Special Report 251

UPDATE OF THE MINERAL LAND CLASSIFICATION FOR CONSTRUCTION AGGREGATE RESOURCES IN THE MONTEREY BAY PRODUCTION-CONSUMPTION REGION

2021

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By

Erica Key (PG 9620)

2021

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AC: Asphaltic Concrete

CGS: California Geological Survey

DMR: Division of Mine Reclamation

DWR: Department of Water Resources

MLC: Mineral Land Classification

MRZ: Mineral Resource Zone

NAIP: National Agricultural Imagery Program

OFR: Open File Report

P-C: Production-Consumption

PCC: Portland-cement-concrete

SMARA: Surface Mining and Reclamation Act (of 1975)

SMGB: State Mining and Geology Board

SR: Special Report

Ton: Short ton (2000 lbs)

USBM: United States Bureau of Mines

Executive Summary

Aggregate (sand, gravel, and crushed stone) is the number one non-fuel mineral commodity in California by value. In 2017, aggregate was valued at $1.49 billion and comprises 42 percent of California's $3.6 billion non-fuel mineral economy (Key, 2019).

California's largest aggregate consumption regions are in the Los Angeles and San Francisco Bay metropolitan areas. As urbanization and other incompatible land uses have precluded areas from mining, the reliance on domestic and international aggregate imports to meet local demand has increased.

Transportation plays a significant role in the final cost of aggregate to the consumer. Increased truck haulage distances not only increase the price of aggregate, but also create environmental and societal impacts such as increased fuel consumption, carbon dioxide emissions, air pollution, traffic congestion, and road maintenance. Maintaining local sources of aggregate is important in reducing the carbon footprint of California's construction projects.

This report (1) identifies new construction aggregate resources in the Monterey Bay Production-Consumption (P-C) Region through the process of classification, (2) estimates current aggregate permitted reserves and unpermitted resources as of December 2017, and (3) forecasts construction aggregate demand in the Monterey Bay P-C Region for the next 50 years to 2068.

Three newly classified construction aggregate resource areas have been added for this update of the Monterey Bay P-C Region. They are as follows:

- Sargent Ranch (Santa Clara County)
- Handley Ranch Quarry (Monterey County)
- Hidden Canyon Quarry (Monterey County)

Based on the updated reserve estimates for the Monterey Bay P-C Region, the following conclusions were reached:

- There are 219 million tons of permitted construction aggregate resources (reserves) within the Monterey Bay P-C Region.
- Approximately 41 percent of aggregate produced in the Monterey Bay region is exported to neighboring P-C regions.
- The projected aggregate demand for the Monterey Bay P-C region through the year 2068 is estimated to be 332 million tons.
- If no additional reserves become available within the Monterey Bay P-C Region, the 219 million tons of reserves are enough to supply the region until the year 2051.
- Approximately 1.1 billion tons of construction aggregate resources underlie the Monterey Bay P-C Region.

The following table compares key data for the Monterey Bay P-C Region for the base data year from the previous report (1997) with data current to the end of 2017.

Comparison:	**1997**	**2017**
Population	937,356	1,143,652
Average Annual Aggregate Production	7.7 million tons	6.6 million tons
Permitted Aggregate Reserves	269 million tons	219 million tons
Projected Years Until Permitted Reserve Depletion	35	33
Aggregate Resources	1,210 million tons	1,100 million tons
Number of Permitted Construction Aggregate Mines	27	29
Number of Aggregate Companies	16	15

Introduction

The California Geological Survey (CGS) presents information on the availability and location of aggregate resources in areas throughout the State for the benefit of local lead agencies. Land-use planners and decision-makers in California are faced with balancing a variety of needs in planning for a sustainable future for their communities. Local land-use decisions regarding aggregate resources often have regional impacts that go beyond local jurisdictional boundaries as existing permitted aggregate supplies are depleted.

Construction aggregate (sand, gravel, and crushed stone) is the number one non-fuel mineral commodity in California by value. In 2017, construction aggregate was valued at $1.49 billion and comprises 42 percent of California's $3.6 billion non-fuel mineral economy (Key, 2019). California's largest aggregate consumption regions are in the Los Angeles and San Francisco Bay metropolitan areas. The reliance on domestic and international construction aggregate imports to meet local demand has increased as urbanization has precluded local areas from mining.

Since construction aggregate is a low unit-value, high bulk-weight commodity, it must be obtained from nearby sources to minimize the impacts associated with transportation. Increased truck haulage distances not only increase the price of construction aggregate, but also creates environmental and societal impacts such as increased fuel consumption, carbon dioxide emissions, air pollution, traffic congestion, and road maintenance. Maintaining local sources of construction aggregate is important in reducing the carbon footprint of California's construction projects.

This report conveys updated information on the status of construction aggregate resources in the Monterey Bay Production-Consumption (P-C) region. First, we explain the background behind why the CGS publishes these reports. Next, we provide current information on the geographic distribution and quantity of construction aggregate resources in the region. We then describe the changes to aggregate production and consumption trends that have occurred since the last report. Finally, we present a 50-year projection of the amount of construction aggregate needed to meet regional demand.

Background

The Surface Mining and Reclamation Act (SMARA) of 1975 was passed by the California State Legislature not only to ensure reclamation of mined lands, but also to respond to the loss of significant mineral resources to urban expansion and other incompatible land uses. *Classification-Designation* is the two-phase process mandated by SMARA to address mineral resource loss. *Classification* is the process of identifying lands that contain significant mineral deposits without regard for present land use or land ownership and is the responsibility of the State Geologist. *Designation* is the formal recognition of those significant mineral deposits by the State Mining and Geology Board (SMGB), after consultation with lead agencies and other interested parties.

This report is the third in a series of mineral land classification reports for construction aggregate in the Monterey Bay P-C Region, which includes all of San Benito, Santa Cruz, and portions of Monterey, Santa Clara, and San Mateo counties (Figure 1). The Monterey Bay P-C Region was first classified for construction aggregate in 1987 (Stinson and others; SR 146). Based on the recommendations in SR 146, the SMGB designated 17 sectors (California Department of Conservation, 1987). A subsequent update (Kohler-Antablin, 1999; OFR 99-01), classified 13 new mineral resource zones (MRZs) and 11 new sectors in the Monterey Bay P-C Region, but no new sectors were designated by the SMGB.

Classification of the Monterey Bay P-C Region with regard to the suitability of the underlying material for use in construction aggregate has been done for all prior reports. Construction aggregate is defined as aggregate suitable for:

- Portland-cement-concrete (PCC)
- Asphaltic concrete (AC)
- Base
- Class I, II, and II subbase

Previous reports have subdivided the category of subbase into five classes (I-V) based on Caltrans specifications (Caltrans, 2018). The classes are based on distribution of aggregate clast size. Caltrans subbase classes IV and V are considered fill and are not classified in this report.

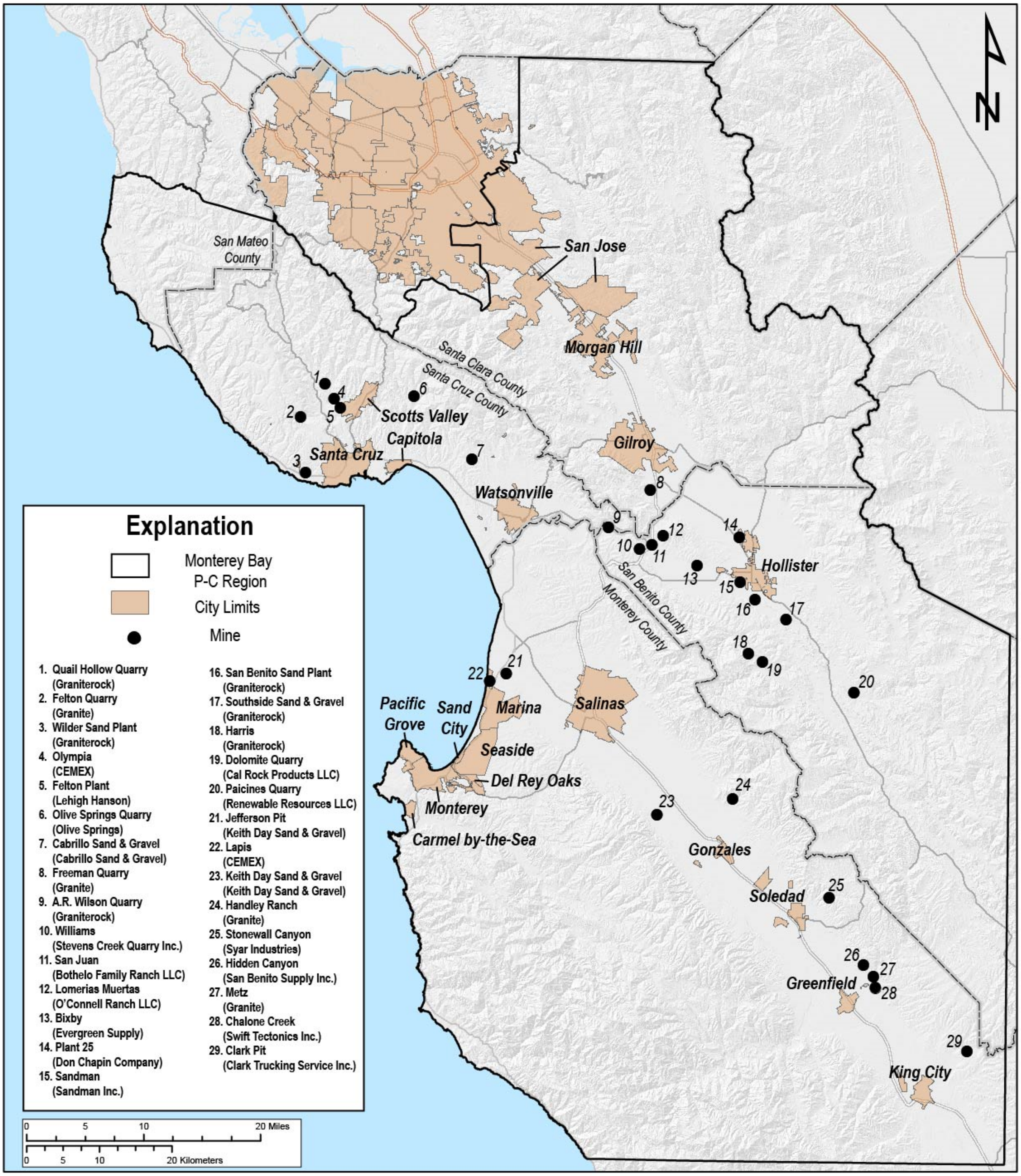

Figure 1. Location map showing the Monterey Bay P-C Region, lead agency jurisdictional boundaries (incorporated city limits), and locations of construction aggregate mining operations evaluated in this report. Numbered list denotes mine name with operator name in parenthesis.

The information provided in this and previous mineral land classification reports is intended to inform the lead agencies of the presence of construction aggregate resources in their jurisdictions. This information can be used to evaluate the effectiveness of their current mineral resource management policies and to plan for future construction aggregate demands within their areas. SMARA requires that lead agency mineral resource management policies be reevaluated and updated as new reports are published. The lead agencies within the Monterey Bay P-C region can be found in Appendix A.

Methods

Mineral Land Classification

Mineral land classification, also referred to as classification, is the process of identifying lands containing significant mineral deposits based solely on geologic and economic factors without regard to existing land use and ownership. The major geologic factors that affect the quality of construction aggregate are rock type and weathering. Rock type and weathering effect the hardness, durability, and potential chemical reactivity of aggregate. Favorable geologic units for construction aggregate in the Monterey Bay P-C Region include stream channel, floodplain, and river terrace deposits, sandstone, and igneous intrusive rocks (e.g. granite). Geologic maps, surface samples and drill data provided by operators, and DWR water well logs were used to determine favorable geology in the surface and subsurface.

In addition to the presence of favorable geologic factors, a mineral deposit must meet the marketability and threshold value criteria adopted by the SMGB (SMGB, 2000) to be classified. The SMGB determined the threshold value of the first marketable product in 1998 dollars to be $12,500,000 for construction aggregate deposits. To reflect 2017 dollars, this was multiplied by an inflation factor of 1.6. This factor was determined by dividing the California Department of Finance's Consumer Price Index (CPI) for 2017 (262.8) by the CPI for 1998 (163.7). The threshold value that a construction aggregate deposit must meet to be classified is **$20,000,000.**

The result of classification is a map of MRZs displaying areas with varying potential to host mineral deposits of economic significance (Plate 1). The areas are put into one of four categories:

- **MRZ-1:** Areas where available geologic information indicates that little likelihood exists for the presence of significant construction aggregate resources.
- **MRZ-2:** Areas where geologic information indicates the presence of significant construction aggregate resources.
- **MRZ-3:** Areas containing known or inferred construction aggregate resources of undetermined mineral resource significance.
- **MRZ-4:** Areas where available geologic information is inadequate to assign to any other mineral resource zone category.

The State Geologist utilizes the concept of sectors to identify areas within MRZ-2s that have land uses compatible with mining. Land use types that are incompatible with mining are not incorporated into sectors. Examples of incompatible land use include high-density residential developments, commercial and industrial developments, and major public infrastructure (SMGB, 2000). Examples of compatible land use include areas that are nonurbanized or have very low-density residential development (1 unit or less per 10 acres), lands that lack high-cost improvements, and lands used for agriculture, silviculture, grazing, or open space (SMGB, 2000). The result of this land use evaluation is a map or maps that illustrate the sectors identified by the State Geologist (Plates 2A and 2B).

Reserves and Resources

Aggregate reserves are calculated with information from deposits for which permits have been granted to allow mining and processing of the material. Reserves are calculated using the permitted area within a sector.

Aggregate 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. Aggregate resources are calculated based on all area within a sector (permitted and unpermitted).

The factors used to determine the areal extent and tonnage of aggregate reserves and resources within the sectors are those used in past mineral land classification reports. They are as follows:

1. Resource and reserve tonnage calculations were based on measurements taken from 1:24,000-scale base maps or maps obtained from aggregate companies with varying scales.
2. Thickness of aggregate deposits were determined by analyzing DWR water well log data, examining active aggregate pits and natural outcrops, and reviewing information provided by persons who have knowledge about aggregate deposits in this region.
3. A standard setback of 100 feet from utility and rail lines and urban developments was used to determine the limits of areas available for mining, unless otherwise stipulated in individual mining plans.
4. The side slopes were generally calculated to have a 1:1 gradient, or, if the deposit was permitted for mining, the side slopes that were specified in the mining plan.
5. In-place densities of 0.04 to 0.08 tons per cubic foot were assumed in calculating sand and gravel resources and densities of 0.08 to 0.09 tons per cubic foot were assumed in calculating crushed stone resources.

Production and Consumption

Production data from 1965 to 2017 was evaluated for this report update. Data from 1965 to 1997 was compiled from OFR 99-01 and SR 146. Data for the years 1998-2017 was collected from the SMARA III database maintained by DMR.

Consumption is the total amount of aggregate used within the region, and is defined as the annual production, including imports and excluding exports. Import and export information is not easy to assess since it is generally not tracked by operators. Quantities, source locations, and final destinations of imports and exports are estimates reported by operators to CGS.

Production-Consumption (P-C) regions are defined as market regions in which 95 percent or more of the aggregate produced is also consumed (Stinson and others, 1986). Sand, gravel, and crushed stone are typically marketed regionally, so their significance is measured on a regional level. Usually, loss of aggregate deposits discussed in these reports would have a significant impact on aggregate supply only within the P-C region.

Based on the high percentage of exports reported by operators, the Monterey Bay P-C region no longer meets the definition of a P-C region. However, the boundary is maintained to define the study area for direct comparison to previous reports.

50-Year Projection of Aggregate Demand

A 50-year projection of construction aggregate demand for the Monterey Bay P-C Region was made based on aggregate production data for 1965-2017. The projection uses an average annual production rate for the region, calculated using construction aggregate production for all years that data are available.

The per capita consumption method was not used in this or OFR 99-01 because more than 40 percent of the aggregate produced in the region is exported to neighboring P-C regions.

Results

Mineral Resource Zones

In previous reports MRZs and sectors in the Monterey Bay P-C Region were confined to the “urbanizing boundary” periodically updated by the California Office of Planning and Research (OPR). The Monterey Bay and neighboring P-C regions have undergone tremendous urbanization since the last urbanization boundary update by OPR in 1978. This regional urban growth has had significant impact on the aggregate resources in the Monterey Bay P-C Region, and there has been development of construction aggregate operations outside of classified areas since OFR 99-01 was published.

Efforts were made in this report to extend classified areas past the previous OPR “urbanization boundary”. The most significant improvement in classification has happened in the Gabilan Range that flanks the northeast side of the Salinas Valley (Plate 1). Much of the Gabilan Range is composed of Mesozoic granite with small, discontinuous metasedimentary pendants, which include marble (Kohler, 2003). As of 2017, two operations mine and crush the granite for construction aggregate. Data from nine current and previously operating quarries in the Gabilan Range, in addition to updated 1:100,000-scale geologic mapping (Rosenberg and Wills, 2016; Wagner and others, 2002), were used to add over 200,000 acres of land classified as MRZ-3 to this report.

Three new areas classified MRZ-2 were added to this report: Sargent Ranch, Handley Ranch, and Hidden Canyon. Since these new MRZ-2 areas also include new sectors, they will be discussed in detail in the following section.

Sectors

OFR 99-01 added 13 MRZ-2 areas to the zones originally classified in SR 146. These MRZ-2s were drawn based on geologic and economic factors, and compatible land use, and the corresponding resources were added to the P-C Region total. However, the previous report did not propose these areas as sectors. This author has treated the added MRZ-2 areas from OFR 99-01 as sectors based on the accepted definition outlined in the Methods section of this report. This section describes only new and changed sectors to this report. See Appendix B for descriptions of all sectors.

New Sectors

Three new sectors have been added in this update and are shown on Plate 2B. These sectors add approximately 199 million tons of construction aggregate resource to the Monterey Bay P-C Region. The new sectors are as follows:

Sector AH (Santa Clara County)

The newly classified Sargent Ranch MRZ-2 is approximately 941 acres and is four miles south of Gilroy. The proposed Sargent Quarry (Freeman Associates LLC) is located within this MRZ-2 and would provide PCC-grade sand and gravel for Santa Clara County. This deposit is composed of siltstone, sandstone, and conglomerate that would be crushed and washed before it is sold. This report also identifies 847 acres of the deposit as a sector based on compatible land use, drill logs, testing data, and geologic mapping provided by Freeman Associates LLC.

Sector W (Monterey County)

The Handley Ranch MRZ-2 is approximately 2,223 acres and was originally described by petition but has not been designated by the SMGB (Kohler, 2003). This report used updated geologic mapping to extend the MRZ-2 area originally proposed by the petition. The deposit is comprised of granite in the Gabilan Range and includes the Handley Ranch Quarry (Granite Construction). The quarry has been producing crushed rock for concrete and other construction projects in the Salinas Valley since 2004. This report also identifies 352 acres of the deposit as a sector based on compatible land use and the presence of the currently active quarry.

Sector X (Monterey County)

The Hidden Canyon MRZ-2 is approximately 3,871 acres and is located approximately five miles east of Greenfield. This deposit is comprised of granite and metasedimentary blocks in the Gabilan Range and includes the Hidden Canyon Quarry (SBS Global). The quarry has been producing crushed rock for concrete and construction projects in the Salinas Valley since 2006. This report also identifies a 428-acre portion of this MRZ-2 as a sector based on compatible land use and the presence of the currently active quarry.

Land Use Changes in Designated Sectors

Updated land use information for sectors described in this report was based on conditions as of May 2018. Land use was determined by reviewing data from lead agencies, field investigations, and the USDA National Agriculture Imagery Program (NAIP) aerial imagery to determine extent of urbanized areas.

Land use changes to two designated sectors have occurred since the last report. These land use changes represent a loss of approximately 88 million tons of sand, gravel, and crushed stone resources to the Monterey Bay P-C Region. These sectors are as follows:

Sectors D-1 and D-2 (San Benito County)

These two sectors comprise approximately 265 acres in San Benito County that were originally defined in SR 146, and designated by the SMGB (DOC, 1987). This area is underlain by Holocene stream channel deposits of the Uvas Creek that are suitable for AC- and PCC-grade aggregate. According to OFR 99-01, mining has not occurred in these sectors since the early 1980s. This area is now a public preserve and is surrounded by medium- to high-density residential developments. Due to the land use changes, it is unlikely that mining will occur here in the future and Sectors D-1 and D-2 should be considered lost. These areas will remain classified as MRZ-2 since significant resource remains in the Uvas Creek.

Sector H (Monterey County)

This 449-acre resource area was originally defined in SR 146, designated by the SMBG (DOC, 1987), and includes the Lapis Mine operated by CEMEX. The Lapis Mine is a significant source of PCC-grade sand for the Monterey Bay and neighboring P-C regions. The California Coastal Commission and CEMEX reached an agreement in 2017 that CEMEX would stop mining the Lapis beach sand deposit by December 31, 2020. CEMEX also agreed to sell the Lapis site to a nonprofit organization that would preserve the property and provide public access. It is unlikely that mining will occur here in the future and Sector H should be considered lost. This area will remain an MRZ-2 since significant resources are left in this deposit.

Sector J (Monterey County)

This 173-acre resource area was originally defined in SR 146, designated by the SMBG (DOC, 1987), and includes a quarry formerly operated by Granite Construction. This resource area is underlain by quartz diorite that was mined and crushed to produce AC- and PCC-grade aggregate. The former quarry was certified reclaimed by Monterey County in 2008. This area is now a public preserve and is surrounded by medium- to high-density residential developments. Due to the reclamation and land use changes, it is unlikely that mining will occur here in the future and Sector J should be considered lost. This area will remain an MRZ-2 since there is still significant resource left in this deposit.

Reserves and Resources

This report considered reserve information reported by operators and production statistics from the Division of Mine Reclamation from 29 mines from 1998-2017 to calculate remaining reserves and resources for the region. There are 219 million tons of permitted construction aggregate reserves within the Monterey Bay P-C region.

Approximately 1.1 billion tons of construction aggregate resources underlie the Monterey Bay P-C Region. This total includes the 219 million tons of permitted construction aggregate reserves.

Production and Consumption

Average annual construction aggregate production in the Monterey Bay P-C Region has decreased from 7.7 million tons per year to 6.6 million tons per year. This decrease is due in part to a significant drop in aggregate production in the region after 2007 (Figure 2).

Approximately 41 percent of aggregate produced in the Monterey Bay P-C Region is exported north to the South San Francisco P-C Region. This percentage is based on production distribution estimates that were reported to CGS by mine operators.

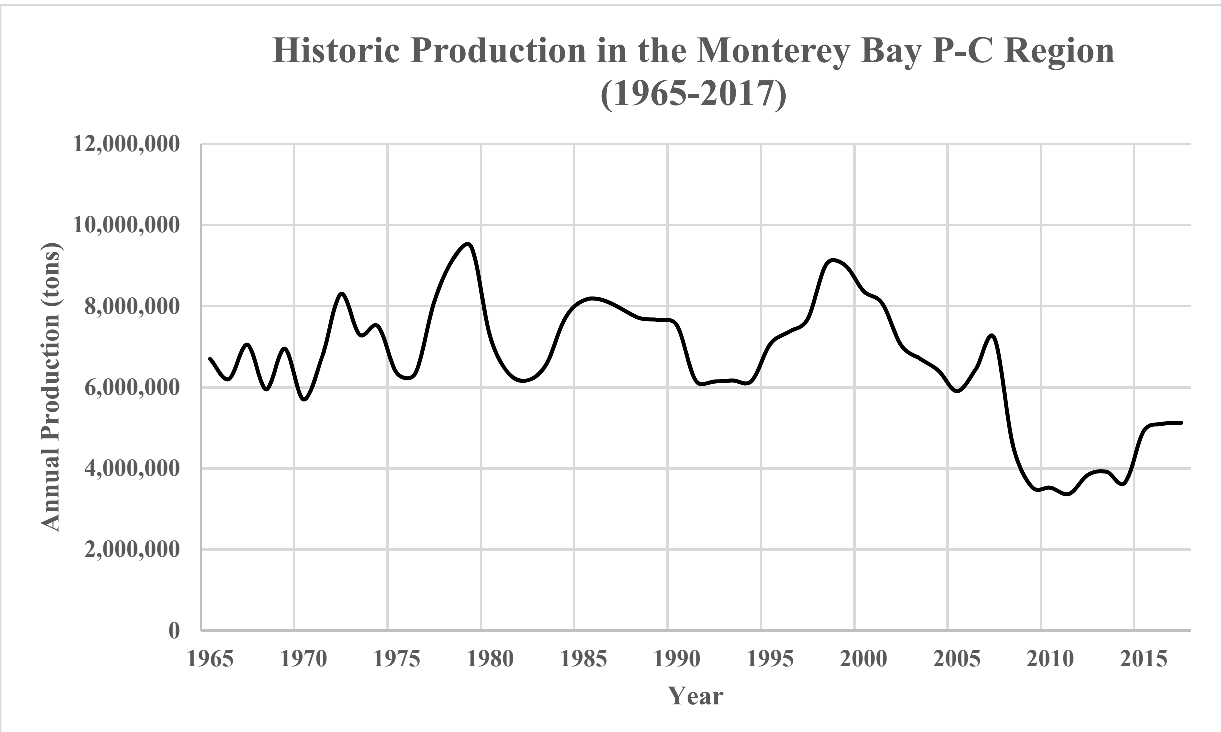

Figure 2. Historic production in the Monterey Bay P-C Region from 1965 through 2017. See Appendix C for total annual production from 1965 through 2017.

50-Year Projection of Aggregate Demand

The projected aggregate demand for the Monterey Bay P-C Region through the year 2068 is estimated to be 332 million tons. This projection was calculated by multiplying the historic average annual production rate of all available data from 1965-2017 by 50 (years). The average annual production rate in the Monterey Bay P-C Region is 6.6 million tons per year. Land use planners should not rely solely on this projection when making decisions for future aggregate needs, as it does not incorporate variables better accounted for by local planners.

Discussion

Construction aggregate production in the Monterey Bay P-C Region is largely driven by demand from neighboring P-C regions, based on discussions with operators in the area. Population in the Monterey Bay P-C Region has steadily increased since 1997 (Figure 3), however production has fluctuated dramatically during that time. Production has been declining since 1997, with a slight uptick in 2005-2007, followed by a significant drop in 2008. Production declined despite steady population increases in the Monterey Bay and neighboring P-C regions. While there is no clear answer to the 1997-2004 downturn, operators attribute the dramatic decline in 2008 to the recession and subsequent slowdown in regional construction projects. There has been an increase in production in the region since 2015 but not to pre-recession levels.

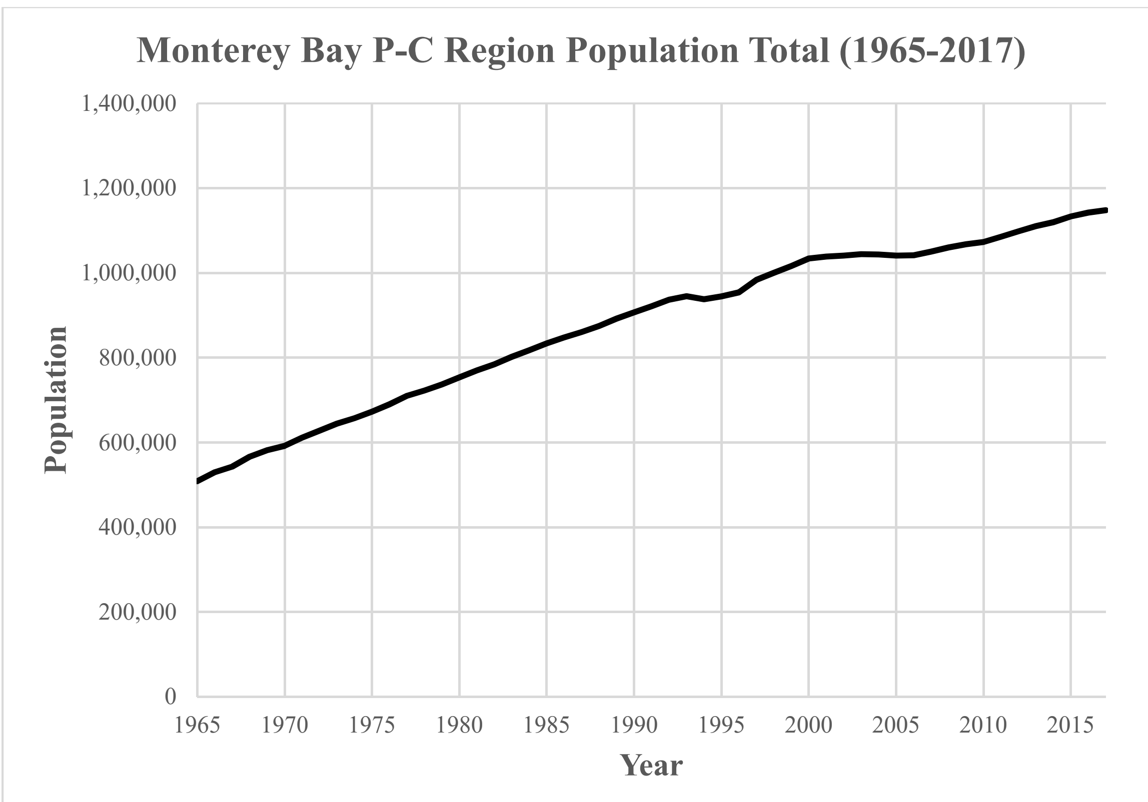

Figure 3. Monterey Bay P-C Region population total from 1965 to 2017. Data is compiled from California Department of Finance Population Statistics (E-6 and P-1 tables; estimates and projections are for fiscal year that runs July-June). Population data contains 19% of the Santa Clara County total population, based on geospatial analysis of U.S. Census data and county area contained within in the P-C Region.

One of California's largest aggregate consumption regions is the South San Francisco Bay metropolitan area (Bay Area), which includes Alameda, Contra Costa, San Francisco, Santa Clara and San Mateo counties. As increased urbanization in the Bay Area has precluded areas from mining, the reliance on domestic and international aggregate imports to meet local demand has increased. This loss of resource in the Bay Area has been supplemented by increased importing of aggregate from the Monterey Bay P-C Region. If no additional reserves become available within the Monterey Bay P-C Region, the 219 million tons of reserves are enough to supply the region until the year 2051. Once these reserves are depleted, the region will likely experience increased aggregate prices, demand will shift to neighboring P-C regions, and international imports of aggregate will increase.

Describing an area as a "Production-Consumption" region assumes that aggregate produced from deposits stay in the region, thus those deposits are only regionally significant. For Monterey Bay, approximately 41 percent of the aggregate produced leaves the region, which suggests that these deposits have statewide significance. Not all areas of the State impacted by mineral resource loss are considered when local lead agencies look to develop land designated as containing a significant mineral resource for an incompatible use. Designating deposits as only regionally significant does not consider the cascading effect that their loss has statewide. Consideration should be given to evaluating aggregate deposits based on their statewide significance.

Conclusions

This report serves as an update to the findings from SR 146 and OFR 99-01. The following is a summary of the two previous reports:

- SR 146 originally described 21 sectors in the Monterey Bay P-C Region, and 17 sectors were designated by the SMGB in 1987.
- SR 146 identified 786 million tons of construction aggregate reserves and estimated 3.1 billion tons of construction aggregate resources were available.
- OFR 99-01 described 11 additional sectors, but they were not designated by the SMGB.
- OFR 99-01 identified 269 million tons of aggregate reserves and estimated 1.21 billion tons of aggregate resources were available.

The following is a summary of findings from this report:

- Three new sectors were described, for a total of 199 million tons of construction aggregate reserves added to the region.
- Four sectors were lost to land use change, for a total of 88 million tons of aggregate reserves lost in the region.
- There are 219 million tons of permitted construction aggregate resources (reserves) within the Monterey Bay P-C Region.
- Approximately 41 percent of construction aggregate produced in the Monterey Bay P-C Region is exported to neighboring P-C regions.
- The projected aggregate demand through the year 2068 is estimated to be 332 million tons.
- If no additional reserves become available within the Monterey Bay P-C Region, the 219 million tons of reserves are estimated to supply the demand of the region until the year 2051 (average annual production of 6.6 million tons based on historic production data).
- Approximately 1.1 billion tons of construction aggregate resources underlie the Monterey Bay P-C Region.

Acknowledgements

CGS gratefully acknowledges the cooperation of local government agencies, mining organizations, and mine operators. Thank you to Janine Bird for working diligently through many iterations to create the final map plates. Thank you to Milton Fonseca for providing GIS support in the early phase of the project. And finally, many thanks to Joshua Goodwin, Brenda Callen, Ben Parrish, and Catherine Wesoloski for providing comments that greatly improved this report.

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Appendix A – Monterey Bay P-C Region Lead Agencies

This table indicates if a given lead agency has lands classified MRZ-2, designated sectors, and/or active mines within its jurisdiction.

Lead Agency	MRZ-2	Designated Sector	Active Mine(s)
Monterey County	**Yes**	**Yes**	**Yes**
Carmel-by-the-Sea	No	No	No
Salinas	No	No	No
Pacific Grove	No	No	No
Sand City	**Yes**	No	No
King City	No	No	No
Greenfield	No	No	No
Soledad	No	No	No
Gonzales	No	No	No
Monterey	**Yes**	No	No
Marina	**Yes**	**Yes**	No
Seaside	**Yes**	No	No
Del Ray Oaks	**Yes**	No	No
San Benito County	**Yes**	**Yes**	**Yes**
Hollister	**Yes**	**Yes**	No
San Juan Bautista	No	No	No
Santa Clara County	**Yes**	**Yes**	No
Gilroy	**Yes**	**Yes**	No
Morgan Hill	No	No	No
San Jose	No	No	No
Santa Cruz County	**Yes**	**Yes**	**Yes**
Santa Cruz	No	No	No
Capitola	No	No	No
Scotts Valley	**Yes**	No	No
Watsonville	No	No	No

Appendix B – Sector Descriptions Organized by County

County	Sector	Mine	Acreage	Designation Status	Source Report	Geology/Use of Material
Monterey	G	Natividad Quarry	305	Designated	SR 146	Large metasedimentary pendant composed primarily of dolomite, hosted in the granite of the Gabilan Range; dolomite is suitable for fill, subbase, and drain rock. Suitability of surrounding granite for construction aggregate is unknown.
Monterey	H	Lapis Mine	489	Designated	SR 146	Quaternary beach and dune sand of Monterey Bay; sand is suitable for PCC and AC aggregate.
Monterey	I	Jefferson Pit	1,695	Designated	SR 146	Quaternary dune sand deposit suitable for AC and PCC aggregate.
Monterey	J	No Mine	174	Designated	SR 146	Cretaceous quartz diorite; fresh unweathered diorite is suitable for AC and possibly PCC aggregate
Monterey	K	No Mine	51	Designated	SR 146	Holocene stream channel and terrace deposits of the Carmel River; suitable for AC and PCC aggregate.
Monterey	N	Metz Quarry	42	Designated	SR 146	Quaternary stream channel and flood plain deposits of Chalone Creek, 85% volcanic (rhyolite), with minor quartzite, limestone, sandstone, schist, and siliceous shale; products are PCC, plaster, and fill sand.
Monterey	O	Chalone Creek	40	Designated	SR 146	Quaternary stream channel and flood plain deposits of Chalone Creek, 85% volcanic (rhyolite), with minor quartzite, limestone, sandstone, schist, and siliceous shale; products are PCC, plaster, and fill sand.
Monterey	P	Clark Pit	192	Designated	SR 146	Holocene stream channel deposits of the San Lorenzo River, which consists of Franciscan lithology, including serpentinite, chert, glaucophane schist, gabbro, and metagraywacke; used mainly for ACC, base, and fill.
Monterey	V	Stonewall Canyon	92	Not Designated	OFR 99-01	Mesozoic granite of the Gabilan Range used for subbase, road base, drain rock, riprap, and sand for agricultural applications.
Monterey	W	Handley Ranch Quarry	352	Not Designated	SR 251	Mesozoic granite of the Gabilan Range; suitable for AC and PCC aggregate.
Monterey	X	Hidden Canyon Quarry	428	Not Designated	SR 251	Mesozoic granite and metasedimentary pendants, including marble and quartzite, of the Gabilan Range; suitable for AC and PCC aggregate.
San Benito	E-1	San Juan Pit	226	Designated	SR 146	Holocene stream channel and terrace deposits of the San Benito River and Tres Pinos Creek; this area is the main source of PCC-grade material for the Monterey Bay PC region.
San Benito	E-2	Bixby	836	Designated	SR 146	Holocene stream channel and terrace deposits of the San Benito River and Tres Pinos Creek; this area is the main source of PCC-grade material for the Monterey Bay PC region.
San Benito	E-3	Sandman	171	Designated	SR 146	Holocene stream channel and terrace deposits of the San Benito River and Tres Pinos Creek; this area is the main source of PCC-grade material for the Monterey Bay P-C region.

County	Sector	Mine	Acreage	Designation Status	Source Report	Geology/Use of Material
San Benito	E-4	No Mine	388	Designated	SR 146	Holocene stream channel and terrace deposits of the San Benito River and Tres Pinos Creek; this area is the main source of PCC-grade material for the Monterey Bay P-C region.
San Benito	E-5	Sand Benito Sand Plant	126	Designated	SR 146	Holocene stream channel and terrace deposits of the San Benito River and Tres Pinos Creek; this area is the main source of PCC-grade material for the Monterey Bay P-C region.
San Benito	E-6	No Mine	217	Designated	SR 146	Holocene stream channel and terrace deposits of the San Benito River and Tres Pinos Creek; this area is the main source of PCC-grade material for the Monterey Bay P-C region.
San Benito	F-1	A.R. Wilson Quarry	300	Designated	SR 146	Jurassic quartz gabbro fractured by the main strand of the San Andreas fault; suitable for AC and PCC aggregate.
San Benito	F-2	No Mine	268	Not Designated	OFR 99-01	Jurassic quartz gabbro fractured by the main strand of the San Andreas fault; suitable for AC and PCC aggregate.
San Benito	Y	Williams Quarry	41	Not Designated	OFR 99-01	Upper to Middle Pliocene Purisima Formation (non-marine?), fine- to medium-grained, poorly consolidated pebbly sandstone; mined predominately for fill sand, could meet concrete aggregate specifications if washed.
San Benito	Z	Lomerias Muertas Quarry	53	Not Designated	OFR 99-01	Upper to Middle Pliocene Purisima Formation (non-marine?), fine- to medium-grained, poorly consolidated pebbly sandstone; coarser percentage is suitable for PCC, finer sands are suitable for fill.
San Benito	AA	SCL/Bolsa Mine	159	Not Designated	OFR 99-01	Pressure ridge created by the San Andreas fault, composed of Quaternary San Benito Formation, unconsolidated light grey sand, gravel, and silt; suitable for Class II aggregate base.
San Benito	AB	No Mine	69	Not Designated	OFR 99-01	Pre-Cretaceous metasedimentary pendants within Mesozoic granite of the Gabilan Range; suitable for AC and PCC aggregate.
San Benito	AC	Harris Quarry	17	Not Designated	OFR 99-01	Lenses of crystalline limestone; Graniterock mined this area from 1986-87, used for Class II base, but may meet PCC-grade specifications.
San Benito	AD	Southside Sand and Gravel; and Paicines Quarries	810	Not Designated	OFR 99-01	Holocene stream channel and terrace deposits of Tres Pinos Creek; suitable for AC and PCC aggregate.
San Benito	AE	Dolomite Quarry	83	Not Designated	OFR 99-01	Dolomite in pre-Cretaceous metasedimentary pendent within Mesozoic granite of Gabilan Range; suitable for base rock and construction aggregate.
Santa Clara	D-1	No Mine	90	Designated	SR 146	Holocene stream channel and terrace deposits of Uvas Creek; suitable for AC and PCC aggregate.
Santa Clara	D-2	No Mine	148	Designated	SR 146	Holocene stream channel and terrace deposits of Uvas Creek; suitable for AC and PCC aggregate.
Santa Clara	D-3	No Mine	277	Designated	SR 146	Holocene stream channel and terrace deposits of Uvas Creek; suitable for AC and PCC aggregate.

County	Sector	Mine	Acreage	Designation Status	Source Report	Geology/Use of Material
Santa Clara	U-1	No Mine	459	Designated	SR 146	Holocene stream channel and terrace deposits of Pacheco Creek; suitable for AC aggregate.
Santa Clara	U-2	No Mine	38	Designated	SR 146	Holocene stream channel and terrace deposits of Pacheco Creek; suitable for AC aggregate.
Santa Clara	U-3	No Mine	46	Designated	SR 146	Holocene stream channel and terrace deposits of Pacheco Creek; suitable for AC aggregate.
Santa Clara	AF	No Mine	91	Not Designated	OFR 99-01	Greenstone within Late Jurassic to Cretaceous Franciscan Formation; suitable for AC aggregate.
Santa Clara	AG	Freeman Quarry	59	Not Designated	OFR 99-01	Brecciated greenstone within Late Jurassic to Cretaceous Franciscan Formation; suitable for AC and PCC aggregate.
Santa Clara	AH	No Mine	752	Not Designated	SR 251	Quaternary marine and non-marine conglomerate, sandstone, and siltstone (probably Pliocene Etchegoin Formation); suitable for AC and PCC aggregate.
Santa Cruz	A	Felton Quarry	265	Designated	SR 146	Cretaceous quartz diorite and metasediments; suitable for PCC and AC aggregate.
Santa Cruz	B-1	Quail Hollow	188	Designated	SR 146	Friable yellow-gray marine sand of the Upper Miocene Santa Margarita Formation; material from Santa Margarita Formation in this area has been used for PCC for 80+ years.
Santa Cruz	B-2	Olympia	140	Designated	SR 146	Friable yellow-gray marine sand of the Upper Miocene Santa Margarita Formation; material from Santa Margarita Formation in this area has been used for PCC for 80+ years.
Santa Cruz	B-3	Felton Plant	255	Designated	SR 146	Friable yellow-gray marine sand of the Upper Miocene Santa Margarita Formation; material from Santa Margarita Formation in this area has been used for PCC for 80+ years.
Santa Cruz	C	Wilder Sand Plant	232	Designated	SR 146	Friable yellow-gray marine sand of the Upper Miocene Santa Margarita Formation; material from Santa Margarita Formation in this area has been used for PCC for 80+ years.
Santa Cruz	L	Olive Springs Quarry	45	Designated	SR 146	Cretaceous quartz diorite; used for PCC, AC, base, and fill.
Santa Cruz	M	Cabrillo Sand and Gravel	24	Designated	SR 146	Pleistocene Aromas Formation, semi-consolidated fluvial and aeolian sands and gravels; used for PCC, base, fill, and drain rock.

Appendix C – Historic Production (1965 – 2017)

Year	Historic Production (in tons)
1965	6,700,000
1966	6,200,000
1967	7,050,000
1968	5,950,000
1969	6,950,000
1970	5,700,000
1971	6,750,000
1972	8,300,000
1973	7,300,000
1974	7,500,000
1975	6,350,000
1976	6,350,000
1977	8,100,000
1978	9,150,000
1979	9,450,000
1980	7,250,000
1981	6,338,000
1982	6,174,000
1983	6,563,000
1984	7,692,000
1985	8,144,000
1986	8,153,000
1987	7,940,000
1988	7,705,000
1989	7,658,000
1990	7,527,000
1991	6,167,000
1992	6,142,000
1993	6,166,000
1994	6,158,000
1995	7,066,000
1996	7,369,000
1997	7,681,000
1998	9,034,210
1999	9,009,048
2000	8,370,193
2001	8,062,034
2002	7,038,675
2003	6,710,996
2004	6,411,117
2005	5,903,911
2006	6,443,551
2007	7,209,527
2008	4,549,049
2009	3,544,789
2010	3,523,896
2011	3,371,157
2012	3,837,897
2013	3,917,517
2014	3,653,638
2015	4,925,080
2016	5,098,740
2017	5,123,316

Appendix D – Historic Population Totals (1965 – 2017)

Year	Total
1965	508,608
1966	529,869
1967	542,801
1968	566,234
1969	581,628
1970	591,875
1971	611,045
1972	627,739
1973	644,232
1974	657,200
1975	672,657
1976	690,112
1977	709,975
1978	722,384
1979	736,969
1980	753,438
1981	769,956
1982	784,304
1983	802,110
1984	817,629
1985	833,795
1986	847,724
1987	860,722
1988	874,854
1989	892,426
1990	907,107

1991	921,372
1992	936,840
1993	945,233
1994	937,758
1995	944,860
1996	954,051
1997	983,734
1998	1,000,118
1999	1,016,541
2000	1,034,015
2001	1,038,828
2002	1,041,089
2003	1,044,421
2004	1,043,659
2005	1,040,761
2006	1,041,887
2007	1,050,399
2008	1,060,104
2009	1,067,824
2010	1,072,965
2011	1,085,482
2012	1,098,227
2013	1,110,458
2014	1,119,653
2015	1,133,478
2016	1,142,496
2017	1,148,069