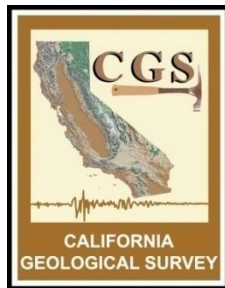


**MINERAL LAND CLASSIFICATION OF THE
POWER HOUSE AGGREGATE PROJECT SITE,
BUTTE COUNTY, CALIFORNIA – FOR
CONSTRUCTION AGGREGATE**

2010



**CALIFORNIA GEOLOGICAL SURVEY
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2010

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EXECUTIVE SUMMARY

In response to a petition submitted under the provisions of the Surface Mining and Reclamation Act of 1975 (SMARA; Public Resources Code § 2712 *et seq.*), the State Geologist has investigated and subsequently classified a portion of the Palermo Quadrangle, Butte County, as MRZ-2 for construction aggregate.

This study is an evaluation of the aggregate potential of the 460-acre Power House Aggregate Project site based on geologic and materials testing data provided by the petitioner. A field examination of the property was conducted on November 3, 2010.

This report explains the classification of the property and presents the conclusions reached in this study. It is intended for the use of the State Mining and Geology Board (SMGB), the petitioner—Granite Construction Company, and the County of Butte that has permitting authority over this property under SMARA.

For a mineral deposit to be considered significant, and therefore eligible for MRZ-2 classification, it must meet criteria established by the SMGB for material quality, marketability, and economic value. The significance of the resources was determined by evaluating the quality of the deposit and its suitability as a marketable commodity and by calculating the volume, tonnage, and value of available aggregate resources contained within the property. Data necessary to evaluate the property were compiled from geologic literature, proprietary company files, and limited field study by the California Geological Survey (CGS) staff.

It is concluded that:

- Aggregate test results provided by the petitioner and analyzed by CGS staff indicate that the material present on the Power House Aggregate Project site meet the specifications for a variety of construction aggregate uses up to and including PCC-grade aggregate.
- Aggregate resources present at the Power House Aggregate Project site exceed the minimum threshold value of \$17.1 million 2009-dollars established by the SMGB.
- The 460-acre Power House Aggregate Project site has been classified MRZ-2 for construction aggregate as shown on Figure 2 of this report.

INTRODUCTION

Background

This report was prepared in response to a petition received by the State Mining and Geology Board (SMGB) on July 27, 2010 from Granite Construction Company. The petition requested that a property, referred to as the Power House Aggregate Project, in southern Butte County be classified for construction aggregate resources under the provisions of the Surface Mining and Reclamation Act of 1975 (SMARA, Public Resources Code Section 2710 *et seq.*). The petition was transmitted to the State Geologist for preliminary evaluation to determine: 1) the quality of the economic-geologic data provided by the petitioner, 2) the likelihood of the property receiving the classification requested by the petitioner, and 3) if present or near-future land use in the immediate area indicates that Mineral Land Classification is advisable. After reviewing the State Geologist's preliminary evaluation, the SMGB accepted the petition on September 9, 2010.

A field examination of the Power House Aggregate Project site was conducted on November 3, 2010.

The study area includes 460 acres located about 7 miles south west of the City of Oroville and about 5 miles northeast of the City of Gridley in southern Butte County, California (see Figure 1). More specifically, the site is located directly to the east of the Feather River and west of the intersection of Power House Hill Road and State Highway 70 in an unincorporated area of Butte County. The site is in Sections 14 and 15, T18N, R3E, Mount Diablo Baseline and Meridian and is shown on the U.S. Geological Survey's Palermo 7.5 - minute topographic quadrangle. The Butte County Assessor Parcel Numbers are: 025-160-046 and 025-160-066.

The petitioned area currently is being used for agriculture, specifically wheat in the eastern third and a walnut orchard in the remaining western portion. Construction aggregate historically has been mined, most recently by Granite Construction Company, to the west and north of the petitioned property. This material has been sold in the surrounding communities for a variety of uses, up to and including PCC-grade aggregate.

The petitioned property has not been previously classified for mineral resources by the State Geologist and there is currently no regional mineral land classification study of Butte County.

The Surface Mining and Reclamation Act of 1975 (SMARA)

SMARA requires the State Geologist to classify land based on the presence, absence, or likely occurrence of significant mineral deposits in certain areas of the state that are subject to urban expansion, or other land uses that are incompatible with mining. The areas to be classified for

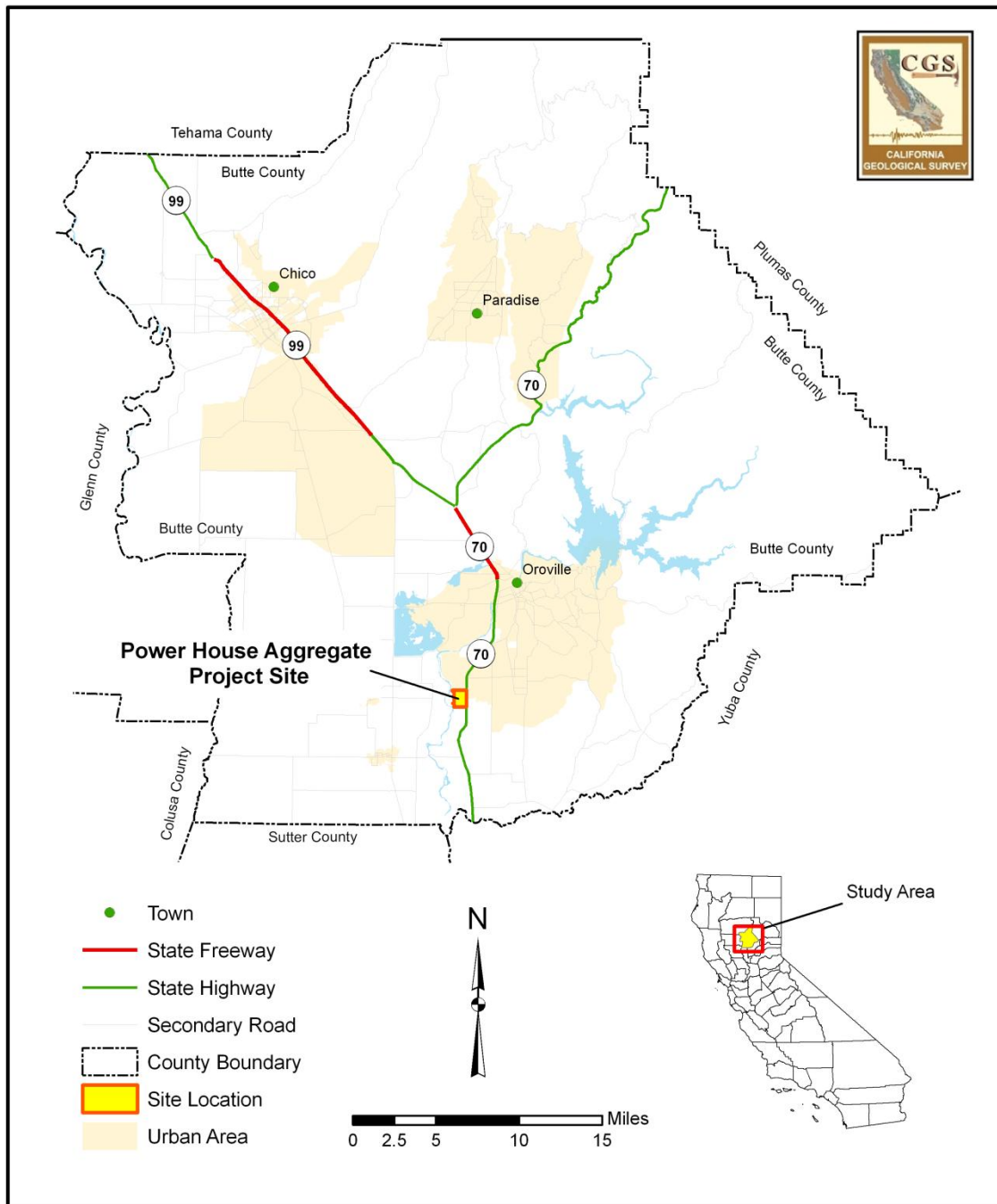


Figure 1. Location of the Power House Aggregate Project Site.

mineral resources are set forth by the SMGB in a 5-year plan, and by the SMGB's acceptance of petitions for classification of specific properties.

The SMGB, upon receipt and acceptance of the classification information, transmits the information to the appropriate lead agencies for incorporation into their general plans and for use in their land-use planning processes.

The primary goal of mineral land classification is to ensure that the mineral resource potential of the land is recognized and considered before local land-use decisions are made that could preclude development of the mineral resource. The availability of mineral resources is vital to California's economy. However, for most mineral commodities, economic deposits are rare, isolated occurrences. In addition, access to land for purposes of mineral exploration and mine development has become increasingly difficult because California is faced with growing land-use competition. As a consequence, local planning agencies are confronted with more complex land-use decisions. If California is to continue supplying raw materials for its construction industry, it is essential that areas containing significant mineral resources be identified so that this information can be incorporated into land-use planning decisions.

MINERAL LAND CLASSIFICATION

As set forth in Section 2761 (b) of SMARA, the State Geologist shall classify land solely on the basis of geologic factors and without regard to existing land use. Areas subject to mineral land classification studies are divided by the State Geologist into various Mineral Resource Zone (MRZ) categories that reflect varying degrees of mineral resource potential as described below:

Mineral Resource Zone (MRZ) Categories

- | | |
|---------------|---|
| MRZ-1: | Areas where available geologic information indicates that little likelihood exists for the presence of significant mineral resources. |
| MRZ-2: | Areas where adequate information indicates that significant mineral resources are present, or where it is judged that a high likelihood for their presence exists. Land included in MRZ-2 is of prime importance because it contains known economic mineral deposits. |
| MRZ-3: | Areas containing known mineral occurrences of undetermined mineral resource significance. Further exploration within these areas could result in the reclassification of specific localities into the MRZ-2 category. |

Classification Criteria

To be considered **significant** for the purpose of mineral land classification, a mineral deposit, or a group of mineral deposits that can be mined as a unit, must meet marketability and threshold value criteria adopted by the SMGB. Threshold values are intended to indicate in a general way the approximate minimum size of a mineral deposit that will be considered significant for classification and designation. The threshold value criteria vary for different minerals depending on their uniqueness and commodity-type category. The SMGB determined threshold value of the first marketable product in 1998 dollars to be \$12,500,000 for a construction aggregate deposit. In order to adjust the threshold value to account for inflation, the value was multiplied by an inflation factor of 1.37. This factor was determined by dividing the U.S. Department of Labor Bureau of Labor Statistics' (California Department of Industrial Relations, Division of Labor Statistics website, 2009) estimated Consumer Price Index (CPI) for 2009 (224.1) by the CPI for 1998 (164.3). The threshold value in 2009 dollars (rounded to the nearest thousand) is: \$17,112,000.

OVERVIEW OF CONSTRUCTION AGGREGATE

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.

The building and paving industries consume large quantities of aggregate and future demand for this commodity is expected to increase throughout California. Approximately 40 percent of all aggregate produced in the U.S. is used in concrete; roughly 90 percent of this is used in high-strength concrete for use in dams, highway abutments, building foundations, and sidewalks. Portland cement concrete-grade aggregate (PCC) is indispensable to the building industry as a construction material.

Of the many grades of aggregate used, PCC-grade aggregate must meet some of the most rigid engineering standards. Aggregate used in PCC must meet specifications to prevent premature deterioration of the concrete. These specifications set standards for the permissible amounts of deleterious substances and cover engineering requirements for size gradation, soundness and abrasion resistance. Laboratory tests of aggregate are used to scientifically evaluate the suitability of materials for use in concrete. Minimum standards for specific tests have been adopted by many government agencies such as the California Department of Transportation (Caltrans).

Because aggregate is a low unit-value, high bulk weight commodity, it should be obtained from nearby sources to minimize the dollar cost to the aggregate consumer and other environmental and economic costs associated with transportation. If nearby sources do not exist, then transportation costs can quickly exceed the value of the aggregate. This factor sets construction aggregate apart from many other mineral commodities, such as gold or copper, which may reach markets far removed from the areas in which they are mined.

Factors Affecting Aggregate Deposit Quality

The two major factors that affect the quality of an aggregate deposit are the rock type and the degree of weathering of the deposit. Rock type determines the hardness, durability, and potential chemical reactivity of the rock when mixed with cement to make concrete. In alluvial sand and gravel deposits, rock type is variable and reflects the rocks present in the drainage basin of the stream or river. In crushed stone deposits, rock type is typically less variable, although in some types of deposits such as sandstones or volcanics, there may be significant variability of rock type within a deposit. Rock type may also influence aggregate shape. For example, some metamorphic rocks such as slates tend to break into thin platy fragments that are unsuitable for many aggregate uses while many volcanic and granitic rocks break into blocky fragments more suited to a wide variety of aggregate uses. Deposit type also affects aggregate shape. For example, in alluvial sand and gravel deposits the natural abrasive action of the stream rounds the edges of rock particles in contrast to the sharp edges of particles from crushed stone deposits.

Weathering is the in-place physical or chemical decay of rock materials at or near the earth's surface. Weathering commonly decreases the physical strength of the rock and may make the material suitable only for uses in which high strength and durability are not specified.

Weathering may also alter the chemical composition of the aggregate making it less suitable for some aggregate uses. If weathering is severe, the material may not be suitable for use as construction aggregate. Typically, the older a deposit is, the more likely it is to have been weathered, and the severity of weathering commonly increases with increasing age of the deposit.

CLASSIFICATION OF THE POWER HOUSE AGGREGATE PROJECT

Geologic Summary

The Power House Aggregate Project site is situated near the eastern edge of the Great Valley Geomorphic Province. The Province consists of a sequence of marine and non-marine sediments that range in age from Jurassic to recent. The rocks of the Sierra Nevada Geomorphic Province are exposed about 5 miles to the east of the project site and are the source for the sediments in the project area. The Sierra Nevada Geomorphic Province consists of accreted metamorphic rocks; mafic, intermediate and felsic intrusive rocks; tertiary volcanic rocks and glacial deposits.

The Power House Aggregate Project site consists of a series of north-south trending terraced river deposits and contains four separate units as originally mapped by Busacca et al (1989). They are (Qa) recent alluvium from the adjacent Feather River; (Qml) sand, silt, and minor gravel from the lower member of the Modesto Formation; and, (Qru and Qrl) silt, sand, and coarse sand from the upper and lower members of the Riverbank Formation.

The Quaternary alluvium (Qa) occurs in the far western third of the study area, near the Feather River. Adjacent to the western boarder of the petition area, historic dredging for gold has occurred in this unit. Aggregate mining for a variety of construction aggregate uses, up to and including PCC, has occurred in this formation to the west and north of the project site. The current mining is by Granite Construction Company. The lower Modesto Formation is exposed in the middle of the study area, just east of the Quaternary alluvium. The upper and lower Riverbank Formations crop out in the eastern portion of the study area.

Drilling and sampling by the petitioner allows for a better understanding of the stratigraphy of these units at the site. Overburden (soil, silts, and clays) thickness ranges between 8 and 25 feet, with an average thickness of about 14 feet. The sand and gravel beds range between 13 and 36 feet thick with an average thickness of 24 feet. Sands are predominantly fine to coarse grained. Gravels range from pebble to cobble, seldom exceeding 10 inches in diameter. Composition of the gravels is predominately metamorphic, with lesser amounts of granitic and volcanic materials. Silts and clays occur, sometimes as part of the matrix and sometimes as discrete horizons. The silts and clays should be manageable by processing or occasional stripping or selective mining. The lithology below the sand and gravel layers becomes increasingly silt and clay rich and has been interpreted by the petitioner as being possibly the upper extent of the Laguna Formation.

Material Quality

Proprietary materials testing results provided by the petitioner were compared to published Caltrans specifications (California Department of Transportation, 2006) by CGS staff. The results show that, with appropriate processing, the material present on the Power House Aggregate Project site could meet the specifications for a variety of construction aggregate products up to, and including, PCC-grade aggregate.

Threshold Value

The total aggregate resource contained on the Power House Aggregate Project site is proprietary information (Public Resources Code Section 2207.1). However, the site contains resources of construction aggregate that exceed the threshold value of \$17.11 million (2009 dollars).

It is possible to demonstrate that the Power House Aggregate Project site contains aggregate resources that exceed the minimum threshold value without revealing proprietary data. Assuming an average selling price of \$10 per ton for construction aggregate in the Oroville/Butte County Region, approximately 1.7 million tons of resources are needed to meet the minimum threshold value of \$17.11 million. Using an average in-place density of 1.76 tons per cubic yard and a waste factor of 10%, the depth of mining necessary to exceed the threshold value over 100 acres of the 460-acre site is less than seven feet. The thickness of suitable rock on the Power House Aggregate Project site meeting specifications for construction aggregate is greater than seven feet.

Property Evaluation

A field investigation of the property by CGS staff, along with an evaluation of the subsurface information and materials test data provided by the petitioner, indicates the following:

- The Power House Aggregate Project site contains aggregate resources suitable for use as construction aggregate up to, and including, PCC-grade aggregate.
- The resources present exceed the threshold value requirements established by the SMGB for inclusion into the MRZ-2 category for construction aggregate.
- The classified area of the Power House Aggregate Project site is shown in Figure 2.

CONCLUSIONS

In accordance with the mandates of the SMARA, the staff of CGS, under the direction of the State Geologist, has evaluated the Power House Aggregate Project site, and it is concluded that significant construction aggregate resources are present on 460 acres of this property. These resources meet the suitability and threshold criteria established by the SMGB for inclusion into the MRZ-2 category for construction aggregate. The area classified MRZ-2 for construction aggregate is shown on Figure 2.

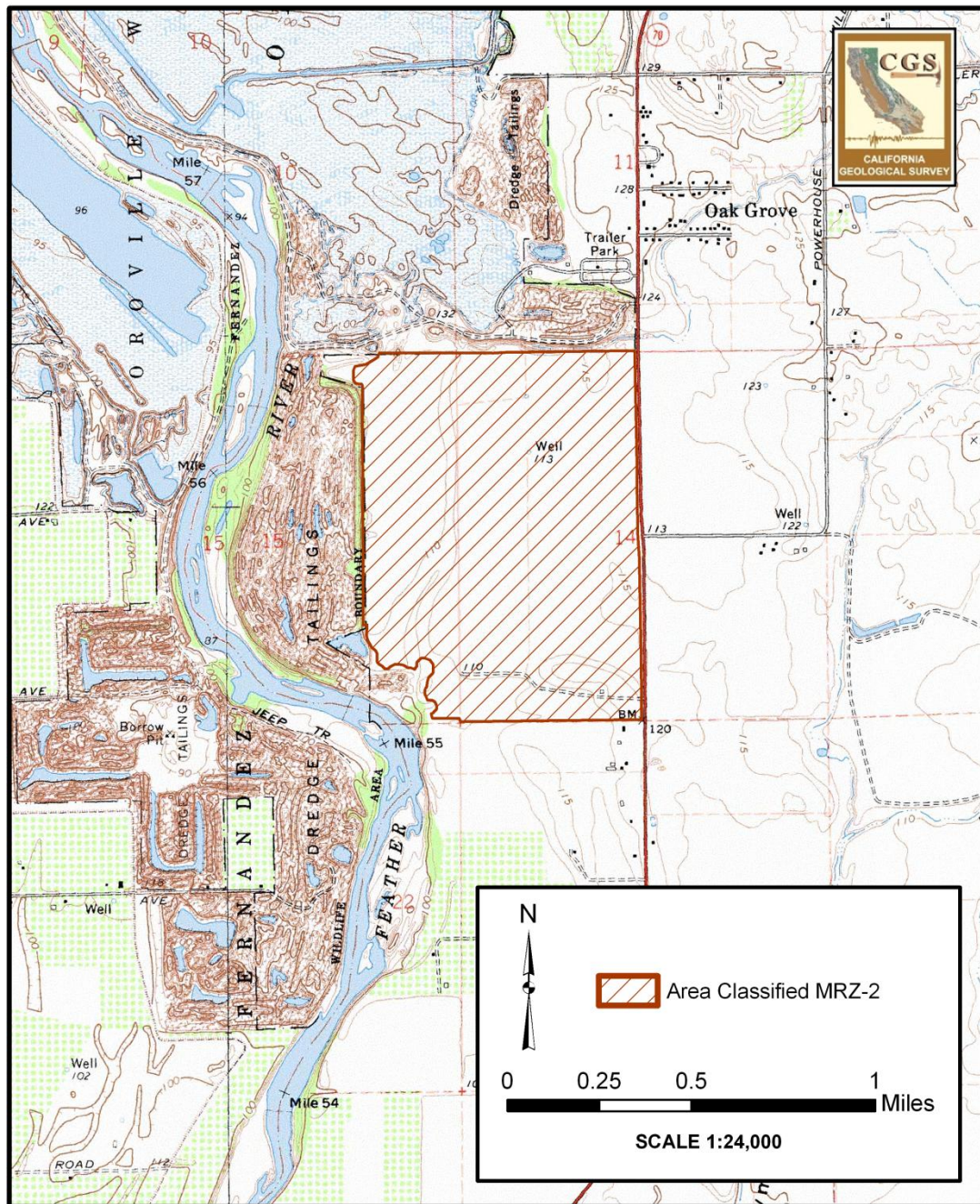


Figure 2. Mineral Land Classification of the Power House Aggregate Project Site for construction aggregate.

REFERENCES CITED

Busacca, Alan J., Singer, Michael J., Verosub, Kenneth L. United States Geological Survey, 1989, Late Cenozoic Stratigraphy of the Feather and Yuba Rivers Area, California, with a Section on Soil Development in Mixed Alluvium at Honcut Creek- Bulletin 1590-G. p.G7-G26

California Department of Industrial Relations, Division of Labor Statistics website, 2009, Consumer Price Indices: <http://www.dlr.ca.gov/dlsr/CPI/PresentCCPI.pdf>

California Department of Transportation, 2006, Standard Specifications available at: www.dot.ca.gov/hq/esc/oe/specifications/Std_Specs/2006_StdSpecs/2006.doc

California Division of Mines and Geology, 2000, California surface mining and reclamation policies and procedures: Special Publication 51, third revision.

State Mining and Geology Board, 1982, Priorities for the classification of mineral lands in urban and non-urban areas: California State Mining and Geology Board, Resolution No. 82-14, 2 p.