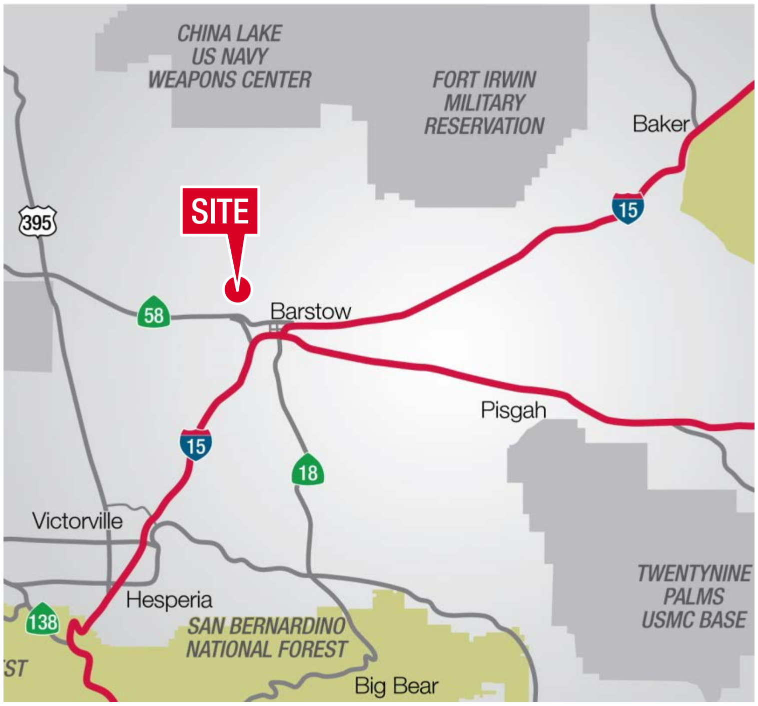
±134 Acres FOR SALE
BEST ROCK QUARRY/MINE



HILLSIDE QUARRY - "READY MIX MATERIALS"

APPROVED OPERATING MINE - OPEN SINCE 2008

LOCAL BUSINESS - HESPERIA/ LAS VEGAS

AMPLE WATER - 100 - 300 GPM

POWER - 600 AMP

33 Kv LINE ADJACENT TO SITE

Best Rock Quarry/Mine

26282 Neuman Rd. • Barstow, CA

Property Highlights

- ±1,440 SF Furnished Office: 1x 24' x60'
- 1x Well @ 100 gpm
- 1x Water Tank @1,000 gal
- 1x 5-yard Loader - Kawasaki 95-Z
- Three (3) Phase Power: 440-600 amps
- "CERTIFIED SCALES"
- AGGREGATES: Essential for the Construction Industry
- Interstate Highways I-15/I-40 and highway 58 **CLOSE**
- Type: Side-hill Quarry/Open Pit
- Mineral Commodity: Aggregates/Decorative Rock
- Quantity of Ore: 300,000 tons per year
- Area currently mined: 55.3± acres
- Anticipated depth: Final high-wall 245± ft.
- **±134 Acres**
- **Offering Price: $4,500,000**
- San Bernardino is expected to need Over One Billion Tons of Aggregate by 2060
- APNs: 0497-071-06,07,08/ 0497-052-07,08

Scott Lisk
909.213.7962 • scottlisk@aol.com
Cal DRE Lic. #00574287

+/- 12 MILLION YARDS Product
Hinkley
BEST ROCK QUARRY
NORTH BARSTOW
58
Existing BNSF Facility
Barstow
Barstow
GRANDVIEW
15
40
Lenwood
Not to Scale
247
Nebo Center
BARSTOW INTERNATIONAL GATEWAY
Hodge
15

+/- 134 Acres

26282 Neuman Road, Barstow, CA 92311

For Sale
Quarry/Mine

AERIAL VIEW

Best Rock Quarry/Mine

26282 Neuman Rd. • Barstow, CA. 92311

REAL ESTATE: +/- 134 ac; APN: 0497-071-06 ...

HILLSIDE QUARRY - "READY MIX MATERIALS"
APPROVED OPERATING MINE - OPEN SINCE 2008
LOCAL BUSINESS - HESPERIA/ LAS VEGAS
AMPLE WATER - 100 - 300 GPM
POWER - 600 AMP
33 Kv LINE ADJACENT TO SITE

Details:
+/- 1,440 sf. Furnished OFFICE: 1 x 24' x 60'
1 x WELL @ +100 gpm
1 x Water Tank @ 1,000 gal
1 x 5-yard Loader – Kawasaki 95 – Z

Three (3) Phase Power: 440 – 600 amps

The mine is producing various quantities of the following:

1. **Limestone**
2. **Granite**
3. **+/- 10 different varieties of**

a. **DECORATIVE ROCK**

b. **DOLLOMITE…**

Additionally, Best Rock is making and selling Class II base, rip pap 4"- 36" 1", 3/4, 1/2, 3/8 SE 30 sand non-spec base and 3-10 ton boulders.

LAS VEGAS To Victorville, CA HIGH SPEED RAIL
https://dotcms.fra.dot.gov/rail-network-development/environment/environmental-reviews/brightline-west-las-vegas-victor-valley

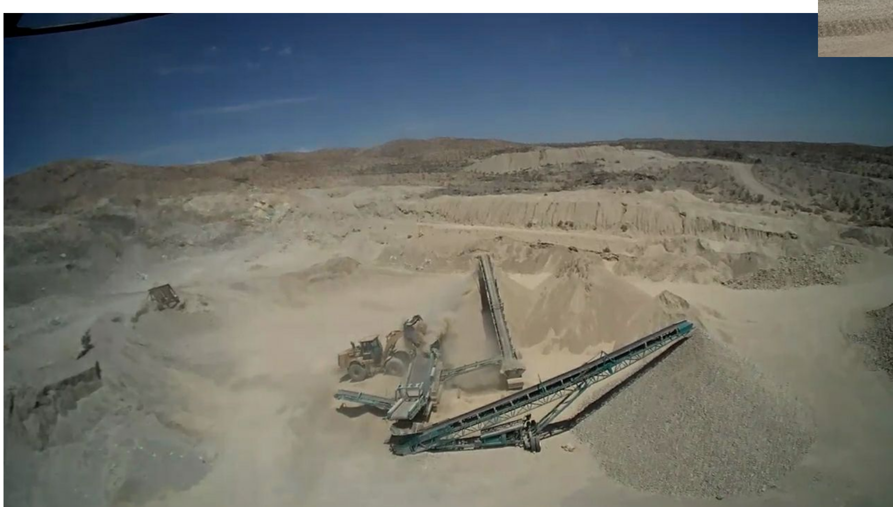
+/- 134 Acres

26282 Neuman Road, Barstow, CA 92311

For Sale

Quarry/Mine

PHOTOS



Best Rock Facebook Address:
www.facebook.com/BestRockQuarryInc/

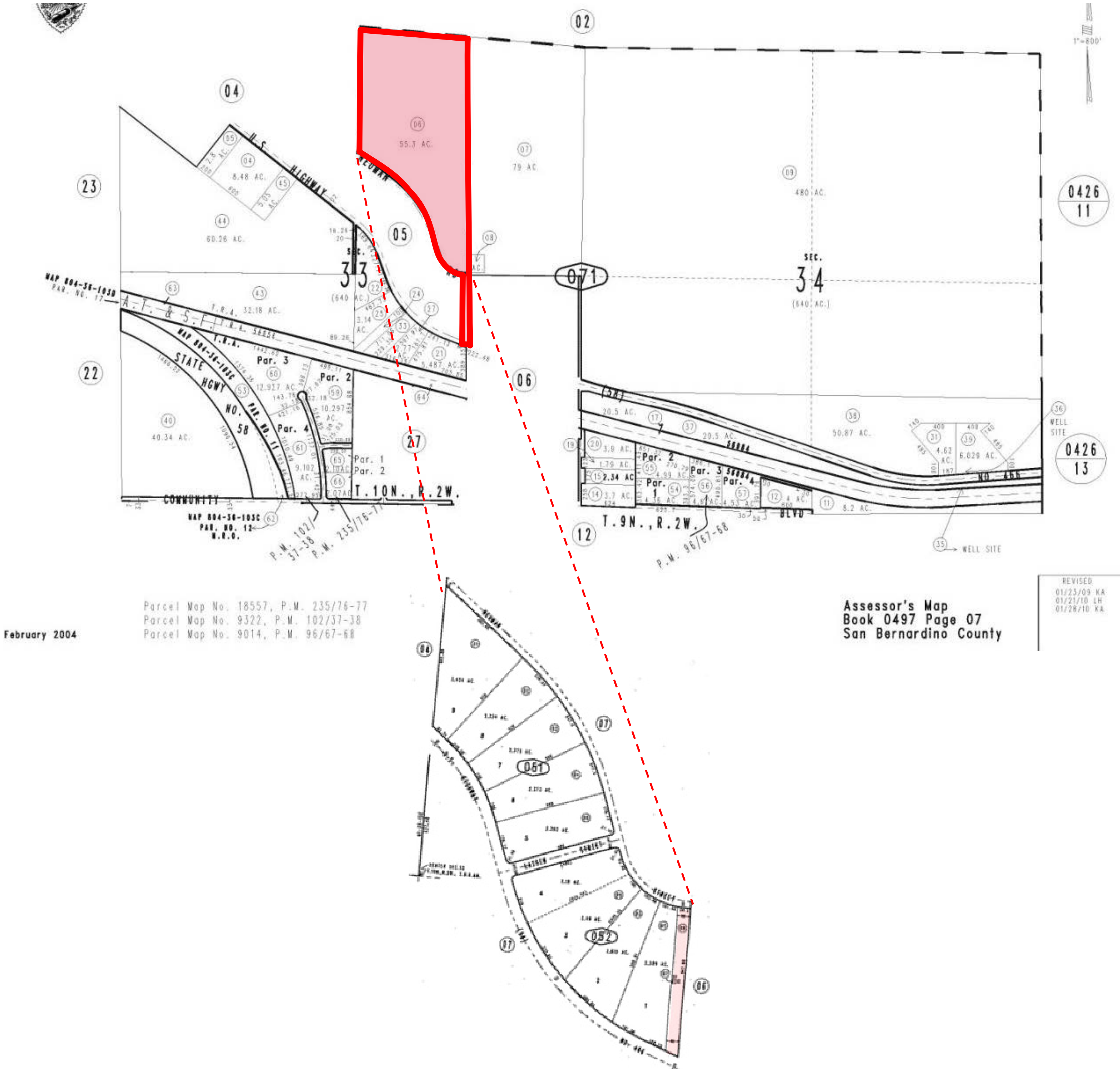
+/- 134 Acres

26282 Neuman Road, Barstow, CA 92311

For Sale

Quarry/Mine

PLAT MAPS



+/- 134 Acres

26282 Neuman Road, Barstow, CA 92311

For Sale

Quarry/Mine

LAS VEGAS To Victorville, CA HIGH SPEED RAIL
https://dotcms.fra.dot.gov/rail-network-development/environment/environmental-reviews/brightline-west-las-vegas-victor-valley

CALIFORNIA'S AGGREGATE INDUSTRY - "Fourth Largest Industry in California"

A vital California economy depends on the accessibility and availability of large local supplies of high-quality construction materials.

California is the nation's leading producer of aggregates. in terms of California's mineral products, the value of the aggregates industry is second only to that of the petroleum industry.

Statewide demand for aggregate is expected to eclipse 12 billion tons over 50 years, based on USGS department estimates.

Barstow/Victorville:
50-year demand (Million Tons) ….163
Permitted Aggregates (Million Tons) … 11

Sand, gravel, and crushed stone are "construction materials." These commodities, collectively referred to as aggregate, provide the bulk and strength to Portland Cement Concrete (PCC), Asphaltic Concrete (AC, commonly called "black top"), plaster, and stucco. Aggregate is also used as road base, subbase, railroad ballast, and fill. Aggregate normally provides from 80 to 100 percent of the material volume in the above uses

An estimated 694 Mt of total construction aggregates was produced and shipped for consumption in the United States in the third quarter of 2018, an increase of 5% compared with that of the third quarter of 2017.

The five leading states, in descending order of production for consumption, were California, Texas, Arizona, Michigan and Washington. Combined, production from these five states equated to 97.2 Mt, representing 37 percent of total U.S. production.
The above estimates are based on information reported to the U.S. Geological Survey (USGS) on its quarterly sample survey by construction aggregates producers.

Aggregates are the only mineral commodity produced in every state in the union and it is estimated that approximately eight tons of aggregates are used for every American each year.

Simply put, aggregates are a necessary means to both construction processes and impact everyone's daily living.

LAS VEGAS To Victorville, CA HIGH SPEED RAIL
https://dotcms.fra.dot.gov/rail-network-development/environment/environmental-reviews/brightline-west-las-vegas-victor-

385 N. Arrowhead Ave, First Floor, San Bernardino, CA 92415 | Phone: 909.387.8311 Fax: 909.387.3223
www.SBCounty.gov

SAN BERNARDINO COUNTY

Land Use Services Department
Mining

Terri Rahhal
Director

June 17, 2020,

Effective Date: June 29, 2020

Applicant
Best Rock Quarry Inc.
26262 Neuman Road
Barstow, CA 92311

Representative
Joe Mathewson
Matcon Corporation
1807 Toyon Lane
Newport Beach, CA 92660

RE: APPROVAL OF10 YEAR TIME EXTENSION TO COMPLETE THE REMAINING AUTHORIZED MINING AND RECLAMATION ACTIVITES AT THE BEST ROCK QUARRY; CA MINE ID #91-36-071; RECLAMATION PLAN #89M-04; APNS:0497-071-06 and -07; PROJECT NO. PRAA-2020-00017

Dear Mr. Mathewson:

The County Land Use Services Department Planning Division has completed its review of your proposed Revision to extend the BEST ROCK quarry operations for 10 years, commencing from the date of this approval, referenced as Project No. PRAA-2020-0017, CA Mine ID 91-36-071, and Mining and Reclamation Plan 89M-04.

The referenced revision was found to be in conformance with the County General Plan, County Development Code and the Surface Mining and Reclamation Act (SMARA). Furthermore, the proposed extension of time will involve no expansion of the current Best Rock Quarry mining operation beyond the operation approved on November 16, 2006 by the County Planning Commission, referenced as Project No. AP20060001. In accordance with California Environmental Quality Act (CEQA) Section 15162 (Subsequent & Negative Declaration) the initial study and mitigated negative declaration adopted at the time of the lead agency's determination continues to apply. The mitigation measures, Conditions of Approval and Best Rock Mining Conditional Use Permit and Reclamation Plan 89M-04 shall remain in effect as this approval is not a substantive change.

The Revised Project has been CONDITIONALLY APPROVED by the San Bernardino County Planning Division subject to compliance with the attached updated Conditions of Approval. The conditions are categorized by a stage of development, indicating when the conditions must be completed, and by the department or agency requiring compliance.

The Planning Division considers your updated and revised Conditions of Approval and Mine and Reclamation Plans your final development criteria/design. This is not considered a conceptual design. Therefore, any modifications and/or alterations will require the submittal, review and approval of a "Revision to an Approved Action Application".

Pursuant to the San Bernardino County Development Code, any interested person may, within 10 days after the date of this notice may file an appeal in writing to the Planning Commission for consideration thereof. The appeal must be made in writing on forms available from the Public Information Counter.

If you have any question or concerns regarding this matter, you may contact me directly at (909) 387-4387 or by e-mail at reuben.arceo@lus.sbcounty.gov.

Sincerely,

Reuben J. Arceo

Reuben J. Arceo, Contract Planner
RA/

Cc: George Kenline, Environmental Compliance Manager

Attachments:
Approved Best Rock Revised Conditions of Approval

TWINING
Engineering a Better Tomorrow

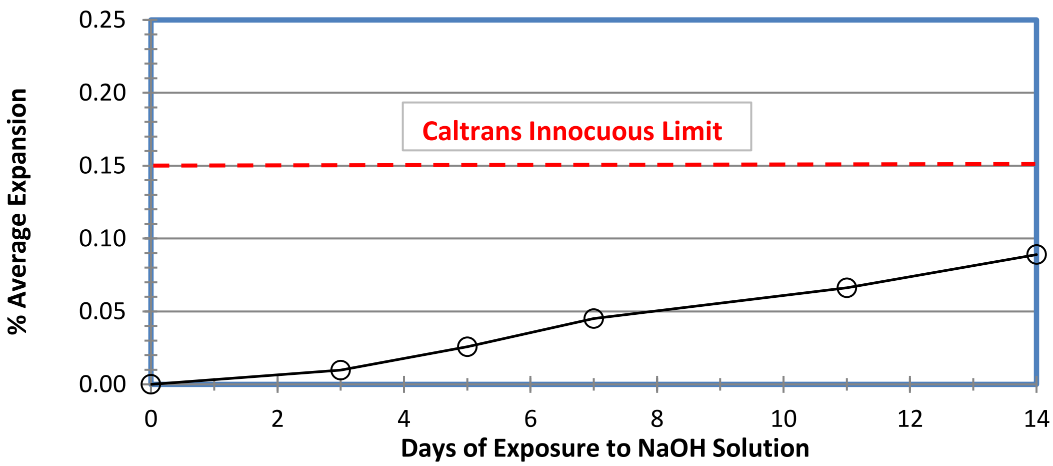
POTENTIAL ALKALI REACTIVITY OF AGGREGATES (ACCELERATED MORTAR-BAR METHOD)
ASTM C1260 (FINAL REPORT)

CLIENT: BEST ROCK INC.
DATE: September 10, 2018
Project # 180760.1
PROJECT: EVALUATION OF AGGREGATE FOR ALKALI-SILICA REACTIVITY
Lab #: CH18-375
ATTENTION: MS. ANNIE FOX

CEMENT USED FOR TESTING
CEMENT, TYPE I/II/V: Mitsubishi, TYPE I/II/V
PROPERTIES OF CEMENT:
*Total Alkalies as Na_2O, % 0.46
*Autoclave Expansion, % 0.03
TEST SOLUTION: 1N NaOH
DATE CAST: August 22, 2018

AGGREGATE SOURCE BEST ROCK INC.
AGGREGATE SIZE 3/8"-MSA
CALTRANS REGISTRATION #: 17-36071-2

*Note: Total alkalies content and autoclave expansion values are reported according to mill certificate of Mitsubishi Type I/II/V dated August 9, 2018 (attached for your reference). Sample of cement was received on July 26, 2018.



Date	NaOH Exposure (Days)	Expansion of Bars (%)				
		A	B	C	D	Average
8/24/2018	0	0.000	0.000	0.000	0.000	**0.00**
8/27/2018	3	0.009	0.010	0.010	0.010	**0.01**
8/29/2018	5	0.025	0.026	0.026	0.026	**0.03**
8/31/2018	7	0.042	0.042	0.047	0.050	**0.05**
9/4/2018	11	0.065	0.061	0.069	0.070	**0.07**
9/7/2018	14	0.090	0.084	0.091	0.091	**0.09**

Notes: *This aggregate demonstrated average expansion at 14-day exposure (in solution of sodium hydroxide) of 0.09% when tested in accordance with ASTM C1260. This is below the maximum expansion limit of 0.15% set forth by Caltrans.*

Respectfully Submitted by:

Twining Inc.

Prepared by:

Yiwen Bu, PE, PhD, LEED AP
Director of Concrete Engineering

Attachment: Portland cement mill certificate

MITSUBISHI CEMENT CORPORATION
CERTIFICATE OF TEST

Portland Cement - Type I, II, II (MH) & V **Date:** **8/9/2018**

Source: **Cushenbury Plant, 5808 State Highway 18, Lucerne Valley, CA 92356**

ASTM designation: C 150 - 16 for Type I, II, II (MH) & V low alkali Cement	Production Period
CALTRANS Specification: Section 90 – 2.01 for Type II modified and V (2006) Specification: Section 90 – 1.02B(2) (2015)	From: 7/1/2018
NDOT Specification: Section 701.03.01 for Type II and V	To: 7/31/2018
AZDOTSpecifications Subsection 1006-2.01 for Type II and V	

Chemical Composition:

	ASTM C-150 Limits				Test
	Type I	Type II	Type V		Results
Silicon Dioxide (SiO_2), %	----	----	----	Min.	21.1
Aluminum Oxide (Al_2O_3), %	----	6.0	----	Max.	4.0
Ferric Oxide (Fe_2O_3), %	----	6.0	----	Max.	3.7
Calcium Oxide (CaO), %	----	----	----		62.8
Magnesium Oxide (MgO), %	6.0	6.0	6.0	Max.	2.5
Sulfur Trioxide (SO_3), %	3.0	3.0	2.3	Max.	2.2
Loss on Ignition (LOI), %	3.5	3.5	3.5	Max.	2.1
Insoluble Residue	1.5	1.5	1.5	Max.	0.59
Total Alkali (%Na_2O + 0.658 * %K_2O)	0.60	0.60	0.60	Max.	0.46
Tricalcium Silicate (C_3S), [b] %	----	----	----		54
Tricalcium Aluminate (C_3A), [b] %	----	8	5	Max.	4
C_4AF + 2*C_3A [b]	----	----	25	Max.	19
C_3S + 4.75*C_3A [b]	----	100	----	Max.	74
CO_2, %	----	----	----		1.3
Limestone, %	5.0	5.0	5.0	Max.	3.4
$CaCO_3$ Limestone Purity, %	70	70	70	Min.	86

PHYSICAL RESULTS:

	Type I	Type II	Type V		Test Results
Blaine Fineness (m^2/kg)	260 / ---	260 / 430	260 / ---	Min / Max	381
325 Mesh (% Passing)	----	----	----		98.4
Autoclave Expansion (%)	0.80	0.80	0.80	Max.	0.03
Time of Set Initial Vicat (minutes)	45 / 375	45 / 375	45 / 375	Min / Max	137
Air Entrainment (% Volume)	12	12	12	Max.	6.3
C1702 Heat of Hydration at 7 Days (J/g)	----	----	----	[a]	338
False Set, %	50	50	50	Min.	91
Color, (L value)	----	----	----		56

Compressive Strength Test:

		Type I		Type II		Type V				
		MPA	psi	MPA	psi	MPA	psi		MPA	PSI
1 Day		----	----	----	----	----	----		13.6	1976
3 Day		12.0	1740	10.0	1450	8.0	1160	Min.	24.5	3551
7 Day		19.0	2760	17.0	2470	15.0	2180	Min.	32.6	4724
28 Day	June 2018	----	----	----	----	21.0	3050	Min.	41.2	5982

This cement has been sampled and tested in accordance with ASTM standard methods and procedures. All tests results are certified to comply with the type specification designated above. No other warranty is made or implied. We are not responsible for improper use or workmanship. The MCC laboratory is AASHTO accredited.
[a] For information only. [b] Adjusted per ASTM C150 A1.6.

MITSUBISHI CEMENT CORPORATION

Tom Gepford
Quality Control Manager

MITSUBISHI CEMENT CORPORATION

CERTIFICATE OF TEST

Source: Cushenbury Plant **Portland Cement - Type I, II, II (MH) & V** **Date: 8/9/2018**

ASTM designation: C 150 - 16 for Type I, II, II (MH) & V low alkali Cement	**Production Period**
CALTRANS Specification: Section 90 – 2.01 for Type II modified and V Specification: Section 90 – 1.02B(2) (2010)	**From: 7/1/2018**
NDOT Specification: Section 701 – 3.01 for Type II and V	**To: 7/31/2018**
AZDOTSpecifications Subsection 1006-2.01 for Type II and V	

Additional Data

Limestone Addition

% Addition:	3.4
SiO2 (%)	8.3
Al_2O_3 (%)	2.5
Fe_2O_3 (%)	0.6
CaO (%)	47.6
SO_3 (%)	0.4

Base Cement Phase Composition

C_3S	54
C_2S	18
C_3A	4
C_4AF	11

We certify that the above described data represents the material used in the cement manufactured during the production period indicated.

MITSUBISHI CEMENT CORPORATION
Cushenbury plant

Tom Gepford

Tom Gepford
Quality Control Manager

Sand Equivalent of Soils and Fine Aggregate

CT217

Report Date: 05/18/18
Sheet: 1 *of* 1
Attachment: DR01, SS02, SA02, MD01, DI01, RV01
Permit No.:
Client Project No.:
Other:
DSA File No.:
DSA Application No.:
DSA LEA No.:

Project Number: 3468.001.100
Project Title: General Quarry Sampling
Project Location: Barstow, CA
Client: Best Rock Quarry

Sample ID: PJM05161802 ☒ **General Compliance** ☐ **Non-Compliance** ☐ **Not Specified**

Desription: Class 2 Aggregate Base
Sample Origin: On Site Stockpile
Laboratory Remarks:

Tested By: Cheyenne Oravets
Mechanical/Manual Shaker: Mechanical

Sand Equivalent Value	Ammount/Value Allowable
29	25

Allowable Based On: Caltrans Class 2 Base Section 26 Specifcation

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.
cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

Reviewed By (Signature) — Clayton Garrison / Laboratory Manager
Name / Title

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Laboratory Compaction Characteristics

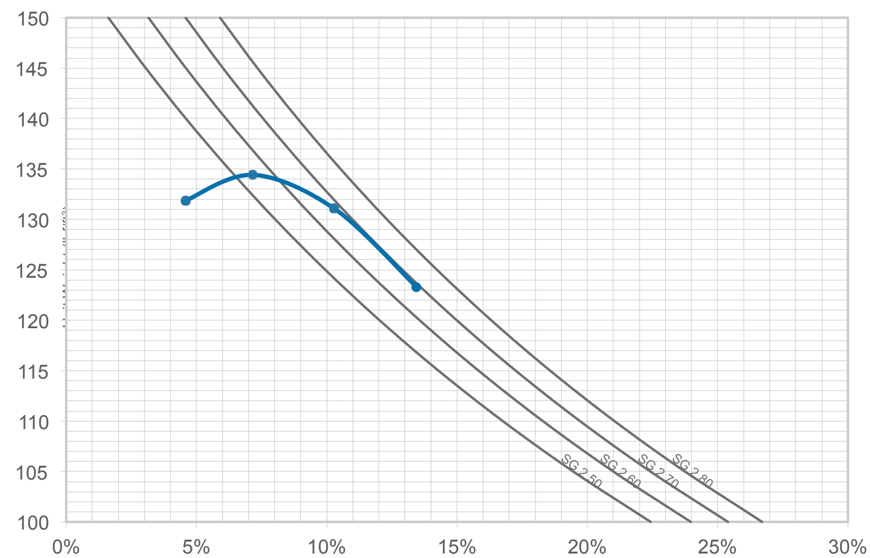
ASTM D1557, D2488

Report Date:	05/18/18
Sheet:	1 *of* 1
Attachment:	DR, SS01, SA02, SE01, DI01, RV01
Permit No.:	
Client Project No.:	
Other:	
DSA File No.:	
DSA Application No.:	
DSA LEA No.:	

Project Number:	3468.001.100
Project Title:	General Quarry Sampling
Project Location:	Barstow, CA
Client:	Best Rock Quarry

Sample ID: PJM05161802 **Maximum Dry Unit Weight** (lbf/ft³): 134.4 **Optimum Moisture Content** (%): 7.2

Classification, ASTM D2488: (Class 2 Aggregate Base) On Site Stockpile
Sample Origin:
Laboratory Remarks:



Tested By:	Cheyenne Oravets
Received Moisture:	0.5%
Preparation:	Wet
Specific Gravity:	ND
SG Method:	NA
Start Weight (lb):	57.9
Retained on 3/4" (lb):	1.0
Retained on 3/8" (lb):	20.4
Retained on No. 4 (lb):	32.6
Retained on 3/4" (%):	1.7%
Retained on 3/8" (%):	35.2%
Retained on No. 4 (%):	56.3%
Oversize Correction:	ND
Mold Volume Factor:	13.36
Tare Weight (lb):	6.24
Rammer Used:	Mechanical
Method Used:	☐ A ☐ B ☒ C

Weight of Soil and Tare (lb):	16.56	17.02	17.06	16.71
Wet Weight (g):	500.6	500.4	502.1	506.3
Dry Weight (g):	478.7	467.0	455.3	446.3
Moisture Content (%):	4.6%	7.2%	10.3%	13.4%
Dry Unit Weight (flb/ft³):	131.8	134.4	131.1	123.3

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.
cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

Reviewed By (Signature)

Clayton Garrison / Laboratory Manager
Name / Title

MerrellJohnson COMPANIES

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Sieve Analysis of Fine and Coarse Aggregates

CT202

Report Date: 05/18/18
Sheet: 1 *of* 1
Attachment: DR01, SS02, SA02, SE01, DI01, RV01, MD01
Permit No.:
Client Project No.:
Other:
DSA File No.:
DSA Application No.:
DSA LEA No.:

Project Number: 3468.001.100
Project Title: General Quarry Sampling
Project Location: Barstow, CA
Client: Best Rock Quarry

Sample ID: PJM05161802 ☒ **General Compliance** ☐ **Non-Compliance** ☐ **Not Specified**

Desription: Class 2 Aggregate Base
Sample Origin: On Site Stockpile
Laboratory Remarks:

Tested By: James Albornoz
Method/Procedure: CT202
Sample Size, g (As Tested): 2523.5
Oven Dry: Yes

Sieve Designation	Percent Passing	Percent Allowable
2"	100	-
1 1/2"	100	-
1"	100	100
3/4"	95	90 - 100
1/2"	65	-
3/8"	55	-
No. 4	41	35 - 65
No. 8	30	-
No. 16	23	-
No. 30	18	10 - 30
No. 50	14	-
No. 100	11	-
No. 200	8.2	2 - 9

Moisture Content (%): 0.6

Percent Allowable Based On: Caltrans 3/4" Max Class 2 Aggregate Base

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.
cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

Reviewed By (Signature)

Clayton Garrison / Laboratory Manager
Name / Title

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Sieve Analysis of Fine and Coarse Aggregates

ASTM C136, C117, D1140, D2216

Report Date: 08/14/17
Sheet: 1 *of* 1
Attachment: SS01
Permit No.:
Client Project No.:
Other:
DSA File No.:
DSA Application No.:
DSA LEA No.:

Project Number: 3468.001.100
Project Title: Best Rock Quarry General Sampling
Project Location: Barstow, CA
Client: Best Rock Quarry

Sample ID: JWB08091701 ☐ **General Compliance** ☐ **Non-Compliance** ☒ **Not Specified**

Desription: 3/8" Aggregates
Sample Origin: Onsite Stockpile
Laboratory Remarks:

Tested By: CRO **Sample Size:** 55.0 lbs
Method/Procedure: C136

Sieve Designation	Percent Passing	Percent Allowable
1"	100	-
3/4"	100	-
1/2"	100	-
3/8"	77	-
No. 4	10	-
No. 8	2	-
No. 16	1	-
No. 30	0	-

Percent Allowable Based On: -

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.
cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

Reviewed By (Signature)

Clayton Garrison / Laboratory Manager
Name / Title

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Sieve Analysis of Fine and Coarse Aggregates

ASTM C136, C117, D1140, D2216

Report Date: 08/14/17
Sheet: 1 *of* 1
Attachment: DR01, SS02
Permit No.:
Client Project No.:
Other:
DSA File No.:
DSA Application No.:
DSA LEA No.:

Project Number: 3468.001.100
Project Title: Best Rock Quarry General Sampling
Project Location: Barstow, CA
Client: Best Rock Quarry

Sample ID: JWB08091702 ☐ General Compliance ☐ Non-Compliance ☒ Not Specified

Desription: 3/4" Aggregates
Sample Origin: Onsite stockpile
Laboratory Remarks:

Tested By: CRO **Sample Size:** 60.0 lbs
Method/Procedure: C136

Sieve Designation	Percent Passing	Percent Allowable
1"	100	-
3/4"	65	-
1/2"	5	-
3/8"	4	-
No. 4	2	-
No. 8	1	-
No. 16	0	-
No. 30	0	-

Percent Allowable Based On: -

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.
cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

Reviewed By (Signature)

Clayton Garrison / Laboratory Manager
Name / Title

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Sieve Analysis of Fine and Coarse Aggregates

ASTM C136, C117, D1140, D2216

Report Date: 08/23/17
Sheet: 1 *of* 1
Attachment:
Permit No.:
Client Project No.:
Other:
DSA File No.:
DSA Application No.:
DSA LEA No.:

Project Number: 3468.001.100
Project Title: Best Rock Quarry General Sampling
Project Location: Barstow, CA
Client: Best Rock Quarry

Sample ID: CLT08221701 ☐ **General Compliance** ☐ **Non-Compliance** ☒ **Not Specified**

Desription: 3" Minus Base Rock
Sample Origin: Client sampled from Best Rock Quarry
Laboratory Remarks:

Tested By: JDA
Method/Procedure: C136
Sample Size: 139.0 lbs

Sieve Designation	Percent Passing	Percent Allowable
3"	96	-
2 1/2"	73	-
2"	28	-
1 1/2"	6	-
1"	0	-
3/4"	0	-

Percent Allowable Based On: -

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.
cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

Reviewed By (Signature)

Clayton Garrison / Laboratory Manager
Name / Title

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October 25, 2016

Best Rock Quarry, Inc.
26282 Neuman Street
Barstow CA 92311

Subject: **Report of Petrographic Analysis**
Erosion Protection Stone
Best Rock Quarry
Barstow, California
Amec Foster Wheeler Project No. 5015-16-0030.01
Amec Foster Wheeler Lab Nos. 30020-30023

Dear Mr. Nickolaisen:

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) is pleased to present the results of our petrographic analysis for the subject project. We understand that rock products from the subject quarry are proposed for possible use in the Langford Lake Road Repair and Drainage Improvement project at the Fort Irwin National Training Center near Barstow, California, as well as other future United States Army Corps of Engineers (USACE) projects. Results of other testing, including wetting and drying (ASTM D5313-12), specific gravity and absorption (ASTM C127-12), magnesium sulfate soundness (ASTM C88-13), and abrasion loss (ASTM C535-12) are presented in a separate report.

Amec Foster Wheeler geologist Mike Farr visited the subject quarry on August 11, 2016 to obtain samples for our analysis. The addressee and USACE engineers Anthony Tintelnot and Jeffrey Meadows were present during the sampling. Two main rock types were identified at the quarry. The main rock types were generally white colored marble, which is referred to as "white rock", and generally gold colored marble, which is referred to as "gold rock". Representative pieces of good and poor quality versions of each of these two rock types were obtained and returned to our laboratory for analysis. The rock samples were assigned laboratory tracking numbers 30020 (good quality white rock), 30021 (poor quality white rock), 30022 (good quality gold rock), and 30023 (poor quality gold rock).

PETROGRAPHIC EVALUATION METHODS

Our petrographic analysis was performed in general accordance with the applicable sections of ASTM C295-12 (Standard Guide for Petrographic Examination of Aggregates for Concrete), with modifications per the United States Army Corps of Engineers project specifications (dated February, 2015) provided to us by the addressee. The primary focus of our analysis was to evaluate the characteristics of the rock samples relevant to their suitability for general use as erosion protection stone. A secondary focus of the analysis was evaluation of constituents within the rock samples that could be potentially deleterious with respect to use in grouted erosion protection stone.

The petrographic analysis was performed on four rock samples consisting of good and poor quality versions of white rock, and good and poor quality versions of gold rock. One thin section slide and one polished section were made from each sample. Alizarin Red S stain was applied to one-half of each slide to help distinguish calcite from dolomite as discussed below. Our petrographic analysis included: visual and hand lens observation of the as-received rock samples; observation of polished sections (cut sections that have been ground flat and smooth) through an AmScope stereographic microscope with magnifications ranging from 7X to 45X; and observation of thin section slides through an Olympus BH-2 petrographic microscope with magnifications ranging from 20X to 400x.

Detailed petrographic descriptions for each sample, including estimated volume percentages of constituent minerals, are presented in Tables 1 through 4 below. Photographs of the rock samples (as-received and polished sections) and photomicrographs of the thin section slides are presented in Appendix A. The surfaces of the polished sections were dampened slightly prior taking the photographs to accentuate the features in the rock.

Minor clay was identified by our petrographic evaluation in the poor quality gold rock sample. Since the various types of clay minerals typically cannot be differentiated by petrographic analysis alone, X-ray diffraction analysis was performed on a portion of this sample to help identify the types of clay minerals present. The X-ray diffraction results are presented in Appendix B.

PETROGRAPHIC DESCRIPTIONS

General

Our analysis indicated that the subject samples are comprised of marble. Marble is a relatively common rock formed by metamorphism of carbonate rocks such as limestone or dolostone. The subject samples are comprised primarily of calcite and dolomite, which occur in variable relative amounts both within and between the samples. Calcite was differentiated from dolomite primarily through Alizarin Red S staining (calcite turns red when exposed to the stain, while dolomite does not). The white rock samples also contain substantial amounts of tremolite, wollastonite, and the forsterite variety of olivine. These minerals are relatively common in metamorphosed carbonate rocks. Other minerals were identified in the samples in somewhat variable but generally minor amounts as described in the detailed petrographic descriptions provided on the following pages.

Clay Content and X-Ray Diffraction Analysis Results

Minor amounts of clay were identified in the poor quality gold rock sample by our petrographic analysis. An X-ray diffraction analysis was performed on a representative portion of this sample to aid in assessing whether expansive clays are present. No significant amounts of clay were identified in the other samples.

Test results, presented in Appendix B, indicate that the clay is comprised primarily of non-expandable clay (illite and/or mica), with subordinate amounts of mixed-layer clay (non-expandable illite interlayered with highly expandable smectite). The illite/mica listed in the X-ray diffraction results in Appendix B represents a combination of mica and illite that has developed from the weathering of the mica, but the relative amounts of each are not known.

Good Quality Marble (White Rock) – Lab No. 30020

As-Received and Polished Section Observations: The as-received good quality white rock sample is an angular, quarried piece of marble with a maximum dimension of about 8 inches. Some sides of the rock sample are semi-planar and may coincide with jointing patterns within the rock. The rock is generally white to light gray in color. The rock generally appears to be fresh to slightly weathered, very strong, and very hard. Distinct layering defined by alternating bands of lighter and darker minerals is visible in the polished section surface. Oxidation visible in the as-received sample and polished section generally appears to be limited to sporadic staining on weathered surfaces and fracture linings.

The good quality white rock polished section exhibits a few readily visible fractures with a maximum width of about 1/16 inch. Most of the fractures are discontinuous. Fracture filling material is primarily calcite, with subordinate iron-oxide. A limited number of carbonate and/or iron-oxide filled microfractures are also visible through the stereographic microscope.

Thin Section Observations: The good quality white rock sample is comprised primarily of calcite and dolomite, although the relative percentages of these two minerals vary considerably within the sample. Dolomite occurs as relatively large, generally subhedral crystals ranging up to about 1 millimeter. It occurs both as individual crystals in a finer grained calcite matrix, as well as in interlocking clusters of crystals with finer grained calcite filling in the limited interstices. Calcite ranges from very fine, anhedral crystals to somewhat larger, subhedral crystals. The larger crystals of both calcite and dolomite exhibit variable but generally relatively well-developed twinning.

Tremolite, wollastonite, mica (primarily muscovite), and forsterite (a variety of olivine) all generally occur as individual, subhedral to euhedral crystals within dolomite crystals and/or within a fine grained calcite matrix. The forsterite crystals exhibit the characteristic olivine fracture pattern. Quartz occurs as minor void filling and/or secondary replacement material. Optically opaque minerals primarily occur as clusters of minute inclusions within dolomite crystals. Microcrystalline, massive iron-oxide occurs as fracture fill material and as oxidation of ovoid grains. Chlorite was observed only in trace amounts.

Only a few limited microfractures were observed in thin section. The fractures are lined primarily with iron-oxide and calcite, although one quartz lined fracture was also observed. One larger iron-oxide and calcite lined fracture was observed with a maximum width of about 0.2 millimeters.

Table 1 – Estimated Composition – Good Quality Marble (White Rock)

Mineral Constituent	Estimated Volume %	Comments
Calcite	20-50	Small, andhedral crystals to large, subhedral crystals
Dolomite	30-60	Primarily large, subhedral crystals
Forsterite (olivine)	10	
Tremolite	4	
Mica	2	Primarily muscovite
Wollastonite	1	
Quartz	1	Secondary replacement and/or void filling
Iron-oxide	1	Microcrystalline, massive
Opaques	1	Clusters of minute inclusions in dolomite

Poor Quality Marble (White Rock) – Lab No. 30021

As-Received and Polished Section Observations: The as-received poor quality white rock sample is an angular, quarried piece of marble with a maximum dimension of about 7 inches. Some sides of the rock sample are semi-planar and may coincide with jointing patterns within the rock. The rock is generally white to light gray to medium gray in color. The rock generally appears to be slightly weathered, very strong, and very hard. Oxidation visible in the as-received sample and polished section is somewhat more prevalent than in the good quality sample, and generally consists of staining on weathered surfaces, fracture linings, and round to ovoid zones of oxidation staining visible in the polished section surface.

The poor quality white rock polished section exhibits somewhat more extensive fracturing than the good quality sample, including some readily visible fractures with a maximum width of about 1/16 inch. Both continuous and discontinuous fractures were observed. Fracture filling material is primarily calcite and iron-oxide. Several carbonate and/or iron-oxide filled microfractures were also observed through the stereographic microscope.

Thin Section Observations: The poor quality white rock sample is comprised primarily of calcite ranging from very fine, anhedral crystals to larger, generally subhedral crystals. The larger crystals exhibit variable but generally relatively well-developed twinning.

Tremolite, wollastonite, and forsterite all generally occur as individual, subhedral to euhedral crystals within dolomite crystals and/or within a fine grained calcite matrix. Quartz occurs as minor void filling and/or secondary replacement material. Optically opaque minerals occur both as clusters of minute inclusions within dolomite crystals, and as scattered larger masses or individual crystals. Microcrystalline, massive iron-oxide occurs as fracture fill material and as oxidation of ovoid grains. Unlike the good quality white rock sample, no dolomite or mica was observed. Chlorite was observed only in trace amounts.

Several fine fractures and microfractures were observed in the poor quality white rock sample. The fractures are lined primarily with iron-oxide and calcite.

Table 2 – Estimated Composition - Poor Quality Marble (White Rock)

Mineral Constituent	Estimated Volume %	Comments
Calcite	75	Small, andhedral crystals to large, subhedral crystals
Forsterite (olivine)	10	
Tremolite	9	
Wollastonite	2	
Iron-oxide	2	Microcrystalline, massive
Quartz	1	Secondary replacement and/or void filling
Opaques	1	Clusters of minute inclusions in dolomite + larger crystals
Chlorite	<1	

Good Quality Marble (Gold Rock) – Lab No. 30022

As-Received and Polished Section Observations: The as-received good quality gold rock sample is an angular, quarried piece of marble with a maximum dimension of about 8 inches. Some sides of the rock sample are semi-planar and may coincide with jointing patterns within the rock. The rock is generally gold to gray in color. The rock generally appears to be slightly weathered, very strong, and very hard. Oxidation visible in the as-received sample and polished section generally consists of staining on weathered surfaces, fracture linings, and splotchy zones of oxidation staining visible in the polished section surface.

The good quality gold rock polished section exhibits several cross-cutting fractures with a maximum width of about 1/16 inch. Most of the fractures are discontinuous. Fracture filling material is primarily calcite, with subordinate iron-oxide. Numerous carbonate and/or iron-oxide filled microfractures are also visible through the stereographic microscope.

Thin Section Observations: The good quality gold rock sample is comprised primarily of dolomite. The dolomite occurs as very large, subhedral, interlocking crystals with well-developed twinning ranging up to about 5 millimeters in width. In some portions of the thin section, the interlocking dolomite crystals from the entire rock mass with no interstitial minerals. Calcite occurs as fine grained anhedral crystals or masses in the relatively limited interstices between the large dolomite crystals, as well as in ovoid to rectangular masses that appear to represent secondary replacement of other minerals.

Mica (primarily muscovite) occurs as scattered clusters or masses of fine crystals. Quartz and chlorite were observed in only trace amounts. Optically opaque minerals occur both as clusters of minute inclusions within dolomite crystals, and as scattered larger masses or individual crystals. Microcrystalline, massive iron-oxide occurs as fracture fill material and as oxidation of ovoid grains.

Numerous irregular, cross-cutting fine fractures and microfractures were observed in thin section. The fractures are lined primarily with calcite and subordinate iron oxide.

Table 3 – Estimated Composition - Good Quality Marble (Gold Rock)

Mineral Constituent	Estimated Volume %	Comments
Calcite	10	Mainly small, andhedral crystals and fracture fill
Dolomite	85	Primarily large, subhedral crystals
Mica	2	Primarily muscovite
Iron-oxide	2	Microcrystalline, massive
Opaques	1	
Quartz	<1	
Chlorite	<1	

Poor Quality Marble (Gold Rock) – Lab No. 30023

As-Received and Polished Section Observations: The as-received poor quality gold rock sample is an angular, quarried piece of marble with a maximum dimension of about 9 inches. The rock is generally gold to dark brown in color. The rock generally appears to be moderately to highly weathered, moderately strong to strong, and hard. Oxidation is extensive throughout the as-received sample and polished section as staining on weathered surfaces, fracture linings, and disseminated within the rock mass.

The poor quality gold rock polished section exhibits abundant cross-cutting fractures. The finer fractures are generally iron-oxide filled. Several large, discontinuous, carbonate-filled fractures ranging up to about 1/4 inch in width were also observed. The fractures and adjacent oxidized zones comprise an estimated 25 percent of the rock mass. Numerous carbonate and/or iron-oxide filled microfractures are also visible through the stereographic microscope. One large irregular void extending about an inch into the surface of the polished section was observed, as well as a few smaller voids.

Thin Section Observations: The poor quality gold rock sample is comprised primarily of dolomite and calcite with abundant cross-cutting calcite and iron-oxide lined fractures. The dolomite occurs as anhedral to subhedral, variably twinned crystals ranging up to about 1 millimeter in width. Some crystals appear to exhibit evidence of cataclastic shearing as described below. Calcite occurs as fine grained anhedral crystals and as extensive fracture fill.

Mica (primarily muscovite) occurs as scattered clusters or masses of fine crystals. Quartz occurs as scattered irregular crystals. Microcrystalline, massive iron-oxide and opaque minerals form a large portion of the rock, both within the rock matrix and as extensive fracture fill. Chlorite was observed in only trace amounts.

Minor amounts of clay were observed in thin section. X-ray diffraction test results (see Appendix B) indicate that the clay is primarily comprised of non-expandable clay (illite and/or mica), with subordinate amounts of mixed-layer clay (non-expandable illite interlayered with highly expandable smectite).

The sample is riddled with abundant irregular, cross-cutting fractures and microfractures that are estimated to comprise about 25 percent of the rock by volume. The fractures are lined primarily with calcite and iron-oxide. Some large fractures up to about 2 millimeters in width were observed to be filled with large calcite crystals and subordinate iron-oxide. Many of the fractures cut through dolomite crystals, and in some cases apparent shearing of the crystals is suggestive of some degree of cataclastic deformation.

Table 4 – Estimated Composition - Poor Quality Marble (Gold Rock)

Mineral Constituent	Estimated Volume %	Comments
Calcite	20	Small, andhedral crystals to large, subhedral crystals
Dolomite	30	Primarily large, subhedral to euhedral crystals
Iron-oxide/opaques	45	Mainly microcrystalline, massive
Clay	2	Mainly illite/mica with some illite/smectite per XRD results
Mica	2	Mainly muscovite
Quartz	1	
Chlorite	<1	

GENERAL SUITABILITY FOR USE AS EROSION PROTECTION

White Rock Samples

The poor quality white rock sample appears to be slightly more weathered and contains more fractures than the good quality sample. However, based on our analysis, both the good quality and poor quality white rock samples generally appear to be in good condition, and appear to possess relatively high strength and durability characteristics. Our analysis did not reveal any characteristics within the good quality or poor quality white rock samples that would make them unsuitable for general use as erosion protection stone.

Gold Rock Samples

The good quality gold rock sample generally appears to be in good condition, and appears to possess relatively high strength and durability characteristics. Our analysis did not reveal any characteristics within the good quality rock samples that would make it unsuitable for general use as erosion protection stone.

The poor quality gold rock sample is extensively weathered and fractured. In addition, the poor quality sample is estimated to contain about 2 percent clay by volume, including some expandable clays as indicated by the X-ray diffraction results discussed above. Based on our analysis, the poor quality gold rock is likely to experience more variability in long term performance than the good quality gold rock if used as erosion protection stone, and some of the poor quality gold rocks could be susceptible to breaking down over time.

SUITABILITY FOR USE IN GROUTED APPLICATIONS

Alkali-Aggregate Reaction in Cementitious Materials

Alkali-aggregate reaction occurs when certain constituents in aggregates react with alkalis in the portland cement in grout or other cementitious materials to form a gel. If sufficient moisture is present, the gel can absorb water and expand, causing deleterious cracking of the grout. The two main forms of deleterious alkali-aggregate reaction are alkali-carbonate reaction and alkali-silica reaction. Alkali-carbonate reaction is relatively rare because the mineral constituents required for this reaction (typically dolomite plus clay) are relatively uncommon in aggregates. Alkali-silica reaction is more common because potentially reactive silica minerals are relatively common in aggregates.

Section 5 of ASTM C295 - 12 provides a list of common alkali-silica reactive constituents found in aggregates, as well as common rock types containing these constituents, as follows:

- Reactive Constituents: Opal, chalcedony, cristobalite, trydimite, highly strained quartz, microcrystalline quartz, volcanic glass, and synthetic siliceous glass.
- Associated Rock Types: Glassy to cryptocrystalline intermediate to acidic volcanic rocks, some argillites, phyllites, greywacke, gneiss, schist, gneissic granite, vein quartz, quartzite, sandstone, and chert.

The reactivity potential of the various forms of silica is to a large degree based on the amount of silica surface area available to react with alkalis in the cement. Forms of silica that are very fine grained (ie., glassy, cryptocrystalline, or microcrystalline), amorphous, porous, fibrous, radial, inclusion-rich, intensely deformed (ie., highly strained) or intensely micro-fractured tend to be more reactive mainly because they present a relatively large surface area that is available for reaction. Many forms of quartz have at least some potential for alkali-silica reactivity, and under the right conditions (particularly where alkali content is high), even aggregates generally thought to be nonreactive can sometimes exhibit signs of alkali-silica reaction. However, in most cases the reactivity level of the more coarsely crystalline and less deformed forms of quartz is not sufficient to cause deleterious cracking in cementitious materials. Some other forms of quartz not included on the list above, including inclusion-rich quartz, have also been shown to be susceptible to deleterious levels of alkali-silica reactivity under certain conditions.

Alkali-Aggregate Reactivity Potential of Subject Samples

Only minor or trace amounts of quartz were identified in the subject samples, and no significant amounts of constituents considered to be susceptible to deleterious levels of alkali-silica reactivity were identified. Accordingly, the subject samples are not likely to be susceptible to deleterious levels of alkali-silica reactivity if used as grouted erosion protection stone.

Our analysis indicates that carbonate minerals (calcite and dolomite) are the main constituents comprising the subject samples. However, the carbonate comprising the good quality white rock, poor quality white rock, and good quality gold rock samples does not appear to be in the form typically associated with deleterious alkali-carbonate reaction (dolomite plus clay). Accordingly, these three samples are not considered to be susceptible to deleterious levels of alkali-carbonate reaction.

Significant amounts of dolomite and minor amounts of clay were identified in the poor quality gold rock sample. This sample could be susceptible to some degree of alkali-carbonate reactivity if used as grouted erosion protection stone, although the degree of reactivity is likely to be relatively low.

CONCLUSIONS

Based on the results of our analysis, the following conclusions are presented:

- Our analysis did not reveal any characteristics within the good quality white rock, poor quality white rock, or good quality gold rock samples that would make them unsuitable for use as erosion protection stone.
- The poor quality gold rock sample is likely to experience more variability in long term performance than the other three samples if used as erosion protection stone, and some of the rocks could be susceptible to breaking down over time.
- The poor quality gold rock sample could be susceptible to some degree of alkali-carbonate reactivity if used as grouted erosion protection stone, although the degree of reactivity is likely to be relatively low.

CLOSURE

This report has been prepared solely for the use of Interwest Pacific, Ltd, and should not be used by other parties without their written authorization.

We trust this information meets your current needs. If more information is needed, please contact Mike Farr at 760-683-4117.

Sincerely,

AMEC FOSTER WHEELER ENVIRONMENT & INFRASTRUCTURE, INC.

Michael P. Farr, CEG #1938
Principal Geologist

David C. Wilson, PE C54734
Senior Principal Engineer

MPF/DCW:mf

Attachments: Appendix A – Photographs and Photomicrographs
Appendix B – X-Ray Diffraction Results

REFERENCES

Canadian Standards Association, Alkali-Aggregate Reaction *in* Concrete Materials and Methods of Concrete Construction, 2009.

Dolar-Mantuani, Ludmila, Handbook of Concrete Aggregates, Noyes Publications, 1983.

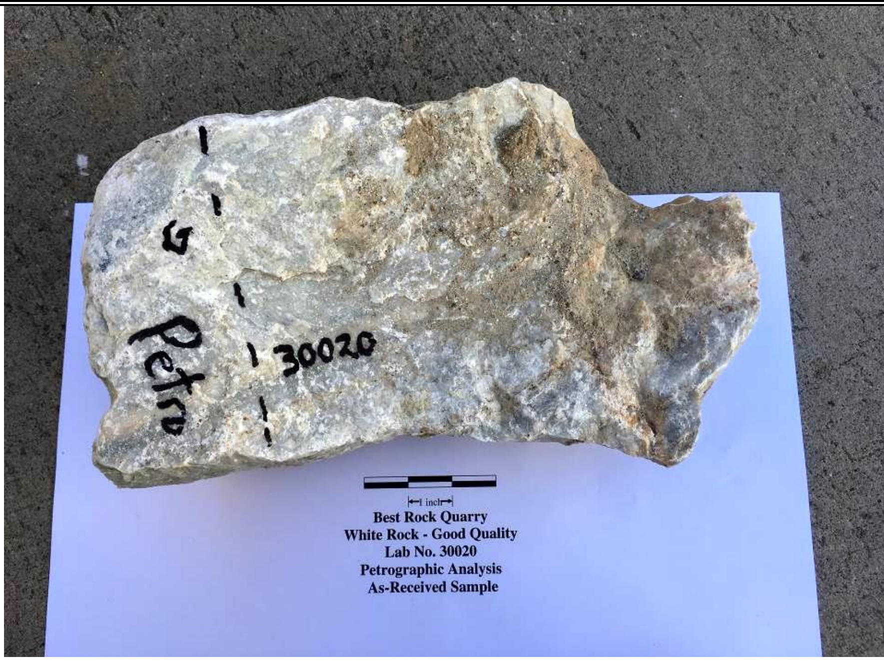
Farny, James A., and Kosmatka, Steven H., Diagnosis and Control of Alkali-Aggregate Reactions in Concrete, Portland Cement Association, 1997.

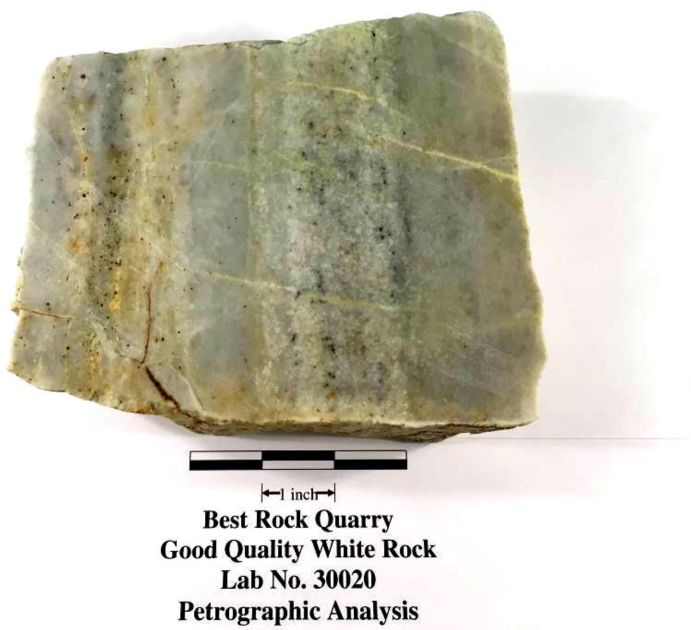
FHWA, Petrographic Methods of Examining Hardened Concrete: a Petrographic Manual, Publication No. FHWA-HRT-04-150, 2004.

Stark, David, Alkali-Silica Reactions in Concrete, *in* Significance of Tests and Properties of Concrete and Concrete Making Materials, ASTM Stock No.: STP169D, Chapter 34, 2006.

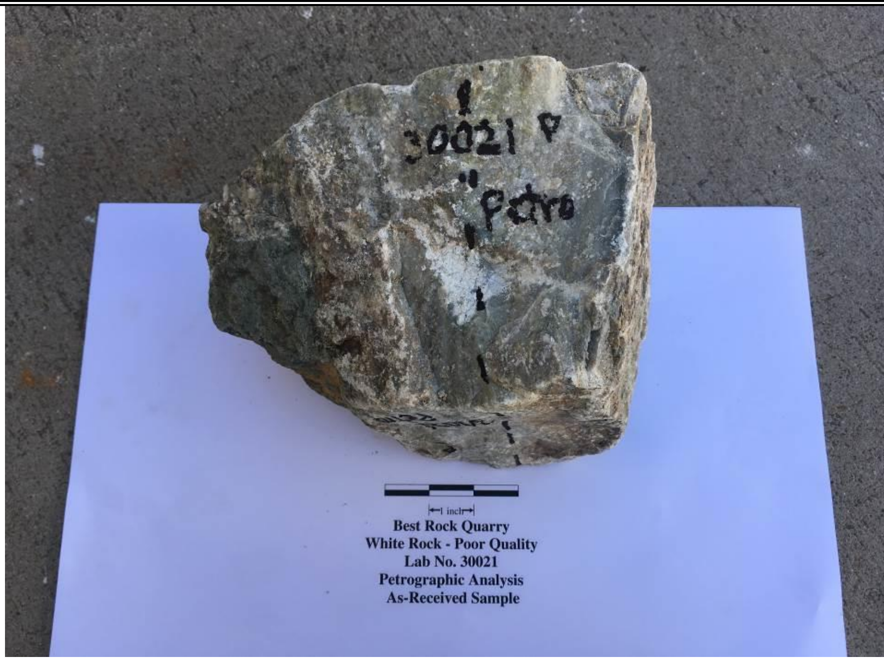
APPENDIX A

PHOTOGRAPHS AND PHOTOMICROGRAPHS

PHOTOGRAPH 1	Remarks
	Good quality marble (white rock), Lab No. 30020, as received sample.

PHOTOGRAPH 2	Remarks
	Good quality marble (white rock), Lab No. 30020, polished section.

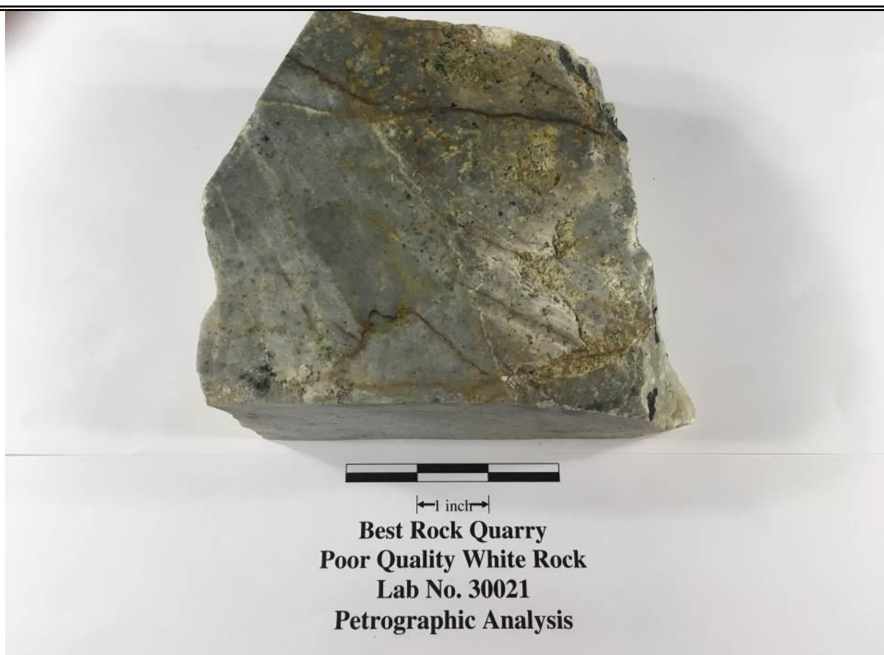
PHOTOGRAPH 3



Remarks

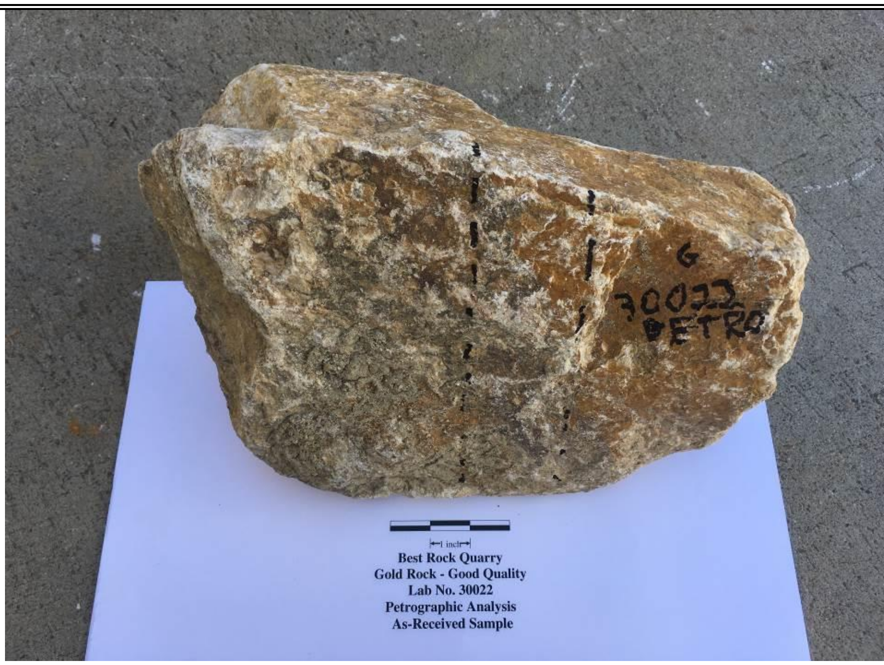
Poor quality marble (white rock), Lab No. 30021, as received sample.

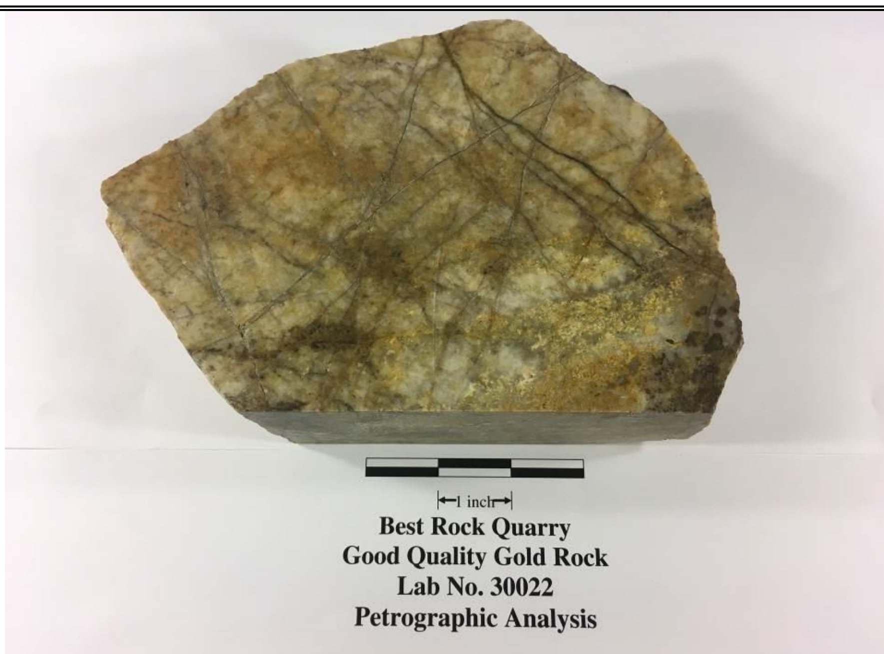
PHOTOGRAPH 4

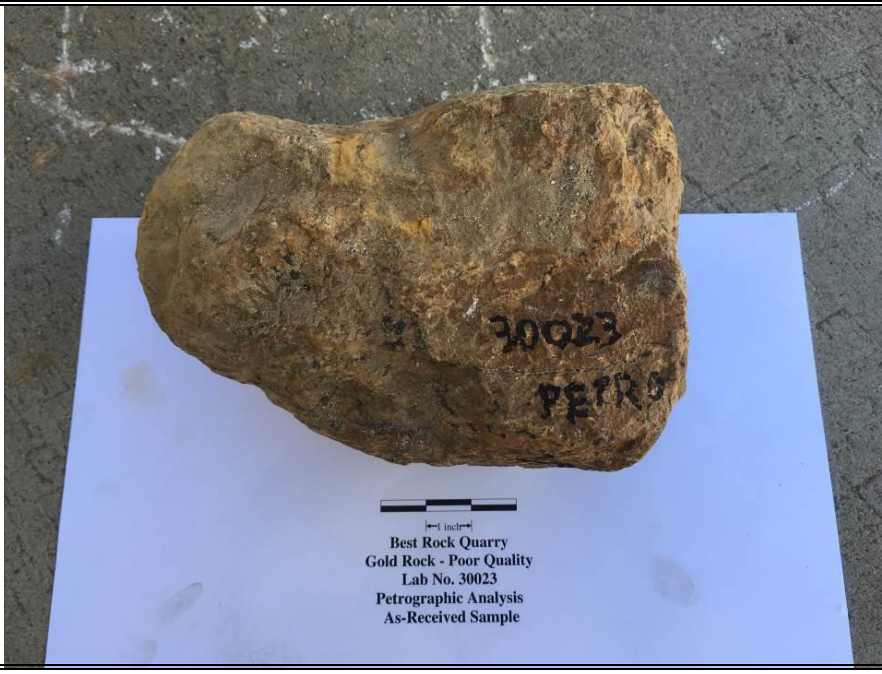


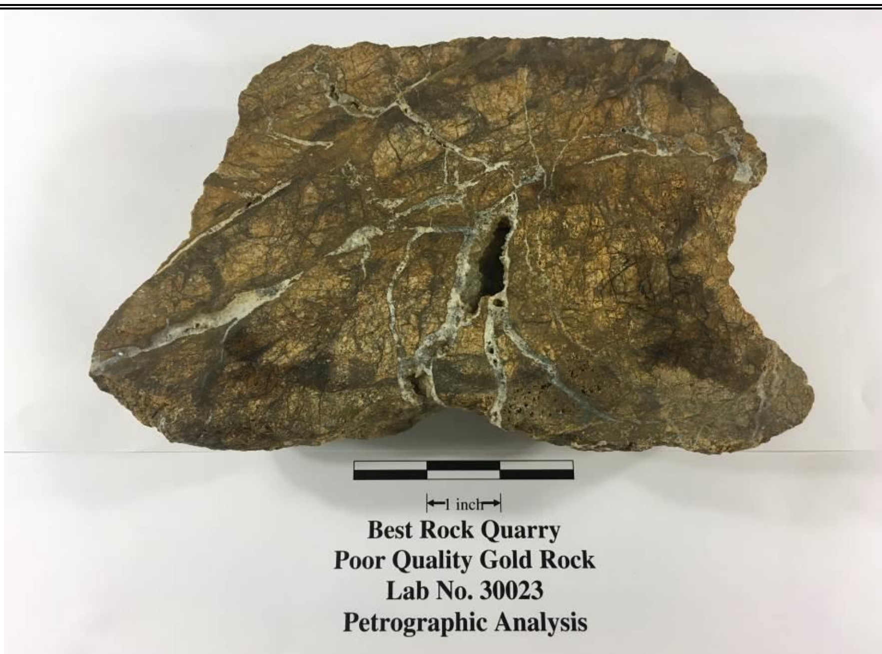
Remarks

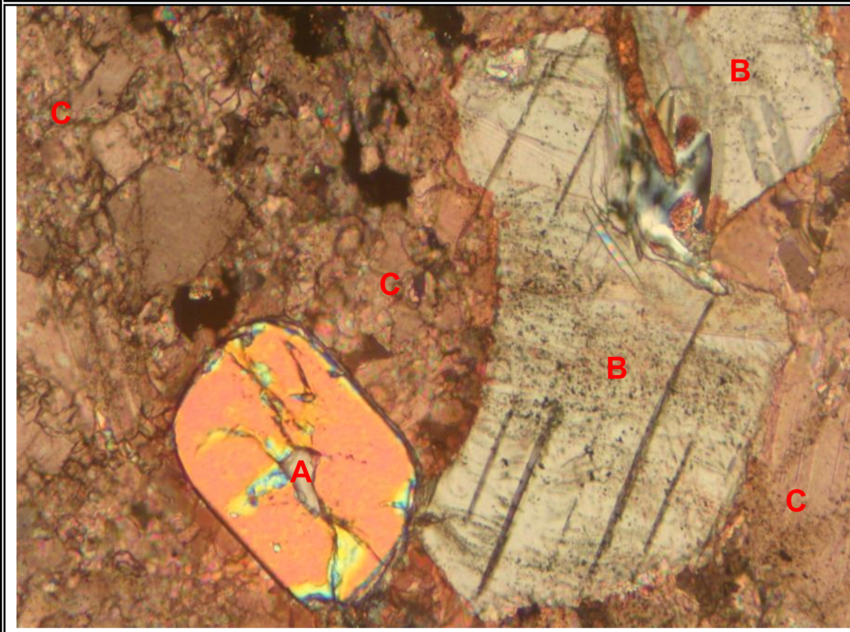
Poor quality marble (white rock), Lab No. 30021, polished section.

PHOTOGRAPH 5	Remarks
	Good quality marble (gold rock), Lab No. 30022, as received sample.

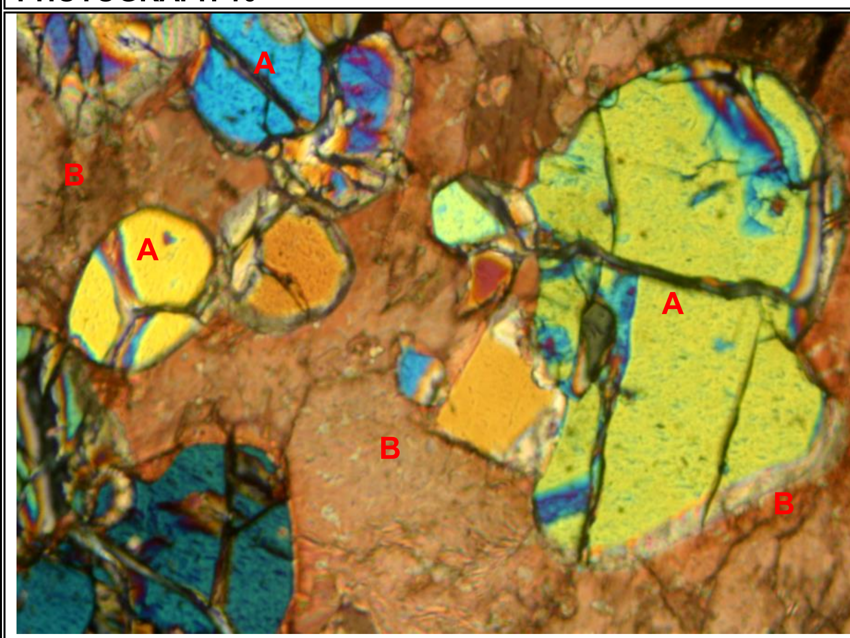
PHOTOGRAPH 6	Remarks
	Good quality marble (gold rock), Lab No. 30022, polished section.

PHOTOGRAPH 7	Remarks
	Poor quality marble (gold rock), Lab No. 30023, as received sample.

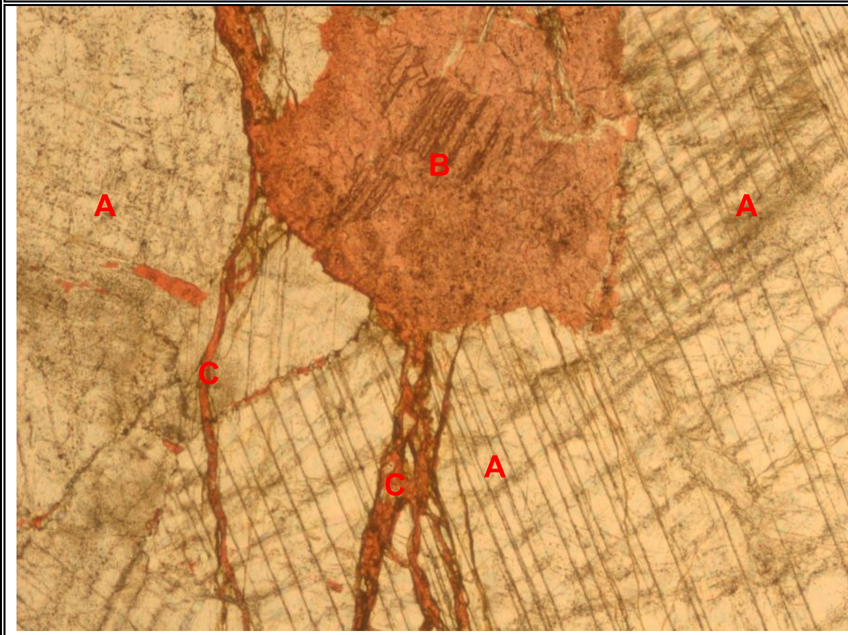
PHOTOGRAPH 8	Remarks
	Poor quality marble (gold rock), Lab No. 30023, polished section.

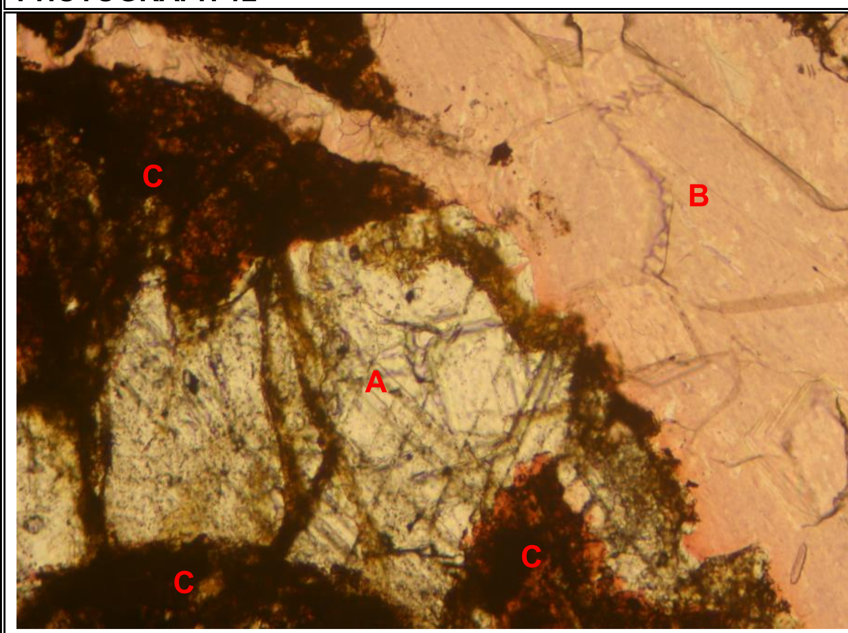
<table>
<tr><th>PHOTOGRAPH 9</th><th>Remarks</th></tr>
<tr><td>
</td><td>Photomicrograph of good quality marble (white rock) thin section showing large forsterite and dolomite crystals in a fine grained calcite matrix. Lab No. 30020, 100X magnification, cross polarized light, horizontal field of view is about 1 mm.

<u>Key:</u>
A – Forsterite crystal (bright colors)
B – Dolomite crystals (light gray)
C – Fine grained calcite (stained pinkish red)</td></tr>
</table>

<table>
<tr><th>PHOTOGRAPH 10</th><th>Remarks</th></tr>
<tr><td>
</td><td>Photomicrograph of poor quality marble (white rock), thin section showing forsterite crystals in a fine grained calcite matrix. Lab No. 30021, 100X magnification, cross polarized light, horizontal field of view is about 1 mm.

<u>Key:</u>
A – Forsterite crystals (bright colors)
B – Fine grained calcite (stained pinkish red)</td></tr>
</table>

PHOTOGRAPH 11	Remarks
	Photomicrograph of good quality marble (gold rock), thin section showing calcite-filled fractures and large dolomite crystals surrounding fine grained calcite. Lab No. 30022, 40X magnification, plane polarized light, horizontal field of view is about 2.5 mm. **Key:** **A –** Dolomite crystals (pinkish white) **B –** Fine grained calcite (stained pinkish red) **C –** Calcite-filled fractures (stained pinkish red)

PHOTOGRAPH 12	Remarks
	Photomicrograph of poor quality marble (gold rock), thin section showing large calcite-filled fracture, and large dolomite crystal surrounded by highly oxidized fine grained matrix. Lab No. 30023, 100X magnification, plane polarized light, horizontal field of view is about 1 mm. **Key:** **A –** Dolomite crystal (white) **B –** Calcite-filled fracture (stained pink) **C –** Fine grained iron-oxide rich matrix (dark reddish brown)

APPENDIX B
X-RAY DIFFRACTION ANALYSIS RESULTS

Weatherford LABORATORIES

X-RAY DIFFRACTION
CLAY ANALYSIS DATA NORMALIZED TO 100%
(WEIGHT %)

Client: Amec Foster Wheeler Environment and Infrastructure, Inc.
Location: Best Rock Quarry
Sample Type: Outcrop
File No: HH-93266
Analyst: G. Torrez

Barcode Number	Sample Number	CLAYS				Normalized Total
		Chlorite	Kaolinite	Illite/Mica	Mx I/S*	
6124853082	1 OC	7	0	77	16	100
		7	0	77	16	100

* Ordered interstratified mixed-layer illite/smectite; Approximately 15-20% expandable interlayers

October 25, 2016

Best Rock Quarry, Inc.
26282 Neuman Street
Barstow CA 92311

Subject:

Report of Rock Quality Testing
Erosion Protection Stone
Best Rock Quarry
Barstow, California
Amec Foster Wheeler Project No. 5015-16-0030.01
Amec Foster Wheeler Lab Nos. 29043, 29044, 30018, 30019

Dear Mr. Nickolaisen:

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) is pleased to present the results of our rock quality testing for the subject project. We understand that rock products from the subject quarry are proposed for possible use in the Langford Lake Road Repair and Drainage Improvement project at the Fort Irwin National Training Center near Barstow, California, as well as other future United States Army Corps of Engineers (USACE) projects.

TEST METHODS

Our testing was performed in general accordance with the ASTM methods listed below, with modifications per the USACE project specifications (dated February, 2015) provided to us by the addressee. Our testing program included the following:

- Wetting and Drying (ASTM D5313-12)
- Specific Gravity and Absorption (ASTM C127-12)
- Magnesium Sulfate Soundness (ASTM C88-13)
- Abrasion Loss (ASTM C535-12)

Petrographic analyses were also performed on rock samples from the subject quarry in accordance with ASTM C295-12. The results of the petrographic analyses are presented in a separate report.

Wetting and Drying Test

Amec Foster Wheeler geologist Mike Farr visited the subject quarry on August 11, 2016 to obtain samples for the wetting and drying test (as well as for the petrographic analyses mentioned above). The addressee and USACE engineers Anthony Tintelnot and Jeffrey Meadows were present during the sampling. The main rock types observed at the quarry were generally white colored marble, which is referred to as “white rock”, and generally gold colored marble, which is referred to as “gold rock”. Two samples were obtained for the wetting and drying test. One sample consisted of representative pieces of good quality white and gold rock, while the other consisted of representative pieces of poor quality white and gold rock. The good quality sample was assigned laboratory tracking number 30018, while the poor quality sample was assigned laboratory tracking number 30019.

The wetting and drying test was performed in general accordance with ASTM D5313-12, with modifications as provided by the referenced USACE project specifications and as described below. The test was performed between August 18 and October 7, 2016. After initial observations, slabs with a thickness of approximately 2-1/2 inches were cut from the selected pieces of rock, and the slabs were then oven dried and weighed. A total of 8 slabs were cut: two white rock slabs and two gold rock slabs for the good quality sample, and two white rock slabs and two gold rock slabs for the poor quality sample. The slabs were then subjected to 30 daily cycles of wetting and drying. The test cycles were generally performed on weekdays, with the slabs being left in a dry condition at room temperature over most weekends. Any fracturing, deterioration, or other significant changes in the samples were documented at the end of each cycle.

Given the location of the subject quarry, it is highly unlikely that rock from the quarry would be used in coastal infrastructure projects. Accordingly, all samples were soaked in a tap water bath with 0.5 percent ethyl alcohol by weight, and no slabs were soaked in the salt water bath indicated by the USACE project specifications. This approach was discussed with the personnel present at the time of sampling as listed above.

Detailed descriptions of the slabs, as well as initial and final slab weights, overall weight change, and percent weight change for each rock slab are presented in Appendix A. Photographs of the as-received samples and before and after photographs of the slabs are presented in Appendix C. The surfaces of the slabs were dampened slightly prior to taking the photographs to accentuate the features in the rock.

Specific Gravity and Absorption, Magnesium Sulfate Soundness, and Abrasion Loss

The specific gravity and absorption, magnesium sulfate soundness, and abrasion loss tests were performed in general accordance with ASTM C127-12, ASTM C88-13, and ASTM C535-12, respectively, with modifications per the referenced USACE project specifications. The main modification was that the various tests were performed on composite samples of approximately 150 pounds of approximately 3 to 4 inch rock rather than the gradations specified by the ASTM methods. The samples were obtained from the subject quarry by a representative of Ninyo and Moore, and delivered to the Amec Foster Wheeler laboratory on April 14, 2015. The sample exhibited a range of apparent rock quality and degree of weathering, but was not divided into “good” and “poor” portions or labeled as such. The sample was visually divided into two portions for testing in the Amec Foster Wheeler laboratory, with the better quality rock being designated as “good” quality and the lower quality rock being designated as “poor” quality. Test results were previously presented in our report dated May 11, 2015. Before and after photographs of the tested samples are presented in Appendix C.

TEST RESULTS

A summary of the test results is presented in Table 1 below, while more detailed test results are presented in Appendix B.

Table 1 – Test Result Summary

Test	Sample ID	Lab No.	Test Result	Specification
Wetting and Drying	Good Quality	30018	No significant fracturing	No significant fracturing
Specific Gravity (Bulk SSD)	Good Quality	29043	2.708	≥ 2.65
Absorption (%)	Good Quality	29043	0.754	≤ 2
Mg Sulfate Soundness (Wt. % Loss)	Good Quality	29043	1.0	≤ 10
Abrasion Loss (%, 500 revs)	Good Quality	29043	<20*	≤ 20
Wetting and Drying	Poor Quality	30019	No significant fracturing	No significant fracturing
Specific Gravity (Bulk SSD)	Poor Quality	29044	2.700	≥ 2.65
Absorption (%)	Poor Quality	29044	1.462	≤ 2
Mg Sulfate Soundness (Wt. % Loss)	Poor Quality	29044	25.1	≤ 10
Abrasion Loss (%, 500 revs)	Poor Quality	29044	>20*	≤ 20

*Interpolated from % wear at 200 revolutions and 1,000 revolutions based on wear rates (see Appendix B).

Wetting and Drying Test

Some of the rock slabs tested lost minor amounts of material from the edges of the slab. These minor losses of material were less than 0.5 of the original slab dry weight. This minor loss of material from the edges of the slabs does not indicate a failing test per the test method and project specifications. Most of the slabs showed a very slight increase in weight over the course of the test, presumably due to an overall net absorption of small amounts of moisture during the test. Minor oxidation staining appeared on scattered areas of some of the slab surfaces over the course of the testing. None of the slabs, including both the good and poor quality slabs, experienced any additional deterioration beyond these minor changes.

Abrasion Loss, Specific Gravity and Absorption, and Magnesium Sulfate Soundness

The good quality rock sample met the USACE project specifications for all tests, while the poor quality rock sample met the specifications for specific gravity and absorption (ASTM C127-12), but not for magnesium sulfate soundness (ASTM C88-13) or abrasion loss (ASTM C535-12).

CLOSURE

This report has been prepared solely for the use of Interwest Pacific, Ltd, and should not be used by other parties without their written authorization.

We trust this information meets your current needs. If more information is needed, please contact Mike Farr at 760-683-4117.

Sincerely,

Amec Foster Wheeler Environment & Infrastructure, Inc.

Registered Geologist Michael P. Farr No. 1938 Certified Engineering Geologist Exp 5-31-17 State of California

Registered Professional Engineer David C. Wilson No. C54734 Exp. 12-31-17 Civil State of California

Michael P. Farr, CEG 1938
Principal Geologist

David C. Wilson, PE C54734
Senior Principal Engineer

MPF:DCW:mpf

Attachments: Appendix A – Wetting and Drying Test Detailed Rock Descriptions
Appendix B – Test Results
Appendix C – Photographs

APPENDIX A
WETTING AND DRYING TEST
DETAILED ROCK SLAB DESCRIPTIONS

Table 2
Lab No. 30018
Good Quality White and Gold Rock (Marble)
Wetting and Drying Test Detailed Descriptions

Sample ID/Bath Type	Initial/ Final Weight (grams)	Weight/ Percent Change	Description
Slab 1 (30018-1) Good Quality White Rock Tap Water	i=5,088.5 f=5,092.4	+3.9g +.08%	The Slab 1 sample is an angular, quarried piece of good quality white rock (marble). The slab is approximately 2-1/2-inches thick, with general dimensions of about 7-1/2 inches by 7 inches. Some of the slab edges are semi-planar and may coincide with jointing patterns within the rock. The rock is generally white to light gray in color, with limited light reddish-brown oxidation staining. The rock generally appears to be fresh to slightly weathered, very strong, and very hard. Layering defined by alternating bands of lighter and darker minerals is visible in the slab surface. Prior to testing, oxidation was limited to sporadic staining on some of the slab edges. Faint oxidation staining gradually developed on the slab surface during testing. Slab 1 exhibits a few readily visible fractures with a maximum width of about 1/16 inch. Most of the fractures are discontinuous. Fracture filling material is primarily calcite. A limited number of carbonate and/or iron-oxide filled microfractures are also visible through the stereographic microscope. No significant changes were noted during testing other than the development of faint oxidation staining on the slab surface as noted above.
Slab 2 (30018-2) Good Quality White Rock Tap Water	i=4,366.1 f=4,359.6	-6.5g -.15%	The Slab 2 sample is an angular, quarried piece of good quality white rock (marble). The slab is approximately 2-1/2-inches thick, with general dimensions of about 7-1/2 inches by 8 inches. Some of the slab edges are semi-planar and may coincide with jointing patterns within the rock. The rock is generally white to light gray in color, with limited light reddish-brown oxidation staining. The rock generally appears to be fresh to slightly weathered, very strong, and very hard. Subtle layering defined by alternating bands of lighter and darker minerals is visible in the slab surface. Prior to testing, oxidation was limited to sporadic staining on some of the slab edges and some fracture filling. Faint oxidation staining gradually developed on the slab surface during testing. Slab 2 exhibits a few readily visible fractures with a maximum width of about 1/16 inch. Fracture filling material is primarily calcite and iron-oxide. A limited number of carbonate and/or iron-oxide filled microfractures are also visible through the stereographic microscope. No significant changes were noted during testing other than the development of faint oxidation staining on the slab surface as noted above, and the loss of very minor amounts of material from the slab edges.
Slab 3 (30018-3) Good Quality Gold Rock Tap Water	i=3,768.1 f=3,755.5	-12.6g -.33%	The Slab 3 sample is an angular, quarried piece of good quality gold rock (marble). The slab is approximately 2-1/2-inches thick, with general dimensions of about 7 inches by 6 inches. Some of the slab edges are semi-planar and may coincide with jointing patterns within the rock. The rock is generally gold to grayish-white to light brown in color, with some dark reddish-brown oxidation staining. The rock generally appears to be slightly weathered, very strong, and very hard. Subtle layering defined by alternating bands of lighter and darker minerals is visible in some areas of the slab surface. About 1/3 of the slab surface also has numerous small, closely spaced voids ranging up to about 1/16 inch. Similar voids ranging up to about 1/8 inch are also exposed on the slab edge adjacent to the slab surface voids. Oxidation staining is extensive on the slab edges, and also occurs as limited fracture filling. Slab 3 exhibits a few readily visible, continuous and discontinuous fractures with a maximum width of about 1/32 inch. Fracture filling material is primarily calcite and iron-oxide. Several carbonate and/or iron-oxide filled microfractures are also visible through the stereographic microscope. No significant changes were noted during testing other than the loss of very minor amounts of material from the slab edges.
Slab 4 (30018-4) Good Quality Gold Rock Tap Water	i=4,201.3 f=4,203.2	+1.9g +.05%	The Slab 4 sample is an angular, quarried piece of good quality gold rock (marble). The slab is approximately 2-1/2-inches thick, with general dimensions of about 9 inches by 6 inches. Some of the slab edges are semi-planar and may coincide with jointing patterns within the rock. The rock is generally gold to medium gray in color, with some reddish-brown oxidation staining. The rock generally appears to be slightly weathered, very strong, and very hard. The slab surface exhibits a splotchy texture lacking well-defined layering. Oxidation staining is variable on the slab edges, and also occurs as relatively limited fracture filling. Slab 4 exhibits several readily visible, continuous and discontinuous fractures with a maximum width of about 1/32 inch. Fracture filling material is primarily calcite and iron-oxide. Several carbonate and/or iron-oxide filled microfractures are also visible through the stereographic microscope. No significant changes were noted during testing.

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Table 3
Lab No. 30019
Poor Quality White and Gold Rock
Wetting and Drying Test Detailed Descriptions

Sample ID/Bath Type	Initial/ Final Weight (grams)	Weight/ Percent Change	Description
Slab 5 (30019-1) Poor Quality White Rock Tap Water	i=3,071.2 f=3,071.8	+.6g +.02%	The Slab 5 sample is an angular, quarried piece of poor quality white rock (marble). The slab is approximately 2-1/2-inches thick, with general dimensions of about 6 inches by 5 inches. Some of the slab edges are semi-planar and may coincide with jointing patterns within the rock. The rock is generally white to medium gray in color, with limited light reddish-brown oxidation staining. The rock generally appears to be slightly weathered, strong, and very hard. Subtle layering defined by alternating bands of lighter and darker minerals is visible in the slab surface. Oxidation occurs as variable staining on some of the slab edges and as fracture filling. Slab 5 exhibits a few readily visible, continuous and discontinuous fractures with a maximum width of about 1/16 inch. Fracture filling material is primarily calcite and iron-oxide. Several carbonate and/or iron-oxide filled microfractures are also visible through the stereographic microscope. No significant changes were noted during testing.
Slab 6 (30019-2) Poor Quality White Rock Tap Water	i=5,096.4 f=5,096.7	+.3g +.01%	The Slab 6 sample is an angular, quarried piece of poor quality white rock (marble). The slab is approximately 2-1/2-inches thick, with general dimensions of about 8 inches by 7 inches. Some of the slab edges are semi-planar and may coincide with jointing patterns within the rock. The rock is generally white to medium gray to dark brown in color. The rock generally appears to be slightly to moderately weathered, strong, and very hard. The slab surface exhibits a somewhat splotchy texture lacking well-defined layering. Oxidation occurs as variable but fairly extensive staining on some of the slab edges as well as along fractures as described below. Slab 6 exhibits numerous irregular and/or cross-cutting fractures with a maximum width of about 1/16 inch. Extensive dark brown oxidation is present within and adjacent to the fractures. Some carbonate fracture filling is also present. Numerous carbonate and/or iron-oxide filled microfractures are also visible through the stereographic microscope. No significant changes were noted during testing.
Slab 7 (30019-3) Poor Quality Gold Rock Tap Water	i=3,884.1 f=3,886.1	+2g .05%	The Slab 7 sample is an angular, quarried piece of poor quality gold rock (marble). The slab is approximately 2-1/2-inches thick, with general dimensions of about 9 inches by 5 inches. Some of the slab edges are semi-planar and may coincide with jointing patterns within the rock. The rock is generally gold to dark brown in color. The rock generally appears to be moderately weathered, strong, and very hard. The slab surface and slab edges exhibit an irregular texture dominated by fracturing and oxidation. The surface of Slab 7 is riddled with abundant irregular and/or cross-cutting fractures. Extensive dark brown oxidation is present within and adjacent to the fractures, with the total width of the oxidized zones ranging up to about 1/4 inch. Some carbonate fracture filling is also present, primarily in narrow, discontinuous fractures. Numerous carbonate and/or iron-oxide filled microfractures are also visible through the stereographic microscope. No significant changes were noted during testing.
Slab 8 (30019-4) Poor Quality Gold Rock Tap Water	i=3,888.4 f=3,891.4	+3g +.08%	The Slab 8 sample is an angular, quarried piece of poor quality gold rock (marble). The slab is approximately 2-1/2-inches thick, with general dimensions of about 8 inches by 8 inches. The rock is generally gold to dark brown in color. The rock generally appears to be moderately weathered, strong, and very hard. The slab surface and slab edges exhibit an irregular texture dominated by fracturing and oxidation. The surface of Slab 8 is riddled with abundant irregular and/or cross-cutting fractures. Extensive dark brown oxidation is present within and adjacent to the fractures, with the total width of the oxidized zones ranging up to about 1/2 inch. In some areas the fractures form a mosaic-like pattern defined by numerous randomly oriented fractures. Some irregular, carbonate-filled fractures generally ranging up to about 1/8 in width are also present. Numerous carbonate and/or iron-oxide filled microfractures are visible through the stereographic microscope. A few scattered voids were observed in the slab surface. The largest void has a width of about 1/4 inch and is lined with euhedral carbonate crystals. No significant changes were noted during testing.

APPENDIX B
TEST RESULTS

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PHYSICAL PROPERTIES OF AGGREGATES

PROJECT:	Fort Irwin Rip Rap	LAB NO.:	29043	JOB NO.:	5015150017.01
LOCATION:	Barstow, Ca.	SAMPLED BY:	Ninyo & Moore	DATE:	02/19/15
CLIENT:	Best Rock Quarry	SUBMITTED BY:	S. Martin	DATE:	04/14/15
TYPE:	Good Quality Rock	AUTHORIZED BY:	S. Martin	DATE:	04/14/15
SOURCE:	Best Rock Quarry	REVIEWED BY:	L. Collins	REPORT DATE:	05/08/15

SIEVE SIZE	% PASSING	SPECIFICATION	TEST		RESULT	SPECIFICATION	TEST STANDARD
4”							
3”							
2”							
1-1/2”							
1-1/8”							
1”			Resistance to Abrasion	% Wear, rev			C535 (mod)*
3/4”				% Wear, 200 rev	8.0		
1/2”				% Wear, 500 rev	<20**	≤20	
3/8”				%Wear, 1000 rev	29.7		
1/4”							
No. 4			Fractured Faces, % by Wt./Cnt.		/		
8							
10			Durability				
16							
30							
40							
50			Specific Gravity	Absorption, %	0.754	≤2.0%	C127 (mod)*
100				Bulk (Dry)	2.688		
200				Bulk (SSD)	2.708	≥2.65	
				Apparent	2.743		

*Test modified per USACE project specifications. Testing performed on approximately 3” to 4” rock rather than ASTM C535 gradation.
**Interpolated from % wear at 200 revolutions and 1,000 revolutions based on wear rates.

Submitted by:

Michael P. Farr, CEG #1938
Principal Engineering Geologist

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PHYSICAL PROPERTIES OF AGGREGATES

PROJECT:	Fort Irwin Rip Rap	LAB NO.:	29044	JOB NO.:	5015150017.01
LOCATION:	Barstow, Ca.	SAMPLED BY:	Ninyo & Moore	DATE:	02/19/15
CLIENT:	Best Rock Quarry	SUBMITTED BY:	S. Martin	DATE:	04/14/15
TYPE:	Poor Quality Rock	AUTHORIZED BY:	S. Martin	DATE:	04/14/15
SOURCE:	Best Rock Quarry	REVIEWED BY:	L. Collins	REPORT DATE:	05/08/15

SIEVE SIZE	% PASSING	SPECIFICATION	TEST		RESULT	SPECIFICATION	TEST STANDARD
4”							
3”							
2”							
1-1/2”							
1-1/8”							
1”			Resistance to Abrasion	% Wear, rev			C535 (mod)*
3/4”				% Wear, 200 rev	15.0		
1/2”				% Wear, 500 rev	>20**	≤20	
3/8”				%Wear, 1000 rev	35.4		
1/4”							
No. 4			Fractured Faces, % by Wt./Cnt.		/		
8							
10			Durability				
16							
30							
40							
50			Specific Gravity	Absorption, %	1.462	≤2.0%	C127 (mod)*
100				Bulk (Dry)	2.661		
200				Bulk (SSD)	2.700	≥2.65	
				Apparent	2.769		

*Test modified per USACE project specifications. Testing performed on approximately 3” to 4” rock rather than ASTM C535 gradation.
**Interpolated from % wear at 200 revolutions and 1,000 revolutions based on wear rates.

Submitted by:

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PHYSICAL PROPERTIES OF AGGREGATES
SOUNDNESS OF AGGREGATE, MAGNESIUM SULFATE
Method ASTM C88 (modified)*

PROJECT: Fort Irwin Rip Rap	PROJECT NO.: 5015150017.01		
LOCATION: Barstow, Ca.	LAB NO.: 29043		
CIENT: Best Rock Quarry	SAMPLED BY:	Ninyo & Moore	DATE: 02/19/15
SAMPLE ID: Good Quality Rock	SUBMITTED BY:	S. Martin	DATE: 04/14/15
SOURCE: Best Rock Quarry	AUTHORIZED BY:	S. Martin	DATE: 04/14/15
	REPORT DATE: 05/8/15		

TABLE 1

Sieve Size	Grading of Original Sample %	Weight of Test Fractions Before Test, g	Percentage Passing Designated Sieve After Test	Weighted Percentage Loss
Soundness Test of Fine Aggregate				
Minus 150 µm (No. 100)				
300 µm (No. 50) to No. 100				
600 µm (No. 30) to No. 50				
1.18 mm (No. 16) to No. 30				
2.36 mm (No. 8) to No. 16				
4.75 mm (No. 4) to No. 8				
9.5 mm (⅜ in.) to No. 4				
Totals				
Soundness Test of Coarse Aggregate				
*4 in. to 3 in. (rough grading)		21,350	1.0	1.0
63 mm (2 ½ in.) to 50 mm (2 in.)				
50 mm (2 in.) to 37.5 mm (1 ½ in.) to 25.0 mm (1 in.)				
37.5 mm (1 ½ in.) to 25.0 mm (1 in.)				
25 mm (1 in.) to 19.0 mm (3/4 in.)				
Totals				**1.0***

**The test method was performed in general accordance of ASTM C88, except the samples consisted of one size which was visually separated to include material that was approximately 3" x 4" per USACE project specifications. The loss was calculated by loss of weight after testing of the aggregate and the remaining material was loosely passed over the 3" sieve. USACE project specifications provided to us by the client call for a weight loss of no more than 10%.*

Submitted by:

Michael P. Farr, CEG #1938
Principal Engineering Geologist

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PHYSICAL PROPERTIES OF AGGREGATES
SOUNDNESS OF AGGREGATE, MAGNESIUM SULFATE
Method ASTM C88 (modified)*

PROJECT: Fort Irwin Rip Rap	PROJECT NO.: 5015150017.01
LOCATION: Barstow, Ca.	LAB NO.: 29044
CIENT: Best Rock Quarry	SAMPLED BY: Ninyo & Moore DATE: 02/19/15
SAMPLE ID: Poor Quality Rock	SUBMITTED BY: S. Maritn DATE: 04/14/15
SOURCE: Best Rock Quarry	AUTHORIZED BY: S. Martin DATE: 04/14/15
	REPORT DATE: 05/11/15

TABLE 1

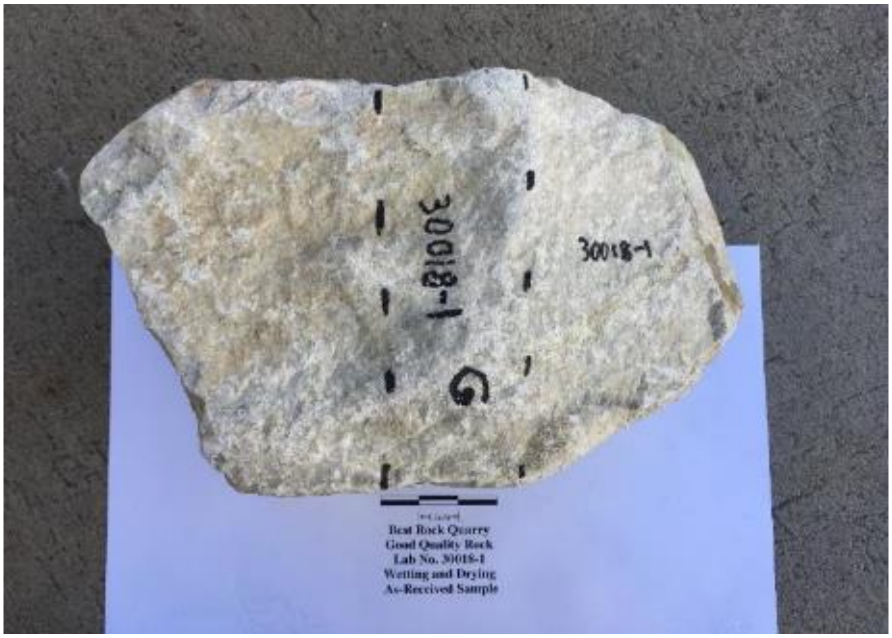
Sieve Size	Grading of Original Sample %	Weight of Test Fractions Before Test, g	Percentage Passing Designated Sieve After Test	Weighted Percentage Loss
Soundness Test of Fine Aggregate				
Minus 150 µm (No. 100)				
300 µm (No. 50) to No. 100				
600 µm (No. 30) to No. 50				
1.18 mm (No. 16) to No. 30				
2.36 mm (No. 8) to No. 16				
4.75 mm (No. 4) to No. 8				
Totals				
Soundness Test of Coarse Aggregate				
*4 in. to 3 in. (rough grading)		21,350	25.1	25.1
63 mm (2 ½ in.) to 50 mm (2 in.)				
50 mm (2 in.) to 37.5 mm (1 ½ in.) to 25.0 mm (1 in.)				
37.5 mm (1 ½ in.) to 25.0 mm (1 in.)				
Totals				**25.1***

**The test method was performed in general accordance of ASTM C88, except the samples consisted of one size which was visually separated to include material that was approximately 3" x 4" per USACE specifications. The loss was calculated by loss of weight after testing of the aggregate and the remaining material was loosely passed over the 3" sieve. USACE project specifications provided to us by the client call for a weight loss of no more than 10%.*

Submitted by:

Michael P. Farr, CEG #1938
Principal Engineering Geologist

APPENDIX C
PHOTOGRAPHS

Photograph #1	Remarks
	Wetting and drying test (ASTM D5313-12), good quality sample, white rock, as-received sample for Slab 1 (30018-1). Black dashed lines indicate approximate location of cuts for test slabs.

Photograph #2	Remarks
	Wetting and drying test (ASTM D5313-12), good quality sample, white rock, as-received sample for Slab 2 (30018-2). Black dashed lines indicate approximate location of cuts for test slabs.

Photograph #3	Remarks
	Wetting and drying test (ASTM D5313-12), good quality sample, gold rock, as-received sample for Slab 3 (30018-3).

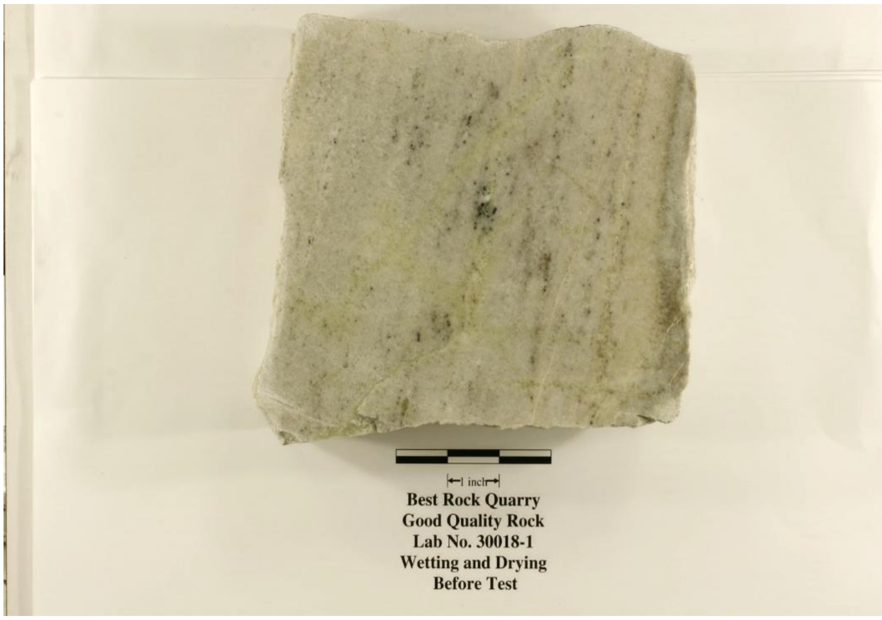
Photograph #4	Remarks
	Wetting and drying test (ASTM D5313-12), good quality sample, gold rock, as-received sample for Slab 4 (30018-4). Black dashed lines indicate approximate location of cuts for test slabs.

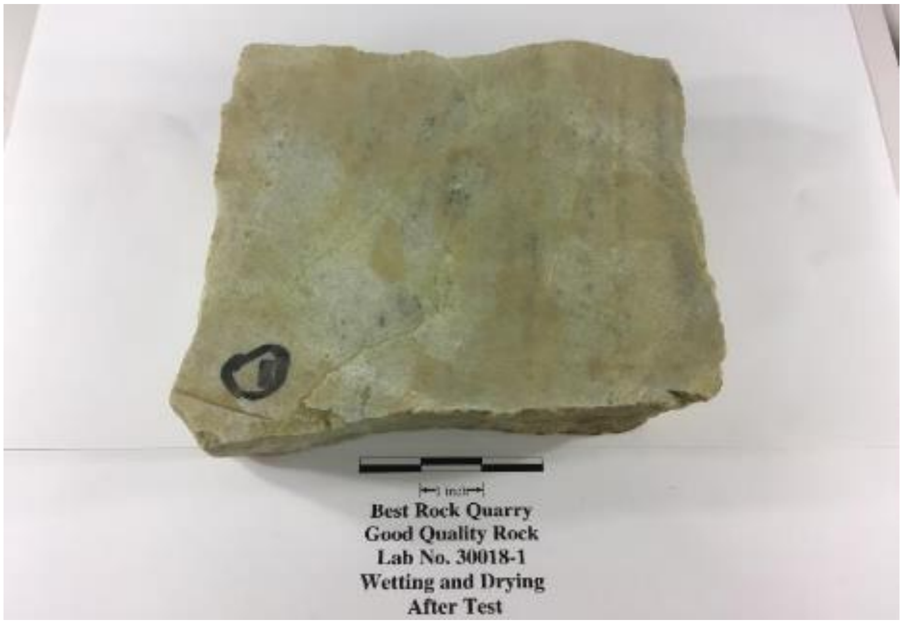
Photograph #5	Remarks
	Wetting and drying test (ASTM D5313-12), poor quality sample, white rock, as-received sample for Slab 5 (30019-1). Black dashed lines indicate approximate location of cuts for test slabs.

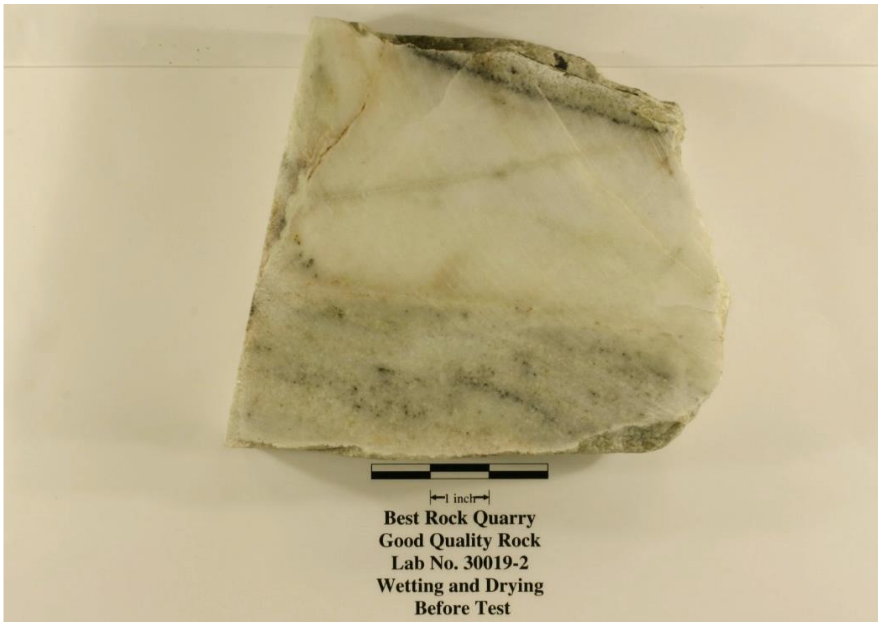
Photograph #6	Remarks
	Wetting and drying test (ASTM D5313-12), poor quality sample, white rock, as-received sample for Slab 6 (30019-2). Black dashed lines indicate approximate location of cuts for test slabs.

Photograph #7	Remarks
	Wetting and drying test (ASTM D5313-12), poor quality sample, gold rock, as-received sample for Slab 7 (30019-3). Black dashed lines indicate approximate location of cuts for test slabs.

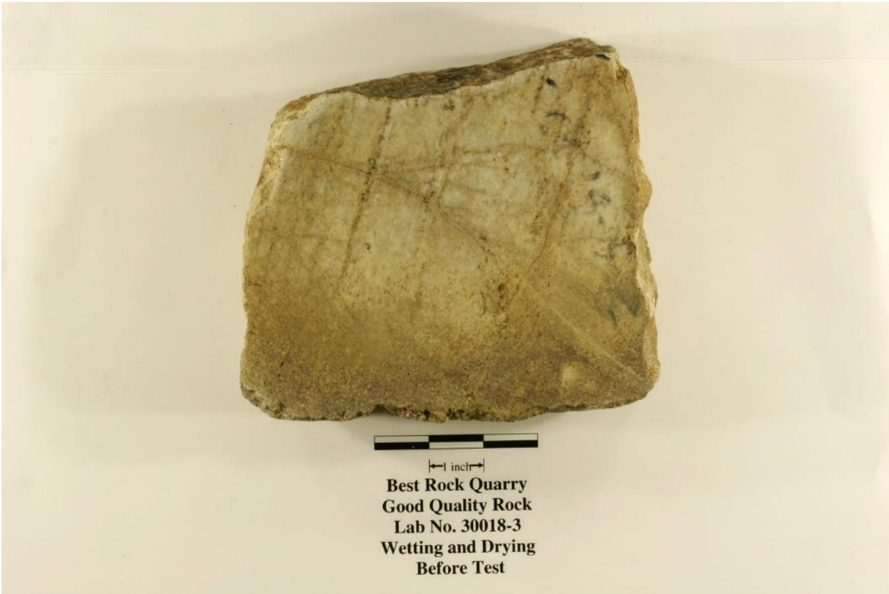
Photograph #8	Remarks
	Wetting and drying test (ASTM D5313-12), poor quality sample, gold rock, as-received sample for Slab 8 (30019-4). Black dashed lines indicate approximate location of cuts for test slabs.

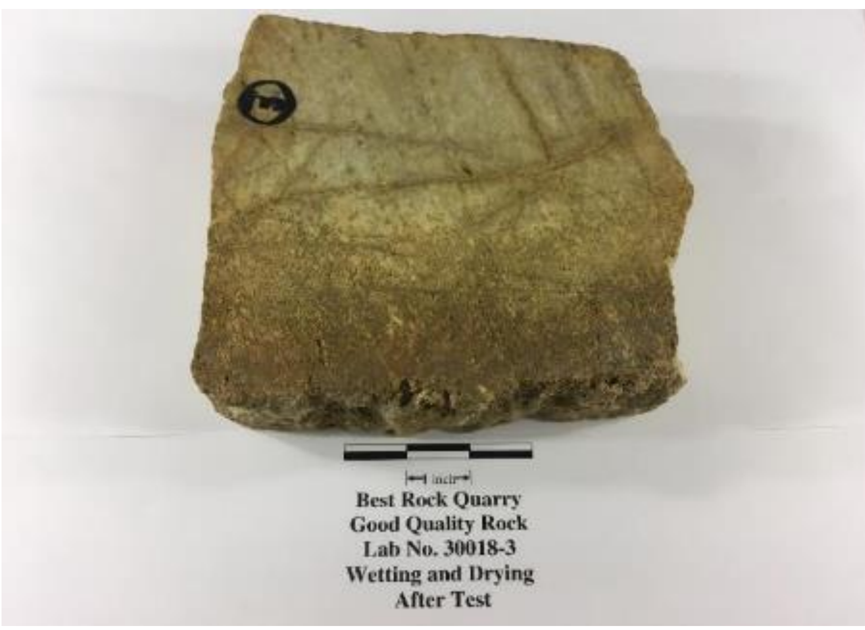
Photograph #9	Remarks
	Wetting and drying test (ASTM D5313-12), good quality sample, Slab 1 (30018-1), white rock, before testing.

Photograph #10	Remarks
	Wetting and drying test (ASTM D5313-12), good quality sample, Slab 1 (30018-1), white rock, after testing.

Photograph #11	Remarks
	Wetting and drying test (ASTM D5313-12), good quality sample, Slab 2 (30018-2), white rock, before testing. (Note: lab number in photo should be 30018-2)

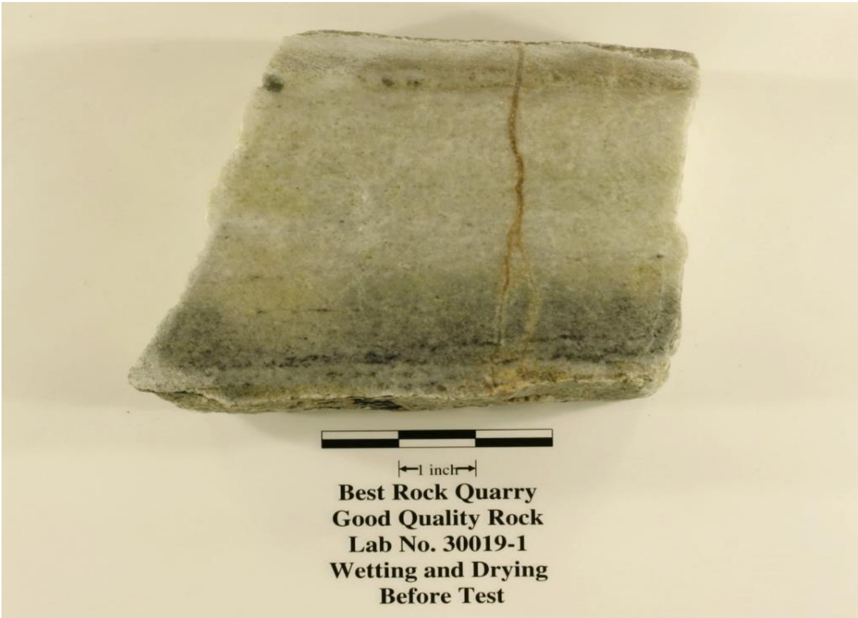
Photograph #12	Remarks
	Wetting and drying test (ASTM D5313-12), good quality sample, Slab 2 (30018-2), white rock, after testing.

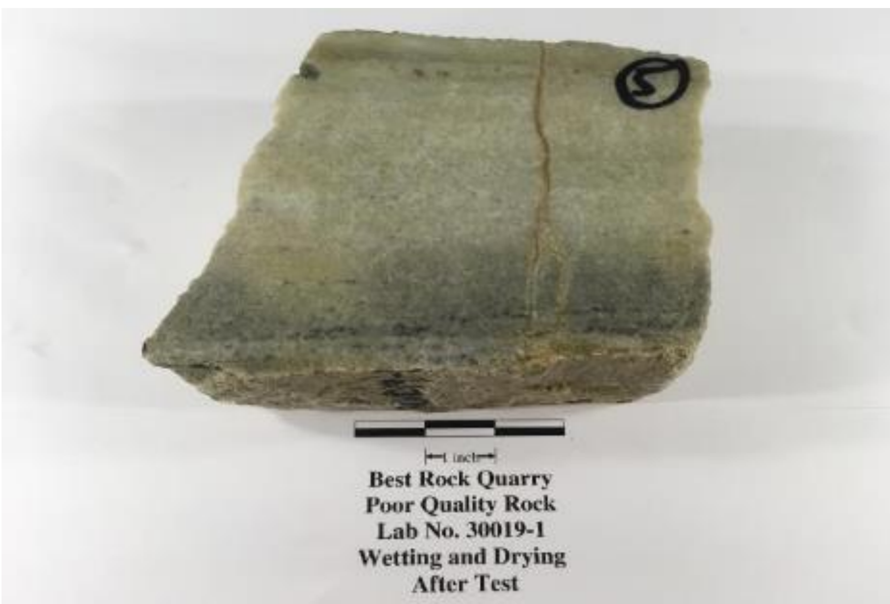
Photograph #13	Remarks
	Wetting and drying test (ASTM D5313-12), good quality sample, Slab 3 (30018-3), gold rock, before testing.

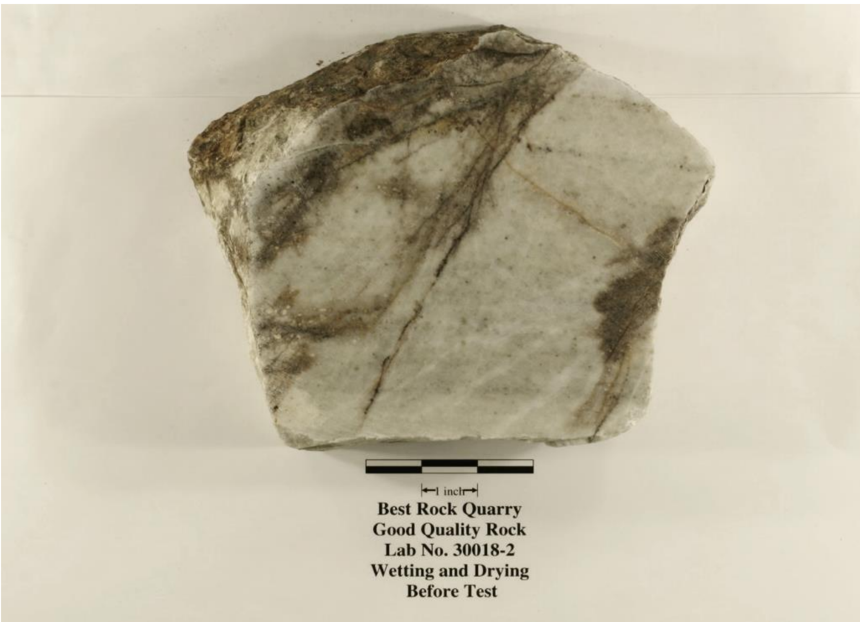
Photograph #14	Remarks
	Wetting and drying test (ASTM D5313-12), good quality sample, Slab 3 (30018-3), gold rock, after testing.

Photograph #15	Remarks
	Wetting and drying test (ASTM D5313-12), good quality sample, Slab 4 (30018-4), gold rock, before testing.

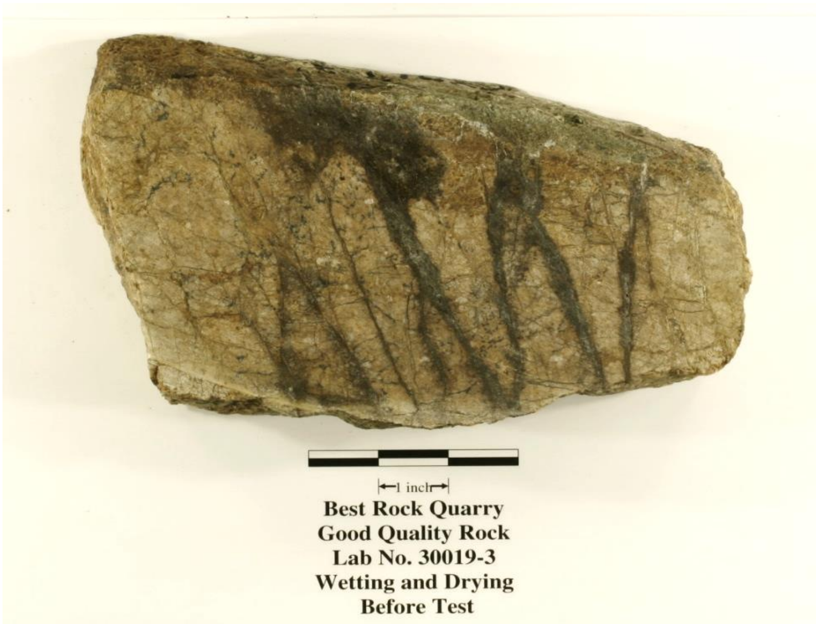
Photograph #16	Remarks
	Wetting and drying test (ASTM D5313-12), good quality sample, Slab 4 (30018-4), gold rock, after testing.

Photograph #17	Remarks
	Wetting and drying test (ASTM D5313-12), poor quality sample, Slab 5 (30019-1), white rock, before testing. (Note: label in photo should say "Poor Quality Rock"

Photograph #18	Remarks
	Wetting and drying test (ASTM D5313-12), poor quality sample, Slab 5 (30019-1), white rock, after testing.

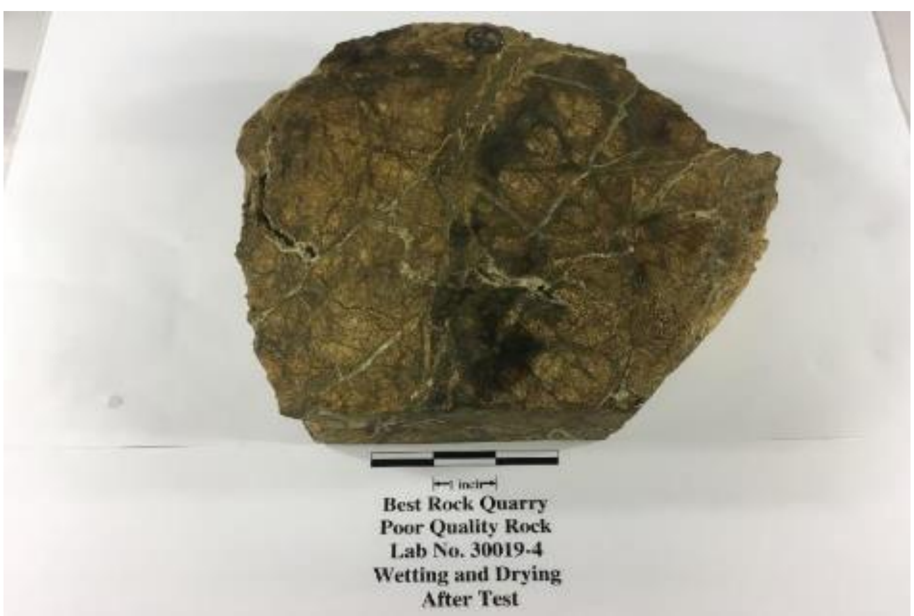
Photograph #19	Remarks
	Wetting and drying test (ASTM D5313-12), poor quality sample, Slab 6 (30019-2), white rock, before testing. (Note: label in photo should say "Poor Quality Rock", lab number should be 30019-2)

Photograph #20	Remarks
	Wetting and drying test (ASTM D5313-12), poor quality sample, Slab 6 (30019-2), white rock, after testing.

Photograph #21	**Remarks**
	Wetting and drying test (ASTM D5313-12), poor quality sample, Slab 7 (30019-3), gold rock, before testing. (Note: label in photo should say "Poor Quality Rock"

Photograph #22	**Remarks**
	Wetting and drying test (ASTM D5313-12), poor quality sample, Slab 7 (30019-3), gold rock, after testing.

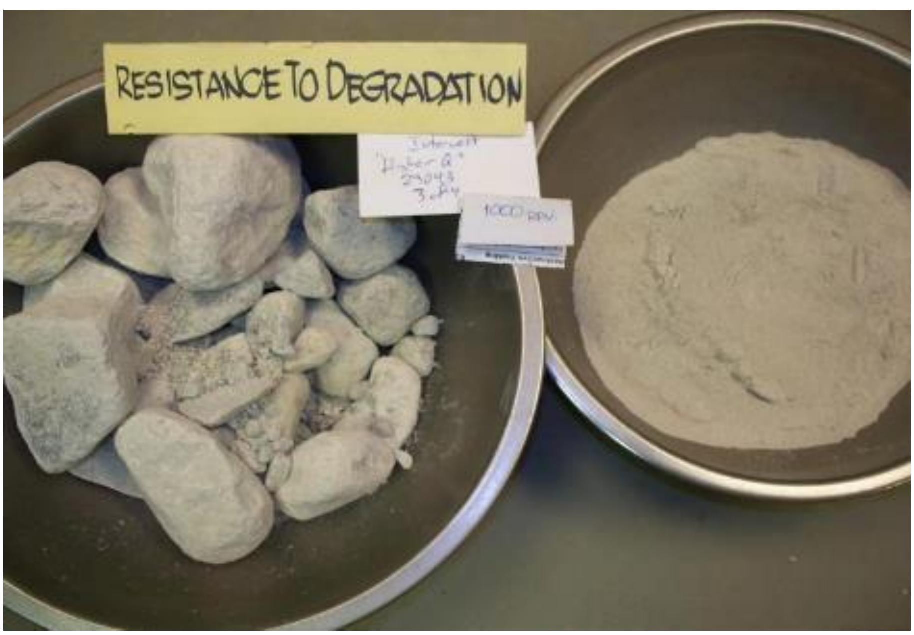
Photograph #23	Remarks
	Wetting and drying test (ASTM D5313-12), poor quality sample, Slab 8 (30019-4), gold rock, before testing. (Note: label in photo should say “Poor Quality Rock”

Photograph #24	Remarks
	Wetting and drying test (ASTM D5313-12), poor quality sample, Slab 8 (30019-4), gold rock, after testing.

Photograph #25	Remarks
	Magnesium sulfate soundness (ASTM C88-13), good quality rock (29043), before testing.

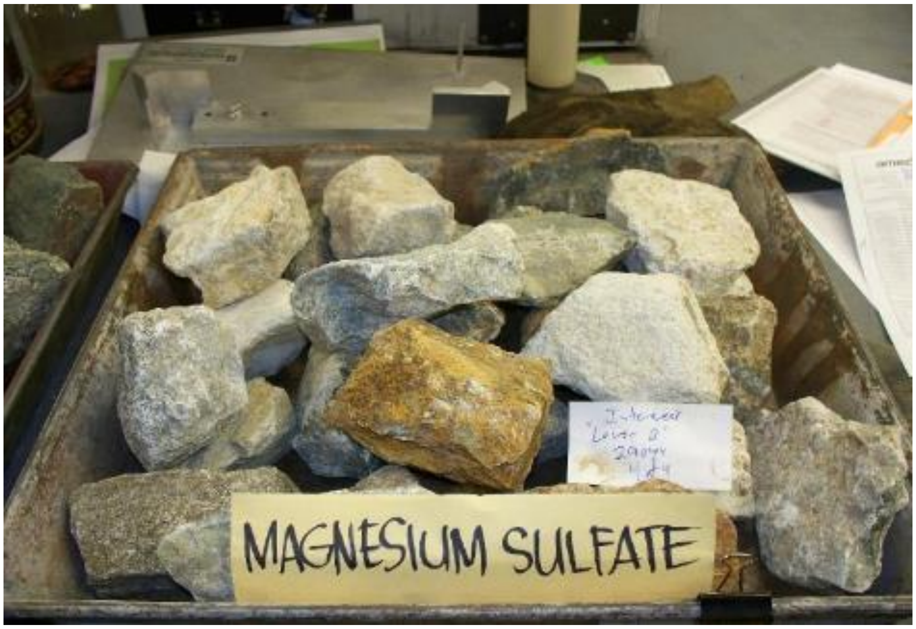
Photograph #26	Remarks
	Magnesium sulfate soundness (ASTM C88-13), good quality rock (29043), after testing.

Photograph #27	Remarks
	Abrasion loss (ASTM C535-12), good quality rock (29043), before testing.

Photograph #28	Remarks
	Abrasion loss (ASTM C535-12), good quality rock (29043), after testing.

Photograph #29	Remarks
	Specific gravity/absorption (ASTM C127-12), good quality rock (29043).

Photograph #30	Remarks
	Intentionally left blank (no "after" photograph taken for specific gravity—test has no effect on sample).

Photograph #31	**Remarks**
	Magnesium sulfate soundness (ASTM C88-13), poor quality rock (29044), before testing.

Photograph #32	**Remarks**
	Magnesium sulfate soundness (ASTM C88-13), poor quality rock (29044), after testing.

Photograph #33	Remarks
	Abrasion loss (ASTM C535-12), poor quality rock (29044), before testing.

Photograph #34	Remarks
	Abrasion loss (ASTM C535-12), poor quality rock (29044), after testing.

Photograph #35	Remarks
	Specific gravity/absorption (ASTM C127-12), poor quality rock (29044).

Photograph #36	Remarks
	Intentionally left blank (no "after" photograph taken for specific gravity—test has no effect on sample).