POVERTY POINT LIMESTONE QUARRY SLOPE STABILITY ASSESSMENT AND DESIGN GUIDELINES

Submitted to: HOLCIM (US) Inc.

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CORPORATION

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1 INTRODUCTION

1.1 TERMS OF REFERENCE

HOLCIM plans an expansion of their limestone and aggregate quarry at Poverty Point. Norwest Corp was engaged by HOLCIM to investigate, evaluate, and report on the stability of rock slopes in the quarry and to make recommendations for future mining. This report lists sources of information, and based on the available data, describes local geology and geologic structure, identifies discontinuity types, rock mass characteristics, and hydrogeological conditions. The report also presents preliminary slope stability assessment results and slope design/mining method guidelines, provides conclusions and makes recommendations to support and verify the stability assessment and slope design. Additional geotechnical information will need to be acquired before design guidelines are finalized.

The site is located 35 miles west of Salt Lake City, Utah near the southwest shore of the Great Salt Lake and at the north end of Skull Valley (see Figure 1.1). The existing quarry was advanced from the southwest to the northeast, generally perpendicular to the strike and updip of rock bedding. The highest point of the existing quarry wall is approximately 200' above the quarry floor. The quarry floor is at 4580' and the top of the wall is at 4800'. A plan view of the existing quarry and the proposed final quarry area appears as Figure 1.2. The small summit behind the quarry wall to the northeast has a maximum elevation of 4920'. The quarry has been inactive for several years.

1.2 POVERTY POINT SOURCES OF INFORMATION

Information used to describe quarry slope conditions and make design recommendations was gathered from sources including:

a) Geologic logs for DH-06-01, DH-06-02, DH-06-03, and DH-06-04 as logged by Tom Newman, February 2006 (Appendix A).

b) Geotechnical Rock Core Logs for DH-06-02, DH-06-03, and DH-06-04 as logged by Eric Martin, February 2006 (Appendix A).

c) Digital photos of core collected at DH-06-02, DH-06-03, and DH-06-04 (see Appendix B)

d) Plan view of Poverty Point Quarry as provided by HOLCIM.

e) Geologic cross-sections A-A', B-B', C-C' showing the interpreted geology in the area as provided by HOLCIM (Appendix C).

f) June 2005 site visit by Gary Stubblefield, Norwest Corp, Salt Lake City with digital photos and quarry description (Appendix D).

g) United States Geological Survey data on precipitation amounts and traditional groundwater levels in the area.

h) Laboratory testing of representative core samples including point load and unconfined compressive strength tests (Appendix E).

i) Rock mass classification of strata based on geotechnical core logs.

1.3 QUARRY DEVELOPMENT AND MINING OPERATIONS

A final quarry development plan has not been completed; however Norwest understands that the current plan would involve expanding the quarry to advance the pit to the 4920' elevation north of the existing quarry. Mine operators plan to begin mining the existing quarry from the northeast, removing the overlying talus, and advancing southwest, downslope and downdip, mining high purity limestone as ore and underlying siliceous limestone for aggregate.

The operation will also include external waste rock dumps, a crushing plant, and associated infrastructure.

It is assumed that, mining will take place using truck and loader/excavator methods. Drilling and blasting will be carried out to achieve suitable fragmentation. The topography of the quarry area and the quarry configuration allows for access into the quarry beginning at the 4920' elevation and advancing with a maximum highwall defined by the height of each lift (20-50'). There will be no final highwall, as the operation will effectively start at the highest point of the existing topography and work downslope, mining along footwall bedding. An endwall will develop on the northwest end of the quarry. Benching of the footwall may be unnecessary, dependent upon ultimate quarry depths and extents defined by HOLCIM.

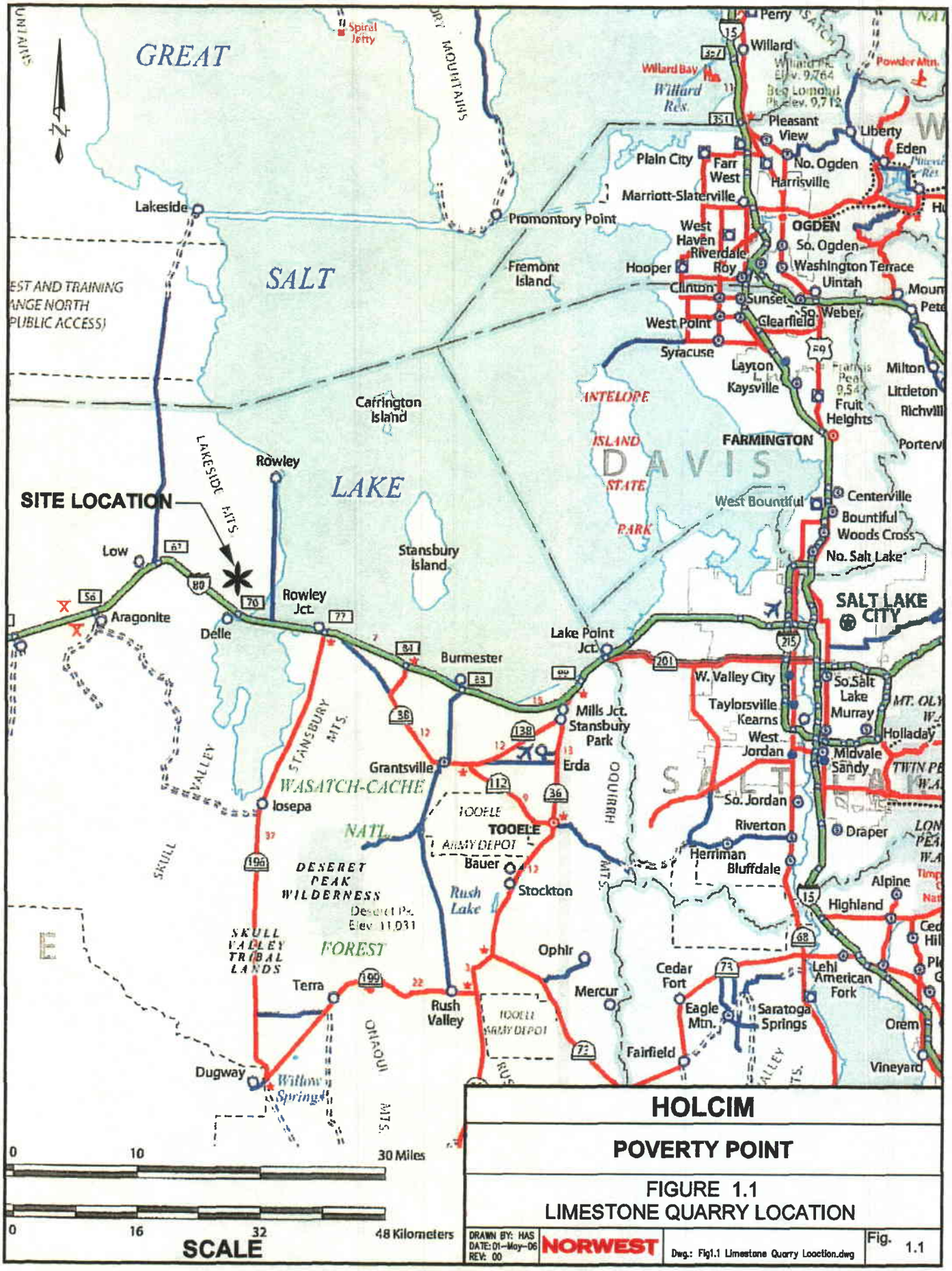

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FIGURE 1.1
LIMESTONE QUARRY LOCATION

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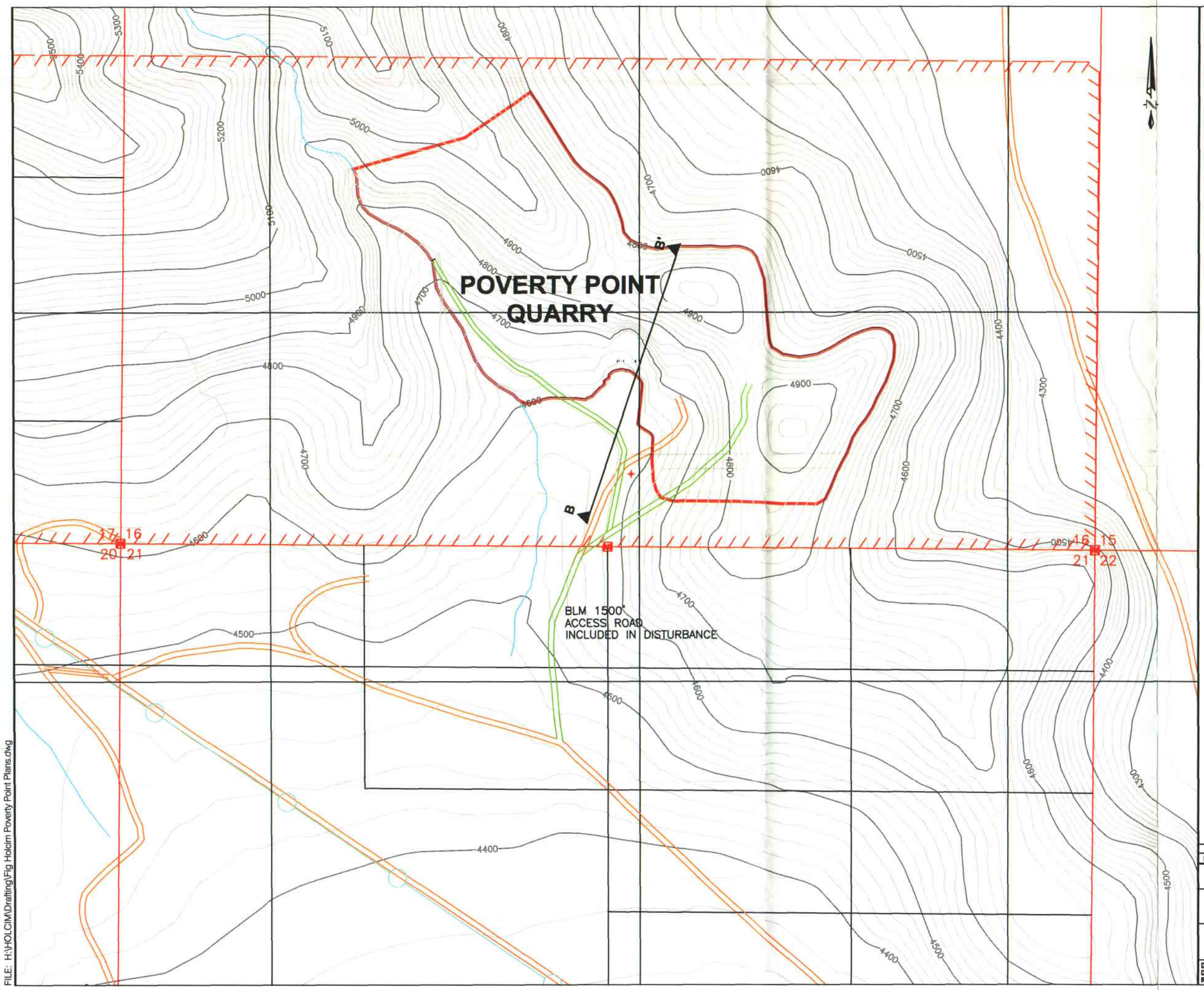
Fig. 1.1



LEGEND

- ROAD (PROPOSED)
- ROAD (UNSURFACED)
- FENCE
- STREAM (INTERMITTENT) / WATER SYMBOL
- HOLCIM PROPERTY BOUNDARY
- PROPOSED QUARRY BOUNDARY

0 500 1000 1500

SCALE: 1" = 500'

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HOLCIM

POVERTY POINT

FIGURE 1.2
PLAN VIEW

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Fig. 1.2

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2 GENERAL GEOLOGY

2.1 POVERTY POINT STRATIGRAPHY

Rock units in the area are as follows:

- Great Blue Formation Limestone - Limestone is the predominant rock type at the quarry. HOLCIM geologists have further defined limestone rock units (based upon chemistry) as either high purity or siliceous. All limestone has origins in the Upper and Middle Pennsylvanian (Palaeozoic Belt Supergroup) shallow marine sediments. Limestone beds have thicknesses varying from 5'-75'. Limestones are fine to medium grain, competent rock with medium to dark grey coloration, calcite healed fractures, some chert bands, minor clay partings, styolites and fossils. Iron staining is also common.

- Great Blue Formation Sandstone – A thin sandstone unit (10') underlies limestone units. Origin is in Upper and Middle Pennsylvanian Palaeozoic Belt Supergroup.

- Cemented Talus – A thick talus unit (20'-75') overlies the limestone in most areas. This unit is composed of well cemented (recemented) Lake Bonneville cobbles and limestone fragments and is commonly identified as a weak conglomerate.

- The surficial material is Quaternary age alluvial deposits of sand and gravel, which overlie the limestone beds at the toe of the existing pit.

A cross-sectional view of quarry stratigraphy developed by HOLCIM geologists and based upon geochemistry appears as Figure 2.1. The cross-section is also shown in plan view on Figure 1.2.

2.2 POVERTY POINT STRUCTURE

The structural geology of the Poverty Point area exhibits gently sloping (19-35°) bedded rock units, dipping out of the existing quarry face. Beds strike from N90W to N45W. Bedding planes are daylighted in quarry walls which have overall wall angles up to 35°.

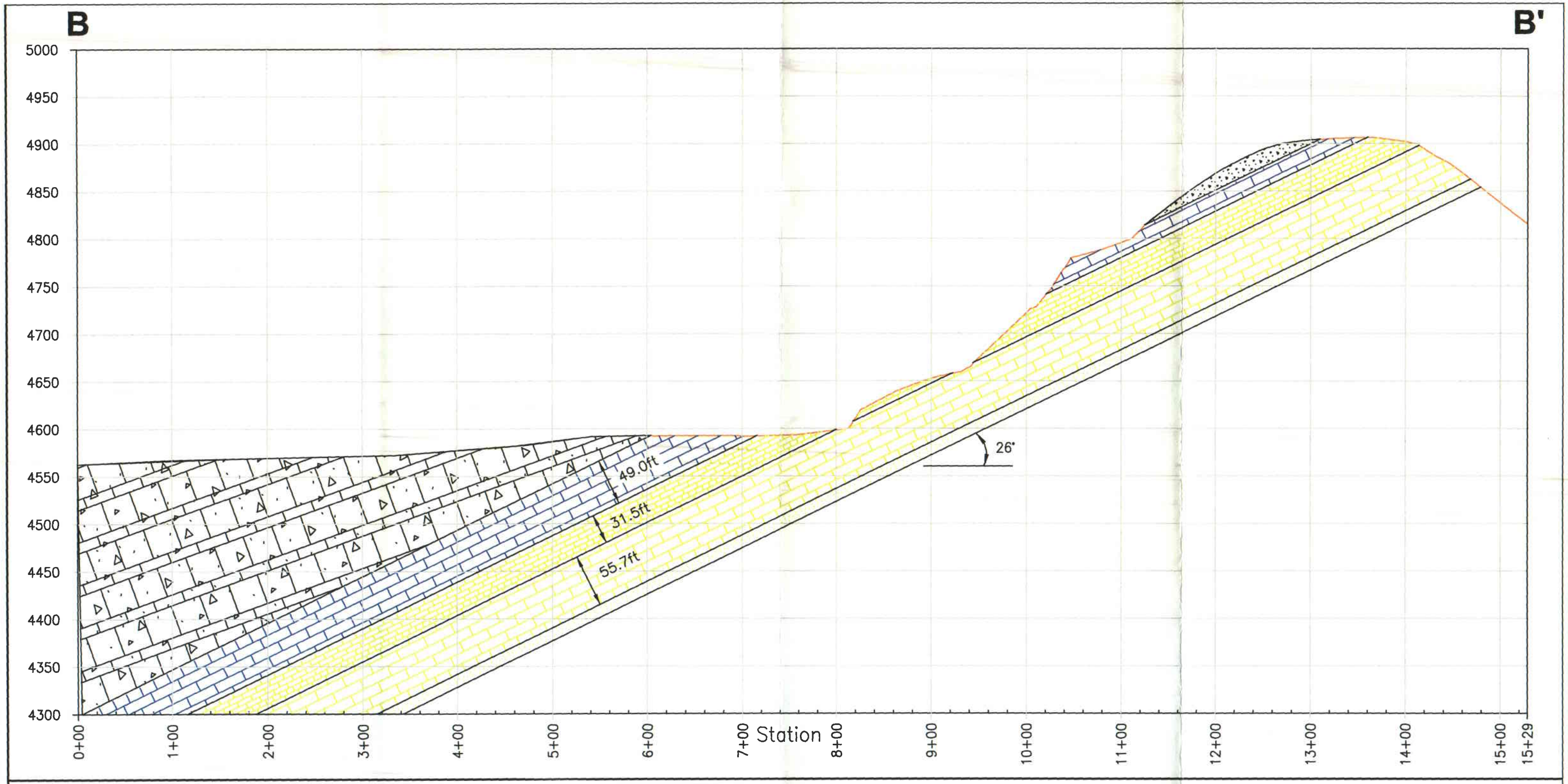
Two fault zones are identified in close proximity to the quarry on plan views provided to Norwest by HOLCIM. One fault passes through the northwest wall of the proposed quarry expansion and strikes N30E, and the other is immediately southeast of the proposed quarry wall and strikes N40E. Field investigators also identified and photographed a fault zone

passing through the middle of the existing quarry. Additional faults are identified both southeast and northwest of the quarry, which have strike orientations ranging from N30E to N50E.

Rock units are generally competent with few throughgoing structures. Discontinuities identified within drill logs were characterized as planar with both rough and smooth surfaces and calcite infilling. Iron oxide staining was also observed. Fractures were mapped with orientations of N22E, N33E and N40W.

Location of faults and orientation mapping of bedded rock units are shown in plan view in Figure 2.2.

During initial start-up efforts at the Poverty Point Quarry, additional geotechnical investigation and analysis should be completed to further identify and describe discontinuities (joint orientations, infilling, presence and character of faulting etc.) and to account for their potential effect on slope stability.



LEGEND

- ALUVIUM
- TALUS (CONGLOMERATE)
- HIGH PURITY Ls
- SILICEOUS Ls
- SANDSTONE

0 50 100 200 300

SCALE: 1" = 100'

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POVERTY POINT

FIGURE 2.1
STRATIGRAPHY

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Fig. 2.1

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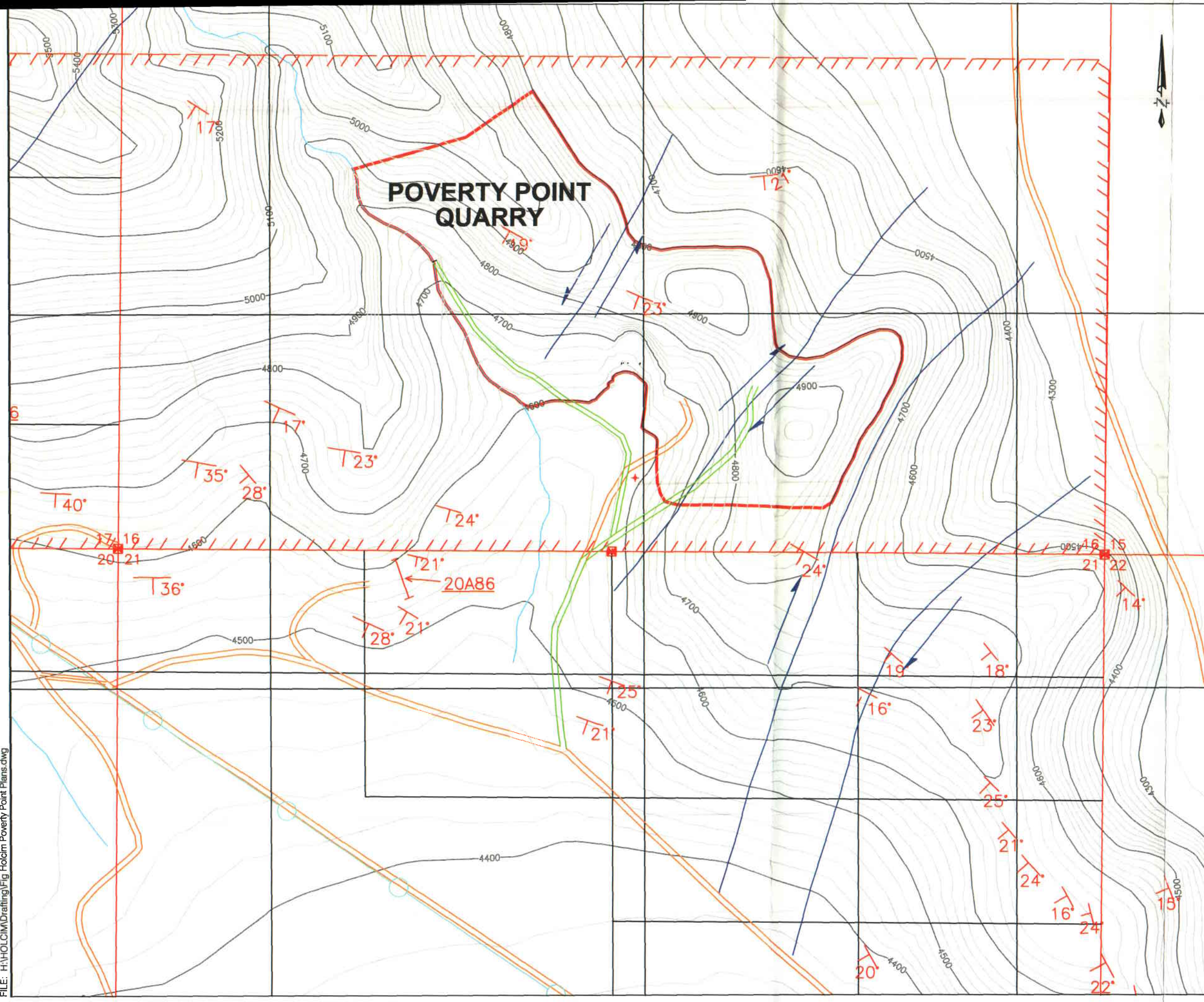

LEGEND

- ROAD (PROPOSED)
- ROAD (UNSURFACED)
- FENCE
- STREAM (INTERMITTENT) / WATER SYMBOL
- HOLCIM PROPERTY BOUNDARY
- 63 / 21.78 — TRIANGULATION STATION & ELEVATION
- DH_50 / 64.2 — DRILL HOLE WITH ELEVATION
- FAULT
- PROPOSED QUARRY BOUNDARY

0 500 1000 1500

SCALE: 1" = 500'

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POVERTY POINT

FIGURE 2.2
STRUCTURE

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Fig. 2.2

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3 ENGINEERING GEOLOGY

This report section describes the engineering geology of the Poverty Point Quarry. In particular, it includes a discussion of the rock joint characteristics and a presentation of the measured and calculated rock mass properties as means for estimating shear strength.

Rational design in bedded slopes is best carried out by assigning engineering properties according to various mappable lithological units. Thus the three main lithologies in the area, limestone, sandstone, and talus (conglomerate) form useful groupings for engineering purposes even though fairly wide variations and gradations can occur within and between these different lithologies.

3.1 ROCK JOINT CHARACTERISTICS

3.1.1 Bedding Joints

Single bedding joints within mappable rock units typically are very persistent, extending for several hundred feet with spacing varying from 1-10'. Due to flexural slip, polished and slickensided bedding surfaces may be common at lithological contacts. It is expected that the spacing, strength, and persistence of bedding will be the major controlling factor for footwall quarry slope stability, in the absence of adversely oriented faulting.

The shear strength of bedding joints is best assessed by considering the weakest bedding planes, as these will control the stability of slopes. In the absence of site specific data, bedding friction angles were based upon typical values for each rock type (see Table 1) for use in preliminary stability evaluation. Site specific values should be confirmed as operations restart.

TABLE 1
DESIGN BEDDING FRICTION ANGLES

Bedding Unit	Friction Angle*
Limestone	30°
Talus (Conglomerate)	30°
Sandstone	25°

*Estimated from Hoek and Bray, 1981

3.1.2 Cross Joints

Minor cross joints have been identified in the existing Poverty Point Quarry face, but systematic mapping has not been carried out, so the degree of orientation scatter and frequency of subsets is not known. Core logging and photos indicate that cross joints are uncommon, but do occur perpendicular to bedding at spacing of 1-20' and are relatively discontinuous. Cross joints are not confined to individual bedding units. Extensive mapping of structural orientations has not been carried out and bench face structure mapping should be undertaken during mining to verify and support design assumptions.

3.1.3 Faults and Shears

Current geological data and interpretation has identified two fault structures which could be mined out and should therefore not influence overall final slope stability. A third fault may be exposed in the existing pit face. No thrust fault or other shear-type structures have been identified. It is likely that some minor structures will occur as mining progresses which may affect overall pit wall stability. Ongoing mapping during operations is necessary to detect adverse structures, and measures for managing resulting slope issues need to be included in the operational plan.

3.2 Rock Mass Characteristics

Rock mass properties were determined from drill hole cores taken from the February 2006 drilling program. Figure 3.1 shows drill hole locations. Representative core samples were chosen for point load and unconfined compression testing. Results are shown in Table 2. Point load and unconfined compression test results fall within the range of generally accepted values for similar rock types.

Table 2

Summary of Laboratory Strength Testing Results

Rock Type	Point Load (Tensile) Strength (MPa)			Unconfined Compressive Strength (MPa)			Range of Typical Values (MPa)	
	Max	Min	Average	Max	Min	Average	Point Load*	UCS**
Limestone	11.4	4.2	7.9	125.8	53.0	84.0	4.0-11.0	50-100

*Adapted from Lama and Vutukuri, 1978
**Hoek and Bray, 1981

Rock mass rating (RMR) classifications for rock units were developed using test data from Table 2 and geotechnical core logging data (Rock Quality Designation (RQD), joint spacing, and joint condition) from drillholes in the existing quarry area. The RMR system provides a means for estimating rock mass shear strengths (Hoek, 1994). For the purpose of calculating RMR, water conditions were estimated as damp. RMR results are summarized in Table 3. RMR calculation results are provided in Appendix F.

TABLE 3
SUMMARY OF ROCK MASS RATING CALCULATION RESULTS

Rock Type	Rock Mass Rating			RMR System Description
	Max	Min	Average	
Limestone	77	30	55	Fair Rock

Unconfined compressive strength (UCS) values indicate that the limestone which comprises the majority of the quarry wall is moderately strong rock and the RMR system confirms this impression based upon point load, core data, and field observations.

The data from Tables 2 and 3 were used to generate rock mass strength parameters using guidelines set forth by Hoek (1994). Mi values (a constant which defines the relationship between principal stresses at the failure point for a given rock) were estimated from a standardized table (Hoek and Karzulovic, 2000). Shear strength envelopes were generated for the limestone rock units within the quarry walls. Shear envelopes were generated using disturbance factors of 0 and 1. Disturbance factors of 0 correlate to rock masses with no significant seismic impacts affecting their structural integrity. Disturbance factors of 1 correlate to rock masses exposed to some seismic impacts (such as that generated by drilling and blasting). Table 4 shows the values used to generate rock mass shear strength envelopes, which in turn are used to characterize rock mass strengths for stability analysis. Shear strength envelope data and curves appear in Appendix G of this report.

TABLE 4
ROCK MASS STRENGTH PROPERTIES FOR STABILITY ANALYSIS

Rock Type	RMR	MI	UCS (MPa)
Limestone	55	9	80

Additional investigation and analyses are required to characterize the rock mass strengths for the other rock units (sandstone and talus/conglomerate). Drilling in 2006 did not intersect either of these units, either due to drill hole location or drillhole depth. Future investigations should be designed to target these rock units, drill to the elevation of the ultimate quarry floor, complete geologic and geotechnical logs, and obtain and test samples of rock core.

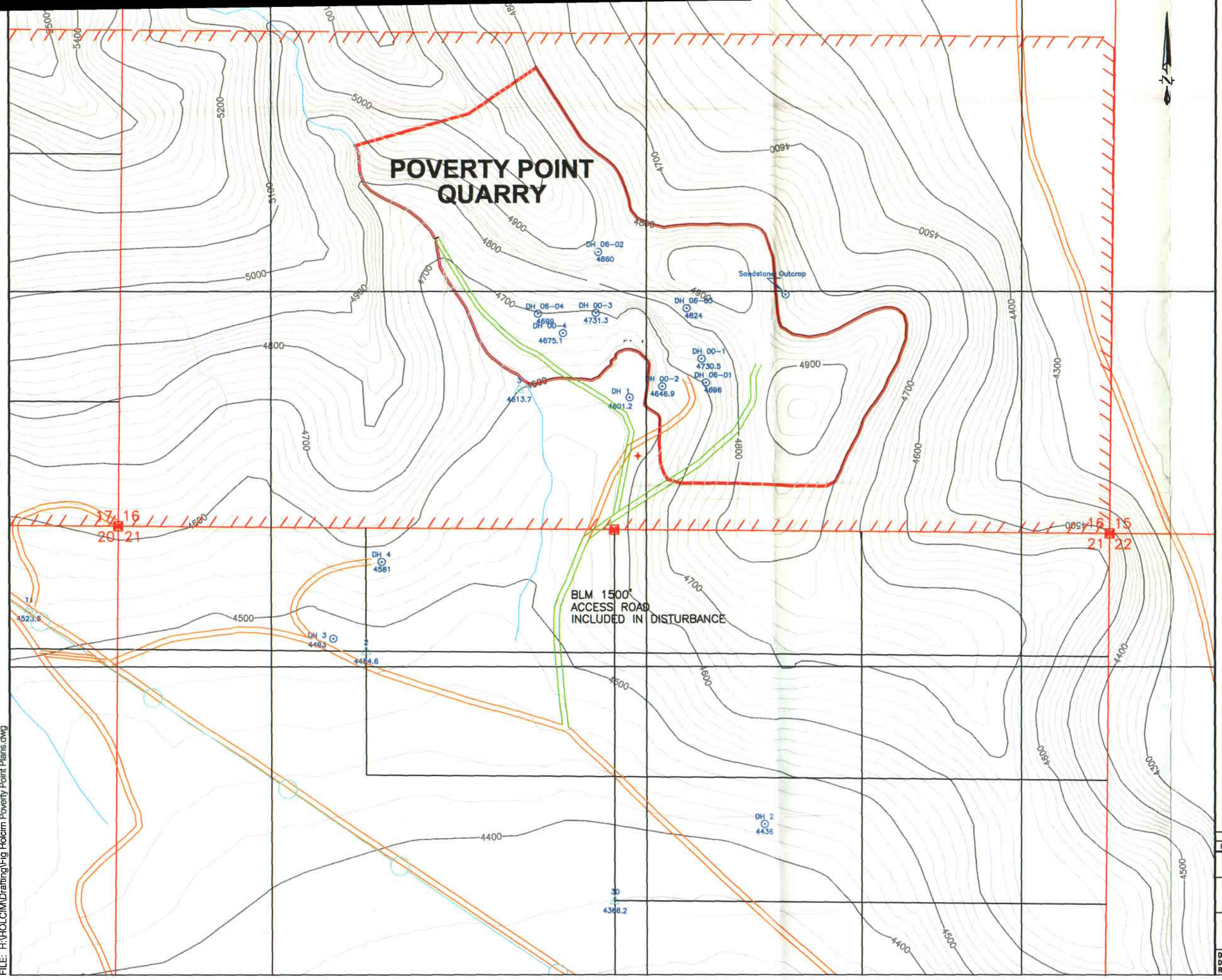
3.3 HYDROGEOLOGY

Limited hydrogeologic data is available for the Poverty Point Quarry; however some qualitative field information can be evaluated and compared to knowledge of groundwater conditions at monitoring sites in similar strata with similar climatological conditions.

The quarry is located on the western edge of the Great Salt Lake Desert with average annual precipitation of 10" (United States Geological Survey). Higher elevations above the quarry may receive as much as 15" annually.

As bedding in the area dips to the southwest, into the existing quarry and away from the planned expansion, water inflow should move out of the mining area through natural seepage and outflow. It is likely all rock units have low hydraulic conductivity, however, flow along bedding planes or discontinuities may be higher. A minor seep was identified on the upper portion of the pit face and small accumulations of water were also noted at the base of the quarry.

Water is not expected to play a critical role in determination of slope stability, as quarry conditions are generally dry. As average groundwater levels have not been reliably established, if future investigations identify water behind pit slopes, its effect upon the integrity of rock units should be accounted for in stability assessment.



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0 500 1000 1500

SCALE: 1" = 500'

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FIGURE 3.1
DRILL HOLES

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Fig. 3.1

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4 SLOPE STABILITY ASSESSMENT

This portion of the report discusses potential failure modes and provides stability assessments for existing quarry slopes, and proposed footwall and endwall slopes. This assessment assumes that, no bench faces, other than the working face, will be developed on footwall slopes.

4.1 EXISTING QUARRY

Quarrying was carried out at Poverty Point prior to the planned expansion addressed in this report. The previous operation developed a quarry advancing from the southwest to the northeast. Rock unit bedding planes strike perpendicular to the direction of mine advance and dip 20-35° southwest. Mining daylighted a number of large bedding planes varying in thickness from 1-50'. These rock units are now retained solely by frictional force and bedding roughness. As it is assumed that the friction angle of bedding units is 30°, in areas where the bedding angles approach 30°, slopes could be at or near a factor of safety (FOS) of 1.0. It is understood that HOLCIM geologists have identified tension cracks above and behind the highwall, which confirms that these slopes are quasi-stable.

4.2 FOOTWALL SLOPE

4.2.1 Potential Failure Mechanisms

There are four primary failure modes that typically govern the design of bedded footwall slopes:

1. Planar slab failure – Daylighted failure planes in steep footwall slopes are obvious stability problems. The existing quarry is a prime example of this failure mode, as daylighted bedded units have become unstable and tension cracks have been identified near the crest of the quarry.
2. Bilinear slab failure – In the absence of daylighted bedding planes, this is the primary failure mechanism considered for stability analyses of the footwall. This mechanism involves sliding parallel to bedding in combination with sliding along a secondary surface dipping out of the slope (Dawson and Barron, 1989). The secondary surface may be a persistent discontinuity surface or, if unfavourably oriented discontinuities are not present, a shear zone (slip surface) developed through the rock mass.
3. Ploughing slab failure – Based on the geologic structure of the quarry, this failure mode is unlikely to occur. No thrust structures that should lead to ploughing were identified at the Poverty Point Quarry.

4. Buckling failure – no contributing factors such as high axial pressures, large curvatures in bedding, or high water pressures were identified. These conditions could be present and slope stability assessments should monitor for them.

4.2.2 Assessment

The unbenched footwall slopes are to be developed on competent rock units (RMR>55), at relatively low angles, and in the absence of daylighting planes of weakness, it is expected that the full height of the quarry footwall may be developed unbenched (up to a maximum wall height of 300'). Measures for controlling the unbenched slopes are discussed in Sections 5 and 6.

Bilinear slab failures have been identified as the primary failure mode in the footwall. Based on current information, variables which may contribute to bilinear failure include:

- slab thickness,
- slab height,
- ground water pressure,
- bedding angle, and
- critical slope angle.

All of these variables were incorporated into the slope stability analysis to determine factors of safety for quarry slopes to bilinear planar failure. Slope/W software was used with fully defined slip surfaces to mimic critical bilinear slab geometries. This software uses the method of slices to calculate the limit equilibrium factor of safety, effectively comparing driving forces to resisting forces. A range of angles for slip surfaces (failure planes) through the rock mass toe were applied. An example of this modeling is shown in Figure 4.1. Slope/W plots appear as Appendix H.

Slope/W analysis was conducted to identify the maximum height of quarry slopes for bedding angles ranging from 20-35° while maintaining a minimum factor of safety of 1.2. A plot of the results is included in Figure 4.1. Results are also reported in Table 5.

TABLE 5
MAXIMUM UNBENCHED FOOTWALL HEIGHTS @ FOS 1.2

Bedding Angle	Footwall Height (ft)
20°	2600
25°	1450
30°	740
35°	485

Results of this initial analysis determined that for the range of bedding angles identified at Poverty Point, footwall slopes may be developed to heights exceeding 400' while maintaining a factor of safety of 1.2.

Slope/W analysis was conducted to identify factors of safety for a range of bedding angles (dip of inclined beds was varied from 20-35°) and a range of slope heights. A sensitivity analysis was also conducted to determine the effect of blast damage (FOS for Disturbed Limestone). Table 6 shows analyses results with FOS for the range of slope/bedding angles, and for undisturbed and disturbed conditions. All wall heights were modeled at 300' with no ground water table.

TABLE 6
UNBENCHED FOOTWALL FACTORS OF SAFETY

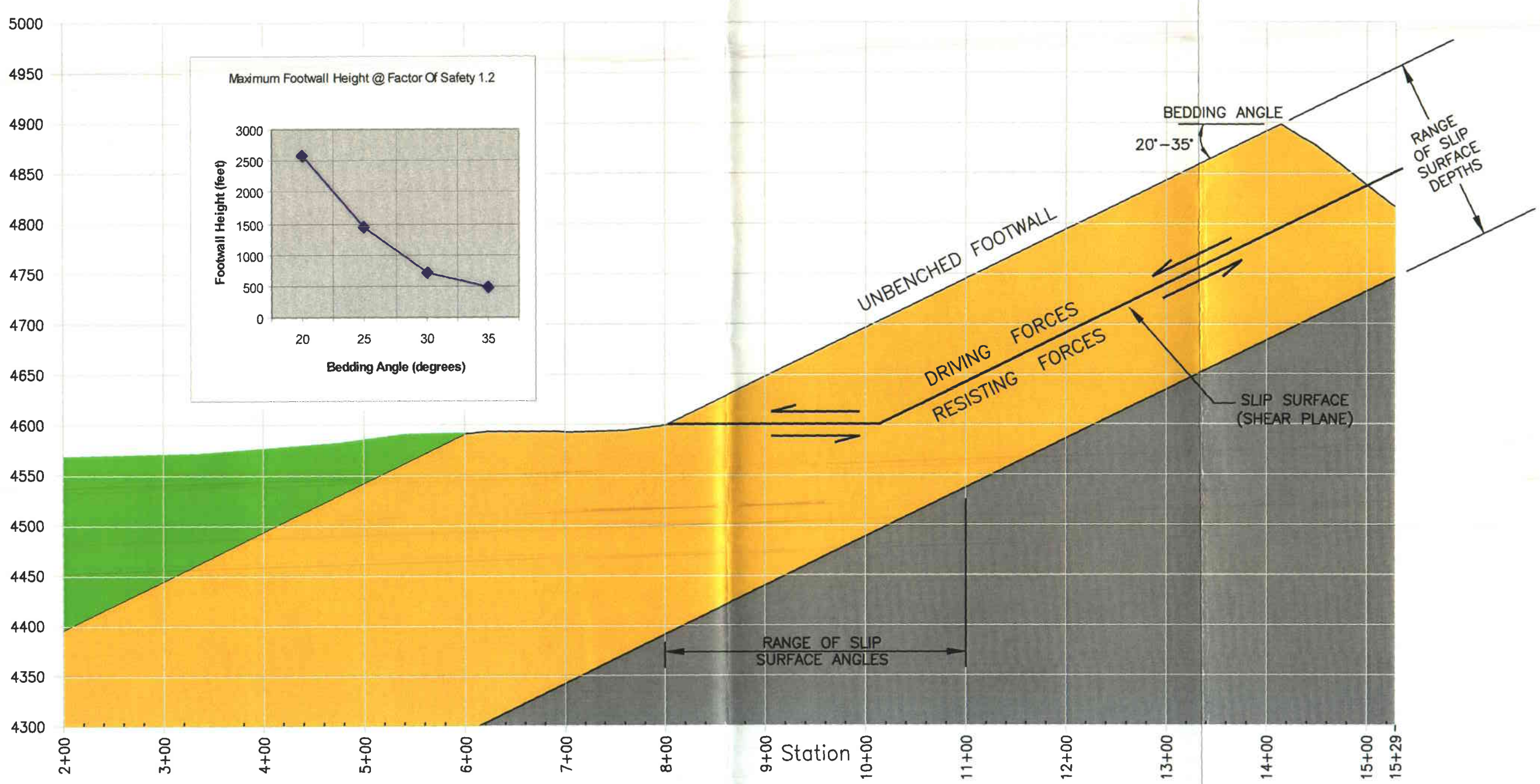
Bedding Angle	Undisturbed Limestone FOS	Disturbed Limestone FOS
20°	4.56	2.63
25°	3.42	1.96
30°	2.83	1.64
35°	2.10	1.22

As the high factors of safety indicate, the limestone units behave as competent rock when subjected to stability analysis. Bedding angles up to 35°, with the footwall in limestone disturbed by blasting, 300' slope heights, and dry conditions will support unbenched footwall slopes. It is reasonable to assume that mine operators should be able to develop the mine from the northeast quarry rim, along unbenched footwall to the bottom of the existing quarry.

Other small-scale slope stability events such as rock ravelling may occur on footwall slopes and should be controlled by operational practices including wall scaling, berming, toe cleanup, trenching, and catch fences as needed.

4.3 ENDWALL SLOPES

The configuration of the Poverty Point Quarry is expected to produce endwalls formed at one or both ends of the quarry. The endwall slopes are relatively narrow and will cut almost perpendicular to the bedding strike, while bedding dips across the endwall. As a result, significant instabilities are unlikely to occur in these areas. As mining progresses, bench face mapping should be carried out to identify potential for planar, wedge, or toppling failures and to provide additional data for geotechnical evaluation. If mining were to advance southwest, while alternately expanding the extent of the working pit face to the northwest and southeast, the development of endwall slopes could be limited. Ultimately, some endwall slope area will be developed in the northwest quarry. Bench heights should be matched to equipment capabilities and regulation berm widths.



BILINEAR SLAB FAILURE CONFIGURATION

LEGEND

- ALUVIUM
- LIMESTONE
- BEDROCK

0 50 100 200 300

SCALE: 1" = 100'

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FIGURE 4.1
STABILITY ASSESSMENT

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Fig. 4.1

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5 PRELIMINARY DESIGN GUIDELINES

This section provides preliminary design guidelines for mining method and slope designs of the Poverty Point Quarry.

5.1 MINING METHOD ON FOOTWALL SLOPES

Figure 5.1 shows the recommended mining method and footwall design. For footwall slopes the following preliminary design guidelines apply:

- Mining is advanced starting at approximate 4920' elevation and moving downslope using 20-50' lifts. Lift size will be dictated by the size of loading equipment used. The general direction of mining is from the northeast to the southwest.
- Footwall slopes are developed parallel to bedding to minimize waste extraction and prevent undercutting and daylighting potentially unstable strata. Overall slope angle varies with bench face angle (20-35°).
- The footwall follows competent strata (sandstone or limestone unit) for the maximum height allowable (up to 300' for 35° bedding angles). .
- If bench face mapping identifies significant discontinuities which could contribute to slope instability, benching will be carried out to comply with equipment capabilities. Site specific design widths should be developed but for initial purposes, the general guideline for bench widths as supplied by the SME Mining Engineering Handbook is as follows:

  Minimum bench width(ft) = 4.5(ft) + 0.2 x bench height(ft)

  A minimum 4ft high berm should be placed on the edge of each bench.

Additional comments:

- It is expected that the Poverty Point Quarry slopes will be dry. If significant water (saturated rock or flowing water) is encountered as mining progresses, additional investigation and remediation should be considered.
- Blast designs are carried out to maintain setback distance from the footwall to limit damage and maintain a continuous bedding plane. Buffer blasting or trim blasting should be considered along trim rows to limit blast damage.

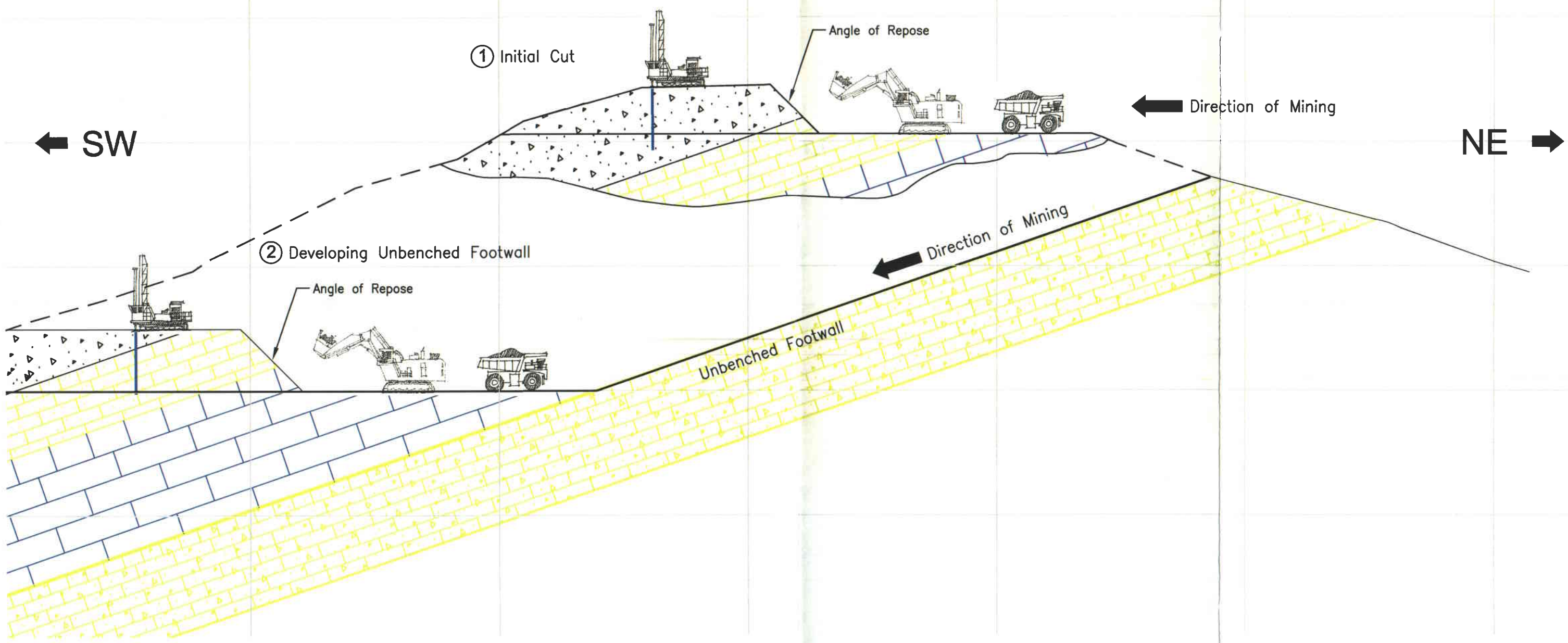
5.2 ENDWALL SLOPES

As endwall slopes are developed, the following preliminary design guidelines are recommended:

- Endwall slopes are developed in accordance with equipment capabilities. Bench face angle is determined by bench face pit mapping and subsequent slope analysis.
- Width of catchment benches for initial design follows general guidelines for bench widths as supplied by the SME Mining Engineering Handbook:

  Minimum bench width(ft) = 4.5(ft) + 0.2 x bench height(ft)

  A minimum 4ft high berm should be placed on the edge of each bench. Bench face pit mapping and subsequent slope analysis may necessitate increasing bench widths to provide for bench scale wedge or toppling failures.
- For overburden and weathered rock slopes, all unconsolidated material shall be sloped to an angle less than the angle of natural repose. In the case of the weathered rock at the Poverty Point Quarry, all bench face angles shall be sloped to <45°.
- Blast designs are carried out to maintain bench face angle. Buffer blasting or trim blasting is carried out along trim rows to limit blast damage.



CONCEPTUAL VIEW OF MINING METHOD

LEGEND

- ALUVIUM
- TALUS
- HIGH PURITY Ls
- SILICEOUS Ls
- SANDSTONE

0 20 40 60 80 100ft

SCALE: 1" = 40'

REV	DATE	DESCRIPTION	BY	CHKD	APRVD
-	-	-	-	-	-

HOLCIM

POVERTY POINT

FIGURE 5.1
MINING METHOD

DRAWN BY: HAS
DATE: 16-May-06
REV: 00

NORWEST

Dwg.: Fig5 Mining Method.dwg

Fig. 5.1

FILE: H:\HOLCIM\Drafting\Fig5 Mining Method.dwg

6 CONCLUSIONS/RECOMMENDATIONS

This report section presents conclusions and recommendations for slope stability at the Poverty Point Quarry. Unless otherwise specified in this report and until superseded by additional slope stability assessment, all operations should be carried out in compliance with MSHA 30CFR Standards.

6.1 CONCLUSIONS

Having evaluated existing geotechnical information for the Poverty Point Quarry, the following conclusions are reached:

- The practice of mining updip of bedding units dipping at or near bedding unit friction angles is technically challenging and increases the potential for wall instability. This practice requires detailed investigation of rock strength properties, extensive slope monitoring, and periodic remediation to limit the potential for slope failure.
- The previous mining method at the Poverty Point Quarry daylighted bedding units dipping into the quarry and contributed to quasi-stable conditions.
- Additional geotechnical investigation should be completed prior to mine start-up to verify design assumptions, define additional geotechnical parameters (see section 6.2) and complete a thorough assessment of slope stability at the Poverty Point Quarry.
- Based upon current knowledge of geotechnical parameters at Poverty Point, the quarry may be developed on unbenched footwall slopes and benched endwalls with mining proceeding downslope and downdip of bedding from the northeast to the southwest.

6.2 RECOMMENDATIONS

These recommendations are made to support and verify preliminary design guidelines and to complete the assessment of quarry slope stability:

1. The previous practice of mining updip should be discontinued. Alternative mining methods are available to HOLCIM operators and should be adopted.
2. Due to the presence of daylighted beds, dipping near or at friction angles, and tension cracks indicating slope movement, the existing quarry floor should be maintained as a restricted access site, signage installed and the area bermed off to prevent access by personnel or mine equipment.
3. Additional geotechnical investigation should be completed, including:

a) Geotechnical core drilling – 2 vertical holes targeted to capture the full extent of footwall strata – the first hole from 4900' to 4600' at the saddle between the east and west knobs, and the second from 5000' on the crest of the west ridge to the 4600' elevation (see Figure 6.1). Depth to water should be identified at each hole.

b) Quarry bench face structure mapping – mapping of strikes, dips, persistence, aperture, surface roughness, water/flow, and other observed structural features.

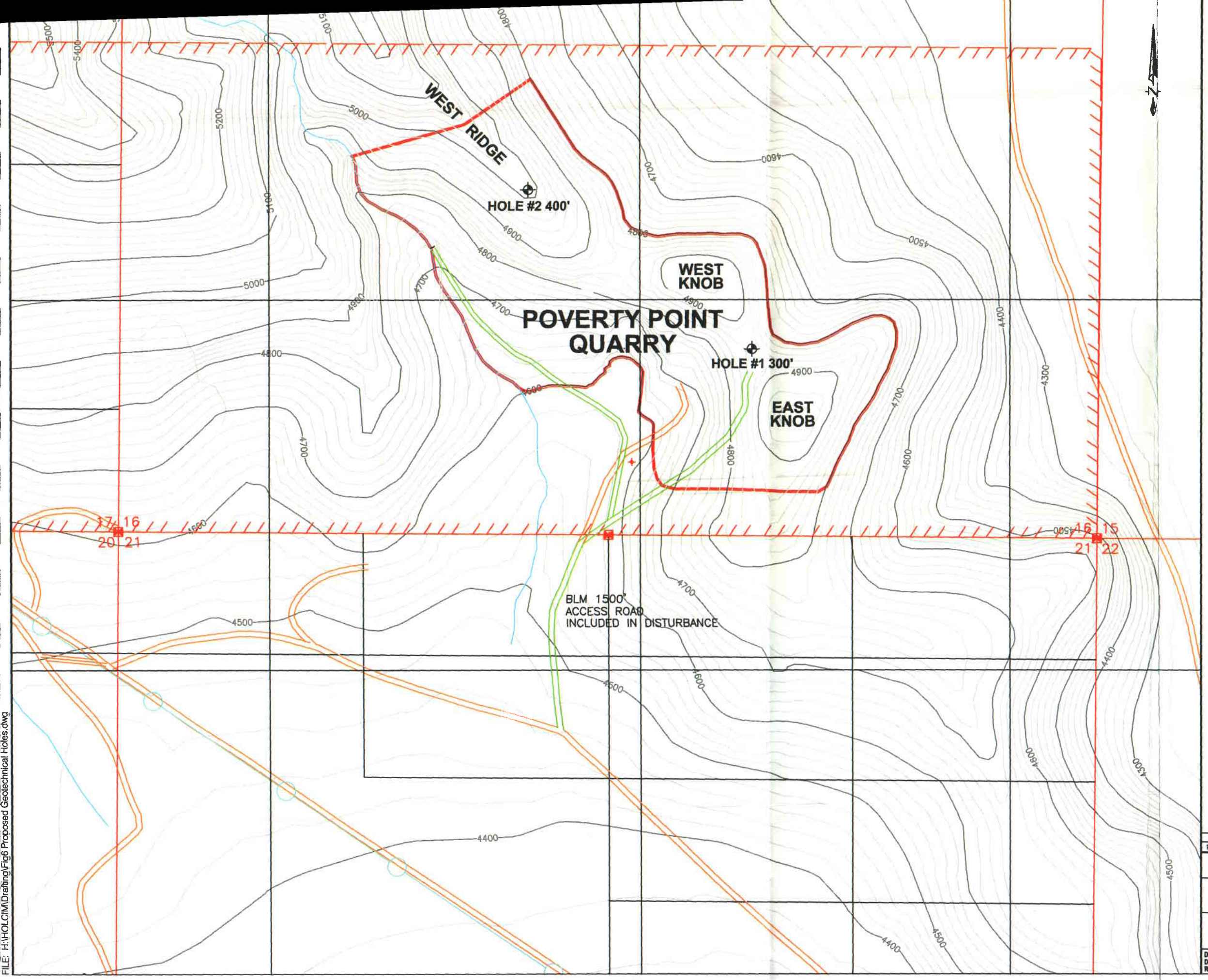
c) Point load and unconfined compressive strength testing of samples from geotechnical core drilling.

d) Direct shear testing of samples from geotechnical core drilling to identify friction angles.

e) Further site investigation – geologic mapping of surface outcrops, identification of hydrogeologic features (seeps, springs, streams).

4. A slope maintenance and monitoring plan should be developed to define procedures which provide for operations, maintenance, and surveillance of quarry slopes. The plan should address cleaning and/or clearing pit walls and benches, construction of catch berms or trenches where necessary, restricted access provisions, and active mitigation of pit walls. The monitoring section should include slope audit procedures, bench face mapping procedures, emergency preparedness plans, and survey slope monitoring. The plan should also include a basic water management plan with descriptions of water audits, identification of water sources, any necessary construction and maintenance of surface run-off diversion measures, filling and grading of tension cracks to minimize water inflow and other mitigation.

5. A controlled blasting plan should be developed to minimize damage to the quarry walls. The plan should include blast audits, fragmentation requirements, contingency plans for overblasting, blasthole parameters, measures to monitor and control hole quality, timing sequence, powder factors and kilocalories per ton, stemming, decking, vibration monitoring and control for vibration frequency and shot duration. Alternate plans for blasts adjacent to final walls should be included.



LEGEND

- ROAD (PROPOSED)
- ROAD (UNSURFACED)
- FENCE
- STREAM (INTERMITTENT) / WATER SYMBOL
- HOLCIM PROPERTY BOUNDARY
- PROPOSED QUARRY BOUNDARY
- GEOTECHNICAL CORE HOLE

0 500 1000 1500

SCALE: 1" = 500'

REV	DATE	DESCRIPTION	BY	CHKD	APRVD

HOLCIM

POVERTY POINT

FIGURE 6.1
PROPOSED GEOTECHNICAL HOLES

DRAWN BY: HAS
DATE: 17-May-06
REV: 00

NORWEST

Dwg.: Fig6 Proposed Geotechnical Holes.dwg

Fig. 6.1

FILE: H:\HOLCIM\Drafting\Fig6 Proposed Geotechnical Holes.dwg

APPENDIX A

Drill Hole Logs

Geologist's Drilling Report — Holcim

Hole NO. DH-06-1

GEOLOGIC LOG OF DRILL HOLE

Sheet 1 of 2

Project: POVERTY POINT 2006 | L.s. Thickness: | Top L.s. Elev.:

Location: POVERTY POINT, UT | O.B. Thickness: | Bottom L.s. Elev.:

Coordinates: | Date Started: 1-30-06 | Total Depth of Hole: 122

Date Finished: 2-2-06 | Contractor: Godbe Drilling

Collar Elevation: N40° 48' 48.8" WGS84 W112° 45' 01.1' -4730 | Hole Logged: 2-2-06 | Driller:

Bearing and Dip: VERT | Water Level: NONE | Logged By: INEWMAN

Thickness	Depth	CORE, RECOVERY DATA — Reason for Lost Core, Water, Casing, Cementing: Depth From	Depth To	Length	Core Size	Actual Length	% Rec.	Sample	Graphic Log	Depth	Formation Description — Bedding, Structure and Geology
											Logging not - not for engineering
0		0	7	7	N/A	0	0	0-7 no sample	GRAVEL		0-7 Overburden - Light gray-gray, black limestone gravels sand carbonate silt, slope wash from above, calcite coatings
10		7	13	6	NQ	0.5	8%	7-13			7-28 Limestone, black, brown mottling, very fine grained, dense, competent bedrock, no fossils
											Stump material
		13	18	5		0.5	10%	13-18			broken, aggregate, thin bedded
20		18	20.5	2.5		.5	20%	18-22.5			
		20.5	22.5	2.5		.5	20%				Great Blue Limestone Fm.
		22.5	28	5.5		1.0	20%	22.5-28			
								28-30			28 - Competent limestone, no visible staining
30		28	34	6.0		5.5	92%	30-34			30-34 Gouge - chunks [illegible] contact mixture with black to [illegible] fragments at 30°
		34	39	5.0		5.1	100%	34-39			34-67.3 Limestone, dk black/brk, v f g, hard brittle, competent, no [illegible] white calcite specks, no fossil
40		39	43	4.0		3.0	75%	39-47			- White calcite veinlet down center of core
		43	47	4.0		3.0	75%				
		47	52	5.0		5.0	100%	47-54			47 - Fracture at 52°
50											grading to medium grained
		52	57	5.0		5.0	100%	54-62			55 - black chert nodules - hard brittle 55.1 - red staining in fracture
60		57	62	5.0		5.0	100%				59 - fracture - red staining
											fossil - white calcite coral
		62	67	5.0		5.0	100%	62-67.3			good competent limestone
											65 - white gouge in fracture plane
70		67	72	5.0		5.0	100%	67.3-70			67.3 - 70 Limestone, lt gray, reddish hue, med grained, competent, hard see p. 2

Hole Size: NQ'

Hole No. DH-06-1

Geologist's Drilling Report — Holcim

Hole NO. DH-06-1

GEOLOGIC LOG OF DRILL HOLE

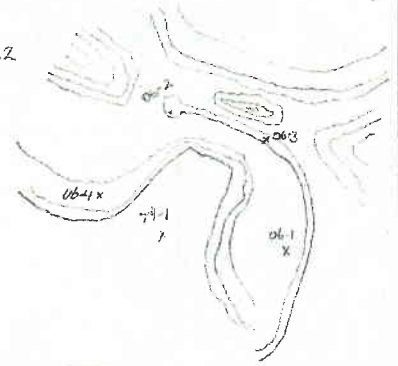
Sheet 2 of 2

Project: Poverty Point 2006
Location: Poverty Point, UT
Coordinates:
Collar Elevation:
Bearing and Dip: Vert

L.s. Thickness:
O.B. Thickness:
Date Started: 1-30-06
Date Finished: 2-2-06
Hole Logged: 2-2-06
Water Level: None

Top L.s. Elev.:
Bottom L.s. Elev.:
Total Depth of Hole: 122
Contractor: Godbe Drilling
Driller:
Logged By: T Newman

Thickness	Depth	CORE, RECOVERY DATA (Reason for Lost Core, Water, Casing, Cementing) Depth From	Depth To	Length	Core Size	Actual Length	% Rec.	Sample	Graphic Log	Depth	Formation Description (Bedding, Structure and Geology)
70		67	72	5.0	NQ	5.0	100%	70-77			67.3-70 Limestone, lt gray-reddish hue, competent, brittle, FeOx staining throughout, no organized cherty-nodules
		72	77	5.0		5.0	100%				70-109 Limestone, dk gray-black, med grained, dense, hard, brittle, white calcite fossils-corals, crinoids, FeOx stained fractures; calcite; calcite
80		77	82	5.0		4.0	80%	77-82			77-77.5 - White Calcite Vein; 80-81 - White Calcite Vein parallel to bedding
		82	86	4.0		3.8		82-90			Fractured in place badly broken 86-90
		86	90	4.0		3.5					
90		90	93	3.0		3.0	100%	90-98			Fossil fragment; Fracture-no staining; calcite vein - 70°
		93	98	5.0		4.8					
100		98	103	5.0		5.0	100%	98-103			Competent dk gray-black limestone
		103	108	5.0		5.0	100%	103-110			calcite-white
110		108	111	3.0		2.8					110-122 Limestone, dk gray, med gr, hard brittle with white calcite veinlets.
		111	113	2		1.5		110-116.5			
		113	116.5	3.5		3.5	100%				Completely fractured no core over 6" long
		116.5	120	3.5		3.0		116.5-122			
120		120	122	2		2	100%		TD 122		TD:122



Hole Size: NQ

Hole No. DH-06-1

Geologist's Drilling Report — **Holcim** — Hole NO. DH-06-2

GEOLOGIC LOG OF DRILL HOLE

Sheet 1 of 2

Project: Poverty Point 2006 | L.s. Thickness: | Top L.s. Elev.:

Location: Poverty Point, UT | O.B. Thickness: | Bottom L.s. Elev.:

Coordinates: N 40° 48' 35.6" WGS84 / W 112° 45' 08.7" 4847' | Date Started: 2-3-06 | Total Depth of Hole: 138

Date Finished: 2-4-06 | Contractor: Cable Drilling

Collar Elevation: | Hole Logged: 2-4-06 | Driller:

Bearing and Dip: VERT | Water Level: NONE | Logged By: JNEWMAN

Thickness	Depth	CORE, RECOVERY DATA — Reason for Lost Core, Water, Casing, Cementing: Depth From	Depth To	Length	RQD (Modified)	Actual Length	% Rec.	Sample	Graphic Log	Depth
0		0	3	3	10/22 45%	2.2	73%	0-8		
		3	6	3	4/20 20%	2.0	67%			
		6	8	2	16/20 80%	2	100%			
10		8	11	3	8/30 4%	2	67%	8-15		
		11	16.5	5.5	20/55 36%	2.1	38%			
		16.5	21	4.5	45/45 100%	5	100%	15-23.3		
20		21	26	5	45/50 90%	5	100%			
		26	31	5	50/50 100%	5	100%	23.3-31		
30		31	36	5	48/50 96%	5	100%	31-36.9		
		36	39	3	0/30 0%	2.5	83%	36.9-42.4		
40		39	43	4	16/40 40%	3.4	85%			
		43	47	4	18/40 45%	4	100%	43-47		
50		47	52	5	10/50 20%	4	100%	47-55.6		
		52	57	5	23/50 46%	2.9	100%			
60		57	62	5	21/50 42%	5	100%	55.6-62		
		62	67	5	6/50 1%	5	100%	62-72		
70		67	72	5	48/50 96%	5	100%			

Formation Description — Bedding, Structure and Geology

Logged wet. 2.8F = 2.8 depth-fracture chart

0 - 15.2 Limestone, dk-black, med grained, hard, competent - fractured, white calcite stars, boulder

2.8F 50°

5.0F - open, few calcite crusted, 50°

7.0F

- badly broken fractured limestone

12-13.5 Fragmented limestone rehealed with calcite veinlets

15.2F 60° white calcite in fracture plane

16.0F 60°

17.5, 17.9F

19.5F - Fe/Ox staining 55°

20.1F - calcite

22F - 20% FeOx, 15.2 - 23.3 Limestone, dk gray - gray, lt. brown, med. grained, competent, white calcite stars

23F - 20% stain

23.3 - 36.9 Limestone, gray-brown mottled, med grained, competent, white calcite veining

29.0F

33.2F Red stained 15° shallow

36.9F - parting - clay - FeOx

36.9 - 42.4 Limestone, dk gray, med grained, competent, calcite stars

42.4-43 Boxwork texture - dissolution forms

44.0F orange clay gouge

45.0F

47.1F 70° Banding to gray color, med-coarse grained, highly fractured 47.1 - 55.6

51.0 cavity

loose carbonate/sandy sand - flowing contact

55.6 - Limestone, dk gr-black med grained hard competent, calcite stars, barite, fractured

61.7-61.5F 70°, 40°

62.8F - 70° - calcite

badly broken vertically down the middle of the core to 72'

61.5F 70° genomic gray color

72 - solid competent limestone

68F - 4" of core - red FeOx staining

Hole Size: NQ/NX RQD Min. 4"

Hole No. DH-06-2

Geologist's Drilling Report — Holcim

Hole NO. DH-06-2

GEOLOGIC LOG OF DRILL HOLE

Sheet 2 of 2

Project: Poverty Point 2006 | L.s. Thickness: | Top L.s. Elev.:

Location: Poverty Point, UT | O.B. Thickness: | Bottom L.s. Elev.:

Coordinates: | Date Started: 2-3-06 | Total Depth of Hole: 138

Date Finished: 2-4-06 | Contractor: Godbe Drilling

Collar Elevation: | Hole Logged: 2-4-06 | Driller:

Bearing and Dip: VERT | Water Level: NONE | Logged By: TNewman

Thickness	Depth	CORE, RECOVERY DATA — Reason for Lost Core, Water, Casing, Cementing: Depth From	Depth To	Length	Modified RQD	Actual Length	% Rec.	Sample	Graphic Log	Depth	Formation Description — Bedding, Structure and Geology
70		67	72	5	48/50 96%	5	100%	62-72			72-122 Limestone, dk gray to gray, med-coarse grained, competent, brittle, uniformly fractured, some healed w/ white calcite,
		72	77	5	36/50 72%	5	100%	72-81.5			-74.3 F - ∥ Rel. Fol. -76 F
80		77	81.5	4.5	22/50 44%	4.5	100%				Fractured with calcite healing -81 - stylolite? 81.5 F 70°
		81.5	86	4.5	20/50 40%	4.5	100%	81.5-92			-83.2 F gouge, clay, calcite -0.8 - broken fractures
		86	87	1	0%	1	100%				-86.2, 86.8 F 25°, 70°
90		87	92	5	21/50 42%	5	100%				-88 F clay, calcite - ∥ -91.5 - F shear along calcite veinlet 70°
		92	97	5	11/50 22%	5	100%	92-97			92-97 - completely fractured with broken
100		97	100	3	0/50 0%	3	100%				97-100 - completely fractured, weathered surface planes
		100	103	3	0/50 0%	3	100%	97-103			100-103 completely fractured weathered surface planes
		103	108	5	.6/50 1%	5	100%				103-108 - completely fractured weathered surface planes
110		108	113	5	12/50 26%	5	100%	103-113			72-122 Fractured Limestone, dk gray-black with bands showing in micro fractures, broad brittle, competent, shear with vertical or ∥ to the fractures (rupture seams), with calcite infilling
		113	118	5	10/50 20%	5	100%				
120		118	121	3	.6/50 2%	3	100%	113-122			broken fractured core
		121	125.5	4.5	12/45 27%	4.5	100%	122-125.5			122 Limestone, dk gray-gray, coarse to med grained, distinct, dull gray color to gray-blue color alone, broad brittle, fractured, arenaceous
130		125.5	130.5	5.0	22/50 44%	4.8	96%	125.5-130.5			
		130.5	135	4.5	12/45 26%	4.5	100%	130.5-138			FRACTURE, possibly along bedding?
		135	138	3	11/30 25%	3	100%				
140									TD:138		TD:138

Geologist's Drilling Report — Holcim

Hole NO. DH-06-3

GEOLOGIC LOG OF DRILL HOLE

Sheet 1 of 2

Project: POVERTY POINT 2006 — L.s. Thickness: — Top L.s. Elev.:

Location: POVERTY POINT, UT — O.B. Thickness: — Bottom L.s. Elev.:

Coordinates: N 40° 48' 52.7 NE584 / W 112° 45' 02.5 4853 — Date Started: 2-5-06 Sunday — Total Depth of Hole: 90

Date Finished: 2-6-06 — Contractor: Badbe Drilling

Collar Elevation: — Hole Logged: 2-6-06 — Driller:

Bearing and Dip: VERT — Water Level: NONE — Logged By: J NEWMAN

Thickness	Depth	CORE, RECOVERY DATA (Reason for Lost Core, Water, Casing, Cementing) Depth From	Depth To	Length	Run Length / RQD	Actual Length	% Rec.	Sample	Graphic Log	Depth
0		0	1.5	0-18" 1.5	0%	.5		0-10		
		1.5	4	0-40" 3.5	0%	2	50%			
		4	8	4	0-40 0%	4	100%			
10		8	10	2	0-20 0%	1.0	50%			
		10	15	5	39/40	5	100%	10-20		
20		15	20	5	50/50 100%	5	100%			
		20	25	5	45/50 90%	5	100%	20-30		
		25	30	5	48/50 96%	5	100%			
30		30	35	5	45/50 90%	5	100%	30-35		
		35	40	5	37/50 74%	5	100%	35-43.4		
40		40	45	5	45/50 90%	5	100%			
		45	50	5	48/50 96%	5	100%	43.4-47.5		
50		50	55	5	47/50 94%	5	100%	47.5-55		
		55	60	5	34/50 68%	5	100%	55-65		
60		60	65	5	31/50 62%	5	100%			
70		65	70	5	47/50 94%	5	100%	65-75		

Formation Description
Bedding, Structure and Geology

LOGGED WET, EXAMPLE 2.8F = 2.8' FRACTURE

0-35 LIMESTONE, dk gray-black, med to fine grained, hard brittle, highly fractured, white calcite veining and fracture in filling

0-10 - FRACTURED broken rock

10.2 58° — 10- Solid competent rock

11.1 F 68° — coarse grained

14.7 F 32° — 15.5-16.5 - thin bedding banding

15.5

16.5 F ∥ to core red fe ox staining

19.5 F 70°

21.5 - F 70° — stylolite at 21.6

23 - ∥ to core - red fe ox staining

24.6 F 55° — solid competent core

26.3 F 20° — 26.0 fossil and 29.5 varved texture

29.7 F 30° - fe ox stained

36.4 F 66°

34.5 F - 70° white calcite filled

35.0 F ∥ red fe ox staining

36.2 F 40°

37.5 F 45°

39.5 F 50° calcite filled

35-47 limestone, dk gray-black, some are dull color to bluish limestone mixing, hard competent

43.4-46 fractured rock healed with white calcite, open cavities ∥ to core

47.5-70 limestone, dk gr-black med grained, hard, competent, white calcite veinlets, fracture planes, bedding planes

48: stylolites

calcite veinlets

52.5 F ∥ fe ox staining open

54 ∥ core red fe ox stained fracture

55.2 F 40°

58.5 F 50° — medium grained

59.7 F 72°

60 F 70°

60.1 F 40° - red-orange fe ox staining

- stylolites ∥ to core!

63.5 F 75° calcite filled

65.7 F 10° fe ox staining

interbedding with brown chert? or insolubles

69.7 F 25° fe ox

NOTE: REC. DUE PENTA. ON BOTTOM OF FIRST 10'

Hole Size: NQ RQD min. 4"

Hole No. DH 06-3

Geologist's Drilling Report — Holcim

Hole NO. DH-03-3

GEOLOGIC LOG OF DRILL HOLE

Sheet 2 of 2

Project: POVERTY POINT 2006 | L.s. Thickness: | Top L.s. Elev.:

Location: POVERTY POINT, UT | O.B. Thickness: | Bottom L.s. Elev.:

Coordinates: | Date Started: 2-5-06 | Total Depth of Hole: 90

Date Finished: 2-6-06 | Contractor: Godbe Drilling

Collar Elevation: | Hole Logged: 2-6-06 | Driller:

Bearing and Dip: VERT | Water Level: NONE | Logged By: TNEWMAN

Thickness	Depth	CORE, RECOVERY DATA — Reason for Lost Core, Water, Casing, Cementing: Depth From	Depth To	Length	modified RQD	Actual Length	% Rec.	Sample	Graphic Log	Depth	Formation Description — Bedding, Structure and Geology
70		70	75	5	45/50 90%	5	100%	65-75			47.5-70.0 LIMESTONE, dk gray-black, med grained, hard competent, layered, fractured-calcite filled, bedding planes-occ. Fe Ox staining. 73.5F 70° 74.5F 75° 77F 70°
80		75	80	5	50/50 100%	5	100%	75-81			70.0-81.0 LIMESTONE, dk gray-brownish tint, fine grained, hard, competent grading to v.f.g., calcite filled fractures, occ dendrites. 79.0F 68° 80.1F 60°
		80	85	5	26/50 52%	5	100%	81-85			FRACTURED broken 81-85 LIMESTONE, dk gray-bluish tint med. grained, competent, brittle. 83.0F 65° 85 FRACTURED
		85	90	5	25/50 50%	5	100%	85-90			85-90 LIMESTONE, dk gray, med grained with black chert-organized, hard basic competent, brown staining. 88.7F 25° Fe Ox staining
90									78:95		
100											
110											

Hole Size: NQ

Hole No. DH-06-3

Geologist's Drilling Report — **Holcim**

Hole NO. DH-06-4

GEOLOGIC LOG OF DRILL HOLE

Sheet 1 of 2

Project: POVERTY POINT 2006
Location: POVERTY POINT, UT
Coordinates: N40° 48' 52.3" N0.83 W112 45° 43.9220
Collar Elevation:
Bearing and Dip: VERT

L.s. Thickness:
O.B. Thickness:
Date Started: 2-6-06
Date Finished: 2-7-06
Hole Logged: 2-7-06
Water Level: NONE

Top L.s. Elev.:
Bottom L.s. Elev.:
Total Depth of Hole: 90.5
Contractor: Bobbe Drilling
Driller:
Logged By: J NEWMAN

Thickness	Depth	CORE, RECOVERY DATA — Depth From	Depth To	Length	MED/FIND RQD	Actual Length	% Rec.	Sample	Graphic Log	Depth	Formation Description — Bedding, Structure and Geology
											LOGGED WET 38.6F: 38.6 FRACTURE
0		0	5	5	26/50 52%	3.5	1	0-1.5			0-1.5 LIMESTONE, GRAY, FINE GRAINED, COMPETENT
								1.5-10			1.5-8.7 LIMESTONE, dk GRAY, - black, MED GR COMPETENT BRITTLE, FRACTURED WITH CALCITE FILLING
		5	10	5	42/50 84%	4.5	90%				5.0 CALCITE VEIN
											8.0F FeOx STAINED 20°
10		10	15	5	0-15 0% 29/50 58%	5	100%	10-21.5			FRACTURED ROCK - SAND GRAVEL
											13.7F 20° FeOx
		15	16.5	1.5	58%	1.5	100%				MED GRAINED, bluish TINT
											FRACTURED
20		16.5	21.5	5	26/50 32%	5	100%				18.0F 45° 19.0F 70°
											BROKEN FRACTURED ROCK
		21.5	26.5	5	16/50 32%	5	100%	21.5-31.5			24.3F FeOx STAINED FRACTURE AT 45°
											LARGE CALCITE VEIN AT 60°
		26.5	31.5	5	35/50 70%	5	100%				27.1F 68° 28.1F 70° calcite filled
30											30.0F ∥ CORE FeOx STAINED
		31.5	36.5	5	35/50 70%	5	100%	31.5-41.5			31.5F FeOx 20° 32.3F FeOx 15° 34.0F FeOx 10°
											FRACTURE ∥ TO CORE - CALCITE FILLED
40		36.5	41.5	5	24/50 48%	5	100%				38.2F 35° 40.0F 60°
											MEDIUM GRAINED LIMESTONE
		41.5	46.5	5	34/50 68%	5	100%	41.5-51.5			42.5F 70° Stylolite - NO insolit
											46.0F FeOx STAINED ∥ TO CORE
50		46.5	51.5	5	29/50 58%	5	100%				49 Stylolite - FeOx STAINED 49.5
											BROKEN FRACTURED
		51.5	56.5	5	23/50 46%	5	100%	51.5-57.0			52.0F ∥ TO CORE FeOx STAINING FRACTURE, FeOx ??
								57-58.3			57.0-58.3 LIMESTONE, dk gray, fine grained, hard COMPETENT, black chert, GRAINING, TO V.F.G.
60		56.5	61.5	5	23/50 46%	5	100%	58.3-66.5			58.3-66.5 LIMESTONE, dk gray, black, bluish TINT, MED-COARSE GRAINED, COMPETENT, BRITTLE, CALCITE FILLED FRACTURES
		61.5	66.5	5	23/50 46%	5	100%				60.0F ∥ TO CORE FeOx 62.5F 45°
											CALCITE VEINLETS FILLING FRACTURES AT 75°
70		66.5	71 STICK-UP	4.5	41/50 82%	4.5	100%	66.5-71			66.5- LIMESTONE, dk GRAY, black MED-FINE GRAINED WITH RED STAINED VEINLETS throughout. Evenly disseminated. Hard BRITTLE 68.5F 60°

Hole Size: NQ RQD min. 4"

Hole No. DH-06-4

Geologist's Drilling Report

Holcim

GEOLOGIC LOG OF DRILL HOLE

Hole NO. DH-06-4

Sheet 2 of 2

Project: POVERTY POINT 2006
Location: POVERTY POINT, UT
Coordinates:
Collar Elevation:
Bearing and Dip: VERT

L.s. Thickness:
O.B. Thickness:
Date Started: 2-6-06
Date Finished: 2-7-06
Hole Logged: 2-7-06
Water Level: NONE

Top L.s. Elev.:
Bottom L.s. Elev.:
Total Depth of Hole: 90.5
Contractor: God be Drilling
Driller:
Logged By: TNEWMAN

Thickness	Depth	CORE, RECOVERY DATA — Reason for Lost Core, Water, Casing, Cementing: Depth From	Depth To	Length	MODIFIED RQD	Actual Length	% Rec.	Sample	Graphic Log	Depth	Formation Description — Bedding, Structure and Geology
70		66.5	71	4.5		4.5	100%	66.5-71			71.6-81.4 LIMESTONE, dk gray-black, FINE TO MED. GRAINED - black CHERT, ORGANIZED hard, COMPETENT, brittle, FeOx staining in fractures
		71	76	5	50/50 100%	4.5	90%	71-81.4			75.8F 70°
		76	81	5	42/50 84%	5	100%				77.4F 28° NOTE: RED FeOx STAING through OUT CORE in MICRO FRACTURES
80		81	85	4	34/40 85%	4	100%	81.4-88.6			81.4-88.6 LIMESTONE, dk gray-black TINT, MED GR hard competent, brittle, calcite; 82.3F 70°; 83.4F ⊥ CORE, FeOx
		85	86	1	1/1 100%	1	100%				
		86	90.5	4.5	25/45 56%	4.5	100%	88.6-90.5			88.6-90.5 LIMESTONE, GRAY, HAT TINT, FINE GRAINED, ARENACEOUS, hard, brittle, COMPETENT, FRACTURED; NO FRACTURED; TD: 90.5
90									TD: 90.5		
100											
110											

Hole Size: NQ RQD min. 4"

Hole No. DH-06-4

NORWEST CORPORATION

Geotechnical - Rock Core Log - Fractures

PROJECT: HOLCIM - Poverty Point

HOLE No: DH-06-02

LOCATION:

DRILLER / RIG:

DATE: 16 Feb 06

CLIENT: Holcim

LOGGED BY: Eric Martin (ERM)

Run #	From:	to
Drilled:	Rec:	=
Core Dia:	Type:	

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	Graphic & Dip TCA	DISCONTINUITIES Type & Description	Core Box	SAMPLES	Fracture Spacing
1	R 1		0-19.9 LS, v dk gray, fine to med grain. Variably abt calcite veins 1-5mm. Zones of rubble w redrilled & caved material. Massive bedding	32	3		Closely Spaced			7 CS 90mm
2										
2.5							Lost Core	B		
3	3.0									
	R 2			0			Rubble	O		VCS
4	4						Lost Core	X		
	R 3			18	3	25	J, Ir, R broke on vein Closely Spaced	1		CS
5.0										
6	6						Lost Core			
7	R 4			52	3	30	J, Pl, S			CS
7.5						50	J, C, S			
8	8									
9	R 5			0	3					CS
10										
11	11						Lost Core			
						85	J, C, S, Ca vein	11.3		
12	R 6			22				B O X		CS
###										
13	13.5						Lost Core	2		
14	R7			32						CS
15										

Conglomerate, Sandstone, Siltstone, Mudstone, Shale

Coal - Bright, Coal - Dull & Bright, Coal - Dull, Bone Coal, Carb Sh

F = Fault, Sh = Shear, J = Joint, B = Bedding, Sm = Smooth, R = Rough

Pl = Planar, St = Stepped, U = Undulating (wavy), C = Curved, Sl = Slickensided, Po = Polished, Broken Core

U = Uniaxial, SD = Slake, PLT = PLT, Q = Quality

UCS = Mpa, Is = Mpa, Diametral -- D --, Axial A

NORWEST CORPORATION

Geotechnical - Rock Core Log - Fractures

PROJECT: HOLCIM - Poverty Point

HOLE No: DH-06-02

LOCATION:

DRILLER / RIG:

DATE: 16 Feb 06

CLIENT: HOLCIM

LOGGED BY: ERM

Run # From: to

Drilled: Rec: =

Core Dia: Type:

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	Graphic & Dip TCA	Type & Description	Core Box	SAMPLES	Fracture Spacing	
16					3	10	J, Pl, R, tr Cl	BOX 2			
						60	J, Pl, S, Ca vein				
	16.5										
17											
18	R										
	8			76	3					CS	CS
19										11	
20			19.9-24.0 LS, med dk gray to dk gray, med grain to coarse grain. Massive, w occ high ∡ Ca veins, bands of lt gray marble-like rock. Grad. ctc's			10	J, Ir, R, Ca vein				
						90	J, C, R, tr Ca	21.0			
21	21				3						
22											
23	R			79				BOX 3		10	CS
	9										
24			24.0 - 37 LS, pale ylw-brn / ylw gry, fine grain. Faint lam. Occ calcite veins								
25											
26	26										
27					2						
	R										
28	10			98		0	DI, C, R			1	WS
						10	J, Pl, S,				
29								29.4			
30											

Conglomerate, Sandstone, Siltstone, Mudstone, Shale

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NORWEST CORPORATION

Geotechnical - Rock Core Log - Fractures

PROJECT: HOLCIM - Poverty Point

HOLE No: DH-06-02

LOCATION:

DRILLER / RIG:

DATE: 16 Feb 06

CLIENT: HOLCIM

LOGGED BY: ERM

Run # From: to

Drilled: Rec: %

Core Dia: Type:

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	Graphic & Dip TCA	DISCONTINUITIES Type & Description	Core Box	SAMPLES	Fracture Spacing
31	31									
32	R					50	J, Pl, S, thin Ca vein			
33	11			88	2			Box 4		6 MWS
34										
35										
36	36						Becomes v. broken			
37	R		37-53 LS, med dk gray to dk gray, fine to coarse grain. Variable unit, Mostly fg / dense w intervals cg w disoln pores, clayey zones		4 (5)		Clay, easy broken			VCS
38	12			0						
39	39									
40	R				3/4			40.2		
41	13			35				Box 5		VCS
42							disoln pores, weak			
43	43									
44	R 14			36	3/4					
45							Clayey, crumbly			

Conglomerate, Sandstone, Siltstone, Mudstone, Shale

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NORWEST CORPORATION

Geotechnical - Rock Core Log - Fractures

PROJECT: HOLCIM - Poverty Point

HOLE No: DH-06-02

LOCATION:

DRILLER / RIG:

DATE: 16 Feb 06

CLIENT: HOLCIM

LOGGED BY: ERM

Run # From: to

Drilled: Rec: =

Core Dia: Type:

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	Graphic & Dip TCA	DISCONTINUITIES Type & Description	Core Box	SAMPLES	Fracture Spacing		
46	R 14				3/4					18+		CS
47	47											
48												
49	R 15			0	5		Clayey / silty zones wx / crumbly	49.0		20+		CS
50						80	J, C, S					
51					3/4			BOX				
52	52											
53	R		53-83 LS, dk gray, med to coarse grain. Mod abt high and low ∡ calcite veins		5		disoln pores, weak	6				
54	16			8			unit fails mostly on Ca vein discont.			8+		CS
55												
56						0	DI, Pl, R					
57	57				3							
58	R											
59	17			11		90	J, C, R			25+		VCS
						70	J, Pl, S, Ca					
60												

Conglomerate
Sandstone
Siltstone
Mudstone
Shale

Coal - Bright
Coal - Dull & Bright
Coal - Dull
Bone Coal
Carb Sh

F = Fault
Sh = Shear
J = Joint
B = Bedding
Sm = Smooth, R = Rough

Pl = Planar, St = Stepped
U = Undulating (wavy)
C = Curved, Sl = Slickensided
Po = Polished
Broken Core

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UCS = Mpa Is = Mpa
Diametral -- D --
Axial A

NORWEST CORPORATION

Geotechnical - Rock Core Log - Fractures

PROJECT: HOLCIM - Poverty Point

HOLE No: DH-06-02

LOCATION:

DRILLER / RIG:

DATE: 17 Feb 06

CLIENT: HOLCIM -

LOGGED BY: ERM

Run # From: to

Drilled: Rec: =

Core Dia: Type:

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	DISCONTINUITIES Graphic & Dip TCA	DISCONTINUITIES Type & Description	Core Box	SAMPLES	Fracture Spacing		
61	R 17		LS, dk gray cont			90 / 35	J, C, R, Ca / J, Pl, S, Ca	60.6				
62	62							B O X				
63	R					60 / 60	J, Pl, R, Ca / J, Pl, R, Ca					
64	18			95	3			7		15+		CS
65												
66						90 / 60	J, C, R, Ca / J, Pl, S, Ca					
67	67											
68												
69	R 19			63	2			69.0		1		WS
70						0	J, Pl, R, tr Cl					
71								B O X				
72	72							8				
73	R			70	2	20	J, Pl, S, tr Cl			5		MWS
74	20											
75												

Conglomerate
Sandstone
Siltstone
Mudstone
Shale

Coal - Bright
Coal - Dull & Bright
Coal - Dull
Bone Coal
Carb Sh

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Pl = Planar, St = Stepped
U = Undulating (wavy)
C = Curved, Sl = Slickensided
Po = Polished
Broken Core

U = Uniaxial
SD = Slake
PLT = PLT
Q = Quality

UCS = Mpa Is = Mpa
Diametral -- D --
Axial A

NORWEST CORPORATION

Geotechnical - Rock Core Log - Fractures

PROJECT: HOLCIM - Poverty Point

HOLE No: DH-06-02

LOCATION:

DRILLER / RIG:

DATE: 17 Feb 06

CLIENT: HOLCIM

LOGGED BY: ERM

Run # From: to

Drilled: Rec: =

Core Dia: Type:

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	DISCONTINUITIES Graphic & Dip TCA	DISCONTINUITIES Type & Description	Core Box	SAMPLES	Fracture Spacing	
76			LS, dk gray, cont.		2	70	J, C, S, Ca				
77	77							77.4			
78	R				3						
79	21			49		90 60	J, Ir, R, Ca J, Pl, S, Ca	BOX		10	CS
80							J, Ir, R				
81	81.5					75	J, Pl, S, Ca	9			
82											
83	R		83-90, LS, dk gray w zones of ylwish-gray staining, med grain, massive. Mod broken, tr ylw-org clay on fx's. Grad ctc's								
84	22			57						9+	CS
85											
86	86				3/4			86			
87	R 23 87			28		25 60	J, Pl, R, tr Cl J, Pl, S	BOX		8	VCS
88	R					15	J, Pl, R, tr Cl				
89	24			15				10		22	VCS
90											

Conglomerate, Sandstone, Siltstone, Mudstone, Shale

Coal - Bright, Coal - Dull & Bright, Coal - Dull, Bone Coal, Carb Sh

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UCS = Mpa, Is = Mpa, Diametral -- D --, Axial A

NORWEST CORPORATION Geotechnical - Rock Core Log - Fractures

PROJECT: HOLCIM - Poverty Point

HOLE No: DH-06-02

LOCATION:

DRILLER / RIG:

DATE: 17 Feb 06

CLIENT: HOLCIM

LOGGED BY: ERM

Run # From: to

Drilled: Rec: =

Core Dia: Type:

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	Graphic & Dip TCA	Type & Description	Core Box	SAMPLES	Fracture Spacing	
91, 92	R 24, 92		90-94, LS, dk gray, med to coarse grain, massive. Minor calcite veining, tr ylw-org clay on open fx's. Grad ctc's	15	2/3	60	J, Pl, S, Ca 3mm	B o x 10			
93, 94, 95	R 25		94-110 LS, dk gray w minor zones of ylw-org staining, med grain, massive. Minor calcite veining. Mod broken. Thin coatings of clay on most open fx surfaces, more so than above or below. Grad ctc's	19		60	J, Pl, S, tr Cl	93.5		25+	vcs
96, 97, 98, 99, 100	97, R 26, 100			0	3	60, 90	J, Pl, S, Cl; J, C, S, Cl	B o x 11		15+	CS
101, 102, 103, 104, 105	R 27, 103, R 28			0, 18			Prominant, wavy vert fx's through most of interval	100.5, B o x 12		10+, 20+	CS

Conglomerate; Sandstone; Siltstone; Mudstone; Shale

Coal - Bright; Coal - Dull & Bright; Coal - Dull; Bone Coal; Carb Sh

F = Fault; Sh = Shear; J = Joint; B = Bedding; Sm = Smooth, R = Rough

Pl = Planar, St = Stepped; U = Undulating (wavy); C = Curved, Sl = Slickensided; Po = Polished; Broken Core

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UCS = Mpa; Is = Mpa; Diametral - D -; Axial A

NORWEST CORPORATION

Geotechnical - Rock Core Log - Fractures

PROJECT: HOLCIM - Poverty Point

HOLE No: DH-06-02

LOCATION:

DRILLER / RIG: DATE:

CLIENT: HOLCIM LOGGED BY: ERM

Run # From: to

Drilled: Rec: =

Core Dia: Type:

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	DISCONTINUITIES Graphic & Dip TCA	Type & Description	Core Box	SAMPLES	Fracture Spacing
106	R 28			18		45	J, Pl, S, Ca	B O X 12		
107					3	90	J, Pl, R, Cl			
108	108									
109										
110	R					60	J, Pl, R, Ca	B O X		
	29		110-116.5 LS, dk gray, med to coarse grain, massive, Mod calcite veining, grad ctc's	38		0	J, Ir, R, Cl	13		20+ CS
111										
112										
113	113				3	65	J, Pl, R, Ca			
114						65	J, Pl, S, Ca			
115	R 30			26		40	J, Pl, S, Ca			25+ VCS
116			116.5 - 123.5 LS, dk gray, med grain, massive Minor calcite veins, grad ctc's			90	J, Pl, S, Ca			
117								117		
118	118							B O X		
119	R 31			23	3	70	J, C, S, tr Cl	14		20+ CS
120						20	J, Pl, S, Cl			

Conglomerate, Sandstone, Siltstone, Mudstone, Shale

Coal - Bright, Coal - Dull & Bright, Coal - Dull, Bone Coal, Carb Sh

F = Fault, Sh = Shear, J = Joint, B = Bedding, Sm = Smooth, R = Rough

Pl = Planar, St = Stepped, U = Undulating (wavy), C = Curved, Sl = Slickensided, Po = Polished, Broken Core

U = Uniaxial, SD = Slake, PLT = PLT, Q = Quality

UCS = Mpa, Is = Mpa, Diametral ~D~, Axial A

NORWEST CORPORATION

Geotechnical - Rock Core Log - Fractures

PROJECT: HOLCIM - Poverty Point

HOLE No: DH-06-02

LOCATION:

DRILLER / RIG:

DATE: 17 Feb 06

CLIENT: HOLCIM

LOGGED BY: FRM

Run # From: to

Drilled: Rec: =

Core Dia: Type:

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	DISCONTINUITIES Graphic & Dip TCA	Type & Description	Core Box	SAMPLES	Fracture Spacing
21	31					10	J, Pl, R	BOX		
	121					45	J, C, S, Ca	14		
22	R									
23	32			33		75	J, Pl, S			20+ CS
						65	J, Pl, S			
24					3			124		
125			123.5-138 LS, lt brn-gray to med dk gray							
	125.5							BOX		
26										
27	R					55	J, Pl, S			
	33					90	J, C, S	15		
28				39						15+ CS
29					3					
130										
	130.5					90	J, C, S, Ca			
31										
	R									
32	34									20+ CS
33				18						
								133.5		
34								BOX		
135	135							16		

Conglomerate, Sandstone, Siltstone, Mudstone, Shale, Coal - Bright, Coal - Dull & Bright, Coal - Dull, Bone Coal, Carb Sh

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Pl = Planar, St = Stepped, U = Undulating (wavy), C = Curved, Sl = Slickensided, Po = Polished, Broken Core

U = Uniaxial, SD = Slake, PLT = PLT, Q = Quality

UCS = Mpa, Is = Mpa, Diametral – D –, Axial A

NORWEST CORPORATION

Geotechnical - Rock Core Log - Fractures

PROJECT: HOLCIM - Poverty Point

HOLE No: DH-06-02

LOCATION:

DRILLER / RIG:

DATE: 17 Feb 06

CLIENT: HOLCIM

LOGGED BY: ERM

Run # From: to

Drilled: Rec: =

Core Dia: Type:

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	DISCONTINUITIES Graphic & Dip TCA	DISCONTINUITIES Type & Description	Core Box	SAMPLES	Fracture Spacing
36	R							BOX		
	35			21	3	60 /	J, Pl, S, Ca	16		20+ CS
37										
138	138					50)	J, C, R, Cl			

Conglomerate
Sandstone
Siltstone
Mudstone
Shale

Coal - Bright
Coal - Dull & Bright
Coal - Dull
Bone Coal
Carb Sh

F = Fault
Sh = Shear
J = Joint
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Po = Polished
Broken Core

U = Uniaxial
SD = Slake
PLT = PLT
Q = Quality

UCS = Mpa Is = Mpa
Diametral D
Axial A

NORWEST CORPORATION Geotechnical - Rock Core Log - Fractures

PROJECT: HOLCIM - Poverty Point

HOLE No: DH-06-03

LOCATION: Logged at Devils Slide Quarry Shop

DRILLER / RIG:

DATE: 15 Feb 06

CLIENT: HOLCIM

LOGGED BY: Eric Martin

Run # From: to

Drilled: Rec: =

Core Dia: Type:

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	Graphic & Dip TCA	DISCONTINUITIES Type & Description	Core Box	SAMPLES	Fracture Spacing
	Run 1			0	3/4		Rubble	0		VCS
			.8 Lost Core				.8 Lost Core			
	1.5		1.5				1.5			
			0-10 med-fine gr LS, v dk gray							
2.5	Run 2			0	3/4		Rubble w a few sm intact pieces			VCS
							3.5			
	3.5 R 3		4.0-6.0 High & calcite filled healed fx's 5-10 mm	0	3/4			B		
5.0	5.0							O		
	Run 4			0	3/4		Rubble w a few intact pieces	X 1		VCS
7.5										
	8.0					35	B 35° Pl, R, Clean			
	Run 5			0	3/4		8.60 Rubble			VCS
			Lost Core				1.7	10.0		
10	10.0		10-12.4 Occ, mostly thin high & Ca veins			20	10.65 J 20° Pl, R, Ca			
						70-70	11.33 J 70° Pl, R, Ca	B		
	Run		10-15.4 med gr. LS, med gray		4	20	11.43 J 70° Pl, R, Ca	O		
						30	11.45 J 20° Pl, R, Ca	X		
						75	11.70 Sh 30° Pl, R, .07 Ca/Cl fill.			11 CS
###	6			91			12.2 J 75° Pl, R, Ca	2		
			14-15 A few high & Calcite veins			30	14.60 J, 30°, Pl, R, +Ca			
15	15.0					80	15.00 J 80°, Pl, R, Ca			

Conglomerate, Sandstone, Siltstone, Mudstone, Shale

Coal - Bright, Coal - Dull & Bright, Coal - Dull, Bone Coal, Carb Sh

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Pl = Planar, St = Stepped, U = Undulating (wavy), C = Curved, Sl = Slickensided, Po = Polished, Broken Core

U = Unknown, SD = Slake, PLT = PLT, Q = Quality

UCS = Mpa, Is = Mpa, Diametral -D-, Axial A

NORWEST CORPORATION Geotechnical - Rock Core Log - Fractures

PROJECT: Holcim - Poverty Point

HOLE No: DH-06-03

LOCATION:

DRILLER / RIG:

DATE: 15 Feb 06

CLIENT: Holcim

LOGGED BY: ERM

Run # | From: | to

Drilled: | Rec: | %

Core Dia: | Type:

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	Graphic & Dip TCA	DISCONTINUITIES Type & Description	Core Box	SAMPLES	Fracture Spacing		
16			15.4 - 17.4 fine gr. LS., dk gry			35	15.46 J 35° Pl, R, Ca					
					3	30	16.2 J 30°, Pl, R, Ca	B				
						30	16.45 J 30°, Pl, R, Ca	O				
17				97				X		3		MWS
	Run							2				
18							Ca vein 2-5 mm					
			17.4 - 22.7, LS, med grain, med gray			50	18.60 J 50°, S, R, Ca					
19								19.2				
	7					30	19.80 J 30°, P, R, Cl Fe					
20	20.0											
							20.7 B 15°, I, R, C					
21	Run						21.45 J 75°, P, S, Ca Fe					
							21.5 J 10°, I, R, Ca Cl					
22				88				B		7		MWS
	8				3		22.50 Ind 0°, Clean	O				
			22.7 - 29.8 LS, fine grain, dk gray, fossils at 26'				23.08 J 10°, I, R, Ca Cl	X				
23								3				
24							24.55 J 50°, P, S, tr Ca					
							24.85 J 20°, I, R, tr Cl					
25	25.0											
26							26.33 B 30°, C, S, C					
	Run						26.68 B 40°, I, R, C					
27				94	3		27.37 B 30°, Pl, R, C			6		MWS
	9											
28							28.10 DI 0°, Clean	28.2				
								B				
29							29.28 J 15°, I, R, tr Cl	O				
							29.4 DI 50°, I, R, C	X				
							29.74 J 15°, I, R, Ca Cl	4				
30							29.9 J 10°, Pl, R, tr Cl					

Conglomerate | Sandstone | Siltstone | Mudstone | Shale

Coal - Bright | Coal - Dull & Bright | Coal - Dull | Bone Coal | Carb Sh

F = Fault | Sh = Shear | J = Joint | B = Bedding | Sm = Smooth, R = Rough

Pl = Planar, St = Stepped | U = Undulating (wavy) | C = Curved, Sl = Slickensided | Po = Polished | Broken Core

U = Uniaxial | SD = Slake | PLT = PLT | Q = Quality

UCS = Mpa | Is = Mpa | Diametral D | Axial A

DI = Drill Induced I = Indeterminate

NORWEST CORPORATION Geotechnical - Rock Core Log - Fractures

PROJECT: Holcim Poverty Point

HOLE No: DH-06-03

LOCATION:

DRILLER / RIG:

DATE: 15 Feb 06

CLIENT: Holcim

LOGGED BY: ERM

Run #: From: to:

Drilled: Rec: %

Core Dia: Type:

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	Graphic & Dip TCA	DISCONTINUITIES Type & Description	Core Box	SAMPLES	Fracture Spacing	
31	Run 10		29.8 - 43.2 LS, med to fine grain, med dk gry to dk gray				31.15 J 40°, S, R, Ca				
32				87	3		32.55 J 10°, C, R, C	Box 4		5	MWS
33			calcite vein 10-15mm				32.70 J 10°, Pl, R, C 33.1 J 75°, Pl, R, Ca 10-15mm Partly leached open				
34							33.9 J 35°, I, R, C				
35			calcite vein 15mm				34.60 J 60°, Pl, R, leach 35.0 J 20°, I, R, Ca				
36	Run 11						35.4 J 60°, Pl, R, Ca 35.5 J 30°, C, R, FeOx 35.9 J 15°, Pl, R, Ca				
37				74	3		36.5 J 50°, Pl, R, Ca 37.0 J 45°, Pl, S, Ca	37.0		12	LS
38							38.0 J 40°, Pl, S, Ca 38.4 J 20°, St, S, Ca	Box 5			
39							39.3 J 75°, Pl, S, Ca 39.4 J 35°, Pl, S, Ca 39.6 I 10°, Pl, R, C				
40							40.0 DI 0°				
41	Run 12						40.55 DI 20°, I, R, C 41.32 J 05°, C, S, Ca				
42				81	3		42.37 DI 15°, C, S, C				
43			43.2 - 46.0 Several prominant high ∠ joints w strong leaching + open cavities				43.25 J 60°, C, R, Ca			4	MWS
44							44.0 DI, I, R, C 44.5 - 46.0 J 75°, C, R, leached w vugs				
45							45.0 DI				

Conglomerate, Sandstone, Siltstone, Mudstone, Shale

Coal - Bright, Coal - Dull & Bright, Coal - Dull, Bone Coal, Carb Sh

F = Fault, Sh = Shear, J = Joint, B = Bedding, Sm = Smooth, R = Rough

Pl = Planar, St = Stepped, U = Undulating (wavy), C = Curved, Sl = Slickensided, Po = Polished, Broken Core

U = Unknown, SD = Slake, PLT = PLT, Q = Quality

UCS = Mpa, Is = Mpa, Diametral D, Axial A

NORWEST CORPORATION Geotechnical - Rock Core Log - Fractures

PROJECT: Holcim - Poverty Point

HOLE No: OH-06-03

LOCATION:

DRILLER / RIG:

DATE: 15 Feb 06

CLIENT: Holcim

LOGGED BY: ERM

Run # From: to

Drilled: Rec: =

Core Dia: Type:

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	Graphic & Dip TCA	DISCONTINUITIES Type & Description	Core Box	SAMPLES	Fracture Spacing
							J cont from above	46		
46	Run		46 - 53.4 LS, med grain, med dk gry, abt mostly high x calcite veins 1 - 10mm		3					
47				68			47.5 J75°, Pl, S, C closed below 47.5	B		7 MWS
48	13						47.5 J20° I, R, tr Cl	O		
							48.4 J50°, C, S, C	X		
49								6		
							49.8 DI			
50							50.0 DI			
51	Run				3		51.2 J10°, C, R, Ca Fe			
52	14			89			52.4 J50°, P, R, Ca			6 MWS
53							52.9 J05°, I, R, tr Cl			
54							54.38 J05°, I, R, C			
55							54.95 J20°, Pl, S, tr Cl	55		
			53.4 - 65.8 LS, med to fine grain, med dk gry. Occ fine calcite veins < 1mm				55.30 J60°, C, R, Ca			
56	Run				3		56.6 J05°, P, S, C	B O X		
57				77				7		6 MWS
58	15						57.53 J60°, I, R, tr Ca			
							57.9 J90°, C, R, Ca			
							58.45 J40°, I, R, C			
59							59.35 J70°, Pl, S, Ca			
							59.7 J65°, Pl, S, Ca			
60										

Conglomerate, Sandstone, Siltstone, Mudstone, Shale, Coal - Bright, Coal - Dull & Bright, Coal - Dull, Bone Coal, Carb Sh

F = Fault, Sh = Shear, J = Joint, B = Bedding, Sm = Smooth, R = Rough

Pl = Planar, St = Stepped, U = Undulating (wavy), C = Curved, Sl = Slickensided, Po = Polished, Broken Core

U = Uninitial, SD = Slake, PLT = PLT, Q = Quality

UCS = Mpa, Ir = Mpa, Diametral -D-, Axial A

NORWEST CORPORATION

Geotechnical - Rock Core Log - Fractures

PROJECT: Holcim - Poverty Point

HOLE No: DH-06-03

LOCATION:

DRILLER / RIG:

DATE: 15 Feb 06

CLIENT: Holcim

LOGGED BY: ERM

Run #	From:	to
Drilled:	Rec:	=
Core Dia:	Type:	

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	DISCONTINUITIES Graphic & Dip TCA	Type & Description	Core Box	SAMPLES	Fracture Spacing	
61	Run 16						60.1 J30°, VI, R, Cl Ca 60.45 J45°, C, S, C 61.45 DI	Box 7			
62				68	3		62.35 DI			8	CS
63							62.4-63.3 J80°, Pl, S, Ca 63.55 J20°, C, S, C				
64							64.45 DI 64.75 DI 65 DI	64.4			
65			65.8-74 LS, med to fine grain, med-lt gry. Occ calcite veins 1-5 mm				65.65 J20°, I, R, tr Cl				
66	Run 17							Box			
67				94	3					4	MWS
68							68.1 J70°, Pl, S, Ca	8			
69							68.9 J15°, I, R, Ca				
70							69.95 DI 70 DI				
71	Run 18						70.74 DI				
72				77	3		72.1 J30°, I, R, Ca			6	MWS
73							73.05 J20°, Pl, R, tr Cl 73.15 J25°, Pl, R, tr Cl 73.15-73.6, J90°, C, S, Ca 73.7 J70°, Pl, R, Ca	73.5			
74							74.5 J50°, Pl, S, C				
75							75 J20°, C, R, tr Cl				

Conglomerate, Sandstone, Siltstone, Mudstone, Shale

Coal - Bright, Coal - Dull & Bright, Coal - Dull, Bone Coal, Carb Sh

F = Fault, Sh = Shear, J = Joint, B = Bedding, Sm = Smooth, R = Rough

Pl = Planar, St = Stepped, U = Undulating (wavy), C = Curved, Sl = Slickensided, Po = Polished, Broken Core

U = Uniaxial, SD = Strife, PLT = PLT, Q = Quality

UCS = Mpa, Is = Mpa, Diametral D, Axial A

NORWEST CORPORATION Geotechnical - Rock Core Log - Fractures

PROJECT: Holcim - Poverty Point

HOLE No:

LOCATION:

DRILLER / RIG:

DATE: 15 Feb 06

CLIENT: Holcim

LOGGED BY: ERM

Run #: From: to:

Drilled: Rec: %

Core Dia: Type:

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	Graphic & Dip TCA	DISCONTINUITIES Type & Description	Core Box	SAMPLES	Fracture Spacing
76	Run 19		74-80.7 LS, olive or dk brnish gray, fine grain	96	3		75.09 J25°, Pl, R, tr Cl 76.3 J40°, C, R, tr Cl 76.9 J60°, C, S, Ca 77.27 J20°, Pl, S, tr Cl	Box 9		7 MWS
77										
78							78.65 J60°, Pl, S, Ca			
79										
80							79.8 J55°, Pl, S, C			
81	Run 20		80.7-84.3 LS, med grain, med dk gray. Mod abt calcite veins <1 mm. Locally very broken along veins.	55	80.7 3/4		80.45 J60°, Pl, S, C 80.65 J60°, I, R, tr Cl 80.75-82.1 J90°, I, R, Ca fx's along Ca veins 82.1 J35°, Pl, R, Ca 82.45 J50°, Pl, S, Ca	82.1		9 CS
82										
83							83.1 J20°, I, R, Ca	Box 10		
84					84.3		84.35 J, I, R, Cl			
85	84.6		Lost Core				Lost			
86	Run 21		84.3-90 LS, fine grain, v dk gray	61	3		85-85.75 J90°, I, R, Ca 86.05 J30°, C, S, Ca 86.15-86.23 Gouge zone filled w clay & rock frags 86.45 J20°, Pl, S, Cl 86.6 J25, Pl, S, Cl			14 CS
87										
88							87.45 J40°, Pl, S, Ca Cl 88.0 J25°, Pl, R, tr Cl 88.07 J30°, Pl, R, Cl			
89							89.05 DI 89.6 J55°, Pl, S, Ca			
90							89.95 J45°, C, R, Ca			
			TD = 90 Feet							

Conglomerate, Sandstone, Siltstone, Mudstone, Shale

Coal - Bright, Coal - Dull & Bright, Coal - Dull, Bone Coal, Carb Sh

F = Fault, Sh = Shear, J = Joint, B = Bedding, Sm = Smooth, R = Rough

Pl = Planar, St = Stepped, U = Undulating (wavy), C = Curved, Sl = Slickensided, Po = Polished, Broken Core

U = Unlaxial, SD = Slake, PLT = PLT, Q = Quality

UCS = Mpa, Is = Mpa, Diametral - D -, Axial A

NORWEST CORPORATION

Geotechnical - Rock Core Log - Fractures

PROJECT: HOLCIM - Poverty Point

HOLE No: DH-06-04

LOCATION:

DRILLER / RIG:

DATE: 15 Feb 06

CLIENT: HOLCIM

LOGGED BY: Eric Martin (ERM)

Run #	From:	to
Drilled:	Rec:	%
Core Dia:	Type:	

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	DISCONTINUITIES Graphic & Dip TCA	Type & Description	Core Box	SAMPLES	Fracture Spacing
1	R 1		0-2 LS, med dk gray, coarse grained, abt calcite veins	0	3					4 CS
2.5	1.5							Box 1		
3	R 2		2-9 LS, dk gray, med gray. Massive to faint lams. Mod calcite veins	60		15	J, Pl, R, Cl			7 CS
4						60	J, C, R, disolń of Ca vein			
5.0	5									
6										
7	R 3			57	3	25	J, Pl, R, lt brn silt/clay			12 CS
7.5										
8										
9										
10	10									
11	R 4		10-11.5 LS, lt olive gray and v dk gray, fine grain, massive. Clay on fx's, zones of rubble	22		90	J, C, R, Cl			5+ CS
11.5	11.5							11.5		
12							minor disolń pits	Box 2		
13	R 5		11.5-53.4 LS, dk gray, med to coarse grained. see below.	60	3					14 CS
14						90	J, C, S, Ca			
15						10	J, Pl, R, tr Cl			

Conglomerate, Sandstone, Siltstone, Mudstone, Shale

Coal - Bright, Coal - Dull & Bright, Coal - Dull, Bone Coal, Carb Sh

F = Fault, Sh = Shear, J = Joint, B = Bedding, Sm = Smooth, R = Rough

Pl = Planar, St = Stepped, U = Undulating (wavy), C = Curved, Sl = Slickensided, Po = Polished, Broken Core

U = Uniaxial, SD = Slake, PLT = PLT, Q = Quality

UCS = Mpa, Is = Mpa, Diametral --D--, Axial A

NORWEST CORPORATION

Geotechnical - Rock Core Log - Fractures

PROJECT: HOLCIM

HOLE No: DH-06-04

LOCATION:

DRILLER / RIG:

DATE: 17 Feb 06

CLIENT:

LOGGED BY: ERM

Run #: From: to:

Drilled: Rec: =

Core Dia: Type:

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	Graphic & Dip TCA	DISCONTINUITIES Type & Description	Core Box	SAMPLES	Fracture Spacing		
16	16.5		11.5-53.4 LS, dk gray to med dk gray, med grain, locally cg. Massive w occ faint	60		60	J, Pl, S	BOX 2				
17	R 6		Streaks / lams. Minor fine calcite veins w occ thick veins 2-15mm	51	2	10	J, Pl, R, Cl			18	CS	
19												
20								20.3				
21	21.5					30	J, Pl, S					
22								BOX 3				
23	R 7			35	2					13	CS	
24												
25						90	J, C, R, Ca vein w disoln					
26	26.5											
27						70	J, Pl, R, Ca w disoln					
28	R 8			83	2	60	J, C, R, Ca			8	CS	
29								29.4				
30												

Conglomerate, Sandstone, Siltstone, Mudstone, Shale, Coal - Bright, Coal - Dull & Bright, Coal - Dull, Bone Coal, Carb Sh

F = Fault, Sh = Shear, J = Joint, B = Bedding, Sm = Smooth, R = Rough

Pl = Planar, St = Stepped, U = Undulating (wavy), C = Curved, Sl = Slickensided, Po = Polished, Broken Core

U = Uniaxial, SD = Slake, PLT = PLT, Q = Quality

UCS = Mpa, Is = Mpa, Diametral - D -, Axial A

NORWEST CORPORATION Geotechnical - Rock Core Log - Fractures

PROJECT: HOLCIM - Poverty Point

HOLE No: DH-06-04

LOCATION:

DRILLER / RIG:

DATE: 17 Feb 06

CLIENT: HOLCIM

LOGGED BY: ERM

Run #: From: to:

Drilled: Rec: %

Core Dia: Type:

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	DISCONTINUITIES Graphic & Dip TCA	Type & Description	Core Box	SAMPLES	Fracture Spacing		
31	31.5		11.5 - 53.4 LS, dk gray cont.	83		10	J, I, R, Cl					
						10	J, I, R, Cl					
32						60	J, C, R, Ca	BOX				
33	R							4				
34	9				2	20	J, C, R, Cl			10		CS
35												
36	36.5			76								
37						90	J, I, R, Ca Irreg vert fx zone along disolh calcite veins. Very broken					
38	R							37.9				
39	10			39				BOX		10		CS
40												
41	41.5							5				
42						60	J, Pl, S, Ca					
43	R											
44	11			79		10	J, C, R, tr Cl			7		CS
45												

Conglomerate, Sandstone, Siltstone, Mudstone, Shale

Coal - Bright, Coal - Dull & Bright, Coal - Dull, Bone Coal, Carb Sh

F = Fault, Sh = Shear, J = Joint, B = Bedding, Sm = Smooth, R = Rough

Pl = Planar, St = Stepped, U = Undulating (wavy), C = Curved, Sl = Slickensided, Po = Polished, Broken Core

U = Unloaded, SD = Slake, PLT = PLT, Q = Quality

UCS = Mpa, Is = Mpa, Diametral D, Axial A

NORWEST CORPORATION Geotechnical - Rock Core Log - Fractures

PROJECT: HOLCIM - Poverty Point

HOLE No: DH-06-04

LOCATION:

DRILLER / RIG:

DATE: 17 Feb 06

CLIENT: HOLCIM

LOGGED BY: ERM

Run # From: to

Drilled: Rec: %

Core Dia: Type:

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	DISCONTINUITIES Graphic & Dip TCA	DISCONTINUITIES Type & Description	Core Box	SAMPLES	Fracture Spacing		
46	46.5		11.5-53.4 LS, dk gray cont.	79				46.5				
47						75	J, Pl, S					
48	R 12			64	2			BOX 6		10		CS
49												
50						90	J, I, R, 1-2 mm Ca vein tr Cl					
51	51.5											
52												
53	R 13		53.4-57 LS, med gray, coarse grain, massive. Disol'n pits, minor calcite veins, Grad cte's	41		90	J, C, S					
54							J, I, R, tr Cl			10		CS
							J, Pl, S					
55					3			55.4				
56	56.5							BOX 7				
57			57-58.8 LS, dk gray, fine grain			90	J, C, S, tr Cl					
58	R 14		Chert bands 10-20cm, Faint lams, grad cte's	54		20	J, I, R on chert			14		CS
59					2							
60						10	J, Pl, R, Cl					

Conglomerate, Sandstone, Siltstone, Mudstone, Shale

Coal - Bright, Coal - Dull & Bright, Coal - Dull, Bone Coal, Carb Sh

F = Fault, Sh = Shear, J = Joint, B = Bedding, Sm = Smooth, R = Rough

Pl = Planar, St = Stepped, U = Undulating (wavy), C = Curved, Sl = Slickensided, Po = Polished, Broken Core

U = Uniaxial, SD = Slake, PLT = PLT, D = Quality

UCS = Mpa, Is = Mpa, Diametral, Axial

NORWEST CORPORATION Geotechnical - Rock Core Log - Fractures

PROJECT: HOLCIM - Poverty Point

HOLE No: DH-06-04

LOCATION:

DRILLER / RIG:

DATE: 17 Feb 06

CLIENT: HOLCIM

LOGGED BY: ERM

Run #: From: to:

Drilled: Rec: %

Core Dia: Type:

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	DISCONTINUITIES Graphic & Dip TCA	DISCONTINUITIES Type & Description	Core Box	SAMPLES	Fracture Spacing	
61	61.5		58.8-69.3 LS, dk gray, med to coarse grain, lam	54				BOX 7			
62	R										
63	15					85	J, Pl, S, Ca			11	CS
64			64-66.5 Abt calcite veins 2-15 mm	51				64.5			
65											
66	66.5					45	J, Pl, S	BOX 8			
67					2						
68	R					70	J, Pl, S				
	16			78						11	CS
69			69.3-81.4 LS, med dk gray to dk gray, fine grained, faint lam.			30	J, Pl, S, tr Cl				
70			Bands/Nodules blk chert 15-30 mm								
71	71										
72	R										
73	17			98				73.6		5	MWS
74						90	J, Pl, R				
75						25	J, Pl, R, tr Cl/Fe ox				

Conglomerate; Sandstone; Siltstone; Mudstone; Shale; Coal - Bright; Coal - Dull & Bright; Coal - Dull; Bone Coal; Carb Sh

F = Fault; Sh = Shear; J = Joint; B = Bedding; Sm = Smooth, R = Rough

Pl = Planar, St = Stepped; U = Undulating (wavy); C = Curved, Sl = Slickensided; Po = Polished; Broken Core

U = Unknown; SD = Shale; PLT = PLT; Q = Quality

UCS = Mpa; Is = Mpa; Diametral - D -; Axial A

NORWEST CORPORATION Geotechnical - Rock Core Log - Fractures

PROJECT: HOLCIM - Poverty Point

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CLIENT: HOLCIM

LOGGED BY: ERM

Run #: From: to:

Drilled: Rec: %

Core Dia: Type:

RUN (ft)	DRILL DEPTH	Graphic Log	LITHOLOGIC DESCRIPTION	RQD %	Strength	Graphic & Dip TCA	Type & Description	Core Box	SAMPLES	Fracture Spacing
76	76		69.3-81.4 LS cont. med dk gry w chert			60	J, Pl, S			
77	R					40	J, Pl, R, Ca, on chert	B		
78	18			81				O		
79								X		8 CS
80								9		
81	81					15	J, Pl, S, tr Cl			
82	R		81.4-88.6 LS, dk gray, med to coarse grained, faint lams		2	70	J, Pl, R	82.4		
83	19		to massive sharp ctc at base	95						8 CS
84						35	J, Pl, S	B		
85	85							O		
86								X		
	R					10	J, Pl, R, tr Cl	10		
87	20			69						
88			88.6-90.5 LS, lt olive gray, fine grained, massive							17 CS
89	89					90	J, C, S, Ca			
	R			0						
90	21									
.5			TD 90.5 ft							

Conglomerate, Sandstone, Siltstone, Mudstone, Shale

Coal - Bright, Coal - Dull & Bright, Coal - Dull, Bone Coal, Carb Sh

F = Fault, Sh = Shear, J = Joint, B = Bedding, Sm = Smooth, R = Rough

Pl = Planar, St = Stepped, U = Undulating (wavy), C = Curved, Sl = Slickensided, Po = Polished, Broken Core

U = Unknown, SD = Shale, PLT = PLT, Q = Quality

UCS = Mpa, Is = Mpa, Diametral D, Axial A

APPENDIX B

Core Photographs

HoLCIM - Poverty Point
Drill Hole - 06-02
Box1 0-11.3
NO. 7973
1b
2
4

HOLCIM - Poverty Point
Drill Hole - 06-02
Box 2 11.3-21
NO. 79
1b
135
165
21

HOLCIM - Poverty Point
Drill Hole - 06-02
Box 3 21 - 29.4

HOLLIM - Poverty Point
Drill Hole - 06-02
Box 4 29.4-40.2
36

HOLCIM - Poverty Point
Drill Hole - 06-02
Box 5 40.2-49

HOLCIM - Poverty Point
Drill Hole - 06-02
Box6 49-60.6
55.6

HOLCIM - Poverty Point
Drill Hole - 06-02
Box 7 60.6-69
62

HOLCIM - Poverty Point
Drill Hole - 06-02
Box 8 69 - 77.4

HOLLIM - Poverty Point
Drill Hole - 06-02
Box 9 77.4-86
PL

HOLCIM - Poverty Point
Drill Hole - 06-02
Box 10 86 - 93.5
92

HOLLIM - Poverty Point
Drill Hole - 06-02
Box 11 93.5 - 100.5

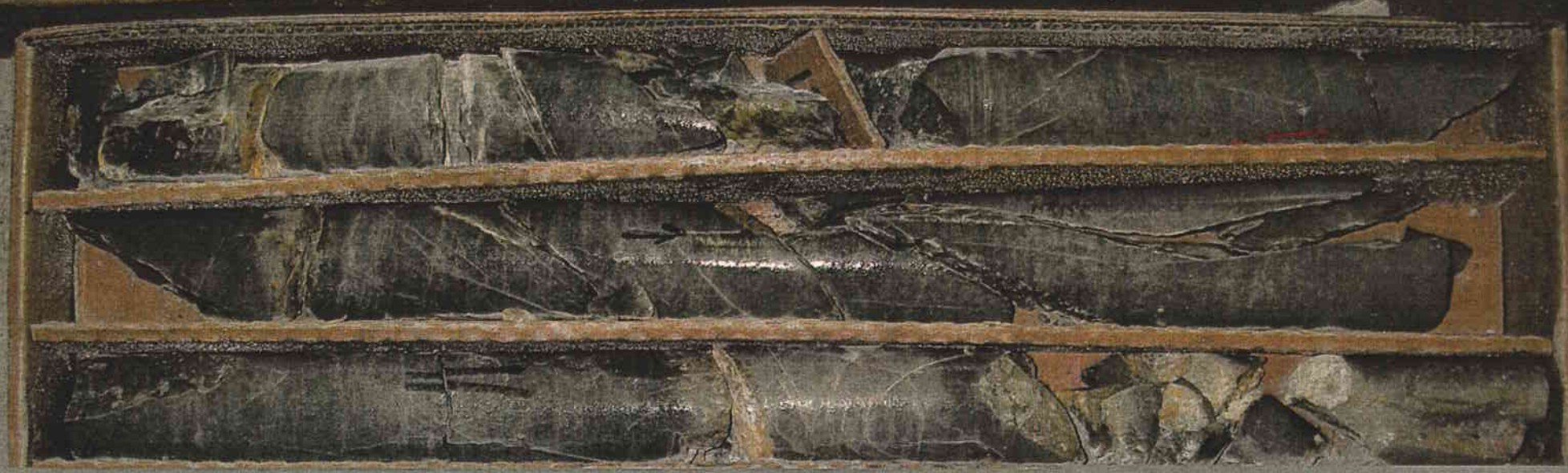
HOLLIM - Poverty Point
Drill Hole - 06-02
Box 12 100.5 - 108

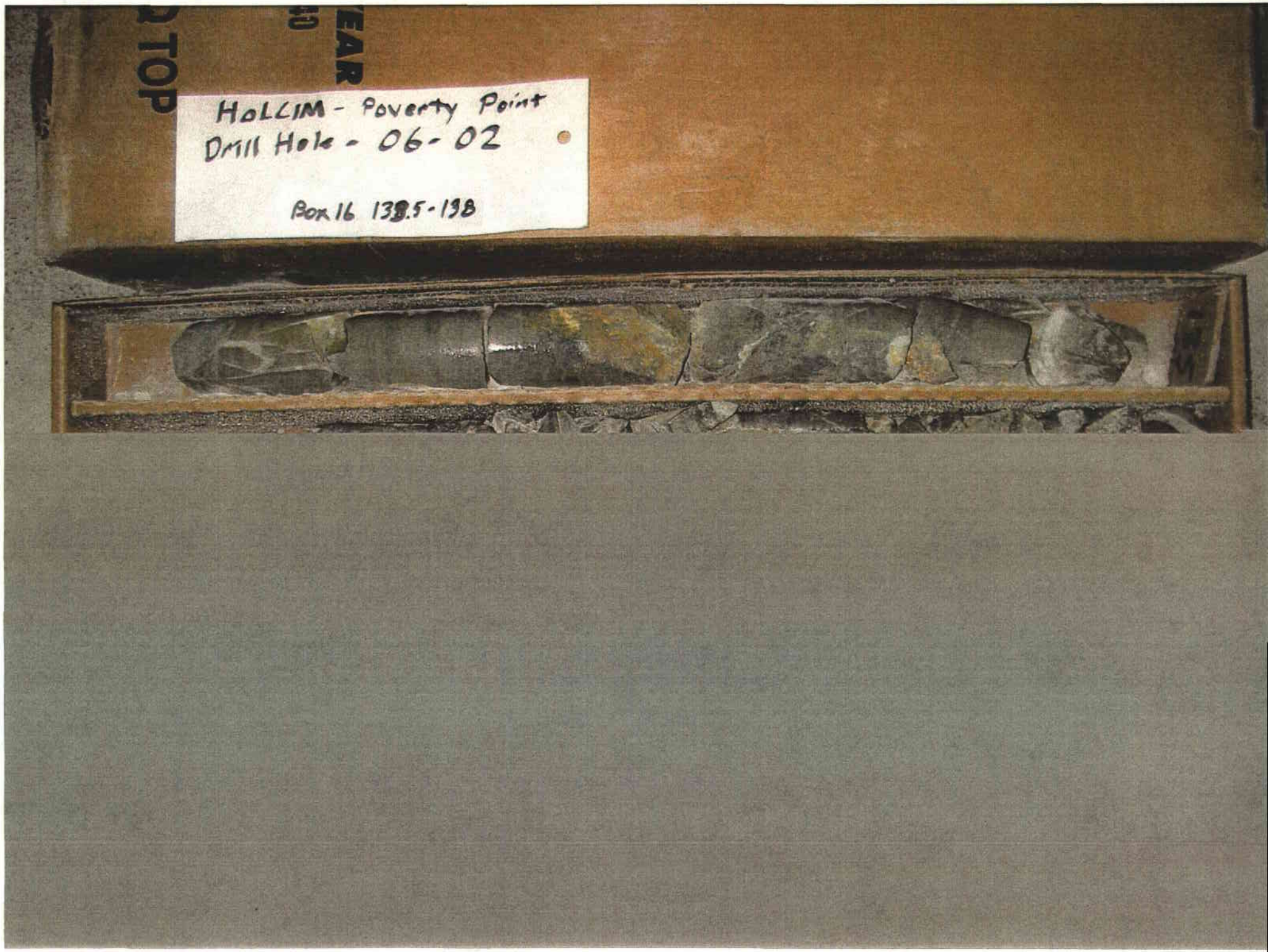
HOLCIM - Poverty Point
Drill Hole - 06-02
Box 13 108-117

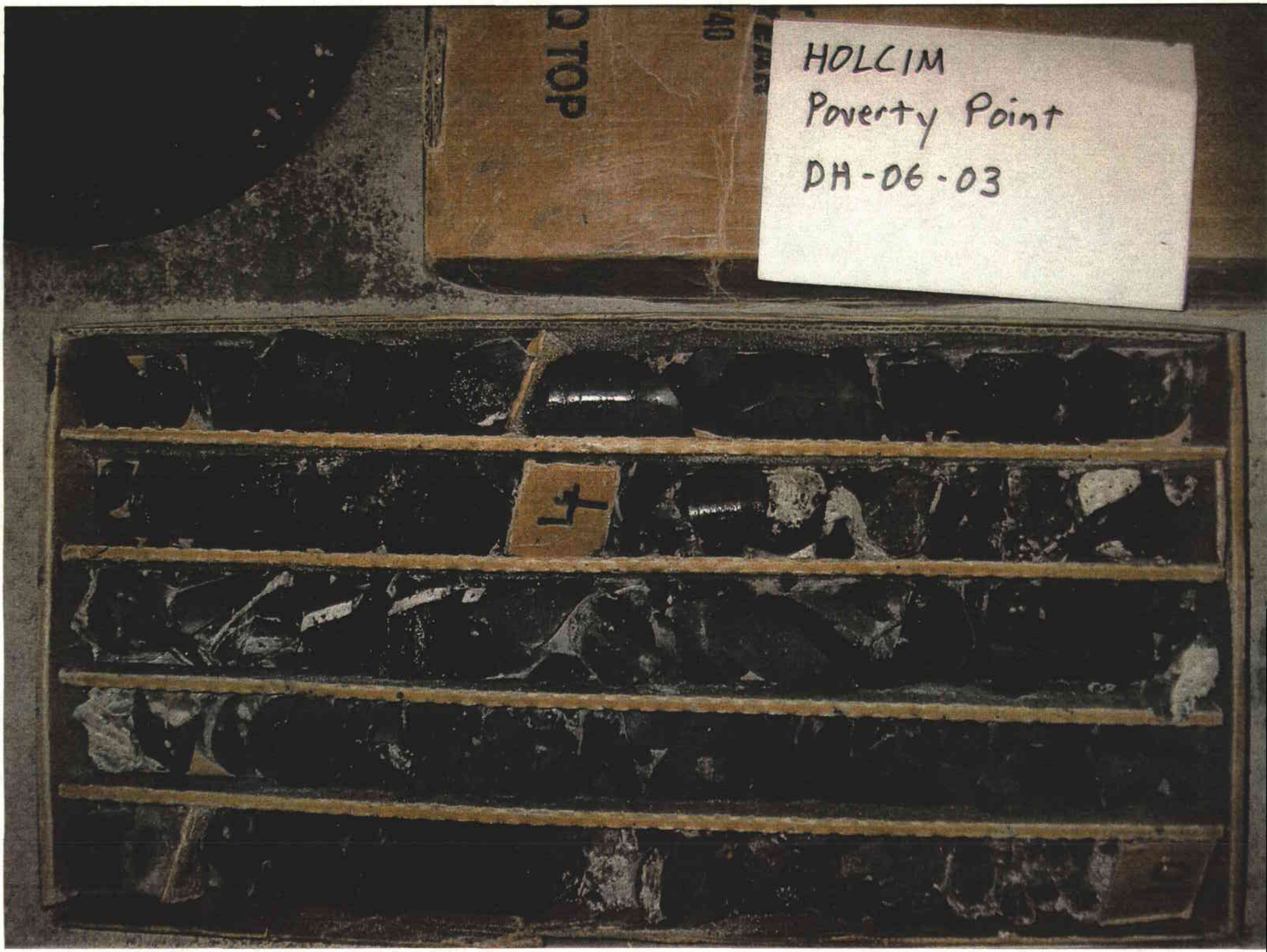
HOLCIM - Poverty Point
Drill Hole - 06-02
Box 14 117-124

HOLCIM - Poverty Point
Drill Hole - 06-02

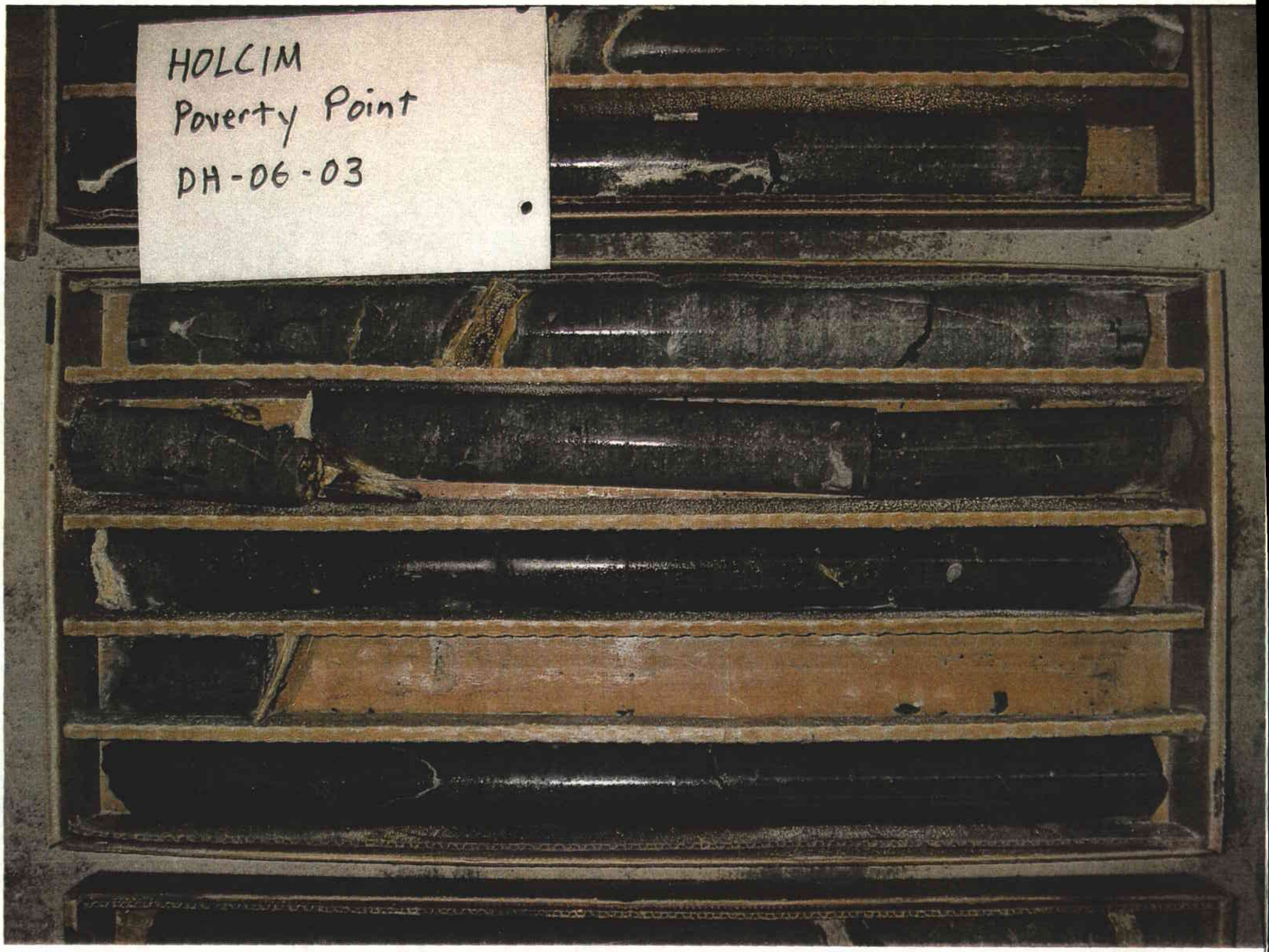
Box 15 124-138.5



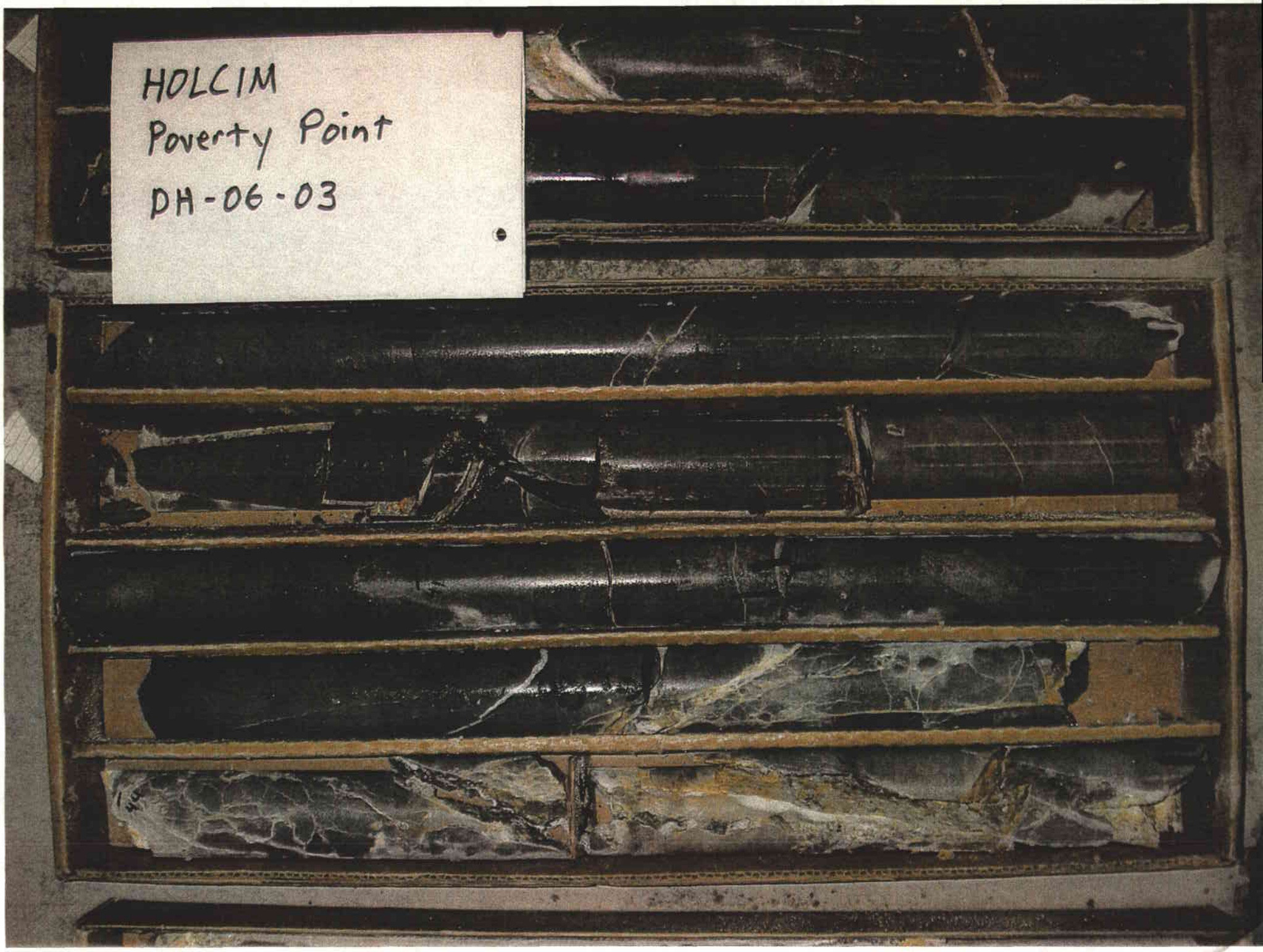

HOLCIM - Poverty Point
Drill Hole - 06-02
Box 16 138.5-198


HOLCIM
Poverty Point
DH-06-03
TOP
4

HOLCIM
Poverty Point
DH-06-03
10

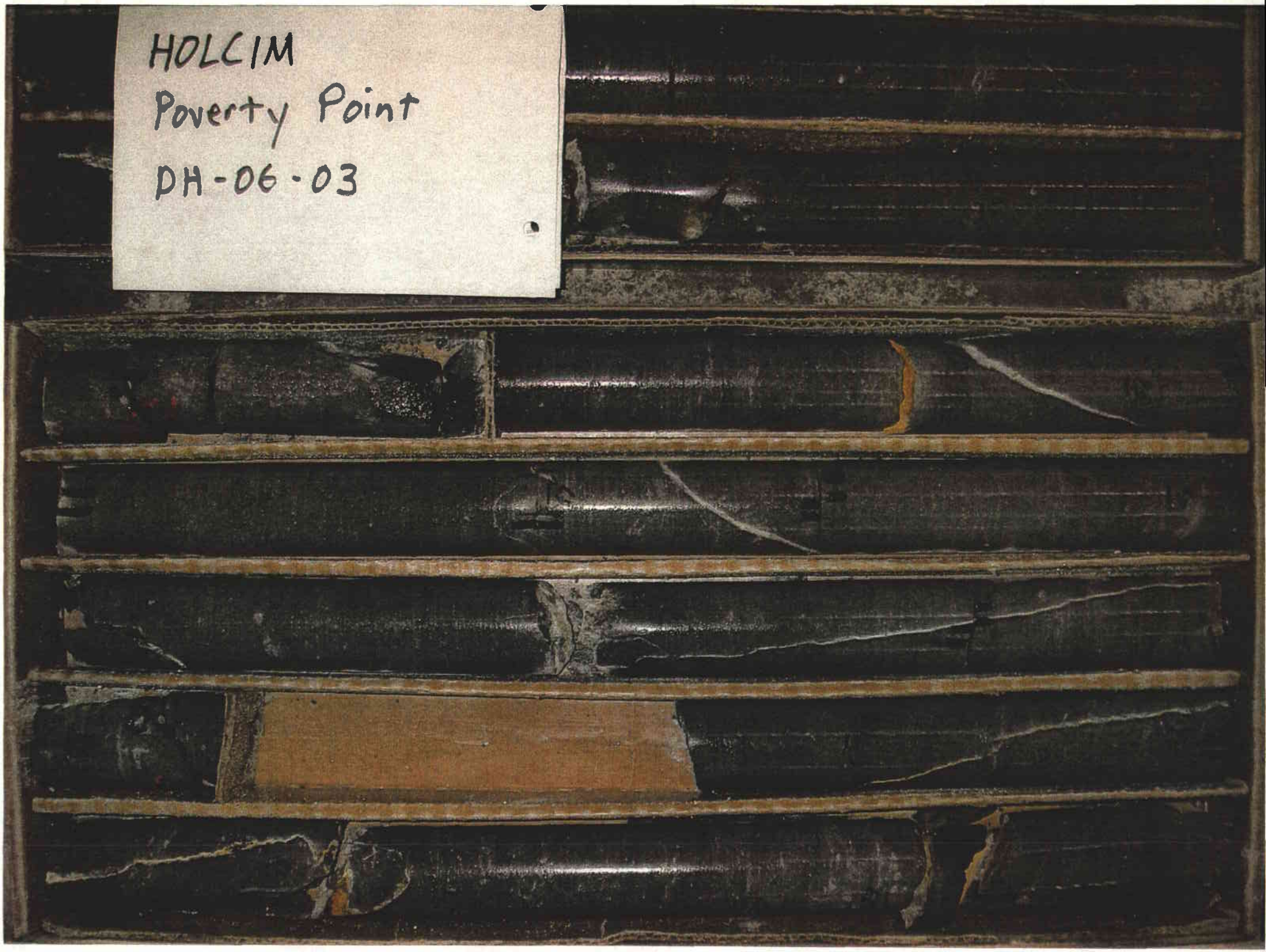

HOLCIM
Poverty Point
DH-06-03

HOLCIM
Poverty Point
DH-06-03


HOLCIM
Poverty Point
DH-06-03

HOLCIM
Poverty Point
DH-06-03

HOLCIM
Poverty Point
DH-06-03

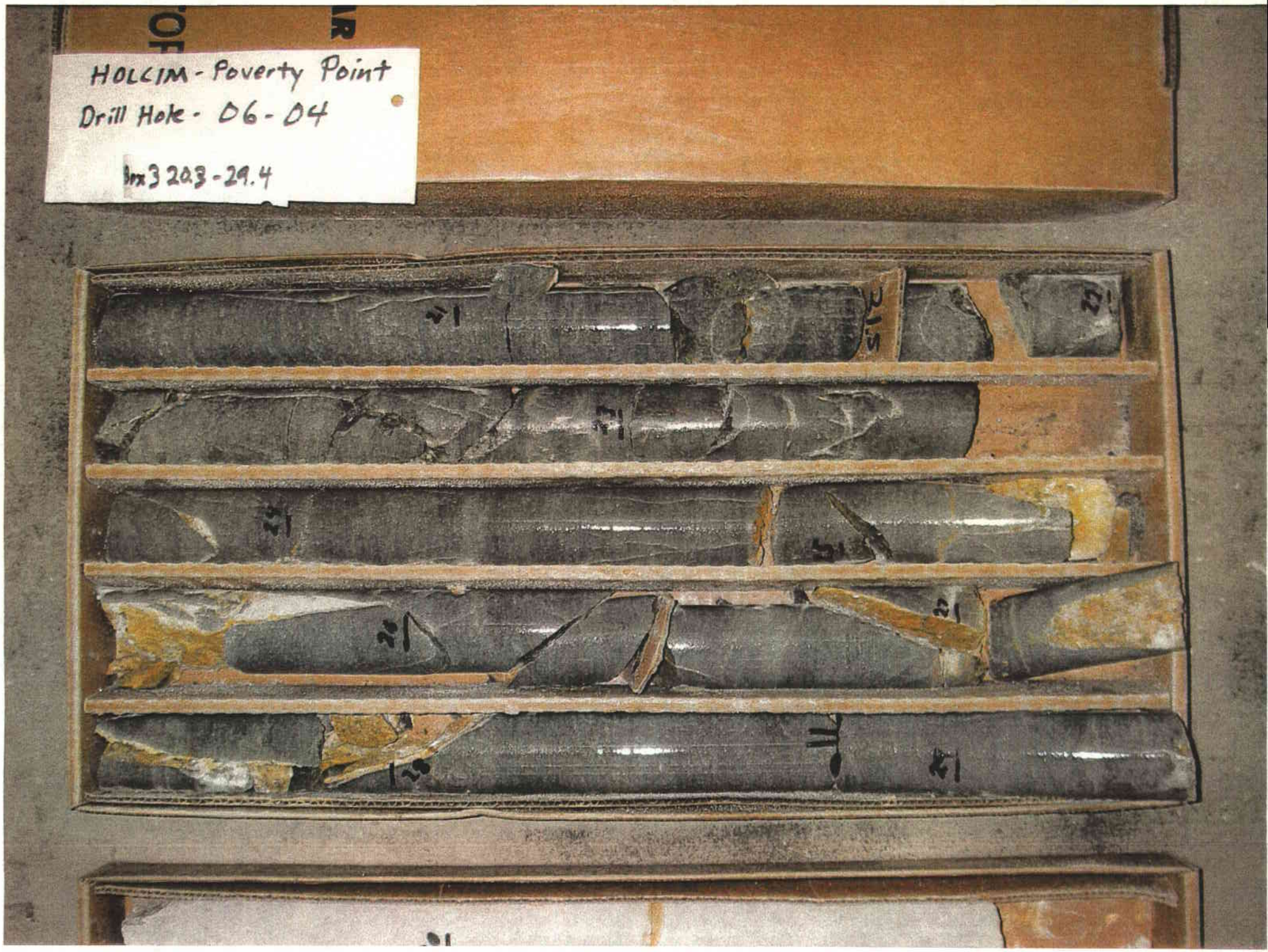

HOLCIM
Poverty Point
DH-06-03

HOLCIM
Poverty Point
DH-06-03

HOLCIM
Poverty Point
DH-06-03

HOLCIM - Poverty Point
Drill Hole - 06-04
Box1 0-11.5
1.5

HOLCIM - Poverty Point
Drill Hole - 06-04
Box 2 11.5-20.3


HOLCIM - Poverty Point
Drill Hole - 06-04
Box 3 203-29.4

HOLCIM - Poverty Point
Drill Hole - 06-04
Box 4 29.4-37.9

HOLCIM - Poverty Point
Drill Hole - 06-04
Box 5 37.9 - 46.3

HOLCIM - Poverty Point
Drill Hole - 06-04
Box 6 46.3 - 55.4

HOLCIM - Poverty Point
Drill Hole - 06-04
Box 7 55.4 - 64.5

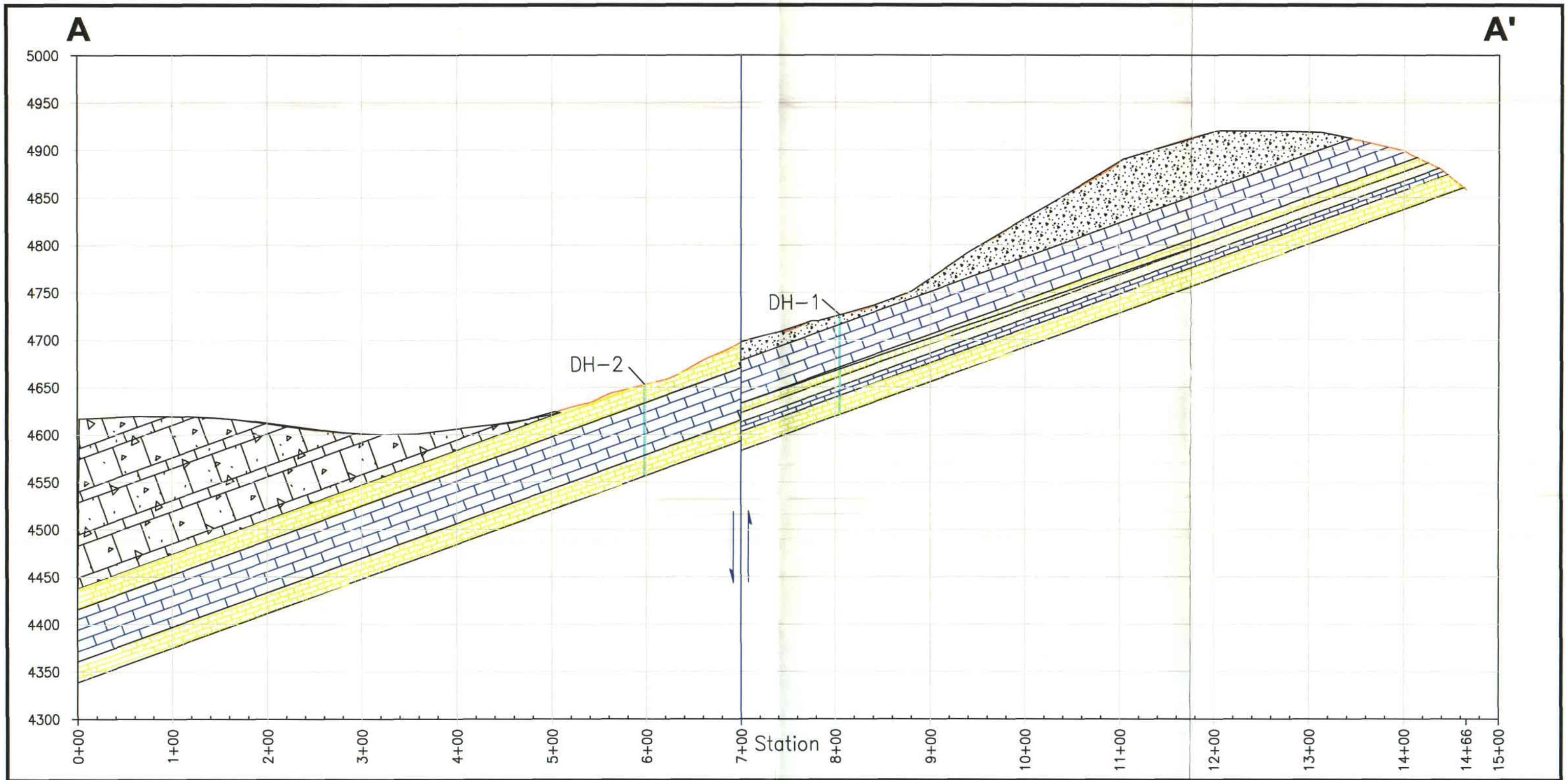
HOLCIM - Poverty Point
Drill Hole - 06-04
Box 8 64.5 - 73.6

HOLCIM - Poverty Point
Drill Hole - 06-04
Box 9 73.6-82.4
76

HOLCIM - Poverty Point
Drill Hole - 06-04
Box 10 82.4-90.5

APPENDIX C

Cross-Sections



LEGEND

- ALUVIUM
- TALUS (CONGLOMERATE)
- HIGH PURITY Ls
- SILICEOUS Ls
- SANDSTONE

0 50 100 200 300

SCALE: 1" = 100'

REV	DATE	DESCRIPTION	BY	CHKD	APRVD

HOLCIM

POVERTY POINT

FIGURE C-1
CROSS-SECTION A-A'

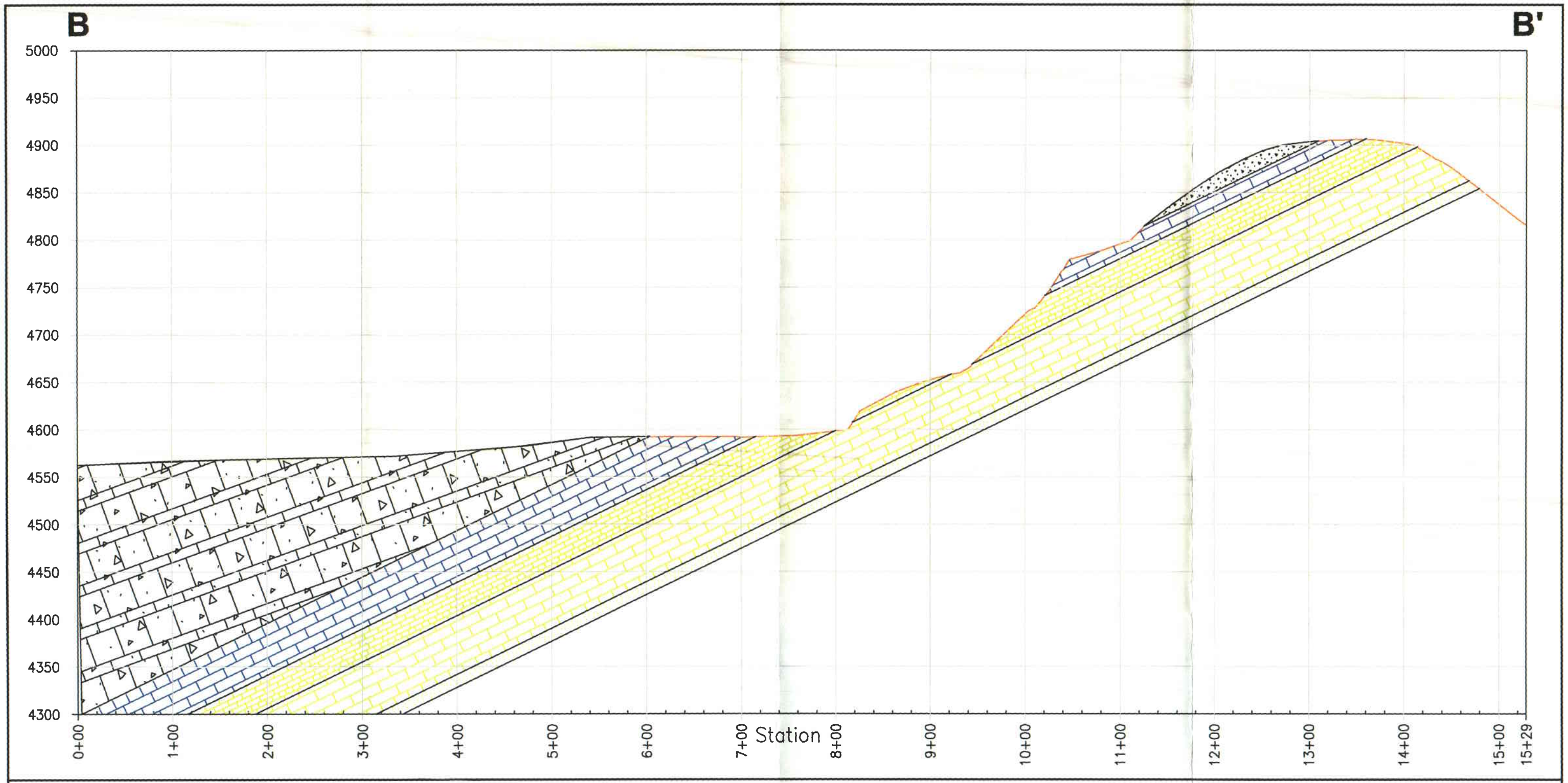
DRAWN BY: HAS
DATE: 01-May-06
REV: 00

NORWEST

Dwg.: FigCs Cross-Sections.dwg

Fig. C-1

FILE: H:\HOLCIM\Drafting\FigCs Cross-Sections.dwg



LEGEND

- ALUVIUM
- TALUS (CONGLOMERATE)
- HIGH PURITY Ls
- SILICEOUS Ls
- SANDSTONE

0 50 100 200 300

SCALE: 1" = 100'

REV	DATE	DESCRIPTION	BY	CHKD	APRVD

HOLCIM

POVERTY POINT

FIGURE C-2
CROSS-SECTION B-B'

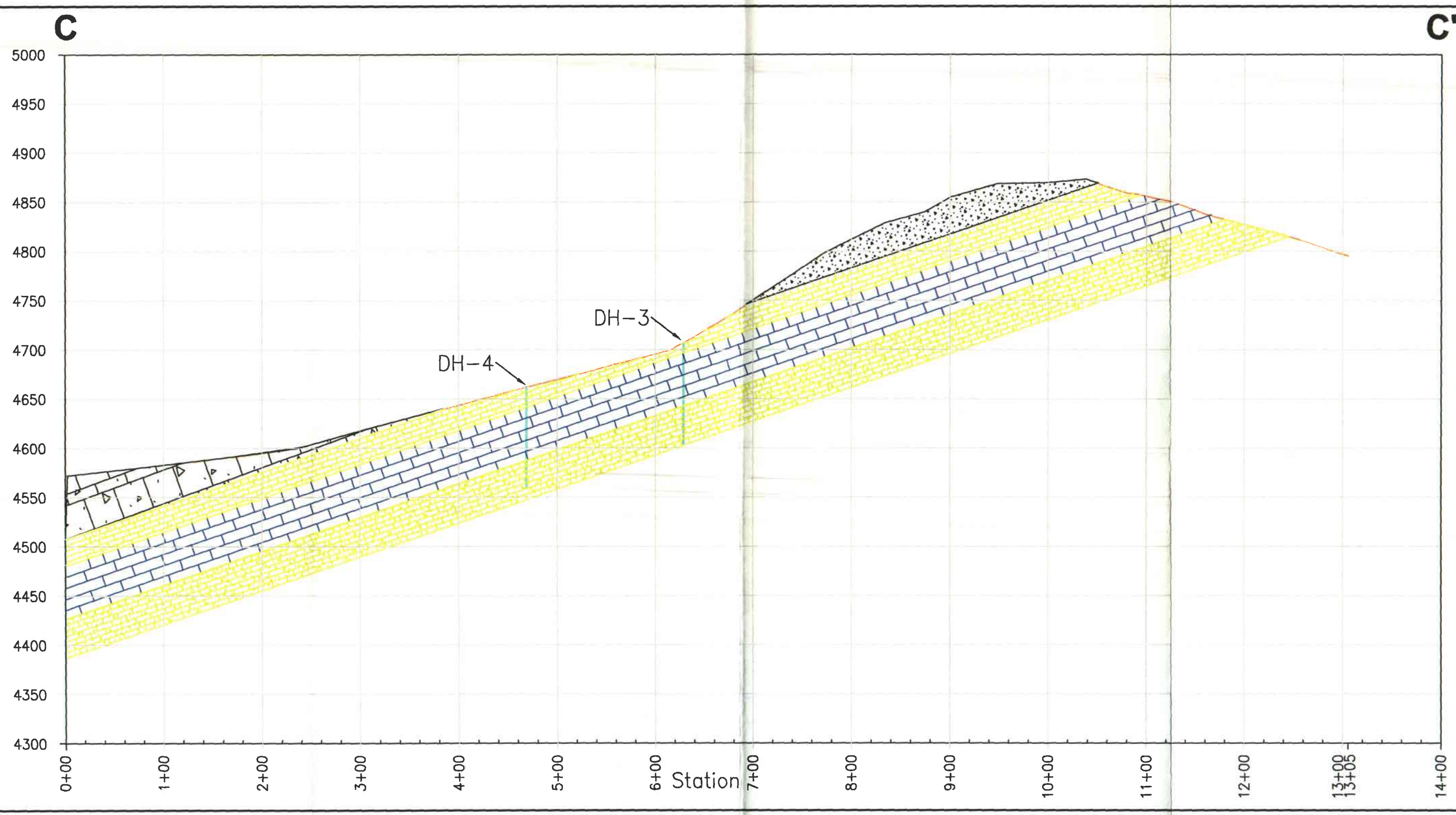
DRAWN BY: HAS
DATE: 01-May-06
REV: 00

NORWEST

Dwg.: FigCs Cross-Sections.dwg

Fig. C-2

H:\HOLCIM\Drafting\FigCs Cross-Sections.dwg



LEGEND

- ALUVIUM
- TALUS (CONGLOMERATE)
- HIGH PURITY Ls
- SILICEOUS Ls
- SANDSTONE

0 50 100 200 300

SCALE: 1" = 100'

REV	DATE	DESCRIPTION	BY	CHKD	APRVD

HOLCIM

POVERTY POINT

FIGURE C-3
CROSS-SECTION C-C'

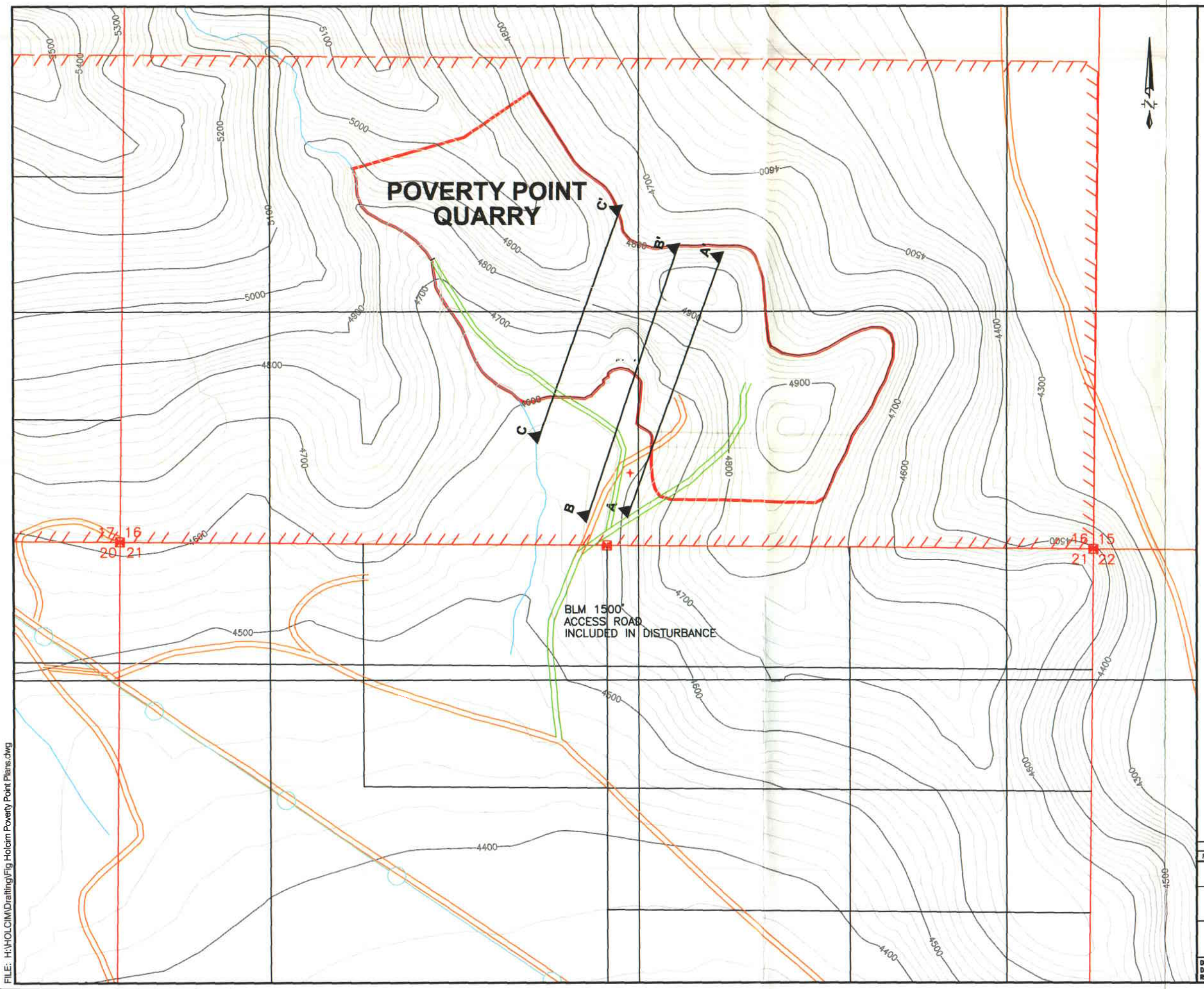
DRAWN BY: HAS
DATE: 01-May-06
REV: 00

NORWEST

Dwg.: FigCs Cross-Sections.dwg

Fig. C-3

FILE: H:\HOLCIM\Drafting\FigCs Cross-Sections.dwg



LEGEND

- ROAD (PROPOSED)
- ROAD (UNSURFACED)
- FENCE
- STREAM (INTERMITTENT) / WATER SYMBOL
- HOLCIM PROPERTY BOUNDARY
- QUARRY BOUNDARY

0 500 1000 1500

SCALE: 1" = 500'

REV	DATE	DESCRIPTION	BY	CHKD	APRVD

HOLCIM

POVERTY POINT

FIGURE C-4
PLAN VIEW

DRAWN BY: HAS
DATE: 01-May-06
REV: 00

NORWEST

Dwg.: Fig_Holcim Poverty Point Plans.dwg

Fig. C-4

FILE: H:\HOLCIM\Drafting\Fig Holcim Poverty Point Plans.dwg

APPENDIX D

Site Inspection Memo

NORWEST
CORPORATION

MEMORANDUM

TO: MIKE TOELLE

FROM: GARY M. STUBBLEFIELD

SUBJECT: POVERTY POINT SITE INSPECTION

DATE: JUNE 9, 2005

JOB #: 05-3213

CC: KIRK WEBER, KEN GEORGE, LANCE STEPHENS

Dear Mike,

I met Paul Johnson and Brian Ward at Rowley junction west of Salt Lake City at 9:30am, and followed them to the Poverty Point Quarry, arriving approximately 10:00am. There was no mining activity, nor equipment at the Quarry. Brian provided some maps of the quarry and we briefly discussed the activities I would be conducting on this inspection. Paul and Brian then departed to return to the Devil's Slide Quarry.

Over the next two hours I walked throughout the quarry taking photos, measuring bedding plane dips, looking for joint patterns, faults and weak zones. My observations are as follows:

- The quarry has had considerable previous mining activity, evidenced by the existence of several (5 to 6) benches from the pit floor at the 4550 ft. elevation, to a saddle near the top of the mountain at the 4850 ft. elevation. It appears the pit was developed from the bottom up, leaving a nearly 300-foot highwall on the north end. The rock appeared to be competent, but exhibited jointing patterns (see photo 36). These joints had thin calcite deposits and were oriented N22°E in one location, and N33°E and N40°W in another location (see photo 43)

- Beds dip to the south at 25 to 35 degrees into the quarry. It appears that the quarry was opened on the south and developed to the north. This left the south end day-lighted to the natural terrain, while the north pit wall rises about 300 hundred feet to the upper reaches of the mountain. I observed a couple of vertical joints that had been in-filled with calcite deposits and a thin (1 inch) layer of sandy clay beneath a thick limestone layer (photo 42). I observed only one small area of possible faulting (photo 37).

136 East South Temple, 12th Floor, Salt Lake City, UT 84111
Tel: (801) 539-0044, USA: (800) 266-6351, Fax: (801) 539-0055

- Near the upper reaches of the quarry, I observed cobblestone, rounded by wave action along the ancient Lake Bonneville shoreline. There was one wet area on the highwall associated with alluvial material overlying the limestone (photo 44). This could potentially weaken the immediate area, but did not seem to impact the broader highwall.

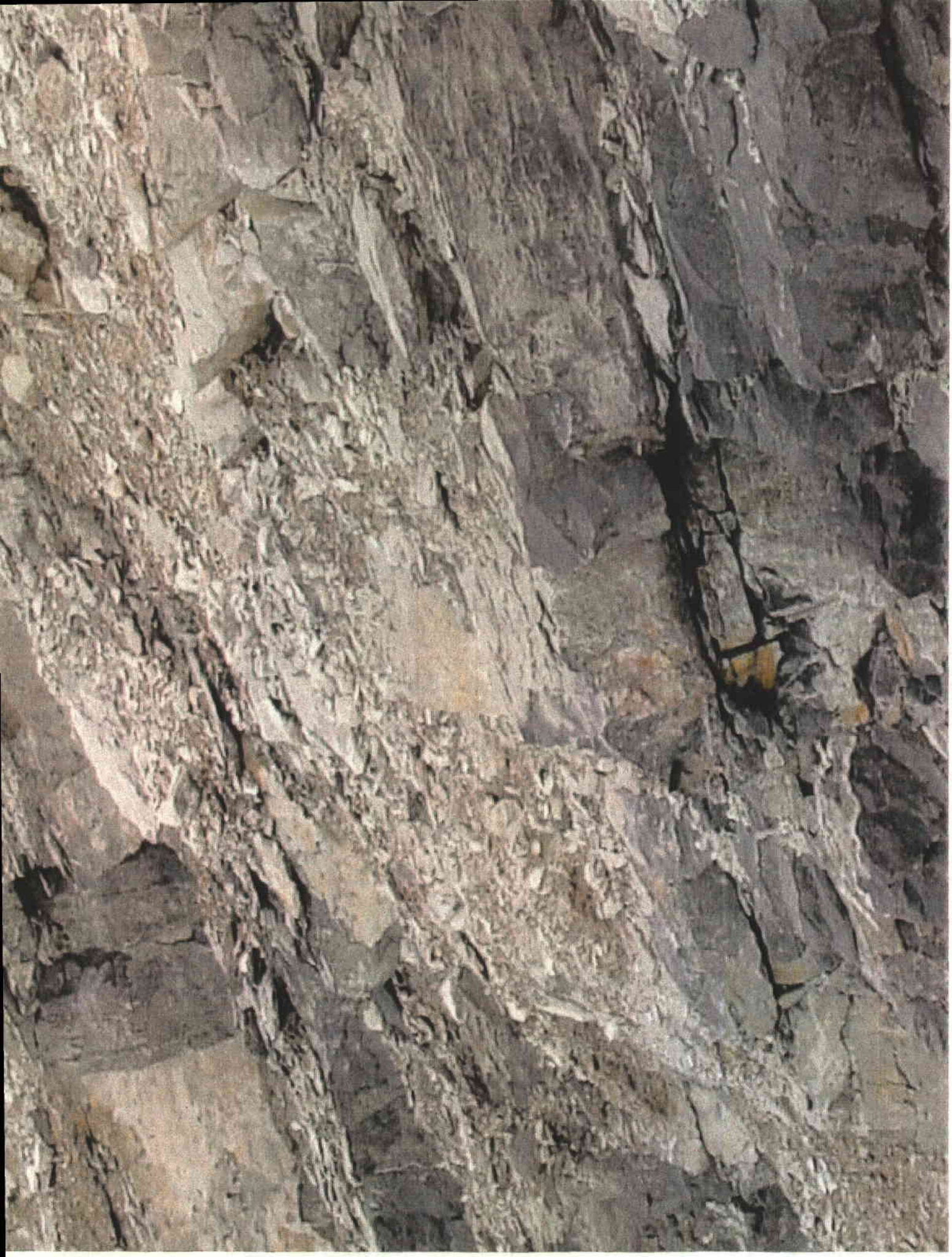
- The north pit wall appeared ragged, i.e., a few overhanging rocks and a jagged face (Photos 33 and 41). I did not observe any actual slope failures, but the joint pattern coupled with the south dipping beds suggest that slope failures could occur if the quarry wall is advanced further northward without un-weighting from the top.

- There was evidence of blasting at the quarry (nonel blasting cord and spent surface delays), which is to be expected. Blasting practices can contribute to slope instability and this should be investigated to determine if improvements could be made.

I will send the photos along with this inspection report to our geotechnical group in Vancouver for their review. From this initial inspection and observations, Norwest will prepare our proposal to conduct a proper geotechnical assessment of the Poverty Point Quarry, including recommendations for improving pit wall stability. We should have this proposal completed by mid-next week.

Sincerely,

Gary Stubblefield, P.E.
Vice President



APPENDIX E

Load Tests

NorWest
MINE SERVICES, INC.

CALCULATION SHEET

DESIGN BY _____ DATE 2·16·06 CHECKED BY _____ SHEET NO. 1

PROJECT HOLCIM JOB NO. 3213

SUBJECT POINT LOAD TESTING

HOLE 06-003

DEPTH	psi
15	1165
25	1270
36	960
~~48~~ 52	960
55	1010
~~64~~ 65	1210
X 70	1395
~~6~~ 80	1500 psi
88	850

NorWest
MINE SERVICES, INC.

CALCULATION SHEET

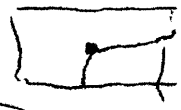
DESIGN BY _____ DATE 2/16/06 CHECKED BY _____ SHEET NO. 2 /

PROJECT HOLCIM JOB NO. 3213

SUBJECT POINT LOAD TESTING

HOLE
06-04

DEPTH	PSI
16.5	1470
23.5	900
35	615
44.5	~~1280~~ 980
58.5	1130
66	960
74.5	665
82.5	1175



FAILURE SOME CALCITE VEINING - DIDNT BREAK ON IT

NorWest
MINE SERVICES, INC.

CALCULATION SHEET

DESIGN BY _____ DATE 2/16/06 CHECKED BY _____ SHEET NO. 3/

PROJECT HOLCIM JOB NO. 3213

SUBJECT POINT LOAD TESTING

HOLE ID

06 - 02

DEPTH	PSI	
16'	1440	DID NOT FAIL SPALLED
18'	1390	
✓ 26.5	1350	
35.5	1150	
46	1395	
57	950	
68	1250	
X 74.25	1105	
80	1210	
92	1340	
~~105.5~~		
X 111	1270	
119.5	405	BROKE FEOx ON BREAK
~~124~~ 125.5	EST 1650	
X 137	1500	

amec

PROJECT:	Norwest Corporation	JOB NO:	6-819-002650
LOCATION:		WORK ORDER NO:	T5585
SAMPLED BY:	AS RECEIVED	DATE PLACED:	
AUTHORIZED BY:		DATE TESTED:	
NOM. MAX SIZE AGGREG:		DATE REC'D:	
CONTRACTOR:		PSI @ 28 DAYS:	
SUPPLIER:		PRODUCT CODE:	
MATERIAL:			

UNCONFINED COMPRESSION - ROCK CORES
ASTM D2938

LAB NO.	1	2	3	4	5
DATE TESTED	3/1/06	3/1/06	3/1/06	3/1/06	03/010/6
AGE (DAYS)					
LENGTH RECEIVED (IN)					
LENGTH BEFORE CAP (IN)					
LENGTH AFTER CAP (IN)	3.6	3.6	3.6	3.6	3.6
DIAMETER (IN)	1.80	1.80	1.80	1.80	1.80
AREA (IN^2)	2.54	2.54	2.54	2.54	2.54
LOAD (LBS.)	19,570	29,480	46,450	29,780	33,570
STRESS (PSI)	7,691	11,585	18,254	11,703	13,192
L/D	2.00	2.00	2.00	2.00	2.00
CORRECTED STRESS (PSI)	7,690	11,580	18,250	11,700	13,190

NOTE:

LOCATION: 5585-1, 3213 Hole 06.03, 25' - 26'
5585-2, 3213 Hole 06.02, 137.5'
5585-3, 3213 Hole 06.02, 26.75'
5585-4, 3213 Hole 06.04, 35.2'
5585-5, 3213 Hole 06.03, 70.3'

Reviewed By: David S Anderson

amec

PROJECT:	Norwest Corporation	JOB NO:	6-819-002650
LOCATION:		WORK ORDER NO:	T5585
SAMPLED BY:	AS RECEIVED	DATE PLACED:	
AUTHORIZED BY:		DATE TESTED:	
NOM. MAX SIZE AGGREG:		DATE REC'D:	
CONTRACTOR:		PSI @ 28 DAYS:	
SUPPLIER:		PRODUCT CODE:	
MATERIAL:			

UNCONFINED COMPRESSION - ROCK CORES
ASTM D2938

LAB NO.	6	7	8	9	10
DATE TESTED	3/1/06	3/1/06	3/1/06	3/1/06	03/010/6
AGE (DAYS)					
LENGTH RECEIVED (IN)					
LENGTH BEFORE CAP (IN)					
LENGTH AFTER CAP (IN)	3.6	3.6	3.6	3.6	3.6
DIAMETER (IN)	1.80	1.80	1.80	1.80	1.80
AREA (IN^2)	2.54	2.54	2.54	2.54	2.54
LOAD (LBS.)	31,220	21,780	26,990	41,130	25,290
STRESS (PSI)	12,269	8,559	10,606	16,163	9,938
L/D	2.00	2.00	2.00	2.00	2.00
CORRECTED STRESS (PSI)	12,270	8,560	10,610	16,160	9,940

NOTE:

LOCATION: 5585-6, 3213 Hole 06.02, 121.0'
5585-7, 3213 Hole 06.03, 48.5'
5585-8, 3213 Hole 06.04, 167.0'
5585-9, 3213 Hole 06.04, 183'
5585-10, 3213 Hole 06.02, 74'

Reviewed By: Derek S. Anderson

amec

PROJECT:	Norwest Corporation	JOB NO:	6-819-002650
LOCATION:		WORK ORDER NO:	T5585
SAMPLED BY:	AS RECEIVED	DATE PLACED:	
AUTHORIZED BY:		DATE TESTED:	
NOM. MAX SIZE AGGREG:		DATE REC'D:	
CONTRACTOR:		PSI @ 28 DAYS:	
SUPPLIER:		PRODUCT CODE:	
MATERIAL:			

UNCONFINED COMPRESSION - ROCK CORES
ASTM D2938

LAB NO.	11
DATE TESTED	3/1/06
AGE (DAYS)	
LENGTH RECEIVED (IN)	
LENGTH BEFORE CAP (IN)	
LENGTH AFTER CAP (IN)	3.6
DIAMETER (IN)	1.80
AREA (IN^2)	2.54
LOAD (LBS.)	35,820
STRESS (PSI)	14,076
L/D	2.00
CORRECTED STRESS (PSI)	14,080

NOTE:

LOCATION: 5585-11, 3213 Hole 06.04, 59.2'

Reviewed By: Derek S Anderson

APPENDIX F

Rock Strength Data

Depth			Classification Parameters						Ratings								
From (ft)	To (ft)	Interval	Rock Strength (Point Load)(MPa)	RQD%	Joint Count	Joint Spacing(ft)	Joint Spacing(m	Joint Conditic	Water Condit	Rock Strengt	RQD	Joint Spacing	Joint Conditic	Water	RMR	Rock Type	Weight Point Load	Weight RMR
0	3	3	2	32	NA	#VALUE!	#VALUE!	damp	4	8	#VALUE!	0	10	#VALUE!	LS	NA	NA
3	4	1	2	0	NA	#VALUE!	#VALUE!	damp	4	3	#VALUE!	0	10	#VALUE!	LS	NA	NA
4	6	2	2	18	NA	#VALUE!	#VALUE!	damp	4	3	#VALUE!	0	10	#VALUE!	LS	NA	NA
6	8	2	2	52	NA	#VALUE!	#VALUE!	damp	4	13	#VALUE!	0	10	#VALUE!	LS	NA	NA
8	11	3	2	0	NA	#VALUE!	#VALUE!	damp	4	3	#VALUE!	0	10	#VALUE!	LS	NA	NA
11	13.5	2.5	2	22	NA	#VALUE!	#VALUE!	damp	4	3	#VALUE!	0	10	#VALUE!	LS	NA	NA
13.5	16.5	3	9.9	32	NA	#VALUE!	#VALUE!	damp	12	8	#VALUE!	0	10	#VALUE!	LS	NA	NA
16.5	21	4.5	9.6	76	11	0.41	0.12	damp	12	17	8	0	10	47	LS	29.7	141
21	26	5	10	79	10	0.50	0.15	damp	12	17	8	0	10	47	LS	43.2	211.5
26	31	5	9.3	98	1	5.00	1.52	damp	12	20	15	0	10	57	LS	50	285
31	36	5	7.9	88	6	0.83	0.25	damp	12	17	10	0	10	49	LS	46.5	245
36	39	3	8	0	20	0.15	0.05	damp	12	3	5	0	10	30	LS	39.5	150
39	43	4	9	35	20	0.20	0.06	damp	12	8	8	0	10	38	LS	24	114
43	47	4	9.6	36	18	0.22	0.07	damp	12	8	8	0	10	38	LS	36	152
47	52	5	7	0	20	0.25	0.08	damp	12	3	8	0	10	33	LS	38.4	132
52	57	5	6.6	8	8	0.63	0.19	damp	12	3	8	0	10	33	LS	35	165
57	62	5	6.6	11	25	0.20	0.06	damp	12	3	8	0	10	33	LS	33	165
62	67	5	7	95	15	0.33	0.10	damp	12	20	8	0	10	50	LS	33	250
67	72	5	8.6	63	1	5.00	1.52	damp	12	13	15	0	10	50	LS	35	250
72	77	5	7.6	70	5	1.00	0.30	damp	12	13	10	0	10	45	LS	43	225
77	81.5	4.5	8.3	49	10	0.45	0.14	damp	12	8	8	0	10	38	LS	38	190
81.5	86	4.5	8	57	9	0.50	0.15	damp	12	13	8	0	11	44	LS	37.35	198
86	87	1	8	28	8	0.13	0.04	damp	12	8	5	0	12	37	LS	36	166.5
87	92	5	9.2	15	22	0.23	0.07	damp	12	3	8	0	13	36	LS	8	36
92	97	5	9.2	19	25	0.20	0.06	damp	12	3	8	0	14	37	LS	46	185
97	100	3	8	0	15	0.20	0.06	damp	12	3	8	0	15	38	LS	46	190
100	103	3	8	0	10	0.30	0.09	damp	12	3	8	0	16	39	LS	24	117
103	108	5	8	18	20	0.25	0.08	damp	12	3	8	0	17	40	LS	24	120
108	113	5	8.8	38	20	0.25	0.08	damp	12	8	8	0	18	46	LS	40	230
113	118	5	6	26	25	0.20	0.06	damp	12	8	8	0	19	47	LS	44	235
118	121	3	2.8	23	20	0.15	0.05	damp	7	3	5	0	20	35	LS	30	175
121	125.5	4.5	11.4	33	20	0.23	0.07	damp	15	8	8	0	21	52	LS	8.4	156
125.5	130.5	5	11.4	18	15	0.33	0.10	damp	15	3	8	0	22	48	LS	51.3	216
130.5	135	4.5	10	21	20	0.23	0.07	damp	12	3	8	0	23	46	LS	57	230
135	138	3	10.3	18	20	0.15	0.05	damp	15	3	5	0	24	47	LS	45	211.5
		121.5								3						1021.35	5141.5

AVG Point Load	8	Range Point Load	4-10
AVG MI	9		
AVG UCS	80	Range UCS	53-123
AVG RMR	42		

Hole No. DH 06-03

Depth			Classification Parameters						Ratings								
From (ft)	To (ft)	Interval	Rock Strength (Point Load)(MPa)	RQD%	Joint Count	Joint Spacing(ft)	Joint Spacing(m)	Joint Condition	Water Condition	Rock Strength	RQD	Joint Spacing	Joint Conditi	Water	RMR	Rock Type	Weight Point Load	Weight RMR
0	1.5	1.5	2	0	18	0.08	0.03	weathered	damp	4	3	5	20	10	42	LS	NA	NA
1.5	3.5	2	2	0	12	0.17	0.05	weathered	damp	4	3	5	20	10	42	LS	NA	NA
3.5	5	1.5	2	0	18	0.08	0.03	weathered	damp	4	3	5	20	10	42	LS	NA	NA
5	8	3	2	0	36	0.08	0.03	weathered	damp	4	3	5	20	10	42	LS	NA	NA
8	10	2	2	0	24	0.08	0.03	weathered	damp	4	3	5	20	10	42	LS	NA	NA
10	15	5	6	91	11	0.45	0.14	slight rough	damp	12	20	8	25	10	75	LS	30	375
15	20	5	8	97	3	1.67	0.51	slight rough	damp	12	17	10	25	10	74	LS	40	370
20	25	5	9	88	7	0.71	0.22	slight rough	damp	12	20	10	25	10	77	LS	45	385
25	30	5	8	94	6	0.83	0.25	smooth	damp	12	17	10	10	10	59	LS	40	295
30	35	5	8	87	5	1.00	0.30	slight rough	damp	12	13	10	25	10	70	LS	40	350
35	40	5	7	74	12	0.42	0.13	smooth	damp	12	17	8	10	10	57	LS	35	285
40	45	5	7	81	4	1.25	0.38	slight rough	damp	12	13	10	25	10	70	LS	35	350
45	50	5	7	68	7	0.71	0.22	smooth	damp	12	17	10	10	10	59	LS	35	295
50	55	5	7	89	6	0.83	0.25	slight rough	damp	12	17	10	25	10	74	LS	35	370
55	60	5	7	77	6	0.83	0.25	smooth	damp	12	13	10	10	10	55	LS	35	275
60	65	5	8	68	8	0.63	0.19	slight rough	damp	12	20	8	25	10	75	LS	40	375
65	70	5	10	94	4	1.25	0.38	slight rough	damp	12	17	10	25	10	74	LS	50	370
70	75	5	10	77	6	0.83	0.25	smooth	damp	12	20	10	10	10	62	LS	50	310
75	80	5	10	96	7	0.71	0.22	slight rough	damp	12	13	10	25	10	70	LS	50	350
80	85	5	10	55	9	0.56	0.17	smooth	damp	12	13	8	10	10	53	LS	50	265
85	90	5	6	61	14	0.36	0.11	slight rough	damp	12	13	8	25	10	68	LS	30	340
		80															640	5360

AVG Point Load	8	Range Point Load	4-10
AVG MI	9		
AVG UCS	80	Range UCS	53-123
AVG RMR	67		

Hole No. DH 06-04

Depth			Classification Parameters								Ratings							
From (ft)	To (ft)	Interval	Rock Strength (Point Load)(MPa)	RQD%	Joint Count	Joint Spacing(ft)	Joint Spacing(m)	Joint Condition	Water Condition	Rock Strength	RQD	Joint Spacing	Joint Condition	Water	RMR	Rock Type	Weight Point Load	Weight RMR
0	1.5	1.5	2	0	18	0.08	0.03	weathered	damp	4	3	5	20	10	42	LS	NA	NA
1.5	5	3.5	6	60	7	0.50	0.15	weathered	damp	12	13	8	20	10	63	LS	21	220.5
5	10	5	6	57	12	0.42	0.13	slight rough	damp	12	13	8	25	10	68	LS	30	340
10	11.5	1.5	4	22	5	0.30	0.09	slight rough	damp	7	3	8	25	10	53	LS	6	79.5
11.5	16.5	5	10	60	14	0.36	0.11	smooth	damp	15	13	8	10	10	56	LS	50.5	280
16.5	21.5	5	8	51	18	0.28	0.08	smooth	damp	12	13	8	10	10	53	LS	40	265
21.5	26.5	5	6	35	13	0.38	0.12	slight rough	damp	12	8	8	25	10	63	LS	31	315
26.5	31.5	5	6	83	8	0.63	0.19	slight rough	damp	12	17	8	25	10	72	LS	30	360
31.5	36.5	5	4	76	10	0.50	0.15	slight rough	damp	12	17	8	25	10	72	LS	21	360
36.5	41.5	5	5	39	10	0.50	0.15	slight rough	damp	12	8	8	25	10	63	LS	25	315
41.5	46.5	5	7	79	7	0.71	0.22	slight rough	damp	12	17	10	25	10	74	LS	34	370
46.5	51.5	5	6	64	10	0.50	0.15	smooth	damp	12	13	8	10	10	53	LS	30	265
51.5	56.5	5	5	41	10	0.50	0.15	smooth	damp	12	8	8	10	10	48	LS	25	240
56.5	61.5	5	8	54	14	0.36	0.11	smooth	damp	12	13	8	10	10	53	LS	39	265
61.5	66.5	5	7	51	11	0.45	0.14	slight rough	damp	12	13	8	25	10	68	LS	33	340
66.5	71	4.5	6	78	11	0.41	0.12	smooth	damp	12	17	8	10	10	57	LS	27	256.5
71	76	5	5	98	5	1.00	0.30	slight rough	damp	12	20	10	25	10	77	LS	23	385
76	81	5	6	81	8	0.63	0.19	smooth	damp	12	17	8	10	10	57	LS	30	285
81	85	4	8	95	8	0.50	0.15	smooth	damp	12	20	8	10	10	60	LS	32.4	240
85	89	4	6	69	17	0.24	0.07	smooth	damp	12	13	8	10	10	53	LS	24	212
89	90.5	1.5	6	0	1	1.50	0.46	smooth	damp	12	3	10	10	10	45	LS	9	67.5
		89															560.9	5461

Assumptions:

Where indicated in yellow, point load values were estimated based upon nearest depth test values, calculated RQD, rock strength (hammer blows), lithologic description, and fracture spacing. Estimatec

Groundwater conditions were estimated as damp - the influence of pore water pressures can be modeled within Slope-W

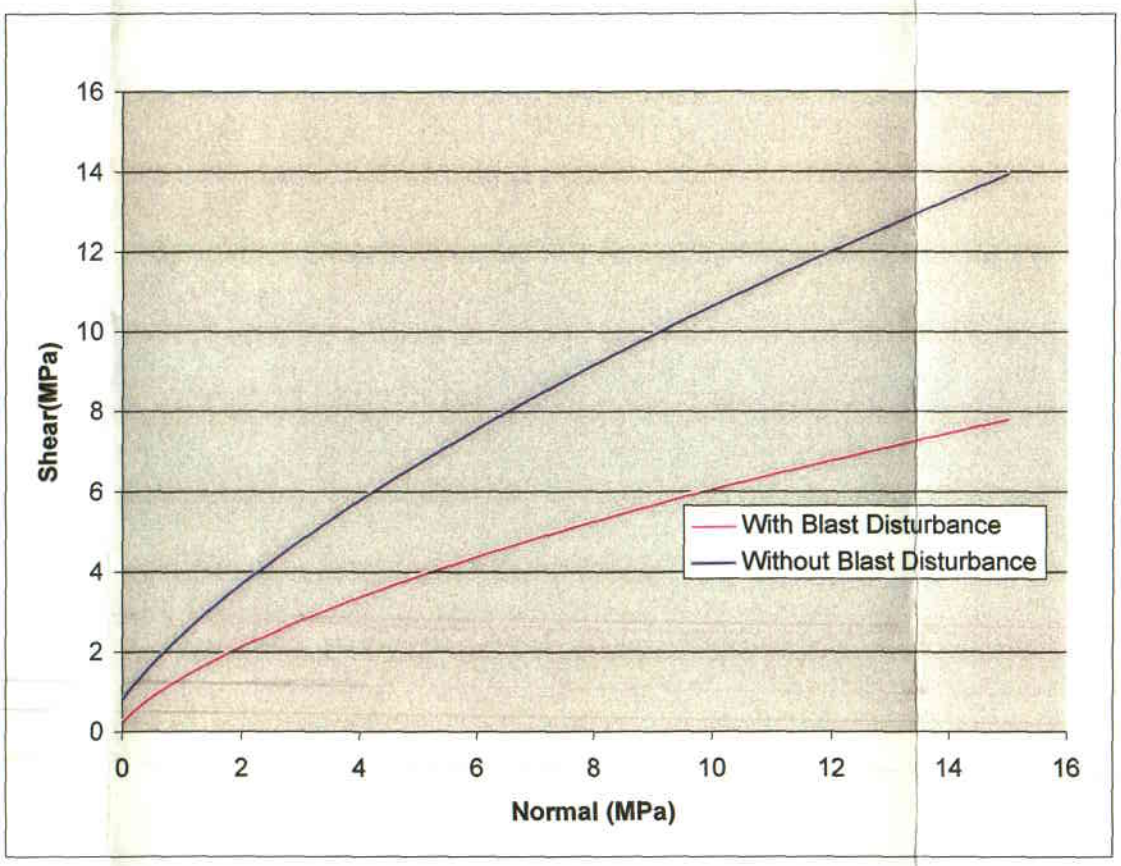
Joint condition was estimated from geotechnical and geologic logs. All joints were planar or slightly curved, and rough or smooth. Calcite and trCl infilled most joints.

AVG Point Load	6	Range Point Load	4-10
AVG MI	9		
AVG UCS	80	Range UCS	53-123
AVG RMR	61		
Total RMR (all holes)	15962.5	AVG RMR (all holes)	55
Total Point Load (all holes)	2222.25	AVG POINT LOAD (all holes)	8
Total Interval (all holes)	290.5		

APPENDIX G

Shear Strength Data

nal (Ml	τ
0	286.8299
50	368.3667
100	443.3211
200	579.9582
400	819.9675
600	1032.442
800	1226.71
1000	1407.575
1500	1817.882
2000	2185.879
3000	2838.807
4000	3416.696
5000	3942.338
6000	4428.593
7000	4883.64
8000	5313.095
9000	5721.027
10000	6110.505
11000	6483.917
12000	6843.163
13000	7189.792
14000	7525.083
15000	7850.108



nal (Ml	τ
0	846.6859
50	948.9059
100	1047.187
200	1234.192
400	1579.699
600	1897.994
800	2196.459
1000	2479.482
1500	3136.403
2000	3739.969
3000	4837.848
4000	5833.696
5000	6756.418
6000	7622.8
7000	8443.734
8000	9226.819
9000	9977.635
10000	10700.44
11000	11398.58
12000	12074.75
13000	12731.16

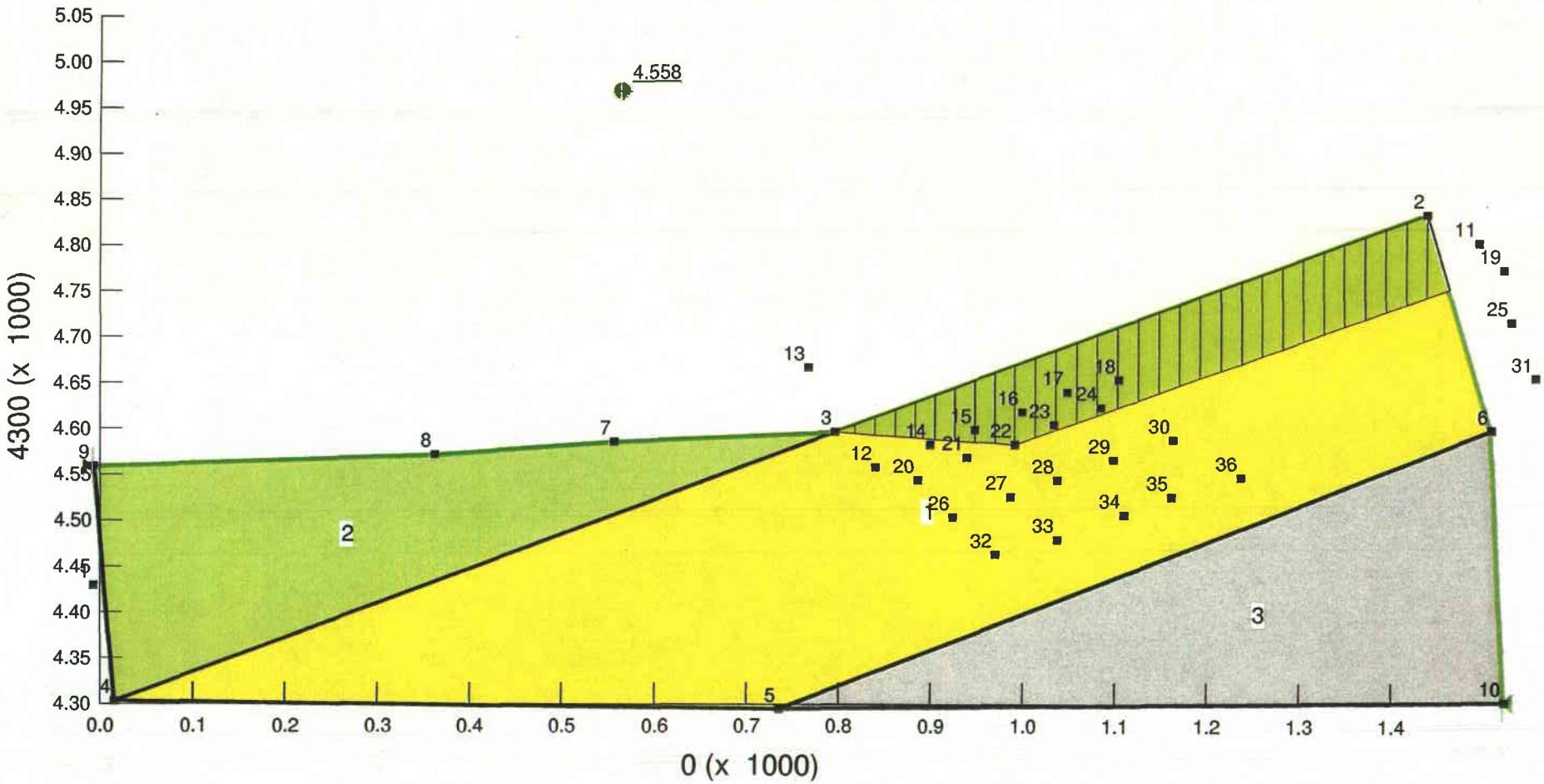
APPENDIX H

Slope/W Analyses

Name: 20 degrees.gsz

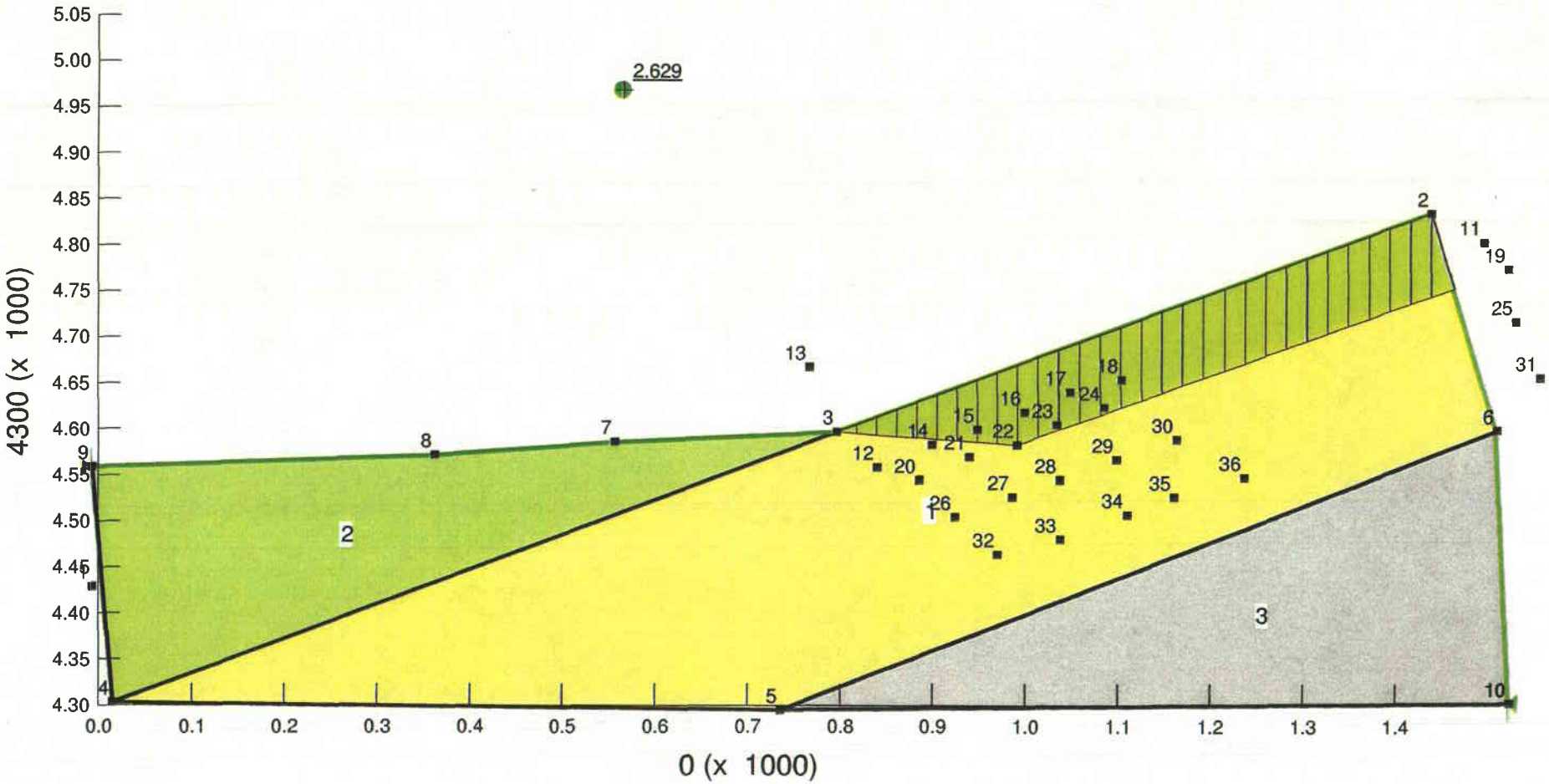
Material #: 1
Description: Blast Disturbed Limestone
Model: ShearNormalFn
Wt: 100
Strength Fn: 1
Material #: 2
Description: Undisturbed Limestone
Model: ShearNormalFn
Wt: 100
Strength Fn: 2

Material #: 3
Description: Alluvium
Model: MohrCoulomb
Wt: 100
Cohesion: 0
Phi: 45
Material #: 4
Description: Bedrock
Model: Bedrock



Name: 20 degrees Disturbed.gszMaterial #: 1
Description: Blast Disturbed Limestone
Model: ShearNormalFn
Wt: 100
Strength Fn: 1
Material #: 2
Description: Undisturbed Limestone
Model: ShearNormalFn
Wt: 100
Strength Fn: 2

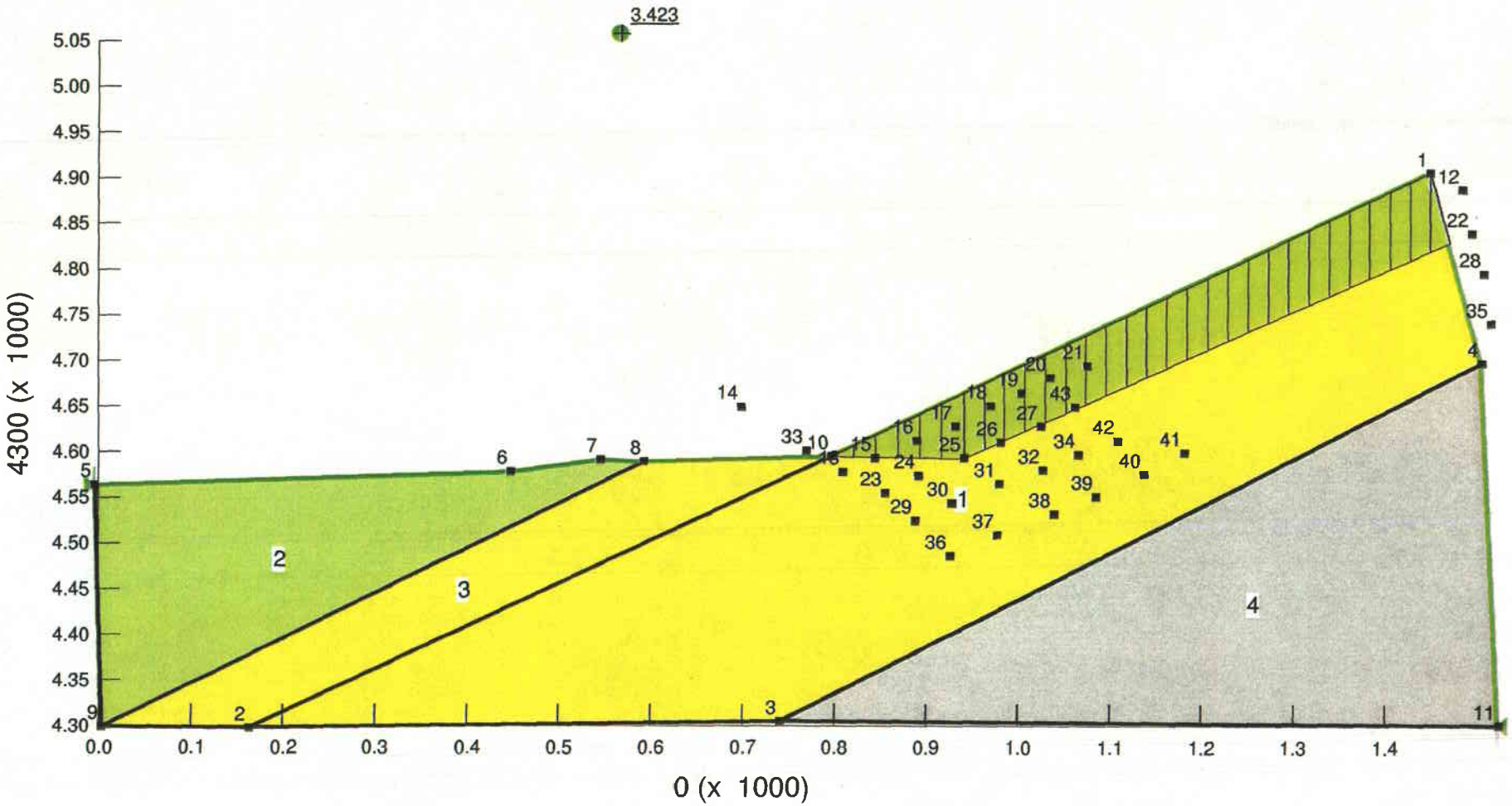
Material #: 3
Description: Alluvium
Model: MohrCoulomb
Wt: 100
Cohesion: 0
Phi: 45
Material #: 4
Description: Bedrock
Model: Bedrock



Name: 25 degrees.gsz

Material #: 1
Description: Blast Disturbed Limestone
Model: ShearNormalFn
Wt: 100
Strength Fn: 1
Material #: 2
Description: Undisturbed Limestone
Model: ShearNormalFn
Wt: 100
Strength Fn: 2

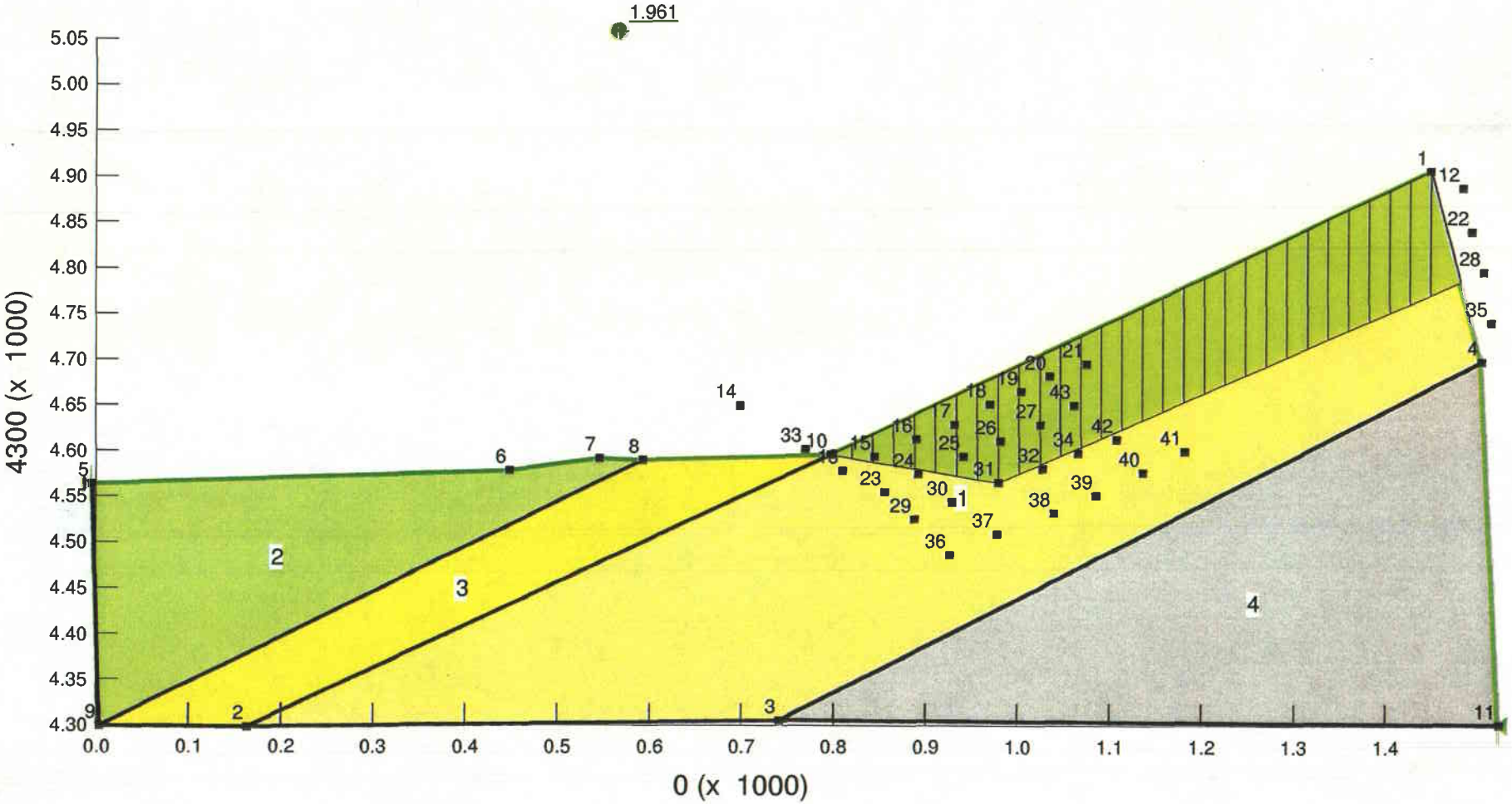
Material #: 3
Description: Alluvium
Model: MohrCoulomb
Wt: 100
Cohesion: 0
Phi: 45
Material #: 4
Description: Bedrock
Model: Bedrock



Name: 25 degrees disturbed.gsz

Material #: 1
Description: Blast Disturbed Limestone
Model: ShearNormalFn
Wt: 100
Strength Fn: 1
Material #: 2
Description: Undisturbed Limestone
Model: ShearNormalFn
Wt: 100
Strength Fn: 2

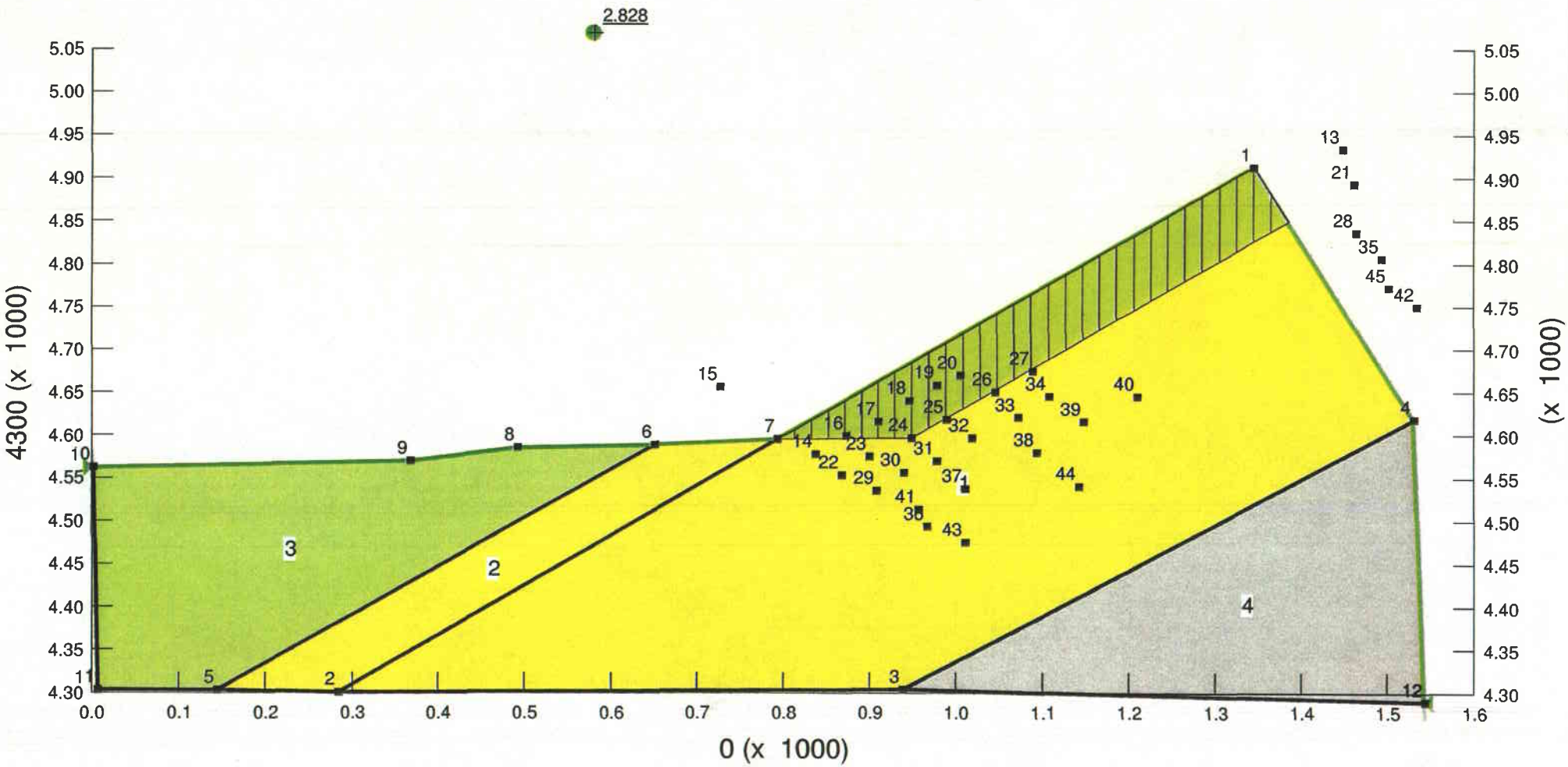
Material #: 3
Description: Alluvium
Model: MohrCoulomb
Wt: 100
Cohesion: 0
Phi: 45
Material #: 4
Description: Bedrock
Model: Bedrock



Name: 30 degrees.gsz

Material #: 1
Description: Blast Disturbed Limestone
Model: ShearNormalFn
Wt: 100
Strength Fn: 1
Material #: 2
Description: Undisturbed Limestone
Model: ShearNormalFn
Wt: 100
Strength Fn: 2

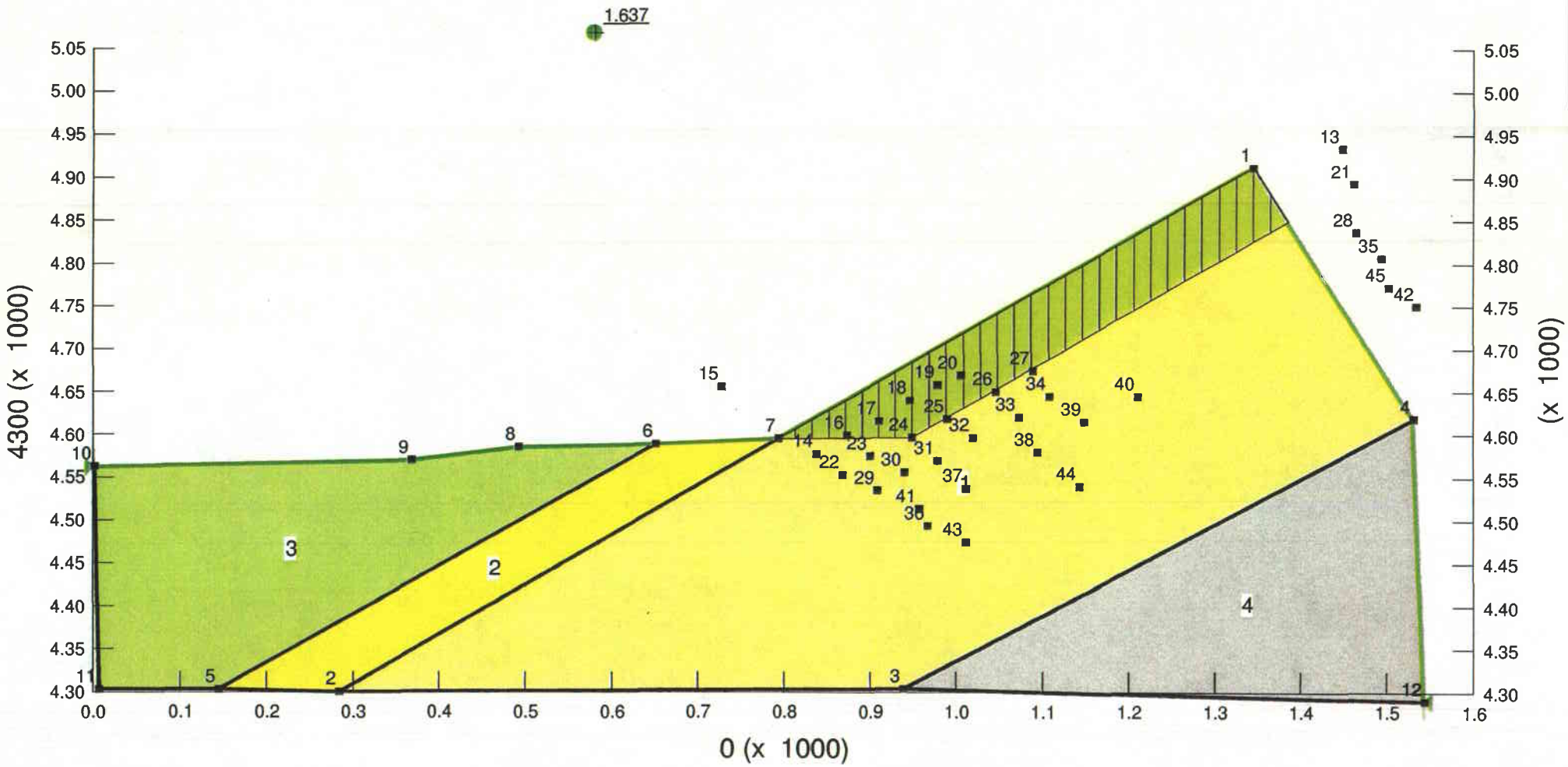
Material #: 3
Description: Alluvium
Model: MohrCoulomb
Wt: 100
Cohesion: 0
Phi: 45
Material #: 4
Description: Bedrock
Model: Bedrock



Name: 30 degrees disturbed.gsz

Material #: 1
Description: Blast Disturbed Limestone
Model: ShearNormalFn
Wt: 100
Strength Fn: 1
Material #: 2
Description: Undisturbed Limestone
Model: ShearNormalFn
Wt: 100
Strength Fn: 2

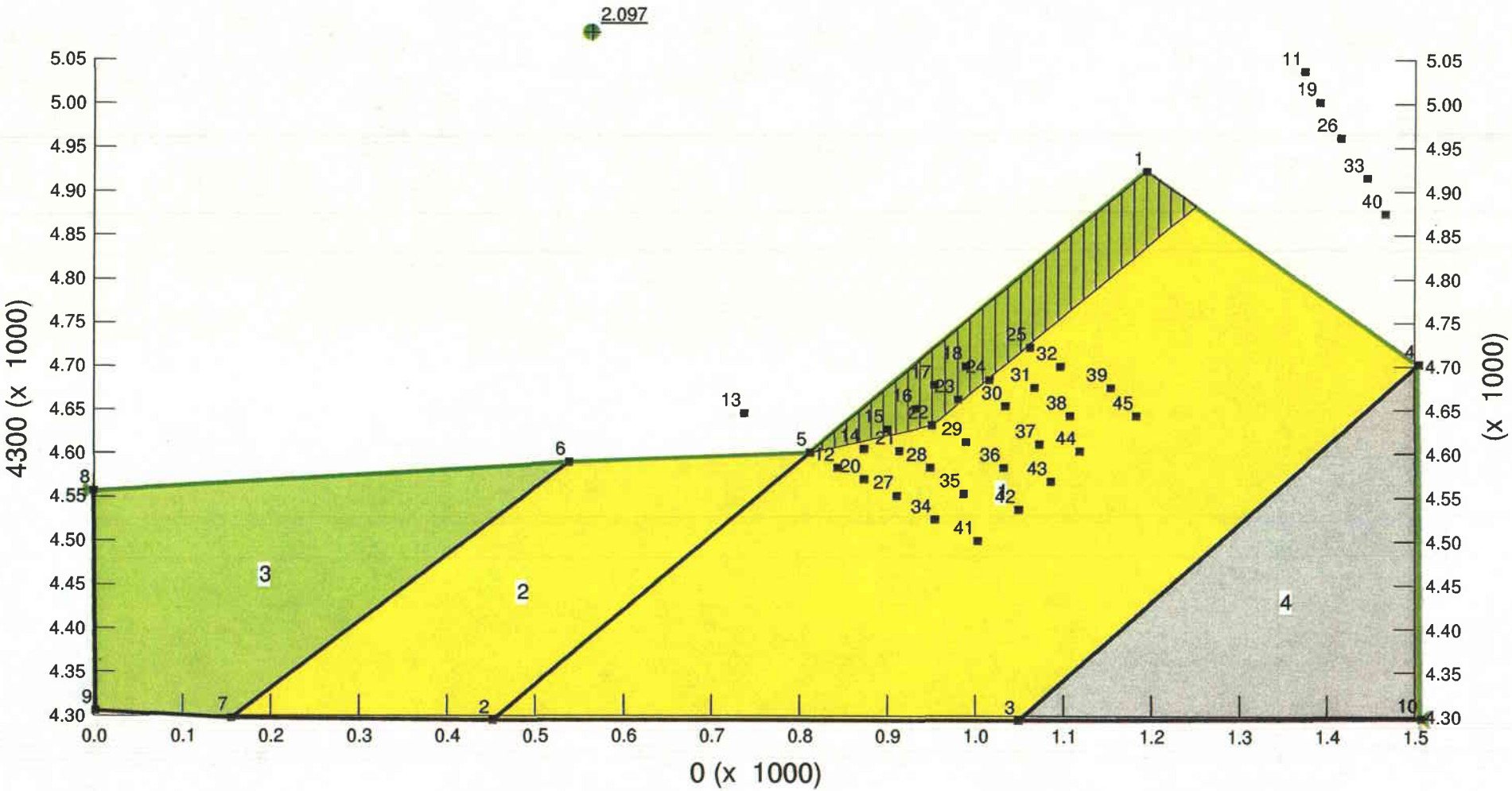
Material #: 3
Description: Alluvium
Model: MohrCoulomb
Wt: 100
Cohesion: 0
Phi: 45
Material #: 4
Description: Bedrock
Model: Bedrock



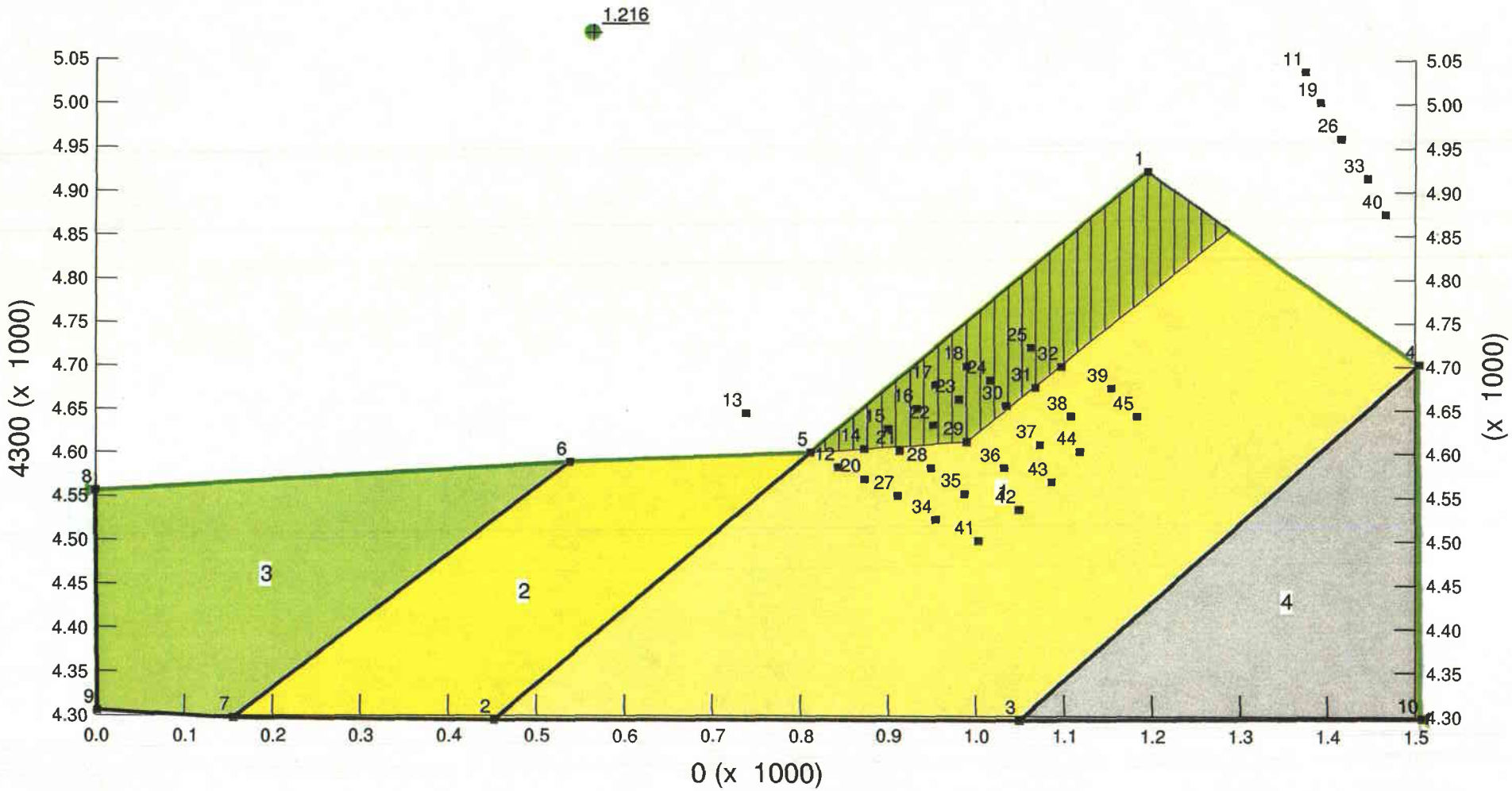
Name: 35 degrees.gsz

Material #: 1
Description: Blast Disturbed Limestone
Model: ShearNormalFn
Wt: 100
Strength Fn: 1
Material #: 2
Description: Undisturbed Limestone
Model: ShearNormalFn
Wt: 100
Strength Fn: 2

Material #: 3
Description: Alluvium
Model: MohrCoulomb
Wt: 100
Cohesion: 0
Phi: 45
Material #: 4
Description: Bedrock
Model: Bedrock



Name: 35 degrees disturbed.gsz

Material #: 1
Description: Blast Disturbed Limestone
Model: ShearNormalFn
Wt: 100
Strength Fn: 1
Material #: 2
Description: Undisturbed Limestone
Model: ShearNormalFn
Wt: 100
Strength Fn: 2

Material #: 3
Description: Alluvium
Model: MohrCoulomb
Wt: 100
Cohesion: 0
Phi: 45
Material #: 4
Description: Bedrock
Model: Bedrock