SPECIAL REPORT 240

UPDATE OF MINERAL LAND CLASSIFICATION: PORTLAND CEMENT CONCRETE-GRADE AGGREGATE IN THE WESTERN SAN DIEGO COUNTY PRODUCTION-CONSUMPTION REGION, CALIFORNIA

2017

CALIFORNIA GEOLOGICAL SURVEY
Department of Conservation

STATE OF CALIFORNIA
EDMUND G. BROWN JR.
GOVERNOR

THE NATURAL RESOURCES AGENCY
JOHN LAIRD
SECRETARY FOR RESOURCES

DEPARTMENT OF CONSERVATION
DAVID BUNN
DIRECTOR

CALIFORNIA GEOLOGICAL SURVEY
JOHN G. PARRISH, PH.D., *STATE GEOLOGIST*

SPECIAL REPORT 240

UPDATE OF MINERAL LAND CLASSIFICATION: PORTLAND CEMENT CONCRETE-GRADE AGGREGATE IN THE WESTERN SAN DIEGO COUNTY PRODUCTION-CONSUMPTION REGION, CALIFORNIA

By

Fred W. Gius (PG 7788), Lawrence L. Busch (PG 6440), and Russell V. Miller (PG 3331)

2017

CALIFORNIA GEOLOGICAL SURVEY'S PUBLIC INFORMATION OFFICES:

Southern California Regional Office
320 West 4th Street, Suite 850
Los Angeles, CA 90013
(213) 239-0878

Library and Headquarters Office
801 K Street, MS 14-31
Sacramento, CA 95814-3531
(916) 445-5716

Bay Area Regional Office
1900 South Norfolk Street, Suite 300
San Mateo, CA 94403
(650) 350-7301

Table of Contents

EXECUTIVE SUMMARY vii

PART I – INTRODUCTION 1

HISTORY OF MINERAL LAND CLASSIFICATION AND DESIGNATION IN THE WESTERN SAN DIEGO COUNTY P-C REGION 3

BACKGROUND 4

OVERVIEW OF PCC-GRADE AGGREGATE 4

OVERVIEW OF CLASSIFICATION 5

OVERVIEW OF DESIGNATION 5

LEAD AGENCY RESPONSE TO CLASSIFICATION 6

PART II - UPDATE OF MINERAL LAND CLASSIFICATION OF PCC-GRADE AGGREGATE IN THE WESTERN SAN DIEGO COUNTY P-C REGION 7

MINERAL RESOURCE ZONES 7

CLASSIFICATION CRITERIA 7

REEVALUATION OF MINERAL LAND CLASSIFICATION FOR PCC-GRADE AGGREGATE 8

Areas Reclassified to MRZ-2 by Petition 8

Areas within the P-C Region Reclassified to MRZ-2 for PCC-Grade Aggregate from MRZ-3 or MRZ-4 in OFR 96-04 9

Areas Outside the P-C Region Classified MRZ-2 in OFR 96-04 9

Area Reclassified to MRZ-2 from MRZ-3 in this Update Report 9

Area Reclassified to MRZ-2 from MRZ-1 and MRZ-3 in this Update Report 9

Areas Reclassified to MRZ-3 from MRZ-2 in this Update Report 10

PART III - REEVALUATION OF PCC-GRADE AGGREGATE RESOURCES IN THE WESTERN SAN DIEGO COUNTY P-C REGION 12

CONCEPTS USED IN IDENTIFYING AGGREGATE RESOURCE SECTORS 12

REEVALUATION OF PREVIOUSLY DESIGNATED AGGREGATE RESOURCE SECTORS 13

Designated Sectors Where No Aggregate Resources Remain Available 15
Designated Sectors Where Part of the Contained Aggregate Resources Remain Available 15
PCC-GRADE AGGREGATE RESOURCE SECTORS IDENTIFIED SINCE THE DESIGNATION OF THE WESTERN SAN DIEGO COUNTY P-C REGION 19
RECALCULATION OF AVAILABLE PCC-GRADE AGGREGATE RESOURCES.....22

PART IV – PCC-GRADE AGGREGATE PRODUCTION IN THE WESTERN SAN DIEGO COUNTY P-C REGION 23
AGGREGATE PRODUCTION DATA 26
AGGREGATE IMPORTS.....27
AGGREGATE CONSUMPTION 27

PART V - UPDATED ESTIMATE OF THE 50-YEAR DEMAND FOR AGGREGATE IN THE WESTERN SAN DIEGO COUNTY P-C REGION 29
POPULATION PROJECTION THROUGH THE YEAR 2065 29
HISTORICAL PER CAPITA AGGREGATE CONSUMPTION.....31
PROJECTED AGGREGATE DEMAND THROUGH THE YEAR 2065 31
COMPARISON OF THE 50-YEAR AGGREGATE DEMAND WITH CURRENT AGGREGATE RESERVES 34
POTENTIAL ALTERNATIVE SOURCES OF AGGREGATE FOR THE WESTERN SAN DIEGO COUNTY P-C REGION 36
RECYCLED AGGREGATE.....40

PART VI - CONCLUSIONS 41

ACKNOWLEDGMENTS.....44

REFERENCES CITED.....44

Appendix

Parameters, Factors, and Assumptions Used in Resource Calculations - Western San Diego County P-C Region (1982-2015)……A-1

Figures

Figure 1. General Location Map of the Western San Diego County P-C Region. 2

Figure 2. A Comparison of 1982 and 1996 Projections of Aggregate Demand for the Western San Diego County P-C Region with Estimated Aggregate Consumption for 1980-2014.....30

Figure 3. Actual and Projected Population in the Western San Diego County P-C Region 1980-2065. 30

Figure 4. Estimated Historical Aggregate Consumption (1985-2014) with Projected Aggregate Demand to 2065. 31

Tables

Table 1. Lead Agencies in the Western San Diego County P-C Region. 6

Table 2. Summary of PCC-Grade Aggregate Resources in Designated Sectors in the Western San Diego County P-C Region as of 2015. 14

Table 3. Summary of PCC-Grade Aggregate Resources in Newly Identified Sectors in the Western San Diego County P-C Region. 21

Table 4. Summary of All Identified PCC-Grade Aggregate Resources in the Western San Diego County P-C Region as of 2015.....22

Table 5. Aggregate Production (all grades) in the Western San Diego County P-C Region 1985-2014. 26

Table 6. Aggregate Production, Estimated Imports, and Estimated Consumption (all grades) in the Western San Diego County P-C Region 1985-2014. 28

Table 7. Population, Estimated Aggregate Consumption, and Estimated Annual Per Capita Consumption in the Western San Diego County P-C Region 1985-2014. 32

Table 8. Projected Population and Projected Aggregate Demand in the Western San Diego County P-C Region 2016-2065. 33

Table 9. Summary of Aggregate Resources, Reserves, Projected 50-year Demand, and Depletion Date for the Western San Diego County P-C Region. 35

Table 10. One-way Import Distance by Truck from Neighboring Production Areas.....37

Table 11. Summary of SANDAG Aggregate Transport Scenarios 39

Table 12. Fuel Consumption and CO_2 Emissions from Aggregate Transport with Payload....39

Table 13. Fuel Consumption and Emissions for Aggregate Transport Scenarios – Estimates per Million Tons of Aggregate Transported 40

Table 14. Comparison of Data Reported in OFR 96-04 to Data Presented in this Update Report.....43

Plates (In Pocket)

Plate 1 Updated Mineral Land Classification Map for Portland Cement Concrete-Grade Aggregate in the Western San Diego County Production-Consumption Region, California

Plate 2A Updated Aggregate Resource Sector Map for Portland Cement Concrete-Grade Aggregate in the Western San Diego County Production-Consumption Region, California – Northern Part

Plate 2B Updated Aggregate Resource Sector Map for Portland Cement Concrete-Grade Aggregate in the Western San Diego County Production-Consumption Region, California – Southern Part

EXECUTIVE SUMMARY

This report is the third in a series of regional mineral land classification reports for portland cement concrete (PCC)-grade aggregate for the Western San Diego County Production-Consumption Region (P-C Region). The original mineral land classification was published as Special Report (SR) 153 in 1982. The first update was published in 1996 as Open-File Report (OFR) 96-04. This current report updates the mineral land classification of the region, reevaluates the region's PCC-grade aggregate resources, and includes an updated 50-year projection of construction aggregate demand for the P-C Region through the year 2065. This update report does not replace SR 153 or OFR 96-04.

SR 153 assisted the State Mining and Geology Board (SMGB) in a subsequent process called *designation*. Designation is the formal recognition by the SMGB of lands containing resources of regional or statewide significance that are needed to meet the future mineral resource needs of the region and the State. In 1985, the SMGB designated construction aggregate resource areas in the P-C Region. This updated report does not change those designations. However, the SMGB may choose to update or modify those designations based on information in this report.

Sand, gravel, and crushed rock are "construction materials." These materials, collectively referred to as aggregate, provide bulk and strength to PCC, asphaltic concrete, Class II Base, and other aggregate commodities such as subbase, drain rock, and fill. The material specifications for PCC-grade aggregate is more restrictive than the specifications for aggregate used in other applications. Deposits that meet the specifications for PCC-grade aggregate are the rarest and most valuable construction aggregate resources.

Urban expansion continues in the P-C Region, threatening to preclude mineral extraction. Consequently, it is important that land-use decisions be made recognizing the presence and importance of local aggregate resources. The objective of this report is to convey information concerning these aggregate resources to land-use planners and decision-makers.

All lands within the P-C Region are assigned Mineral Resource Zone (MRZ) classifications (MRZ-1, MRZ-2, MRZ-3, or MRZ-4) based on geologic factors alone without regard for current land uses. In addition, the State Geologist is responsible for calculating the amount of aggregate resources contained in areas classified as MRZ-2. The mineral land classification map for the P-C Region is shown on Plate 1. Understanding that there are lands within these areas that have been urbanized, the State Geologist limits aggregate resource calculations to areas within "Sectors." Sectors are areas classified as MRZ-2 that have current land uses deemed compatible with possible future mining. For this update, the determination of compatible land uses was based on information from satellite imagery, field reconnaissance, and consultation with local planners as of January 2015. The updated aggregate resource sector map is shown on Plates 2A and 2B. The State Geologist then calculates the available resources of each Sector and identifies remaining resources that have been permitted for mining (i.e., "reserves"). The reserves and resources within all Sectors are compared with a forecast of the 50-year needs of the region.

REEVALUATION OF PCC-GRADE AGGREGATE RESOURCES

This update report reevaluated the PCC-grade aggregate resources in areas originally designated by the SMGB and new areas identified in subsequent mineral land classification reports including this update report. In 1985, the SMGB designated 50,982 acres in the P-C Region as containing construction aggregate deposits of "regional significance." At that time, it was estimated that the designated areas contained 5,880 million tons of PCC-grade aggregate resources. As of 2015, about 5,700 million tons of resources remain in previously designated Sectors. Although the difference is relatively small, it accommodates the loss of 14,436 acres (28% of the designated area) to land uses incompatible with future mining, production of aggregate from designated areas, and changes in resource estimates based on reevaluation of the previously designated areas.

Nine new aggregate resource Sectors (AA through II) for PCC-grade aggregate have been identified since the 1985 designation. These yet to be designated Sectors total 1,461 acres and contain an estimated 282 million tons of PCC-grade aggregate resources, increasing the total estimated resources in the P-C Region to 5,982 million tons. These nine new Sectors may be considered for designation by the SMGB at a future date.

Of the 690,400 acres making up the P-C Region, about 38,006 acres are identified as previously designated sectors or newly identified sectors in this study. This amounts to about 5.5 percent of the P-C Region. Reserves make up only about 2,575 acres or less than 0.4 percent of the area of the P-C Region.

Aggregate resources in the P-C Region occur on a mix of public, private, federal, and tribal lands. Of the almost six billion tons of PCC-grade aggregate resources identified in this report, approximately two-thirds are located on various government or tribal lands. This includes approximately two billion tons of resources located within the boundaries of the U.S. Department of the Navy Marine Corps Air Station Miramar.

PCC-GRADE AGGREGATE PRODUCTION

Based on December 2014 data from the California Division of Mine Reclamation, eight companies had current, valid permits to operate 18 mining properties capable of producing PCC-grade aggregate in the P-C Region. The locations of the currently permitted mines are shown on Plates 2A and 2B.

Aggregate production data for the P-C Region were obtained from aggregate producers, the U.S. Bureau of Mines, the California Division of Mine Reclamation, and other sources. Total production from the P-C Region from 1985 through 2014 is reported to be about 285 million tons. Since 1985, annual aggregate production ranged from 15.5 million tons in 1990 to 4.5 million tons in 2010.

Since the mid-1990s, local aggregate production has not been sufficient to meet local demand in the P-C Region. This shortfall has been met by importing construction aggregate, predominately

sand, from neighboring aggregate producing regions. At various times, construction aggregate has been imported into the P-C Region from mines in Los Angeles, San Bernardino, Riverside, and Imperial counties, and Baja California, Mexico. While the tonnages of aggregate produced in a region are reported to the State annually, information on imports to, and exports from, a region are not. For this update report, an estimate of annual aggregate imports in the P-C Region was made based on information from operators and local governments. This estimate was used to determine the amount of aggregate consumed within the P-C Region from 1995 to 2014. We also assumed that aggregate "consumption" equals documented historical regional production plus the estimated aggregate imports into the region for the same period. This "consumption" information was used to project the future aggregate demand for the P-C Region.

ESTIMATE OF THE 50-YEAR AGGREGATE DEMAND

The SMGB guidelines for the classification and designation of mineral land specify that mineral land classification reports include an estimate of the total quantity of construction aggregate needed to supply the region in which it occurs for the next 50 years. Published population projections by the California Department of Finance estimate the population of the P-C Region to increase by 794,180 (approximately 26%) to 3,868,828 in 2065 from 3,074,648 in 2016. For this update report, an annual per capita consumption rate of 4.3 tons was multiplied by the projected population for each year to project aggregate demand. Based on this projection, an estimated 760 million tons of construction aggregate will be needed to satisfy demand in the P-C Region through the year 2065.

Of the 760 million tons of construction aggregate needed to meet the 50-year demand, 380 million tons will be used in PCC. Total PCC-grade aggregate reserves in the P-C Region are estimated to be approximately 271 million tons as of 2015. Reserves were calculated based on review of lead agency permit files, approved reclamation plans, and consultation with planners and industry representatives. The 271 million tons of reserves are projected to last into the year 2035, assuming mining will continue until depleted. If all PCC-grade aggregate reserves were used exclusively as PCC-grade aggregate, the supply would theoretically last into the year 2052. However, much of the PCC-grade aggregate reserves are likely to be used for non-PCC products, and a depletion date of 2035 is more realistic.

Potential alternative sources of aggregate for the P-C Region to help address the projected deficiency include crushed rock sources within or adjacent to the P-C Region, synergistic aggregate production, and imported aggregate. Synergistic aggregate production occurs when production of aggregate materials is associated with the development of other necessary projects, e.g., landfill operations, habitat restoration projects, and public/private development projects.

Imports have played an important part in meeting the P-C Region's construction aggregate demand since the mid-1990s. There are advantages and disadvantages to importing construction aggregate. Imports can provide needed aggregate in areas with depleted reserves/resources. However, importing aggregate from neighboring regions also leads to more rapid depletion of reserves/resources in those regions. When compared to local production, importing aggregate is often more expensive and results in higher emissions of greenhouse gases, air pollution, traffic

congestion, and road wear and maintenance because of increased truck traffic. These impacts occur both within the importing region and in the neighboring regions that supply the material and through which the material is transported.

CONCLUSIONS

The following summarizes some of the major conclusions reached in this update report. Key results of this update are presented in Table ES-1.

- Since the designation of 50,982 acres in 1985, 14,436 acres have been lost to urbanization or other incompatible land uses. The remaining 36,546 acres contain 5,700 million tons of PCC-grade aggregate resources.

- This update report identifies an additional 1,461 acres of undesignated land containing an estimated 282 million tons of PCC-grade aggregate resources.

- An estimated 5,982 million tons of PCC-grade aggregate resources, both designated and non-designated, are identified in the P-C Region.

- The projected demand of construction aggregate in the P-C Region for the next 50 years (through the year 2065) is estimated to be 760 million tons. Of this total, 380 million tons will likely be used for PCC.

- The 271 million tons of currently permitted PCC-grade aggregate reserves are projected to last to the year 2035.

- Presently, the P-C Region consumes more PCC-grade aggregate than it produces; the balance of the Region's demand is imported from adjacent California regions and Baja California, Mexico.

- Land-use planners and decision-makers in the P-C Region are faced with balancing a wide variety of needs in planning for a sustainable future for their communities. These include the need to plan carefully for the use of lands containing construction aggregate resources, to consider the permitting of additional aggregate resources in the P-C Region, and to take into consideration the demands of neighboring regions that are competing for the resources being imported into the San Diego area.

Table ES-1. Results Presented in this Update Report

	Special Report 240
Population (2015)	3,050,422
Total PCC-Grade Resources	5,982 million tons
Projected 50-Year Demand of All Grades of Construction Aggregate	760 million tons
Projected 50-Year Demand of PCC-Grade Aggregate	380 million tons
Total Permitted PCC-Grade Aggregate Reserves	271 million tons
Calculated Annual Per Capita Consumption	4.3 tons
Calculated Years Until Depletion	20
PCC Aggregate Mines	18
Number of Mining Companies	8

PART I – INTRODUCTION

This report is the third in a series of regional mineral land classification reports for portland cement concrete (PCC)-grade aggregate in the Western San Diego County Production-Consumption (P-C) Region. The original report, California Division of Mines and Geology [now California Geological Survey (CGS)] Special Report 153 (SR 153): *Mineral Land Classification: Aggregate Materials in the Western San Diego County Production-Consumption Region*, was published in 1982 (Kohler and Miller, 1982) and was updated in 1996 (Miller, 1996). This current report updates the mineral land classification of the region, reevaluates the region's PCC-grade aggregate resources, and includes an updated 50-year projection of construction aggregate demand for the region through the year 2065. Aggregate production data used in this update are current through December 2014; land-use data is current as of January 2015.

The Western San Diego County P-C Region includes the western-most part of San Diego County (Figure 1). The P-C Region was originally defined in SR 153 as the area encompassing: 1) the entire metropolitan area of San Diego County; 2) areas expected to urbanize in the years 1990-2010; and 3) any resource areas providing or expected to provide aggregate material to the urbanized and urbanizing areas. This P-C Region boundary is retained in this update report. The P-C Region covers approximately 1,079 square miles; it includes eighteen incorporated cities: Carlsbad, Chula Vista, Coronado, Del Mar, El Cajon, Encinitas, Escondido, Imperial Beach, La Mesa, Lemon Grove, National City, Oceanside, Poway, San Diego, San Marcos, Santee, Solana Beach, and Vista.

Geographically, the Western San Diego County P-C Region includes the coastal plain, the western foothills, and west flowing river valleys of San Diego County. Topographic relief varies from nearly flat to steep. Major drainages in the study area are the San Luis Rey River, draining the northern part of the county; the San Dieguito River/Santa Ysabel Creek, San Diego River, and Sweetwater River, which drain the central part of the county; and the Otay and Tijuana rivers, which drain the southern parts of the county. Geologically, the Region includes: 1) relatively flat-lying and relatively undeformed Cretaceous age to recent sedimentary rocks of the coastal plain; 2) Mesozoic age volcanic and plutonic rocks of the western foothills of the Peninsular Ranges batholith; and 3) alluvium filled river valleys penetrating eastward into the central parts of the Peninsular Ranges.

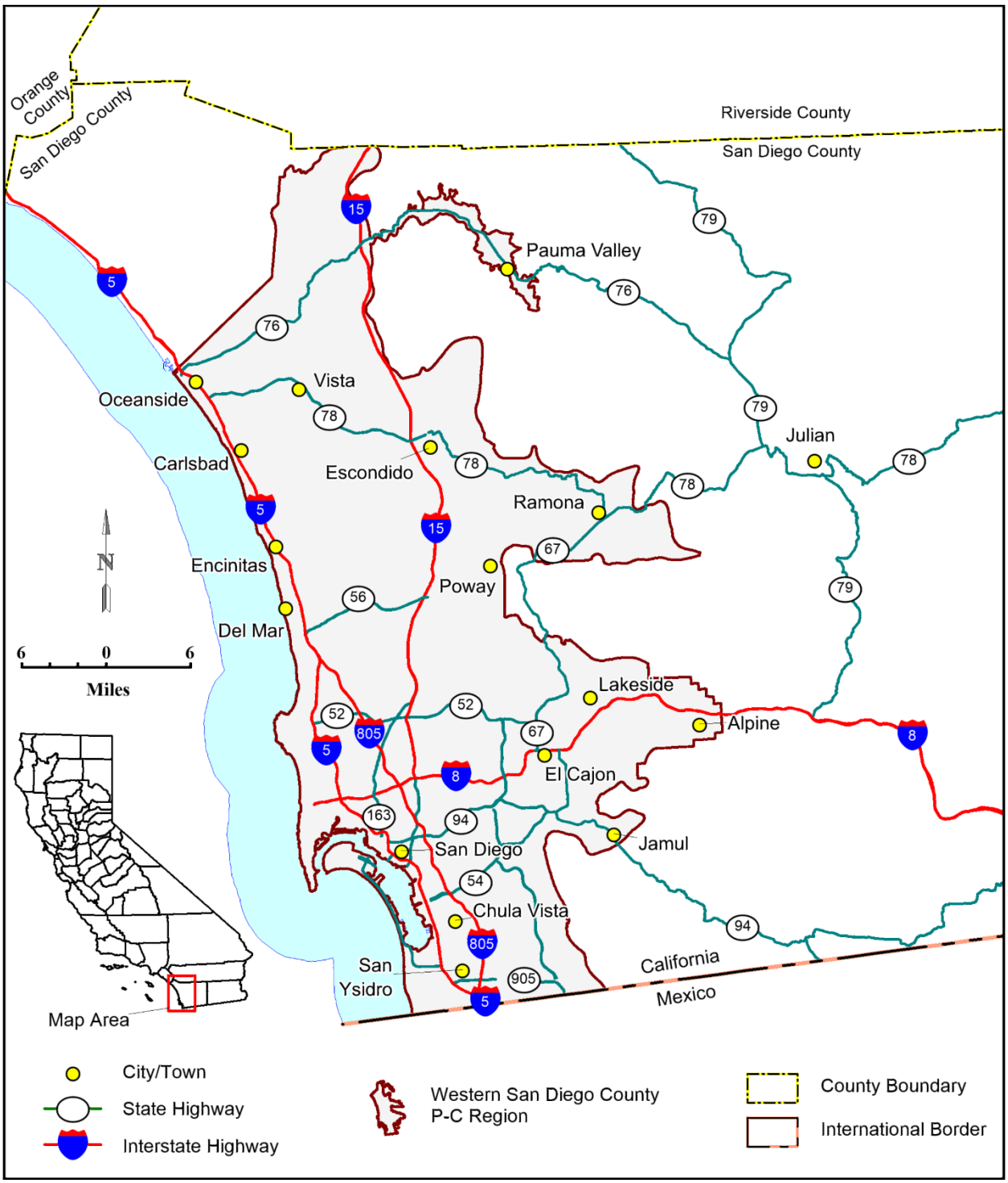

Figure 1. General Location Map of the Western San Diego County P-C Region.

HISTORY OF MINERAL LAND CLASSIFICATION AND DESIGNATION IN THE WESTERN SAN DIEGO COUNTY P-C REGION

In 1982, the California Division of Mines and Geology published the original mineral land classification study of the Western San Diego County P-C Region. Since publication of the initial report, three Mineral Land Classification petitions and an update to the original study have been published. These reports are listed below in chronological order.

Special Report 153 (1982): *Mineral Land Classification: Aggregate Materials in the Western San Diego County Production-Consumption Region* (Kohler and Miller, 1982).

Open File Report 88-16 (1988): *Mineral Land Classification of the Sycamore Ridge Property, San Marcos Quadrangle, San Diego County, California - for Portland Cement Concrete Grade Aggregate* (Clinkenbeard, 1988), classified a 486-acre area in the Merriam Mountains north of the City of San Marcos for PCC-grade aggregate. (Petition)

Open File Report 89-15 (1989): *Mineral Land Classification of the Pankey Ranch Site, Bonsall Quadrangle, San Diego County, California – for Aggregate Materials* (Clinkenbeard, 1989), classified a 76-acre area encompassing Rosemary's Mountain for mixed aggregate. (Petition)

Open-File Report 96-04 (1996): *Update of Mineral Land Classification: Aggregate Materials in the Western San Diego County Production-Consumption Region* (Miller, 1996), updated SR 153 and incorporated information from Open File Report (OFR) 88-16 and OFR 89-15.

Special Report 191 (2006): *Mineral Land Classification of National Quarries' Twin Oaks Valley Road Site, San Marcos, San Diego County, California – for Construction-Grade Aggregate Resources* (Busch, 2006), classified a 164-acre area on the west side of Twin Oaks Valley for construction aggregate. (Petition)

SR 153 assisted the State Mining and Geology Board (SMGB) in a subsequent process called *designation*. Designation is the formal recognition by the SMGB of lands containing resources of regional or statewide significance that are needed to meet future demand. In 1985, the SMGB designated construction aggregate resource areas of regional significance in the Western San Diego County P-C Region in SMARA Designation Report No. 4 - *Designation of Regionally Significant Construction Aggregate Resource Areas in the Western San Diego County Production-Consumption Region* (California Department of Conservation, State Mining and Geology Board, April 1985). In that action, the SMGB designated nineteen areas (Sectors) within the Western San Diego County P-C Region as having aggregate resources of regional significance. The SMGB has taken no additional designation actions in the Western San Diego County P-C Region since the 1985 designation.

This report updates OFR 96-04 and incorporates information from SR 191. This update report also evaluates the impacts of the land-use changes that have taken place in the previously

designated areas since designation. Details of these changes are given in the section titled: *Reevaluation of Designated Aggregate Resource Sectors* contained within Part III of this report. The SMGB may designate new areas, or alter the designation of lands within the Western San Diego County P-C Region based on the information in this report.

BACKGROUND

SR 153, OFR 88-16, OFR 89-15, OFR 96-04, SR 191, and this update report were generated by the State Geologist as specified by the Surface Mining and Reclamation Act of 1975 (SMARA, PRC 2710 et seq.). SMARA was passed by the California State Legislature in response to the loss of significant mineral resources due to urban expansion, the need for current information concerning the location and quantity of essential mineral deposits, and to ensure reclamation of mined lands. To address mineral resource conservation, SMARA mandates a two-phase process known as *Classification-Designation*.

The objective of the Classification-Designation process is to ensure, through appropriate local lead agency policies and procedures, that mineral materials will be available when needed and do not become inaccessible as a result of inadequate information during the land-use decision-making process.

SMARA mandates that the SMGB develop guidelines for mineral land classification. The SMGB adopted SMARA guidelines on June 30, 1978 and revised them in 2000. The guidelines are available on the California Department of Conservation website at http://www.conservation.ca.gov/SMGB/Guidelines/ClassDesig.pdf.

SMARA requires the State Geologist to classify specified areas into Mineral Resource Zones (MRZs). The guidelines also direct the State Geologist to include the following additional information in regional classification reports for construction aggregate resources: (1) the location and estimated total quantity of construction aggregate in areas with land-uses compatible with potential mining; (2) limits of the market area that these potential resources would supply; and (3) an estimate of the total quantity of aggregate material that will be needed to supply the area for the next 50 years. This additional information is not required for Mineral Land Classification petitions.

OVERVIEW OF PCC-GRADE AGGREGATE

Sand, gravel, and crushed rock are “construction materials.” These materials, collectively referred to as aggregate, provide bulk and strength to PCC, asphaltic concrete (AC), Class II Base, and other aggregate commodities such as subbase, drain rock, and fill. Aggregate normally provides 80 to 100 percent of the volume in these uses. This update report reassesses and reclassifies lands in the Western San Diego County P-C Region for PCC-grade aggregate resources, which typically are used to supply other grades of aggregate. The material specifications for PCC-grade aggregate are more restrictive than the specifications for the other grades of aggregate. This restrictiveness makes deposits for use as PCC-grade aggregate the scarcest and most valuable of aggregate resources.

OVERVIEW OF CLASSIFICATION

The regional classification of aggregate resources involves the six distinct but interrelated steps that are listed below:

1. Determination of Study Area Boundary: A study area may be a county, a part of a county, or a region that may contain all or part(s) of one or more counties.

2. Establishment of Mineral Resource Zones (MRZs): All lands within the study area are assigned MRZ classifications (MRZ-1, MRZ-2, MRZ-3, or MRZ-4) based on geologic appraisal. The geologic appraisals include a study of pertinent geologic reports and maps, and field investigations of geologic units exposed in outcrops and at active and inactive mines and quarries.

3. Identification of Sectors: Lands known to contain significant aggregate resources (areas classified as MRZ-2 in Step 2, above) are evaluated to determine if current uses of these lands preclude mining. Lands currently permitted for mining and areas found to have land uses compatible with possible mining are identified as *Sectors*.

4. Calculation of Resource Tonnages within Sectors: Investigation and analysis of on-site conditions, measurement of the areal extent of deposits, drill-hole information, waste-material percentages, and deposit densities are used to calculate total tonnages of aggregate *reserves* and *resources* within each Sector. Reserves are deposits permitted for mining; resources are all aggregate materials identified in Sectors, including reserves.

5. Forecast of 50-Year Needs and the Life Expectancy of Current Reserves: The total tonnage of aggregate needed to satisfy the demand in the area over the next 50 years is estimated.

6. Identification of Alternative Resources: Alternative sources of aggregate are identified and briefly discussed.

The MRZ classification system previously used in SR 153 and OFR 96-04 is used in this report. The classification system is discussed in Part II of this report.

OVERVIEW OF DESIGNATION

This update report contains the classification phase of the *Classification-Designation* process required by SMARA. The designation phase follows the receipt and acceptance of this classification report by the SMGB. Designation is the formal recognition by the SMGB, after consultation with lead agencies and other interested parties, of areas containing mineral deposits of regional or statewide economic significance. Procedures for the designation of lands containing significant mineral deposits are specified in Section II.2 of the SMGB's Guidelines for Classification and Designation of Mineral Lands (SMGB, 2000).

LEAD AGENCY RESPONSE TO CLASSIFICATION

The SMGB, upon receipt of the classification report from the State Geologist, transmits the report to the appropriate lead agencies and makes it available to other interested parties. Within 12 months of receipt of the report, each lead agency must develop and adopt mineral resource management policies to be incorporated in its general plan. These policies will:

1. Recognize the mineral land classification information, including the Mineral Land Classification Maps transmitted to the lead agency by the SMGB.
2. Emphasize the conservation and development of the identified mineral deposits.

Lead agencies that have jurisdiction within the Western San Diego County P-C Region are shown in Table 1. The information in this update and the revised projection of aggregate demands on the P-C Region should be used by the lead agencies in evaluating the effectiveness of their current mineral resource management policies and in planning for future construction aggregate demands both in their jurisdictions and in neighboring areas. These policies should be updated as necessary.

Table 1. Lead Agencies in the Western San Diego County P-C Region.

Land Use Jurisdiction (County or Incorporated City)	Areas Classified MRZ-2 in Jurisdiction	Designated Land in Jurisdiction
County of San Diego	✓	✓
City of Carlsbad	✓	✓
City of Chula Vista	✓	✓
City of Coronado		
City of Del Mar		
City of El Cajon	✓	
City of Encinitas		
City of Escondido	✓	✓
City of Imperial Beach	✓	✓
City of La Mesa	✓	
City of Lemon Grove		
City of National City		
City of Oceanside	✓	✓
City of Poway	✓	✓
City of San Diego	✓	✓
City of San Marcos	✓	
City of Santee	✓	✓
City of Solano Beach		
City of Vista	✓	

PART II - UPDATE OF MINERAL LAND CLASSIFICATION OF PCC-GRADE AGGREGATE IN THE WESTERN SAN DIEGO COUNTY P-C REGION

This section of the report contains updated information concerning the location, quality, and quantity of PCC-grade aggregate resources in the Western San Diego County P-C Region.

MINERAL RESOURCE ZONES

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 are divided by the State Geologist into various MRZ categories that reflect varying degrees of mineral resource potential.

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 deposits are present, or where it is judged that a high likelihood for their presence exists. This zone shall be applied to known mineral deposits or areas where well-developed lines of reasoning, based upon economic-geologic principles and adequate data, demonstrate that the likelihood for occurrence of significant mineral deposits is high.

MRZ-3: Areas containing mineral occurrences of undetermined mineral resource significance.

MRZ-4: Areas where available information is inadequate for assignment to any other MRZ category.

CLASSIFICATION CRITERIA

To be considered *significant* for 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 (http://www.conservation.ca.gov/smgb/pages/index.aspx). Mineral deposits considered significant in this report must meet the specifications for PCC-grade aggregate. 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 mineral deposits 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 construction aggregate deposits. To adjust these threshold values to reflect 2015 dollars, each value was multiplied by an inflation factor of 1.53. This factor was determined by

dividing the U.S. Department of Labor's estimated Consumer Price Index for California (California Department of Finance website, February 2016) for December 2015 (250.711), by the Consumer Price Index for 1998 (163.7). The threshold value in 2015 dollars for construction aggregate is $19,144,000. The average price of concrete-grade aggregate (AC- and PCC-) in the Western San Diego County P-C Region ranges from about $16 to $18 per ton; washed concrete-grade sand ranges from about $20 to $24 per ton. Therefore, assuming an average price of $20 per ton, $19,144,000 equates to about one million tons of aggregate material.

REEVALUATION OF MINERAL LAND CLASSIFICATION FOR PCC-GRADE AGGREGATE

This report reevaluates the original mineral land classification of the Western San Diego County P-C Region in SR 153 published in 1982, and the first update report (OFR 96-04) published in 1996. It also includes information published in the petition reports OFR 88-16 (Clinkenbeard, 1988), OFR 89-15 (Clinkenbeard, 1989), and SR 191 (Busch, 2006). A description of the areas reclassified in these petition reports is included below. Analysis of new data obtained since those five publications resulted in two new areas (Jamacha Rock Quarry and Cottonwood Golf Course) in the Western San Diego County P-C Region being reclassified from MRZ-1 or MRZ-3 to MRZ-2 for PCC-grade aggregate. Seven areas have also been reclassified from MRZ-2 to MRZ-3 because of apparent depletion of resources. Plate 1 provides the Updated Mineral Land Classification Map.

Areas Reclassified to MRZ-2 by Petition

Prior to this update report, three sites were previously reclassified to MRZ-2 by petition. These petitions include:

Sycamore Ridge Property: A 482-acre area in northwestern San Diego County, on the west flank of the Merriam Mountains, five miles northeast of the City of San Marcos. The area is underlain by Cretaceous age granodiorite of the Peninsular Ranges batholith. Test data provided by the petitioner indicates material from this site meets quality standards for PCC-grade aggregate. The property was reclassified to MRZ-2 from MRZ-3 in OFR 88-16 (Clinkenbeard, 1988).

Rosemary's Mountain Quarry Property: A 78-acre area in northern San Diego County, north of State Route 76, approximately one mile east of Interstate Highway 15. The area is underlain by the Cretaceous age leucogranodiorite of Indian Mountain. Test data provided by the petitioner indicates fresh rock material from this site meets quality standards for PCC- and AC-grade aggregate, base, and subbase. The property was classified MRZ-2 for aggregate materials in OFR 89-15 (Clinkenbeard, 1989).

Twin Oaks Quarry Property: A 164-acre area in northwestern San Diego County, low on the east slope of the San Marcos Mountains, five miles north of the City of San Marcos. The area is underlain by Cretaceous age gabbro and granodiorite of the Peninsular Ranges batholith. Test data provided by the petitioner shows that, with appropriate processing, material from this site meets quality standards for PCC- and AC-grade aggregate. The property was reclassified to MRZ-2 from MRZ-3 in SR 191 (Busch, 2006).

Areas within the P-C Region Reclassified to MRZ-2 for PCC-Grade Aggregate from MRZ-3 or MRZ-4 in OFR 96-04

The first update report for the Western San Diego County P-C Region (Miller, 1996) reclassified several areas within the P-C Region from MRZ-3 or MRZ-4 to MRZ-2 for PCC-grade aggregate. These include:

- San Marcos Quarry area (MRZ-3 to MRZ-2, 544 acres),
- TTT Quarry (MRZ-3 to MRZ-2, 36 acres),
- San Vicente Creek area (MRZ-4 to MRZ-2, 696 acres),
- Hester's Granite Quarry (MRZ-3 to MRZ-2, 112 acres),
- A part of Dehesa Valley (MRZ-4 to MRZ-2, 196 acres), and
- Sycamore Ridge Property (482 acres previously reclassified to MRZ -2 by petition).

Areas Outside the P-C Region Classified MRZ-2 in OFR 96-04

OFR 96-04 also classified two areas outside of the Western San Diego County P-C Region boundary as MRZ-2:

- The previously mentioned Rosemary's Mountain/Pankey Ranch site (adjacent to the P-C Region at the San Luis Rey River [78 acres] had previously been classified MRZ-2 for "Mixed Aggregate" by petition), and
- The Jamul Quarry (3 miles east of the P-C Region [158 acres] was classified MRZ-2 for PCC-grade aggregate.

Area Reclassified to MRZ-2 from MRZ-3 in this Update Report

In this update report, one area in the Western San Diego County P-C Region is reclassified to MRZ-2 for PCC-grade aggregate from MRZ-3:

> Jamacha Rock Quarry: Approximately 65 acres, two miles south of El Cajon and two miles east of Casa de Oro, are reclassified to MRZ-2 (PCC) from MRZ-3. Here, quartz-diorite and gabbro are mined to produce decomposed granite, fill, and crushed rock aggregate. Mining, which began in the 1940s, originally produced decomposed granite; more recently, unweathered rock suitable for use as crushed rock aggregate of PCC-grade has been exposed.

Area Reclassified to MRZ-2 from MRZ-1 and MRZ-3 in this Update Report

In this update report one area in the Western San Diego County P-C Region is reclassified to MRZ-2 from MRZ-1 and MRZ-3:

> Cottonwood Golf Course: Approximately 167 acres, four miles southeast of El Cajon and three miles east of Casa de Oro, are reclassified to MRZ-2 from MRZ-1 and MRZ-3.

Alluvial sand and gravel deposits along the middle reach of the Sweetwater River Valley near Jamacha historically have been mined on a small scale. Aggregate resource evaluation reports provided to CGS indicate that aggregate resources at this site meet engineering specifications for PCC-grade aggregate and threshold value requirements.

Areas Reclassified to MRZ-3 from MRZ-2 in this Update Report

Hanson Aggregates, Inc. Oceanside/Carlsbad Pit: An 82-acre site in the City of Oceanside south of State Route 78 and west of College Avenue, previously classified MRZ-2 for PCC-grade aggregate in SR 153 and OFR 96-04, is reclassified to MRZ-3 for PCC-grade aggregate. This area was underlain by dacite volcanic rocks. The material, previously mined for a variety of uses, is apparently mined-out; the site is being developed to other uses.

Hanson Aggregates, Inc. Pala Sand Pit: A 127-acre site in the San Luis Rey River Valley south of State Route 76 and west of Pala, previously classified MRZ-2 for PCC-grade aggregate in SR 153 and OFR 96-04, is reclassified as MRZ-3 for PCC-grade aggregate in this update report. This site was underlain by Quaternary age alluvial deposits of the San Luis Rey River. The material, PCC-grade sand and gravel, is reportedly mined-out and site reclamation was certified complete by the lead agency in 2005.

CalMat Company Pala Reservation Pit: A 220-acre site in the San Luis Rey River Valley north of State Route 76 and east of Pala, previously classified MRZ-2 for PCC-grade aggregate in SR 153 and OFR 96-04 is reclassified as MRZ-3 for PCC-grade aggregate in this update report. This site was underlain by alluvial fan deposits eroded from the Palomar Mountains. These sand and gravel deposits of PCC-grade are apparently mined-out. The site is within the jurisdiction of the Pala Band of Mission Indians.

Miramar Marine Corp Air Station: Approximately 1,116 acres south of the main runways of the Marine Corp Air Station Miramar, north of State Route 52 previously classified MRZ-2 for PCC-grade aggregate in SR 153 and OFR 96-04 is reclassified as MRZ-3 for PCC-grade aggregate in this update report. This site is now the location of nearly filled municipal landfills; it was underlain by sand and gravel deposits of the Eocene age Poway Fan.

Enniss, Inc. San Vicente Pits: Two areas totaling about 37 acres along San Vicente Creek in the Moreno Valley south of San Vicente Reservoir and east of State Route 67 were classified MRZ-2 for PCC-grade aggregate in OFR 96-04. These areas are reclassified MRZ-3 for PCC-grade aggregate in this update report. This site was underlain by Quaternary age alluvial deposits of the San Vicente Creek. The material, sand and gravel of PCC-grade, is reportedly mined-out.

Hanson Aggregates, Inc. El Monte Sand Pit: A 104-acre site in the San Diego River Valley east of Lakeside, previously classified MRZ-2 for PCC-grade aggregate in SR 153 and OFR 96-04 is reclassified as MRZ-3 in this update report. This site is underlain by Quaternary age alluvial deposits of the San Diego River. The material, sand and gravel of PCC-grade, is reported to be mined-out. The site ceased production in 2009.

Sloan Canyon Sand Co., Sloan Canyon Sand Mine: A 166-acre site in the Sweetwater River Valley east of El Cajon near the community of Dehesa, previously classified MRZ-2 for PCC-grade aggregate in SR 153 and OFR 96-04 is reclassified as MRZ-3 in this update report. This site was underlain by Quaternary age alluvial deposits of the Sweetwater River. The material, sand and gravel of PCC-grade, is reported to be mined-out. The site ceased production in 2008; reclamation is in progress.

PART III - REEVALUATION OF PCC-GRADE AGGREGATE RESOURCES IN THE WESTERN SAN DIEGO COUNTY P-C REGION

This section of the report reevaluates the PCC-grade aggregate resources in the Western San Diego County P-C Region based on updated information. This reevaluation includes the areas originally designated by the SMGB and new areas identified in subsequent mineral land classification reports including this update report. These areas include:

- The nineteen Sectors designated by the SMGB in 1985,
- The five areas reclassified to MRZ-2 for PCC-grade aggregate in OFR 96-04,
- The Sycamore Ridge Property classified MRZ-2 for PCC-grade aggregate in OFR 88-16,
- The Rosemary's Mountain area classified MRZ-2 for PCC-grade aggregate in OFR 89-15,
- The Twin Oaks Quarry Property classified MRZ-2 for PCC-grade aggregate in SR 191,
- The Superior Ready Mix Jamacha Quarry reclassified to MRZ-2 for PCC-grade aggregate in this report, and
- The Cottonwood Golf Course/Sweetwater River area reclassified to MRZ-2 for PCC-grade aggregate in this report.

Reserve calculations in these areas are based on mining permits valid as of November 2015.

CONCEPTS USED IN IDENTIFYING AGGREGATE RESOURCE SECTORS

In the mineral land classification process, the identification and creation of MRZs is based on geologic factors alone without regard for current land uses. This results in the identification of resource areas on the maps, but does little to put into context the resource base available to meet the future needs of a region.

The State Geologist is responsible for identifying and calculating the amount of aggregate resources contained in areas classified as MRZ-2. Recognizing that there are lands within these areas that have already been urbanized, and therefore the mineral resources within them have a limited opportunity for conservation, development, and utilization, the State Geologist limits the aggregate resource calculations to areas within "Sectors."

Sectors are areas classified as MRZ-2 by the State Geologist, and that have current land uses deemed compatible with mining. The SMGB defines compatible land uses as those that are non-urbanized or that have very low-density residential developments (one dwelling unit per ten acres or less); land without high-cost improvements; and land used for agriculture, grazing, or open space. Urbanization and/or incompatible land uses are defined by the SMGB as improvements of high cost, such as high-density residential developments, intensive industrial developments, commercial developments, and major public facilities.

The delineation of Sectors helps land-use planners and local governments focus on the areas that remain accessible for potential mineral extraction. The State Geologist calculates the available resources of each Sector and identifies the amount of remaining resources that are permitted for mining (i.e., "reserves"). The calculated amount of reserves and resources within all the Sectors of a region are compared with the State Geologist's forecast of the 50-year needs of that region for the particular mineral resource.

Each Sector, or group of Sectors, meets or exceeds the SMGB's criteria for threshold value. Each Sector may be considered for designation as an area of regional or statewide significance by the SMGB pursuant to SMARA. The SMGB only considers lands within Sectors for designation. For this update, the determination of land use as accessible for mineral extraction was based on conditions as of January 2015. The land use was determined by referencing satellite imagery, field reconnaissance, and consulting local planners.

The SMGB's criteria for identifying Sectors focuses on the apparent suitability of the land for mining and does not take into consideration land commitments, other than approved housing tracts or Specific Plans, that may restrict the accessibility of some Sectors for mining. Therefore, it is possible that the available resource base as calculated by the State Geologist may be overestimated.

REEVALUATION OF PREVIOUSLY DESIGNATED AGGREGATE RESOURCE SECTORS

In 1985, the SMGB designated nineteen Sectors in the Western San Diego County P-C Region as containing aggregate resources of regional significance (SMGB, 1985). Designated Sectors J and V were further subdivided into subsectors J(1), J(5), and J(6); and V(1) and V(2), respectively. For this update report, the areas of the designated Sectors were determined, and revised in the case of incompatible land uses, using Geographic Information System technology and modern aerial imagery. Revisions, which result from changes in land use within Sectors, are shown on Plates 2A and 2B. Original and revised Sector areas and resources are summarized in Table 2.

In this update report, three designated Sectors are identified as having no available aggregate resources remaining -- Sector A, Subsector J(1), and Sector N. Deposit thicknesses, density, and the percentage of PCC-grade material contained were reviewed from earlier reports and revised where new information was available. The nineteen designated Sectors and subsectors with remaining aggregate resources in the Western San Diego County P-C Region are: Sectors B, C, D, E, F, H, I, J(5), J(6), K, M, O, P, Q, R, S, U, V(1) and V(2).

The total area of the original designated Sectors was 50,982 acres. Resource calculations in the original SMARA Designation Report (1985) reported 5,880 million tons of PCC-grade aggregate were recoverable from the designated Sectors.

Where available, the parameters and assumptions used in tonnage calculations for the various reports, including this update report, are included as Appendix A.

Table 2. Summary of PCC-Grade Aggregate Resources in Designated Sectors in the Western San Diego County P-C Region as of 2015.

SECTOR (Designated in 1985*)	**ORIGINAL DESIGNATED AREA** (acres)	**DESIGNATED AREA REMAINING IN 2015** (acres)	**AREA LOST** (acres)	**RESOURCES DESIGNATED IN 1985*** (tons)	**RESOURCES IN 2015#** (tons)
A	79	0	79	10,000,000	0
B	1,325	619	706	140,000,000	78,000,000
C	2,026	1,459	567	190,000,000	160,000,000
D	3,326	2,730	596	330,000,000	436,000,000
E	5,905	4,241	1,664	690,000,000	482,000,000
F	267	156	111	20,000,000	20,000,000
H	43	43	0	P	P
I	3,448	2,982	466	40,000,000	400,000,000
J (1)	474	0	474	3,520,000,000	0
J (5)	1,301	631	670		42,000,000
J (6)	26,230	18,850	7,380		3,095,000,000
K	97	86	11	20,000,000	P
M	1,835	1,134	701	90,000,000	172,000,000
N	100	0	100	10,000,000	0
O	151	151	0	20,000,000	4,000,000
P	212	181	31	30,000,000	15,000,000
Q	310	147	163	P	6,000,000
R	1,358	1,082	276	10,000,000	6,000,000
S	395	374	21	250,000,000	500,000,000
U	1,686	1,355	331	70,000,000	232,000,000
V (1)	268	224	44	10,000,000	18,000,000
V (2)	146	101	45		5,000,000
Totals	**50,982**	**36,546**	**14,436**	**5,880,000,000**	**5,700,000,000**

*: SMARA Designation Report No. 4 (SMGB, 1985).

#: Recalculated for this Report.

P: Proprietary Data.

Designated Sectors Where No Aggregate Resources Remain Available

Three areas designated by the SMGB in 1985 have been depleted by mining or are no longer available due to incompatible land uses. These areas are:

Sector A – An outcrop of dacitic volcanic rocks southeast of the City of Oceanside, south of State Route 78 and west of College Avenue (Plate 2A). This site historically was mined by South Coast Materials Company and Hanson Aggregates. This Sector covers 79 acres and was estimated to contain 10 million tons of PCC-grade aggregate resources in 1985.

Changes in Sector A: This Sector has been depleted by mining.

Sector J(1) – Mesa-forming conglomerate deposits in two areas west of the community of Rancho Bernardo and Interstate Highway 15 (Plate 2A). This Sector covers 474 acres and is estimated to contain about 40 million tons of PCC-grade aggregate resources.

Changes in Sector J(1): Since designation, all 474 acres of Sector J(1) have been urbanized. This has reduced the amount of available aggregate resources by an estimated 40 million tons.

Sector N – Alluvial deposits of the Sweetwater River near the community of Sunnyside between Sweetwater and Bonita roads, south of State Route 54 and west of State Route 125 (Plate 2B). The area of this Sector is 100 acres; the estimated PCC-grade aggregate resources totaled 10 million tons.

Changes in Sector N: This Sector is being utilized for park land uses incompatible with mining; the contained aggregate resources (10 million tons) are precluded from mining.

Designated Sectors Where Part of the Contained Aggregate Resources Remain Available

With the exception of Sectors A, J(1), and N described above, the remaining SMGB designated Sectors remain wholly or partially unaltered by urbanization or other incompatible land uses. A summary follows describing the factors, conditions, and status (as of 2015) of the remaining designated Sectors. These Sectors, including areas remaining available and those depleted by mining or lost to land uses incompatible with mining, are shown on Plates 2A and 2B.

Sector B – Channel and floodplain deposits of the San Luis Rey River from near Douglass Drive in the City of Oceanside and extending east about six miles to a point about 2,000 feet west of Vista Way and the old Bonsall bridge (Plate 2A).

Changes in Sector B: 706 acres of Sector B, primarily in the west, have been precluded from mining by urbanization. Approximately 619 acres containing 78 million tons of PCC-grade aggregate remain in Sector B.

Sector C – Channel and floodplain deposits of the San Luis Rey River from approximately 2,000 feet west of Vista Way at State Route 78 (Bonsall bridge) upstream to approximately 5,000 feet east of the Interstate Highway 15 bridge (Plate 2A).

Changes in Sector C: 567 acres have been precluded from mining by incompatible land uses. The remaining 1,459 acres in Sector C contain 160 million tons of PCC-grade aggregate.

Sector D – Fluvial and alluvial deposits of the San Luis Rey River; Sector D extends discontinuously from 500 feet east of Interstate Highway 15 upstream to the community of Rincon (Plate 2A).

Changes in Sector D: 596 acres have been depleted by mining or urbanized in this Sector. Approximately 2,730 acres containing 436 million tons of PCC-grade aggregate remain in Sector D.

Sector E – Alluvial fan deposits on the north side of San Luis Rey River from the community of Pala east to Pauma Valley (Plate 2A).

Changes in Sector E: 1,664 acres of this Sector have been urbanized or depleted by mining. Approximately 4,241 acres containing 482 million tons of PCC-grade aggregate remain in Sector E.

Sector F – Alluvial fan deposits on the east side of San Luis Rey River near the community of Rincon (Plate 2A).

Changes in Sector F: 111 acres of Sector F are now urbanized. Approximately 156 acres, containing 20 million tons of PCC-grade aggregate resources, remain in Sector F.

Sector H – Includes an area of the granitic rocks in the Merriam Mountains east of Twin Oaks Valley Road, approximately five miles north of the City of San Marcos (Plate 2A). The area of this Sector is 43 acres and the aggregate resource total is proprietary.

Changes in Sector H: There are no changes to Sector H.

Sector I – Channel and floodplain deposits of the San Dieguito River/Santa Ysabel Creek and tributaries upstream from Lake Hodges to the east end of San Pasqual Valley (Plate 2A).

Changes in Sector I: 466 acres have been precluded from mining by urbanization. Approximately 2,982 acres containing 400 million tons of mostly sand-size PCC-grade aggregate material remain accessible in Sector I.

Sector J – Mesa-forming conglomerate deposits in four areas in or near the communities of Rancho Bernardo, Rancho Penasquitos, Mira Mesa, Tierra Santa, the cities of Poway and Santee, and the Miramar Marine Corps Air Station. Only three subsectors, J(1), J(5),

and J(6) were previously designated. Subsector J(1) is shown on Plate 2A; subsectors J(5) and J(6) are shown on Plate 2B.

Changes in Sector J: Subsector J(1) covers 474 acres and has been completely urbanized. Subsector J(5) covers 1,301 acres, of which 670 acres are urbanized. Subsector J(6) cover 26,230 acres, of which 7,380 acres are urbanized or lost to incompatible land uses. In total, Sector J includes 28,005 acres, of which 8,524 are mined out or are areas otherwise precluded from mining by incompatible land uses. Approximately 19,481 acres, containing over 3,100 million tons of mostly coarse PCC-grade aggregate material, remain in Sector J.

Sector K – Underlain by metavolcanic rocks of the Santiago Peak Volcanics, north of the San Diego River in Mission Gorge (Plate 2B). The area of this Sector is 97 acres.

Changes in Sector K: 11 acres in Sector K adjacent to the San Diego River consist of protected wetlands and are precluded from mining. The aggregate resource total is proprietary.

Sector M – Channel and floodplain deposits of the San Diego River from Magnolia Avenue in the City of Santee east to within one mile of El Capitan Reservoir Dam (Plate 2B).

Changes in Sector M: 701 acres are mined out or otherwise precluded from mining by urbanization. Approximately 1,134 acres, containing an estimated 172 million tons of PCC-grade aggregate material, remain in Sector M.

Sector O – Alluvial deposits of the Sweetwater River upstream of Sweetwater Reservoir (Plate 2B). The area of this Sector is 151 acres.

Changes in Sector O: Resource recalculation for this update report indicated four million tons of aggregate resources compared to 20 million tons in previous reports.

Sector P – Alluvial deposits of the Sweetwater River in upper Jamacha Valley bounded on the west by Willow Glen Road between Hillsdale Road and Dehesa Road, southeast of the City of El Cajon (Plate 2B).

Changes in Sector P: 31 acres are mined out or otherwise precluded from mining by urbanization. Approximately 181 acres, containing 15 million tons of PCC-grade aggregate material, remain in Sector P.

Sector Q – Alluvial deposits of the Sweetwater River from the Singing Hills Golf Course/Sycuan Resort extending upstream about four miles (Plate 2B).

Changes in Sector Q: 163 acres are mined out or otherwise precluded from mining. Approximately 147 acres remain in Sector Q; this area, located mostly upstream of the

bridge on Sloan Canyon Road, is estimated to contain six million tons of PCC-grade aggregate material.

Sector R – Channel and floodplain deposits of the Otay River upstream from Interstate Highway 805 to near the eastern end of Otay Valley (Plate 2B). SR 153 reported that most of the area of Sector R has been mined to a depth of approximately 15 feet; at this depth, operators reportedly encountered a clay layer. SR 153 inferred the presence of additional PCC-grade resources exist beneath the clay layer.

Changes in Sector R: The original area of Designated Sector R was 1,358 acres; 276 acres have been urbanized leaving an area of 1,082 acres. An estimated six million tons of PCC-grade aggregate remain in Sector R. Additional inferred resources may exist at depth in Sector R.

Sector S – Metavolcanic rocks of the Santiago Peak Volcanics at Rock Mountain on the north side of upper Otay Valley (Plate 2B).

Changes in Sector S: The area of Sector S is 395 acres, of which, 21 acres have land uses not compatible with mining. The remaining 374 acres contain approximately 500 million tons of aggregate resources (including reserves). The permitted reserves are proprietary.

Sector U – Floodplain deposits of the Tijuana River from the international boundary downstream (west) about four miles (Plate 2B).

Changes in Sector U: The area of Sector U is 1,686 acres, of which, 331 acres have land uses incompatible with mining; these areas are shown on Plate 2B. The remaining 1,355 acres contain 232 million tons of PCC-grade resources (mostly sand).

Sector V – Mesa-forming conglomerate deposits of the San Diego and Lindavista Formations in the Border Highlands area south of the Tijuana River (Plate 2B). Sector V is subdivided into two subsectors, V(1) and V(2). The area of Sectors V(1) and V(2) is 268 acres and 146 acres, respectively.

Changes in Sector V: Of the 414 acres originally designated in Sector V, 44 acres of V(1) and 45 acres of V(2) are depleted or otherwise precluded from mining. Approximately 23 million tons of PCC-grade aggregate material are contained in the remaining 325 acres.

Reevaluation of the previously designated sectors indicates the total area designated by the SMGB was 50,982 acres. Of this designated area, an estimated 14,436 acres have been lost to urbanization, infrastructure, or other incompatible land uses. There has also been depletion of designated aggregate resources by production; these figures are not given due to concerns about revealing confidential production data.

The original resource calculations in SMARA Designation Report No. 4 reported a total of 5,880 million tons of PCC-grade aggregate were recoverable from designated sectors in the Western San Diego County P-C Region. Reevaluation of available PCC-grade aggregate resources for this update report -- using resource parameters from the original reports,

reinterpretations of original data, and new data -- indicates that about 5,700 million tons of resources remain accessible in previously designated Sectors as of 2015. While the difference between these appears to be relatively small, it accommodates several factors. For example:

- The loss of 14,436 acres (about 28%) of the originally designated area to land uses incompatible with future mining,
- Production of aggregate from designated areas since designation, and
- Changes in resource estimates (both additions and subtractions) based on reevaluation of the remaining previously designated areas.

Note in Table 2 that there are some differences in the tonnage values from Designation Report No. 4 (1985) and the values recalculated for this report. Information on the parameters used to calculate the resource numbers for the original designation report are unavailable. The updated values are based on the best current estimates of the various parameters (deposit thickness, density, waste factor, area) for each Sector. In some cases, these may be different from the values used originally resulting in either higher or lower resource estimates for a given Sector. Changes in acreage due to land use changes (areas lost to incompatible land use or depletion) also account for some of the differences. Appendix A contains the parameters and assumptions used in the tonnage calculations for this report and, where available, for the various earlier reports.

PCC-GRADE AGGREGATE RESOURCE SECTORS IDENTIFIED SINCE THE DESIGNATION OF THE WESTERN SAN DIEGO COUNTY P-C REGION

Nine new (yet, undesignated) aggregate resource Sectors for PCC-grade aggregate are identified in this update report: from north to south, the Sectors are identified as AA through II. Values used to calculate resources and reserves are included in Appendix A. Descriptions of these new Sectors follow:

Sector AA – Approximately 78 acres in the Pala/Rainbow area of north San Diego County (Plate 2A). It is on the north side of State Highway 76 approximately 1.25 miles east of Interstate Highway 15. Granodiorite and tonalite of Cretaceous age is mined to produce crushed rock aggregate, some of which is PCC-grade. The presence of significant aggregate resources in Sector AA was documented in OFR 89-15 (Clinkenbeard, 1989). The site was included in areas classified as MRZ-2 in OFR 96-04 (Miller, 1996). Granite Construction's Rosemary's Mountain Quarry is in Sector AA. Reserve and resource information is proprietary.

Sector BB – Approximately 164 acres northeast of the City of Vista and two miles west of Interstate Highway 15 in northern San Diego County (Plate 2A); it is west of Twin Oaks Valley Road in the South Fork of Gopher Canyon on the east slope of the San Marcos Mountains. Gabbro and diorite of Cretaceous age is mined to produce crushed rock aggregate, some of which is PCC-grade. The presence of significant aggregate

resources in Sector BB is documented in SR 191 (Busch, 2006). The Superior Ready Mix Twin Oaks Valley Road Quarry is in Sector BB. Reserve and resource information is proprietary.

Sector CC – Approximately 482 acres in northern San Diego County in the Merriam Mountains (Plate 2A). It is east of Twin Oaks Valley Road and west of Interstate Highway 15 between the South Fork of Gopher Canyon and the South Fork of Moosa Canyon. The presence of significant aggregate resources in Sector CC is documented in OFR 88-16 (Clinkenbeard, 1988) and OFR 96-04 (Miller, 1996). Granodiorite of Cretaceous age is the dominant rock-type; it has been demonstrated to be suitable for use as crushed rock aggregate of PCC-grade. It is estimated that approximately 120 million mineable tons of PCC-grade crushed rock aggregate resources exist in Sector CC. Hanson's inactive North Twin Oaks Valley Road Quarry is in Sector H, one-half mile west of Sector CC.

Sector DD – Approximately 180 acres of alluvial sand and gravel deposits along San Vicente Creek in northern Moreno Valley east of State Highway 67, south of San Vicente Reservoir and two miles north of the community of Lakeside in central San Diego County (Plate 2B). The site was classified MRZ-2 in OFR 96-04 (Miller, 1996). It is adjacent to the Enniss Sand Pit. It is estimated that approximately six million tons of PCC-grade alluvial sand and gravel resources are present in Sector DD.

Sector EE – Approximately 65 acres in central San Diego County (Plate 2B); it is west of Jamacha Road about two miles south of the City of El Cajon and two miles east of Casa de Oro. Cretaceous age quartz-diorite and gabbro of the western zone of the Peninsular Ranges batholith is mined to produce decomposed granite, fill, and crushed rock aggregate. Mining began in the 1940s primarily for decomposed granite and fill; more recently, mining has uncovered unweathered hard granitic rock suitable for use as crushed rock aggregate of PCC-grade. Sector EE is the site of the Superior Ready Mix Jamacha Rock Quarry. Reserve and resource information is proprietary.

Sector FF – Approximately 103 acres in central San Diego County about four miles southeast of the City of El Cajon and four miles northeast of Casa de Oro (Plate 2B); it is west of the Sweetwater River. Cretaceous age hornblende gabbro and quartz-diorite of the western zone of the Peninsular Ranges batholith is mined to produce decomposed granite, base, and crushed rock aggregate of PCC-grade. The presence of significant aggregate resources in Sector FF was reported in OFR 96-04 (Miller, 1996); the site was reclassified at that time from MRZ-3 to MRZ-2. Sector FF is the site of Hester's Granite Quarry operated by Robertson's Ready Mix. Reserve and resource information is proprietary.

Sector GG – Approximately 64 acres of alluvial sand and gravel deposits in Dehesa Valley, a tributary to the Sweetwater River approximately six miles east of El Cajon and five miles southwest of Alpine in central San Diego County (Plate 2B). The area underlain by Sector GG was reclassified from MRZ-4 to MRZ-2 in OFR 96-04 (Miller, 1996). Sector GG is adjacent to, and upstream of, the mined-out Sloan Canyon Sand Mine in Designated Sector Q. An estimated two million tons of PCC-grade alluvial sand and gravel resources are present in Sector GG.

Sector HH – Approximately 167 acres of alluvial sand and gravel deposits in Jamacha Valley along the middle reach of the Sweetwater River Valley approximately four miles southeast of the City of El Cajon and three miles east of Casa de Oro in central San Diego County (Plate 2B). Sector HH is reclassified in this update report from MRZ-3 and MRZ-4 to MRZ-2; this action is based on an aggregate resource evaluation report (TerraMins, 2006) provided to CGS in 2016 by the property owner. Sector HH is adjacent to, and downstream of Designated Sector P. Reserve and resource information is proprietary.

Sector II – Approximately 158 acres, about six miles north of the International Border in southern San Diego County (Plate 2B). It is immediately south of Otay Lakes Road, ten miles east of the City of Chula Vista and one mile east of Lower Otay Reservoir. Mesozoic age Santiago Peak Volcanic rocks are the source of crushed rock for use as PCC-grade aggregate. The presence of significant aggregate resources in Sector II was reported in OFR 96-04 (Miller, 1996), where the site was reclassified from MRZ-3 to MRZ-2. Sector II is the site of the Jamul Quarry. Reserve and resource information is proprietary.

To summarize, newly identified Sector areas AA through II total a combined 1,461 acres and contain an estimated 282 million tons of PCC-grade aggregate resources. Table 3 summarizes PCC-grade aggregate resources in the nine newly identified Sectors. Sectors AA through II may be considered for designation by the SMGB at a future date.

Table 3. Summary of PCC-Grade Aggregate Resources in Newly Identified Sectors in the Western San Diego County P-C Region.

NEW SECTOR	SECTOR AREA (acres)	NEW SECTOR PCC-GRADE RESOURCES (tons)
AA	78	P
BB	164	P
CC	482	120,000,000
DD	180	6,000,000
EE	65	P
FF	103	P
GG	64	2,000,000
HH	167	P
II	158	P
Totals	**1,461**	**282,000,000**

P: Proprietary Data.

RECALCULATION OF AVAILABLE PCC-GRADE AGGREGATE RESOURCES

As described above, the SMGB (1985) designated 50,982 acres in the Western San Diego County P-C Region as being of "regional significance." At that time, it was estimated that the designated areas contained 5,880 million tons of PCC-grade aggregate resources. The designated areas were identified as nineteen Sectors [with two of the Sectors further subdivided into five sub-Sectors, identified as J(1), J(5), and J(6); and V(1) and V(2)].

By the year 2015, three designated Sectors (A, J(1), and N) were, for various reasons, no longer available to provide aggregate resources. Parts of other Sectors are also identified as being unavailable for resource extraction. In total, incompatible land uses have reduced the area of the SMGB designated Sectors by 14,436 acres, a 28% reduction in area (Table 2).

Additional PCC-grade aggregate resources are identified as nine new Sectors in this update report; most have been previously identified in CGS reports published after SR 153. These new Sectors, identified as AA through II, total 1,461 acres and contain an estimated 282 million tons of PCC-grade aggregate. These newly identified resources, and the reevaluation and recalculation of resources in existing designated Sectors, have resulted in a slight increase in the total estimated PCC-grade resources for the P-C Region to 5,982 million tons — a net gain of about two percent compared to the resources contained in the SMGB designated areas.

Table 4 summarizes the current combined identified PCC-Grade Aggregate Resources in the Western San Diego County P-C Region.

Table 4. Summary of All Identified PCC-Grade Aggregate Resources in the Western San Diego County P-C Region as of 2015.

PCC-Grade Aggregate Resources Remaining in Designated Sectors	**5,700 million tons**
PCC-Grade Aggregate Resources Identified Since Designation	**282 million tons**
2015 Total Identified PCC-Grade Aggregate Resources	**5,982 million tons**

PART IV – PCC-GRADE AGGREGATE PRODUCTION IN THE WESTERN SAN DIEGO COUNTY P-C REGION

As of December 2014, based on data from the California Division of Mine Reclamation, eight companies had current, valid permits to operate eighteen mining properties capable of producing PCC-grade aggregate in the Western San Diego County P-C Region (one production site was operated as part of a permit for a municipal waste landfill). Four additional mining operations in the Region produce construction aggregate that has not been demonstrated to be of PCC-grade quality. The eight companies producing PCC-grade aggregate are:

- Hanson Aggregates West, Inc. (six properties),
- Superior Ready Mix Concrete L.P. (five properties),
- Vulcan Materials Company, CalMat Division (three properties),
- Granite Construction, Inc. (one property),
- Robertson's Ready Mix Ltd. (one property),
- Enniss, Inc. (one property),
- M.J. Baxter Drilling Company (one property), and
- RCP Block and Brick, Inc. (one property).

Permitted mining operations as of December 2014 are shown on Plates 2A and 2B. Brief descriptions of the operations follow:

Hanson Aggregates West, Inc. operates permitted mines in the City and County of San Diego. In the City of San Diego, it operates the Carroll Canyon Quarry (California Mine ID Number (CMID 91-37-0007), the Miramar Pit (CMID 91-37-0013), and at the Sycamore Landfill site (The Sycamore Landfill site produces aggregate as a byproduct of municipal waste landfill activities but does not operate as permitted mine and does not have a California Mine ID number). In the County of San Diego, it operates the Highway 67 and Vigilante Road Pit (CMID 91-37-0036), the Slaughterhouse Canyon Quarry (CMID 91-37-0021), and the Channel Road Pit (CMID 91-37-0065) in the Lakeside area.

The Carroll Canyon, Highway 67 & Vigilante Road, Slaughterhouse Canyon, Miramar Pit, and the Sycamore Landfill site all produce PCC and other grades of aggregate from Poway Group sediment of Eocene age. The Highway 67 & Vigilante Road and Slaughterhouse Canyon quarries could potentially produce additional aggregate from underlying Cretaceous-age granitic basement. The Channel Road Pit produces PCC-grade sand and gravel from alluvial deposits of Quaternary age.

Superior Ready Mix Concrete L.P. operates permitted mines in the City and County of San Diego. It operates the Canyon Rock Quarry (CMID 91-37-0024) in the City of San Diego. The Twin Oaks Valley Quarry (CMID 91-37-0052), the Willow Sand Resources

Pit (CMID 91-37-0010), the TTT Quarry (CMID 91-37-0019), and the Jamacha Rock Quarry (CMID 91-37-0011) operate in the County of San Diego.

The Canyon Rock Quarry produces PCC and other grades of aggregate from meta-andesite and other metavolcanic rocks of the Santiago Peak Volcanics of Mesozoic age. The Twin Oaks Valley Quarry produces PCC and other grades of aggregate from gabbro and diorite of Cretaceous age. Willow Sand Resources Pit produces PCC-grade sand and gravel from alluvial deposits of Quaternary age. The TTT Quarry produces PCC and other grades of aggregate from a fine- to medium-grained leucocratic intrusive rock of Mesozoic age. The Jamacha Rock Quarry produces PCC and other grades of aggregate from gabbro and quartz diorite of Cretaceous age.

Vulcan Materials Company CalMat Division operates the Rock Mountain Quarry (CMID 91-37-0035) in Chula Vista, the Carroll Canyon Pit (CMID 91-37-0029) in the City of San Diego, and the Poway Pit (CMID 91-37-0030) in the City of Poway.

The Carroll Canyon Pit and the Poway Pit produce PCC and other grades of aggregate from Poway Group sediments of Eocene age. The Rock Mountain Quarry produces PCC and other grades of aggregate from meta-andesite and other metavolcanic rocks of the Santiago Peak Volcanics of Mesozoic age.

Granite Construction, Inc. operates the Rosemary's Mountain Quarry near Fallbrook, in the County of San Diego. Rosemary's Mountain Quarry (CMID 91-37-0066) produces PCC and other grades of aggregate from Mesozoic-age granitic rocks.

Robertson's Ready Mix operates Hester's Granite Quarry southeast of El Cajon in San Diego County. Hester's Granite Quarry (CMID 91-37-0020) produces PCC and other grades of aggregate from gabbro and quartz diorite of Mesozoic age.

Enniss, Inc. operates the Enniss Sand Pit in Lakeside, San Diego County. The Enniss Pit (CMID 91-37-0041) produces PCC-grade sand and gravel from alluvial deposits of Quaternary age.

M.J. Baxter Drilling Company operates the M.J. Baxter Drilling Company Mine (CMID 91-37-0064) north of Lakeside in the County of San Diego. It is adjacent to Hanson's Highway 67 and Vigilante Road Pit. It produces PCC-grade aggregate and other material from Cretaceous age granitic basement.

RCP Block and Brick, Inc. operates RCP Pits 1, 2, 3, & 5 Inclusive in the City of Santee. RCP Pits 1, 2, 3, & 5 Inclusive (CMID 91-37-0025) produce PCC-grade sand and gravel from alluvial deposits of Quaternary age along the San Diego River.

In OFR 96-04 (Miller, 1996), it was noted that there had been a large decrease in both the number of instream sand mines and the reserves of instream sand between 1980 (25 mines and 121 million tons of reserves) and 1995 (eight mines and 55 million tons of reserves). In this report, there are four remaining sand mines, some of which are near depletion, containing approximately one million tons of reserves. As these mines have closed over time, the demand for sand in the Western San Diego County P-C Region has been met by importing material from

neighboring counties and/or Mexico. As discussed elsewhere in this report, importing sand results in increased aggregate costs, more rapid depletion of reserves in neighboring regions, and increased environmental and societal impacts in both the importing and exporting regions.

While instream mining has decreased in many parts of the State because of increasing environmental concerns, some jurisdictions have found environmentally compatible ways to allow sustainable production from local alluvial sources. For example, San Luis Obispo and Santa Barbara counties, in seeking to ensure future access to a large part of their concrete-grade sand and gravel resources in the Santa Maria and Sisquoc Rivers, jointly adopted the Santa Maria and Sisquoc Rivers Specific Plan (Santa Barbara County, 1997; San Luis Obispo County, 1998). This Plan provides for the coordinated long-term production of sand and gravel from a 12-mile section of the rivers in a manner that minimizes environmental impacts and ensures reclamation compatible with the surrounding land uses.

Permitted, Non-PCC-Grade Aggregate Producers

In 2014, four companies had valid permits to operate four mining properties producing construction materials of non-PCC-grade aggregate in the Western San Diego County P-C Region. The four companies producing non-PCC-grade construction materials are:

> Inland Valley Materials, Inc. operates the Inland Valley Materials Quarry on approximately 13 acres southeast of Escondido in the County of San Diego. This Quarry produces construction aggregate and decomposed granite from Cretaceous age tonalite of the Peninsular Ranges batholith.
>
> JEB Sand and Gravel Company operates the JEB Sand and Gravel Quarry on approximately 20 acres east of Escondido in the County of San Diego. This Quarry produces construction materials and decomposed granite from Cretaceous age granitic rocks of the Peninsular Ranges batholith.
>
> Mark Turvey operates the Turvey DG Pit on approximately 16 acres south of Interstate Highway I-8 west of the community of Alpine in the County of San Diego. The Turvey DG Pit produces decomposed granite and construction materials from weathered crystalline rocks of the Peninsular Ranges batholith.
>
> C.W. McGrath, Inc. operates the Tunnel Hill Pit on approximately 30 acres south of Lakeside in the County of San Diego. The pit produces fill dirt, decomposed granite and granite from granitic rocks of the Peninsular Ranges batholith.

These sites currently produce lower grades of construction aggregate such as fill and decomposed granite. The material produced from these sites has not currently been demonstrated to meet specifications for PCC-grade aggregate. Continued mining at these sites may or may not uncover less weathered materials that could meet PCC-grade quality specifications with additional processing. The locations of these operations are shown on Plates 2A and 2B.

AGGREGATE PRODUCTION DATA

Aggregate production data for the Western San Diego County P-C Region for 1985 through 1994 are taken from OFR 96-04 (Miller, 1996). These data were obtained from the U.S. Bureau of Mines and producers. For the few years with no reported production (in the 1980s), production was interpolated from the data for adjacent years. Data from 1995 through 2014 are derived from annual mine production data collected by the California Department of Conservation Division of Mine Reclamation, industry, and other sources.

Total production from the Western San Diego County P-C Region from 1985 through 2014 is reported to be about 285 million tons (Table 5). Since 1985, annual aggregate production in the Western San Diego County P-C Region has ranged from 15.5 million tons in 1990 to 4.5 million tons in 2010. Some of the variability in production may be due to economic fluctuations, such as the decrease that coincides with the economic recession beginning in 2007.

Table 5. Aggregate Production (all grades) in the Western San Diego County P-C Region 1985-2014.

YEAR	REPORTED PRODUCTION* (tons)	YEAR	REPORTED PRODUCTION* (tons)
1985	12,100,000	2000	11,315,484
1986	13,500,000	2001	11,441,118
1987	13,300,000	2002	10,492,933
1988	14,000,000	2003	10,770,572
1989	13,300,000	2004	10,108,095
1990	15,500,000	2005	9,421,189
1991	10,800,000	2006	9,461,491
1992	11,000,000	2007	7,014,226
1993	9,500,000	2008	5,813,336
1994	7,900,000	2009	4,611,606
1995	8,449,371	2010	4,538,609
1996	7,131,284	2011	4,749,818
1997	9,965,066	2012	4,866,021
1998	10,582,279	2013	5,794,047
1999	11,736,601	2014	5,714,407
		Total	**284,900,000†**

* 1985 to 1994 from OFR 96-04 (Miller, 1996); 1995 to 2014 from California Division of Mine Reclamation records.
† Rounded to nearest hundred thousand tons.

AGGREGATE IMPORTS

In some regions, local aggregate production is sufficient to meet the local demand, but in others, there is more demand than can be met by local production leading to a shortfall that is typically met by importing construction aggregate from neighboring aggregate producing regions. This is currently the situation in the Western San Diego County P-C Region. The San Diego Association of Governments (SANDAG) in their 2011 San Diego Region Aggregate Supply Study (SANDAG Service Bureau, 2011) found that local sources were adequate to meet local demands from 1975 through the early 1990s, but since the mid-1990s, additional aggregate (mostly sand) has been imported into the region to meet local demand. They found that aggregate has been imported from a variety of other regions including San Bernardino, Los Angeles, Riverside, and Imperial counties as well as from Mexico.

These findings are consistent with the information provided by San Diego County and the aggregate operators in this study. At various times, construction aggregate has been imported into the Western San Diego County P-C Region from mines in Los Angeles, San Bernardino, Riverside, and Imperial counties. Material has also been imported from Baja California, Mexico both overland and through the Port of San Diego.

For example, the 2014 mineral land classification update for the Temescal Valley Production Area, (SR 231; Miller and Busch, 2014) found that exports into the Western San Diego County P-C Region from the Temescal Valley Production Area for 2012 was estimated to be approximately five percent of the total aggregate production of the Temescal Valley Area. For 2012, this amounted to about 476,000 tons.

While the tonnages of aggregate produced in a region are reported annually, information on where the material is used is not. Aggregate producers may be hesitant to discuss specifics of their market regions because of the competitive nature of the industry. So, detailed information on annual aggregate import/export in a region is often difficult to obtain.

For this study, an estimate of the amount of aggregate imported into the Western San Diego County P-C Region has been made. Data on imports was collected from operators or other entities, such as local government or the Port of San Diego, to estimate annual aggregate imports into the Western San Diego County P-C region from 1995 to 2014. In addition, information on production of aggregate from non-mining sources such as landfill operations, habitat restoration projects, etc., was also collected. This information was used to make a conservative estimate on a year-by-year basis of the aggregate used in the Western San Diego County P-C Region from imports and local non-mine sources to better estimate the amount of aggregate used within the region from 1995 to 2014.

AGGREGATE CONSUMPTION

A “Production-Consumption Region” is, by the original definition, a study area in which 95% of aggregate produced is also consumed. CGS mineral land classification studies for a region typically employ the assumption that regional aggregate “production” equals regional aggregate

"consumption." For the Western San Diego County P-C Region, this assumption is no longer valid because of the import of materials from outside the P-C Region. In this report, we assume that aggregate "consumption" equals documented historical regional production, plus the estimated aggregate imports into the region for the same time period (see Table 6). This information will be used to project the future construction aggregate demand for the Western San Diego County P-C Region in the next chapter.

Table 6. Aggregate Production, Estimated Imports, and Estimated Consumption (all grades) in the Western San Diego County P-C Region 1985-2014.

YEAR	REPORTED PRODUCTION* (tons)	ESTIMATED IMPORTS (tons)	ESTIMATED CONSUMPTION* (tons)
1985	12,100,000	--	12,100,000
1986	13,500,000	--	13,500,000
1987	13,300,000	--	13,300,000
1988	14,000,000	--	14,000,000
1989	13,300,000	--	13,300,000
1990	15,500,000	--	15,500,000
1991	10,800,000	--	10,800,000
1992	11,000,000	--	11,000,000
1993	9,500,000	--	9,500,000
1994	7,900,000	--	7,900,000
1995	8,449,371	1,615,570	10,064,941
1996	7,131,284	1,613,755	8,745,039
1997	9,965,066	1,752,630	11,717,696
1998	10,582,279	1,789,700	12,371,979
1999	11,736,601	2,151,060	13,887,661
2000	11,315,484	2,866,635	14,182,119
2001	11,441,118	2,599,005	14,040,123
2002	10,492,933	3,238,740	13,731,673
2003	10,770,572	3,105,150	13,875,722
2004	10,108,095	2,862,950	12,971,045
2005	9,421,189	1,822,629	11,243,818
2006	9,461,491	1,807,038	11,268,529
2007	7,014,226	1,773,436	8,787,662
2008	5,813,336	1,736,959	7,550,295
2009	4,611,606	1,361,513	5,973,119
2010	4,538,609	1,408,003	5,946,612
2011	4,749,818	1,550,132	6,299,950
2012	4,866,021	1,451,164	6,317,185
2013	5,794,047	1,697,443	7,491,490
2014	5,714,407	2,129,159	7,843,566
Totals	**284,900,000†**	**40,300,000†**	**325,200,000†**

* 1985 to 1994 from OFR 96-04 (Miller, 1996); 1995 to 2014 from California Division of Mine Reclamation records.

† Rounded to nearest hundred thousand tons

PART V - UPDATED ESTIMATE OF THE 50-YEAR DEMAND FOR AGGREGATE IN THE WESTERN SAN DIEGO COUNTY P-C REGION

The SMGB guidelines for the classification and designation of mineral land (SMGB, 2000) specify that mineral land classification reports for regions containing construction materials classified as MRZ-2 include, "An estimate of the total quantity of construction aggregate that will be needed to supply the requirements of the county or marketing region in which it occurs for the next 50 years. The marketing region is defined as the area within which such material is usually mined and marketed. The amount of construction aggregate needed for the next 50 years is projected using past consumption rates adjusted for anticipated changes in population." This section of the report contains the revised estimate of aggregate demands for the Western San Diego County P-C Region, projected through the year 2065.

A comparison between the earlier projected aggregate demand calculations for the Western San Diego County P-C Region from SR 153 and OFR 96-04, and actual estimated consumption data for the region from the period of 1980 to 2014, is shown in Figure 2. Using an annual per capita consumption of 5.4 tons, OFR 96-04 projected that the demand for aggregate in the Western San Diego County P-C Region for 1995-2014 would be 233 million tons. Estimated consumption (reported production plus estimated imports) from the Western San Diego County P-C Region for the period is approximately 204 million tons – about 12 percent less than the previously projected demand. Some of the decrease in consumption may be due to variations in the economy such as the economic recession in the early 1990s and in 2007. Population growth in the region was also less than projected in OFR 96-04, possibly leading to reduced demand and production. A portion of the difference may also be associated with estimating actual aggregate consumption in a region that both produces aggregate and imports an undocumented amount of aggregate to meet local needs.

POPULATION PROJECTION THROUGH THE YEAR 2065

Historic population data for the Western San Diego County P-C Region for the years 1980 to 1990 were taken from OFR 96-04. Population data for the years 1991 to 2000 were interpolated between the 1990 population value from OFR 96-04 and 2000 population value from the 2000 Census (U.S. Census Bureau, 2000). Population data for the years 2000 to 2010 were interpolated from the U.S. Census Bureau (2000) data and U.S. Census Bureau (2010) data. Data for 2011 through 2015 data were obtained from the Census Bureau. Census Bureau figures were adjusted by a factor of 0.94 to reflect the fact that the population of the Western San Diego County P-C Region is calculated to be 94 percent of the population of San Diego County.

The population projection for the Western San Diego County P-C Region for 2016 to 2065 (Figure 3) was estimated from projections for counties published by the California Department of Finance Demographic Research Unit (California Department of Finance, 2014) and the population percentage factor for the P-C Region, cited above.

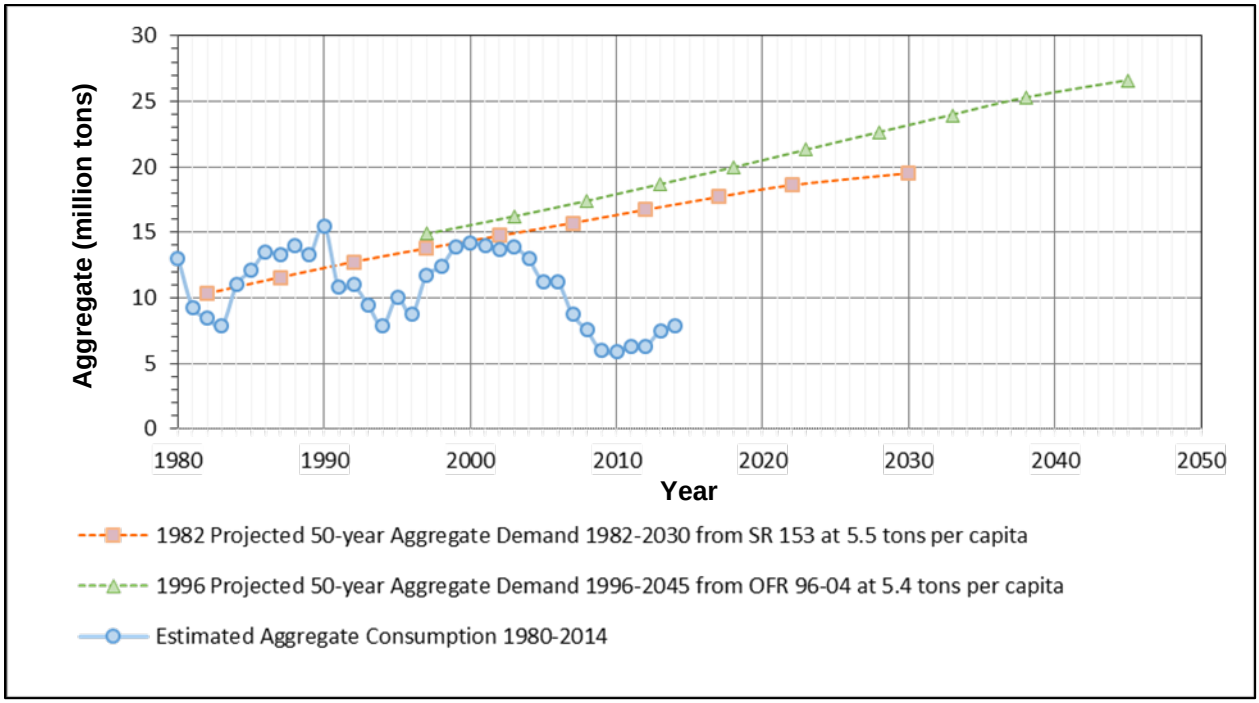

Figure 2. A Comparison of 1982 and 1996 Projections of Aggregate Demand for the Western San Diego County P-C Region with Estimated Aggregate Consumption for 1980-2014.

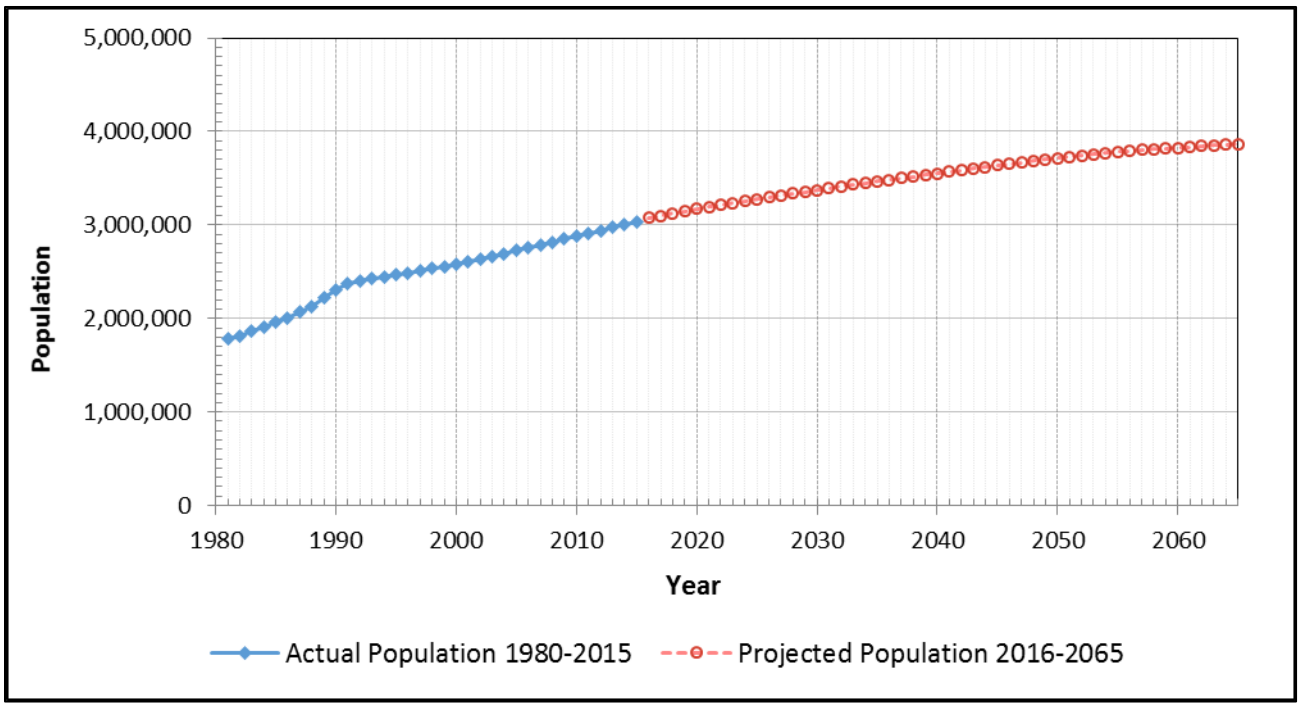

Figure 3. Actual and Projected Population in the Western San Diego County P-C Region 1980-2065.

The Department of Finance report provides population projections for counties in California for the years 2015, 2020, 2025, 2030, 2035, 2040, 2045, 2050, 2055, and 2060. Yearly population estimates were interpolated from the 5-year projected values and extrapolated for the years 2061 through 2065. The population of the Western San Diego County P-C Region is projected to increase by 794,180 to 3,868,828 in 2065 from 3,074,648 in 2016, an increase of about 26 percent.

HISTORICAL PER CAPITA AGGREGATE CONSUMPTION

An analysis using population growth data and historical annual per capita consumption is used to forecast future aggregate demand for a P-C Region. The annual per capita consumption is calculated by dividing the estimated aggregate consumption by the population for each year. The calculated average of the annual per capita consumption for the years 1985 to 2014 is 4.3 tons (Table 7).

PROJECTED AGGREGATE DEMAND THROUGH THE YEAR 2065

An analysis of the projected population and average annual per capita consumption rate, derived by the methods described in preceding sections, was used to forecast the aggregate demand of the Western San Diego County P-C Region for the years 2016 through 2065. The calculated annual per capita consumption rate of 4.3 tons/person/year was multiplied by the projected population for each year to produce the projected aggregate demand shown in Table 8. The estimated historical aggregate consumption with the projected aggregate demand are shown in Figure 4.

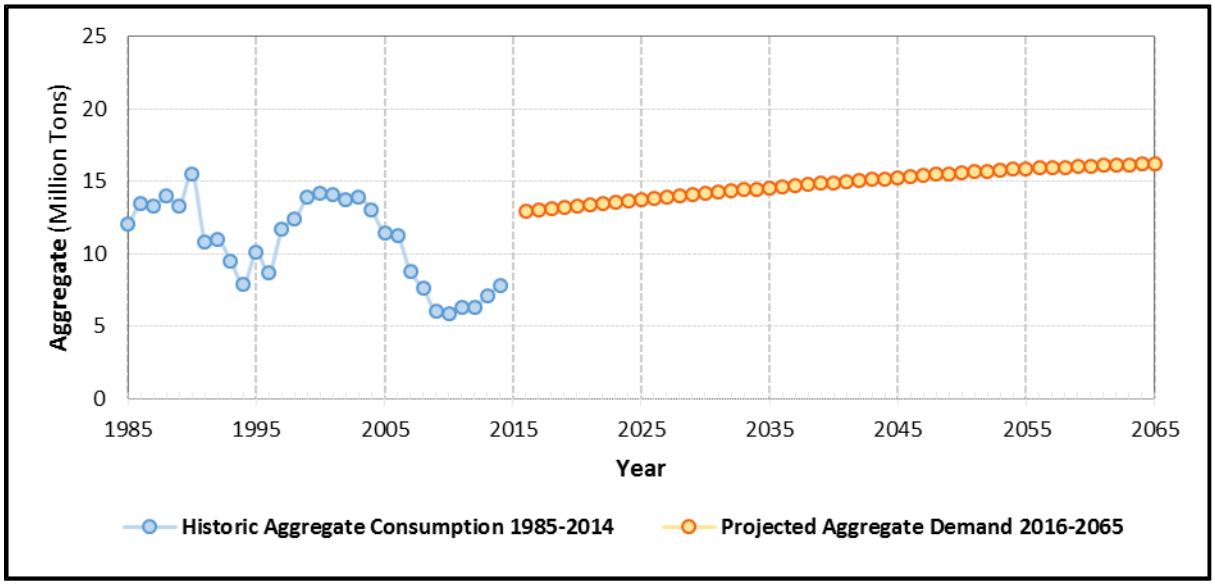

Figure 4. Estimated Historical Aggregate Consumption (1985-2014) with Projected Aggregate Demand to 2065.

Table 7. Population, Estimated Aggregate Consumption, and Estimated Annual Per Capita Consumption in the Western San Diego County P-C Region 1985-2014.

YEAR	POPULATION+	ESTIMATED AGGREGATE CONSUMPTION^* (tons)	ESTIMATED ANNUAL PER CAPITA CONSUMPTION^ (tons)
1985	2,007,595	12,100,000	6.0
1986	2,070,945	13,500,000	6.5
1987	2,120,177	13,300,000	6.3
1988	2,219,355	14,000,000	6.3
1989	2,301,024	13,300,000	5.8
1990	2,377,957	15,500,000	6.5
1991	2,400,196	10,800,000	4.5
1992	2,422,434	11,000,000	4.5
1993	2,444,673	9,500,000	3.9
1994	2,466,912	7,900,000	3.2
1995	2,489,151	10,064,941	4.0
1996	2,511,389	8,745,039	3.5
1997	2,533,628	11,717,696	4.6
1998	2,555,867	12,371,979	4.8
1999	2,578,105	13,887,661	5.4
2000	2,600,344	14,182,119	5.5
2001	2,631,269	14,040,123	5.3
2002	2,662,194	13,731,673	5.2
2003	2,693,120	13,875,722	5.2
2004	2,724,045	12,971,045	4.8
2005	2,754,969	11,243,818	4.1
2006	2,785,894	11,268,529	4.0
2007	2,816,819	8,787,662	3.1
2008	2,847,744	7,550,295	2.7
2009	2,878,669	5,973,119	2.1
2010	2,909,594	5,946,612	2.0
2011	2,940,519	6,299,950	2.1
2012	2,971,444	6,317,185	2.1
2013	3,002,369	7,491,490	2.5
2014	3,026,196	7,843,566	2.6
		Total: 325,200,000† (tons)	**Average: 4.3** (tons)

\+ Calculated as 94% of San Diego County population

^ Estimated Consumption = Regional Production + Estimated Net Imports.

* Values for 1985 – 1994 from OFR 96-04 (Miller, 1996).

† Rounded to nearest hundred thousand tons.

Table 8. Projected Population and Projected Aggregate Demand in the Western San Diego County P-C Region 2016-2065.

YEAR	PROJECTED* POPULATION	PROJECTED AGGREGATE DEMAND+ (all grades - in tons)	YEAR	PROJECTED* POPULATION	PROJECTED AGGREGATE DEMAND+ (all grades - in tons)
2016	3,074,648	13,220,986	2041	3,569,857	15,350,385
2017	3,099,273	13,326,874	2042	3,586,551	15,422,169
2018	3,123,897	13,432,757	2043	3,603,246	15,493,958
2019	3,148,522	13,538,645	2044	3,619,940	15,565,742
2020	3,173,146	13,644,528	2045	3,636,634	15,637,526
2021	3,193,164	13,730,605	2046	3,652,567	15,706,038
2022	3,213,487	13,817,994	2047	3,668,500	15,774,550
2023	3,233,657	13,904,725	2048	3,684,434	15,843,066
2024	3,253,828	13,991,460	2049	3,700,367	15,911,578
2025	3,273,998	14,078,191	2050	3,716,300	15,980,090
2026	3,294,109	14,164,669	2051	3,729,911	16,038,617
2027	3,314,220	14,251,146	2052	3,743,522	16,097,145
2028	3,334,332	14,337,628	2053	3,757,132	16,155,668
2029	3,354,443	14,424,105	2054	3,770,743	16,214,195
2030	3,374,554	14,510,582	2055	3,784,354	16,272,722
2031	3,393,285	14,591,125	2056	3,792,801	16,309,044
2032	3,412,016	14,671,669	2057	3,801,249	16,345,371
2033	3,430,748	14,752,216	2058	3,809,696	16,381,693
2034	3,449,479	14,832,760	2059	3,818,144	16,418,019
2035	3,468,210	14,913,303	2060	3,826,591	16,454,341
2036	3,485,201	14,986,364	2061	3,835,038	16,490,663
2037	3,502,191	15,059,421	2062	3,843,486	16,526,990
2038	3,519,182	15,132,483	2063	3,851,933	16,563,312
2039	3,536,172	15,205,540	2064	3,860,381	16,599,638
2040	3,553,163	15,278,601	2065	3,868,828	16,635,960
			Projected 50-Year Aggregate Demand:		**760,000,000** tons†

* California Department of Finance, 2014.

+ Calculated at 4.3 tons per capita.

† Rounded to the nearest million tons.

The projection presented in Figure 4 shows that an estimated 760 million tons of aggregate will be needed to satisfy future demand in the Western San Diego County P-C Region through the year 2065. Of this total, it is estimated that approximately 50 percent, or 380 million tons, will be used in PCC and AC, with the remainder being used in other construction aggregates. This percentage is based on estimates of current PCC-grade aggregate usage.

This updated 50-year projected demand is 27 percent lower than the 50-year demand projected in 1996 in OFR 96-04. Some of the difference in the projected 50-year demand numbers is due to the different per capita values used in the two reports. Open File Report 96-04 used an annual per capita consumption of 5.4 tons based on data for the years 1960 to 1994. This update uses an annual per capita consumption of 4.3 tons using data for the years 1985 to 2014. Part of the higher per capita consumption in OFR 96-04 may reflect the inclusion of data from the 1960s and early 1970s when the State was investing in infrastructure and associated development. Some of the difference in projected aggregate demand is likely caused by newer population projections used in this report, which project lower growth rates for the region. As previously discussed, some aggregate consumed in the region has been imported from neighboring counties and Mexico since the mid-1990s. Information on the exact amounts imported on an annual basis is unavailable. We have made a conservative estimate of these imports and contributions from non-mining sources to estimate the regional consumption of aggregate. If we have underestimated the actual consumption, the average annual per capita consumption could be greater than 4.3 tons. Thus, the projected future demand would be greater than 760 million tons.

COMPARISON OF THE 50-YEAR AGGREGATE DEMAND WITH CURRENT AGGREGATE RESERVES

The term “reserves” is used in CGS mineral land classification reports to refer to identified mineral resources that are “permitted to be mined.” Generally, this implies the operator possesses a valid permit and reclamation plan approved by the local lead agency.

The amount of PCC-grade aggregate reserves in the Western San Diego County P-C Region was calculated based on careful review of lead agency permit files, approved reclamation plans, and consultation with planners and industry representatives. Total PCC-grade aggregate reserves in the Western San Diego County P-C Region are estimated to be approximately 271 million tons as of 2015; these reserves are projected to last into the year 2035. It is important to note that not all aggregate reserves may be minable under the present permits because of operating restrictions or permit expiration dates.

Comparing regional needs to available reserves and resources demonstrates the important aggregate resource issues facing lead agencies in the region. These issues include the need to plan carefully for the use of lands containing these resources and the need to consider the permitting of additional aggregate resources in the P-C Region before currently permitted deposits are depleted.

In addition to population growth, other factors that could increase aggregate demand and accelerate depletion of reserves in the region include large-scale construction projects or catastrophic events (such as earthquakes) requiring rebuilding in or near the P-C Region.

Planning should take into consideration not only the demands of western San Diego County, but also the demands of neighboring regions that are currently competing for the resources imported into the San Diego area. For example, the Temescal Valley Production Area, an important source for imports into the Western San Diego County P-C Region, also exports a significant amount of its aggregate to major market areas in four surrounding counties (San Diego, Los Angeles, Orange, and San Bernardino) and this could increase in the future. Department of Finance estimates show the population for the five-county area containing Los Angeles, Orange, San Bernardino, Riverside, and San Diego counties is expected to increase by about 6.5 million people between 2010 and 2060 (California Department of Finance website, January 2013). Of that 6.5 million, Riverside County population is expected to grow by 2 million and San Bernardino County by about 1.4 million. Much of the future growth in these two counties will likely occur in the Inland Empire region served by source areas that also import aggregate into the Western San Diego County P-C Region and other neighboring regions. Population growth in these regions is likely to increase demand for aggregate.

Table 9 summarizes the identified aggregate resources and projected future aggregate demands for the Western San Diego County P-C Region. The projected lifespan of the aggregate reserves assumes that mining of these reserves will continue until they are depleted. Should unforeseen events occur, such as massive urban renewal, infrastructure projects, reconstruction in the wake of a disaster, or major economic recession, the demand for concrete aggregate in the P-C Region could change considerably.

Table 9. Summary of Aggregate Resources, Reserves, Projected 50-year Demand, and Depletion Date for the Western San Diego County P-C Region.

Estimated PCC-Grade Aggregate Resources	**5,982 million tons**
PCC-Grade Aggregate Reserves (Permitted Resources)	**271 million tons**
Projected 50-Year Demand for All Grades of Construction Aggregate	**760 million tons**
Projected 50-Year Demand of PCC-Grade Aggregate for Use in Portland Cement Concrete	**380 million tons**
Estimated Years Until Depletion of Current PCC-Grade Aggregate Reserves	**20**
Estimated Depletion Date of PCC-Grade Aggregate Reserves	**2035**

POTENTIAL ALTERNATIVE SOURCES OF AGGREGATE FOR THE WESTERN SAN DIEGO COUNTY P-C REGION

Potential additional sources of PCC-grade aggregate are likely to exist within and near the Western San Diego County P-C Region beyond those deposits classified as MRZ-2 in this update report.

Crushed Rock Sources

The Cretaceous plutonic and metavolcanic rocks of the western Peninsular Ranges batholith are potential alternative sources of PCC-quality crushed-rock aggregate. Sectors H, K, S, AA, BB, CC, EE, and FF within the P-C Region and Sector II outside of the P-C Region are all examples of locations where unweathered, chemically and physically resistant plutonic or metavolcanic rocks are demonstrated to be suitable for use as PCC-grade aggregate.

Other suitable areas of unweathered plutonic or metavolcanic rocks may exist within some of the MRZ-3 areas in the Western San Diego County P-C Region or in areas east of the P-C Region. Some may be adjacent to existing mines; others may not be near current or historic mining operations. However, while some plutonic and metavolcanic rocks of the Peninsular Ranges batholith are suitable as PCC-grade aggregate, rock from many locations may not be suitable. Some granitic rocks may be deeply weathered; some metavolcanic, metasedimentary, and older granitic rocks contain sulfide minerals or other deleterious materials. Older metasedimentary rocks, commonly present in the central part of the County, often occur as mixtures of rock types that may render a deposit unsuitable. Further exploration and testing is necessary to identify other areas containing plutonic or metavolcanic rocks suitable for PCC-grade aggregate. In addition to meeting quality requirements, alternative sources must be located close enough to the market region to be competitive with other aggregate sources in the region.

Synergistic Aggregate Production

Another potential alternative source of aggregate in the Western San Diego County P-C Region is synergistic aggregate production. Synergistic aggregate production occurs when production of aggregate materials is associated with the development of other necessary projects or beneficial land uses. This brings needed aggregate into the market from what would normally be perceived as non-mining projects. Such projects that have occurred in San Diego County include:

> Sycamore Landfill, west of the City of Santee, is a currently active example of synergistic aggregate production. Under the Sycamore Landfill Master Plan, the landfill owner/operator is subcontracting the excavation of 30-40 million cubic yards (50-70 million tons) of native earth material to expand landfill capacity, provide suitable landfill cover material, and produce PCC-grade aggregate as a co-product. This has the benefit of providing both needed landfill capacity and needed construction aggregate to the local market.
>
> California State University San Marcos is an example where aggregate extraction activities successfully facilitated the development of the campus and surrounding areas.

Possible project types that may be candidates for synergistic aggregate production include:

- Construction and operation of municipal waste landfills;
- Dredging of streams, flood control channels, sedimentation or debris basins, and reservoirs to remove sediment build-up and increase capacity;
- Habitat restoration projects;
- Public or private development projects; and
- Road/Highway construction or realignment projects.

Any such project will need evaluation on a case-by-case basis to determine if it meets local needs. While it may not be possible to incorporate synergistic aggregate production into all such projects, consideration of its inclusion by planners and decision makers could lead to needed aggregate resources entering the local market, and reducing transportation costs and environmental impacts when compared to aggregate imported from outside of the Western San Diego County P-C Region.

Imported Aggregate

As discussed in the previous chapter, prior to the early to mid-1990s, the demand for construction aggregate in the Western San Diego County P-C Region was apparently met by aggregate production from within the region. Since that time, imports have played a part in meeting the region's construction aggregate demand. Aggregate, predominantly sand, has been imported by truck from production areas in Thermal, Lake Elsinore, and Corona in Riverside County; Rialto in San Bernardino County; Irwindale in Los Angeles County; and Ocotillo in Imperial County. Aggregate has also been imported both by water and overland from Baja California, Mexico (SANDAG Service Bureau, 2011). Therefore, imports are already serving as an alternative source of aggregate for the Western San Diego County P-C Region. Table 10 presents one way distances from production areas in neighboring regions to the City of San Diego.

Table 10. One-way Import Distance by Truck from Neighboring Production Areas

COUNTY	PRODUCTION AREA	APPROXIMATE ONE WAY DISTANCE TO SAN DIEGO (miles)
Riverside	Thermal	169
Riverside	Lake Elsinore	75
Riverside	Corona	97
San Bernardino	Rialto	110
Los Angeles	Irwindale	129
Imperial	Ocotillo	87

There are both advantages and disadvantages to importing construction aggregate. Imports can provide needed aggregate in areas with depleted reserves/resources and can supply specific types of aggregate that are in short supply in the region. However, imported aggregate is often more expensive because of additional transportation costs. Increased costs for aggregate leads to more expensive construction projects in both the public and private sectors. Importing aggregate from neighboring regions also leads to more rapid depletion of reserves/resources in those regions, potentially contributing to price increases or aggregate shortages in those regions.

In addition to the greater economic costs, there are often increased environmental and societal costs associated with the import of aggregate when compared to local production. The environmental impacts include higher emissions of greenhouse gases, such as carbon dioxide (CO_2), and air pollution. The societal impacts include increased traffic congestion and road wear and maintenance due to increased truck traffic. In the case of imports, these environmental and societal impacts occur both within the importing region and in the neighboring regions that supply the material and through which the material is transported.

Currently almost all aggregate produced or imported into the Western San Diego County P-C Region is transported to its final point of use by truck. In discussions of aggregate import, other modes of transportation such as rail, barge, or ship are often mentioned as alternative methods of moving aggregate. SANDAG evaluated fuel use and CO_2 emissions for several scenarios involving different transport options for importing aggregate into the San Diego area (SANDAG Service Bureau, 2011).

They looked at the impacts based on various combinations of transport options for the following five scenarios:

- In region production,
- Import by truck from neighboring regions,
- Import by rail/truck from San Bernardino County,
- Import by barge/truck from Baja California, Mexico, and
- Import by ship/truck from British Columbia, Canada.

In the SANDAG study, fuel consumption, CO_2 emissions, and some other pollutant emissions (nitrogen oxides (NO_x) and particulate matter (PM)) were estimated based on round-trip travel, with aggregate transported to the point of use and the vehicle returning empty. For scenarios involving non-truck transport (rail, barge, and ship), delivery to the final point of use by truck was included. The transport scenarios and transport type and mileage considerations are presented in Table 11. More detail can be found in the SANDAG study (SANDAG Service Bureau, 2011).

Transportation methods that move larger amounts of aggregate per load can be more efficient in terms of fuel consumption (gallons of fuel consumed per net ton-mile traveled) and CO_2, NO_x, and PM emissions (grams of CO_2, NO_x, and PM emitted per net ton-mile traveled). However, even though these transport options may be more efficient on a net ton-mile basis, the total fuel consumption and emissions are dependent on the distance traveled. If those distances are large, total fuel consumption and emissions may exceed those of less efficient transportation methods

over shorter distances. This is demonstrated by SANDAG's findings. Even though transport by rail, barge, and ship have lower fuel consumption and CO_2 emissions per net ton-mile than transport by truck (Table 12), the total fuel usage and CO_2 emissions for those transport scenarios are greater than in-region production with truck delivery because of the distances involved (Table 13).

Table 11. Summary of SANDAG Aggregate Transport Scenarios

SANDAG AGGREGATE TRANSPORT SCENARIOS	
TRANSPORT OPTION	**MILEAGE BY MODE**
Local: Truck	26 miles one way / 52 miles round trip
Import: Truck	100 miles one way / 200 miles round trip
Import: Rail + Truck	Rail: 200 miles one way / 400 miles round trip Truck: 20 miles one way / 40 miles round trip
Import: Barge + Truck	Barge: 70 miles one way / 140 miles round trip Truck: 20 miles one way / 40 miles round trip
Import: Ship + Truck	Ship: 1,540 miles one way / 3,080 miles round trip Truck: 20 miles one way / 40 miles round trip

Adapted from SANDAG Service Bureau, 2011

Table 12. Fuel Consumption and CO_2 Emissions from Aggregate Transport with Payload

Mode	Payload	Fuel Consumption (gallons/net ton per mile)	CO_2 Emissions (grams/net ton per mile)
Truck	25 tons	0.0086	86.9
Rail	100 tons per hopper car	0.0021	21.4
Barge	1,500 tons	0.0068	69.6
Ship	72,786 tons	0.0004	5.3

Adapted from Tables 4-2 and 4-4, SANDAG Service Bureau, 2011

Table 13. Fuel Consumption and Emissions for Aggregate Transport Scenarios – Estimates per Million Tons of Aggregate Transported

Transport Option	Total Fuel Consumption (gallons)	Total CO_2 Emissions (metric tons)	Total NO_x Emissions (metric tons)	Total PM Emissions (metric tons)
Local: Truck	296,000	3,000	26.5	1.1
Import: Truck	1,138,000	11,537	102	4.4
Import: Rail + Truck	788,000	7,985	120.4	3.3
Import: Barge + Truck	804,000	8,210	147.1	5.1
Import: Ship + Truck	1,406,000	16,703	282.2	16.3

Adapted from SANDAG Service Bureau, 2011

Table 13 shows that, per million tons of aggregate transported, local production with transport by truck consumes less fuel and produces less CO_2, NOx, and PM than the other transport options investigated by SANDAG. Transport Option 2, import of one million tons of aggregate by truck from neighboring regions, consumes almost four times as much fuel and produces almost four times the emissions as the local production and delivery of a similar amount of aggregate. In addition, the impacts occur not only in the Western San Diego County P-C Region, but in neighboring regions which the materials are transported.

RECYCLED AGGREGATE

Asphalt and concrete are the most recycled materials in California by tonnage. Recycling programs that recover demolition rubble, such as concrete and asphalt, significantly help reduce the waste-stream going into landfills and extend the life of existing aggregate mines. However, recycled aggregate generally is not suitable for use as PCC-grade aggregate.

Many aggregate plants are equipped to collect and make base-grade aggregate from this material. In the current market, recycled base enjoys a lower price than “virgin” base material. Although California aggregate companies mainly process demolition debris into road base material, the use of recycled asphalt pavement has been steadily increasing since a percentage is now allowed to be added directly to hot asphalt mix to make AC.

In the Western San Diego County P-C Region, as in all the urban southern California areas, the rate of recycling of demolition waste is high. However, unless there is a large change in the use of recycled material for aggregate, there will not be a significant change in the demand for production of high-grade aggregate from virgin materials in the P-C Region. The supply of recycled aggregate is much less than the total demand for aggregate in the region.

PART VI - CONCLUSIONS

This update report reevaluates previously designated mineral resource sectors in the Western San Diego County P-C Region, recalculates the available resources, and identifies new mineral resource sectors based on recent information. The updated Mineral Land Classification and the updated Aggregate Resource Sectors are shown on Plate 1, Plate 2A, and Plate 2B.

As of January 2015, the Western San Diego County P-C Region contained approximately 5,982 million tons of designated and undesignated PCC-grade aggregate resources. This represents an increase of about 102 million tons from the 5,880 million tons of aggregate resources designated by the SMGB in1985. While the difference appears to be relatively small, it accommodates several factors including:

- The loss of 14,436 acres (about 28%) of the originally designated area to land uses incompatible with mining,
- Production of aggregate from designated areas since designation in 1985,
- Changes in resource estimates (both additions and subtractions) based on reevaluation of the remaining previously designated areas, and
- An additional 1,461 acres containing 282 million tons of currently undesignated aggregate resources identified in this study.

Of the 690,400 acres making up the Western San Diego County P-C Region, about 38,006 acres are identified as previously designated aggregate resource sectors or newly identified aggregate resource sectors in this study. This amounts to about 5.5 percent of the region. Reserves (currently permitted resources) make up only about 2,575 acres or less than 0.4 percent of the area of the region.

Aggregate resources in the Western San Diego County P-C Region occur on a mix of public, private, federal, and tribal lands. Of the almost six billion tons of PCC-grade aggregate resources identified in this report, approximately two-thirds are located on various government or tribal lands. This includes approximately two billion tons of resources located within the boundaries of the U.S. Department of the Navy Marine Corps Air Station Miramar. Permitting jurisdictions include the County of San Diego, the City of San Diego, the City of Chula Vista, the City of Poway, the City of Santee, the City of Imperial Beach, and various federal and tribal entities.

Based on available historical population and production data, and population projections, the Western San Diego County P-C Region will need approximately 760 million tons of aggregate during the next 50 years. Of this projected demand, it is estimated that 50 percent, or approximately 380 million tons, must be suitable for use in PCC. The current PCC-grade reserves of 271 million tons may last until 2035. These numbers are estimates and the actual lifespan of existing permitted reserves can be influenced by many factors. In periods of high economic growth, demand may increase, shortening the life of permitted reserves. Large projects, such as the construction or maintenance of major infrastructure, or rebuilding after a

disaster such as an earthquake could also deplete permitted reserves more rapidly. Conversely, a slow economy may reduce demand for a period of time, extending the life of permitted reserves, or new or expanded permits may be granted, increasing the permitted reserves and the lifespan of permitted reserves in an area.

In 1982 there were 46 mines producing PCC-grade construction aggregate in the Western San Diego County P-C Region (SR 153). By 1996 there were 27 mines (OFR 96-04) and in this study 18 mines producing PCC-grade aggregate in the region. SANDAG has projected that nine of the sixteen active and significant aggregate mining operations identified in their 2011 study could close before 2030 (SANDAG Service Bureau, 2011). Many of the mines that closed over the years supplied sand, a necessary component of PCC and other aggregate products. As a result, most of the aggregate currently imported into the San Diego region is sand. This has led to increased prices for construction aggregate in the region due in part to increased transportation costs. Future potential mine closures will include mines that produce all types of construction aggregate.

As mines close or reserves are depleted, the local demand for aggregate may be met in several ways:

- New mines, or expansions to existing mines, may be permitted, increasing the local supply of needed aggregate,
- Other mines in the region may increase production to fill the demand, and
- Aggregate imports may increase.

Permitting of new mines, or expansions to existing mines, maintains local production of needed construction aggregate. If other existing mines increase production to meet local demand, and no new mines or expansions are permitted, this would accelerate the overall depletion of local reserves. If the Western San Diego County P-C Region began to import not just sand, but other types of aggregate to replace dwindling reserves, it could lead to further increases in the cost of aggregate and in the societal and environmental impacts associated with the transportation of aggregate.

The San Diego area has, at various times, imported construction aggregate from Riverside, San Bernardino, Los Angeles, and Imperial counties and from Mexico. Production areas in several of these counties are facing potential future shortages of their own (Clinkenbeard, 2012) and San Diego is not the only Southern California region competing for additional aggregate supplies through imports. For example, the Temescal Valley Production Area is an important source of aggregate to consumers in San Diego, Los Angeles, Orange, western San Bernardino, and western Riverside counties.

Land-use planners and decision makers in California are faced with balancing a wide variety of needs in planning for a sustainable future for their communities. Mining is often seen as a controversial land use during the permitting process. However, there are benefits to having local sources of construction aggregate. Increasingly, as existing permitted aggregate supplies are depleted, local land-use decisions regarding aggregate resources can have regional impacts that go beyond local jurisdictional boundaries. Planning for future construction aggregate needs in the Western San Diego County P-C Region should take into consideration not only the needs of

Western San Diego County, but also the needs of neighboring regions. Importing aggregate from neighboring regions leads to more rapid depletion of reserves/resources in those regions, potentially contributing to price increases or aggregate shortages in those regions. In addition to the greater economic costs, there are often increased environmental and societal costs associated with the import of aggregate when compared to local production. The environmental impacts include higher emissions of greenhouse gases, such as CO_2, and air pollution. The societal impacts include increased traffic congestion and road maintenance due to increased truck traffic. In the case of imports, these environmental and societal impacts occur both within the importing region and in the neighboring regions that supply the material and through which the material is transported. Reliance on imports also places responsibility and authority for permitting related to local aggregate supply in the hands of decision makers in other jurisdictions.

A comparison of the results of this update with those of the previous update report (OFR 96-04) is presented in Table 14.

Table 14. Comparison of Data Reported in OFR 96-04 to Data Presented in this Update Report

	1995 (OFR 96-04)	**2015** (SR 240)
Population	2,593,562	3,050,422
Total PCC-Grade Resources	6,094 million tons	5,982 million tons
Projected 50-Year Demand of for All Grades of Construction Aggregate	1,050 million tons	760 million tons
Projected 50-Year Demand of PCC-Grade Aggregate	735 million tons	380 million tons
Total Permitted Aggregate Reserves	352 million tons	271 million tons
Permitted Instream Sand Reserves	55 million tons	1 million tons
Calculated Annual Per Capita Consumption	5.4 tons	4.3 tons
Calculated Years Until Depletion	20	20
PCC Aggregate Mines	27	18
Number of Mining Companies	16	8
Price of Aggregate Per Ton	$8.00	$17 - $22*

* $17 (PCC-, AC-grade aggregate), $22 (washed PCC-grade sand)

ACKNOWLEDGMENTS

The California Geological Survey gratefully acknowledges the cooperation of all the local government agencies, organizations, industry consultants, and the aggregate producers, all of whom provided information during the course of this study. Special thanks are extended to Milton Fonseca for his contributions to the GIS design and map layout of the Plates presented in this update report.

REFERENCES CITED

Anderson, T.P., Loyd, R.C., Clark, W.B., Miller, R.V., Corbaley, Richard, Kohler, Susan, and Bushnell, M.M., 1979, Mineral land classification of the Greater Los Angeles Area, Part I, Description of the mineral land classification project of the greater Los Angeles area, part II, Classification of sand and gravel resource areas, San Fernando Valley Production-Consumption Region: California Division of Mines and Geology, Special Report 143, 79 p.

Busch, Lawrence L., 2006, Mineral Land Classification of National Quarries' Twin Oaks Valley Road Site, San Marcos, San Diego County, California - for Construction Aggregate Resources: California Geological Survey, Special Report 191, 18 p.

California Department of Finance, 2014, Report P-1: Summary Population Projections, December 2014: http://www.dof.ca.gov/research/demographic/reports/projections/p-1/.

California Department of Finance, 2016, Consumer Price Index for U.S. and California - All Urban Consumer Series (February, 2016): http://www.dof.ca.gov/html/fs_data/latestecondata/fs_price.htm.

California State Mining and Geology Board, 1985, Designation of Regionally Significant Construction Aggregate Resource Areas in the Western San Diego County Production-Consumption Region: SMARA Designation Report No. 4.

California State Mining and Geology Board, 2000, California Surface Mining and Reclamation Policies and Procedures: California Department of Conservation website, http://www.conservation.ca.gov/SMGB/Guidelines/ClassDesig.pdf.

Clinkenbeard, J.C., 1988, Mineral Land Classification of the Sycamore Ridge Property, San Marcos Quadrangle, San Diego County, California - for Portland Cement Concrete Grade Aggregate: Division of Mines and Geology, Open File Report 88-16, 15 p., 2 plates.

Clinkenbeard, J.C., 1989, Mineral Land Classification of the Pankey Ranch Site, Bonsall Quadrangle, San Diego County, California – for Aggregate Materials: Division of Mines and Geology, Open File Report 89-15, 1 p., 1 plate.

Clinkenbeard, J.C., 2012, Aggregate Sustainability in California, California Geological Survey, Map Sheet 52 (Updated 2012) scale 1:1,100,000, 27p.

Kohler, S.L. and Miller, R.V., 1982, Mineral Land Classification: Aggregate Materials in the Western San Diego County Production-Consumption Region: California Department of Conservation, Division of Mines and Geology, Special Report 153.

Miller, R.V., 1994, Update of Mineral Land Classification of Portland Cement Concrete Aggregate in Ventura, Los Angeles, and Orange Counties, California, Part II, Los Angeles County: California Department of Conservation, Division of Mine and Geology, Open-File Report 94-14.

Miller, R.V., 1996, Update of Mineral Land Classification: Aggregate Materials in the Western San Diego County Production-Consumption Region: California Department of Conservation, Division of Mines and Geology, Open-File Report 96-04.

Miller, R.V., and Busch, L.L., 2014, Update of Mineral Land Classification for Portland Cement Concrete-Grade Aggregate in the Temescal Valley Production Area, Riverside County, California: California Geological Survey, Department of Conservation, Special Report 231.

TerraMins, Inc., 2006, Quality Assessment of Fluvial Materials at the Cottonwood Golf Course for Construction Aggregate Sand Resources, El Cajon, San Diego County, California.

San Diego Association of Governments Service Bureau, January 2011, San Diego Region Aggregate Supply Study: 118 p., http://www.sandag.org/uploads/publicationid/publicationid_1558_12638.pdf.

San Luis Obispo County, 1998, Santa Maria and Sisquoc Rivers Specific Plan: adopted January 20, 1998.

Santa Barbara County, 1997, Santa Maria and Sisquoc Rivers Specific Plan: adopted December 9, 1997.

U.S. Census Bureau, 2000, Table DP-1. Profile of General Demographic Characteristics: 2000; Census 2000.

U.S. Census Bureau, 2010 Population Finder - 2010 Demographic Profile of San Diego County; (5/2016). http://www.census.gov/popfinder/.

Appendix

Parameters, Factors, and Assumptions
Used in Resource Calculations
Western San Diego County P-C Region (1982-2015)

Sector	Data Source	Area of Sector† (Acres)	Thickness of Deposit (Feet)	Density Factor (Tons/Ft^3)	Waste Factor (Percent)	PCC-Grade Resources (Tons)
A	CDMG Classification Report SR 153 (1982)	587	up to 300	0.090	5	400,000,000
	SMARA Designation Report No. 4 (1985)	79	NR	NR	NR	10,000,000
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	NR
	This Update Report (SR 240, 2017)	0	- -	- -	- -	0
B	CDMG Classification Report SR 153 (1982)	1,307	100	0.055	15	240,000,000
	SMARA Designation Report No. 4 (1985)	1,325	NR	NR	NR	140,000,000
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	80,000,000
	This Update Report (SR 240, 2017)	619	25-100	0.055	15	78,000,000
C	CDMG Classification Report SR 153 (1982)	2,160	95	0.055	10	220,000,000
	SMARA Designation Report No. 4 (1985)	2,026	NR	NR	NR	190,000,000
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	169,000,000‡
	This Update Report (SR 240, 2017)	1,459	25-60	0.055	10	160,000,000
D	CDMG Classification Report SR 153 (1982)	3,740	90-200	0.055	7	770,000,000
	SMARA Designation Report No. 4 (1985)	3,326	NR	NR	NR	330,000,000
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	308,000,000‡
	This Update Report (SR 240, 2017)	2,730	20-90	0.055	7-10	436,000,000
E	CDMG Classification Report SR 153 (1982)	5,818	40-80	0.065	25	830,000,000
	SMARA Designation Report No. 4 (1985)	5,905	NR	NR	NR	690,000,000
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	652,000,000‡
	This Update Report (SR 240, 2017)	4,241	50-60	0.055	25	482,000,000

Sector	Data Source	Area of Sector† (Acres)	Thickness of Deposit (Feet)	Density Factor (Tons/Ft^3)	Waste Factor (Percent)	PCC-Grade Resources (Tons)
F	CDMG Classification Report SR 153 (1982)	857	80	0.065	25	140,000,000
	SMARA Designation Report No. 4 (1985)	267	NR	NR	NR	20,000,000
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	20,000,000‡
	This Update Report (SR 240, 2017)	156	75	0.065	25	20,000,000
H	CDMG Classification Report SR 153 (1982)	124	475	0.082	5	P
	SMARA Designation Report No. 4 (1985)	43	NR	NR	NR	P
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	0‡*
	This Update Report (SR 240, 2017)	43	680	0.082	5	P
I	CDMG Classification Report SR 153 (1982)	3,521	85	0.055	10	510,000,000
	SMARA Designation Report No. 4 (1985)	3,448	NR	NR	NR	40,000,000
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	39,000,000‡
	This Update Report (SR 240, 2017)	2,982	25-75	0.055	10	400,000,000
J (1)	CDMG Classification Report SR 153 (1982)	**	Up to 500	0.065	30	**
	SMARA Designation Report No. 4 (1985)	474	NR	NR	NR	**
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	**
	This Update Report (SR 240, 2017)	0	50	0.065	40	0
J (5)	CDMG Classification Report SR 153 (1982)	**	Up to 500	0.065	30	**
	SMARA Designation Report No. 4 (1985)	1,301	NR	NR	NR	**
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	**
	This Update Report (SR 240, 2017)	631	40-60	0.065	40	42,000,000

Sector	Data Source	Area of Sector† (Acres)	Thickness of Deposit (Feet)	Density Factor (Tons/Ft^3)	Waste Factor (Percent)	PCC-Grade Resources (Tons)
J (6)	CDMG Classification Report SR 153 (1982)	35,661**	Up to 500	0.065	30	5,810,000,000**
	SMARA Designation Report No. 4 (1985)	26,230	NR	NR	NR	3,520,000,000**
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	3,027,000,000‡**
	This Update Report (SR 240, 2017)	18,850	40-400	0.065	30-40	3,095,000,000
K	CDMG Classification Report SR 153 (1982)	386	Up to 300	0.090	5	140,000,000
	SMARA Designation Report No. 4 (1985)	97	NR	NR	NR	20,000,000
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	20,000,000‡
	This Update Report (SR 240, 2017)	86	100	0.090	10	P
M	CDMG Classification Report SR 153 (1982)	2,150	155	0.055	15	540,000,000
	SMARA Designation Report No. 4 (1985)	1,835	NR	NR	NR	90,000,000
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	49,000,000‡
	This Update Report (SR 240, 2017)	1,134	20-100	0.055	10-30	172,000,000
N	CDMG Classification Report SR 153 (1982)	150	60	0.055	25	10,000,000
	SMARA Designation Report No. 4 (1985)	100	NR	NR	NR	10,000,000
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	0
	This Update Report (SR 240, 2017)	0	50	0.055	25	0
O	CDMG Classification Report SR 153 (1982)	183	15	0.055	25	>20,000,000
	SMARA Designation Report No. 4 (1985)	151	NR	NR	NR	20,000,000
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	20,000,000
	This Update Report (SR 240, 2017)	151	10-20	0.055	25-40	4,000,000

Sector	Data Source	Area of Sector† (Acres)	Thickness of Deposit (Feet)	Density Factor (Tons/Ft^3)	Waste Factor (Percent)	PCC-Grade Resources (Tons)
P	CDMG Classification Report SR 153 (1982)	343	60	0.055	20	30,000,000
	SMARA Designation Report No. 4 (1985)	212	NR	NR	NR	30,000,000
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	29,000,000‡
	This Update Report (SR 240, 2017)	171	60	0.055	20	15,000,000
Q	CDMG Classification Report SR 153 (1982)	400	60	0.055	10	P
	SMARA Designation Report No. 4 (1985)	310	NR	NR	NR	P
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	0‡
	This Update Report (SR 240, 2017)	147	25	0.055	10	6,000,000
R	CDMG Classification Report SR 153 (1982)	2,727	70	0.065	40	170,000,000
	SMARA Designation Report No. 4 (1985)	1,358	NR	NR	NR	10,000,000
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	10,000,000‡
	This Update Report (SR 240, 2017)	1,082	40	0.060	40	6,000,000
S	CDMG Classification Report SR 153 (1982)	360	Up to 450	0.090	5	250,000,000
	SMARA Designation Report No. 4 (1985)	395	NR	NR	NR	250,000,000
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	221,000,000‡
	This Update Report (SR 240, 2017)	374	900	0.090	5	500,000,000
U	CDMG Classification Report SR 153 (1982)	2,197	90	0.055	10	400,000,000
	SMARA Designation Report No. 4 (1985)	1,686	NR	NR	NR	70,000,000
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	70,000,000‡
	This Update Report (SR 240, 2017)	1,355	90	0.055	10	232,000,000

Sector	Data Source	Area of Sector† (Acres)	Thickness of Deposit (Feet)	Density Factor (Tons/Ft^3)	Waste Factor (Percent)	PCC-Grade Resources (Tons)
V (1)	CDMG Classification Report SR 153 (1982)	***	Up to 200	0.070	35	***
	SMARA Designation Report No. 4 (1985)	268	NR	NR	NR	***
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	***
	This Update Report (SR 240, 2017)	194	60	0.065	10	18,000,000
V (2)	CDMG Classification Report SR 153 (1982)	475***	Up to 200	0.070	35	120,000,000***
	SMARA Designation Report No. 4 (1985)	146	NR	NR	NR	10,000,000***
	CDMG Classification Report OFR 96-04 (1996)	NR	NR	NR	NR	10,000,000***
	This Update Report (SR 240, 2017)	101	40-60	0.065	35	5,000,000
Totals	CDMG Classification Report SR 153 (1982)	**62,937**	- -	- -	- -	**11,900,000,000**
	SMARA Designation Report No. 4 (1985)	**50,982**	- -	- -	- -	**5,880,000,000**
	CDMG Classification Report OFR 96-04 (1996)	- -	- -	- -	- -	**4,725,000,000‡**
	This Update Report (SR 240, 2017)	**36,545**	- -	- -	- -	**5,700,000,000**

P Proprietary

NR Not Reported

† Areas not reported in Designation Report No. 4; acreage presented in this appendix for the Designation Report were calculated in 2016 from original maps using GIS.

‡ Unpermitted resources as of January, 1996.

* Resource permitted for commodity other than PCC.

** Total for J(1), J(5), and J(6) combined in SR 153 (1982), Designation Report No. 4 (1985), and OFR 96-04 (1996).

*** Total for V(1) and V(2) combined in SR 153 (1982), Designation Report No. 4 (1985), and OFR 96-04 (1996).

Sector locations shown on Plate 2A and Plate 2B.