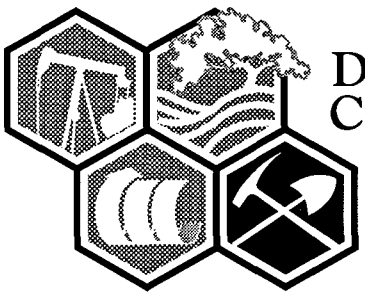
CALIFORNIA DEPARTMENT OF CONSERVATION
DIVISION OF MINES AND GEOLOGY

DMG OPEN-FILE REPORT 96-04

UPDATE OF MINERAL LAND CLASSIFICATION: AGGREGATE MATERIALS IN THE WESTERN SAN DIEGO COUNTY PRODUCTION-CONSUMPTION REGION

1996



DEPARTMENT OF CONSERVATION
Division of Mines and Geology

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JAMES F. DAVIS, *STATE GEOLOGIST*

UPDATE OF MINERAL LAND CLASSIFICATION: AGGREGATE MATERIALS IN THE WESTERN SAN DIEGO COUNTY PRODUCTION-CONSUMPTION REGION

BY

Russell V. Miller

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EXECUTIVE SUMMARY

This report updates information presented in a classification study on portland cement concrete (PCC)-grade aggregate in western San Diego County in 1982. That study was published by the Department of Conservation's Division of Mines and Geology (DMG) as Special Report 153 - Mineral Land Classification: Aggregate Materials in the Western San Diego County Production-Consumption Region (Kohler and Miller, 1982). Special Report 153 included the urban and urbanizing parts of western San Diego County as a single production-consumption (P-C) region. Active mines within the county that extract mineral commodities other than PCC-grade aggregate, were not classified in this study.

The material specifications for PCC-grade aggregate are more restrictive than the specifications for aggregate used in other applications. Deposits that are acceptable for use as PCC-grade aggregate are the rarest and most valuable of aggregate resources.

Data contained within this update were current as of January 1996, with the exception of the figures relating to annual aggregate production, which are complete only to December 1994. In this case, the 1994 data is the most recent available.

The initial classification report-- Special Report 153--and the subsequent designation of the area by the State Mining and Geology Board in 1985, both required local lead agencies in western San Diego County to incorporate that data into their General Plan and adopt Mineral Resource Management Policies to address that data.

The specific actions required of local lead agencies by this report are that the City of San Marcos must incorporate the reclassification information on Plates 3 and 4 (Revised Mineral Land Classification Maps of the San Marcos and Rancho Santa Fe Quadrangles) into their general plan and the County of San Diego must incorporate the reclassification information on Plates 5 and 6 (Revised Mineral Land Classification Maps of the San Vicente Reservoir and El Cajon Quadrangles) and the classification information on Plates 7 and 8 (Revised Mineral Land Classification Maps of the Jamul Mountains and Dulzura Quadrangles) into their general plan.

Based on this update study and assuming that the consumption forecast is accurate, the following conclusions were reached:

- The aggregate reserves have significantly decreased since the 1982 study. The 352 million tons of presently permitted PCC-grade aggregate reserves within western San

Diego County are enough to continue to supply the demand of the county for 20 years - until the year 2016. In 1982, the region had 78 million tons more--430 million tons--for a 32-year supply. More than 80 percent of the total drop in aggregate reserves from 1980 to 1995 is accounted for by the drop in access to instream sand reserves. This will eventually lead to higher costs for PCC-grade sand.

- As of January 1996, 27 mines, 24 of which are active, operated by 16 different mining companies were producing, or permitted to produce, PCC-grade aggregate in western San Diego County. In 1980 there were 48 mines operated by 20 companies. This large decline is attributable mainly to the drop in the number of instream sand mines--from 24 in 1980 to 8 in 1995.

- Within designated areas there are presently 5,269 million tons of PCC-grade aggregate resources available. In 1985, there were 5,635 million tons of aggregate resources within the designated areas. Since 1985, 413 million tons have been lost to urbanization. Another 825 million tons have been identified, since 1985, outside of designated areas.

- It is highly unlikely that all of the identified aggregate resources will be mined. Access to aggregate resources could be substantially restricted by the adoption of competing resource conservation measures--such as the Multiple Species Conservation Plan and the Multiple Habitat Conservation Plan. Local lead agencies must be aware that such measures could sharply reduce the availability of the resources identified in this study.

- The average annual per capita consumption rate has decreased from 5.5 tons, as reported in the 1982 report, to 5.4 tons as of 1995.

- The anticipated consumption of aggregate in western San Diego County through the year 2045 is estimated to be 1,050 million tons, of which 70 percent or 735 million tons must be of PCC quality.

- The forecast of aggregate demand for the Western San Diego P-C Region, published in the 1982 report, for the period 1980 to 1994, was within 2 percent of the aggregate production measured for that period for this study. This level of forecast accuracy is not expected for the simplistic forecast technique used and should not be expected of the forecast made for the next 50-year period.

Changes in Mineral Land Classification of the Region Since 1982

There are seven changes in the mineral land classification of western San Diego County from this earlier report. They are: 1) the reclassification of the Sycamore Ridge property from MRZ-3 to MRZ-2 for PCC-grade aggregate in 1988 (Clinkenbeard, 1988); 2) the inclusion of the Pankey Ranch site, classified as Mineral Resource Zone (MRZ)-2 for mixed-grade aggregate in 1989 (Clinkenbeard, 1989); 3) the reclassification of the San Marcos quarry from MRZ-3 to MRZ-2 in this study; 4) the reclassification of the TTT quarry from MRZ-3 to MRZ-2 in this study; 5) the reclassification of Hester's Granite quarry from MRZ-3 to MRZ-2 in this study; 6) the reclassification of San Vicente Creek from MRZ-4 to MRZ-2 in this study; and 7) the classification of the Jamul quarry as MRZ-2 in this study. Both the Pankey Ranch site and the Jamul quarry are outside of the boundary of the Western San Diego County P-C Region as drawn for Special Report 153. However, both deposits can supply significant amounts of aggregate to the western San Diego County area.

The following table compares 1980 and 1995 data on population, aggregate demand, reserves, annual per capita consumption, projected depletion of reserves, resources, number of aggregate mines, number of aggregate companies, and the price of aggregate in western San Diego County.

COMPARISON OF:	1980	1995
POPULATION	**1,778,469**	**2,593,562**
CALCULATED ANNUAL AGGREGATE DEMAND	**11 MILLION TONS**	**14 MILLION TONS**
TOTAL PERMITTED AGGREGATE RESERVES	**430 MILLION TONS**	**352 MILLION TONS**
PERMITTED INSTREAM SAND RESERVES	**121 MILLION TONS**	**55 MILLION TONS**
CALCULATED ANNUAL PER CAPITA CONSUMPTION	**5.5 TONS**	**5.4 TONS**
CALCULATED YEARS UNTIL DEPLETION	**32 YEARS**	**20 YEARS**
UNPERMITTED AGGREGATE RESOURCES	**5.5 BILLION TONS**	**5.7 BILLION TONS**
PCC AGGREGATE MINES	**48**	**27 (24 active)**
NO. OF COMPANIES	**20**	**16**
PRICE OF AGGREGATE PER TON	**$4.00**	**$8.00**

PART I - CLASSIFICATION OF AGGREGATE MATERIALS IN WESTERN SAN DIEGO COUNTY

INTRODUCTION

In 1982, the Department of Conservation's Division of Mines and Geology (DMG) published a study on the aggregate resources of western San Diego County titled "Special Report 153, Mineral Land Classification: Aggregate Materials in the Western San Diego County Production-Consumption (P-C) Region" (Kohler and Miller, 1982).

The State Mining and Geology Board (Board) designated areas within the county as having aggregate resources of regional significance (California Department of Conservation, 1985).

This report (Open-File Report 96-04) conveys important updated information on the present aggregate resources in western San Diego County for the benefit of local lead agencies (see Table 1 for list of lead agencies). This report (Open-File Report 96-04) is not intended to replace Special Report 153 (Kohler and Miller, 1982). The only actions required of local lead agencies by this report (Open-File Report 96-04) are that the City of San Marcos must incorporate the reclassification information on Plates 3 and 4 (Revised Mineral Land Classification Maps of the San Marcos and Rancho Santa Fe Quadrangles) into their general plan and the County of San Diego must incorporate the reclassification information on Plates 5 and 6 (Revised Mineral Land Classification Maps of the San Vicente Reservoir and El Cajon Quadrangles) and the classification information on Plates 7 and 8 (Revised Mineral Land Classification Maps of the Jamul Mountains and Dulzura Quadrangles) into their general plan (Figures 1, 2, and 3).

The original 1982 classification study, as well as this update, was conducted as specified by the Surface Mining and Reclamation Act (SMARA) of 1975. Section I, Subsection 7 of the State Mining and Geology Board Guidelines for Classification and Designation of Mineral Lands adopted in 1978, requires the State Geologist to review mineral land classification information after a period of no longer than 10 years to determine whether reclassification and/or revision of projected requirements of construction materials is necessary. It was determined that a revision of projected requirements was necessary for San Diego County.

Data contained within this update were current as of January 1996, with the exception of the figures relating to annual aggregate production; which are complete only to December 1994. In this case, the 1994 data is the most recent available from the U.S. Geological Survey.

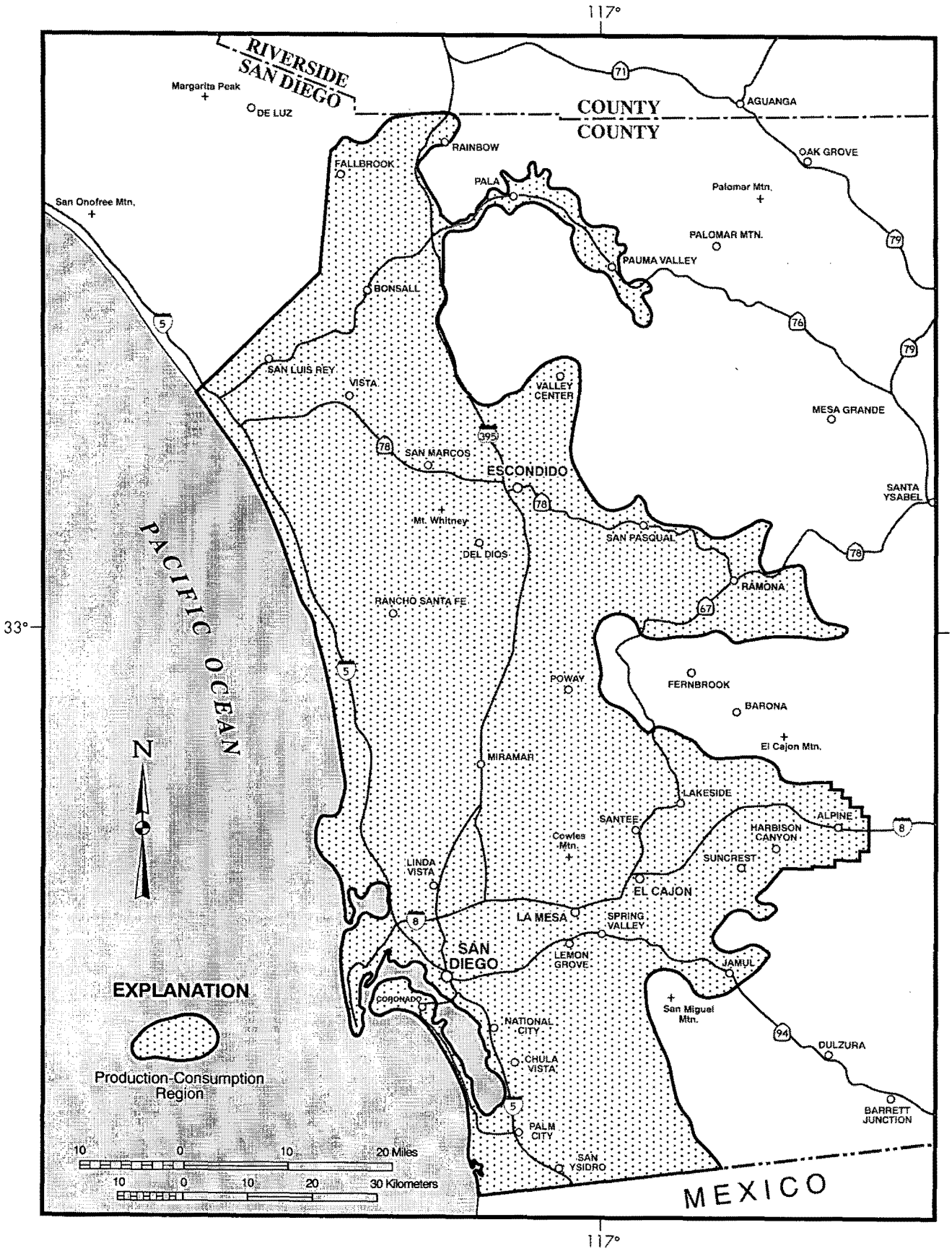

Figure 1. Location of the Western San Diego Production-Consumption Region.

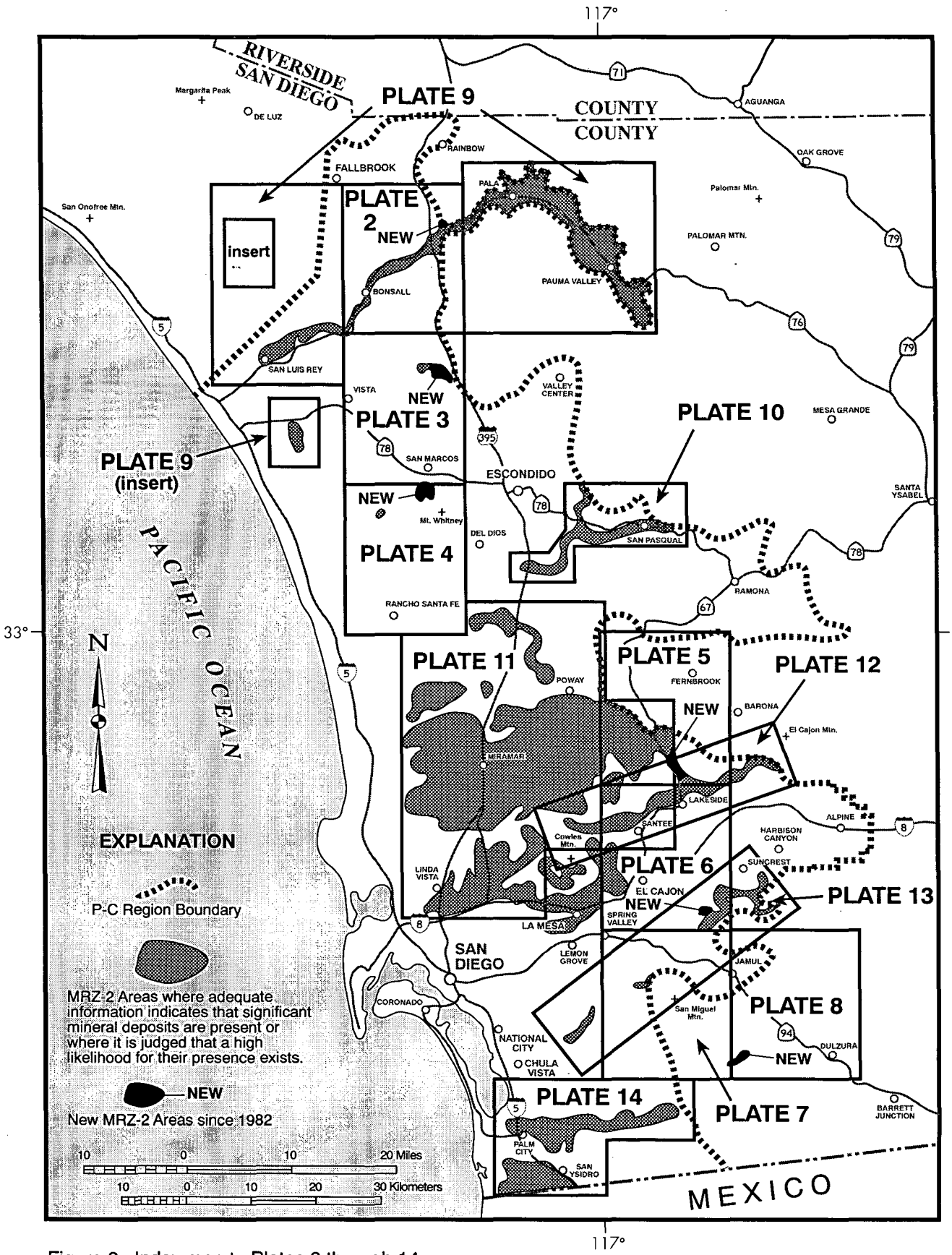

Figure 2. Index map to Plates 2 through 14.

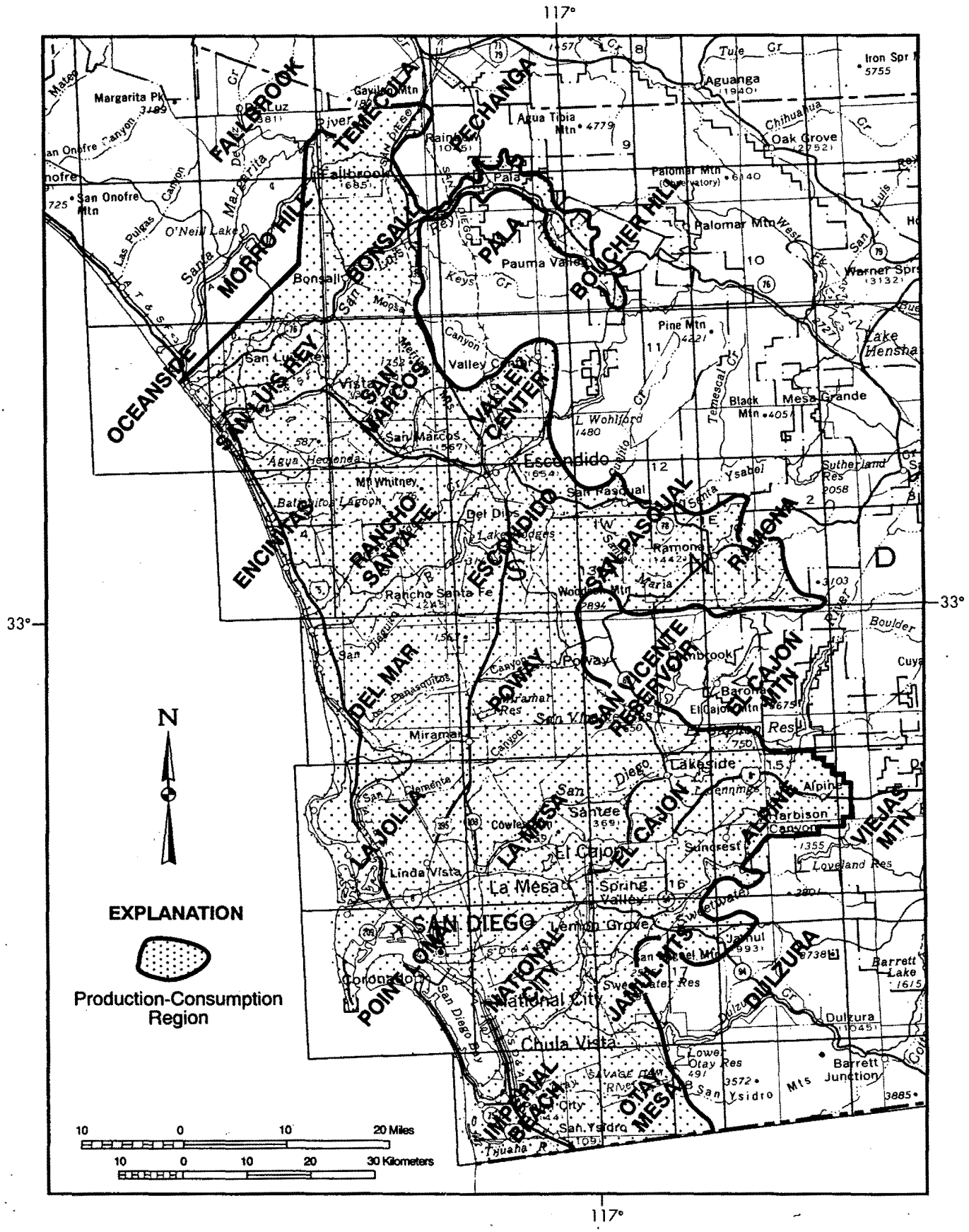

Figure 3. Index map of U.S. Geological Survey quadrangles covering the Western San Diego County Production-Consumption Region.

Table 1. Lead agencies (county and incorporated city governments) in western San Diego County.

+*City of Carlsbad
+ City of Chula Vista
  City of Coronado
  City of Del Mar
  City of El Cajon
  City of Encinitas
  City of Escondido
  City of Imperial Beach
  City of La Mesa
  City of Lemon Grove
  City of National City
+ City of Oceanside
+*City of Poway
+*City of San Diego
+*City of San Marcos
+*City of Santee
  City of Solana Beach
 *City of Vista
+*County of San Diego
+*United States Navy, Miramar Naval Air Station

+Agencies that have land classified as MRZ-2 for PCC-grade aggregate within their jurisdiction.
*Agencies that have active aggregate operations within their jurisdiction.

Special Report 153 (Kohler and Miller, 1982) covered the highly urbanized parts of western San Diego County. For that report the region was examined for reserves and resources of PCC-grade aggregate, and projections for future demand of aggregate to the year 2030 were made. This present report is a reexamination of the availability of aggregate resources in the classified and designated areas within western San Diego County. This report also projects the demand for aggregate for western San Diego County to the year 2045.

The mineral resource zonation of western San Diego County for PCC-grade aggregate is generalized on Plate 1 of this report, at a scale of 1:100,000. The classification is taken from Special Report 153 (Kohler and Miller, 1982), Open-File Report 88-16 (Clinkenbeard, 1988), and Open-File Report 89-15 (Clinkenbeard, 1989) with the changes noted below. The nomenclature in use in those three reports has been kept.

There are seven changes in the mineral land classification of western San Diego County from the earlier classification reports. They are: 1) the reclassification of the Sycamore Ridge property from MRZ-3 to MRZ-2 for PCC-grade aggregate in 1988 (Clinkenbeard, 1988); 2) the inclusion of the Pankey Ranch site, classified as Mineral Resource Zone (MRZ)-2 for mixed-grade aggregate in 1989 (Clinkenbeard, 1989); 3) the reclassification of the San Marcos quarry from MRZ-3 to MRZ-2 in this study; 4) the reclassification of the TTT quarry from MRZ-3 to MRZ-2 in this study; 5) the reclassification of Hester's Granite quarry from MRZ-3 to MRZ-2 in this study; 6) the reclassification of San Vicente Creek from MRZ-4 to MRZ-2 in this study; and 7) the classification of the Jamul quarry as MRZ-2 in this study. Both the Pankey Ranch site and the Jamul quarry are outside of the boundary of the Western San Diego County P-C Region as drawn for Special Report 153. However, both deposits can supply significant amounts of aggregate to the western San Diego County area.

A review was made of the present availability (as of January, 1996) of the aggregate resources in the designated areas of western San Diego County. Eight percent of the designated areas have been urbanized with housing and industrial parks since 1985, the date they were originally designated by the Board. These areas shown on Plates 9 through 14 (Maps Showing Designated Areas Urbanized), at a scale of 1:48,000 (see Figure 2).

Active mines within western San Diego County that extract mineral commodities other than PCC-grade aggregate, were not included in this study.

REEVALUATION OF PCC-GRADE AGGREGATE IN WESTERN SAN DIEGO COUNTY

A reevaluation of aggregate resources in western San Diego County is presented in this section of the report. The reassessment was conducted on the basis of a quantitative evaluation of suitable PCC-grade aggregate resources classified as MRZ-2.

The material specifications for PCC-grade aggregate are more restrictive than the specifications for aggregate used in other applications. Deposits that are acceptable for use as PCC-grade aggregate are the rarest and most valuable of aggregate resources.

Concepts Used in Identifying Available Aggregate Resources

The State Geologist is responsible for calculating aggregate resources for those areas classified as MRZ-2 for PCC-grade aggregate. Recognizing that there are lands within these areas that have already been urbanized and therefore have a limited opportunity for mineral resource conservation and extraction, the State Geologist has limited the calculation of aggregate resource tonnages to areas classified as MRZ-2 for PCC-grade aggregate that have not been urbanized. These areas were identified in the 1982 report (Kohler and Miller, 1982) as Sectors. Available PCC-grade aggregate resources in the western San Diego County P-C Region were delineated as Sectors A through V. All of the original Sector boundaries and their identification letters are shown on Plates 9 through 14 in this report. Areas within those Sectors that are now unavailable for mining are also depicted on Plates 9 through 14 (Maps Showing Urbanization of Designated Areas since 1985).

For purposes of identification of available aggregate resources, incompatible uses of land are defined as improvements of high cost, such as high-density residential developments, intensive industrial developments, commercial developments, and major public facilities. Lands that have compatible uses are defined as those that are nonurbanized or that have very low density residential development (1 unit per 10 acres), land that does not have high-cost improvements, and lands used for agriculture, silviculture, grazing, or open space.

For this report, determination of use of lands classified as MRZ-2 for PCC-grade aggregate was based upon conditions of the lands at the time of the study (as of January, 1996). The use of the lands was determined after reference to aerial photographs and field reconnaissance.

The revised reserve and resource calculations of aggregate in the area are compared with the State Geologist's new forecast of the 50-year needs of the region. The comparison of regional

needs with available reserves and resources provides the opportunity to focus attention on the mineral resource issues confronting the region, such as the need to plan carefully for the use of any lands containing mineral resources, and the need to consider the permitting of additional mining operations in the region as currently mined deposits are depleted.

It is highly unlikely that all available aggregate resources calculated for this report will ultimately be mined. There may be political constraints and other issues confronting local government in making aggregate resources available for extraction that are not accounted for. For instance, in San Diego County there are two wildlife and habitat conservation measures that are pending--the Multiple Species Conservation Plan and the Multiple Habitat Conservation Plan. It is important for local governments to carefully review the estimated resources in light of any such competing resource conservation plans.

Calculation of Available Resources

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. 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.

Factors Considered in Calculations

The resource calculations given here are limited to those PCC-grade aggregate resources in the Sectors designated by the Board in 1984 and published in 1985 (California Department of Conservation, 1985); the Sycamore Ridge deposit, reclassified to MRZ-2 in 1988; part of the Pankey Ranch deposit, classified MRZ-2 for mixed aggregate in 1989; the San Marcos quarry, TTT quarry, Hester's Granite quarry, and the San Vicente Creek deposits, reclassified to MRZ-2 in this study; and the Jamul quarry classified MRZ-2 in this study. The changes in the areas identified as available for mining in the designation report are shown on Plates 9 though 14 (Maps Showing Urbanization of Designated Areas since 1985) of this report.

The factors used in this study to determine the areal extent and tonnage of PCC-grade aggregate resources remaining within the Sectors are the same as those used in Special Report 153 (Kohler and Miller, 1982). They are as follows:

1. Resource tonnage calculations were based on measurements taken from base maps that have a scale of 1:24,000 or maps with varying scales obtained from aggregate companies.

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 waste, 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 (Kohler and Miller, 1982) 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.

4. A standard setback of 100 feet from utility and rail lines and urban developments 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 was 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 alluvial resources, 0.090 tons per cubic foot for the Santiago Peak Volcanics, 0.080 to 0.090 tons per cubic foot for granitic rocks, 0.065 tons per cubic foot for the Stadium and Pomerado conglomerates and the alluvial fans east of Pala, and 0.070 tons per cubic foot for the San Diego Formation conglomerate.

Resource Sectors

All lands in western San Diego County designated as having significant extractable PCC-grade aggregate deposits were divided into 19 Sectors in the 1985 report (California Department of Conservation, 1985). Detailed descriptions of the Sectors are in the original classification report by Kohler and Miller (1982).

Sector A - A small hill of Santiago Peak Volcanics, east of Oceanside.
Sector B - Channel and flood-plain deposits of the San Luis Rey River from near North River Road in Oceanside and extending about 6 miles upstream.
Sector C - Channel and flood-plain deposits of the San Luis Rey River from near the Highway 78 bridge upstream to near the Interstate 15 bridge.
Sector D - Alluvial deposits of the San Luis Rey River, extending discontinuously from the Interstate 15 bridge, upstream to the community of Rincon.
Sector E - Alluvial fan deposits on the northern and and eastern side of San Luis Rey River from Pala to Pauma Valley.
Sector F - Alluvial fan deposits on the eastern side of San Luis Rey River near the community of Rincon.
Sector H - Includes a part of the granitic rocks in the Merriam Mountains, north of San Marcos.
Sector I - Channel and flood-plain deposits in the San Dieguito River and tributaries from Lake Hodges to the eastern end of San Pasqual Valley.
Sector J - Mesa-forming Stadium and Pomerado conglomerates centered around the Miramar area.
Sector K - Metavolcanic rocks of the Santiago Peak Volcanics located in Mission Gorge.
Sector M - Channel and flood-plain deposits of the San Diego River from the City of Santee to within 1 mile of El Capitan Dam.
Sector N - Alluvial deposits of the Sweetwater River located near the community of Sunnyside.
Sector O - Alluvial deposits of the Sweetwater River located at the upper end Sweetwater Reservoir.
Sector P - Alluvial deposits of the Sweetwater River located in upper Jamacha Valley.
Sector Q - Alluvial deposits of the Sweetwater River extending from near the Singing Hills Golf Course upstream about 4 miles.
Sector R - Channel and flood-plain deposits of the Otay River from Interstate 805 to near the head of Otay Valley.
Sector S - Metavolcanic rock deposits of Rock Mountain on the north side of upper Otay Valley.
Sector U - Flood-plain deposits of the Tijuana River from the international boundary downstream about 4 miles.
Sector V - Conglomerate deposits of the San Diego Formation in the Border Highlands, immediately south of the Tijuana River.

Newly Identified Aggregate Resource Areas Classified MRZ-2

Since the classification and designation of these Sectors, seven additional deposits have been classified as MRZ-2 for PCC-grade aggregate. Two of the deposits, Sycamore Ridge Property and the Pankey Ranch Site, were classified earlier by petition. For this report, five deposits were classified or reclassified as MRZ-2. In classifying these five deposits the SMARA guidelines were followed which require that:

1. The deposit be composed of material that is suitable as a marketable commodity (PCC-grade aggregate, in this study).

2. The deposit meets a minimum value of $12,150,000, based on the gross selling price of the first marketable product (which equated to $5,000,000 1978-dollars, when the guidelines were written).

Sycamore Ridge Property

In 1988, a granitic rock deposit covering 486 acres in the Merriam Mountains was reclassified from MRZ-3 to MRZ-2 for PCC-grade aggregate in response to a petition by H.G. Fenton Material Company (Plate 3, Revised Mineral Land Classification Map of the San Marcos Quadrangle). The deposit was described by Clinkenbeard (1988).

Pankey Ranch Site

In 1989, a deposit of predominantly granitic rock, covering about 76 acres in northern San Diego County was classified MRZ-2 for mixed construction aggregate materials (Plate 2, Revised Mineral Land Classification Map of the Bonsall Quadrangle). Some of the deposit is suitable for PCC-grade aggregate. The deposit was described by Clinkenbeard (1989).

San Marcos Quarry

South Coast Materials Company has been excavating material from a 544-acre site south of San Marcos since 1988. The mining is part of the site preparation for development of the Rancho Coronado University area. The deposit consists of both granitics of the southern California Batholith--predominantly quartz diorite and granodiorite--on the northeastern part of the property and metavolcanics of the Santiago Peak Volcanics on the southwestern part of the property (Tan, 1986). Material from the deposit is crushed and used for a construction aggregate including PCC-grade aggregate. The metavolcanic rocks are not as high quality as the granitics and must be blended with them to meet the specifications for PCC-grade aggregate. The property is reclassified from MRZ-3 to MRZ-2 (Plates 3 and 4, Revised Mineral

Land Classification Maps of the San Marcos and Rancho Santa Fe Quadrangles).

TTT Quarry

The Superior Rock Products Company mines crushed stone from the TTT quarry, west of Highway 67, about 2 miles north of Lakeside. The crushed stone is suitable for use as PCC-grade aggregate. The deposit consists of light-colored, fresh, fine-grained quartz monzonite. This granitic body does not appear to extend beyond the property boundary to the south. The deposit was quarried for dimension stone from the early 1900s to about 1946. The deposit has been mined for aggregate since the mid-1980s. The property has been reclassified from MRZ-3 to MRZ-2 for PCC-grade aggregate (Plate 5, Revised Mineral Land Classification Map of the San Vicente Reservoir Quadrangle).

San Vicente Creek

The Enniss Materials Company has been mining PCC-grade sand from San Vicente Creek since 1991. Based on this, the deposits in San Vicente Creek, downstream of San Vicente Reservoir Dam are reclassified from MRZ-4 to MRZ-2 for PCC-grade aggregate resources (Plate 5, Revised Mineral Land Classification Map of the San Vicente Reservoir Quadrangle). This newly identified Aggregate Resource Area covers about 450 acres. The deposit consists of sand deposits in San Vicente Creek and flood plain. The deposit is at least 70 feet thick.

Hester's Granite Quarry

East County Materials Company has produced PCC-grade aggregate from this location, on the east side of Sweetwater River, southeast of El Cajon, since 1984. The quarried rock is a deeply weathered hornblende gabbro that is a part of the granitics of the southern California Batholith. The weathered material is sold as decomposed granite and base material and the hard boulders are broken and used for rip rap and crushed aggregate. The quarry covers about 100 acres and has been reclassified from MRZ-3 to MRZ-2 for PCC-grade aggregate resources (Plate 6, Revised Mineral Land Classification Map of the El Cajon Quadrangle).

Jamul Quarry

California Commercial Asphalt Company has recently permitted a quarry about 3 miles outside of the production-consumption region boundary, on the south side of Jamul Creek and Dulzura Creek, about 1 mile upstream of Lower Otay Reservoir. The deposit consists of metavolcanic rock of the Santiago Peak Volcanics and is suitable for PCC-grade aggregate. The 148-acre quarry is classified MRZ-2 for PCC-grade aggregate (Plates 7 and

8, Revised Mineral Land Classification Maps of the Jamul Mountains and Dulzura Quadrangles).

PCC-Grade Aggregate Deposits Below Minimum Threshold Value

Harmony Grove Quarries

PCC-grade aggregate is being mined from a granitic deposit in a small hill located about 1/2 mile northeast of the community of Harmony Grove. The Ashland Granite Corporation produces PCC-grade aggregate from this deposit. Harmony Rock Products, Inc., owned by H.G. Fenton Material Company, also mined PCC-grade aggregate from this deposit until 1994. The remaining reserves of the Ashland Granite Corporation quarry are below the minimum threshold value of $12,150,000 ($5,000,000 1978-dollars), and there is not enough information about the quality of the rock outside of their property to include any other parts of the deposit.

Vista Quarry

PCC-grade aggregate has been quarried by Wyroc, Inc. for many years from a granitic deposit in the City of Vista along Sycamore Avenue. Too little of the deposit remains to be mined to meet the threshold value of $12,150,000 ($5,000,000 1978-dollars).

Aggregate Resources in Western San Diego County

Since the mineral land classification and designation of PCC-grade aggregate resources in western San Diego County in 1982 and 1985 respectively, some of the identified aggregate resources have become unavailable due to urban development. About 8 percent of the unpermitted aggregate resources in designated areas has undergone land-use changes that preclude mining. Most of the areas urbanized were developed for housing and industrial parks (Table 2). The aggregate resources now unavailable due to these changes in land use are approximately 413 million tons. The county has permitted 64 million tons of PCC-grade aggregate since 1985 in designated areas. This leaves 4,725 million tons of the original 5,205 million tons of unpermitted PCC-grade aggregate resources in designated areas. Table 2 is a summary of the unpermitted PCC-grade aggregate resources in designated areas in western San Diego County.

Besides the unpermitted aggregate resources in the designated areas, there have been significant unpermitted aggregate deposits identified outside of designated areas since 1985. Two areas, the Sycamore Ridge property, classified in response to petitions in 1988, and the San Vicente Creek deposit,

Table 2. Unpermitted PCC-grade aggregate resources unavailable due to urbanization in designated areas in western San Diego County. Figures are in millions of tons.

DESIGNATED SECTOR	UNPERMITTED RESOURCES IN DESIGNATION REPORT	RESOURCES LOST TO URBANIZATION	RESOURCES PERMITTED SINCE FIRST REPORT	UNPERMITTED RESOURCES AS OF JANUARY, 1996
San Luis Rey River Resource Area				
A	0	-	-	0
B	140	60[1]	0	80
C	190	20[1]	1	169
D	310	0	1	308
E	652	0	0	652
F	20	0	0	20
H*	0[2]	0	0	0[2]
San Pasqual Valley Resource Area				
I	39	0	0	39
Kearney Mesa-Mission Valley Resource Area				
J	3,402	313[1]	62	3,027
K	20	0	0	20
Upper San Diego River Resource Area				
M*	63	11[1]	3	49
Sweetwater River Resource Area				
N	9	9	0	0
O	20	0	0	20
P	29	0	0	29
Q	0	-	-	0
Otay Valley Resource Area				
R	10	0.2[1]	0	10
S	221	0	0	221
Tijuana River Resource Area				
U*	70	0	0	70
Border Highlands Resource Area				
V	10	0	0	10
TOTALS	5,205	413.2	67	4,725
% of 1980 Total		8%	1%	91%

(1) Housing and industrial parks. (2) Resource is permitted for commodity other than PCC-grade aggregate.

* Sectors G, L, and T were not designated.

identified in this study, have added several hundreds of millions of tons to the unpermitted aggregate resources of the area. The total of unpermitted aggregate resources in the western San Diego County area, within and outside of the designated areas, is now 5,740 million tons, about 200 million tons more than in 1980.

In 1980 there were 430 million tons of permitted PCC-grade aggregate reserves in western San Diego County (Kohler and Miller, 1982). As of January, 1995 there were 352 million tons of permitted PCC-grade aggregate reserves in western San Diego County. In this study three other significant deposits of PCC-grade aggregate resources were found to be permitted for mining in areas outside of designated lands--the San Marcos (UCLH) quarry, south of San Marcos; the TTT quarry, north of Lakeside; and the Jamul quarry, east of Otay Reservoir.

Recycled Aggregate

Recycled construction and demolition waste material has become widely used in western San Diego County for class II base, with an estimated 16 operations installed mostly at large aggregate production plants. Figure 4 shows aggregate production plants with recycling operations. No figures have been collected for the amount of material recycled, but it is estimated that, at present, less than 10 percent of the production of base material is from recycled waste. Separate production figures for base material was not collected for this study, so an estimate of the tonnage of recycled aggregate cannot be made. Also, there is limited recycling of asphalt paving (RAP). Old asphalt paving is torn up and mixed in small percentages with new asphalt paving at the batch plant.

Both of these types of recycling operations are important to the supply of PCC-grade aggregate in the county since they reduce the demand on virgin PCC-grade aggregate resources. Although recycled material cannot now be used to make PCC-grade aggregate, historically, PCC-grade aggregate resources have been used for base and asphaltic aggregate material. It has been economic to mine PCC-grade aggregate deposits not only for PCC-grade aggregate, but also for all other grades of aggregate, including base and asphaltic aggregate. As recycled waste is used as base and asphaltic aggregate material in western San Diego County, a higher percentage of the virgin material can be used for PCC-grade aggregate. This will tend to extend the life of the PCC-grade aggregate resources in the county.

PART II - ESTIMATED 50-YEAR CONSUMPTION OF AGGREGATE IN WESTERN SAN DIEGO COUNTY

The Board, as specified in its guidelines for classification and designation of mineral land (California State Mining and Geology Board, 1983, p. 23), 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." In the guidelines the Board also specifies that the State Geologist periodically review (every 10 years or less) the information in the reports to determine if a revision is warranted.

AGGREGATE PRODUCTION IN WESTERN SAN DIEGO COUNTY

At the time of this study, the following 16 companies had permitted mining operations producing PCC-grade aggregate in western San Diego County:

Ashland Granite Corporation
Asphalt, Inc.
C.W. McGrath, Inc.
CalMat Company
California Commercial Asphalt Company
East County Materials Company
Enniss Enterprises, Inc.
H.G. Fenton Material Company
Nelson and Sloan Company
Pauma Valley Country Club
RCP Block and Brick, Inc.
Sim J. Harris Company (Beazer, USA)
South Coast Materials Company, Inc. (Beazer, USA)
Superior Ready Mix Concrete, Inc.
Valley Materials and Supply Company, Inc.
Wyroc, Inc.

The 16 companies are permitted to mine PCC-grade aggregate from 27 different locations in western San Diego County. Twenty-four of those locations have active mining operations. Most of the aggregate production plants produce crushed stone; only eight of the operations mine material from river channels which is

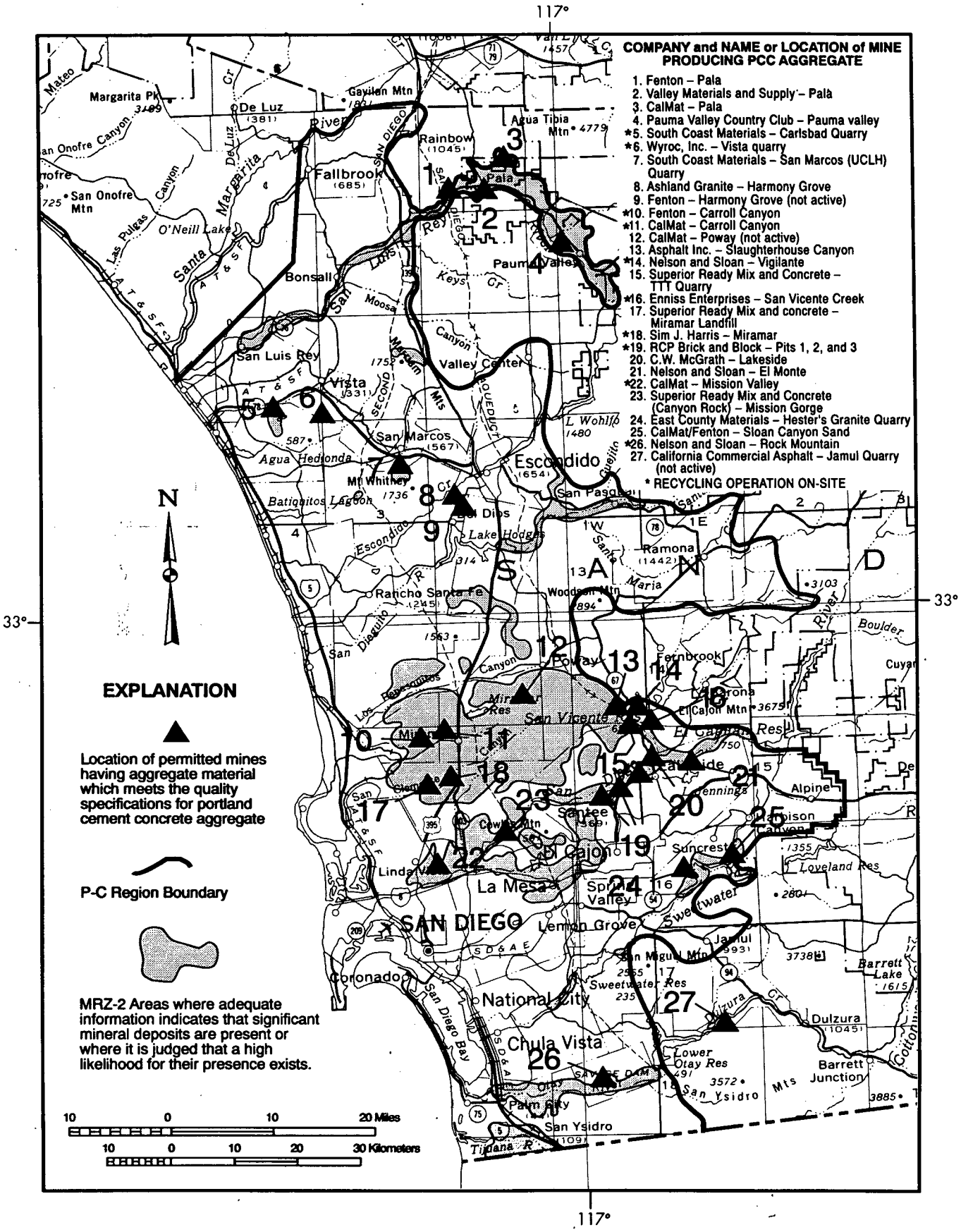

Figure 4. Map of western San Diego County area showing locations of sand and gravel mines that have permits to mine aggregate.

dominantly sand. Rounded gravel is produced from deposits of Stadium and Pomerado conglomerates, but the San Diego market readily accepts crushed aggregate for use in PCC.

The Ashland Granite Corporation mines and crushes aggregate from a granitic deposit at Harmony Grove. The H.G. Fenton Material Company mined aggregate on property adjacent to Ashland Granite Corp. until the permitted material was depleted in 1994. This deposit has also been mined for dimension stone.

Asphalt, Inc. mines conglomerate of the Stadium Conglomerate Formation in Slaughterhouse Canyon. About 1/2 mile east, Nelson and Sloan mines aggregate from the same formation at the Vigilante quarry. There are two other aggregate operations in the area: the TTT quarry, owned by Superior Ready Mix Concrete Company, located immediately east of the Asphalt, Inc. plant, which mines crushed aggregate from a light-colored granitic deposit; and the Enniss Enterprises sand pit in San Vicente Creek, about 1/2 mile east of the TTT quarry.

Three companies are mining sand from the upper San Diego River. In 1980 there were eight companies mining sand in this part of the river. The five companies no longer mining sand had depleted their permitted reserves. The three remaining companies are C.W. McGrath in Lakeside, RCP Block and Brick in Santee, and Nelson and Sloan at the El Monte pit, about 2 miles upstream from Lakeside.

CalMat Company mines aggregate from four operations in western San Diego County. CalMat operates mines on the north side of Mission Valley and in Carroll Canyon, both excavating material from the Stadium Conglomerate Formation. CalMat, in partnership with the H.G. Fenton Material Company, owns the Sloan Canyon Sand Company which mines sand from the bed of Sweetwater River. CalMat operates a pit in the north part of the county on the Pala Indian Reservation. At that location material is mined from an alluvial fan on the north side of the San Luis Rey River. CalMat also has a permit to mine Stadium Conglomerate Formation material from the Poway quarry on the north side of Beeler Canyon in the City of Poway. This operation, previously owned by Padre Transit Mix Company, is not presently active.

California Commercial Asphalt Company has recently completed the permit process on the Jamul quarry in southern San Diego County about 1 mile east of Otay Reservoir. Production has not yet begun.

East County Materials Company produces crushed PCC-grade aggregate from Hester's Granite quarry southeast of El Cajon, on the west side of Sweetwater River.

H.G. Fenton Material Company has three active sand and gravel operations in the county. It produces sand from the Pala pit along the upper San Luis Rey River near Pala, sand and gravel from the Carroll Canyon plant, and sand from the joint operation with CalMat of Sloan Canyon Sand Company on the Sweetwater River. H.G. Fenton Material Company's quarry at Harmony Grove recently ceased production.

Nelson and Sloan Company produces PCC-grade aggregate from three operations - the Vigilante plant north of Lakeside on the east side of Highway 67, which uses material from the Stadium Conglomerate Formation; the El Monte plant, which uses sand from the upper San Diego River; and the Rock Mountain plant which uses quarried rock from a metavolcanic deposit on Rock Mountain. The Nelson and Sloan Border Highlands quarry is now in the final reclamation phase.

Since 1979, the Pauma Valley Country Club, on the San Luis Rey River, has been permitted to remove sand from a catch basin, designed to minimize deposition of sand on their golf course. The amount of sand produced depends entirely on replenishment during periods of rainfall.

RCP Block and Brick Company operates a dredge on the upper San Diego River to supply sand for its concrete block production facility.

The Sim J. Harris Company produces PCC-grade aggregate material from the Stadium Conglomerate Formation along upper San Clemente Canyon on land surrounded by the Miramar Naval Base. This facility has recently been temporarily shut down.

South Coast Materials Company mines two quarries for crushed PCC-grade aggregate, the Carlsbad quarry and the San Marcos (UCLH) quarry. At the Carlsbad quarry, located on the border between the cities of Carlsbad and Oceanside, metavolcanic rock is mined. At the San Marcos quarry, in the southern part of the City of San Marcos, both metavolcanic and granitic rocks have been mined since 1988.

Superior Ready Mix Concrete Company operates three quarries. Superior excavates at the Miramar Landfill in advance of the landfilling, it operates the TTT quarry north of Lakeside, and it also operates the Mission Gorge quarry under the name of Canyon Rock Company. The Mission Gorge operation was previously owned by V.R. Dennis Company. The Stadium Conglomerate Formation is mined at the Miramar Landfill; a granitic rock is mined at the TTT quarry; and metavolcanic rock is quarried at Mission Gorge.

Valley Materials and Supply Company mines sand from a small pit on the upper San Luis Rey River, on the Pala Indian

Reservation. The excavation area will be ultimately used as a reservoir adjacent to the river.

Wyroc, Inc. mines metavolcanic rock from the Vista quarry, located along Sycamore Avenue in the City of Vista. The mine is being surrounded by the southward development of the city. Very little reserves or resources are left available for mining.

Twenty-six sand and gravel mines have closed since the original classification report was published in 1982. Some of those mines began production since 1982. Most of these have been sand mines in the major rivers - San Luis Rey, San Dieguito, San Diego, Sweetwater, Otay, and Tijuana rivers. In the 1982 report there were 15 companies listed as mining sand from 24 pits that are no longer in operation. Also, there have been several other sand mines that operated for short periods between 1982 and 1992. Many of these sand pits ceased operation due to their inability to complete new permitting processes required for regulations associated with instream mining. Along the San Luis Rey River - Marron Brothers ceased operation of their last pit in 1991; Gordon Sand and Gravel Company operated from 1985 to 1991; L E Morrison Sand Company and J.W. Sand and Materials Company operated from 1986 to 1991; and California Sand and Gravel Company mined for a few years in the mid 1980s. Along the San Dieguito River, above Lake Hodges in San Pasqual Valley, several small sand mining operations were active in the late 1970s and early 1980s - CalMat Company, Escondido Ready Mix Company, H.G. Fenton Material Company, Stevens Trucking Company, and Roger Gordon. There is no active sand mining in San Pasqual Valley at present. In the San Diego River, upstream of Mission Gorge, Woodward Sand Company, CalMat Company, and Dave Martin Trucking Company have ceased operations since 1982. Along Sweetwater River, Nelson and Sloan Company and Gene C. Taylor Company no longer mine sand. Along the Otay River, Taylor Trucking and Materials Company and several pits operated by Nelson and Sloan Company ceased mining during the 1980s. In the Tijuana River floodplain, Hofer and Son Company is the only sand mining operation (this mine is not included in this report because only fill sand is sold).

In 1980 there were 20 companies producing PCC-grade aggregate from 48 mines in western San Diego County (Kohler and Miller, 1982). At present, 16 mining companies own 27 aggregate pits and quarries, 24 of which actively produce PCC-grade aggregate; the remaining three are permitted to produce PCC-grade aggregate but are not presently active. In 1980 the total aggregate reserves of the 20 companies was 430 million tons. As of January 1995, the total PCC-grade aggregate reserves of the 16 operating companies was 352 million tons. An important shift in the type of reserves from 1980 to 1995 has been a reduction in the instream sand reserves. In 1980 there were 24 mines producing sand exclusively from instream deposits and one which

had instream sand reserves, but mined from an off-stream deposit. These 25 mines had 121 million tons of instream sand reserves. In 1995 there were only eight instream sand mines with a total reserve of 55 million tons. This reduction of 66 million tons of sand reserves is important because of the extra cost of producing sand from other available sources such as quarries in metavolcanic and granitic rocks and mines in Stadium and Pomerado conglomerate formations. These operations must either intensify the crushing of hard rock to produce more sand or, in the case of the conglomerate formations, upgrade, through extensive processing, a material which does not now meet PCC-grade sand specifications. Both methods lead to higher costs for sand.

Some of the historical aggregate production data for western San Diego County were obtained from mining records of the U.S. Department of the Interior, Bureau of Mines and the aggregate companies. The U.S. Bureau of Mines records are compiled from responses to voluntary questionnaires that are sent annually or biannually to all known mining operators. Each producer is 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 these data every other year. Because of this, more than half of the production information for those years was either supplied by the mine operators or estimated. The estimations were made by averaging the production amounts from adjacent years. Approximately 9 percent of the total production was estimated by this method. Since 1989, the Department of Conservation has kept production records.

As shown on Table 3, aggregate production in western San Diego County has averaged about 11.4 million tons per year since 1980. In 1994 the total aggregate production was 7.9 million tons valued at approximately 63 million dollars. The annual variations in production result primarily from changes in urban growth, large construction projects such as freeways, and changes in the economy.

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). During a recent aggregate study for Los Angeles County (Miller, 1994), a statistical analysis of aggregate consumption versus population suggested that roughly 2/3 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. But, other factors, such as

major public construction projects, can randomly add large amounts of aggregate to consumption figures. The average per-capita consumption rate calculated by Kohler and Miller (1982) for the Western San Diego P-C Region for the years 1960 to 1979 was 5.5 tons. For the years 1980 to 1994 the region had an average annual per-capita consumption rate of 5.3 tons (Table 3). For this report, the projected aggregate consumption of western San Diego County was calculated by averaging the per-capita consumption rates from 1960 to 1994. This gives an annual consumption rate of 5.4 tons per person.

It is calculated, from historical marketing of aggregate, that over 95 percent of the PCC-grade aggregate produced in western San Diego County is consumed in the county. There is some importation of aggregate from the Temescal Valley production areas in Riverside County into northern San Diego County--mostly sand--and exportation from northern San Diego County into Riverside County. During years of high demand in northern San Diego County there are probably more imports from Riverside County than exports.

PROJECTED AGGREGATE DEMAND THROUGH THE YEAR 2045

A simple analysis using the population projection published by the California Department of Finance (1993) and the annual per-capita consumption figure of 5.4 tons was made to forecast the aggregate consumption of western San Diego County through the year 2045 (Table 4).

The results of these projections show that an estimated 1,050 million tons of aggregate will be needed to satisfy the future demand through the year 2045 in western San Diego County. Of this total, about 70 percent, or 735 million tons, must be of PCC grade.

The variations from year to year in aggregate production rate (Figure 5) probably reflect to a large degree, changes in urban growth rates and intermittent large construction projects (for example, freeways). In part, these variations also result from incompleteness and inaccuracies in the production records supplied by the U.S. Bureau of Mines. Certainly the economic climate is a powerful variable that influences aggregate demand. Very high interest rates, for example, as in California in 1979 and 1980, tended to lower the amount of new construction and consequently lower the demand for aggregate. Also, the economic recession at the beginning of the 1990s caused a sharp drop in aggregate production. High consumption of aggregate occurred in the region in the mid- and late-1980s as the construction

Table 3. Population, aggregate production, and per capita consumption in western San Diego County during the years 1980 through 1994.

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

YEAR	POPULATION	PER CAPITA CONSUMPTION (in tons)	RECORDED AGGREGATE PRODUCTION (in tons)
1980	1,778,469	7.3	13,000,000
1981	1,815,489	5.1	9,300,000
1982	1,859,542	4.6	8,500,000
1983	1,910,030	4.1	7,900,000
1984	1,961,148	5.6	11,000,000
1985	2,007,595	6.0	12,100,000
1986	2,070,945	6.5	13,500,000
1987	2,120,177	6.3	13,300,000
1988	2,219,355	6.3	14,000,000
1989	2,301,024	5.8	13,300,000
1990	2,377,957	6.5	15,500,000
1991	2,422,226	4.5	10,800,000
1992	2,475,915	4.4	11,000,000
1993	2,520,980	3.8	9,500,000
1994	2,556,583	3.1	7,900,000
TOTAL			170,600,000

Average annual per capita consumption from 1980 to 1994 was 5.3 tons.

Sources for population data:

San Diego Association of Governments, 1989.
San Diego Association of Governments, 1990.
San Diego Association of Governments, 1992.
San Diego Association of Governments, 1994.

Table 4. Projected aggregate consumption through the year 2045 in western San Diego County.

Based on an annual per capita consumption rate of 5.4 tons. All tonnage figures rounded to nearest 100,000.

YEARS	PROJECTED DEMAND FOR ALL AGGREGATE (tons)	*PROJECTED CONSUMPTION OF PCC AGGREGATE (tons)
1995-2000	89,400,000	62,600,000
2001-2005	81,200,000	56,800,000
2006-2010	87,100,000	61,000,000
2011-2015	93,400,000	65,400,000
2016-2020	99,800,000	69,900,000
2021-2025	106,500,000	74,600,000
2026-2030	113,200,000	79,200,000
2031-2035	119,800,000	83,900,000
2036-2040	126,300,000	88,400,000
2041-2045	132,900,000	93,000,000
TOTALS	1,049,600,000	734,800,000

* This figure is based on the estimate that 70% of the aggregate consumed will be used in portland cement concrete.

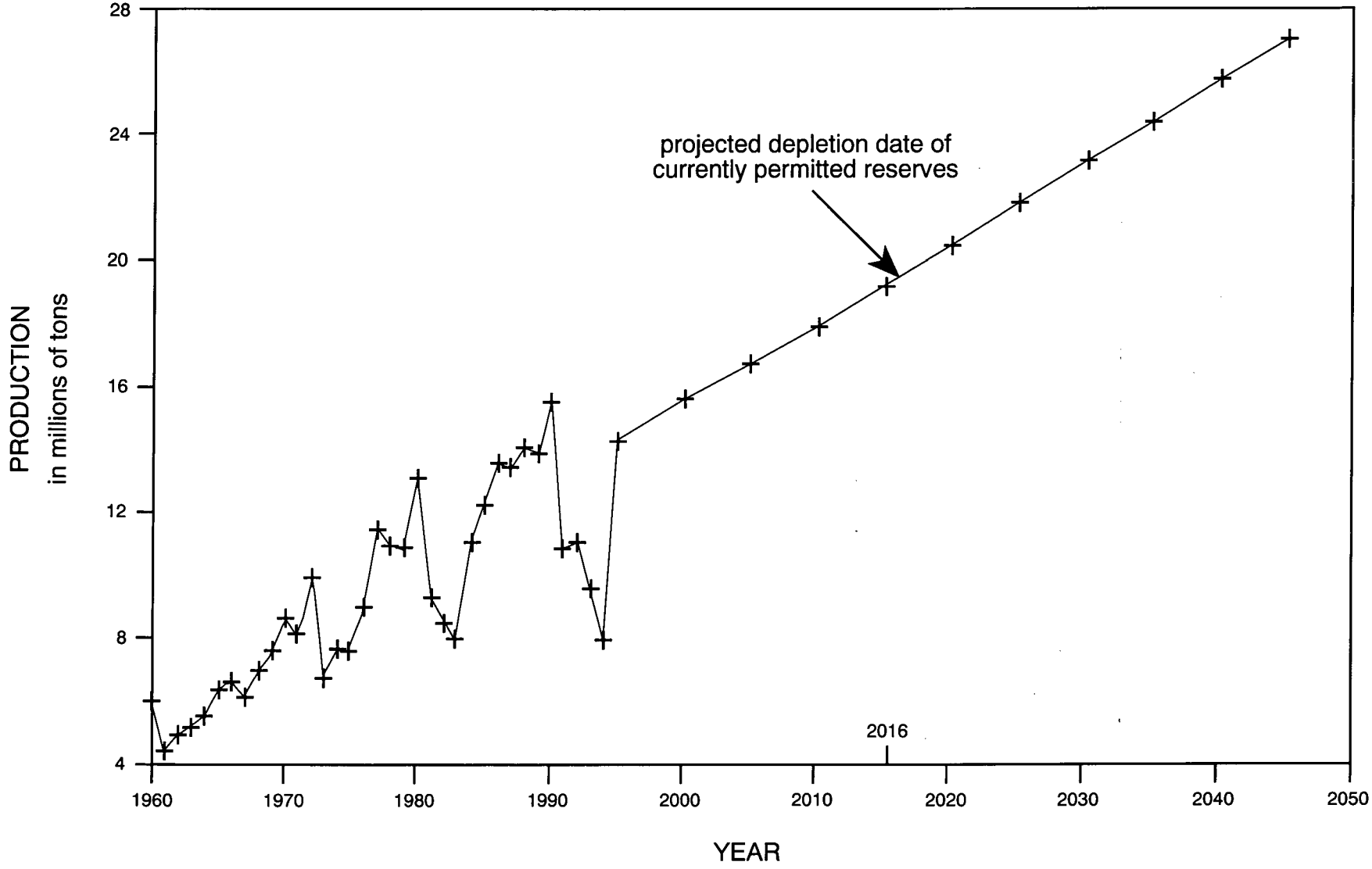

Figure 5. Aggregate production in western San Diego County—1960 to 1994, with projection to 2045.

industry recovered after the economic recession in the early 1980s. Major unforeseen events such as disaster reconstruction in the wake of an earthquake or a major economic recession could cause aggregate demand to change radically.

COMPARISON OF THE 50-YEAR AGGREGATE DEMAND WITH CURRENT RESERVES

The total PCC-grade aggregate reserves of 352 million tons in western San Diego County are projected to last 20 years, until the year 2016, at the present rate of production. According to limited U.S. Bureau of Mines aggregate production statistics, for the years 1980 through 1994, about 70 percent of the total aggregate consumed in San Diego County was used in PCC. This equates to 735 million tons of PCC-grade aggregate that will be needed within the next 50 years. If all of the PCC-grade aggregate reserves were used exclusively for PCC-grade aggregate, the supply would theoretically last 26 years. In reality, much of the PCC-grade aggregate reserves will be used for other products, and a depletion date of 2016 is more likely. Table 5 is a summary of present aggregate resources and future aggregate demands for western San Diego County.

Table 5. Summary of aggregate resources and projected 50-year consumption for western San Diego County.

o PCC-grade aggregate resources (includes PCC-grade aggregate reserves)	6,094,000,000 tons
o PCC-grade aggregate reserves	352,000,000 tons
o 50-year demand, all aggregate	1,050,000,000 tons
o 50-year demand, PCC-grade aggregate (70%)	735,000,000 tons

PART III - ALTERNATIVE SOURCES OF AGGREGATE

The potential sources of PCC-grade aggregate, in addition to the deposits classified as MRZ-2, that exist within and near western San Diego County were discussed in Special Report 153 (Kohler and Miller, 1982). This included potential resources within western San Diego County that were classified as MRZ-3 and aggregate production districts in neighboring counties. Further information has been developed on the potential resources of crushed granitic and metavolcanic rocks and an alluvial deposit within western San Diego County and the importation of aggregate from Riverside County.

CRUSHED ROCK SOURCES

It was noted in the original report (Kohler and Miller, 1982) that the metavolcanic and granitic rocks, which underlie a large part of the county, may become an important PCC-grade aggregate source in the future. There are uncertainties about the quality of these rock types because the metavolcanic rocks are not uniform in character and the granitic rocks typically are capped by a deep overburden of weathered material. However, additional sources of crushed rock suitable for PCC-grade aggregate have been developed since 1982 within these rock types in western San Diego County. PCC-grade aggregate has been permitted for mining from several deposits of granitic and metavolcanic rocks. Production has begun from some of these deposits.

The San Marcos quarry, the TTT quarry, and Hester's Granite quarry are all producing PCC-grade aggregate from granitic rocks. The granitic body being mined at the TTT quarry, near Lakeside, is small and may not extend much beyond the permit boundary. The PCC-grade granitic rocks being crushed at Hester's Granite quarry are generally boulders of fresh rock within deeply weathered parts of the deposit. Although this type of granitic deposit is common in San Diego County, it is not generally economically minable for PCC-grade aggregate. Large quantities of weathered granitics must be mined and sold to yield the lesser amount of fresh boulders which can be crushed for PCC-grade aggregate. Hester's Granite quarry has marketed primarily the weathered material and has been able, therefore, to crush and sell the fresh rock as a co-product. The granitics being excavated at the San Marcos quarry may be similar to the granitics at the Twin Oaks quarry in the Merriam Mountains which were classified MRZ-2 in the original report and the adjacent Sycamore Ridge deposit that was reclassified as MRZ-2 by petition in 1988 (Clinkenbeard, 1988). The granitic rocks on the Pankey Ranch property were classified MRZ-2 by petition in 1989 (Clinkenbeard, 1989).

The San Marcos quarry is the only new deposit of metavolcanic rocks producing aggregate in western San Diego County. The metavolcanic rocks in this deposit, however, are not of PCC-grade and are mixed with crushed granitic rocks from another quarry on the property. The Jamul quarry is a recently permitted deposit of metavolcanic rocks in the southern part of the county, but is not yet actively being mined.

ALLUVIAL DEPOSITS

The alluvium in San Vicente Creek, a tributary of the upper San Diego River, reclassified from MRZ-4 to MRZ-2, is being mined for PCC-grade sand by Enniss Materials Company. It is probable that this deposit was of PCC quality, but no information was available when the original classification study was made.

No additional information has been developed concerning the other alternative sources of PCC-grade aggregate in western San Diego County that were mentioned in the original classification report.

TEMESCAL VALLEY PRODUCTION AREA IN RIVERSIDE COUNTY

Aggregate resource availability in the Temescal Valley area, which borders western San Diego County on the north, was detailed in Special Report 165 (Miller and others, 1991). In that report it was noted that San Diego County was supplied with significant quantities of PCC-grade aggregate from the Temescal Valley area. In 1993, an informal telephone survey was made of aggregate producers in Temescal Valley to estimate the amount of aggregate being sold in San Diego County. At that time it was estimated that over 2 million tons per year was being imported from that area into northern San Diego County and an unknown amount was being exported from a producer in northern San Diego County into Riverside County. For this study a similar survey showed that in 1994 a much smaller amount of aggregate, mostly sand, was being imported from Temescal Valley, and aggregate is still being exported from northern San Diego County into Riverside County. The decrease in aggregate consumption in western San Diego County in the last few years, as shown in Table 3, may explain the decrease in imports. It is likely that the Temescal Valley area will continue to be a source of aggregate materials for northern San Diego County during periods of increasing demand.

PART IV - REVIEW OF THE WESTERN SAN DIEGO COUNTY PRODUCTION-CONSUMPTION REGION

The original mineral land classification of aggregate resources in the Western San Diego County P-C Region was published in 1982 as Special Report 153 (Kohler and Miller, 1982). That report's projection for aggregate consumption of the region was based on an annual per-capita consumption rate of 5.5 tons and a population projection by the California Department of Finance and DMG staff.

The 1982 report by Kohler and Miller projected that aggregate demand in the Western San Diego P-C Region would be 174,735,000 tons from 1980 to 1994 (Figure 6). Table 3 gives a measurement, from 1980 to 1994, of 170,600,000 tons of aggregate produced by mines in the Western San Diego County P-C Region. This close-to-predicted aggregate demand resulted from the combination of a 6 percent larger increase in population than predicted and a slightly lower annual per capita consumption rate of 5.3 tons, compared to the 5.5 tons used in the projection (Figure 6). There were 137,000 more people in the region in 1994 than were predicted by the 1982 report (Figure 7).

Projections of future aggregate demand should not be expected to be as close to the actual demand as was the case over the last 14 years for the Western San Diego County P-C Region. The method used in this and the original report for projecting aggregate demand is very simple and does not take into account fluctuations in the economy, either regionally or nationally. Such simple projections are only meant to be general long-range planning guides for local lead agencies. The real-time variations in aggregate production as shown on Figure 6 cannot be predicted with any confidence, even for short terms.

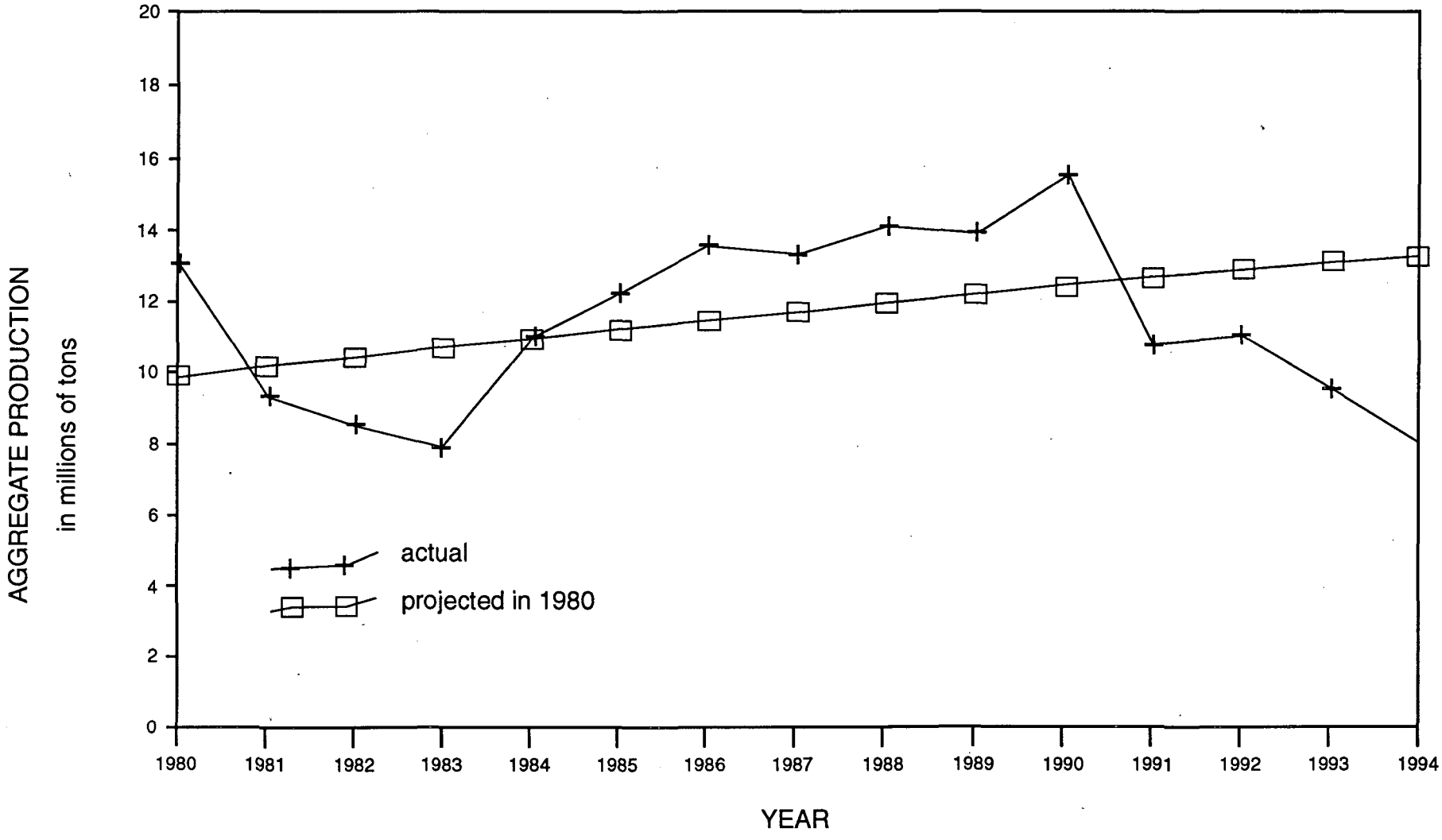

Figure 6. Comparison of aggregate production in the Western San Diego County Production-Consumption Region for the years 1980 to 1994, with the forecast in Special Report 153 (Kohler and Miller, 1982).

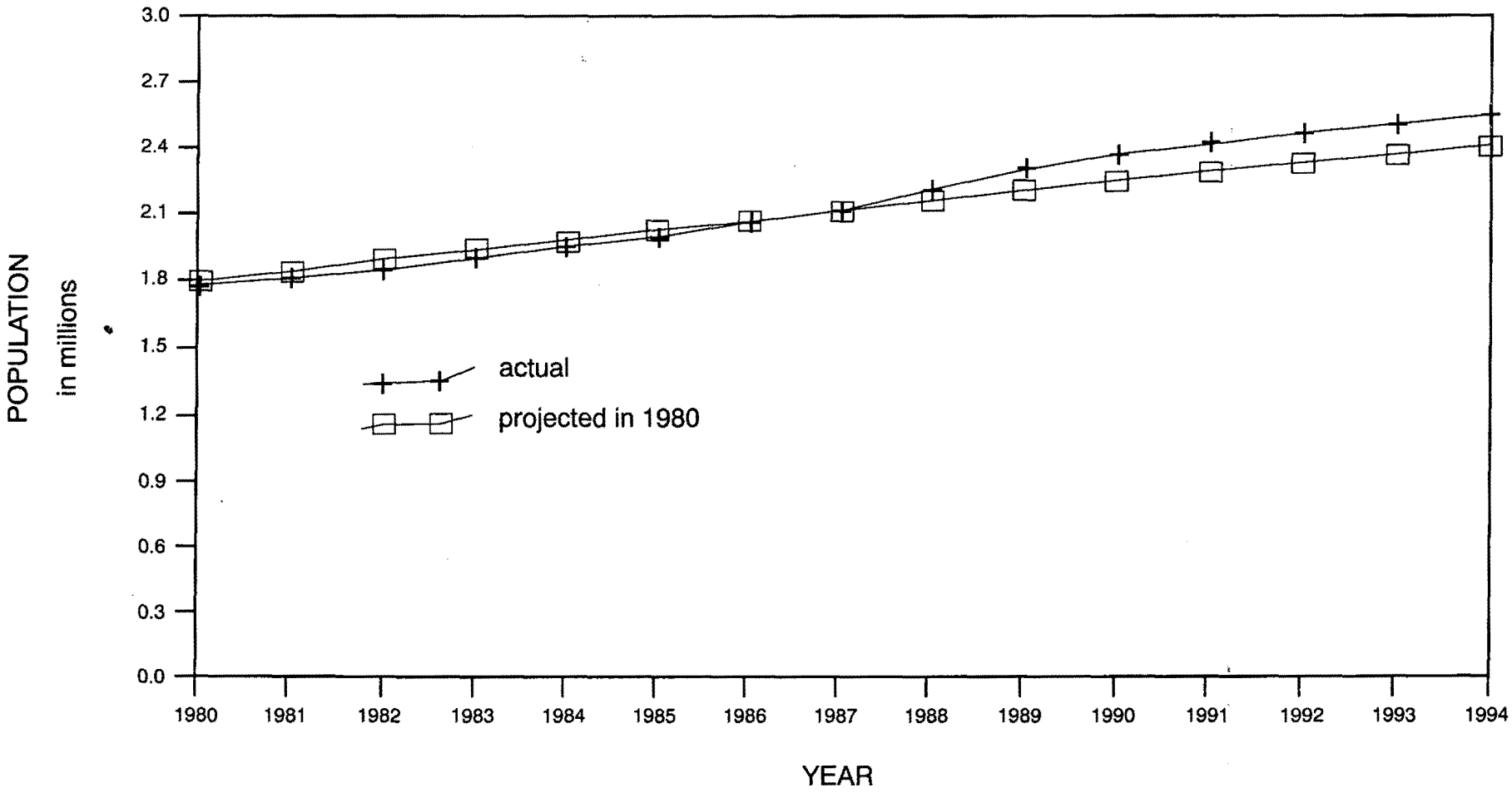

Figure 7. Comparison of population in the Western San Diego County Production-Consumption Region for the years 1980 to 1994, with the forecast in Special Report 153 (Kohler and Miller, 1982).

PART V - CONCLUSIONS

Within western San Diego County, 19 Aggregate Resource Sectors have previously been classified, five areas have been reclassified, and two areas have been newly classified as containing significant resources of PCC-grade aggregate. The 19 Aggregate Resource Sectors are also designated by the Board as being of regional significance. A reevaluation of the designated areas indicates that they contain 5,269 million tons of geologically and technologically available PCC-grade aggregate resources. This is made up of three components: unpermitted resources, reserves permitted for PCC-grade aggregate production, and resources permitted for production of other commodities. There are also 825 million tons of geologically and technologically available resources which have been identified outside of the designated areas, but within, or very close to, the Western San Diego County P-C Region giving a total for the Western San Diego County P-C Region of 6,094 million tons of aggregate resources. This is 164 million tons more PCC-grade aggregate resources than were available in 1980.

The average annual per capita consumption rate of aggregate materials in the Western San Diego County P-C Region from 1960 to 1995 is 5.4 tons. This is a reduction from the 5.5 ton per capita consumption rate from 1960 to 1980. The population has increased 6 percent more from 1980 to 1995 than was projected in 1980.

Based upon available production data and population projections, western San Diego County will need to be provided with 1,050 million tons of aggregate during the next 50 years. Of this projected demand, approximately 70 percent, or 735 million tons, must be suitable for use in PCC. The presently permitted aggregate reserves of 352 million tons will last to the year 2016, 20 years from the present. The present PCC-grade aggregate reserve total is 78 million tons less than was available in 1980. Over 80 percent of this decline in reserves is due to a decline in permitted instream sand deposits. If a major earthquake or similar unforeseen catastrophic event strikes the county and necessitates reconstruction, existing reserves may be depleted sooner.

Imports and exports of aggregate for the region were estimated to be about equal in 1994; although, in past years of higher demand, imports were higher than exports. The importing and exporting of aggregate materials takes place between northern San Diego County and the Temescal Valley region in western Riverside County.

The forecast of aggregate demand of 174,735,000 tons, published in the 1982 report, for the period 1980 to 1994, was

within 2 percent of the aggregate production of 170,600,000 tons measured for that period for this study. This level of accuracy is not expected for the simplistic forecast technique used and should not be expected of the forecast made for the next 50-year period. This same forecast technique gave less accurate results in Ventura and Los Angeles counties (Miller, 1992 and 1994).

No conclusion was reached on the effectiveness of designation in preserving significant aggregate resources. Eight percent of the designated aggregate resource--413 million tons--were lost to urbanization. However, several hundred million tons of resources were added to the total available through development of new deposits outside of designated lands. This has resulted in a net increase of over 100 million tons in the total of available PCC-grade aggregate resources in western San Diego County.

ACKNOWLEDGMENTS

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Also, the following people were of help with aggregate import information in the Temescal Valley area of Riverside County: John Dickey, Standard Ready Mix Concrete Company; Jim Grace, R.J. Noble Company; George Jackson, Santa Ana River Rock Company; Cristine Jones, Sun West Materials Company; Mark Miller, Werner Corporation; and Pat Werner, Chandler's Sand and Gravel Company.

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APPENDIX

CALIFORNIA MINERAL LAND CLASSIFICATION SYSTEM

MINERAL RESOURCE ZONE CATEGORIES

DMG has classified the western San Diego County area according to the presence or absence of significant concrete-grade aggregate deposits. The land classification is presented in the form of Mineral Resource Zones, or MRZ's. Directions for the identification of Mineral Resource Zones are set forth in DMG's Special Publication 51 in the section "Guidelines for Classification and Designation of Mineral Lands" (California State Mining and Geology Board, 1983).

The guidelines for establishing the Mineral Resource Zones are as follows:

MRZ-1: Areas where available geologic information indicates that little likelihood exists for the presence of significant mineral resources.

MRZ-2a: Areas underlain by mineral deposits where geologic data indicate that significant measured or indicated resources are present. As shown on the California Mineral Land Classification Diagram (Figure 8), MRZ-2 is divided on the basis of both degree of knowledge and economic factors. Areas classified MRZ-2a contain discovered mineral deposits that are either measured or indicated reserves as determined by such evidence as drilling records, sample analysis, surface exposure, and mine information. Land included in the MRZ-2a category is of prime importance because it contains known economic mineral deposits.

MRZ-2b: Areas underlain by mineral deposits where geologic information indicates that significant inferred resources are present. For this report, areas classified MRZ-2b contain discovered mineral deposits that are significant inferred resources as determined by their lateral extension from proven deposits or their similarity to proven deposits. Further exploration work could result in upgrading areas classified MRZ-2b to MRZ-2a.

MRZ-3a: Areas containing known mineral occurrences of undetermined mineral resource significance. Further exploration work within these areas could

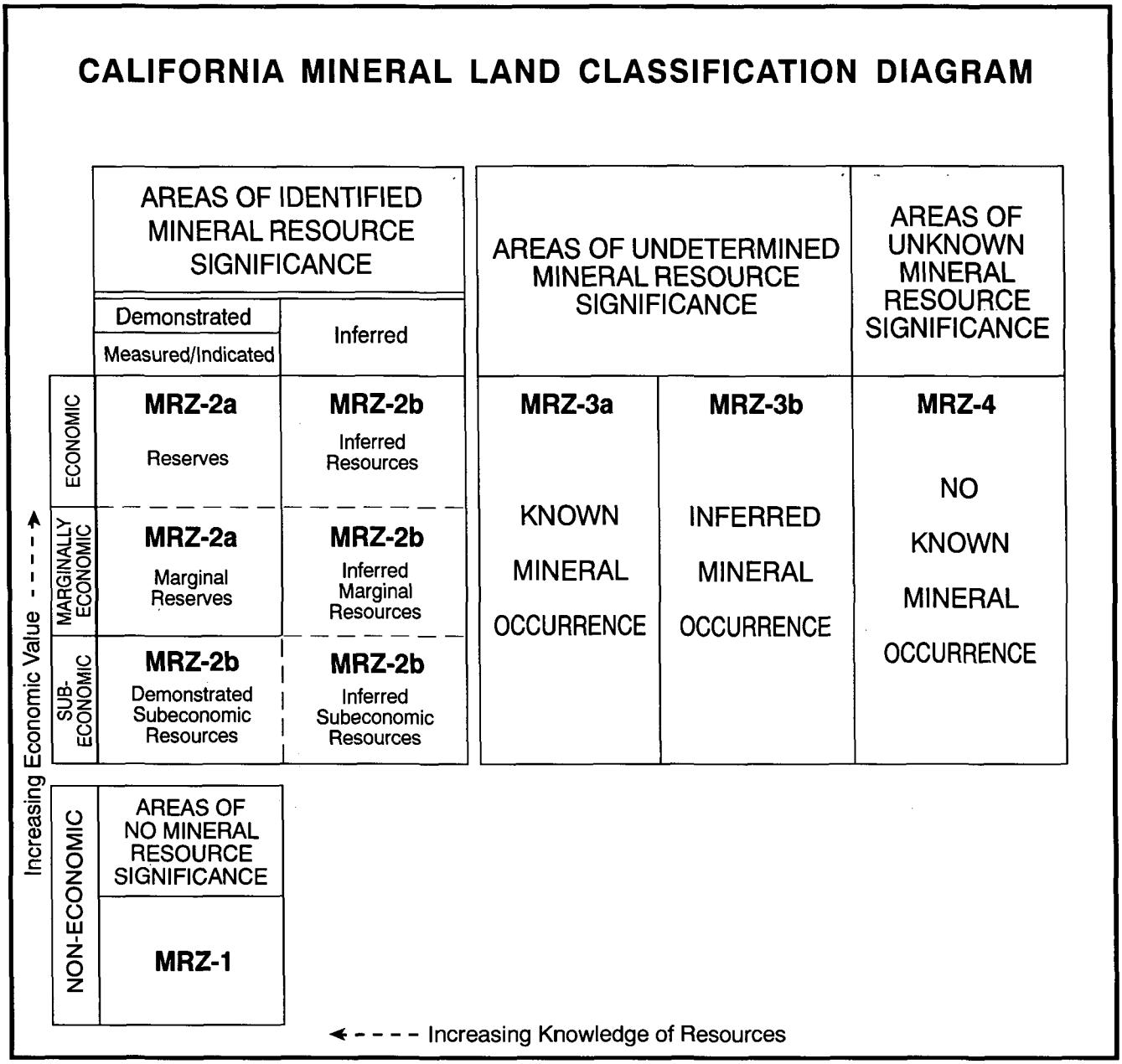

Figure 8. California Mineral Land Classification Diagram: Diagramatic relationship of mineral resource zone categories to the resource/reserve classification system. Adapted from U.S. Bureau of Mines/U.S. Geological Survey (1980).

result in the reclassification of specific localities into MRZ-2a or MRZ-2b categories. As shown on the California Mineral Land Classification Diagram, MRZ-3 is divided on the basis of knowledge of economic characteristics of the resources.

MRZ-3b: Areas containing inferred mineral occurrences of undetermined mineral resource significance. Land classified MRZ-3b represents areas in geologic settings that appear to be favorable environments for the occurrence of specific mineral deposits. Further exploration work could result in the reclassification of all or part of these areas into the MRZ-2a or MRZ-2b categories.

MRZ-4: Areas of no known mineral occurrences where geologic information does not rule out either the presence or absence of significant mineral resources.

The distinction between the MRZ-1 and the MRZ-4 categories is important for land-use considerations. It must be emphasized that MRZ-4 classification does not imply that there is little likelihood for the presence of mineral resources, but rather there is a lack of knowledge regarding mineral occurrence. Further exploration work could well result in the reclassification of land in MRZ-4 areas to MRZ-3 or MRZ-2 categories.

MINERAL RESOURCE/RESERVE CLASSIFICATION NOMENCLATURE

Following are definitions of the nomenclature associated with the California Mineral Land Classification Diagram (Figure 6). It is important to refer to these definitions when studying the different resource categories shown on the California Mineral Land Classification Diagram. Particular attention should be given to the distinction between a mineral deposit and a resource and to how a mineral deposit may relate to resources.

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MINERAL DEPOSIT: A mass of natural occurring mineral material, e.g. metal ores or nonmetallic minerals, usually of economic value, without regard to mode of origin. The mineral material may be of value for its chemical and/or physical characteristics.

MINERAL OCCURRENCE: Any ore or economic mineral in any concentration found in bedrock or as float; especially a valuable mineral in sufficient concentration to suggest further exploration.

ECONOMIC: This term implies that profitable extraction or production under defined investment assumptions has been established, analytically demonstrated, or assumed with reasonable certainty.

MINERAL RESOURCE: A concentration of naturally occurring solid, liquid, or gaseous material in or on the Earth's crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible. The terms resource and mineral resource are synonymous in this report.

RESERVES: That part of the resource base which could be economically extracted or produced at the time of determination. For the purposes of this report, the term reserves has been further restricted to include only those deposits for which a valid mining permit has been granted by the appropriate lead agency.

IDENTIFIED MINERAL RESOURCES: Resources whose location, grade, quality, and quantity are known or estimated from specific geologic evidence. Identified mineral resources include economic, marginally economic, and subeconomic components. To reflect varying degrees of geologic certainty, these economic divisions can be subdivided into demonstrated and inferred.

DEMONSTRATED: A term for the sum of measured plus indicated.

MEASURED: Quantity is computed from dimensions reveled in outcrops, trench workings, or drill holes; grade and/or quality are computed from the results of detailed sampling. The sites for inspection, sampling, and measurement are spaced so closely and the geologic character is so well defined that size, shape, depth, and mineral content of the resource are well established.

INDICATED: Quantity and grade and/or quality are computed from information similar to that used for measured resources, but the sites for inspection, sampling, and measurement are further apart or otherwise less adequately spaced. The degree of assurance, although lower than that for measured resources, is

high enough to assume continuity between points of observation.

INFERRED: Estimates are based on an assumed continuity beyond measured and/or indicated resources, for which there is geologic evidence. Inferred resources may or may not be supported by samples or measurements.

MARGINAL RESERVES: That part of the demonstrated reserve base that, at the time of determination, borders on being economically producible. The essential characteristic of this term is economic uncertainty. Included are resources that would be producible, given postulated changes in economic or technologic factors.

MARGINAL RESOURCES: That part of the inferred resource base that, at the time of determination, would be economically producible, given postulated changes in economic or technologic factors.

SUBECONOMIC RESOURCES: The part of identified resources that does not meet the economic criteria of marginal reserves and marginal resources.