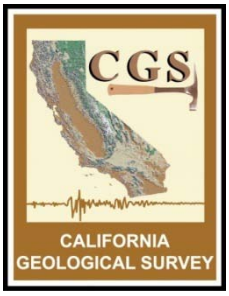
SPECIAL REPORT 210

UPDATE OF MINERAL LAND CLASSIFICATION: AGGREGATE MATERIALS IN THE BAKERSFIELD PRODUCTION-CONSUMPTION REGION, KERN COUNTY, CALIFORNIA

2009



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SPECIAL REPORT 210

UPDATE OF MINERAL LAND CLASSIFICATION: AGGREGATE MATERIALS IN THE BAKERSFIELD PRODUCTION-CONSUMPTION REGION, KERN COUNTY, CALIFORNIA

By

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PG #6440

2009

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Table of Contents

Figures

Tables

Plates (In Pocket)

EXECUTIVE SUMMARY

This report updates information presented in a classification report on portland cement concrete-grade (PCC) aggregate in the Bakersfield Production-Consumption (P-C) Region first published in 1988. That report was published by the California Department of Conservation's Division of Mines and Geology (now California Geological Survey) as Special Report 147 (SR 147) – *Mineral Land Classification: Aggregate Materials in the Bakersfield Production-Consumption Region* (Cole, 1984).

The publication of SR 147 accomplished part-one of the two-part *Classification-Designation process*. Part-two of the two-step process, which normally would have included the State Mining and Geology Board (Board) designating lands within the Bakersfield Production-Consumption (P-C) Region as having mineral resources of statewide or regional significance, was not completed. This report presents a reevaluation and update of SR 147 for the benefit of local lead agencies in the Bakersfield P-C Region.

Sand and gravel deposits having material suitable for use as construction aggregate are classified in this update report. Emphasis was placed on deposits of PCC-grade aggregate; however permitted deposits suitable for lower grades of aggregate use, such as asphaltic aggregate, base, subbase, and fill were also included. Only PCC-grade deposits were placed in Sectors for potential consideration for designation by the State Mining and Geology Board.

In this update report, the following conclusions are made:

- Currently permitted reserves are projected to last through the year 2031, 22 years from the present (2009).

- In this update report an additional 2,456 acres of land containing an estimated 442 million tons of resources are identified in areas adjacent to the Bakersfield P-C Region.

- The anticipated consumption of aggregate in the Bakersfield P-C Region for the next 50 years (through the year 2058) is estimated to be 467 million tons, of which 224 million tons must be PCC quality. This is more than twice the previous 50-year projection.

- An estimated 4,279 million tons of unpermitted PCC-grade aggregate resources are identified in the Bakersfield P-C Region and adjacent areas.

PART I - INTRODUCTION

In 1988, a report titled "Mineral Land Classification: Aggregate Materials in Bakersfield Production-Consumption Region" (Cole, 1988) was published by the California Division of Mines and Geology (predecessor to the California Geological Survey or "CGS"). It is referred to in this update report as SR 147. In SR 147, a part of western Kern County was classified for aggregate materials (see Figure 1). The area of the region is 1,794 square miles, and is covered by all or part of 46 U.S. Geological Survey 7-1/2 minute quadrangle maps as shown on Figure 2.

The publication of SR 147 and this update report represents the classification phase of the two-part classification-designation process. The second phase of the process, the designation by the State Mining and Geology Board (Board) of lands within the Bakersfield Production-Consumption (P-C) Region to be of regional or statewide economic significance has not yet occurred.

This report presents a reevaluation and update of SR 147 for the benefit of local lead agencies in the Bakersfield P-C Region (see Table 1 for a list of lead agencies). New information on resource sectors, aggregate resources and reserves, aggregate consumption, and projected 50-year aggregate demand in the Bakersfield P-C Region have been incorporated to assist land use planners and decision makers to better understand, and plan for, the Region's future construction aggregate needs. Most users will find that this report meets their information needs; however those users wanting more detailed information on the geology and original mineral resource zoning will find it in SR 147.

BACKGROUND

SR 147 and this update were produced by the State Geologist as specified by the Surface Mining and Reclamation Act (SMARA) of 1975. 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 adequate mined-land reclamation. To address mineral resource conservation, SMARA mandated the two-phase process called 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 Board develop guidelines for mineral land classification. The Board adopted SMARA guidelines on June 30, 1978 and revised them in 2000. The guidelines are available on the State Mining and Geology Board website at http:/www.consrv.ca.gov/SMGB/Guidelines/ClassDesig.pdf.

The guidelines require the State Geologist to classify specified areas into Mineral Resource Zones (MRZs). The guidelines also require that classification reports for construction aggregate resources include the following additional information: (1) the location and estimated total

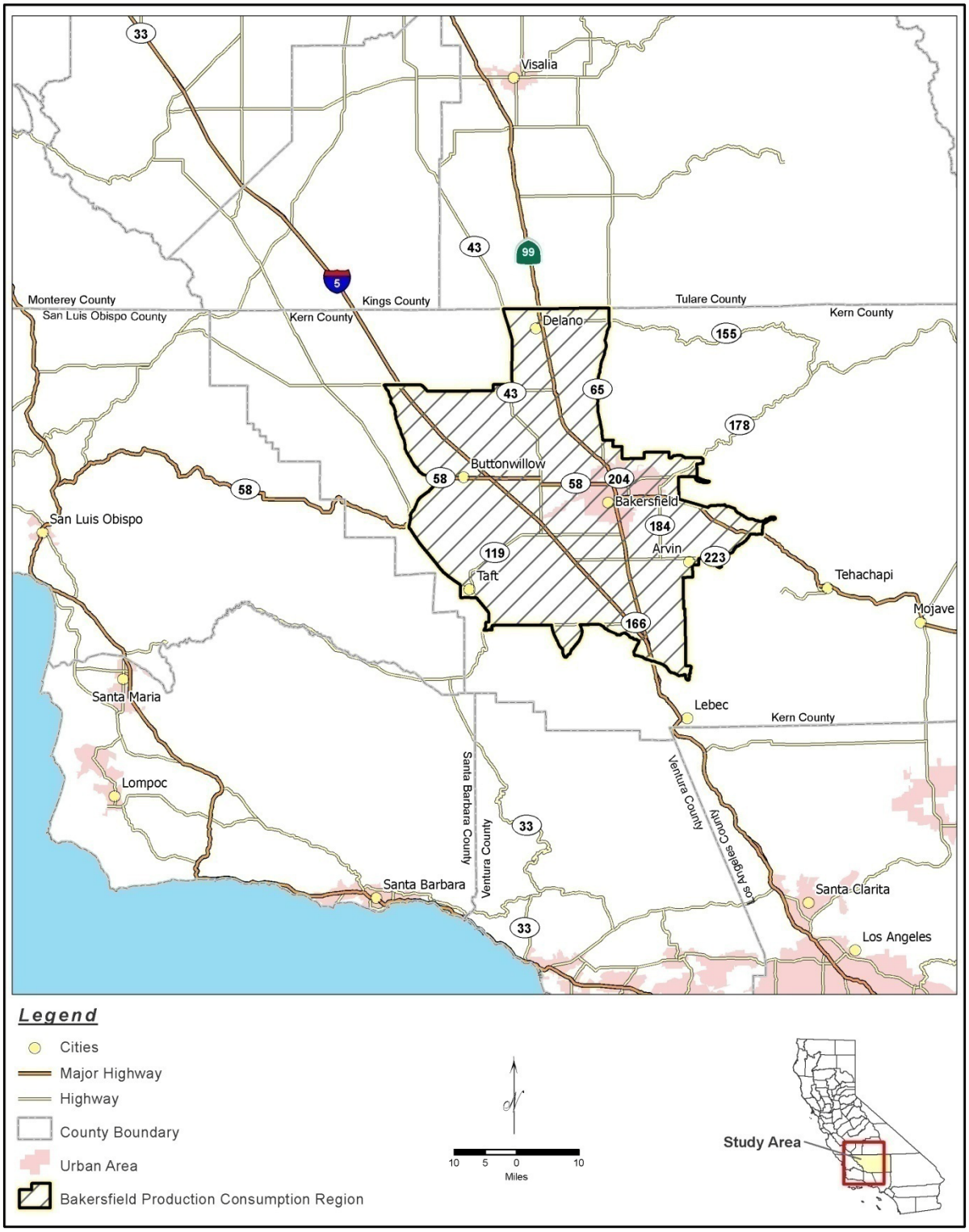


Figure 1. General location map of the Bakersfield Production-Consumption Region

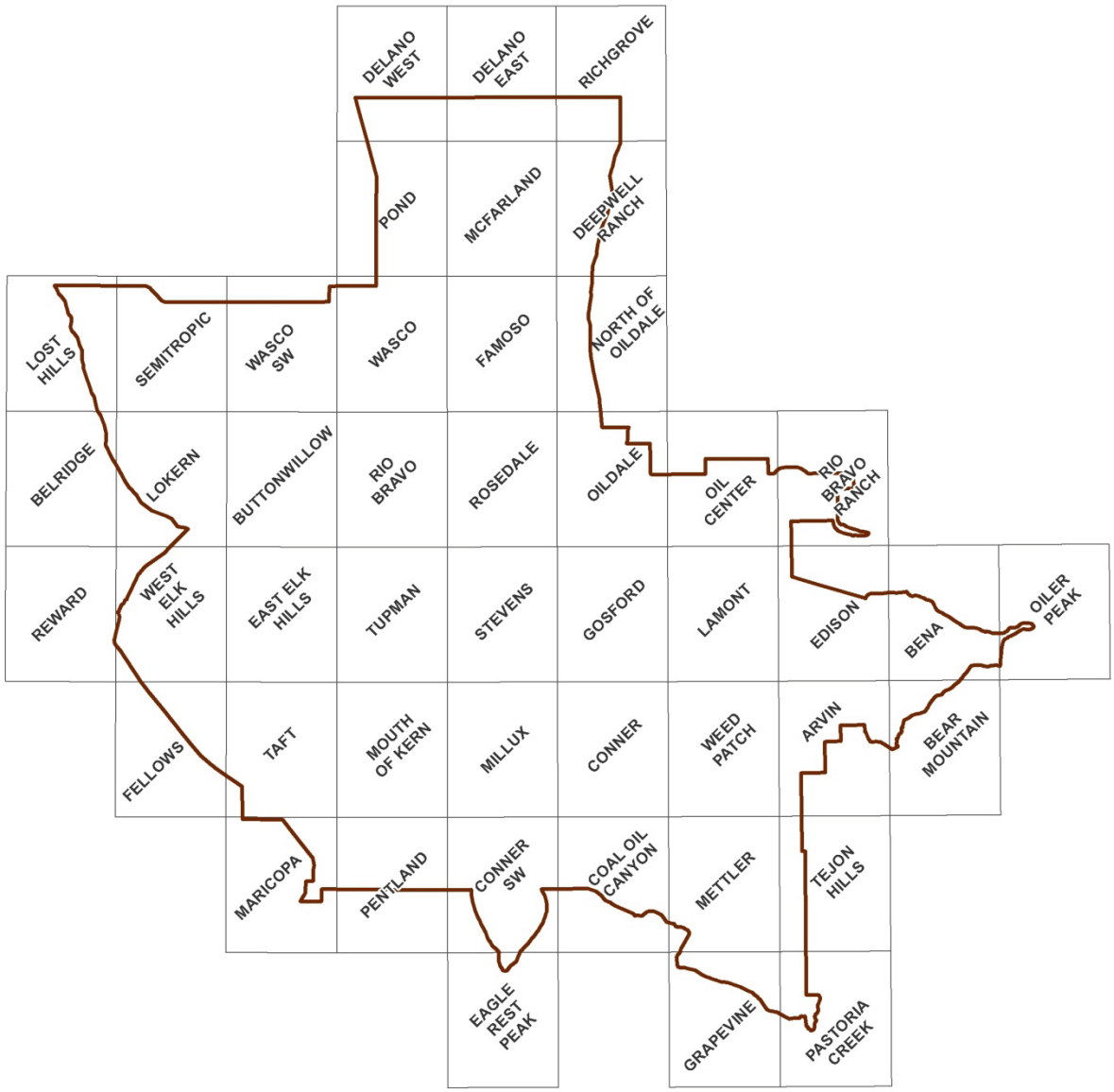


Figure 2. Index map of U.S. Geological Survey 7-1/2 minute quadrangle maps covering the Bakersfield P-C Region

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.

Table 1. Lead agencies in the Bakersfield P-C Region (County and incorporated city governments).

LEAD AGENCY	Lead agencies with active aggregate operations within their jurisdiction	Lead agencies with land classified as MRZ-2 for PCC-grade aggregate within their jurisdiction
County of Kern	●	●
City of Bakersfield		●
City of Arvin		
City of Delano		
City of Maricopa		
City of McFarland		
City of Shafter		
City of Taft		
City of Wasco		

OVERVIEW OF CLASSIFICATION

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

1. Determination of Study Boundary: Study areas may be a county, a portion of a county, or a P-C region that may contain parts of one or more counties. P-C regions were originally selected such that the majority (95 percent) of the construction aggregate produced in the region was consumed in the region.

2. Establishment of Mineral Resource Zones (MRZs): Based on geologic appraisals, lands within the study area were classified in SR 147 as MRZ-1, MRZ-2, or MRZ-3 for specific construction aggregate types, or grades. Three aggregate grade subdivisions were used: 1) portland cement concrete-grade (PCC); 2) asphalt concrete-grade (AC); and 3) base and fill. In this update report, this MRZ classification has been retained and is shown on Plate 1. This classification system is discussed in Part II of this report. 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 portland cement concrete-grade aggregate resources (areas classified as MRZ-2 (PCC) in Step 2 above) are evaluated to determine if current uses of these lands preclude mining. Areas currently permitted for mining and areas found to have land uses compatible with possible mining are identified as *Sectors* (Plates 2a and 2b).

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 in land owned or controlled by an aggregate producer and permitted for mining; resources are all deposits of aggregate, including the permitted reserves.

5. Forecast of 50-Year Needs and the Life Expectancy of Current Reserves: The total tonnage of aggregate needed to satisfy the estimated demand in the study area over the next 50 years is based on multiplying the projected population over that period with the average annual per-capita rate of total aggregate consumption from 1980 to the time of the study. Results of this forecast are used to determine the life expectancy of the study area's current reserves.

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

When the determination of the study boundary for the Bakersfield P-C Region originally was made in the mid-1980s, the region produced at least 95 percent of the aggregate consumed within the region. Since then, supply patterns have changed slightly. Based on discussions with aggregate operators, it is estimated that for the time period from 2002 through 2007, approximately 8 percent of the construction aggregate consumed in the Region was imported from outside of Kern County.

OVERVIEW OF DESIGNATION

This update report contains the classification step of the two-phase process provided by SMARA. The designation phase follows the receipt and acceptance of this classification report by the Board. Designation is the formal recognition by the Board, 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 Board's Guidelines for Classification and Designation of Mineral Lands (http:/www.consrv.ca.gov/SMGB/Guidelines/ClassDesig.pdf).

LEAD AGENCY RESPONSE TO DESIGNATION

The Board, upon receipt of the classification information from the State Geologist, transmits the classification 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 classification maps transmitted to the lead agency by the Board.

2. Emphasize the conservation and development of the identified mineral deposits.

Lead agencies that have jurisdiction within the Bakersfield P-C Region are shown in Table 1. The information in this update and the revised projection of aggregate needs in the 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 in their jurisdictions. These plans should be updated if necessary.

PART II - MINERAL LAND CLASSIFICATION OF AGGREGATE RESOURCES IN THE BAKERSFIELD P-C REGION

This section of the report contains information concerning the location, quality, and quantity of aggregate resources in the Bakersfield 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 studies are divided by the State Geologist into various Mineral Resource Zone (MRZ) categories that reflect varying degrees of mineral resource potential. When SR 147 was written, the nomenclature for mineral land classification consisted of four categories – MRZ-1, MRZ-2, MRZ-3, and MRZ-4. Since then, the nomenclature has been expanded to include subdivisions of the MRZ-2 and MRZ-3 categories into "a" and "b" subcategories, as explained in the Board's Guidelines for Classification and Designation of Mineral Lands under Section I, part 3. However, the original mineral land classification categories remain valid for this region and, for simplicity, have been retained in this update report. Following is a brief description of the three MRZ categories used in this update report (MRZ-4 is not used):

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 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 known or inferred mineral occurrences of undetermined mineral resource significance.

Lands within the study area were classified for three construction aggregate grades: PCC-grade, AC-grade, and base and fill. It should be noted that the material in lands classified MRZ -2 (PCC) must achieve the highest specifications of the three, and should not be considered equivalent to material in land classified MRZ-2 (AC) or MRZ-2 (Base and Fill).

CLASSIFICATION CRITERIA

To be considered **significant** for the purpose of mineral land classification, a mineral deposit, or a group of mineral deposits that can be mined as a unit, must meet marketability and threshold value criteria adopted by the Board (California State Mining and Geology Board website). Threshold values are intended to indicate in a general way the approximate minimum size of a mineral deposit that will be considered significant for classification and designation. The

threshold value criteria vary for different minerals depending on their uniqueness and commodity-type category. The Board determined threshold value of the first marketable product in 1998 dollars to be $1,250,000 for metallic and rare mineral deposits, $2,500,000 for industrial mineral deposits other than construction aggregate, and $12,500,000 for construction aggregate deposits. In order to adjust these threshold values to reflect 2008 dollars, each value was multiplied by an inflation factor of 1.39. This factor was determined by dividing the U.S. Department of Labor's estimated Consumer Price Index (CPI) for California (California Department of Finance website, 2008) for August 2008 (228.0), by the CPI for 1998 (163.7). Threshold values in 2008 dollars (rounded to the nearest thousand) are as follows:

Metallic or rare mineral deposits	$ 1,741,000
Industrial minerals other than construction aggregate	$ 3,482,000
Construction aggregate	$ 17,410,000

The average price of construction aggregate prices in the Bakersfield P-C Region is about $12 per ton; therefore, $17,410,000 equates to about 1.45 million tons of aggregate material.

REEVALUATION OF MINERAL LAND CLASSIFICATION FOR CONSTRUCTION AGGREGATES IN THE BAKERSFIELD P-C REGION AND ADJACENT AREAS

Analysis of new data obtained since the publication of SR 147 has resulted in reclassification in four areas within the Bakersfield P-C Region. These are the Buttonwillow area, the James Road area, the Arvin-Sycamore Creek area, and the San Emigdio Creek area. New information also provides for the classification of three areas near the P-C Region as MRZ-2 for portland cement concrete-grade aggregate.

Areas Reclassified Within the Bakersfield P-C Region

The Buttonwillow Area

An 81-acre area south of the community of Buttonwillow – the site of Syndex LLC's Buttonwillow Compaction Products mine – was reclassified to MRZ-2 for Base and Fill Materials, from MRZ-3.

The James Road Area

A 69-acre area south of James Road and east of State Highway 65 was reclassified to MRZ-1 from MRZ-2 for PCC-Grade Aggregate due to the deposit being mined out. A 23-acre area south of James Road was reclassified to MRZ-3 from MRZ-2 for AC-grade aggregate due to uncertainty regarding the amount and quality of material remaining at this location.

The Arvin-Sycamore Creek Area

In SR 147 an 81-acre area east of Arvin and south of State Highway 233 (the site of Granite Construction Company's Arvin Pit) was classified MRZ-2 for AC-grade aggregate. Subsequently, through permitted expansions, the mine area was increased to approximately 155

acres. Through the same time period approximately 34 acres were mined out. This results in a 40 acre net increase in the area classified MRZ-2 (AC); to a new total of 121 acres. The 34 acres mined-out were reclassified as MRZ-1 from MRZ-2.

The San Emigdio Creek Area

Approximately 155 acres in the San Emigdio Creek area, now mined out, have been reclassified to MRZ-1 from MRZ-2 (PCC).

Areas Adjacent to the P-C Region Newly Classified MRZ-2 for PCC-Grade Aggregate

Three areas adjacent to the boundary of the Bakersfield P-C Region have been classified MRZ-2 for PCC-grade aggregate in this update. Although these areas are outside of the P-C Region, they have been classified and included in this report because of their nearness and potential to provide aggregate to the Bakersfield P-C Region in the future.

El Paso Creek (MRZ-2 PCC)

This MRZ-2 contains sand and gravel deposits that are part of the El Paso Creek alluvial fan (Plate 1) and cover an area of 2,151 acres. Exploration for aggregate deposits by one of the active mine operators in the Bakersfield P-C Region has yielded new information on the quality of aggregate material in this area.

Cuddy Creek (MRZ-2 PCC)

This MRZ-2 contains sand and gravel deposits of Cuddy Creek (Plate 1, insert) and covers an area of 206 acres. Historically, a series of operators have extracted PCC-grade aggregate from the deposits of Cuddy Creek.

La Liebre Ranch (MRZ-2 PCC)

This MRZ-2 contains sand and gravel deposits of Little Sycamore Creek (Plate 1, insert) and covers an area of 125 acres. A series of operators have extracted PCC-grade aggregate from the deposits of Little Sycamore Creek.

PCC-GRADE AGGREGATE SECTORS IN THE BAKERSFIELD P-C REGION

An evaluation of PCC-grade aggregate resources in the Bakersfield P-C Region is presented in this section of the report. The evaluation was based on a quantitative evaluation of suitable PCC-grade aggregate resources classified as MRZ-2.

Concepts Used in Identifying Aggregate Resource Sectors

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 further limits the aggregate resource calculations to areas within "Sectors."

Sectors are areas that have been classified as MRZ-2 by the State Geologist, and that have current land uses deemed compatible with potential mining based on criteria provided by the Board. Compatible land uses are defined 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 as improvements of high cost, such as high-density residential developments, intensive industrial developments, commercial developments, and major public facilities.

Mineral land classification, which is done without regard for current land use, results in a delineation of the resource areas on maps; but this by itself does very little to put into perspective the resource base that is available to meet the future needs of a region. Sectors are used to focus the attention of land-use planners and local governments on the areas that remain accessible for mineral extraction. The State Geologist calculates the available resources of each Sector and identifies the amount of remaining resources that have been permitted for mining. Resources that have been permitted for mining are termed "reserves." The calculated reserves and resources of all the Sectors within a P-C Region are compared with the State Geologist's forecast of the 50-year needs of that P-C Region for the particular mineral resource.

Each Sector, or group of Sectors, meets or exceeds the Board's threshold value, and each Sector may be considered for designation as an area of regional or statewide significance by the Board pursuant to SMARA. The Board only considers areas in Sectors for designation.

For this update, the determination of land use as non-urbanized was based on conditions of the lands as of December 2008. The land use was determined by reference to satellite imagery, field reconnaissance, and consultation with local planners.

The Board's criteria for creating Sectors focuses on the apparent suitability of the land for mining and does not take into consideration land commitments (other than approved tracts or Specific Plans) that may have been made that restrict the accessibility of some of the Sectors for mining. It is possible, therefore, that the available resource base as calculated by the State Geologist may be overestimated.

Calculation of Available Resources

Special Report 147 identified Mineral Resource Sectors in the P-C Region. However, these Sectors have not been designated by the Board. Individual Resource Sectors from SR-147, although similar, are not directly comparable to the Sectors presented in this update report

because of land use changes, revisions in the methods and parameters used in calculations, and changes to identification numbers of individual subsectors (see Appendix B and Appendix C).

The resource estimates presented in this update are limited to PCC-grade aggregate resources identified in Sectors (i.e. areas classified MRZ-2 for PCC and not precluded from mining by incompatible land uses). Some Sectors are subdivided into numbered subsectors to recognize the location of existing highways, canals, bridges, power lines, pipelines, etc., to allow for more realistic resource tonnage calculations.

Area calculations for this update report used Geographic Information System (GIS) software. Resource tonnage calculations for this report were made by calculating the volume of a deposit and multiplying by factors such as in-place density and estimates of the waste content of the materials. The calculations are current as of December 2008. Many factors used in this report to describe the PCC-grade aggregate resources within Sectors are the same as those used in SP 147 and listed in that report.

PCC-Grade Aggregate Resource Sectors

In this update report, all lands in and adjacent to the Bakersfield P-C Region classified as containing significant PCC-grade aggregate resources (MRZ-2) and not precluded from mining by incompatible land uses, were divided into eleven Sectors - A, B, C, D, E, F, G, H, I, J, and K. The Sectors (with the exception of Sector A, G, I, and K) are further subdivided into 58 subsectors. The areas of the Sectors were calculated for this update using a GIS; the total area is 20,193 acres; with 17,737 acres inside the P-C Region, and 2,456 acres of newly identified PCC-grade aggregate resources adjacent to the Region. These Sectors are not currently designated, but may be considered for designation by the Board in the future. Following is a brief description of the Sectors, which are shown on Plates 2a and 2b. The area and resources in each Subsector are listed in Appendix A.

<u>Sectors Within the Bakersfield P-C Region</u>

Sector A – Deposits of the James Road Resource Area, five miles north of Bakersfield and southwest of the intersection of James Road and State Highway 65, are in a small alluvial fan composed of reworked sediments derived from older alluvial fan deposits and the Kern River Formation (Cole, 1988) The deposit east of Highway 65 has been mined out. The area of Sector A is 247 acres; estimated resources are nine million tons.

Sector B – Deposits of the Kern River floodplain and alluvial fan, north of the Rosedale Highway and west of Highway 99. Sector B is divided into five subsectors identified as B-1 through B-5. The combined area of the subsectors of Sector B is 231 acres; estimated resources are 19 million tons.

Sector C – Deposits of the Kern River floodplain along the main course of the Kern River from Coffee Road east to Rio Bravo Ranch. Sector C is divided into 21 subsectors identified as C-1 through C-21. The combined area of the subsectors is 1,418 acres; estimated resources are 99 million tons.

Sector D – Deposits of the floodplain and alluvial fan of Cottonwood Creek, ten miles east of Bakersfield, and south of State Highway 178. Sector D is divided into four subsectors identified as D-1 through D-4. The combined area of the subsectors is 356 acres; estimated resources are 18 million tons.

Sector E – Deposits of the floodplain of Caliente Creek, 15 to 20 miles east of Bakersfield, and north of State Highway 58. Sector E is divided into 10 subsectors identified as E-1 through E-10. The combined area of the subsectors is 2,685 acres; estimated resources are approximately 343 million tons.

Sector F – Deposits of the alluvial fan of San Emigdio Creek, 25 miles southwest of Bakersfield, north and south of State Highway 166. Sector F is divided into eleven subsectors identified as F-1 through F-11. The combined area of the subsectors is 11,271 acres; estimated resources are 3,266 million tons (including reserves).

Sector G – Deposits of the Wheeler Ridge Resource Area, 25 miles south of Bakersfield, west of Interstate Highway 5, and south of State Highway 166. The deposits are in an uplifted ridge of Pleistocene sand and gravel of the Tulare Formation (Cole, 1988). The area of Sector G is 882 acres; estimated resources are 121 million tons (including reserves).

Sector H – Deposits of the alluvial fan of Pastoria Creek, 30 miles southeast of Bakersfield, and north of Edmonston Pumping Plant Road. Sector H is divided into five subsectors identified as H-1 through H-5. The combined area of the subsectors is 467 acres; estimated resources are 110 million tons (including reserves).

Variability in Resource Estimates, 1985 to 2007

A comparison of PCC-grade aggregate resources in Sectors in the Bakersfield P-C Region from SR 147 (5.3 billion tons), and the recalculated resources in this update report (4.0 billion tons), indicates a reduction of 1.3 billion tons. This difference results from:

- Aggregate production between 1985 and 2007;
- Areas lost to incompatible land uses from 1985 through 2008; and,
- Changes to the size and shape of individual Sectors and revisions to some of the values used in the calculations resulting from improved information.

Aggregate resources have been reduced by about 87 million tons because of aggregate production (all grades) between 1985 and 2007.

Urbanization or other changes in land use have resulted in a loss of 1,150 acres containing approximately 210 million tons of aggregate resources between 1985 and 2008. This is a loss of approximately 6 percent of the resource area and a loss of approximately 4 percent of the resource tonnage compared to SR 147.

The largest part of the difference, approximately 1 billion tons, results from the reevaluation and recalculation of resources in this update report. Most of this difference is in the San Emigdio Creek alluvial fan resource area (Sectors E and F in SR 147 – Sector F this study) in the southern

part of the P-C Region. Continuous aggregate production has occurred in this area since 1985 and some land use changes (roads, oil fields) have occurred. The recalculation of resources for this Sector incorporates these changes and is based on more conservative estimates of deposit geometry, thickness, and waste factors than those used previously. The resource estimate in this update report is approximately 3.3 billion tons, or about 1 billion tons less than the prior estimate of 4.3 billion tons.

Newly Identified Resource Sectors Adjacent to the Bakersfield P-C Region

This report describes three newly identified aggregate resource sectors covering an area of approximately 2,456 acres. These are in areas adjacent to the Bakersfield P-C Region. These new areas are identified as Sector I, Sector J, which contains 2 subsectors, and Sector K (Plate 2b). These Sectors are described below and summarized in Table 2. The area and resources in each Subsector are listed in Appendix A.

Sector I – Deposits of the alluvial fan of El Paso Creek, 25 miles southeast of Bakersfield, east of Rancho Road and south of Sebastian Road. PCC-grade aggregate deposits of Sector I were identified as a result of exploration activities of the Granite Construction Company. The area of Sector I is 2,151 acres; estimated resources are 426 million tons.

Sector J – Deposits of the floodplain of Cuddy Creek located 40 miles south of Bakersfield, along Frazier Mountain Park Road, two miles west of Interstate Highway 5. Sector J, a historic source of PCC-grade aggregate, is divided into two subsectors identified as J-1 and J-2. The combined area of the subsectors is 180 acres; estimated resources are ten million tons.

Sector K – Basement outcrops and the alluvial fan and floodplain of Little Sycamore Creek (La Liebre Ranch area), 40 miles southeast of Bakersfield, east of Interstate Highway 5 and north of State Highway 138. Sector K is a historic source of PCC-grade aggregate. The area of Sector K is 125 acres; estimated resources are seven million tons (including reserves).

Table 2. Sectors I, J, and K acreages and aggregate resources.

Sector	Acres	PCC-Grade Aggregate Resources (million tons)
I	2,151	425.6
J-1	35	2.6
J-2	145	6.9
K	125	6.9*
Totals	**2,456**	**442**

* includes reserves

Aggregate Resources in the Bakersfield P-C Region

Within the Bakersfield P-C Region, revised Sectors (areas classified MRZ-2 and considered available for mining), total 17,737 acres. Recalculation of revised Sectors for this update report indicates the presence of approximately 3,986 million tons of PCC-grade aggregate resources in the P-C Region. Newly identified aggregate resources (Sectors I, J, and K described above), covering 2,456 acres contain an additional 442 million tons of PCC-grade aggregate.

As shown in Table 3, there are now 4,428 million tons of PCC-grade aggregate resources identified in and near the Bakersfield P-C Region. The PCC-grade aggregate reserves (permitted resources) have decreased to 149 million tons from the 212 million tons given in SR 147.

Table 3. Summary of identified PCC-grade aggregate resources and reserves in the Bakersfield P-C Region and adjacent areas in 2008.

Sector	**Resources In 2008** (million tons)	**Reserves (Permitted Resources) In 2008** (million tons)
A	9	0
B	19	0
C	99	0
D	18	0
E	343	0
F	3,266	P
G	121	P
H	110	P
I†	426	0
J†	10	0
K†	7	P
Totals	**4,428**	**149**

P Sector contains reserves that are proprietary.
† Newly identified Sector adjacent to the Bakersfield P-C Region

PART III – AGGREGATE PRODUCTION IN THE BAKERSFIELD P-C REGION

As of December 2008, the following two companies operated three mines producing PCC-grade aggregate in the Bakersfield P-C Region:

- Vulcan Materials Company (two mines)
- Griffith Company

Following are brief descriptions of the above company operations:

Vulcan operates the Wheeler Ridge Mine in Sector G, 25 miles south of Bakersfield, west of Interstate Highway 5 and south of State Highway 166. Here it produces PCC-grade aggregate from an uplifted ridge of Pleistocene sand and gravels of the Tulare Formation. Vulcan also operates the San Emigdio Mine in Sector F, 25 miles southwest of Bakersfield, south of State Highway 166, where it produces PCC-grade aggregate from sand and gravel deposits of the alluvial fan of San Emigdio Creek.

Griffith Company operates the Pastoria Creek Mine in Sector H, 30 miles southeast of Bakersfield north of the Edmonston Pumping Plant Road, where it produces PCC-grade aggregate from sand and gravel deposits of the alluvial fan of Pastoria Creek.

In addition to these three mines, Granite Construction Company produces AC-grade, and other construction aggregates from its Arvin Pit. The Edison Sand Company and the Caliente Sand and Mineral Company produce fill sand from their respective mines on Caliente Ridge. Syndex LLC produces sand, base, and fill materials from its Buttonwillow Compaction Products mine south of Buttonwillow. Beyond the P-C Region boundary, the B & B Company produces PCC-grade, and other aggregates, from the La Liebre mine two miles east and four miles north of Quail Lake, east of Lebec.

AGGREGATE PRODUCTION DATA

Aggregate production data for the Bakersfield P-C Region from 1980 to 1990 were collected from records of the U.S. Department of the Interior's Bureau of Mines (now part of the U.S. Geological Survey) and from the aggregate producers. The U.S. Bureau of Mines' records were compiled from responses to voluntary questionnaires sent annually, or biennially, to all known mine operators. Each producer was requested to divulge the production from each of their producing properties for the preceding year. The accuracy of these figures depends on the accuracy of the producers' responses. For the years 1991 through 2006, annual mine production data from the California Department of Conservation's Office of Mine Reclamation were used. As shown in Table 4 and Figure 3, aggregate consumption in the Bakersfield P-C Region has increased from 2.1 million tons in 1980 to 4.9 million tons in 2007 – the last year production figures are available. Through the same time period, nearly 100 million tons of aggregate have been consumed in the Region; an average annual consumption rate of 7.4 tons per capita.

Table 4. Population, Estimated Construction Aggregate Consumption (all grades), and Per Capita Consumption in the Bakersfield P-C Region 1980-2007

Year	Population	Estimated Annual Consumption (tons)*	Per Capita Consumption (tons/person)
1980	321,000	2,109,000	6.6
1981	331,300	2,070,000	6.2
1982	341,500	2,346,000	6.9
1983	351,800	2,392,000	6.8
1984	362,000	2,743,000	7.6
1985	373,316	2,922,000	7.8
1986	384,632	3,102,000	8.1
1987	395,948	3,302,000	8.3
1988	407,264	3,503,000	8.6
1989	418,580	3,505,000	8.4
1990	429,896	3,507,000	8.2
1991	441,162	3,528,000	8.0
1992	452,428	3,227,000	7.1
1993	463,694	2,955,000	6.4
1994	474,960	2,854,000	6.0
1995	486,226	2,947,000	6.1
1996	497,491	2,957,000	5.9
1997	508,757	2,581,000	5.1
1998	520,023	3,083,000	5.9
1999	531,289	4,017,000	7.6
2000	542,555	3,965,000	7.3
2001	552,328	4,838,000	8.8
2002	566,152	4,547,000	8.0
2003	582,055	4,733,000	8.1
2004	600,560	4,667,000	7.8
2005	619,526	5,228,000	8.4
2006	639,182	6,063,000	9.5
2007	657,351	4,945,000	7.5
		98,636,000 **Total**	**7.4** **Average**

* Consumption = regional production +/- net imports/exports. Aggregate consumption figures are rounded to the nearest 1,000 tons.

PART IV – UPDATED ESTIMATE OF 50-YEAR CONSUMPTION OF AGGREGATE IN THE BAKERSFIELD P-C REGION

The Board, as specified in its guidelines for classification and designation of mineral land (California State Mining and Geology Board, 2000), requires that mineral land classification reports for regions containing construction materials classified as MRZ-2 include, "An estimate of the total quantity of each such construction material that will be needed to supply the requirements of both the county and the 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 each construction material mineral resource needed for the next 50 years shall be projected using past consumption rates adjusted for anticipated changes in market conditions and mining technology." This section contains the revised estimate of aggregate needs for the Bakersfield P-C Region, projected through the year 2058.

CORRELATION BETWEEN AGGREGATE PRODUCTION AND POPULATION

Past studies of production-consumption regions in California have shown a correlation between the amount of aggregate consumed and the population of the market area (Anderson and others, 1979). An aggregate report for Los Angeles County (Miller, 1994) contains a statistical analysis of aggregate consumption versus population suggesting that roughly two-thirds of the variation in aggregate consumption could be attributed to population variation. The fact that large market regions such as Los Angeles County show a correlation between aggregate production and population indicate that population is a major factor in determining aggregate consumption in many areas. Other factors, such as major public construction projects can randomly add large amounts of aggregate to consumption figures. The economy also has a strong influence on aggregate demand, but the simple factor of population was selected because it most influences aggregate demand over long periods of time.

A comparison of the projected aggregate demand for the Bakersfield P-C Region from SR 147 (1988) and actual production data for the period of 1985 to 2007 is shown in Figure 3. Using an annual per capita consumption rate of 7.4 tons, SR 147 projected that the demand for aggregate in the Bakersfield P-C region for 1985-2007 would be 78 million tons. Actual aggregate consumption in the Bakersfield P-C Region for 1985-2007 was 87 million tons. The difference between projected demand and actual consumption was nine million tons - 11.5 percent greater than projected. This difference is because population increased at a rate faster than was projected. Population of the Bakersfield P-C Region in 1997 was 8.9 percent greater than projected, and in 2007, 19.3 percent greater than projected. Information provided by the aggregate producers indicates that from 2003 through 2007, imports of aggregate from outside of Kern County averaged approximately 8 percent of total aggregate consumption for the region.

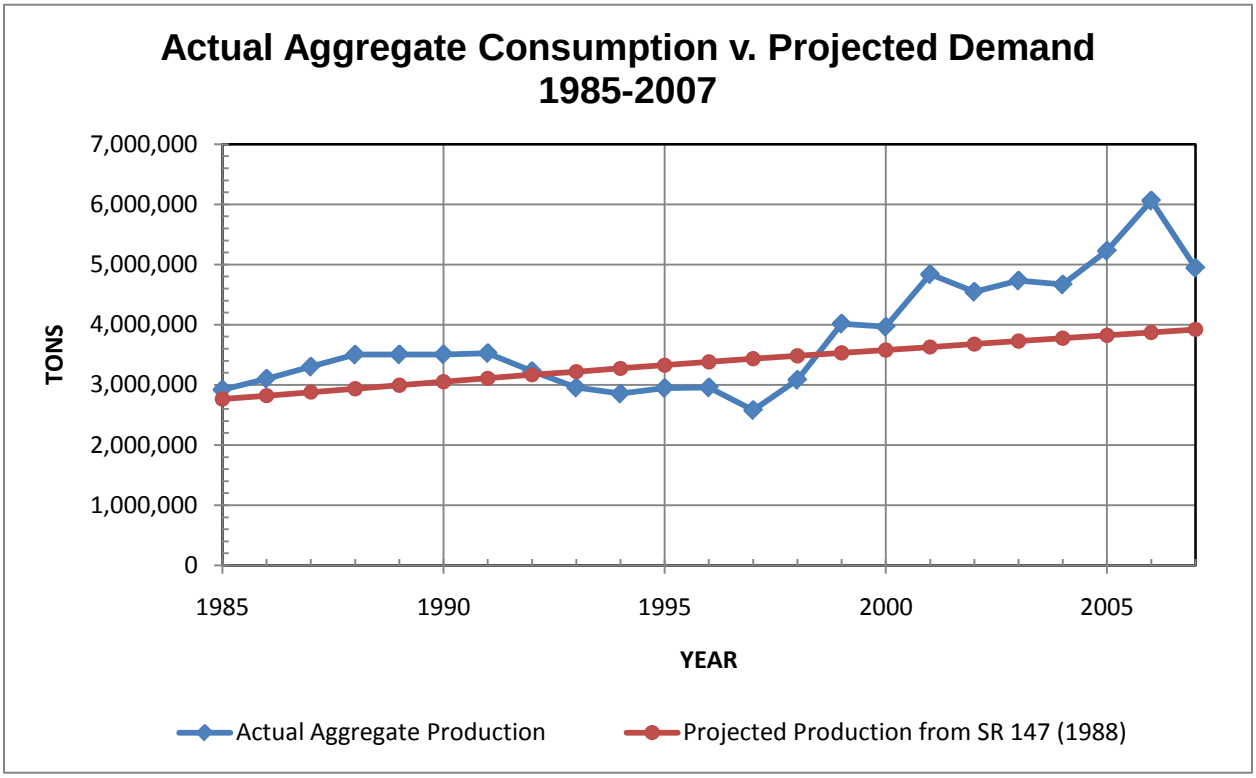


Figure 3. Comparison of projected demand in the Bakersfield P-C Region with actual PCC-grade aggregate consumption, 1985-2007.

Population data for the Bakersfield P-C Region for the years 1981 to 2007 were obtained from SR 147 for the period 1980-1985, and from census tract population data from the U.S. Census Bureau (2008) for the 1990 and 2000 censuses. Complete census tracts within the Region were summed with the population of partial tracts. The population of partial tracts was taken to be the same percentage as the included area. The populations between census years are interpolated. The average per capita aggregate consumption rate for the years 1980 through 2007 was 7.4 tons per person per year (Table 4). This rate was used for projecting future aggregate demands.

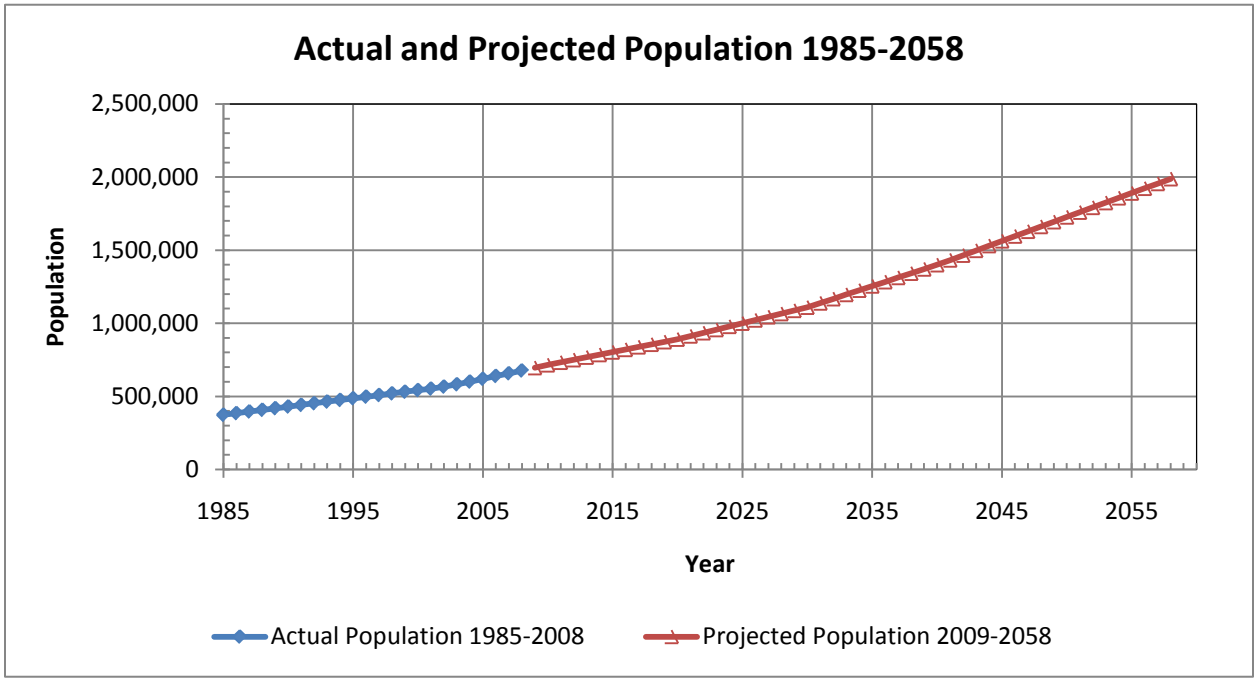
POPULATION PROJECTION FOR THE BAKERSFIELD P-C REGION THROUGH THE YEAR 2058

The year-2000 population for the census tracts within the P-C Region was divided by the total year-2000 population of Kern County. The resulting ratio (82 percent of Kern County's total population) was used to estimate the Bakersfield P-C Region's future population for the years 2010, 2020, 2030, 2040 and 2050.

The population projection for the Bakersfield P-C Region (Figure 4) was estimated from official projections for counties published by the California Department of Finance's Demographic

Research Unit (California Department of Finance, 2008) and the population percentage factor for the P-C Region, cited above. Report 06 P-1(on the California Department of Finance's website) provides population projections for counties in California for the years 2010, 2020, 2030, 2040 and 2050. Yearly population estimates were interpolated from the bracketing 10-year projected population numbers and extrapolated for the years 2051 through 2058. The population of the Bakersfield P-C Region is projected to increase from 695,662 in 2009 to 1,988,543 in 2058.

Figure 4. Population of the Bakersfield P-C Region 1985-2008 with projection to 2058.



PROJECTED AGGREGATE DEMAND FOR THE BAKERSFIELD P-C REGION THROUGH THE YEAR 2058

An analysis using projected population and annual per capita consumption rate, derived by methods described in preceding sections, was used to forecast the aggregate demand of the Bakersfield P-C Region through the year 2058 (Table 5). The calculated annual per capita consumption rate of 7.4 tons (from Table 4) was multiplied by the projected annual population for each year through the year 2058.

The result of this projection shows that an estimated 467 million tons of aggregate will be needed to satisfy future demand in the Bakersfield P-C Region through the year 2058. Of this total, it is estimated that approximately 48 percent, or 224 million tons, will be used in PCC, with the remainder being used in other construction aggregates. This percentage is based on estimates of current aggregate usage by the producers. This updated 50-year demand is more than twice the 50-year demand projected in SR-147.

Table 5. Projected Population and Aggregate Demand in the Bakersfield P-C Region 2009-2058

YEAR	PROJECTED POPULATION	PROJECTED AGGREGATE DEMAND (all grades - in tons)	ESTIMATED PCC AGGREGATE DEMAND (in tons)	YEAR	PROJECTED POPULATION	PROJECTED AGGREGATE DEMAND (all grades - in tons)	ESTIMATED PCC AGGREGATE DEMAND (in tons)
2009	695,662	5,147,899	2,470,991	2035	1,254,545	9,283,633	4,456,144
2010	714,817	5,289,646	2,539,030	2036	1,283,623	9,498,810	4,559,429
2011	732,397	5,419,738	2,601,474	2037	1,312,701	9,713,987	4,662,714
2012	749,976	5,549,822	2,663,915	2038	1,341,780	9,929,172	4,766,003
2013	767,556	5,679,914	2,726,359	2039	1,370,858	10,144,349	4,869,288
2014	785,135	5,809,999	2,788,800	2040	1,399,936	10,359,526	4,972,573
2015	802,715	5,940,091	2,851,244	2041	1,432,636	10,601,506	5,088,723
2016	820,295	6,070,183	2,913,688	2042	1,465,337	10,843,494	5,204,877
2017	837,874	6,200,268	2,976,128	2043	1,498,037	11,085,474	5,321,027
2018	855,454	6,330,360	3,038,573	2044	1,530,738	11,327,461	5,437,181
2019	873,033	6,460,444	3,101,013	2045	1,563,438	11,569,441	5,553,332
2020	890,613	6,590,536	3,163,457	2046	1,596,138	11,811,421	5,669,482
2021	912,467	6,752,256	3,241,083	2047	1,628,839	12,053,409	5,785,636
2022	934,321	6,913,975	3,318,708	2048	1,661,539	12,295,389	5,901,787
2023	956,175	7,075,695	3,396,334	2049	1,694,240	12,537,376	6,017,940
2024	978,029	7,237,415	3,473,959	2050	1,726,940	12,779,356	6,134,091
2025	999,884	7,399,142	3,551,588	2051	1,759,640	13,021,336	6,250,241
2026	1,021,738	7,560,861	3,629,213	2052	1,792,341	13,263,323	6,366,395
2027	1,043,592	7,722,581	3,706,839	2053	1,825,041	13,505,303	6,482,546
2028	1,065,446	7,884,300	3,784,464	2054	1,857,742	13,747,291	6,598,700
2029	1,087,300	8,046,020	3,862,090	2055	1,890,442	13,989,271	6,714,850
2030	1,109,154	8,207,740	3,939,715	2056	1,923,142	14,231,251	6,831,000
2031	1,138,232	8,422,917	4,043,000	2057	1,955,843	14,473,238	6,947,154
2032	1,167,310	8,638,094	4,146,285	2058	1,988,543	14,715,218	7,063,305
2033	1,196,389	8,853,279	4,249,574	**50-Year Demand:**		**467,051,666**	**224,184,800**
2034	1,225,467	9,068,456	4,352,859				

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

The total PCC-grade aggregate reserves of 149 million tons in the Bakersfield P-C Region are projected to last 22 years (into the year 2031). If all of the PCC-grade aggregate reserves were to be used exclusively for PCC aggregate, the supply would theoretically last 38 years (into 2047). In reality, 52 percent of the PCC-grade aggregate reserves likely will be used for lower grade aggregate products, and a depletion date of 2030 is more realistic. However, even this date may be optimistic. An important consideration is that not all of the aggregate reserves may be minable under the present permits because of operating restrictions or because of expiration dates that may not allow reserves to be completely mined.

Comparing regional needs to available reserves and resources demonstrates the construction aggregate resource issues confronting the region. This includes 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 region before currently permitted deposits are depleted.

Table 6 is a summary of present aggregate resources and estimated future aggregate demands for the Bakersfield P-C Region. The projected lifespan of the aggregate reserves assumes that mining of these reserves will continue to be permitted until the reserves are depleted. In addition, should unforeseen events occur, such as massive urban renewal, economic stimulus infrastructure projects, reconstruction in the wake of a disaster, or major economic recession, the demand for construction aggregate in the Bakersfield P-C Region could change considerably, which could alter the lifespan of aggregate reserves in the region.

Table 6. Summary of PCC-grade aggregate resources, PCC-grade aggregate reserves, projected 50-year demand, and depletion date for the Bakersfield P-C Region.

Estimated PCC-Grade Aggregate Resources	**4,428 Million Tons**
PCC-Grade Aggregate Reserves	**149 Million Tons**
Projected 50-Year Construction Aggregate Demand (all aggregate grades)	**467 Million Tons**
Projected 50-Year Demand for PCC Aggregate	**224 Million Tons**
Estimated Years Until Depletion of Current PCC-Grade Aggregate Reserves	**22 Years**
Estimated Depletion Date of PCC-Grade Aggregate Reserves	**2031**

POTENTIAL ALTERNATIVE SOURCES OF AGGREGATE FOR THE BAKERSFIELD P-C REGION

Potential sources of portland cement concrete aggregate, in addition to the deposits classified MRZ-2 in this update, exist within and near the Bakersfield P-C Region. The potential sources within the region are in areas that are classified as MRZ-3 and include areas underlain by Holocene alluvial deposits, Tertiary sedimentary deposits, and crystalline rocks. Too little is known about these deposits to allow more than a general description. SR 147 contains a description of these deposits in the section titled "Alternative Sources of Aggregate."

Sources outside of the Bakersfield P-C Region are the production areas in the neighboring Tulare P-C Region (Taylor, 1997) to the north, the Tehachapi Mountains to the east and south, and the Cuyama Valley to the southwest. The additional transportation costs incurred by bringing in aggregate from these other areas could increase the price of construction aggregate in the Bakersfield P-C Region.

RECYCLED AGGREGATE

During the past two decades, the use of recycled inert demolition debris such as concrete rubble and slab asphalt rubble has steadily increased in California. The most recycled materials in California, by tonnage, are asphalt and concrete. Recycling programs that recover demolition rubble, such as concrete and asphalt, significantly help reduce the waste-stream going into landfills and also extend the life of existing aggregate mines. However, recycled aggregate generally is not suitable for use as PCC aggregate. The bulk of recycled aggregate is used as base materials.

In the Bakersfield P-C Region, as in the greater Los Angeles area, the rate of recycling of demolition waste is high. Based on producer estimates, roughly 300,000 tons of recycled aggregate is produced from demolished construction materials annually in the P-C Region. Unless there is a large change in the use of recycled material for aggregate, there will not be a significant effect on the mining of new aggregate deposits and the projection of future demand for raw aggregate materials will not change significantly.

PART IV - CONCLUSIONS

SR 147 identified 5.3 billion tons of PCC-grade aggregate resources in the Bakersfield P-C Region. Reevaluation and recalculation of those resources in this study resulted in a decrease of about 1.3 billion tons to 4 billion tons of resources. The difference is primarily because of the use of more conservative parameters in the resource calculations and also to production and land use changes. Three new areas containing 442 million tons PCC-grade aggregate resources adjacent to the P-C Region have been identified and included, resulting in a total of 4.4 billion tons of PCC-grade aggregate resources for the P-C Region.

Based on available historic population and production data, and population projections, the Bakersfield P-C Region will need to produce 467 million tons of aggregate during the next 50 years. Of this projected demand, it is estimated that 48 percent, or 224 million tons, must be suitable for use in PCC. The presently permitted PCC-grade aggregate reserves of 149 million tons represent approximately 32 percent of the projected construction aggregate demand of the next 50 years. These permitted reserves are projected to last until the year 2031, 22 years from the present. If a major earthquake or similar unforeseen catastrophic event strikes the region and necessitates reconstruction, existing reserves may be depleted sooner. A comparison of the results of the current study with those of the 1987 study is presented in Table 7.

Table 7. Results of this update report compared with Special Report 147 for the Bakersfield P-C Region.

	Previous Report†	This Update Report
Identified PCC-Grade Aggregate Resources*	**5,280 Million Tons**	**4,428 Million Tons**
PCC-Grade Aggregate Reserves*	**212 Million Tons**	**149 Million Tons**
Projected 50-year Aggregate Demand	**201 Million Tons**	**467 Million Tons**
Estimated Number of Years Until Reserves* are Depleted	**49 Years**	**22 Years**
Estimated Depletion Date of Reserves*	**2037**	**2031**
Calculated Per Capita Aggregate Consumption	**7.4 Tons**	**7.4 Tons**

† SR 147 (California Department of Conservation, 1988).
* Reserves are aggregate deposits that have been determined to be acceptable for commercial use, that exist within properties owned or leased by aggregate producing companies, and for which permits have been granted to allow mining and processing of the material. Resources include reserves as well as all potentially usable aggregate materials that may be mined in the future, but for which no permit allowing mining has been granted.

ACKNOWLEDGMENTS

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REFERENCES

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.

Cole, J. W., 1988, Mineral land classification: aggregate materials in the Bakersfield Production-Consumption Region: California Division of Mines and Geology Special Report 147, 27 p.

California Department of Finance, 2007, Population projections for California counties 2000-2050. Website: http://www.dof.ca.gov/html/DEMOGRAP/Reports/Projections/P1.asp.

California Department of Finance, 2008, Financial & Economic Data: http://www.dof.ca.gov/html/fs%5Fdata/latestecondata/fs%5Fprice.htm.

California State Mining and Geology Board, 2000, California surface mining and reclamation policies and procedures: California Department of Conservation website: http://www.consrv.ca.gov/SMGB/Guidelines/ClassDesig.pdf.

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 Mines and Geology Open-File Report 94-14.

Taylor, G.C., 1997, Mineral land classification of concrete aggregate resources in the Tulare County Production-Consumption Region, California: Division of Mines and Geology Open-File Report 97-01.

U.S. Census Bureau, 2008, Census 2000 Summary File 1 (SF-1) 100-Percent Data. Website: http://factfinder.census.gov.

APPENDIX A– SECTOR SUMMARIES

Sector	**Acres** in Sector	**Resources*** (million tons)	**Reserves** (Permitted Resources; million tons)
A	247	9.0	0
B-1	108	9.3	0
B-2	70	6.9	0
B-3	24	1.7	0
B-4	14	0.6	0
B-5	15	0.9	0
C-1	20	1.3	0
C-2	149	11.2	0
C-3	8	0.5	0
C-4	51	3.6	0
C-5	36	2.1	0
C-6	18	1.2	0
C-7	14	0.9	0
C-8	46	3.4	0
C-9	85	6.4	0
C-10	15	1.0	0
C-11	124	8.5	0
C-12	104	7.2	0
C-13	26	1.8	0
C-14	163	12.1	0
C-15	32	1.6	0
C-16	12	0.5	0
C-17	101	5.8	0
C-18	70	3.5	0
C-19	80	5.9	0
C-20	11	0.7	0
C-21	253	19.4	0
D-1	105	4.9	0
D-2	19	0.8	0
D-3	101	5.4	0
D-4	131	7.2	0
E-1	572	86.6	0
E-2	1330	200.4	0
E-3	357	29.8	0
E-4	171	13.5	0
E-5	18	1.1	0
E-6	8	0.4	0
E-7	11	0.4	0
E-8	45	2.1	0
E-9	24	1.3	0
E-10	149	7.4	0
F-1	289	37.9	0
F-2	44	3.9	0
F-3	782	133.3	0
F-4	142	18.8	0
F-5	1,468	327.5	0
F-6	347	58.7	0
F-7	183	34.0	0
F-8	2,254	668.4	P
F-9	1,566	514.7	0
F-10	3,356	1,169.2	P
F-11	840	299.7	0
G	882	120.6	P
H-1	35	2.5	0
H-2	48	5.3	0
H-3	47	6.7	0
H-4	108	19.6	0
H-5	409	75.9	P
I †	2,151	425.6	0
J-1 †	35	2.6	0
J-2 †	145	6.9	0
K †	125	6.9	P
TOTALS	**20,193**	**4,428**	**149**

* Includes Reserves † Newly identified Sector outside P-C Region boundary

P Sector contains reserves that are proprietary

APPENDIX B – CORRELATION BETWEEN SECTORS IN THIS STUDY AND SECTORS IN SPECIAL REPORT 147

Sector (This Update Report)	Corresponding Sector(s) in SR-147 (Cole, 1988)
A	A-2
B-1	C-8
B-2	C-7
B-3	C-9
B-4	C-11
B-5	C-10
C-1	C-20
C-2	C-20
C-3	C-19
C-4	C-18
C-5	C-16
C-6	C-15
C-7	C-14
C-8	C-6
C-9	C-5
C-10	C-3
C-11	C-2, B-5
C-12	C-1, B-5
C-13	C-1, B-5
C-14	B-5
C-15	B-4
C-16	B-4
C-17	B-2
C-18	B-2
C-19	BB
C-20	AA
C-21	B-1
D-1	D-1
D-2	D-2
D-3	D-3
D-4	D-4
E-1	I-6
E-2	I-5
E-3	I-4
E-4	I-1
E-5	I-3
E-6	I-2
E-7	J-4
E-8	J-3
E-9	J-2
E-10	J-1
F-1	F-2
F-2	F-2
F-3	F-1, E-5
F-4	F-1, E-5
F-5	E-4
F-6	E-3
F-7	E-3
F-8	E-2
F-9	E-2
F-10	E-1
F-11	E-1
G	G-1
H-1	H-1
H-2	H-2
H-3	H-3
H-4	H-4
H-5	H-5
I	New Sector, not in SR 147
J-1	New Sector, not in SR 147
J-2	New Sector, not in SR 147
K	New Sector, not in SR 147

APPENDIX C - STATUS OF SECTORS IN SPECIAL REPORT 147

Sector in SR-147	Sector(s) (This Update Report)	Comments:
A-1	none	Mined out
A-2	A	Reconfigured
AA	C-20	Reduced, incompatible land-use
B-1	C-21	- -
B-2	C-17, C-18	Divided, incompatible land use
B-3	none	Urbanized
B-4	C-15, C16	Reduced, incompatible land-use
B-5	C-11, C-12, C-13,C-14	Reconfigured, divided
BB	C-19	- -
C-1	C-12, C-13	Reconfigured
C-2	C-11	Reconfigured
C-3	C-10	- -
C-4	none	Urbanized
C-5	C-9	- -
C-6	C-8	- -
C-7	B-2	Partially urbanized
C-8	B-1	- -
C-9	B-3	Partially urbanized
C-10	B-5	Partially urbanized
C-11	B-4	Partially urbanized
C-12	none	Incompatible land-use
C-13	none	Incompatible land-use
C-14	C-7	Reconfigured
C-15	C-6	Reconfigured
C-16	C-5	Reconfigured
C-17	none	Urbanized
C-18	C-4	Reconfigured
C-19	C-3	Reconfigured, incompatible land-use
C-20	C-1, C-2	Reconfigured, incompatible land-use
D-1	D-1	Reconfigured
D-2	D-2	- -
D-3	D-3	Reconfigured
D-4	D-4	Reconfigured
E-1	F-10, F-11	Divided, incompatible land use
E-2	F-8, F-9	Divided, incompatible land use, partially mined out
E-3	F-6, F-7	Reconfigured, divided, incompatible land use
E-4	F-5	- -
E-5	F-3, F-4	Reconfigured, divided, incompatible land use
F-1	F-3, F-4	Reconfigured, divided
F-2	F-1, F-2	Divided, incompatible land use
G-1	G	- -
H-1	H-1	- -
H-2	H-2	- -
H-3	H-3	- -
H-4	H-4	- -
H-5	H-5	Reconfigured, incompatible land use, urbanized
I-1	E-4	- -
I-2	E-6	- -
I-3	E-5	- -
I-4	E-3	- -
I-5	E-2	- -
I-6	E-1	- -
J-1	E-10	- -
J-2	E-9	Reconfigured
J-3	E-8	Reconfigured
J-4	E-7	Reconfigured
Not in SR-147	I	- -
Not in SR-147	J-1	- -
Not in SR-147	J-2	- -
Not in SR-147	K	- -