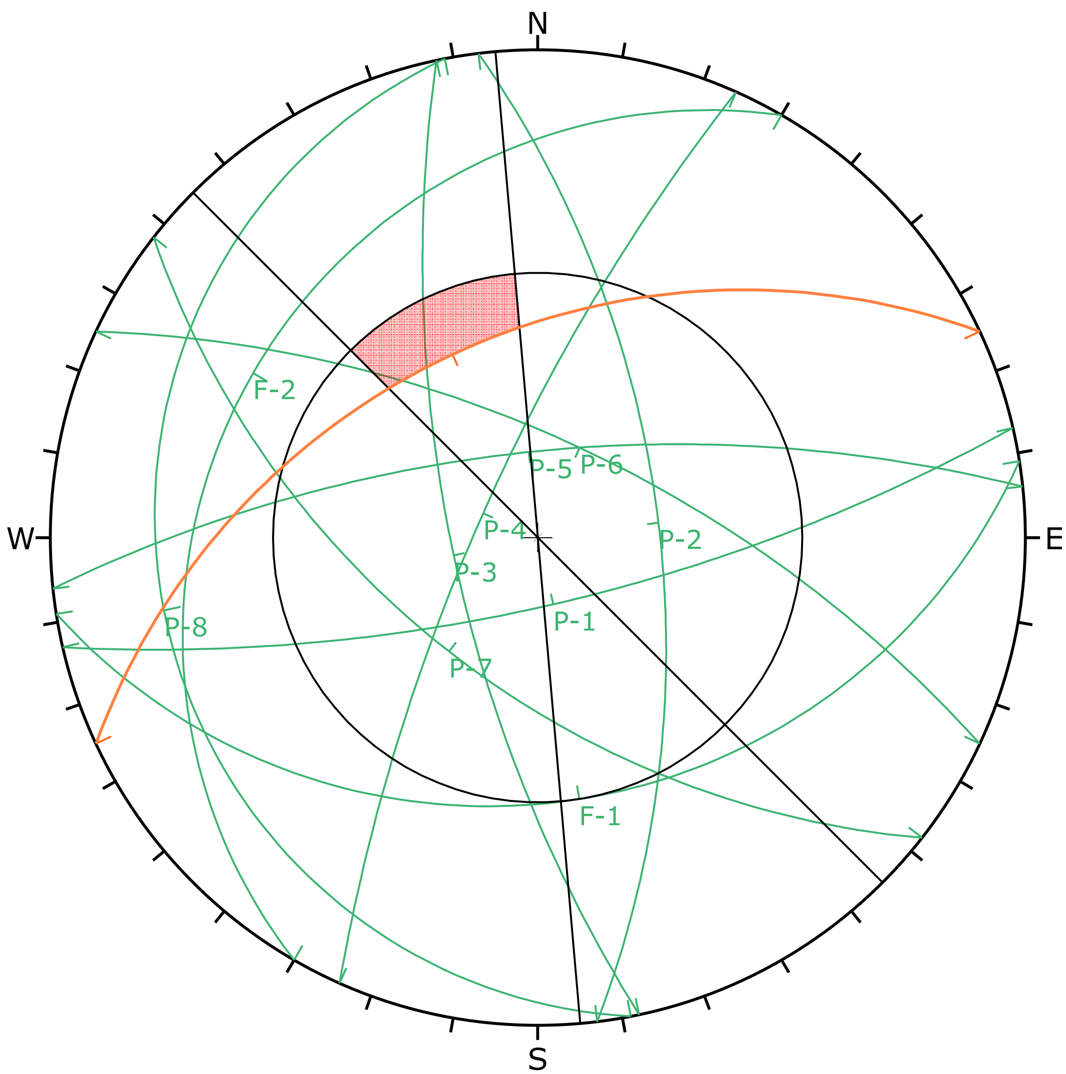
Symbol	Feature
▫	Critical Intersection

Kinematic Analysis	Wedge Sliding		
Slope Dip	45		
Slope Dip Direction	335		
Friction Angle	33°		
	Critical	Total	%
Wedge Sliding	1	45	2.22%

	Color	Dip	Dip Direction	Label
User Planes				
13		45	335	SE Wall
12		33	171	F-1
11		22	300	F-2
3		74	167	P-1
4		62	83	P-2
5		70	258	P-3
6		76	294	P-4
7		70	354	P-5
8		67	25	P-6
9		57	218	P-7
10		14	259	P-8

Schnabel ENGINEERING	Project: 2024 Spec Agg Quarry Structural Geology Evaluation		
	Analysis Description: Kinematic Analysis - Southeast Wall		
	Drawn By: JDS	Client: Martin Marietta	
DIPS 8.025	Date: 1/23/2024	File Name: ALLDATA_Report2024_GlobAdjust_KA_Southeast Wall.dips8	

Figure 31



Kinematic Analysis	Planar Sliding		
Slope Dip	45		
Slope Dip Direction	335		
Friction Angle	33°		
Lateral Limits	20°		
	Critical	Total	%
Planar Sliding (All)	0	10	0.00%

	Color	Dip	Dip Direction	Label
User Planes				
13		45	335	SE Wall
12		33	171	F-1
11		22	300	F-2
3		74	167	P-1
4		62	83	P-2
5		70	258	P-3
6		76	294	P-4
7		70	354	P-5
8		67	25	P-6
9		57	218	P-7
10		14	259	P-8

Schnabel ENGINEERING

DIPS 8.025

Project	2024 Spec Agg Quarry Structural Geology Evaluation		
Analysis Description	Kinematic Analysis - Southeast Wall		
Drawn By	JDS	*Client*	Martin Marietta
Date	1/23/2024	*File Name*	ALLDATA_Report2024_GlobAdjust_KA_Southeast Wall.dips8

ATTACHMENTS

Photo Log

Photo 1: Looking West at Southern Walls, Bench EL 6440 (June 2023)

Photo 2: Looking SE at Southern Walls, Bench EL 6440 (November 2023)

Photo 3: Looking SW at south temporary excavation wall, Bench EL 6405 (November 2023)

Photo 4: Looking NE at East temporary excavation wall, Bench EL 6405 (November 2023)

Photo 5: Looking SE at fault in Southern Walls, Bench EL 6440 (June 2023)

Photo 6: Looking SW at local shear zone in Southern Walls, Bench EL 6440 (June 2023)

Photo 7: Looking West at folding in temporary west excavation wall, Bench EL 6440 (Nov. 2023)

Photo 8: Looking south at fault in corner of south and west temporary excavation, Bench EL 6405 (November 2023)

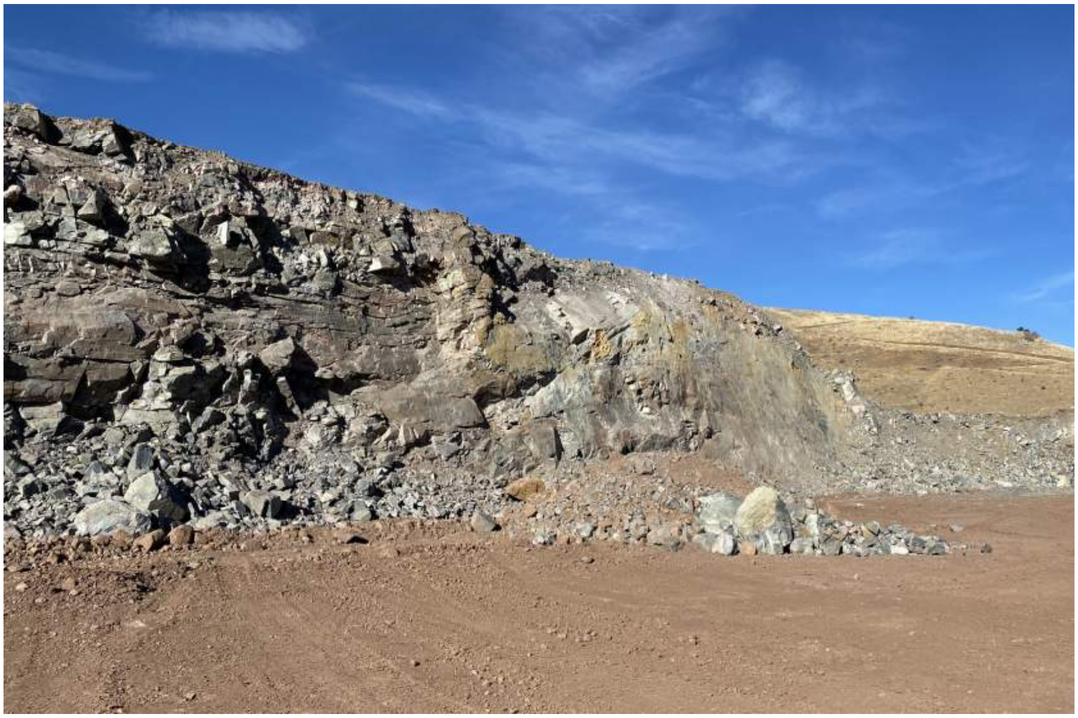


Photo 9: Looking NW at massive face of west temporary excavation, Bench EL 6405 (November 2023)

Photo 10: Looking NW at localized shear zone in east temporary excavation, Bench EL 6405 (November 2023)

Photo 11: Looking East at Northeast Walls 1-2 (June 2023)

Photo 12: Looking East at Northeast Walls 1-2 (November 2023)

Photo 13: Looking East at access road temporary walls in Main Pit (June 2023)

Photo 14: Looking East at access road temporary walls in Main Pit (November 2023)

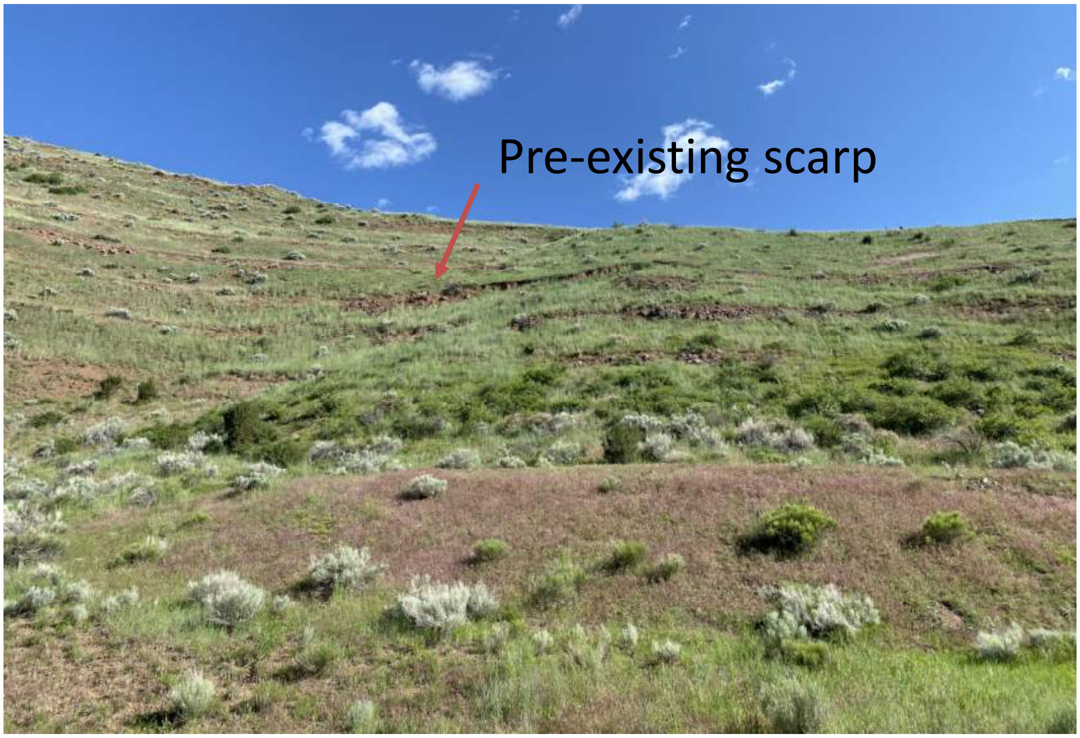


Photo 15: Looking North from Main Pit access road at pre-existing scarp on Northeast Wall 1 (June 2023)

Photo 16: Looking North from Main Pit access road at pre-existing scarp on Northeast Wall 1 (November 2023)

Photo 17: High waterline stake observed at bottom of Main Pit (November 2023)

Photo 18: Looking West at Northeast Walls from top of Main Pit