SPECIAL REPORT 199

UPDATE OF MINERAL LAND CLASSIFICATION FOR PORTLAND CEMENT CONCRETE-GRADE AGGREGATE IN THE STOCKTON-LODI PRODUCTION-CONSUMPTION REGION, SAN JOAQUIN AND STANISLAUS COUNTIES, CALIFORNIA

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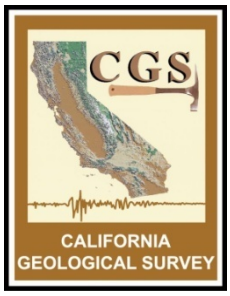

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EXECUTIVE SUMMARY

This report updates information presented in a classification study on portland cement concrete-grade (PCC) aggregate in the Stockton-Lodi Production-Consumption (P-C) Region published in 1988. Results of that study were published by the Department of Conservation's Division of Mines and Geology (now California Geological Survey) as Special Report 160—*Mineral Land Classification of Portland Cement Concrete Aggregate in the Stockton-Lodi Production- Consumption Region*. Special Report 160 included the urban and urbanizing parts of San Joaquin County and a small portion of northern Stanislaus County, centered on the cities of Stockton, Lodi and Tracy.

This report presents a reevaluation and update of PCC aggregate resources in the Stockton-Lodi Production-Consumption Region for the benefit of local lead agencies in the region. Deposits that meet the specifications for PCC-grade aggregate are among the scarcest and most valuable construction aggregate resources. Aggregate deposits of lower grade, such as asphaltic aggregate, base and subbase aggregate, and fill were not considered in the classification process because of their general abundance in the Stockton-Lodi P-C Region. However, most mines that produce PCC aggregate in the Stockton-Lodi P-C Region also produce the lower grades of aggregate.

This report also provides an updated 50-year projection of construction aggregate needs for the Stockton-Lodi Production-Consumption Region through the year 2060. Aggregate production data used in this update were current as of December 2010; land use data in this update is current as of July 2010.

In this update study the following conclusions are made:

- The 232 million tons of currently permitted PCC-grade construction aggregate reserves are projected to last through 2033, 23 years from the present (2011).

- The projected 50-year demand for construction aggregate in the Stockton-Lodi P-C Region is 687 million tons, of which 275 million tons must be PCC-grade. This is more than double the prior 50-year projection of 281 million tons (all grades) made in 1988 in Special Report 160.

- In this update report 2,081 acres containing 340 million tons of PCC-grade construction aggregate and 267 acres containing a proprietary amount of PCC-grade sand have been reclassified MRZ-1 due to depletion by mining or loss to incompatible land use since the completion of Special Report 160.

- In this update report, an additional 3,740 acres of land containing more than 600 million tons of PCC-grade construction aggregate resources and 289 acres containing a proprietary amount of PCC-grade sand resources have been reclassified MRZ-2 in the Stockton-Lodi P-C Region.

- An estimated 969 million tons of PCC-grade construction aggregate resources and 67 million tons of PCC-grade sand resources are identified in the Stockton-Lodi Production-Consumption Region.

The original classification study of the Stockton-Lodi P-C Region, published in 1988, 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 1988, the SMGB designated sand and gravel resource areas of regional significance in the Stockton-Lodi P-C Region which was published as SMARA Designation Report No. 9 (California Department of Conservation, 1989). **This update classification report does not change that designation.**

PART I - INTRODUCTION

This report updates the mineral land classification for portland cement concrete (PCC) aggregate in the Stockton-Lodi Production-Consumption (P-C) Region located in San Joaquin and Stanislaus counties, California. The mineral land classification of the area was previously described in California Department of Conservation's Division of Mines and Geology (now California Geological Survey or "CGS") Special Report 160, *Mineral Land Classification of Portland Cement Aggregate in the Stockton-Lodi Production-Consumption Region*" (Jensen and Silva, 1988). Special Report 160 (SR 160) classified the urban and urbanizing areas surrounding Lodi, Stockton and Tracy in San Joaquin County and a small portion of northern Stanislaus County (Figure 1). SR 160 also contained projections of the 50-year demand for construction aggregate and PCC-grade aggregate in the P-C Region.

The Stockton-Lodi P-C Region (Figure 1) encompasses approximately 412 square miles and is covered by all or part of 17 U.S. Geological Survey 7½ minute quadrangle maps as shown on Plate 1.

This report presents a reevaluation and update of identified PCC-grade aggregate resources for the benefit of local lead agencies in the Stockton-Lodi P-C Region. New information on aggregate resources and reserves, resource sectors, aggregate consumption, and projected 50-year aggregate demand in the Stockton-Lodi P-C Region are presented to help land-use planners, decision makers, and the public to 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 160.

BACKGROUND

Mineral Land Classification studies are produced by the State Geologist as specified by the Surface Mining and Reclamation Act (SMARA, PRC 2710 et seq.) 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 a 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 State Mining and Geology Board (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 web site at http:/www.consrv.ca.gov/ SMGB/Guidelines/ClassDesig.pdf.

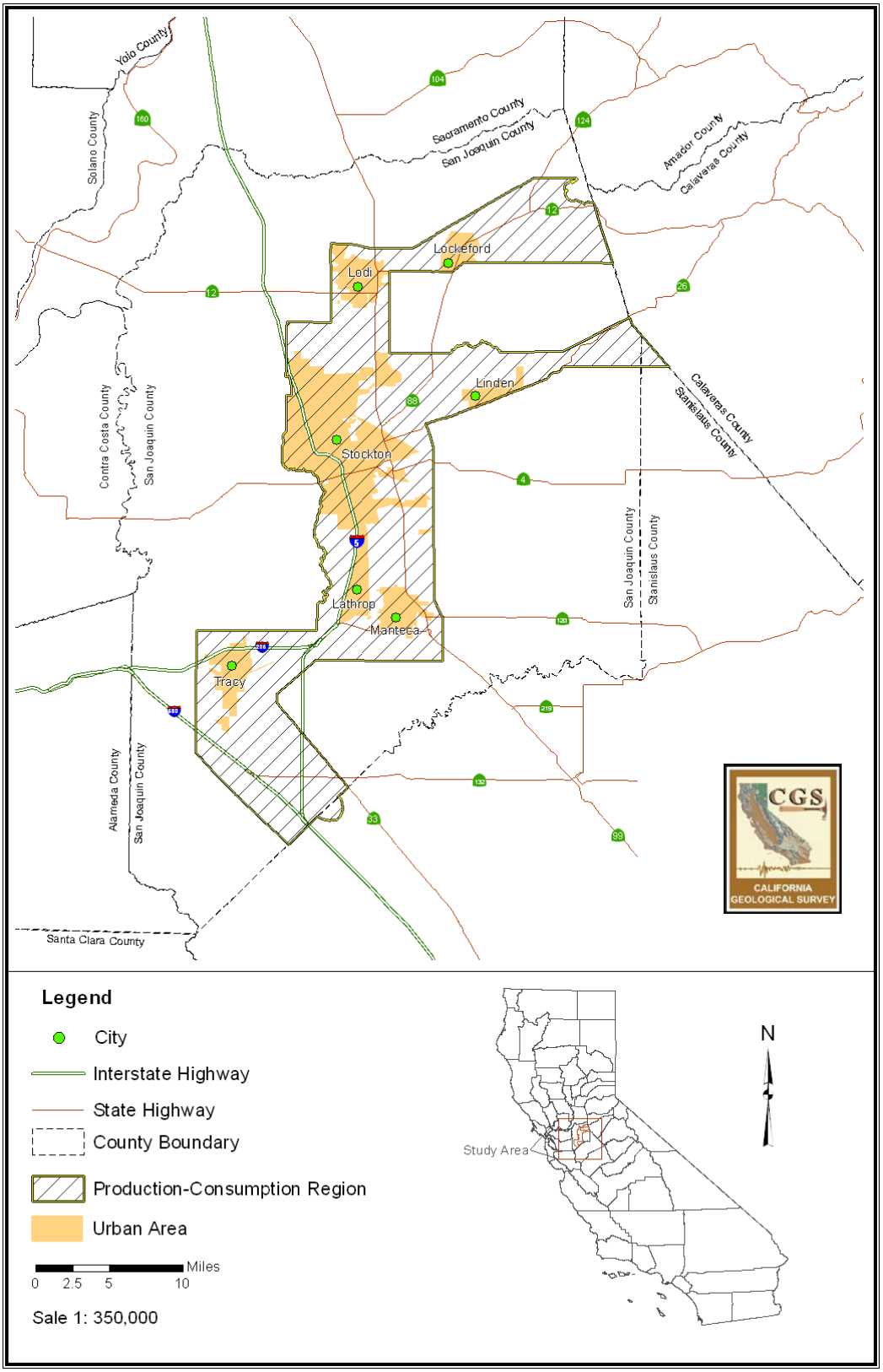

Figure 1. General location of the Stockton-Lodi P-C Region

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 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.

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. Where possible, P-C regions were selected such that the majority (95 percent) of the construction aggregate produced in the region is consumed in the region.

2. Establishment of Mineral Resource Zones (MRZs): Based on geologic appraisals, lands within the study area were classified in SR 160 as MRZ-1, MRZ-2, or MRZ-3. 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 aggregate resources (areas classified as MRZ-2 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*.

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 (deposits in land owned or controlled by an aggregate producer and permitted for mining) and resources (all deposits of aggregate, including the permitted reserves) within each Sector.

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 study area over the next 50 years is estimated by multiplying the projected population over that period with the average annual per-capita rate of total aggregate consumption derived from historic population and production data. Results of this forecast are used to estimate the date of depletion of current reserves in the Region.

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

When the study boundary for the Stockton-Lodi P-C Region was originally defined in the early 1980s, the region consumed approximately 85 percent of the aggregate produced within the region. Since then, marketing patterns have changed so that this is no longer true. Based on discussions with aggregate operators, it is estimated that approximately 25-30 percent of the region's aggregate production in the years 2000 to 2007 was exported beyond the P-C Region boundary (Figure 1). Two factors have led to this increase in inter-regional aggregate commerce. First, the depletion of aggregate reserves in large areas such as Contra Costa County and Alameda County has increased the demand for imports from the Stockton-Lodi P-C Region into those regions. Second, consolidation of aggregate companies has led to longer hauls to company-owned concrete batch plants outside of the P-C Region. With the recent recession and slow economic recovery in California, demand for aggregate in adjacent regions has declined and therefore exports from the Stockton-Lodi P-C Region have also declined. However, as the economy improves and the construction industry recovers, exports from the region may again increase.

Sand, gravel, and crushed stone are "construction materials." These commodities, collectively referred to as construction aggregate, provide the bulk and strength to portland cement concrete (PCC), asphaltic concrete (AC, commonly called "black top"), plaster, and stucco. Aggregate is also used as road base, subbase, railroad ballast, and fill. Aggregate normally provides from 80 to 100% of the material volume in the above uses.

In this updated mineral land classification report, aggregate that meets the specifications for use in PCC is classified. Such aggregate is termed "PCC-grade aggregate" and makes up about 40% of the current aggregate demand in the Stockton-Lodi P-C Region. The material quality specifications for PCC-grade aggregate are more restrictive than the specifications for aggregate for other applications. The restrictiveness of these specifications makes deposits acceptable for use as PCC-grade aggregate the scarcest and most valuable aggregate resources. This also means that aggregate produced from such deposits can be and is commonly used in applications other than concrete. Because of its versatility, value, importance in construction, and relative scarcity, deposits of concrete aggregate are of major concern when planning for future availability of aggregate commodities.

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 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 (http:/www.consrv.ca.gov/SMGB/Guidelines/ClassDesig.pdf).

The SMGB previously designated lands in the Stockton-Lodi P-C Region in a report titled "Designation of Regionally Significant Construction Aggregate Resources in the Stockton-Lodi Production-Consumption Region: SMARA Designation Report No. 9" (California Department of Conservation, 1988). This update report reviews the current land uses of the previously designated areas, but does not alter that designation. The SMGB may revise the designation of the Stockton-Lodi P-C Region based in part on information contained in this update report.

LEAD AGENCY RESPONSE TO CLASSIFICATION

The SMGB, 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 SMGB.

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

Lead agencies that have jurisdiction within the Stockton-Lodi 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.

Table 1. Lead agencies (county and incorporated city governments) in the Stockton-Lodi P-C Region.

LEAD AGENCY	Agencies that have land classified as MRZ-2 for PCC-grade aggregate within their jurisdiction	Agencies that have active aggregate operations within their jurisdiction
County of San Joaquin	•	•
City of Lodi		
City of Manteca		
City of Stockton		
City of Tracy		
County of Stanislaus	•	•

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

This section of the report contains information concerning the location, quality, and quantity of aggregate resources in the Stockton-Lodi P-C region. The updated mineral land classification is shown on Plate 1.

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 160 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 subdivision of the MRZ-2 and MRZ-3 categories into "a" and "b" subcategories, as explained in the SMGB's Guidelines for Classification and Designation of Mineral Lands under Section I, part 3. 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 MRZ categories used in this update report:

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.

MRZ-4: Areas where available information is inadequate to assign any other classification.

Classification of the Stockton-Lodi P-C Region was done with regard to the suitability of the material for use in PCC aggregate. Materials suitable only for asphaltic aggregate, base, subbase, and fill were not classified because of their relative abundance in the region.

CLASSIFICATION CRITERIA

To be considered *significant* for the purpose of mineral land classification, a mineral deposit, or a group of mineral deposits that can be mined as a unit, must meet marketability and threshold value criteria adopted by the SMGB (see 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 criteria vary for different minerals depending on (1) whether they are strategic or non-strategic minerals, (2) their uniqueness or rarity, and (3) their commodity-type category (metallic minerals or industrial minerals). For example, to be considered significant, the threshold value of the first marketable product for a metallic ore deposit (such as a gold deposit) is $1,250,000 1998-dollars, $2,500,000 1998-dollars for an industrial mineral deposit (such as a diatomite or clay deposit), and $12,500,000 1998-dollars for a construction aggregate deposit (such as a sand and gravel or crushed-stone deposit). In order to adjust the threshold values to reflect 2010 dollars, the values were multiplied by an inflation factor of 1.39. This factor was determined by dividing the U.S. Department of Labor's (California Department of Finance, 2010), estimated Consumer Price Index (CPI) for 2010 (226.9) by the CPI for 1998 (163.7). The results (rounded to the nearest $1,000) are:

Metallic Deposits	$ 1,738,000
Industrial Minerals	$ 3,475,000
Construction Aggregate	$ 17,375,000

PCC-grade aggregate sells for about $13 per ton in the Stockton-Lodi P-C Region; therefore, $17,375,000 equates to about 1.3 million tons of PCC-grade aggregate material.

RESERVES AND RESOURCES

In this report, reserves are calculations of tonnages of aggregate 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. Permits may be required by agencies other than the county, as is the case in rivers where a permit may also be required by the U.S. Army Corps of Engineers. 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, or for which marketability has not been established.

REEVALUATION OF MINERAL LAND CLASSIFICATION FOR PCC-GRADE AGGREGATE IN THE STOCKTON-LODI P-C REGION

At the time SR 160 was completed the Stockton-Lodi P-C Region was supplied with PCC-grade aggregate from deposits on the Corral Hollow Creek alluvial fan near Tracy and from flood plain deposits of the Mokelumne River near Lodi. Since that time, the deposits near Tracy have been largely depleted. As of December 2010, PCC-grade aggregate was being produced from three deposits in the Stockton-Lodi PC Region, two deposits in the alluvial fans of Lone Tree Creek and Hospital Creek west of Vernalis and one deposit in the floodplain of the Mokelumne River east of Lodi. Additionally, PCC-grade sand is produced from one deposit on the San Joaquin River near Lathrop.

The Lone Tree Creek and Hospital Creek alluvial fans are on the eastern flank of the Diablo Range in southwestern San Joaquin County. The fans are Pleistocene to Holocene in age and are composed of older reworked alluvial deposits. Portions of both fans were classified for PCC-grade aggregate in SR 160. New information has allowed the classification of additional resources related to these two alluvial fans as discussed below.

PCC-grade aggregate is also produced from Mokelumne River flood plain deposits East of Lodi. Production from this area began in the first half of the last century. Classification of resources in this area as MRZ-2 has never been possible because of a lack of exploration data in areas that are unmined, but the majority of material produced from the deposit is PCC-grade aggregate.

Brown Sand Inc. has produced sand from a deposit along the San Joaquin River Southwest of Lathrop since 1969. Although much of the sand has historically been used for specialty sand products, evaluation of test data during the preparation of SR 160 indicated that the material would meet the specifications for use in PCC. Several areas have been mined out and reclaimed since the publication of SR 160 and one new area has recently been permitted for mining.

A review and reevaluation of the Stockton-Lodi P-C Region, including analysis of recently obtained geologic data, resulted in several significant changes to the mineral land classification of the Region. Three areas totaling approximately 4,665 acres have been reclassified MRZ-2 based on new information on the location, extent and quality of aggregate deposits. In addition, mining since 1988 has depleted the resources in several areas on the Corral Hollow Creek fan near Tracy and also in areas south west of the City of Lathrop on the San Joaquin River.

Areas Reclassified from MRZ-3 to MRZ-2 for PCC-Grade Aggregate

Three areas are reclassified from MRZ-3 to MRZ-2 in this report. Two areas in the Lone Tree and Hospital creek areas are reclassified MRZ-2 for PCC-grade aggregate (Plate 1). One area near Lathrop is reclassified MRZ-2 for PCC-grade sand (Plate 1).

The first reclassified area to the west-northwest of Lone Tree Creek consists of approximately 1,172 acres that were previously classified MRZ-3 as well as one small area that was previously classified MRZ-1. Teichert Aggregates has a permit to mine PCC-grade aggregate in the area to the south of Highway 132. The reclassified area is interpreted as being a portion of the Lone Tree Creek alluvial fan. Subsurface data that was not previously available allowed for better understanding of formations at depth. Based on this new data the area is reclassified MRZ-2 for PCC-grade aggregate.

The second reclassified area is located between Lone Tree and Hospital creeks and extends into Stanislaus County. It consists of approximately 3,168 acres that were previously classified MRZ-3 as well as a small area that was previously classified MRZ-1. Teichert Aggregates, Granite Construction and DSS/Knife River Inc., each have active mining operations producing PCC-grade aggregate in the western portion of this reclassified area. The eastern portion of the reclassified area has been explored by several mining companies, and several of these operators have begun the permitting process. The reclassified area is interpreted as being a portion of the coalescing alluvial fans of Lone Tree Creek and Hospital Creek to the west and to the east as part of the Hospital Creek fan. Production data and subsurface data that were not previously available allowed for better understanding of formations at depth. Based on this new data the area is reclassified MRZ-2 for PCC-grade aggregate.

The third reclassified area is located southwest of the City of Lathrop west of the San Joaquin River and consists of approximately 325 acres that were previously classified MRZ-3 as well as a small area that was previously classified MRZ-1. Brown Sand Inc., is actively mining in the adjacent area and possesses permits to mine the newly classified area for PCC-grade sand.

Areas Reclassified from MRZ-2 to MRZ-1 for PCC-Grade Aggregate

Aggregate mining since the publication of SR 160 in 1988 has resulted in the depletion of resources in several areas of the Stockton-Lodi P-C Region. These include areas on the Corral Hollow Creek alluvial fan near Tracy and areas near Lathrop. These areas have been reclassified from MRZ-2 to MRZ-1 in this update to reflect the depletion of resources. These areas are described below and are shown on Plate 1.

The Corral Hollow Creek production area near Tracy has produced the largest amount of PCC-grade aggregate in the P-C Region since 1988. Mining here has depleted the resources in 28 areas totaling approximately 1404 acres.

The production area near Lathrop contains six depleted areas totaling approximately 267 acres. Several of the areas were reclaimed as lakes and subsequent residential development has occurred surrounding the lakes.

In the Mokelumne River Production area approximately 150 acres has been reclassified from MRZ-3 to MRZ-1 because of depletion due to mining. This area was not classified MRZ-2 in the previous report because it could not be demonstrated that the resources met the required threshold value for classification.

PART III – PCC-GRADE AGGREGATE RESOURCE SECTORS IN THE STOCKTON-LODI P-C REGION

CONCEPTS USED IN IDENTIFYING AVAILABLE AGGREGATE RESOURCES

The State Geologist is responsible for calculating aggregate resources for those areas classified as MRZ-2 for aggregate. Recognizing that there are lands within these areas that have already been urbanized and therefore have a limited opportunity for mineral resource 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 SMGB. 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 SMGB threshold value, and 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 resources in Sectors for designation.

For this update, the determination of land use as non-urbanized was based on conditions of the lands as of July 2010. The land use was determined by reference to satellite imagery, field reconnaissance, and consultation with local planners.

The SMGB'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

The resource calculations given here are for those PCC-grade aggregate resources remaining in the Sectors designated by the SMGB in July 1988 and incorporated into administrative law in October 1989 (California Department of Conservation, 1988) as well as the new Sectors resulting from areas reclassified MRZ-2 in this report. The changes in the previously designated sectors are shown on Plate 2.

Most of the factors used in this study to determine the areal extent and tonnage of PCC-grade aggregate resources remaining within the designated Sectors are the same as those used in Special Report 160 although resource thicknesses have changed for some of the designated Sectors:

1. Resource tonnage calculations for this report used area calculations generated from Geographic Information System (GIS) software.

2. Even in proven PCC-grade aggregate deposits, a small percentage of the aggregate cannot be used in concrete and is considered as "waste." Waste includes pit-run and production wastes, both of which may be utilized in non-PCC uses, primarily fill. Known waste percentages were extrapolated to deposits in untested areas from proven, nearby PCC-grade aggregate deposits.

3. Thicknesses of PCC-grade aggregate deposits were determined in the original report (Jensen and Silva, 1988) through analysis of water well log data, examination of active aggregate pits and natural outcrops, and other information provided by persons who have knowledge concerning aggregate deposits in this region. Many of these thicknesses have changed since publication of SR 160, which required recalculation of resources in previously designated Sectors. Based on discussions with operators during this update, the resources in several previously designated Sectors have been recalculated using increased deposit thicknesses.

4. A standard setback of 100 feet from utility and rail lines and urban development was used in determining the limits of areas available for mining, unless otherwise stipulated on individual mining plans. A setback of 300 feet from the centerline of the California Aqueduct and the Delta Mendota Canal was used in determining the limits of areas available for mining.

5. Side slopes were generally calculated to have a 1:1 gradient, or, if the deposit is permitted for mining, the side slopes of the mining plan.

6. In place densities of 0.055 to 0.065 tons per cubic foot were assumed in calculating the tonnage of sand and gravel resources.

The calculations of resource tonnage lost to urbanization or mining for this report were made by assuming that the tonnage of resources lost was proportional to the area lost to urban development or mining in each sector based on the resources estimates made in SR 160.

PREVIOUSLY DESIGNATED RESOURCE SECTORS

In SR 160, all lands in the Stockton-Lodi P-C Region classified as having significant extractable PCC-grade aggregate resources (MRZ-2) and not precluded from mining by incompatible land use, were divided into seven Sectors, A-1, A-2, A-3, A-4, B, C and D, and further subdivided into 84 subsectors. Detailed descriptions of the Sectors are available in SR 160. In 1989, the SMGB designated a total of 76 subsectors in Sectors A-1 through D as regionally significant aggregate resources. Following is a brief summary of the designated Sectors.

Resource Sectors A-1, A-2, A-3, and A-4 encompass a large alluvial fan centered on Corral Hollow Creek near Tracy. These resource Sectors were further subdivided into numerous adjacent but individual subsectors because of existing urbanization and intervening incompatible land uses such as canals, streets, and railroads. The 43 subsectors designated as regionally significant by the SMGB in 1989 contained approximately 2,728 acres and 464.2 million tons of aggregate resources.

The Corral Hollow Creek area was the major construction aggregate production area in the Stockton-Lodi P-C Region in the late 1980s, but many of those resources are now depleted. In addition some resources in the northern portion of the Corral Hollow Creek fan that were previously designated have been lost to urbanization caused by the expansion of the City of Tracy. Most construction aggregate production has since shifted further south to resources in the Lone Tree Creek and Hospital Creek alluvial fans.

Resource Sector B consists of a 1,250-acre portion of the alluvial fan associated with Lone Tree Creek. The sector is situated on the west side of the San Joaquin Valley near the base of the Diablo Range. This sector was divided into several smaller subsectors because of intervening incompatible land uses such as highways and canals. The 13 subsectors designated as regionally significant by the SMGB in 1989 contained approximately 1,226 acres and 64.1 million tons of aggregate resources. Land use within the sector includes floodway, open space, and farming.

Resource Sector C covers an 877-acre portion of the alluvial fan formed by Hospital Creek along the western edge of the Valley. This deposit is located on the west side of the San Joaquin Valley near the intersection of Interstate 5 and Interstate 580. As with the other sectors, Resource Sector C was divided into several subsectors because of intervening roadways, canals, and power lines. The eight subsectors designated as regionally significant by the SMGB in 1989 contained approximately 877 acres and 37.6 million tons of aggregate resources. Land use in this sector includes farming, aggregate mining, and open space.

Resource Sector D consists of a large PCC-grade sand deposit situated along the San Joaquin River west of Manteca and south of Lathrop near the middle of the Valley. This sector covers approximately 878 acres. The deposit was divided into several separate subsectors because of

the location of the main channel of the river, roadways (Interstate 5 and 120), and railroads. The 12 subsectors designated as regionally significant by the SMGB in 1989 contained approximately 878 acres and 89.6 million tons of PCC-grade sand resources. Land use in and adjacent to this sector generally includes farming, open space, rural residential and recreational development. Areas in the east and west portions of Sector D that were previously designated have been depleted by mining with those in the east subsequently being reclaimed into lakes and residential housing.

NEWLY IDENTIFIED RESOURCE SECTORS

The new aggregate resource sectors E, F, and G are derived from the two areas newly reclassified MRZ-2 for PCC-grade aggregate resources and one area reclassified MRZ-2 for PCC-grade sand in this study. These three sectors have been further subdivided into 20 subsectors to accommodate roads, canals, and other potentially incompatible land uses. The newly identified Sectors E and F total 3,736 acres containing approximately 600 million tons of PCC-grade aggregate resources. The newly identified Sector G has an area of 289 acres. PCC-grade sand resources contained in this Sector are proprietary.

1. Sector E (Sub Sectors E-1 through E-10) is approximately 2,810 acres, located in the southern portion of the P-C Region between Hospital and Lone Tree creeks and extending southward into Stanislaus County. Reclassification of this area is based on proprietary drilling data made available to CGS and as such, both resource and reserves figures for this area are proprietary and cannot be disclosed.

2. Sector F (Sub Sector F-1 through F-7) contains approximately 926 acres, located in the southern portion of the P-C Region in and to the west of Lone Tree Creek in San Joaquin County. Reclassification of this area is based on proprietary drilling data made available to CGS and as such, both resource and reserves figures for this area are proprietary and cannot be disclosed.

3. Sector G (Sub Sectors G-1 and G-2) contains approximately 289 acres, located to the south of Interstate 205 and the west of the San Joaquin River in the central portion of the P-C Region. Brown Sand Inc. mines PCC-grade sand primarily used in specialty sand products from these deposits. Reclassification of this area is based on proprietary drilling data made available to CGS and as such, both resource and reserves figures for this area are proprietary and cannot be disclosed.

OTHER RESOURCES

The flood plain of the Mokelumne River east of Lodi contains several active and reclaimed mining pits and produces PCC-grade construction aggregate as well as the full array of lower grade construction aggregate and decorative rock. The area has been producing construction aggregate since the 1930s and currently George Reed/Basic Resources is mining the deposits

there. Current production figures estimate that as much as 60 percent of the products from this district are used in making PCC-grade construction aggregate. Even with the long history of mining in the area, the limited availability of data on the extent and quality of materials in those areas not already mined makes it difficult to verify that the deposits meet the criteria for MRZ-2 classification. Therefore, as in SR 160, these deposits have been classified MRZ-3 in this report.

The Mokelumne River flood plain deposits represent an important resource for the northern portion of the PC-Region, but the area does not meet the criteria to be classified MRZ-2. They have not been converted to Sectors and are not included in resource figures for the P-C Region.

CHANGES TO PREVIOUSLY DESIGNATED AGGREGATE RESOURCE SECTORS IN THE STOCKTON-LODI P-C REGION

Since the 1989 designation of PCC-grade aggregate resources in the Stockton-Lodi P-C Region, 2,097 acres within designated Sectors A, B, and C containing about 340 million tons of aggregate resources have been depleted by mining or lost to land use changes potentially incompatible with mining (Table 2 and Plate 2).

- 1,404 acres containing approximately 206 million tons of PCC-grade aggregate resources were depleted by mining.

- 677 acres containing 134 million tons of PCC-grade aggregate resources became unavailable to mining due to urbanization.

These changes have reduced the designated PCC-grade aggregate resources about 60 percent, from the 566 million tons designated in 1989 to 226 million tons.

The calculations of resource tonnage lost to urbanization or mining for this report were made by assuming that the tonnage of resources lost was proportional to the area lost to urban development or mining in each sector based on the resources estimates made in SR 160.

The total aggregate production for the P-C Region from 1987 to 2010 (160.5 million tons) does not equal the 206 million tons of resources in Sectors identified as depleted by mining in this report. The discrepancy of about 24 percent (49 million tons) is a result of several factors. First, seldom are all of the resources recovered from a given sector. This may be due to permit conditions (depth limits, setbacks, slope requirements, etc.) or facility designs that limit the extent of mining and the amount of recoverable resources in a Sector. Second, geologic variability within a Sector may result in economically recoverable resources being less than the originally estimated resources for some Sectors. In the Sectors identified as depleted by mining, the remaining resources are generally considered uneconomic by the operators that mined within those Sectors.

In Sector D, about 289 acres of land containing PCC-Grade sand resources have been depleted by mining. The actual resource/reserve tonnages are proprietary because all of the areas were mined by a single company. This includes all or parts of subsectors D-9, D-10, and D-11. These PCC-grade sand resources are considered separately from the PCC-grade aggregate resources to maintain consistency with SR 160 and the 1989 designation report.

Table 2. PCC-grade aggregate resources lost to incompatible land uses, 1988 to 2010.

SECTOR	Acres Designated in Sector in 1988	Acres Lost to Depletion Due to Mining	Acres Lost to Incompatible Uses	Resources Lost (tons)
A-1b	3	3		*
A-1c	3	3		*
A-1d	9	9		*
A-1f	16	16		*
A-1h	144	144		*
A-1i	46	46		*
A-1j	28	28		*
A-1k	68	68		*
A-1n	22	22		*
A-1o	42	42		*
A-1p	53	53		*
A-1q	28	28		*
A-2a	43		43	7,300,000
A-2b	211		15	2,979,000
A-2c	396		396	80,100,000
A-2h	71		71	12,900,000
A-2i	152		152	29,300,000
A-2j	38	38		*
A-2n	323	323		*
A-2p	33	33		*
A-2q	73	73		*
A-2r	10	10		*
A-2s	51	51		*
A-2t	39	39		*
A-2u	43	43		*
A-2v	19	19		*
A-2w	65	65		*
A-2y	37	37		*
A-2z	16	16		*
A-3a	31	31		*
A-3b	33	33		*
A-3c	76	76		*
A-4a	16	16		*
A-4b	39	39		*
Total	**2277**	**1404**	**677**	**340,279,000**
D-9	289	197		*
D-10	9	9		*
D-11	51	51		*
D-12	10	10		*
Total	**359**	**267**		*

*** concealed to protect proprietary information**

SUMMARY OF AGGREGATE RESOURCES IN THE STOCKTON-LODI P-C REGION

In 1989 the SMGB designated approximately 4,835 acres containing 565.8 million tons of PCC-grade aggregate resources in Sectors A-1, A-2, A-3, A-4, B, and C. The SMGB also designated approximately 877 acres containing 89.6 million tons of PCC-grade sand resources in Sector D (California Department of Conservation, 1989). These previously designated resources have been used as a starting point for updating the resource estimates in this report.

For this update, the designated sectors were digitized in a Geographic Information System (GIS) and the areas were recalculated. These recalculations showed discrepancies with the original Sector area calculations in SR 160 totaling approximately 84 acres. This gave an overall decrease in total area designated of about 1.4 percent. Digitized Sectors were then modified to increase accuracy of the data at a larger scale. For example digital buffers around canals and roadways instead of hand measuring distances as in the past, allowed for a more precise sector shape. These modifications increased and decreased the area of several sectors. Sector areas were again recalculated using GIS software which resulted in a total net decrease of 102 acres or 2.0 percent of the area classified in the original report.

The total designated resources were calculated as 566 million tons for PCC-grade aggregate and 90 million tons for PCC-grade sand in the designation report (California Department of Conservation, 1989). The resources in 2010 have been recalculated at 969 million tons of PCC-grade aggregate and 67 million tons of PCC-grade sand, including resources in the newly identified sectors.

Since the designation of PCC-grade aggregate resources in the Stockton-Lodi P-C Region in 1988, 340 million tons of the identified aggregate resources have become unavailable due to depletion by mining or to urbanization.

VARIABILITY IN RESOURCE ESTIMATES, 1989 TO 2010

A comparison of PCC-grade aggregate resources designated in 1989 (566 million tons of aggregate resources), and the recalculated resources in this update report (969 million tons) indicates an increase of approximately 403 million tons. This difference has resulted from:

- Reductions of approximately 340 million tons of construction aggregate resources because of production, urbanization, or other changes in land use between 1986 and 2010.
- Additions of about 600 million tons of PCC-grade aggregate resources in new areas reclassified MRZ-2 (Sectors E and F) in this report.
- Additions of about 143 million tons of construction aggregate resources resulting from recalculation of resources in Sectors B and C based on new information (better subsurface information and revised mining depths) since the publication of SR 160.

In addition to designating PCC-grade construction aggregate resources, the SMGB designated 90 million tons of PCC-grade sand resources near the City of Lathrop. Since that time, changes have occurred including reductions from production by a single operator (proprietary) and the additions from areas reclassified in this report (Sector G reserves/resources proprietary). There are currently approximately 67 million tons of PCC-grade sand resources identified in this area.

In 1986 there were 80 million tons of permitted PCC-grade aggregate reserves in the Stockton-Lodi P C Region (Jensen and Silva, 1988). As of December 2010 there were 232 million tons of permitted PCC-grade aggregate reserves in the Stockton-Lodi P C Region.

PART IV - AGGREGATE PRODUCTION IN THE STOCKTON-LODI P-C REGION

As of December 2010, seven active mines operated by seven mining companies are permitted to mine PCC-grade aggregate (including PCC-grade sand) in the Stockton-Lodi P-C Region. These seven active PCC-grade aggregate mining operations and three non-PCC-grade aggregate mining operations are shown in Figure 2.

ACTIVE MINING OPERATIONS

At the time of this update, the following seven companies had active permits to mine PCC-grade aggregate in the Stockton-Lodi P-C Region:

- Basic Resources, Inc., George Reed, Inc.
- Brown Sand, Inc.
- DSS Company
- Granite Construction Company Inc.
- KRC Aggregate, Inc.
- RMC Cemex (formerly RMC Lonestar, Inc.)
- Teichert Aggregates

Basic Resources, Inc. George Reed, Inc. operates the only PCC-grade aggregate mining operation in the Mokelumne River flood plain deposits east of Lodi. Along with PCC-grade aggregate it also produces all grades of aggregate as well as decorative cobbles.

Brown Sand, Inc. operates the only PCC-grade sand mining operation in the P-C region. Production from its deposit along the San Joaquin River southwest of Lathrop has been ongoing since 1969.

D.S.S. Company in a joint venture with KRC Aggregate, Inc. produces PCC-grade aggregate from their Vernalis mine operation southwest of Vernalis on the Hospital Creek alluvial fan.

Granite Construction Company Inc. produces PCC-grade aggregate from its Vernalis plant located southwest of Vernalis and east of Highway 580 on the Lone Tree/Hospital Creek deposits. Granite Construction Inc. previously operated mines in the Corral Hollow Creek area; these areas are either idle or have been reclaimed. Granite is now fully permitted to mine several areas in the Lone Tree/Hospital Creek deposit and completed their new processing facility at the Vernalis site in August of 2009.

RMC Cemex operates PCC-grade aggregate mining operations in the Corral Hollow Creek fan deposits near Tracy and is in the process of permitting properties in the Hospital Creek deposits to the southwest of Vernalis.

Teichert Aggregates produces PCC-grade aggregates from two operations in western San Joaquin County. Teichert's operations include the Pereina property in the Corral Hollow Creek

deposit and the Vernalis property in the Lone Tree/Hospital Creek deposit. Construction of Teichert's Vernalis processing plant was completed in 2000, and will eventually become Teichert's only producing facility in the area when deposits at Pereina are depleted.

Several new mining operations are in various stages of the permitting process in the Vernalis production area. Most of these proposed mining operations are contingent upon a new highway interchange at Highway 132 and Bird Road to better facilitate the increased amount of truck traffic. The cost of the interchange is to be split among several mining companies that are the frequent users of the existing intersection that has been determined to be inadequate for heavy truck traffic. With the significant decrease in demand in recent years many mine operators have postponed starting the permitting process or have filed extensions to permits pending an increase in aggregate demand.

These new mining permits would represent a significant addition of reserves to the P-C Region in the future.

AGGREGATE PRODUCTION SINCE 1986

The original classification report by Jensen and Silva (1988) included production data through 1986. Aggregate production data for the Stockton-Lodi P-C Region from 1960-1989 was obtained from mining records of the U.S. Department of the Interior, Bureau of Mines (now part of the U.S. Geological Survey) and the aggregate companies. The U.S. Bureau of Mines' records were compiled from responses to voluntary questionnaires that are sent annually or biennially to all known mining operators. Each producer was requested to divulge the production from each of his producing properties for the preceding year. The accuracy of these figures depends on the producer's response. For the years 1980 to 1989, the U.S. Bureau of Mines compiled this data every other year. Because of this, more than half of the production information for the years 1984 through 1989 was either supplied by the mine operators or estimated. The estimations were made by averaging the production amounts from adjacent years. Approximately 3 percent of the total production was estimated by this method. Beginning in 1990, the California Department of Conservation has kept production records.

As shown on Table 3, aggregate production in the Stockton-Lodi P-C Region has ranged from about 3.1 to 11.5 million tons per year since 1986 for a total production of 160.5 million tons.

AGGREGATE MARKETING DISTRIBUTION PATTERN OF THE STOCKTON-LODI P-C REGION

In SR 160 it was estimated that approximately 10-15 percent of all production in the Stockton-Lodi P-C Region from 1986-1987 was exported to neighboring regions and/or counties. Ten percent of the aggregate from the Mokelumne River production area was exported into

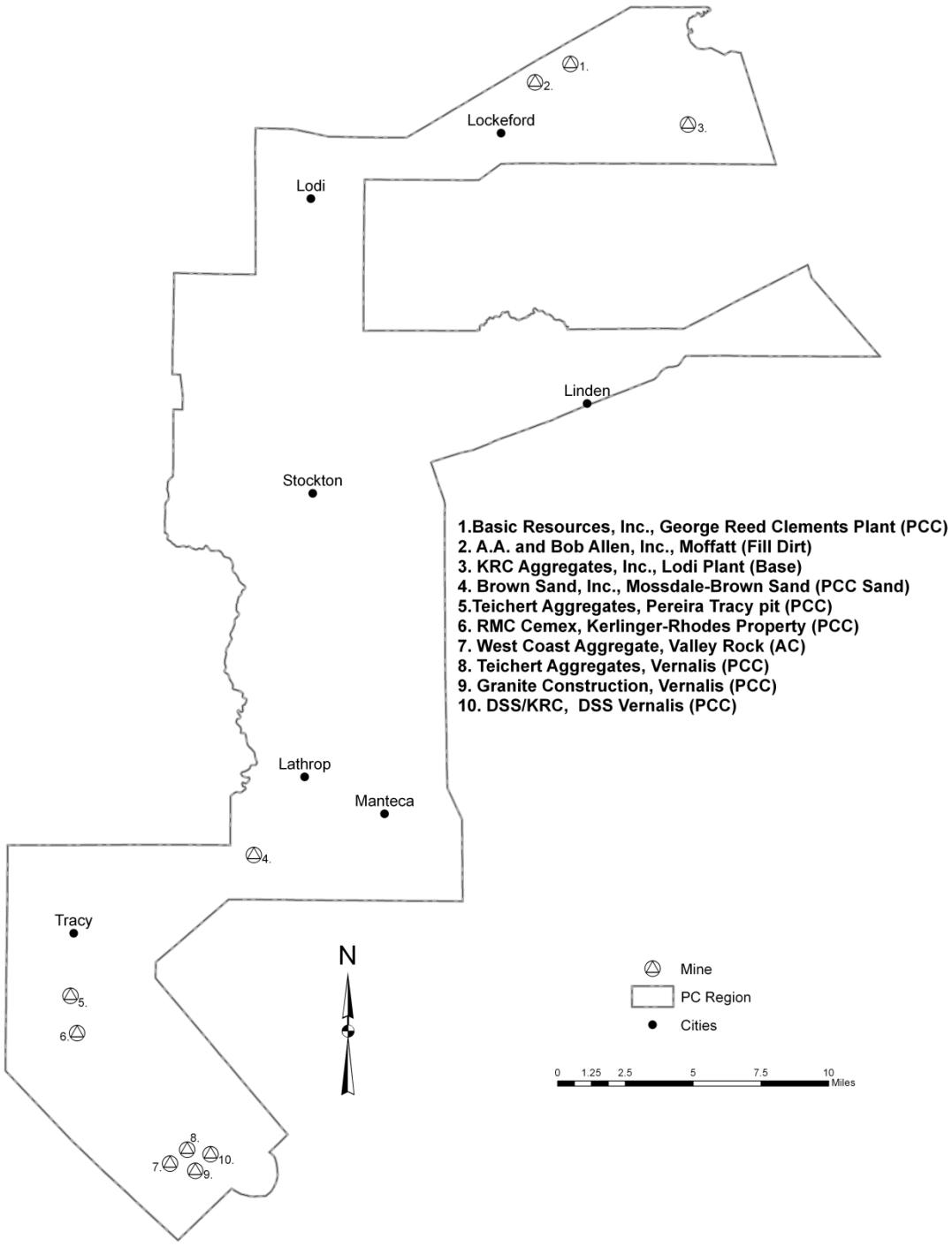

Figure 2. Location of active mines producing PCC- and other grades of aggregate material in the Stockton-Lodi P-C Region

Table 3. Aggregate production (all grades) in the Stockton-Lodi P-C Region during the years 1987 through 2010. Figures are rounded to the nearest 1,000 tons.

YEAR	RECORDED AGGREGATE PRODUCTION (in tons)	YEAR	RECORDED AGGREGATE PRODUCTION (in tons)
1987	3,735,000	1999	8,556,000
1988	3,093,000	2000	9,053,000
1989	3,262,000	2001	8,981,000
1990	3,592,000	2002	11,383,000
1991	4,900,000	2003	10,834,000
1992	4,193,000	2004	10,793,000
1993	4,474,000	2005	11,526,000
1994	4,707,000	2006	10,645,000
1995	5,392,000	2007	9,326,000
1996	5,429,000	2008	6,486,000
1997	6,407,000	2009	3,479,000
1998	7,000,000	2010	3,245,000
		TOTAL	160,491,000

neighboring Amador and Calaveras Counties and 15 percent of the aggregate from the Tracy production area was exported into Contra Costa and Alameda Counties.

Based on discussion with aggregate producers, export of aggregate from the Stockton-Lodi P-C Region from 2000 to 2007 showed a significant increase compared to the previous estimate. Within the Mokelumne River production area exports increased to approximately 30 percent with material being marketed into southern Sacramento, Amador and Calaveras Counties. Exports from the Tracy production area also increased with 25 percent of its total production going to Contra Costa and Alameda Counties (Figure 3). In total 25-30 percent of all aggregate produced in the Stockton-Lodi P-C Region for this time period was exported to other regions and/or counties. With the downturn of the economy beginning in 2006 both production and export of aggregate from the Stockton-Lodi P-C Region has decreased significantly. As the economy improves it is likely that both production and export of aggregate from the region will again increase.

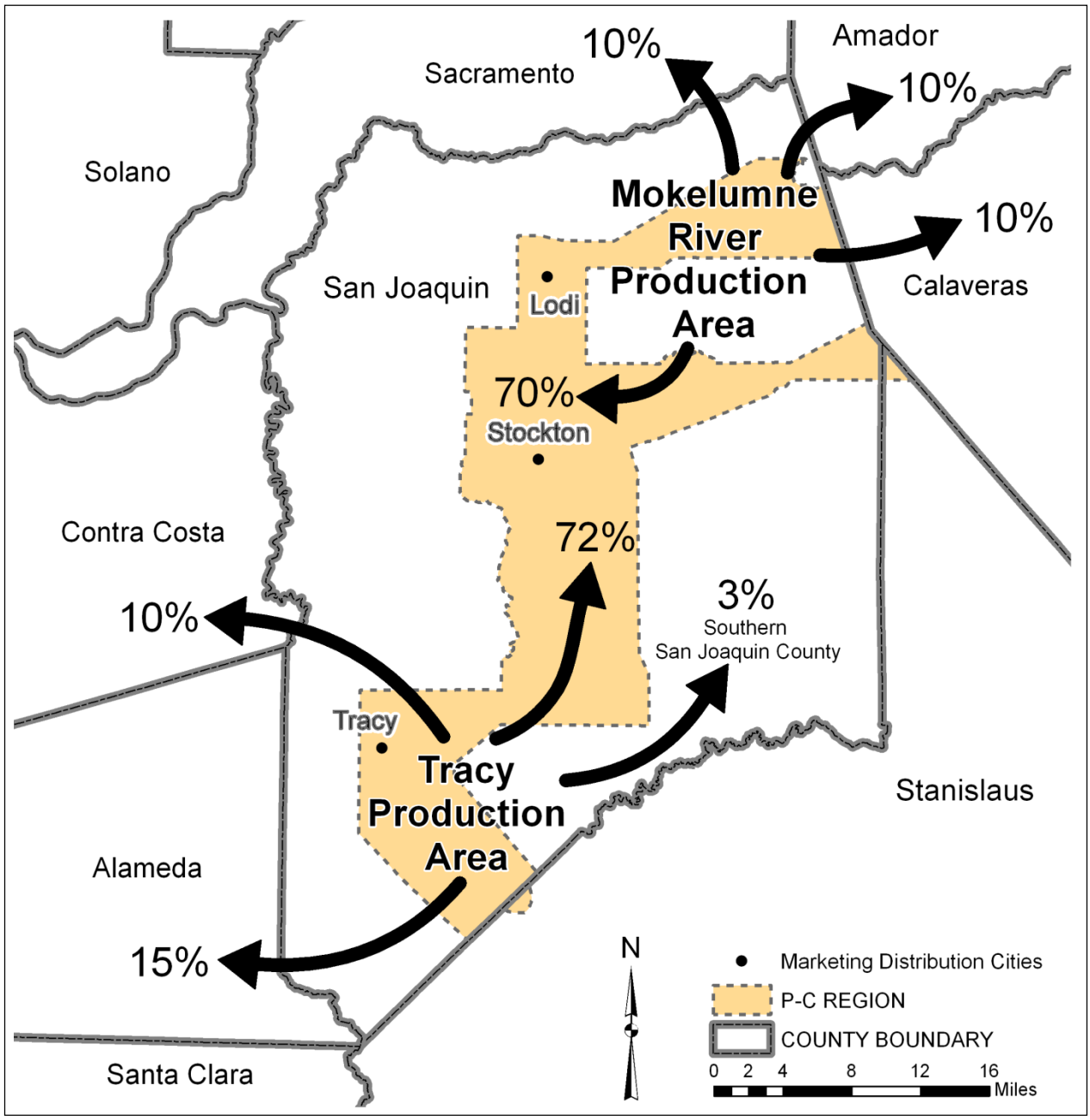

Figure 3. PCC-grade aggregate marketing distribution for the Stockton-Lodi P-C Region 2000-2007

PART V - UPDATED ESTIMATE OF 50-YEAR CONSUMPTION OF AGGREGATE IN THE STOCKTON-LODI P-C REGION

The SMGB, as specified in its guidelines for classification and designation of mineral lands (California State Mining and Geology Board), 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." The SMGB guidelines also specify that the State Geologist periodically review (every 10 years or less) the information in the reports to determine if a revision is warranted. This section contains the revised estimate of construction aggregate and PCC-grade aggregate needs for the Stockton-Lodi P-C Region projected to the year 2060.

CORRELATIONS BETWEEN AGGREGATE PRODUCTION AND POPULATION

Past studies of marketing areas 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 study 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 some large market regions such as Los Angeles County show a correlation between aggregate production and population indicates that population is a major factor in determining aggregate consumption in any area. 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 Stockton-Lodi P-C Region from SR 160 (1988) and actual production data for the period of 1987 to 2010 is shown in Figure 4. Using an annual per capita consumption rate of 8.5 tons, SR 160 projected that the demand for aggregate in the Stockton-Lodi P-C Region for 1987-2010 would be 109 million tons. Actual aggregate production in the Stockton-Lodi P-C Region for 1987-2010 was approximately 160.5 million tons, which is 47 percent (or 55.5 million tons) greater than projected demand. This difference was likely a result of population growth above that which was projected, increased construction within the P-C region, and increased export of materials out of the P-C region. Some of this above projected population growth was driven by migration of Bay Area residents moving into the Tracy and Manteca areas starting in the late 1980’s. Increased export of aggregate from the Stockton-Lodi P-C region to Alameda and Contra Costa counties in the late 1990’s through mid to late 2000’s also likely contributed to this difference.

The export of aggregate from a P-C Region can inflate the apparent per capita aggregate consumption for that region. It is difficult to quantify the actual amounts of aggregate exported out of the P-C Region for any given year. The amount of aggregate being exported can be roughly estimated by discussion with aggregate producers, but cannot be documented or derived from reported production data. Although exact data is unavailable, it is estimated that less than thirty percent of all aggregate produced in the Stockton-Lodi P-C Region is exported out of the region, and it is concluded that the 50-year projection based on population growth (thus per capita) is accurate for this study.

The wide variations from year to year of the historic aggregate consumption (Table 4) probably reflect, to a large degree, changes in urban growth rates and intermittent large construction projects such as freeways and large tracts of residential construction. In part, these variations could also result from incompleteness and inaccuracies of the production record. Increasing and decreasing trends in consumption across several years can be caused by changes in the general economic climate. The high economic growth during the mid-to late 1980's and the recession of the early 1990's as well as the construction boom of the early 2000's and current economic recession starting in 2006 are all reflected in the aggregate production record. As the economy improves it is likely that both consumption of aggregate within the region and export of aggregate from the region will again increase, however it is not possible to predict either the magnitude or timing of these potential increases.

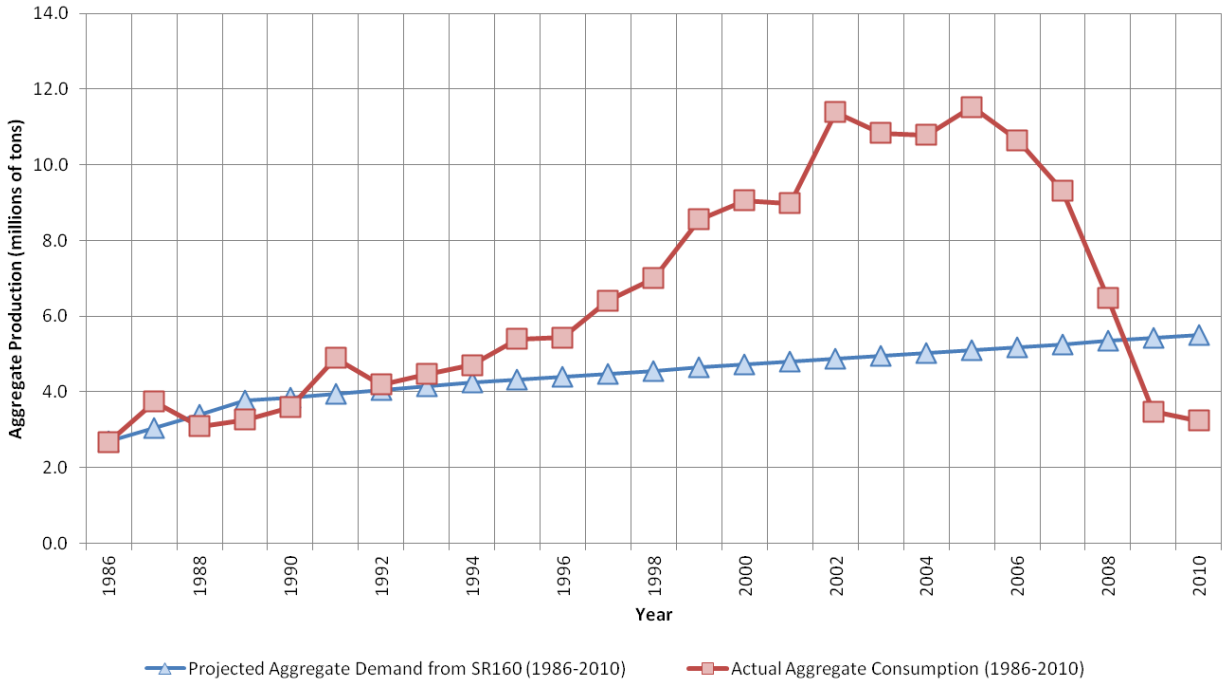

Figure 4. Comparison of projected aggregate consumption and actual production in Stockton-Lodi P-C Region for the years 1986 through 2010.

Table 4. Population, aggregate production, and per capita consumption in the Stockton-Lodi P-C Region 1960 through 2010.

YEAR	POPULATION	RECORDED AGGREGATE PRODUCTION (in tons)	PER CAPITA CONSUMPTION (in tons)	YEAR	POPULATION	RECORDED AGGREGATE PRODUCTION (in tons)	PER CAPITA CONSUMPTION (in tons)
1960	237,000	1,700,000	7.2	1986	402,000	2,675,000	6.7
1961	241,000	2,343,000	9.7	1987	441,600	3,735,000	8.5
1962	245,000	1,996,000	8.1	1988	454,800	3,093,000	6.8
1963	249,000	2,496,000	10.0	1989	466,300	3,262,000	7.0
1964	253,000	2,734,000	10.8	1990	481,000	3,592,000	7.5
1965	257,000	3,153,000	12.3	1991	490,300	4,900,000	10.0
1966	261,000	3,222,000	12.3	1992	499,900	4,193,000	8.4
1967	265,000	2,742,000	10.3	1993	507,200	4,474,000	8.8
1968	269,000	2,496,000	9.3	1994	513,100	4,707,000	9.2
1969	273,000	2,597,000	9.5	1995	531,900	5,392,000	10.1
1970	277,000	2,544,000	9.2	1996	537,700	5,429,000	10.1
1971	282,000	3,057,000	10.8	1997	545,300	6,407,000	11.7
1972	287,000	2,085,000	7.3	1998	552,300	7,000,000	12.7
1973	293,600	1,780,000	6.1	1999	563,100	8,556,000	15.2
1974	298,000	2,411,000	8.1	2000	567,600	9,053,000	15.9
1975	303,000	1,513,000	5.0	2001	590,900	8,981,000	15.2
1976	309,000	2,375,000	7.7	2002	607,000	11,383,000	18.8
1977	314,000	2,800,000	8.9	2003	626,000	10,834,000	17.3
1978	319,000	2,905,000	9.1	2004	642,000	10,793,000	16.8
1979	325,000	2,972,000	9.1	2005	656,000	11,526,000	17.6
1980	330,000	2,737,000	8.3	2006	662,400	10,645,000	16.1
1981	342,000	2,227,000	6.5	2007	667,900	9,326,000	14.0
1982	354,000	1,717,000	4.9	2008	672,400	6,486,000	9.6
1983	366,000	2,238,000	6.1	2009	674,860	3,479,000	5.2
1984	378,000	2,463,000	6.5	2010	685,300	3,245,000	4.7
1985	390,000	2,825,000	7.2	AVERAGE			9.9

Population figures are rounded to the nearest 100. Aggregate production figures are rounded to the nearest 1,000 tons.

POPULATION PROJECTION FOR THE STOCKTON-LODI P-C REGION THROUGH THE YEAR 2060

The population projection for the Stockton-Lodi P-C Region (Figure 5) was estimated from projections for San Joaquin County published by the State of California Department of Finance in July of 2007 (Dept. of Finance 2007). Because more than 95 percent of the population of San Joaquin County resides within the boundaries of the P-C Region, the population projection for the County as a whole was used to represent the P-C Region. The small portion of Stanislaus County in the P-C region has little to no populated areas so no data on Stanislaus County was used in the population projection. The projection gives the estimated population of San Joaquin County every decade from 2000 to 2050. Rate of growth between decade predictions was averaged to provide the graphical representation. For the years 2050 through 2060 the average rate of population increase between 2040 and 2050 was continued to the year 2060 (Figure 4). The population of the Stockton-Lodi P-C Region is projected to increase from 741,000 in 2010 to 2,090,500 in 2060.

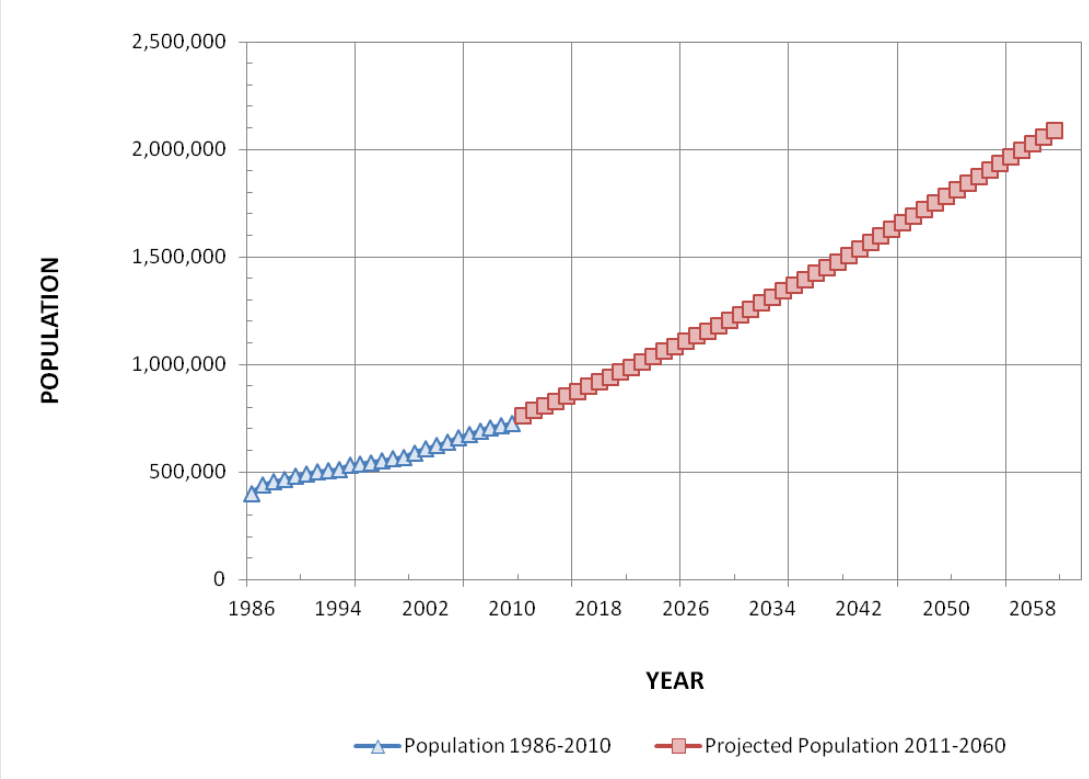

Figure 5. Population of the Stockton-Lodi PC region through the year 2060

PROJECTED AGGREGATE DEMAND FOR THE STOCKTON-LODI P-C REGION THROUGH THE YEAR 2060

A simple analysis using the population projection derived by the method explained in the preceding section and the annual per capita consumption rate for 1960-2010 was made to project the aggregate consumption of the Stockton-Lodi P-C Region through the year 2060 (Table 5). The calculated historic annual per capita consumption of 9.9 tons was multiplied by the projected annual population. The PCC-grade aggregate consumption rate was estimated in the original classification report (Jensen and Silva, 1988) as 40 percent of the total aggregate production. Discussions with operators indicate that this is still a valid estimate and it was used to project the PCC-grade aggregate demand.

The PCC-grade sand reserves are not included in resource and reserve figures that are used in the 50-year projection of PCC-grade aggregate demand for the P-C Region. Although it was determined in SR 160 that the sand from these deposits can meet PCC specifications, historically these deposits have been mined for specialty sands. Because portland cement concrete requires an approximately 50-50 mix of coarse and fine aggregate, an equivalent-sized supply of PCC-grade coarse aggregate would be needed to utilize the sand reserves in portland cement concrete.

The result of this projection shows that an estimated 687 million tons of aggregate will be needed to satisfy the future demand through the year 2060 in the Stockton-Lodi P-C Region. Of this

total, about 40 percent, or 275 million tons, must be of PCC grade. This is approximately 2.4 times the 50-year projection of 113 million tons of PCC grade aggregate made in the original classification report by Jensen and Silva (1988).

Table 5. Projected population and aggregate demand in the Stockton-Lodi P-C Region 2011-2060

YEAR	PROJECTED POPULATION*	PROJECTED AGGREGATE DEMAND (in tons)**	PROJECTED PCC AGGREGATE DEMAND (in tons)**	YEAR	PROJECTED POPULATION*	PROJECTED AGGREGATE DEMAND (in tons)**	PROJECTED PCC AGGREGATE DEMAND (in tons)**
2011	763,800	7,638,000	3,055,000	2037	1,395,800	13,818,000	5,527,000
2012	786,200	7,862,000	3,145,000	2038	1,423,000	14,088,000	5,635,000
2013	808,500	8,085,000	3,234,000	2039	1,450,200	14,357,000	5,743,000
2014	830,900	8,309,000	3,324,000	2040	1,477,500	14,627,000	5,851,000
2015	853,300	8,533,000	3,413,000	2041	1,508,100	14,930,000	5,972,000
2016	875,600	8,756,000	3,502,000	2042	1,538,800	15,234,000	6,094,000
2017	898,000	8,980,000	3,592,000	2043	1,569,400	15,537,000	6,215,000
2018	920,400	9,204,000	3,682,000	2044	1,600,100	15,841,000	6,336,000
2019	942,700	9,427,000	3,771,000	2045	1,630,700	16,144,000	6,458,000
2020	965,100	9,651,000	3,860,000	2046	1,661,400	16,448,000	6,579,000
2021	989,100	9,891,000	3,956,000	2047	1,692,000	16,751,000	6,700,000
2022	1,013,100	10,131,000	4,052,000	2048	1,722,700	17,054,000	6,822,000
2023	1,037,100	10,371,000	4,148,000	2049	1,753,300	17,358,000	6,943,000
2024	1,061,100	10,611,000	4,244,000	2050	1,784,000	17,661,000	7,064,000
2025	1,085,100	10,851,000	4,340,000	2051	1,814,600	17,965,000	7,186,000
2026	1,109,200	11,092,000	4,437,000	2052	1,845,300	18,268,000	7,307,000
2027	1,133,200	11,332,000	4,533,000	2053	1,875,900	18,572,000	7,429,000
2028	1,157,200	11,572,000	4,629,000	2054	1,906,600	18,875,000	7,550,000
2029	1,181,200	11,812,000	4,725,000	2055	1,937,200	19,179,000	7,672,000
2030	1,205,200	12,052,000	4,821,000	2056	1,967,900	19,482,000	7,793,000
2031	1,232,400	12,324,000	4,930,000	2057	1,998,500	19,785,000	7,914,000
2032	1,259,700	12,597,000	5,039,000	2058	2,029,200	20,089,000	8,036,000
2033	1,286,900	12,869,000	5,148,000	2059	2,059,800	20,392,000	8,157,000
2034	1,314,100	13,141,000	5,256,000	2060	2,090,473	20,696,000	8,278,000
2035	1,341,300	13,413,000	5,365,000	**Total 50 Year Demand:**		687,204,000	274,882,000
2036	1,368,600	13,549,000	5,420,000				

*** Population figures are rounded to the nearest 100.**

**** Aggregate figures are rounded to the nearest 1,000 tons**

COMPARISON OF THE 50-YEAR AGGREGATE DEMAND WITH CURRENT RESERVES

The total PCC-grade aggregate reserves of 232 million tons (Table 6) in the Stockton-Lodi P-C Region are projected to last 23 years (into the year 2033). If all of these reserves were to be used exclusively as PCC aggregate, the supply would theoretically last 40 years (into 2049). In reality, about 60 percent of the aggregate reserves will likely be used for other lower grade aggregate products such as base and subbase, and a depletion date of 2033 is considered more realistic. However, even this date may be optimistic. An important consideration is that not all

of the aggregate reserves may be minable under existing permits because of operating restrictions or because of expiration dates that may not allow reserves to be completely mined. While California is currently in a period of reduced aggregate demand because of the recession and slow economic recovery, it is likely that, as the economy improves, demand for aggregate will again increase. However, it is not possible to predict either the magnitude or timing of such an increase.

Several mining companies have begun the permitting of new mines in the Vernalis production area. With the significant decrease in demand due to the economic recession and subsequent slow recovery, many of these proposed mining permits currently are on hold pending the return of a stronger regional aggregate demand. These proposed mines, should they be permitted, would represent a significant addition of reserves to the P-C Region in the future.

Table 6. Summary of aggregate resources and projected 50-year consumption for the Stockton-Lodi P-C Region.

Estimated PCC Aggregate Resources	**969 Million Tons**
PCC-Grade Aggregate Reserves	**232 Million Tons**
Projected 50-Year Construction Aggregate Demand (all aggregate grades)	**687 Million Tons**
Projected 50-Year Demand for PCC Aggregate	**275 Million Tons**
Estimated Years Until Depletion of Current PCC-Grade Aggregate Reserves	**23 Years**
Estimated Depletion Date of PCC-Grade Aggregate Reserves	**2033**

ALTERNATIVE SOURCES OF AGGREGATE

Potential sources of PCC-grade aggregate, in addition to the deposits classified as MRZ-2, that exist within or near the Stockton-Lodi P-C Region were discussed in Special Report 160 (Jensen and Silva, 1988). They included potential resources within the Stockton-Lodi P-C Region that were classified as MRZ-3 and aggregate production districts in neighboring counties.

The potential resources mentioned in Special Report 160 that lie within the Stockton-Lodi P-C Region include areas underlain by Quaternary alluvium, Tertiary sediments and volcanic rocks. No new information was found regarding the suitability of either the Quaternary alluvial channels or fans on the valley floor or the two Tertiary gravel units on the eastern side of the region for use as PCC. This situation could change in the near future as KRC Aggregate is currently seeking a permit to mine 1,100 acres underlain in part by the Laguna Formation. If preliminary test results are validated, and this material is able to meet PCC specifications with upgraded beneficiation techniques, then this operation could add significantly to the PCC-grade reserves/resources of the Stockton-Lode PC region. Crushed rock resources in the Sierra Nevada Mountains are another potential source of aggregate for which no new information was found regarding suitability for use as PCC aggregate.

RECYCLED AGGREGATE

Recycling of construction and demolition waste material as Class II base has become common in the Stockton-Lodi P-C Region. Six operations recycle PCC and AC waste in the region: Cal-Crush in Ripon; D.H. Winn Trucking, Inc in Lockeford; FTG Construction Materials in both Lodi and Stockton; Granite Construction Company in French Camp; and Teichert Aggregates in Tracy. These recycling operations are of minor importance to the supply of PCC-grade aggregate in the county and have been estimated at 200,000 tons per year. Although recycled material currently cannot be used to make PCC aggregate, historically, PCC-grade aggregate resources have been used for base material. If more recycled construction aggregate is used as base material in the Stockton-Lodi P-C Region, a higher percentage of the virgin material can be used for PCC aggregate. This would tend to extend the life of the PCC-grade aggregate resources in the county.

PART VI -CONCLUSIONS

The Stockton-Lodi P-C Region contains about 969 million tons PCC-grade aggregate resources. This represents an increase in PCC-grade aggregate resources of about 403 million tons from the 566 million tons of PCC-grade aggregate resources designated in 1989. This updated figure includes a decrease of about 340 million tons because of production and urbanization. The new resource estimate also includes an increase of about 143 million tons resulting from the recalculation of existing aggregate resources, and 600 million tons of newly reclassified, but not previously designated, aggregate resources in the Lone Tree Creek and Hospital Creek areas in southwestern San Joaquin County.

The P-C Region also contains 67 million tons of PCC-grade sand resources along the San Joaquin River near Lathrop. This represents a decrease from the 90 million tons of sand resources designated in 1989. However the updated figure of 67 million tons includes both reductions from production and addition of newly reclassified resources/reserves identified in this study. Both production and new reserves/resources are proprietary.

Based on available historic population and production data, and population projections, the Stockton-Lodi P-C Region will need 687 million tons of aggregate during the next 50 years. Of this projected demand, it is estimated that 40 percent, or 275 million tons, must be suitable for use in PCC. The presently permitted PCC-grade aggregate reserves of 232 million tons represent about 34 percent of the total projected construction aggregate demand of the next 50 years. These permitted reserves are projected to last until the year 2033, or 23 years from the present. If a large scale construction project or catastrophic events (i.e. earthquake) requiring rebuilding were to happen in the P-C Region, existing reserves may be depleted sooner than projected. The relationship between demand, reserves, and resources is illustrated in Figure 6. A comparison of the results of the current study with those of the 1989 study is presented in Table 7.

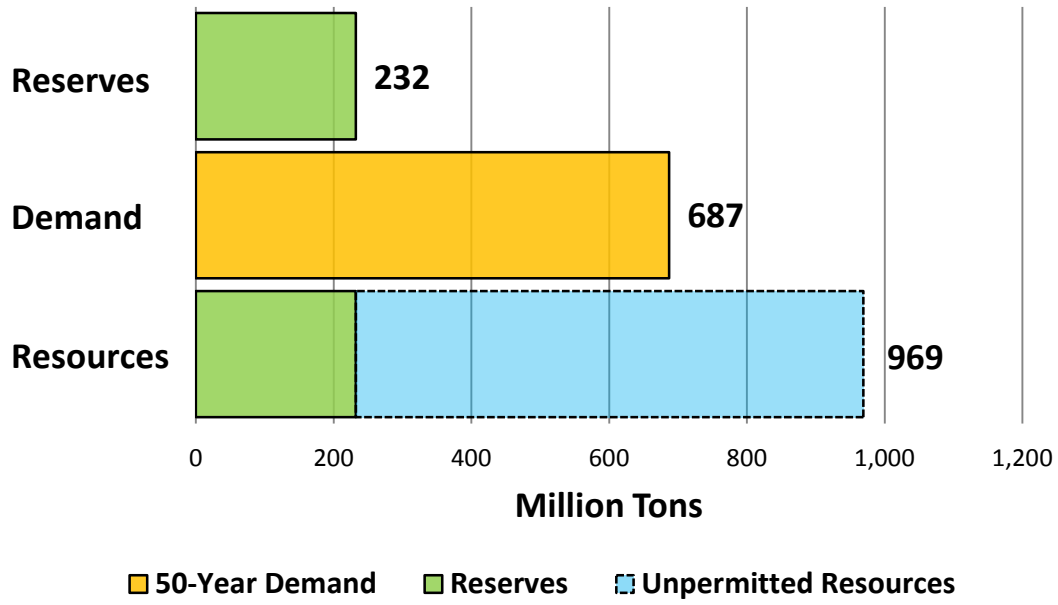

Figure 6. Comparison of reserves, demand and resources in the Stockton-Lodi P-C Region. Note: The terms resources and reserves are defined as follows. Reserves are deposits for which mining permits have been granted. The term resource includes both reserves and unpermitted resources.

Table 7. Comparison of Special Report 160 data with data concluded in this report.

COMPARISON OF:	1986	2010
POPULATION	402,000	685,000
CALCULATED ANNUAL AGGREGATE DEMAND	2.5 MILLION TONS	4.7 MILLION TONS
TOTAL PERMITTED AGGREGATE RESERVES*	80 MILLION TONS	232 MILLION TONS
CALCULATED ANNUAL PER CAPITA CONSUMPTION	8.5 TONS (1960-1986 average)	9.9 TONS (1960-2010 average)
PROJECTED 50-YEAR NEED FOR AGGREGATE	281 MILLION TONS (through the year 2036)	687 MILLION TONS (through the year 2060)
PROJECTED 50-YEAR NEED FOR AGGREGATE OF PCC QUALITY	113 MILLION TONS	275 MILLION TONS
CALCULATED YEARS UNTIL DEPLETION OF RESERVES	16 YEARS (through the year 2004)	23 YEARS (through the year 2033)
AGGREGATE RESOURCES*	599 MILLION TONS	969 MILLION TONS
PCC AGGREGATE MINES	12	7
NO. OF COMPANIES	9	7

*** The terms resources and reserves are defined as follows. Reserves are deposits for which local use permits have been granted. The term resource includes both reserves and unpermitted resources. Nonpermitted resources are usable materials that could be mined in the future, but for which no local use permit allowing extraction has been granted, or for which development has not been definitely established to be feasible based upon current technological or economic conditions.**

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APPENDIX A – STOCKTON-LODI P-C REGION SECTOR SUMMARIES

Table A-1. Summary of Designated Sector acreages, PCC-grade aggregate resources, and reserves in the Stockton-Lodi P-C Region in 2010. (Note: Sectors A-1, A-2, A-3, A-4, B, C, and D were previously designated by the SMGB. Newly identified Sectors E,F and G are not designated.)

Sector	Acres Remaining in Sector	Resources in 2010 (million tons)	Reserves (Permitted Resources) in 2010 (million tons)
A-1a	7	0.9	0
A-1b	0	0†	P
A-1c	0	0†	P
A-1d	0	0†	P
A-1e	23	4.3	0
A-1f	0	0†	P
A-1g	38	7.8	0
A-1h	0	0†	P
A-1i	0	0†	P
A-1j	0	0†	P
A-1k	0	0†	P
A-1l	18	3.1	0
A-1m	30	6.1	0
A-1n	0	0†	P
A-1o	0	0†	P
A-1p	0	0†	P
A-1q	0	0†	P
A-2a	0	0††	0
A-2b	196	38.7	0
A-2c	0	0††	0
A-2d	29	P	P
A-2e	186	P	P

Sector	**Acres Remaining in Sector**	**Resources in 2010** (million tons)	**Reserves (Permitted Resources) in 2010** (million tons)
A-2h	0	0††	0
A-2i	0	0††	0
A-2j	0	0†	P
A-2n	0	0†	P
A-2o	119	22.9	0
A-2p	0	0†	P
A-2q	0	0†	P
A-2r	0	0†	P
A-2s	0	0†	P
A-2t	0	0†	P
A-2u	0	0†	P
A-2v	0	0†	P
A-2w	0	0†	P
A-2x	22	3.1	0
A-2y	0	0†	P
A-2z	0	0†	P
A-3a	0	0†	P
A-3b	0	0†	P
A-3c	0	0†	P
A-4a	0	0†	P
A-4b	0	0†	P
B-1	22	0.4	P
B-2	24	1	0
B-3	15	P	P
B-4	250	P	P
B-5	20	0.9	0
B-6	85	P	P
B-7	361	P	P
B-8	59	2.4	0

Sector	**Acres Remaining in Sector**	**Resources in 2010** (million tons)	**Reserves (Permitted Resources) in 2010** (million tons)
B-9	12	P	P
B-11	28	P	P
B-12	49	1.9	0
B-13	89	3.6	0
B-14	205	8.4	0
C-1	30	0.7	0
C-2	104	2.4	0
C-3	12	P	P
C-4	25	P	P
C-6	143	P	P
C-7	144	P	P
C-8	34	1.3	0
C-9	388	70.8	0
D-1	2	0.5	0
D-2	74	9.5	0
D-3	35	P	P
D-4	130	P	P
D-6	23	3.3	0
D-7	128	P	P
D-8	21	P	P
D-9	92	P	P
D-10	0	0	P
D-11	0	0	0
D-12	0	0	0
D-13	30	4.2	0
E-1	115	P	P
E-2	223	P	P
E-3	2	P	P
E-4	65	P	P
E-5	175	P	P
E-6	354	P	P
E-7	190	P	P

Sector	Acres Remaining in Sector	Resources in 2010 (million tons)	Reserves (Permitted Resources) in 2010 (million tons)
E-8	7	P	P
E-9	203	P	P
E-10	1479	P	P
F-1	75	P	P
F-2	66	P	P
F-3	233	P	P
F-4	20	P	P
F-5	163	P	P
F-6	20	P	P
F-7	179	P	P
F-8	73	P	P
F-9	5	P	P
F-10	93	P	P
G-1	143	P	P
G-2	146	P	P
Totals	**7262**	**1036**	**232**

P Sector contains reserves that are proprietary
† Depleted due to mining
†† Completely lost to urbanization

Note: Sectors A-2f, A-2g, A-2k, A-2l, A-2m, B-10, C-5, and D-5 from SR 160 were never designated and are not included in this appendix.