

Construction Specification 009 Rock Riprap

SCOPE

The work shall consist of testing, furnishing, transporting, and placing rock riprap, including filter, bedding or geotextile materials where specified, in the construction of loose rock riprap revetments, blankets, rock toes, crossings, rock chutes, channel linings and other similar structures.

QUALITY OF MATERIALS

The rock shall be obtained from tested sources unless exempted below. Rock sources used for streambank protection, lined waterways, rock chutes, or other similar major projects (Engineering Job Approval Authority Job Class II and greater) shall be tested prior to use. A test is required a minimum of every ten (10) years. The Technician may require a more current test.

Rock riprap from igneous or metamorphic origins such as granite, basalt, and quartzite may be used without testing. Dolomite from quarries within the map legend units shown in Figure 1 may also be used without testing:

- Dolomite (Sd) - all counties.
- Sinipee Group (Os) and Prairie du Chien (Opc) exempt only in the following counties: Marinette, Oconto, Shawano, Brown, Outagamie, Calumet, Winnebago, Green Lake, and Fond du Lac.

The Technician shall inspect and approve sources of these rock types prior to use and determine if testing is required.

Rock for equipment or cattle channel crossings, access roads, heavy use area protection or similar minor structures need not be tested.

Individual rock fragments shall be dense, sound and free from cracks, seams and other defects conducive to accelerated weathering. The rock fragments shall be angular to subrounded in shape. The least dimension of each individual rock fragment shall be not less than one-third the greatest dimension of the fragment. It should also be free from dirt, clay, sand, rock fines and other materials not meeting the gradation limits. Rock shall be excavated, selected and handled as necessary to meet the grading requirements stated in the construction plans.

Representative samples of rock requiring testing shall conform to the following requirements:

Bulk Specific Gravity (saturated surface-dry basis). Not less than 2.50 when tested in accordance with ASTM Specification C 127 on samples prepared as described for soundness testing.

Absorption. Not more than four (4.0) percent when tested in accordance with ASTM C 127 on samples prepared as described for soundness testing.

Soundness. The weight loss in five cycles shall not be more than 28 percent when tested by the sodium sulfate soundness test method in the modified ASTM C 88 or AASHTO T 104. Losses

in excess of 20 percent are acceptable only when the design D50 rock size has been increased by 10 percent for a loss of 20-23.9 percent or 20 percent for a loss of 24-28 percent.

METHODS OF TESTING

Bulk Specific Gravity and Absorption shall be determined by ASTM C 127 on samples prepared as described for rock cube soundness testing.

Rock Cube Soundness. Soundness testing shall be performed by ASTM C 88 for coarse aggregate modified as follows.

The sodium sulfate soundness test shall be performed on a test sample of 5000 ± 300 grams of rock fragments, reasonably uniform in size and cubical in shape and weighing, after sampling, approximately 100 grams each. The test sample shall be obtained from rock samples that are representative of the total rock mass, as noted in ASTM Specification D 4992, and that have been

sawed into slabs as described in ASTM Specification D 5121. The samples shall be further reduced in size by sawing the slabs into cubic blocks. The thickness of the slabs and the size of the sawed blocks shall be determined by the size of the available test apparatus and as necessary to provide, after sawing, the approximate 100 gram samples.

Due to internal defects, some of the cubes may break during the sawing process or during the initial soaking period. Cubes that break during this preparatory process shall not be tested. Such breakage, including an approximation of the percentage of cubes that break, shall be noted in the test report.

After the sample has been dried, following completion of the final test cycle and washing to remove the sodium sulfate, the loss of weight shall be determined by subtracting from the original weight

of the sample the final weight of all fragments which have not broken into three or more fragments. (Samples that break into three or more large fragments during testing will be assigned a final weight of 0.0.) The test report shall show the percentage loss of the weight. Photographic documentation of all samples before and after testing shall be part of the test report.

A rock source may be rejected if the rock from that source deteriorates in less than 5 years under similar use and exposure conditions expected for the rock to be installed under this specification, even though it meets the testing requirements stated above.

Deterioration is defined as the visual loss of more than one-quarter of the original rock volume, or severe cracking that would cause a rock to split.

GRADATION

The gradation of the rock riprap and filter or bedding material shall be as shown in the construction plans. Rock used for streambank protection, lined waterways, rock chutes, or other similar major projects (Engineering Job Approval Authority Job Class II and greater) shall have a gradation verification be done by one of the following methods. Method A Measurement of a random truck load of stone (reference sample) according to the procedure outlined in EFH-17, Procedure for Determining Rock Weights, Sizes, and Gradations; or ASTM D5519, Standard Test Methods for Particle Size Analysis of Natural and Man-Made Riprap Materials (Test Method A).

Method B

Creation of reference samples of rock of at least 0.5 tons, made according to the procedure outlined in EFH-17 (Tables 1 - 5), creating the envelope limits of the gradation specified.

Control of project gradation will be by visual inspection comparing rock delivered to the reference samples.

The reference sample(s) may be used as part of the finished riprap or remain at the quarry.

Any difference of opinion between the Technician and the Contractor shall be resolved by dumping and checking (by measurement) the gradation of a random truck load of stone by Method A. Mechanical equipment, a sorting site, and labor needed to assist in checking gradation shall be provided by the Contractor at no additional cost.

SUBGRADE PREPARATION

The subgrade surfaces on which the riprap, filter or bedding material is to be placed shall be cut or filled and graded to the lines and grades as shown on the drawings or as directed by the Technician. When fill to subgrade lines is required, it shall consist of approved materials and shall be compacted as specified in Wisconsin Construction Specification 3, Earthfill. Riprap, filter, bedding or geotextile shall not be placed until the foundation preparation is completed, and approved by the Technician.

FILTER AND BEDDING

Filter or bedding material, when required, shall be spread uniformly on the prepared subgrade surfaces to the depth shown on the drawings. The surfaces of the layers shall be finished reasonably free of mounds,

dips or windrows and shall meet the gradation shown on the plans or as specified in Wisconsin Construction Specification 8.

Geotextile, when required, shall meet the requirements shown on the drawings and as specified in Wisconsin Construction Specification 13, Geotextiles.

PLACING ROCK RIPRAP

The rock riprap shall be placed by equipment on the surfaces and to the depths specified. The rock riprap shall be installed to the full course thickness in one operation and in such a manner as to avoid displacement of underlying materials. The rock for riprap shall be delivered and placed in a manner that will ensure that the riprap in-place shall be reasonably homogeneous with the larger rocks uniformly distributed and firmly in contact one to another with the smaller rocks and spalls filling the voids between the larger rocks. Some hand placing may be required to provide a neat and uniform surface or to prevent damage to structures.

VEGETATED ROCK RIPRAP

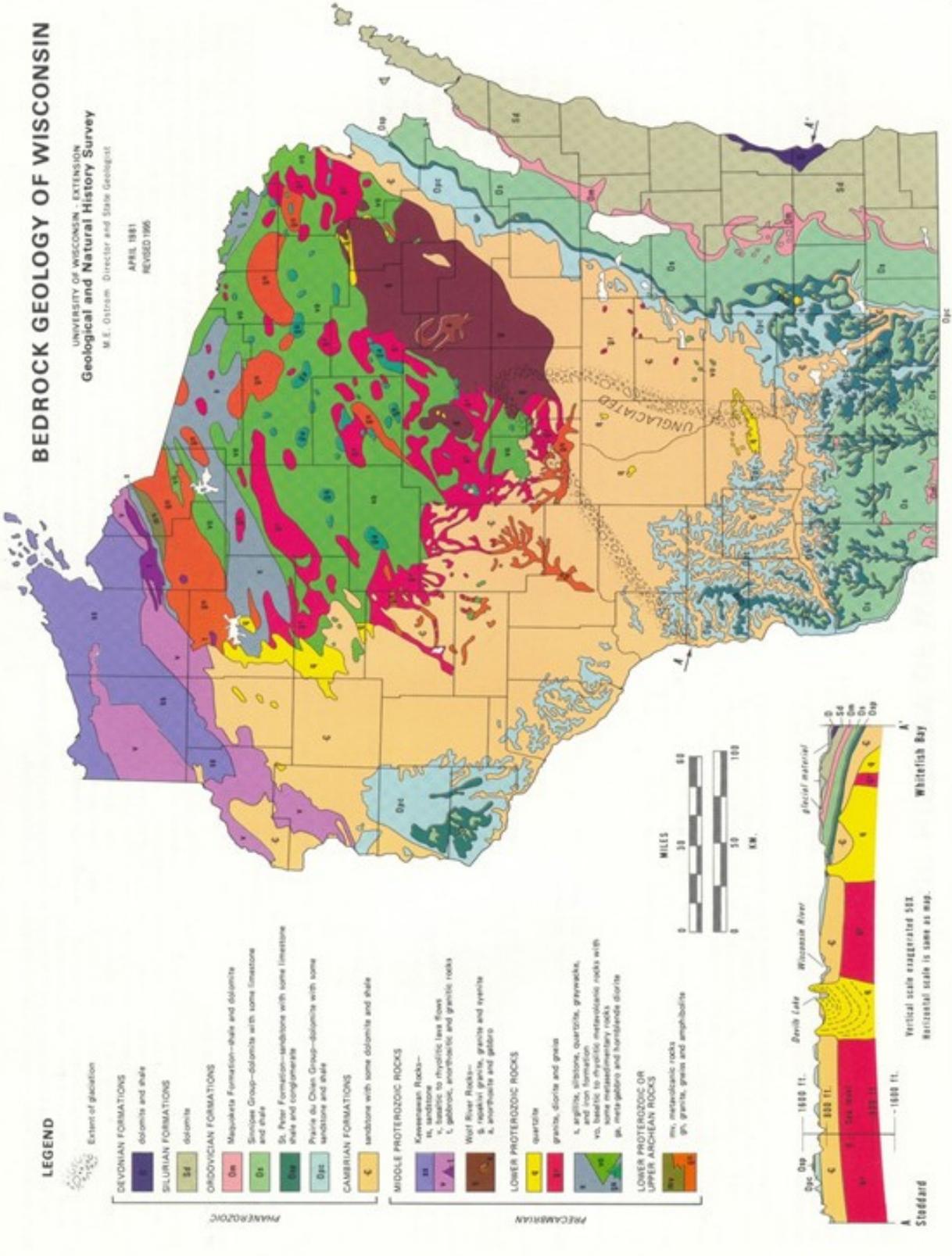
If the rock riprap is to be vegetated, topsoil shall be placed by equipment in the riprap voids (surface) and on the surface of the rock to the depth specified. The topsoil placement shall not take place before the placement of the rock riprap is approved by the Technician. Topsoil shall be placed in such a manner as to avoid displacement of the underlying rock.

The topsoil may extend from the top of the riprap down to the bankfull elevation (OHWM) or as shown on the drawings. Care shall be taken so topsoil is retained on the rock and is not allowed into the water body. The area shall be seeded and mulched within 12 hours following topsoil placement.

BEDROCK GEOLOGY OF WISCONSIN

UNIVERSITY OF WISCONSIN - EXTENSION
 Geological and Natural History Survey
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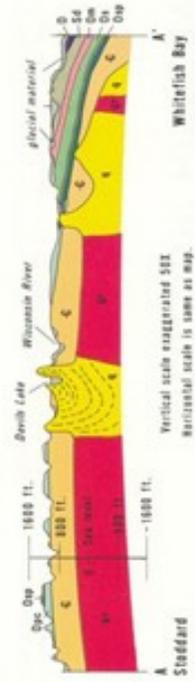
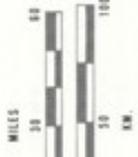
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LEGEND



- DEVONIAN FORMATIONS**
 - colombite and shale
- SILURIAN FORMATIONS**
 - S4 dolomite
- ORDOVICIAN FORMATIONS**
 - Os Mequonite Formation—shale and dolomite
 - Os Success Group—dolomite with some limestone and shale
 - Os St. Peter Formation—sandstone with some limestone shale and conglomerate
 - Os Prairie du Chien Group—dolomite with some sandstone and shale
- CAMBRIAN FORMATIONS**
 - C sandstone with some dolomite and shale
- MIDDLE PROTEROZOIC ROCKS**
 - Keweenaw Rocks—Ks sandstone, rhyolite lava flows, gabbro, amphibolite and gneissic rocks
 - Wolf River Rocks—Wg rhyolite, granite and syenite, amphibolite and gabbro
- LOWER PROTEROZOIC ROCKS**
 - quartzite
 - granite, diorite and gneiss
 - gabbro, diorite, quartzite, pyroxenite, and iron formation
 - vs. basaltic to rhyolitic mafic igneous rocks with some metamafic rocks
 - gn. meta-gabbro and hornblende diorite
- LOWER PROTEROZOIC OR UPPER ARCHEAN ROCKS**
 - ms, meta-igneous rocks
 - gn, granite, gneiss and amphibolite



Specific Site Requirements