Date of Contact: February 13, 2017
Date of Report: March 2, 2017

STATE OF MINNESOTA - DEPARTMENT OF TRANSPORTATION

GEOTECHNICAL ENGINEERING SECTION

GEOLOGY CONTACT REPORT

Attendees:	Jason Richter,	Mn/DOT Chief Engineering Geologist
	Joe Hudak,	Mn/DOT Asst. Engineering Geologist
	Micah Holzbauer,	Mn/DOT Asst. Engineering Geologist
	Charlie Kramer,	MnDOT D-7 Materials Engineer
	Kyle Pattison,	Owner, Pattison Sand Company
	Chance Harvey,	Civil Engineer/Planning and Development, Pattison Sand Company
	Josh Sherman,	Mine Engineer/QC and Limestone Development, Pattison Sand Company
	Gary Zeidlike,	Retired/IADOT, Advisor to Pattison Sand Company

TYPE OF WORK: Quarry Investigation **Source #:** 93073

REASON FOR CONTACT: Assess proposed ledge per MnDOT 3601 (RipRap Material) and sample for IR testing.

Fig. 1: Photo of production ledge looking southwest.

A rip-rap analysis was requested by Charlie Kramer for the Pattison Sand Company (Figure 1). The aggregate source is owned and operated by Kyle Pattison of Clayton, IA. The analysis was undertaken by Jason Richter and assisted by Joe Hudak and Micah Holzbauer. The source is located approximately 1.5 miles southeast of Clayton, IA on CR56 in Clayton County. The newly excavated area is currently about 1 acre in size.

BACKGROUND:

According to Kyle Pattison, the property and business were established for agricultural purposes. In 1969, a river terminal was constructed to export grain. In 1983, the on-site silica sand operation was bought from Martin Marietta (mining had been taking place on the property since the 1800's). Pattison Sand Company began producing silica sand in 2008 with unit trains (100 cars) eventually shipping to PA, ND, TX. Surface and underground excavations are currently taking place in the St. Peter Sandstone which is being produced primarily for frack sand utilized in oil reservoir development. Currently, loading operations are blocking train traffic for up to 3 hours, thus, necessitating a rail switching system for on-site loading. A 3 to 4 year construction project is underway to align rail through the Pattison property. An estimated 98 million tons of carbonate bedrock will be available for aggregate production during excavations. Pattison Sand Company is interested in railing carbonate aggregate into MN market; Mathiowetz Construction has communicated interest in rip rap materials for projects in D7. Consequently, Charlie Kremer requested assistance from the Geology Unit in assessing this new, potential source. Pattison is also interested in producing aggregate for bituminous, concrete and base purposes.

OBSERVATIONS:

Observations of the source revealed a roughly 30 foot thick blasted ledge face (Figure 2). The upper 8 to 10 of the exposed ledge is comprised of thin bedded, weathered/iron oxidized dolostone and dolostone variants which are stripped and separated from rip rap production. This stripping ledge is locally described as a 'transition zone' present between overlying St. Peter Sandstone and underlying Oneota Dolostone. According to Kyle Pattison, the St. Peter Sandstone is unusually thick in this area (>200 feet) suggesting that the 'transition zone' may be a stunted equivalent of the Shakopee Formation, specifically, the New Richmond Member. Thorough inspections of this uppermost ledge were not performed mainly due to poor access.

Fig. 2: Photo of portion of production ledge showing fresh dolostone and upper, weathered dolostone stripping ledge (separated by black line)

The lower 22 feet of exposed production ledge is comprised of dolostone belonging to the Oneota Formation. Characterization and discernment of the various beds within the production ledge was hampered by the presence of a thin film of silt coating much of the faces following blasting. However, the dolostone appears to be mostly fresh, crystalline and mostly thin bedded (0.5' to 1.0') with some medium beds (1' to 3'). High compressive strengths are inferred from this ledge material based on the level of difficulty experienced while attempting to fragment with a sledge hammer. The lower 6.5', as well as some scattered beds/zones, are vuggy with iron oxidation; some high angle joint faces also show iron oxidation. A 6-inch thick bed of argillaceous dolostone was visible between 3.5' and 4.0'. Pockets of coarse calcite were visible in some of the rip rap sized particles in a nearby stockpile.

Fig. 3: Photo of dolostone particle in muckpile

Individual beds from the exposed Oneota Formation (lower 22') were identified and measured by Jason Richter and sampled by Geology Unit personnel for insoluble residue testing (Figures 3 and 4). Accessing sample sites was accomplished by climbing muckpiles along the exposed ledge face and via cherry picker (for higher elevation sites). Consequently, sampling was performed at diverse locations along the face as opposed to being confined to one vertical section, such as along the quarry tape. Pattison Sand Company will submit samples to a certified lab which will prepare the samples and perform the MnDOT-modified insoluble residue test as specified in the MnDOT Laboratory Manual.

RECOMMENDATION:

The presence of mostly fresh, crystalline, thin to medium bedded and strong Oneota Dolostone present in the lower production ledge suggests that favorable performance can be expected for rip rap applications. Thin beds/seams of freeze-thaw susceptible material did not appear to be prevalent in this ledge. Cracks resulting from the crushing process did not appear to be prevalent in stockpiled rip rap particles. Observations of the stockpiles and bedding thicknesses suggest that, at least, Class III is likely attainable. Pattison personnel were also adamant that the upper stripping ledge would not be included during rip rap production. UPDATE (March 27, 2017): Insoluble residue test results reveal passing -#200 results with all samples registering below 2% by mass (10% max per MnDOT spec. 3601.2A.1(4)) (see attached 'Report of Chemical Analyses). Pattison should be aware that despite these observations and test results, quality and gradation expectations must be maintained during rip-rap production.

Pattison personnel also mentioned that they may pursue production for concrete, bituminous and base applications. Again, observations of the blasted faces and rip rap stockpiles (as well as passing insoluble residue results) suggest that new source testing on the same Oneota/production ledge would likely yield favorable results. If pursued, then a Class B rating would be assigned to material produced from the Oneota/production ledge per Mn/DOT specifications 2360.2, 3137.2 and 3139.2. Lithologies in the overlying stripping ledge are technically unknown but, from a distance, appeared to be mostly dolostone and dolostone variants which would also qualify as Class B material. However, depending on the proposed application the degree of weathering in the stripping ledge in addition to unknown deleterious lithologies could compromise and/or yield failing results with respect to one or all of the following aggregate test methods: absorption, insoluble residue, magnesium sulfate, LAR and lithological summary (particularly, % soft particles). Though not well-observed, chert is typically found as nodules scattered within the Oneota Formation; it is possible that unsound chert is present in amounts which could exceed specifications for concrete usage. Pattison has been advised to follow MnDOT's new source testing procedures if there is interest in producing aggregate for concrete and bituminous applications.

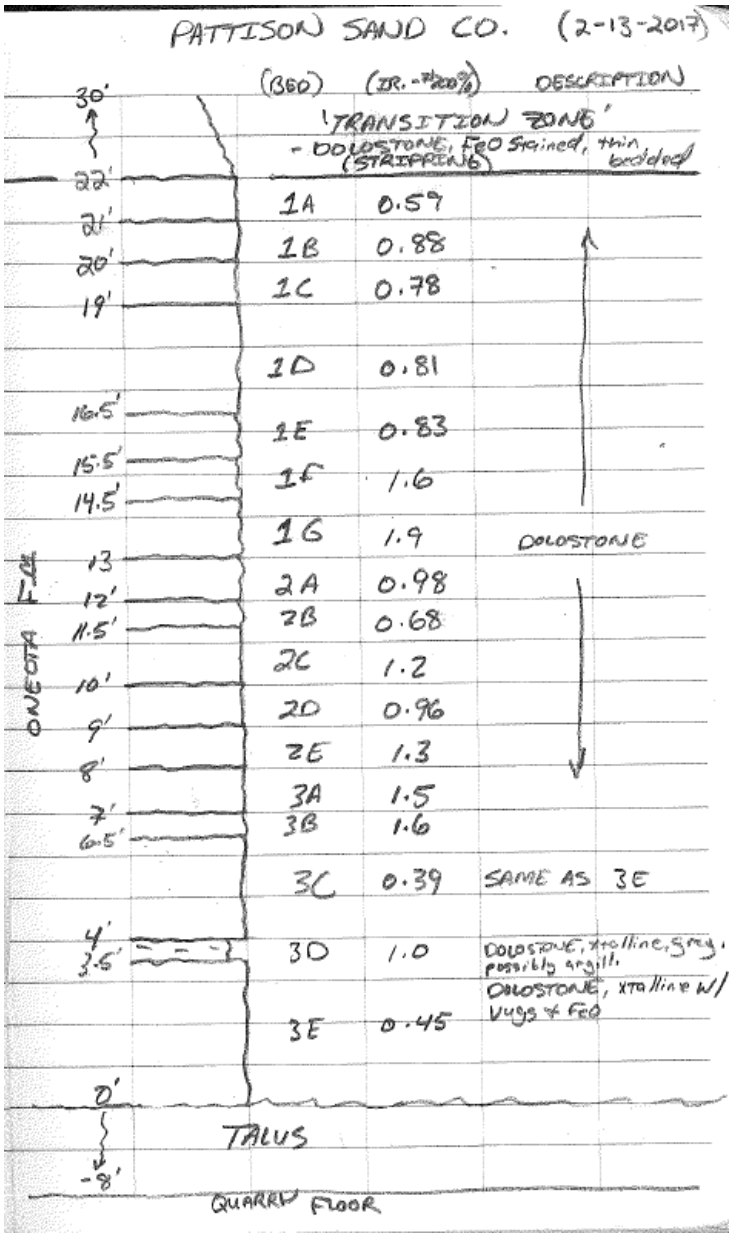

Fig. 4: Scan from field notebook showing delineated beds, bedding plane elevations (see quarry tape in Figure 2), insoluble residue results and bed descriptions (where acquirable).

By: Jason Richter, PG

Jason Richter
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AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
- ENVIRONMENTAL
- GEOTECHNICAL
- MATERIALS
- FORENSICS

REPORT OF CHEMICAL ANALYSIS

PROJECT:

MATERIAL CHECK
FRENCHTOWN ONEOTA O1A
PO NO. 007521

REPORTED TO:

PATTISON SAND, LLC
701 1ST STREET
CLAYTON, IA 52049

ATTN: JOSH SHERMAN

AET PROJECT NO: 24-02050

DATE: MARCH 24, 2017

INTRODUCTION

This report presents the results of laboratory work performed by our firm on seventeen (17) aggregate samples submitted to us by Josh Sherman of Pattison Sand, LLC on February 24, 2017. The scope of our work was limited to documenting the acid insoluble residue -75 µm (#200) fraction content of the samples in accordance with MnDOT 1221.0 "Determination of Acid Insoluble Residue in Limestone and Dolostone (MnDOT ASTM C3042 modified)."

TEST RESULTS

Insoluble Residue -75 µm (#200) fraction

Sample Identification	Triplicate Result %	% Insoluble Residue (avg)
1A	0.64 0.61 0.51	0.59
1B	0.98 0.87 0.79	0.88
1C	0.83 0.81 0.70	0.78
1D	0.82 0.87 0.72	0.81
1E	0.81 0.87 0.82	0.83

Sample Identification	Triplicate Result %	% Insoluble Residue (avg)
1F	1.6 1.6 1.6	1.6
1G	2.1 1.8 1.7	1.9
2A	1.0 0.9 1.0	0.98
2B	0.68 0.85 0.51	0.68
2C	1.1 1.1 1.2	1.2
2D	0.97 0.95 0.96	0.96
2E	1.1 1.3 1.5	1.3
3A	1.5 1.6 1.5	1.5
3B	1.7 1.5 1.5	1.6
3C	0.28 0.40 0.48	0.39
3D	1.0 0.96 1.1	1.0

Sample Identification	Triplicate Result %	% Insoluble Residue (avg)
3E	0.47	0.45
	0.38	
	0.51	

TEST PROCEDURES

Laboratory testing was performed on February 14, 2017 and subsequent dates following MnDOT 1221.0 "Determination of Acid Insoluble Residue in Limestone and Dolostone (MnDOT ASTM D3042 modified)". In triplicate, 100 grams of dried sample was placed in 2000 milliliter glass beaker. 500 milliliters of 6N hydrochloric acid was slowly added and stirred until no bubbling was apparent. The beaker was heated on hot plate to a gentle boil for 10 minutes and then allowed to cool. The sample was transferred through a # 200 US Standard Sieve with a pre weighed filter paper to collect the insoluble residue. The collected material was rinsed with water then dried to determine the insoluble residue on a dry basis. The reported value is an average of the triplicate analysis.

REMARKS

The test samples will be retained for a period of at least thirty days from the date of this report. Unless further instructions are received by that time, the samples may be discarded. The test result relates only to the samples tested. No warranty, express or implied, is made.

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