PIONEER

January 5, 2022

Tim Cazier
CO DRMS
1313 Sherman Street, Room 215
Denver, CO 80203

RE: J&J Stone Pit #1 Permit No. M-2011-004 TR-2
Response to Preliminary Adequacy Review Dated December 22, 2021

Dear Mr. Cazier,

Please find KrauthCo's blasting plan guided by the Divisions blasting plan guidance.

Respectfully submitted

Angela M. Bellantoni Ph.D.

CC: Mike Krauth

630 Plaza Drive, Suite 150
Highlands Ranch, CO 80129
www.pioneerco.com

FOURMILE SANDSTONE QUARRY BLASTING PLAN

1. **Blast Schedule Notification:**
   a. Krauthco / Pioneer, 800 Garden Park Road, Canon City Colorado 719-371-1678
   b. 800 Garden Park Road, Canon City, Colorado
   c. One / two day(s) of anticipated use of explosives
   d. Access will be restricted by use of locked gates, blocked vehicle traffic, and security personal conducting visual inspections for unauthorized persons or vehicles.
   e. The explosives foreman will contact the quarry manager prior to commencement of an initiation by phone. All persons, on site will be notified to stop all activities and leave the area. A head-count and location will be performed by the quarry manager. The explosives foreman will give horn/air blasts for pre-initiation warning. The explosives foreman will sound an all clear, after successful initiation and when he determines the site is clear and safe.
   f. The Fourmile quarry site has only one neighbor adjoining the property to the east Figure 1). The quarry foreman always notifies the neighbor, days in advance, and prior to initiation of the limited use of explosives. All employees are notified by quarry manager and a review of emergency protocols is conducted. The pre-blast survey, of this site, suggests that explosive use should be minimum energy use, and use of delays, for the fracturing of stone to maximize the products and limit the air and sound vibrations. This method results in sound discharge similar to machine gun fire, which is often heard at the local gun range one-mile from this site. A notification to EMS and local officials is the responsibility of the explosives professional when necessary and or in accordance with any state and local guidelines.

Figure 1: John Waters residence and nearest structure

2. **Pre-Blast Surveys –where agreed to and approved by structure owners:**
   a. A geologic survey of the site was conducted, in 2011, which gives a detailed snapshot into the formation, as to material composure, type, and strata. This detailed report shows a

deposit and formation largely composed of quartz sand bound by clay and natural cemented particles. This deposit is layered on a horizontal plane with natural fracturing, on this plane. Energy absorption should traverse these planes fairly easy and vertical intersection of these planes at right angles (drill holes) should split the deposit targets with low yield of excess energy. (Appendix A: KrauthCo, J&J Stone Geological Reconnaissance Report by Randy Roberts-Geological Engineer conducted July of 2011)

b. The only structure within one half-mile, (.4634 miles), is the John Waters residence, to the east of the property. The quarry manager has visited the residence and discussed the purpose and use of explosives with the owner. We reviewed the pre-existing conditions and issues that the structure has had, prior to use of any explosives. The residence has had some settling issues that have been addressed, by the homeowner. Given the distance and separation of the residence and quarry by a large canyon and ravine, which is likely a snap-joint in the deposit plate, it is unlikely that any vibration damage would occur, with limited yield and delayed charges. This report and conclusion was concurred with, by the explosives professional.

c. No structures or contents were identified as sensitive to blasting.

3. Blast Plan:

a. **Ground vibration** is measured in several ways including, particle displacement, particle velocity, particle acceleration and particle frequency. Ground vibration controls are regulated by a measured calculation of the four principles and applied to blast plan to remain under the threshold of recommended blast induced thresholds by the U.S. Bureau of Mines. Site and blast specific calculations will be prepared by the licensed blasting contractor and presented to Fourmile prior to execution of the contract.

b. **Limits on air blast**, commonly referred to as “air-overpressure”, are determined by several factors, and must be calculated by the blasting professional to insure that thresholds set by the Colorado Department of Labor regulations not to exceed charge weight and distance to nearest structure. Site and blast specific calculations will be prepared by the licensed blasting contractor and presented to Fourmile prior to execution of the contract.

c. It is critical to identify and monitor any **adverse effects** of the blasting. At the Fourmile quarry, the site is relatively sheltered and isolated from public roadways, water sources, commerce, and urban areas. The primary concern is the John Waters property and residence, located approximately one-half mile to the east of site. Ground vibration, noise, and dust or fly-rock potential must be calculated, by the blasting professional and accommodated for in the blasting pattern and weight to not approach in regulatory thresholds. The quarry manager has reviewed the information provided by the blasting professional to include but not limited to credentials, insurances, experience, site specific conditions, geological reports, technical revisions and recommendations of the U.S. Bureau of Mines, MSHA., A.T.F., and the CO DRMS. A pre and post-blasting meeting with the land and structure owner shall be conducted by the quarry manager.

d. **Monitoring** systems are the responsibility of the blasting professional if and when required. Based on the highly technical calculations and liabilities of the blasting professional, each blast must be calculated and determination of the thresholds be made. It is the responsibility of the blasting professional to absolutely insure that if a threshold will even be approached, then that particular event must be monitored and measured. The unique

nature of this particular quarry is that a relatively low volume of energy is required to simply loosen and crack, or simply relieve the existing natural shear planes of the deposit. Previous use of fracturing agents such as expansive mortar (DEXPAN) and low-yield explosives (Sierra blasting systems), as well as hydraulic breakers confirm the nature of this deposit under pressure, over the last decade of mining. Explosive use events have only been employed annually or bi-annually over the last few years, to increase the mining volume, when necessary. The other methods of loosening or fracturing the deposit are the primary methods to maximize the highest yields of dimensional stone and boulders.

e. **Blasting protocols and procedures** are a concerted, combinative effort of the quarry manager and blasting professional to ensure that the safety of all human life, property, and the environment are protected from injury or damage. Similar to the blast radius, the protocols start at the center of blasting area. It is the responsibility of the blasting professional to calculate the minimum amount of agents necessary to complete the task, to determine the equipment and materials necessary to complete the desired result, and to do so within the limitations and regulations set forth by all regulatory agencies to do so. It shall always be the responsibility of the quarry manager to shadow the blasting professionals and his/her decisions as to how they may impact persons, property, and environmental assets within the blasting radius. This information shall be discussed between the parties and any concerns from either party shall be mitigated, prior to initiation. Once blasting procedures commence, the blasting radius shall be controlled by the explosives professional. Only in the event of a pre-initiation emergency, such as a health emergency or unsafe condition being detected. The Quarry manager will notify the explosives professional who has sole control of initiation. Everyone on-site will remain in place until the site is deemed safe by the explosives professional.

f. **Anticipated typical blast design** for the Fourmile quarry shall be to drill patterns and depths for use of ANFO, small boosters, and ignitable primers that can maximize a splitting effect of the dimensional sandstone. It has been recommended by a blasting professional to delay each line and to lift and heave at each row towards the relief portion of the first initiation point. The expected product should be a large quantity of loosened material, left in situ, that has simply been relieved on the vertical drill holes and horizontal natural planes. The target product of the blast should be boulders and rubble size material. The number of holes and depth will likely be only 10-12’ foot holes, averaging 75-100 holes per event. Approximately 8’ of 1/4” minus sand will be used to stem every hole. 16 lbs of ANFO and 18 grains of detonation cord will be used in each hole.25/42ms delays on surface.

g. **Blast monitoring** shall be used if and when any regulatory threshold is being approached based on above mentioned calculations provided by the blasting contractor. As with the liability, it shall be the responsibility of the blasting professional to determine when necessary to conduct monitoring and the type if required.

Randy Roberts

Geological Engineer

1022 S. 9th. St., Canon City, CO 81212

Email: wethink@bresnan.net

Office: 719-269-7533 Cell: 719-371-3341

August 2, 2011

Ms. Angela Bellantoni
Environmental Alternatives Inc.
1107 Main St.
Canon City, CO 81212

Re: KrauthCo, J&J Stone Geological Reconnaissance Report

Ms. Bellantoni,

Attached to this letter of transmittal you will find the geological report requested by yourself and Mr. Mike Krauth of Krauthco covering the above referenced property. Field work was completed during the last week of July, 2011, and results are summarized in this report.

Please advise if you have any specific questions or comments that may require clarification.

Regards,
Randy Roberts

KrauthCo Dimension Stone Property

Geological Reconnaissance Report

S1/2 SW14 Sec. 2 T18S, R70W

Fremont County, Colorado

July 25, 2011

Randy D. Roberts

Geological Engineer

Content

Summary

A reconnaissance geological survey was authorized by and completed for the KrauthCo properties in the vicinity of the company's J&J Stone Quarry in Fremont County, Colorado. Dimension stone resources were identified across and beyond the bounds of the property.

Three potential dimension stone intervals were identified, all within the Cretaceous Dakota Group. An upper Primary Continuous facies is found generally as surface dipslope outcrop across the property. Thickness ranges from 6ft to 15ft. with an average in-place thickness of approximately 11 ft. Using an anticipated resource recovery of an estimated 95%, 10.5 ft of recoverable resource might be anticipated.

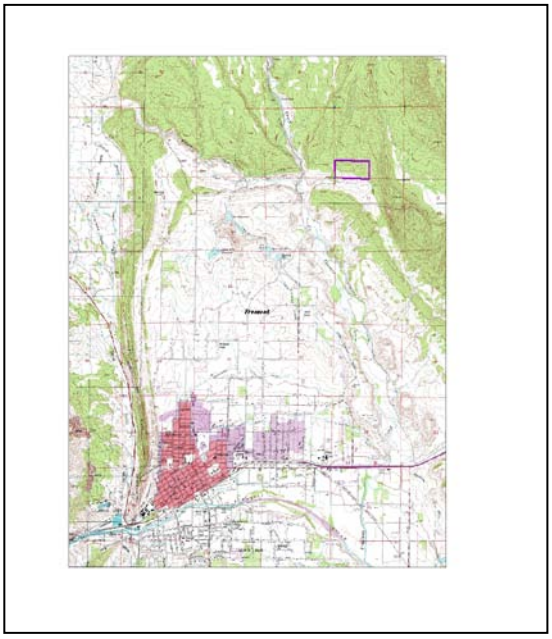
A Secondary Intermittent Facies lies below the Upper Primary Facies and is estimated to be approximately 30 -60 ft. thick due to the variable nature of the sedimentary environment. A resource recovery factor of 30% is proposed. A conservative net recoverable thickness would then be 10 ft.

A Tertiary Variable Facies is indicated by inspection of the Four Mile Creek road cut 1mi NW of the KrauthCo Property. This potential zone is estimated to be approximately 100 ft. thick, but no reasonable estimate of recoverable resource can be made without completion of drilling across the property.

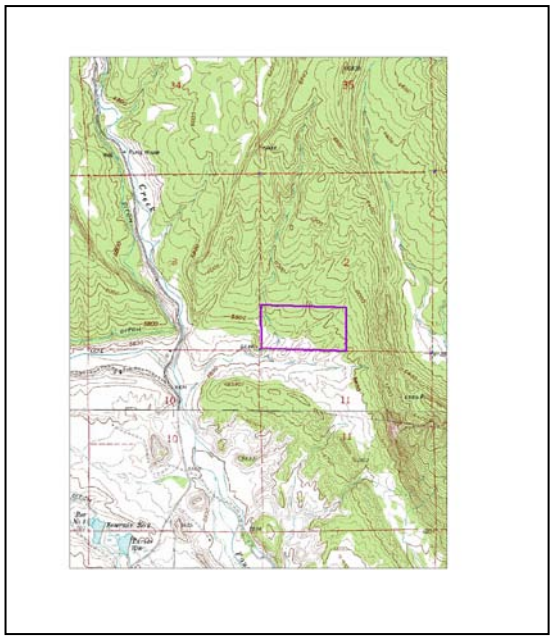
Surface inspection suggests that a combined thickness of approximately 20 ft. of dimension stone exists across the majority of the KrauthCo Property. Because cover, terrain, irregular deposition and differential erosion are evident, a rotary drilling program would be reasonable to pursue, especially to better evaluate the potential for the secondary and tertiary targets.

Scope & Proposed Activities

This reconnaissance geological report provides a description of dimension stone resources found across approximately 70 acres in the SE1/2 SW1/4 of Section 2, T18S R70W, Fremont County, Colorado. The report is based upon a search of published literature as well as field inspections to verify and refine published surface geology maps & stratigraphic sections. In addition, the approximate extent and thickness of known dimension stone resources are evaluated.



General Location Map



Location & Access Map

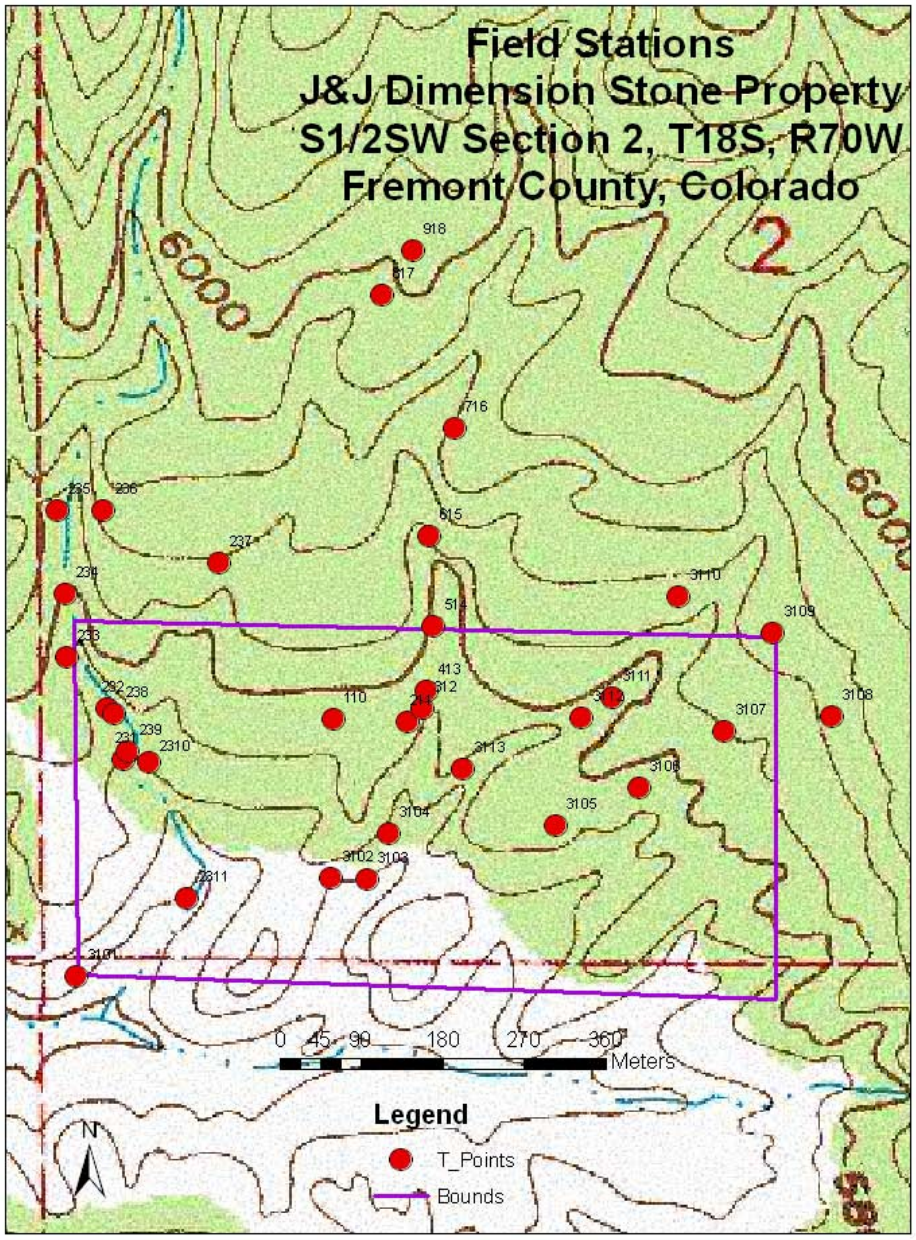
Field Activities

The property was initially inspected on July 21, 2011 with Mr. Mike Krauth, of KrauthCo Corporation, owner and operator of the J&J Stone Pit #1. Mr. Krauth authorized entry and provided required MSHA & MLRB orientation and training to gain access to the active mine permit area. One active and one historic quarry were observed as shown in photos below. Mr. Krauth identified the characteristics and nature of the resource currently being produced. A brief inspection was made to discuss the required procedure to make the requested resource review.

The property was more thoroughly traversed during the last two weeks of July, 2011. Streambed outcrops were located and measured for an estimate of in place resource and waste thickness. Select outcrops were photographed and described with all locales identified by GPS using UTM Zone 13 coordinates. In addition, the full Dakota Group section was observed in the valley of Four Mile Creek approximately one mile northwest of the property. Field samples of primary lithological layers were collected and microscopically observed and described.

Lower J&J Pit

Upper J&J Pit


Field Stations
J&J Dimension Stone Property
S1/2SW Section 2, T18S, R70W
Fremont County, Colorado
6000
2
918
917
716
235
236
615
237
3110
3109
413
312
3111
3108
3107
3113
3106
3105
3104
3102
3103
2311
2310
239
238
232
0 45 90 180 270 360
Meters
Legend
T_Points
Bounds
N

Field Map

Historic and current dimension stone production from the J&J Pit is from bedded, fractured sandstone within the Cretaceous Dakota Group. Beds range in thickness from a fraction of an inch up to a maximum resource thickness of 3 ft. Beds less than 2inches are considered waste while beds greater than 3 ft. are considered massive sandstone and currently lie outside of the definition of mineable resource.

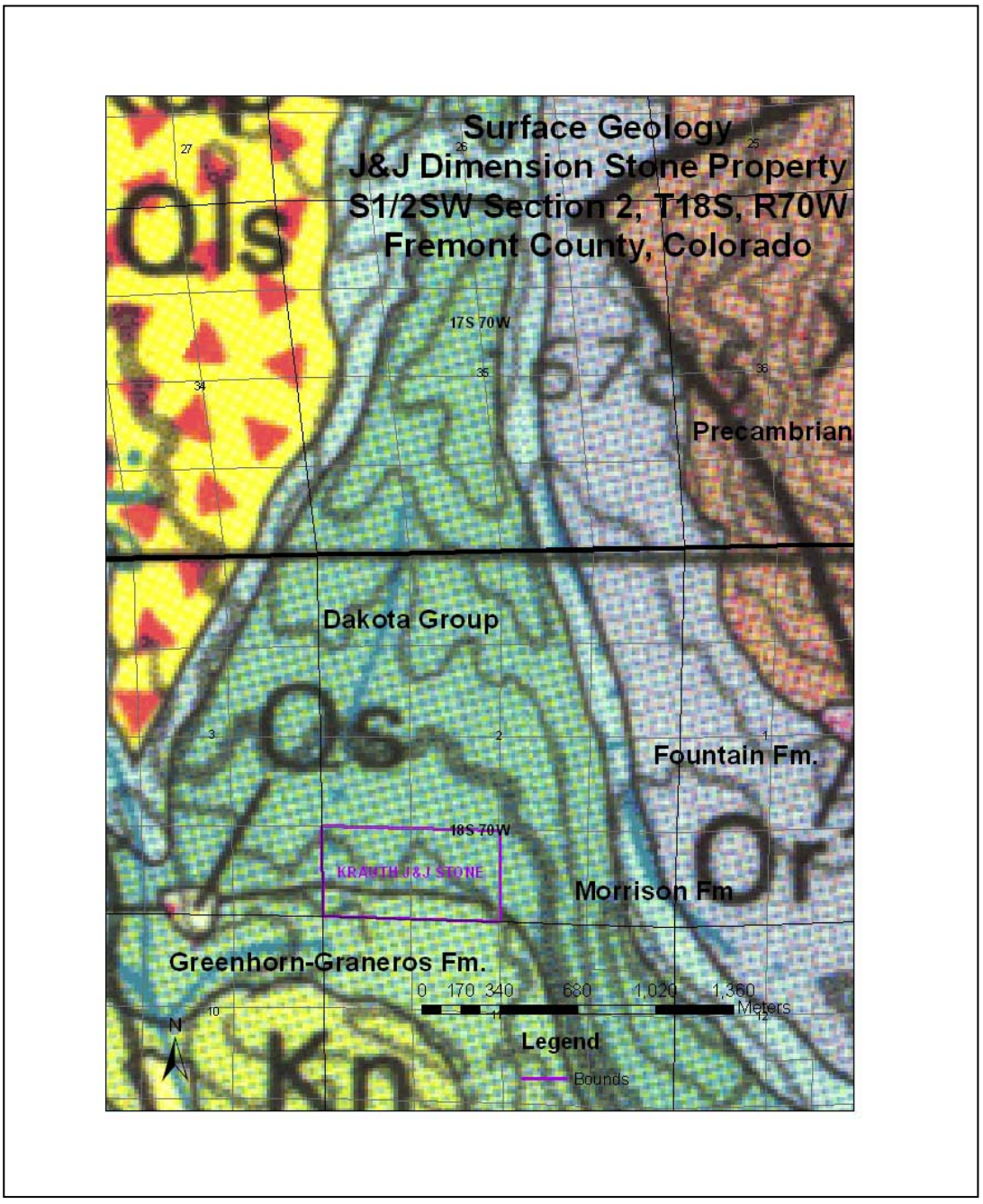
J&J Pit Dimension Stone Photographs

These Dakota sandstone beds are comprised of tan to light gray, moderately well sorted, very fine to fine grained, rounded, frosted quartz sand. The sandstone is generally non-friable and bound by clay and silica cement with moderate porosity and permeability. Sandstone beds are irregularly bleached with mottled and banded iron and manganese staining. Mafic mineral grains and black organic plant material are common. Occasional marble to golf ball size sand, pyrite and iron nodules are found, along with numerous empty casts of eroded nodules. Weathered surfaces demonstrate various colors and shapes, with ripple marks, filled fractures, and worm burrows/tracks found on select surfaces.

Partings and layers between beds range from a fraction of an inch to several feet. These layers and beds range from friable silty sand to dark grey platy siliceous shale. Sandstone layers of the Primary Facies appear massive in outcrop and often contain clay parting layers less than 1mm thick which cause noticeable bed variation over short distances.

Outcrop Geology

Surface geology and outcrop is shown on the map below.



Field inspection confirms that the Graneros Shale (light green) is at the surface and overlies the Dakota along the southern edge of the property. This formation covers the J&J dimension stone resource, thinning from approximately 50 ft. at the south line to 0 ft within 200 ft of the south property boundary. The base of the Graneros, directly above the Dakota Sandstone, transitions from blue-grey shale to sandier, laminated, platy shale with maximum transition thickness approximately 10 ft.

Graneros Fm.

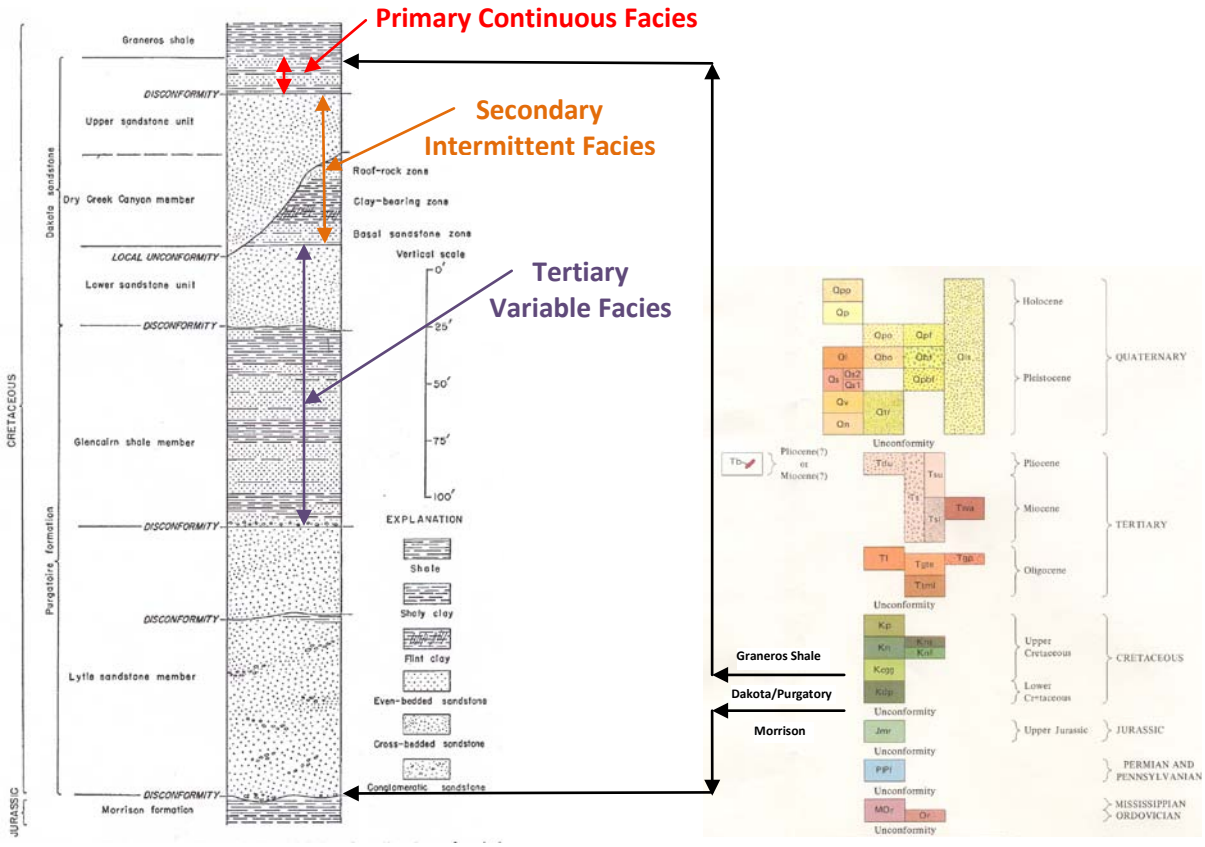
Graneros Transition

The Dakota Group, shown in dark green on the surface geology and outcrop map, lies directly below the Graneros Shale. The Dakota is found at the surface as a dipslope which strikes generally E-W and dips into the Canon City Embayment at 10-15 degrees. Valleys and gulches cut through the upper 50 ft. of the Dakota on the property. The uppermost layers of the Dakota thin northward to north, losing up to 20-30 ft of the upper sands by the time the outcrop ends on the mesa approximately one mile north of the property. The photograph below shows all but the uppermost Dakota Group down to the contact with the underlying Morrison Formation.

Four Mile Creek Road Cut

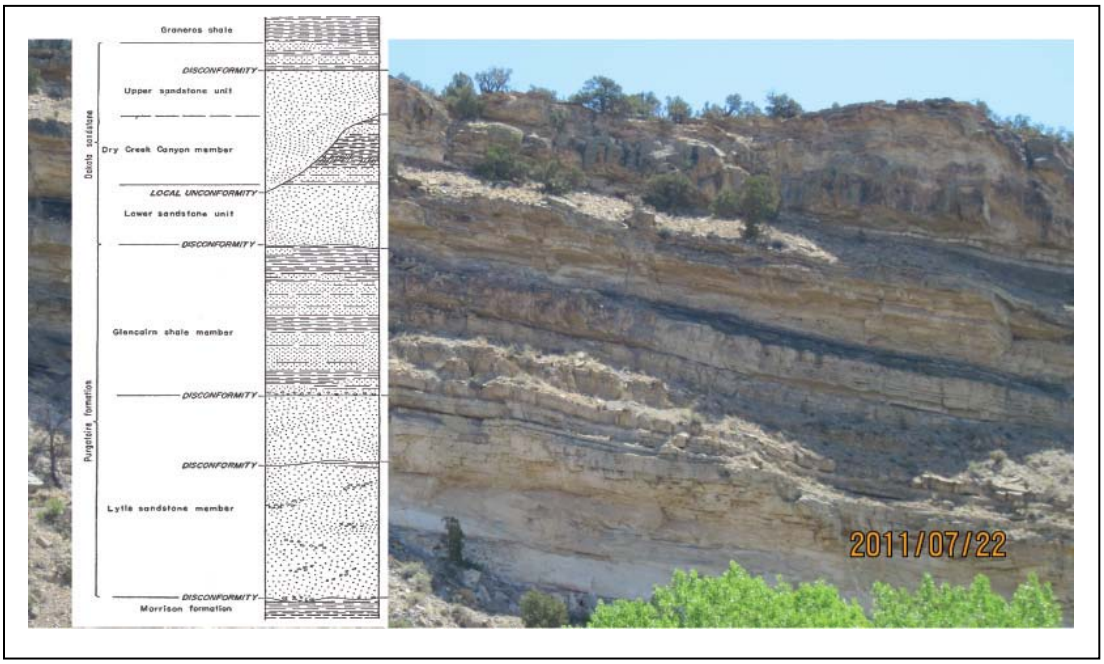
Stratigraphy

The generalized stratigraphic section in the general vicinity of the property is shown on the right of the figure below. Rocks range in age from Precambrian granite and gneiss to Quaternary sands and gravels. The stratigraphic section found on and in the near vicinity of the Krauth property is generally consistent with the expanded section on the left.



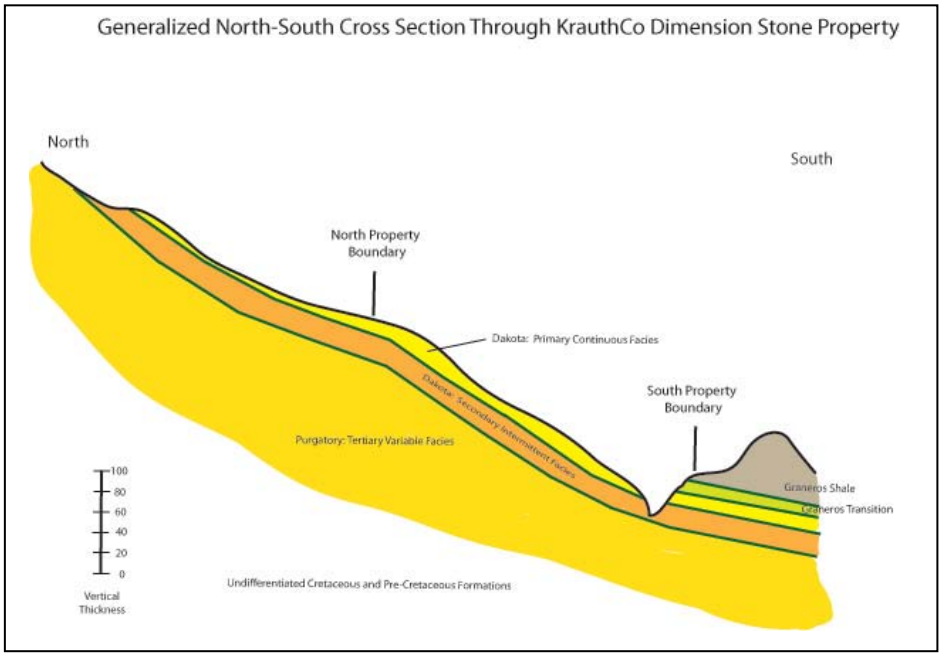
Expanded Section **Generalized Section**

As shown on the expanded section above, the 300ft. thick Dakota Group consists of the 200ft. thick Purgatory Formation below the 100 ft. thick Dakota Sandstone. This section is largely visible in the Four Mile Creek road cut along County Rd. 9 (Red Canyon-Shelf Road) approximately 1 mile northwest of the property. Note that the uppermost part of the Upper sandstone unit has been eroded north of the Krauth Property. The annotated photograph below shows an approximate correlation between regional Dakota Group Stratigraphy and the bedding at the Four Mile Creek road cut.



Structure

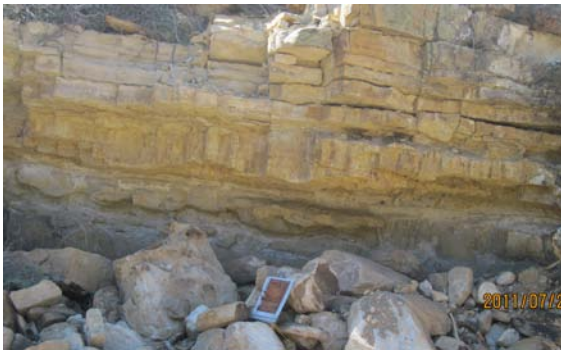
Formations in the vicinity of the KrauthCo Property are bounded on the east by a steep dipslope which strikes generally NW and dips SW from about 35-45 degrees. Strike changes to a more E-W direction along the north edge of the property and forms a gentle dipslope southwestward to the southern border of the property. Strike generally corresponds to topography. Dip angles typically range from 10-15 degrees S or SW.

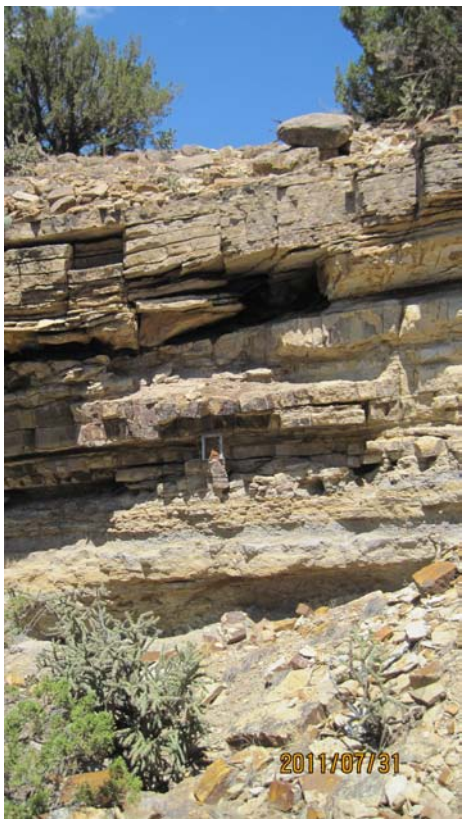


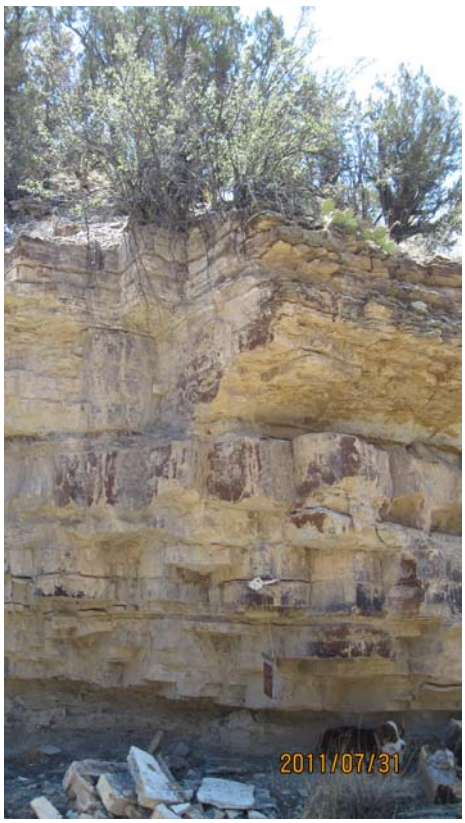
Resource Description

As shown on the expanded section, the dimension resources on the Krauth Property have been divided into three categories, all within the Dakota-Purgatory Formations. The Primary Continuous Facies (PCF) over the Secondary Intermittent Facies (SIF) which, in turn, overlies the Tertiary Variable Facies (TVF).

The Primary Continuous Facies appears to be overbank sheet sands which are somewhat variable in extent laterally, but relatively consistent in thickness over greater distance. Individual beds can be traced for up to 200 ft before fading away and being replaced by one or more similar sheet sands. Measured sections of the PCF in multiple drainages across the property indicate the PCF ranges from a minimum thickness of 8 ft to a maximum of 15 ft. This facies appears to thin northward and eastward due to changes in deposition and erosion. Average PCF thickness across the property is estimated to be approximately 11 ft. Of this 11 ft. partings are generally quite thin ranging from about 1mm to 1inch. Using a recovery factor of 95%, one can estimate a recoverable resource thickness of approximately 10.5 ft. Photos below show the nature and variation in the PCF across the property..



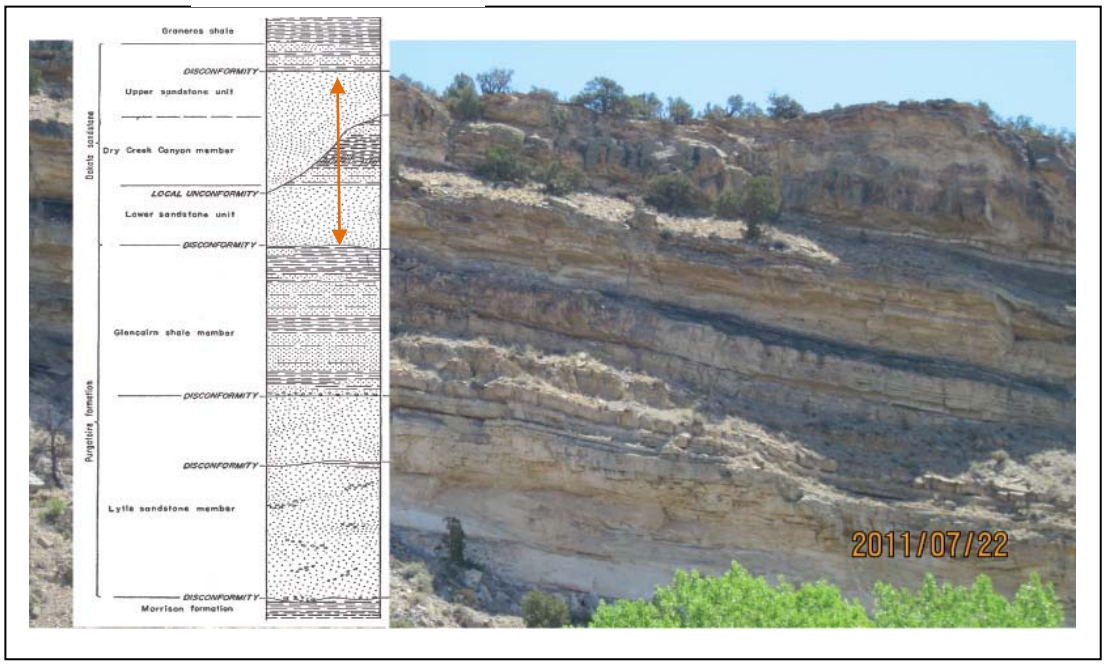




The Secondary Intermittent Facies (SIF) section generally corresponds to the basal part of the upper sandstone unit and part of the Dry Creek Member of the Dakota. The composition and sedimentary structures of this facies indicate a highly variable channel and shallow still water environment consistent with a deltaic setting. Sand bodies vary dramatically in thickness and character over short distances and are often cross bedded with silty friable upper and lower contacts. Individual sand lenses range from 1-2 inches up to 3-5 or more feet thick. Lenses thin and thicken over estimated distances of 10-50 ft, pinching out into silty zones as well as black organic shale zones from 1in. to 4 ft. in observed outcrop.

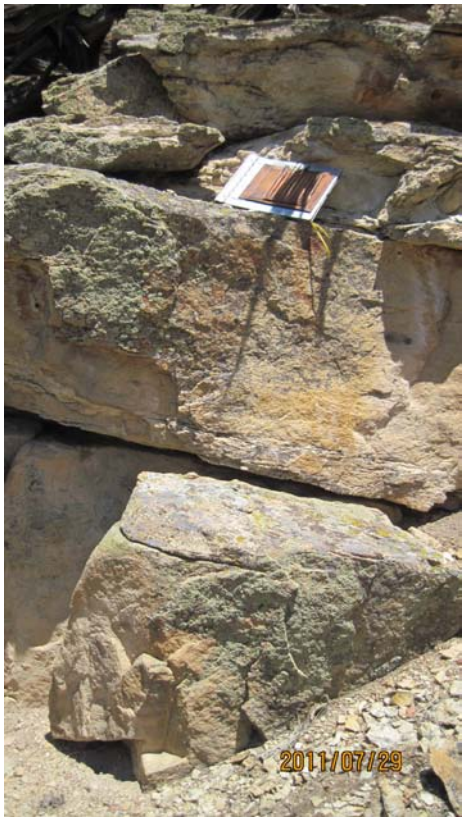
The upper bound of this zone is relatively easy to identify with blocky sheet sands above, and variable cross bedded sands, silts, and shales below. The lower boundary of the SIF is more difficult to identify on outcrop but appears to grade into massive cross bedded sandstone that is frequently a chocolate brown floor in drainage bottoms. A rough estimate of 30ft-60 ft. average thickness can be made, with a dimension stone recovery factor, depending on location, ranging from 10% recovery to 60%,with an estimated average of 30%. Loss will occur where shale beds exist or where channel sands are too thick and massive for resource recovery. Using the most conservative of those estimates, one might expect an average thickness 9 ft. of recoverable dimension stone might be recovered from the Secondary Intermittent Facies.

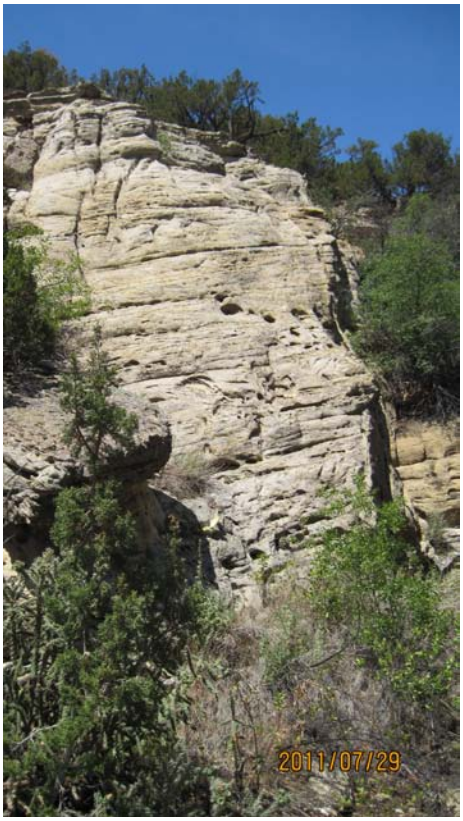
Secondary Intermittent Facies



Below are photos showing the nature and variability of the Secondary Intermittent Facies on and near the Krauth Property.

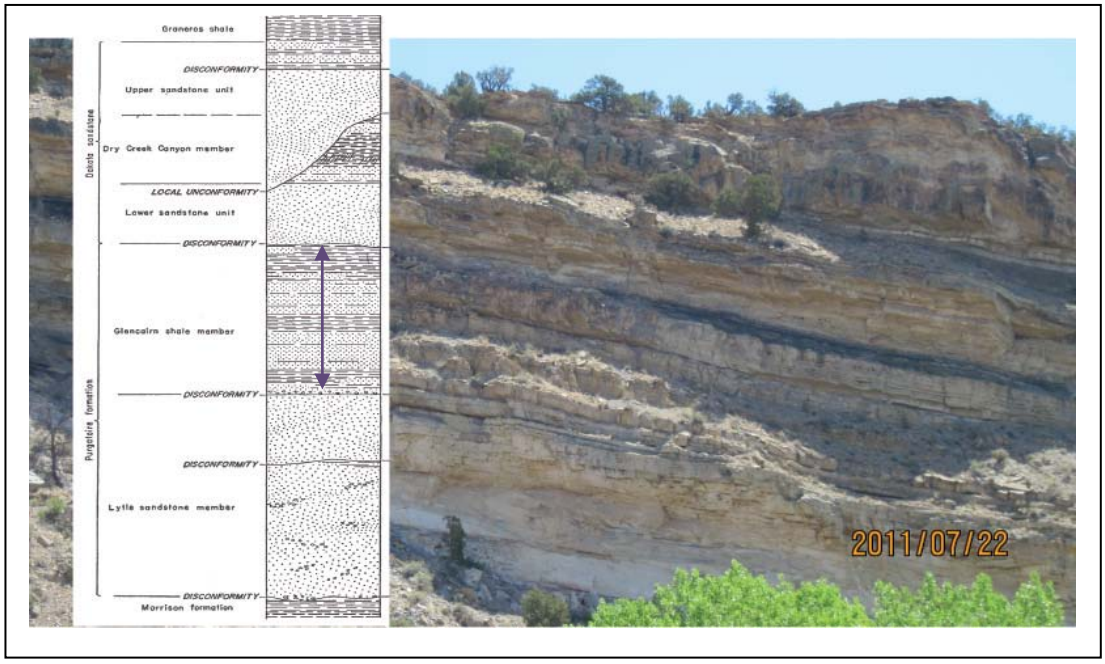

2011/07/29


2011/07/29


2011/07/29

The existence of a Tertiary Variable Facies is suggested by inspection of the Four Mile Creek road cut as shown in the earlier photo. Review of that photograph suggests sandstone variability in the lower part of the upper Dakota Sandstone, as well as sand lenses in that part of the Purgatory Formation that corresponds to the Glencairn Shale. This zone was not found to outcrop on the KrauthCo Property but can be assumed to part of the geologic section at depth. This roadcut suggests that recoverable dimension stone resources might well exist beneath the KrauthCo Property, only a patterned drilling program would allow for resource evaluation. If the sand layers observed at the road cut are, in fact found to be recoverable dimension stone, the 100 ft. TVF thickness could add significant resources as long as economics allow for recovery.

Tertiary
Variable Facies



Field Notes

Map series 31#

JJStone Field **GPS1 0482620x4261834**.Brass cap corner of property. continue eastward to point of ridge, steep valley to south. **GPS2 048290x4261979**. Contact between graneros and Dakota transition zone. **Gps3 0482940x4261942** drop downinto valley to south east of pit. Approximately 100ft se of last station. Contact between Dakota prime and graneros transition zone. Uncertainty… last station has layers/rubble of Dakota but appears on top of transition and on top of graneros. Possible small fault or major outwash from north. . Dip 210e at 10degrees. From 3 go up gully bottom measuring sandstone thickness as section but very chopped up. 6,8,17,9,6,10,12,10. **Gps 4 0482963x4261991** follow up creek bottom here see pretty good section of prime rock. Photo taken. Continue up prime section. Have 6,9,7,6 above here looks to be into transition of graneros. Continue from last station 100ft to north… **gps 5 0483148x4262001** drainage splits forks top of prime goes both directions, gullies washed down to top of prime sand with approx 25ft of graneros transition and shale above this contact to south. bit confusing geology here.. clearly big gully to south is granersos shale at least 30-50ft thick. I appear to be standing on graneros transition prime contact right here. **Gps6 0483241x4262042**. (maybe missing gps point in this description) At contact between graneros transition and top of Dakota prime. Photo. Strike n75w dip 10s. continue climb to ene to next small drainage before going off to east now again at contact of graneros transiton and top of Dakota prime. Photo. Strike n45w, 14south dip. Go ne up gully measuring sandstone steps 12,6,8,12,6,ratty 8 with top 2 solid, 2ft silty platey break with layers 1-2in thick at most. 18, 12, additional 3ft ratty with 7in good layer capped by 8in good. **gps 7 0483374x4262106** Photo this point where someone has built rock wall in gully bottom. . **New gps 8 0483455x4262122** is furthest east point. Prime Dakota rubble. Approx 300ft east is base of steep Dakota dipslope striking est n-s and dip of 45inot basin. Go northwest back toward property several hundered feet. **Gps 9 0483389x4262215** brass cap 16h corner section 2 photo continued dip slope material with surface seen in shallow gullies. Drop into steep gully and climb up far side. **Gps 10 0483290x4262255**. Hand level approx 25-30ft lower channel section. Photo across valley looks like after 25ft of channel appears to be about 10ft prime caprock. Looking across valley with photo it appears channel trans has 30% recovery covered by about same 10ft of prime. **Gps 11 0483211x4262143** drop down continue down steep gully to southwest dropping through numerous layers of channel sands with quite a bit of recoverable. Looks like sides of gully are getting shorter bringing closer to prime outcrop? Continue 50-100ft **gps 12 0483183x4262120** standing on channel facies looking at very clear and clean section of Dakota prime. Photo taken appears to be 15ft of prime here still with about 90% recovery because of 2 major silt zones about 2ft upper tan and lower 1ft that is gray siltstone. Move 50ft down gully. Good solid outcrop of Dakota prime with platey transition at top of outcrop roughly 15ft of prime material until you get down to bottom 2 ft which is silty shale. Appears to be 90% recovery in Dakota prime. Best section of Dakota prime in all of one chunk seen on property. Continue down creek 50ft **gps 13 0483046x4262063**. Photo showing again excellent section of Dakota prime underlain by transitional photo taken of 15ft Dakota prime.

Series number 23# on map

Gps#1 is 0482671x4262074. Location is creek bottom right above upper pit showing section mined in upper pit, showing that at base of this section the sandstone turns friable and pretty ratty and pretty silty. Estimate 10ft. thick at thick at this point. **Gps#2 is 0482652x4262131**. North 30.443min w105 11.938 min. photo taken of outcrop in creek bottom showing basal massive cross bedded Dakota sandstone showing likely base of potential reserves. This would be the ratty 10% zone with layered 90% zone above. Looks like 90%zone may be outcropping and disappearing right above us here. Continue up creek bottom. Next **gps site #3 0482607x4262187**.and photo showing dark brown cross bedded layered sandstone dropping deeper into Dakota section. **Gps #4 0482606x4262257** This site shows layers that range from 1-2ft with silty sand partings that may or may not allow separation of layers. Photo taken. Next **gps #5 0482597x426350.** Continued up drainage up several sandstone steps to fork in drainage 2 photos taken one showing backwash cave the other showing laying down dead tree with cottonwood. **Gps #6 0482648x4262350** climbed due east out of draw to top of the dipslope. Dimension stone largely lost in talus but appears to be about 5 ft. **Gps #7 0482776x4262291** traversed ese across dipslope to next drainage to SE. 2 photos taken showing that dimension stone is here, estimated thickness about 12-15 ft at this point but it appears layers have thickened and less parted with average thickness about 1-2ft. this side of gully average thickness about 8-10 inches thick with some layers down to 3inches. Would say this still has certain amount of mineable material. From last station follow draw down 200ft approx and notice that dimension stone

continues but appears to thin somewhat. Cross over back to west to this **gps point #8 0482660x4262125** into large drainage (original drainage) take photo of outcrop showing massive cross bedded sandstone overlain by dimension stone layer. Dimension stone thickness appears to be 10-20 ft right here. That 15 ft partially consistent with shale break lower 10% zone. Appears that best material, prime zone, is only about 5 ft -8ft thick right here. (above upper quarry) addition. Road cut rising out of upper quarry area. Move down gully from last gps point to good outcrop **gps #9 0482675x4262083**, section measured 6 ft overall prime overlaying very friable tan sand, photo taken. Also between here and last gps point a hand eye level survey taken from top of massive Dakota crossbedded sand throuth the 30% zone giving 30 ft. thickness. Estimate of productive sandstone is 10-20% because even layers are pretty friable, non siliceous sand. Addition to this station at measured section, it comes at a very well bulldozed road climbing up from creek bottom with orange flagged lath. Addition. Outcrop measured corresponds to the layers mined in the upper pit. **Gps #10 0482598x4262071 (wrong)**. Remeasure pit section at top of upper pit **0482698x4262071** repeat. Dip s10e approximately 15-18deg. Measure mined layers on top of pit bottom layer which is about the same as the upper layers on last measured section. Two dominant fracture sets here, both vertical, one running s45w, other s65e, the frequency spacing 1-5ft spacings, predominantly you can see lots of 1-2 ft rectangular slab sizes. Black stained ripple marks at top of basal pit layer. Pit bottom gps **#11 0482740x4261920**. Collect samples of dimension stone, upper contact with Benton, partings, as well as channel sands and channel clays. One sample of overlying Benton shale by outhouse

Microscopic Examination

Micrososcopic sample exam of JJStone samples. Bag 1. Overlying graneros shale is black to gunbarrel gray shale, flakey and fissile, speckled with white alkali material on fractured surfaces. Including minor mafic fragments as well as sand grain sized probably altered pyrite orange and dusty looking. The shale matrix has a vitreous velvety rainbow luster under bright sunlight. Bag2. Basal Benton shale overlying Dakota dimension stone. Character changes from massive Benton to fissile parted shale with many chips and fragments on outcrop. Variable dark-light gray with significant increase in carbonaceous material and partings and iron staining on surfaces between shale layers. You can see carbonaceous woody fragments layered in with partings. Bag 3 Dakota dimension stone material. Tan to light gray to white to buff moderately well sorted very fine to fine grained sandstone, well rounded medium grained subrounded fine grain tends to be frosted and in with white fine clay matrix. Occasional organic inclusions, occasional mafic fragments, minor iron staining. Appers to be oxidized with very fine frosted quartz grains, peppered with orange possible aphanitic pyrite with no crystal shape remaining. Minor partings dominated by very paper thin layers of clay with increased organic material. Bag 4. Dakota channel sands below sheet sands. Variable with many clay and shale zones and partings. Some areas highly organic with lots of clay, very fine sand, medium sand, poorly sorted with other places very fine siltstone weakly laminated with organics and white clay. Other places pencil diameter chunks of organic coaly material embedded in sand. Other places medium to light gray clay and shale clasts embedded in sand. Bag 5. Dakota parting layers. Primarly thin shaley zones with interlayered siltstone, highly organic. Shales composed largely of black organic fragments with occasional inclusions of dimension stone sand about pea sized. Fine grained sand with lots of altered aphanitic pyrite. Very thinkly laminated siltstone, fissile shale and claystone laminations are 1mm to 5mm thick.

References

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