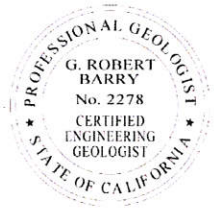
State of California | California Natural Resources Agency

Memorandum

Date: August 7, 2015

Project Geology
Report No. 90-00-05

To: Linus Paulus, Chief
State Water Project Acquisitions Section



From: G. Robert Barry, Chief
Project Geology Section
Department of Water Resources

Subject: Mineral Remoteness Evaluation, Parcel APN 0090-210-140, Decker Island, Solano County, California

Executive Summary

The Mineral Remoteness Evaluation for APN 0090-210-140 (parcel) on Decker Island is detailed below. This evaluation is based on a review of the surface mining potential of the property and additional regional data. This review includes a comprehensive search of oil and gas databases and mineral resource zone (MRZ) maps of geologic resources.

Based on this research, we conclude that the likelihood of economic resource removal on the parcel of interest on Decker Island is 'so remote as to be negligible'.

Introduction

Decker Island is located immediately east of the Sacramento River Deep Water Ship Channel, approximately 35 miles south of downtown Sacramento, and 20 miles southeast of Fairfield, in Solano County, California. One parcel on the island is being considered for a conservation easement by DWR. The parcel is about 140 acres in size and is presently owned by the Sacramento-Yolo Port District.

The location and Assessor's parcel map for Decker Island are shown on Figure 1 and Figure 2, respectively. A map of the regional setting is shown on Figure 3.

The mineral rights associated with the parcel are severed. This means that the property owners do not own all the mineral rights on or under the parcel proposed for the conservation easement. For this reason limiting surface mining and subsurface oil or gas extraction (surface mining) in the future is a key restriction of the conservation easement. Internal Revenue Service regulations deny deductibility of a charitable donation unless the possibility of surface mining is found by a professional geologist to be 'so remote as to be negligible.'

This mineral remoteness evaluation (assessment) has been prepared to evaluate the 'so remote as to be negligible' condition for Decker Island. The assessment and opinions included in this Memorandum are based on a review of the surface mining

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potential over the island. We also consider gas well production data and geologic information from adjacent areas. This mineral remoteness evaluation was conducted by John Curless in the Project Geology Section.

Data Sources

The following data sources were reviewed to identify potential mineral deposits on the property:

Surface Mineral Data

The Department of Conservation's (DOC) California Geological Survey (CGS) provides objective geologic expertise and information about California's diverse non-fuel mineral resources. CGS's maps, reports, and other data products assist in recognizing, developing, and protecting important mineral resources.

CGS manages a program that provides objective economic geologic expertise to assist in the protection and development of mineral resources through the land-use planning process. The program is mandated by the Surface Mining and Reclamation Act of 1975 (SMARA). The primary products are mineral land classification maps and reports. Local agencies are required to use the classification information when developing land-use plans and when making land-use decisions.

CGS has not classified land on Decker Island as having any mineral resource significance. They evaluated the land, and considered the land as not having any mineral resources of significance.

Oil and Gas Data

Databases are maintained by the U.S. Geological Survey (USGS) and DOC's – Division of Oil, Gas, and Geothermal Resources (DOGGR) for classification of oil and gas resources.

The oil and gas data are available in a web-based searchable format at the following locations. USGS Fact Sheet 2007-3014 presents an assessment of undiscovered natural gas resources of the Sacramento Basin Province of California. The fact sheet is available online at http://pubs.usgs.gov/fs/2007/3014/.

DOGGR's gas, and geothermal resources well finder is available online at http://www.conservation.ca.gov/dog/Pages/Wellfinder.aspx. Figure 4 shows the

location of Decker Island and the seven gas well locations within the parcels of interest from the DOGGR well finder database.

Important Farmland Data

The DOC's Division of Land Resource Protection (DLRP) Farmland Mapping and Monitoring Program (FMMP) produces maps and statistical data used for analyzing impacts on California's agricultural resources. Agricultural land is rated according to soil quality and irrigation status; the best quality land is called "Prime Farmland". The maps are updated every two years with the use of a computer mapping system, aerial imagery, public review, and field reconnaissance.

The Important Farmland data is available in a web-based searchable format, the California Important Farmland Finder. Figure 5 shows the location of Decker Island and surrounding land classification on DLRP's Important Farmland finder. This figure shows that some land bordering Decker Island has been classified as "Prime Farmland". However, Decker Island itself has been classified as "Other Land". Consequently, it is not considered "Prime Farmland".

General Description

Solano County extends from San Pablo Bay in the west to the Central Valley in the east, and is centrally located between the San Francisco and Sacramento metropolitan regions. The county encompasses approximately 910 square miles consisting of 830 square miles of land and 80 square miles of water. Approximately 128 square miles of the county, or 14 percent of the total land area, lies within seven incorporated cities: Benicia, Dixon, Fairfield, Rio Vista, Suisun City, Vacaville, and Vallejo.

Solano County lies at the intersection of numerous geographical and geological provinces that, together with variations in hydrology and climate, have resulted in the formation of unique and rare biological and ecological conditions and a rich diversity of native species and habitats. Solano County is home to both natural gas deposits and valuable wind resources. Its soils and water resources contribute to a rich agricultural landscape.

Surface mineral resources in Solano County are confined principally to the Coast Range. The county has several inactive mercury mines there, which are subject to ongoing environmental monitoring. These mines were active in the first half of the twentieth century. Subsurface resources (oil and gas) are found in certain areas throughout the valley. Most of the alluvial soils on the valley floor have a high agricultural productivity and are largely designated as "Prime Farmland".

Regional Geology

Solano County is located along the western edge on the Great Valley geomorphic province of California. The Great Valley is an alluvial plain approximately 50 miles wide and 400 miles long in the central portion of California. The Great Valley's northern portion is the Sacramento Valley, drained by the Sacramento River, and its southern portion is the San Joaquin Valley, drained by the San Joaquin River. The geology of the Great Valley is typified by thick sequences of alluvial sediments derived primarily from erosion of the mountains of the Sierra Nevada to the east, and to a lesser extent, erosion of the Klamath Mountains and Cascade Range to the north.

Sacramento Valley natural gas fields are found primarily in Cretaceous and Tertiary age sedimentary deposits. Hydrocarbons are contained within structural traps where channel sands cross over geologic structural highs. Sea levels fluctuated during deposition, creating an alternating sequence of marine and non-marine sands and shales forming the reservoirs and cap rock present today.

Decker Island is located within the Sacramento-San Joaquin River Delta (Delta), which is an expansive inland river delta and estuary. The Delta formed at the western edge of the Central Valley at the confluence of the Sacramento and San Joaquin rivers. The Delta lies east of where the rivers enter at the head of Suisun Bay. The total area of the Delta, including both land and water, is about 1,100 square miles.

The Delta was formed by a rise in sea level following glaciation. This led to the accumulation of Sacramento and San Joaquin River sediment behind the Carquinez Strait, the sole outlet from the Central Valley to the San Pablo and San Francisco Bays and the Pacific Ocean. The narrowness of the Carquinez Strait coupled with tidal action has caused the sediment to accumulate and form expansive islands. Geologically, the Delta has existed for about 10,000 years, since the end of the last Ice Age. In its natural state, the Delta was a large freshwater marsh, consisting of many shallow channels and sloughs surrounding low islands of peat and tule.

Site Geology

Decker Island is located just east of the Sacramento River Deep Water Ship Channel. Most of the island consists of open grassland, formerly used for crop production; tidal berm; and managed wetland, including open water features.

Figure 3 shows the regional setting of Decker Island. The geology and topography of the area reflect the lowlands of the delta, which include alluviated tideland and marshland of the Sacramento River and associated man-made channels and sloughs.

Strata ranging in age from late Eocene (Nortonville and Markley formations) to Miocene and Pliocene time (nonmarine deposits). Dips vary widely, but mostly east dips ranging from 30 to 80 degrees. Soils in the area are derived from these weathered deposits. Most of the soils are silt loams, clays, and sands.

Surface Mineral and Natural Gas Resources

The Central Valley of California is rich in several mineral resources of economic interest. These resources include: construction aggregate (sand and gravel), oil and gas, precious metals, clay, gypsum, and other limited deposits. In the vicinity of Decker Island the most important mineral resource is natural gas.

Sand and Gravel Resources

In the Sacramento Valley, sand and gravel represent major economic natural resources. Sand and gravel used as construction aggregate are extracted from young stream deposits associated with present rivers and creeks. In addition, deposits are found along riverbanks, on flood plains, and in alluvial fans from former channels. Aggregate is also extracted from old gold dredge tailings near the Sierra foothills. The most common mineral resource in the region is aggregate, in the form of sand and gravel, which is used for road base and in production of Portland cement concrete.

CGS is the agency responsible for designating potential sand and gravel resource areas. Under the 1975 State Mining and Reclamation Act (SMARA), areas of economic interests are designated. No specific sand and gravel resources are currently designated under SMARA on or near Decker Island. No active surface mineral resources would be affected by the proposed conservation easement.

While an adjacent parcel is considered a mine under SMARA, it is producing material that was stockpiled on site from past dredging activities for the Sacramento River Deep Water Ship Channel. Decker Island (DI) Aggregate produces sand and clay and creates a custom blend of materials prior to shipping by barge to one of their load out facilities for delivery.

None of the land on Decker Island was identified within the CGS mineral land classification zones for Portland cement concrete-grade aggregate, or within any of the mineral resource zones identified by CGS. Therefore, based upon the CGS report, it is unlikely that any source of material on site would be mined in view of other large higher-quality regional sources.

Natural Gas Resources

The Sacramento Valley is a natural gas province. Numerous gas fields are located throughout the valley. Oil and gas exploration in the Central Valley began in the mid-1800s. Most fields in the Sacramento Valley produce "dry" gas, with minimal heavier gas components or petroleum liquids. Natural gas fields are located in the central and eastern parts of Solano County, which includes Decker Island (Figure 4).

USGS National Oil and Gas Assessment (NOGA)

NOGA assesses the natural gas reserves and the reserve growth potential of the United States. The USGS Central Energy Team provides periodic assessments of the oil and natural gas resources of the United States. The Energy Program uses a total petroleum systems approach to evaluate the probable presence of undiscovered subsurface accumulations of oil and natural gas resources in the United States and around the world. Using this approach, research projects provide the basis for estimating resource volumes in conventional and unconventional (continuous) oil and natural gas accumulations, including coal-bed methane, and gas from low-permeability geologic units. These scientific activities yield geologically based estimates of undiscovered, technically recoverable oil and gas resources. The website (http://energy.usgs.gov/OilGas/AssessmentsData/NationalOilGasAssessment.aspx) includes an online interactive mapping system that displays the results of the assessments including oil and gas cell locations, gas assessment units, and surface geology.

The Sacramento Basin Province (Code: 5009) forms the northern half of California's Central Valley. It is an elongate, northwest-trending structural trough filled with more than 20,000 feet of Early Cretaceous (~145 to 100 million years old) and younger marine and nonmarine sedimentary rocks. The Sacramento Basin oil and gas province has been extensively explored for petroleum resources, and more than nine trillion cubic feet of natural gas have so far been produced.

The USGS recently completed a new assessment of undiscovered natural gas resources of the Sacramento Basin Province of California. Using a geology-based assessment methodology, the USGS mean estimates of undiscovered, technically recoverable resources are 534 billion cubic feet of natural gas and 323 thousand barrels of natural gas liquids in the Sacramento Basin Province. Additional undiscovered oil accumulations larger than 0.5 million barrels are considered unlikely.

DOC - DOGGR

DOGGR oversees the drilling, operation, maintenance, and plugging and abandonment of oil, natural gas, and geothermal wells. The regulatory program emphasizes the wise development of oil, natural gas, and geothermal resources in the state through sound engineering practices that protect the environment, prevent pollution, and ensure public safety. Online maps (http://www.conservation.ca.gov/dog/Pages/Index.aspx) were created to provide access to the DOGGR database via the Internet. The website provides access to production data and detailed geothermal well data including an inventory of new, active, dual, plugged, and geothermal well locations.

Table 1 lists the details of the seven wells located near Decker Island. Figure 4 shows their locations relative to the island. Table 1 lists DOGGR's gas well number and status, as well as the date the well was drilled (Spud Date) and when it was plugged (Abandonment Date). The operator of the gas well is also given. Table 1 shows that all of the gas wells nearest Decker Island no longer produce and are plugged.

Table 1: List of Gas Wells near Decker Island.

Gas Well #	Status	Spud Date	Abandonment Date	Operator
09520093	Plugged	6/11/1969	9/12/1979	Chevron U.S.A.
09520154	Plugged	9/21/1971	10/18/1971	Phillips Petroleum
06700248	Plugged	10/24/1952	11/7/1952	Amerada Hess Corp
06720039	Plugged	11/14/1970	11/26/1970	Phillips Petroleum
06720343	Plugged	9/10/1999	1/24/2002	Output Exploration LLC
06720045	Plugged	8/3/1971	8/16/1971	Phillips Petroleum
06720307	Plugged	12/31/1995	3/4/1996	Amerada Hess Corp

The DOGGR website shows that the gas wells located near Decker Island are associated with the Rio Vista and Sherman Island Gas Fields. Figure 6 shows that the Rio Vista Gas Field is the largest in California. However, this field has been in steady decline over recent years as shown in Figure 6 (2010 to 2014 data) and Figure 7 (1977 to 1998 data).

Production records for the Sherman Island Gas Field are shown in Figure 8. The most recent data are from 1977 to 1998 and show that only one to two wells were producing gas in a steady decline over those years.

Figure 9 shows the Rio Vista Gas Field in relation to Decker Island. A transparency of a plan view of the geology was combined with the gas field limits. The figure shows that

Decker Island is at the southwest margin of the geologic structure controlling the gas field production zone. Based on the fact that Decker Island is located adjacent to a depleted gas field and all seven wells within the vicinity of the parcel of interest have been plugged since at least 2002, it is unlikely that any source of natural gas would be produced in view of other significantly larger regional sources.

Overall Conclusions and Opinion

Based upon review of the geologic resources and economic conditions, surface and subsurface minerals identified on the parcel discussed herein are unlikely to be mined because:

There is an overabundance of sand and gravel deposits in the region, which are closer to consumers. Decker Island is located in a wet area and is small in size. DI Aggregate produces from an adjacent property from past imported material (dredge spoil) stockpiled on site. Based on the property's size and location future extraction of sand and gravel is unlikely.

Gas wells on the parcel of interest on Decker Island are unlikely to come into future commercial production because (1) there are no gas wells nor gas delivery infrastructure on Decker Island, (2) the location of the parcel is on a non-productive margin of the Rio Vista Gas Field and, (3) the Sherman Island Gas Field has steadily declined over recent years.

Based on these criteria, the likelihood of economic mineral resource removal at the time of this assessment is so remote as to be negligible.

Thank you for allowing Project Geology to assist with this project. If you have any questions or need additional information, please contact John Curless at 916-376-9877 or me at 916-376-9874.

cc: Joe Royer, 510-1

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Hosford Scheirer, Allegra; Tennyson, Marilyn E.; Magoon, Leslie B.; Charpentier, Ronald R.; Cook, Troy A.; Klett, Timothy R.; Pollastro, Richard M.; and Schenk, Christopher J., 2007, Assessment of undiscovered natural gas resources of the Sacramento Basin Province of California, 2006: U.S. Geological Survey Fact Sheet 2007-3014. Available online at: http://pubs.usgs.gov/fs/2007/3014/

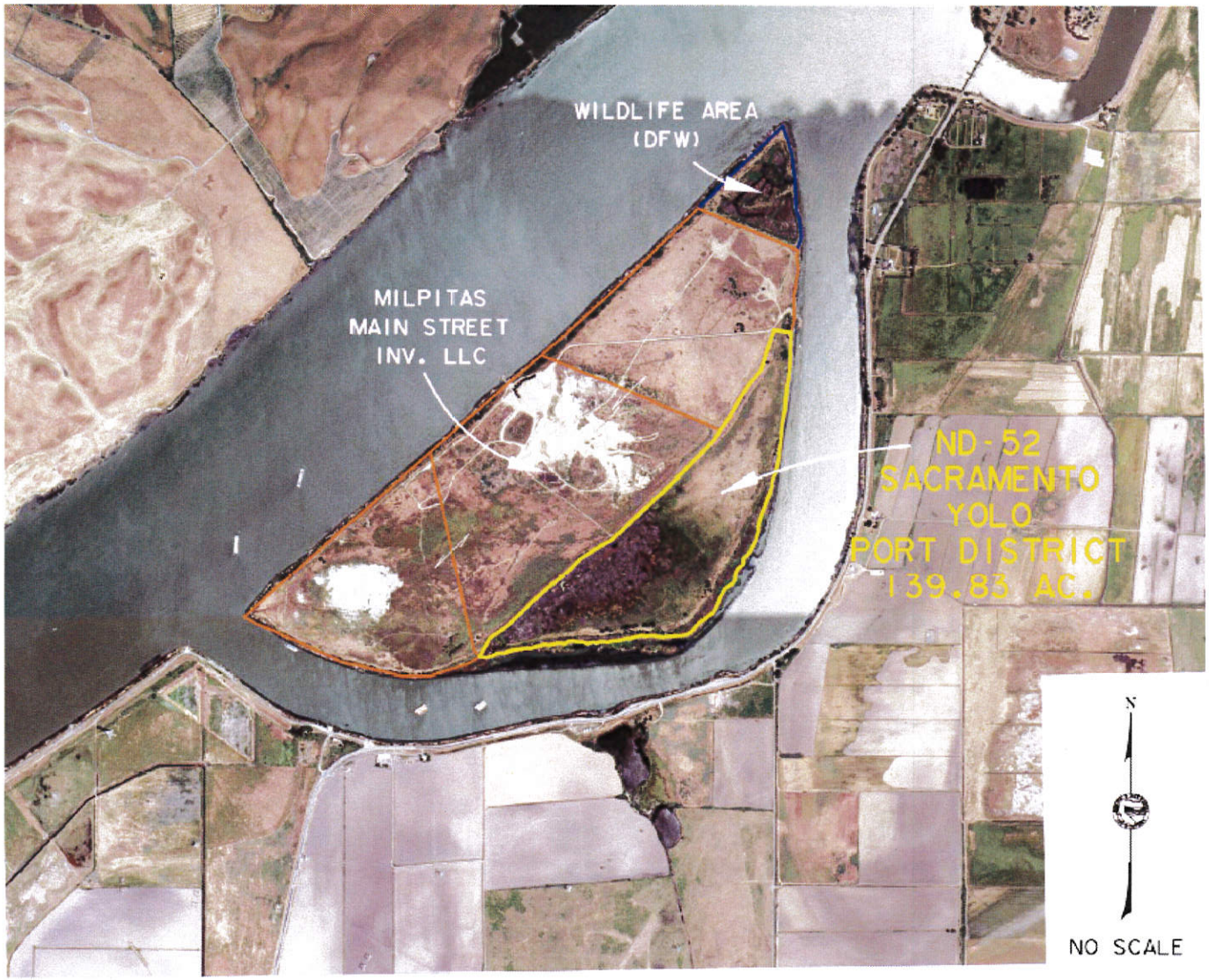


Figure 1: Location map for the Sacramento-Yolo Port District parcel on Decker Island.

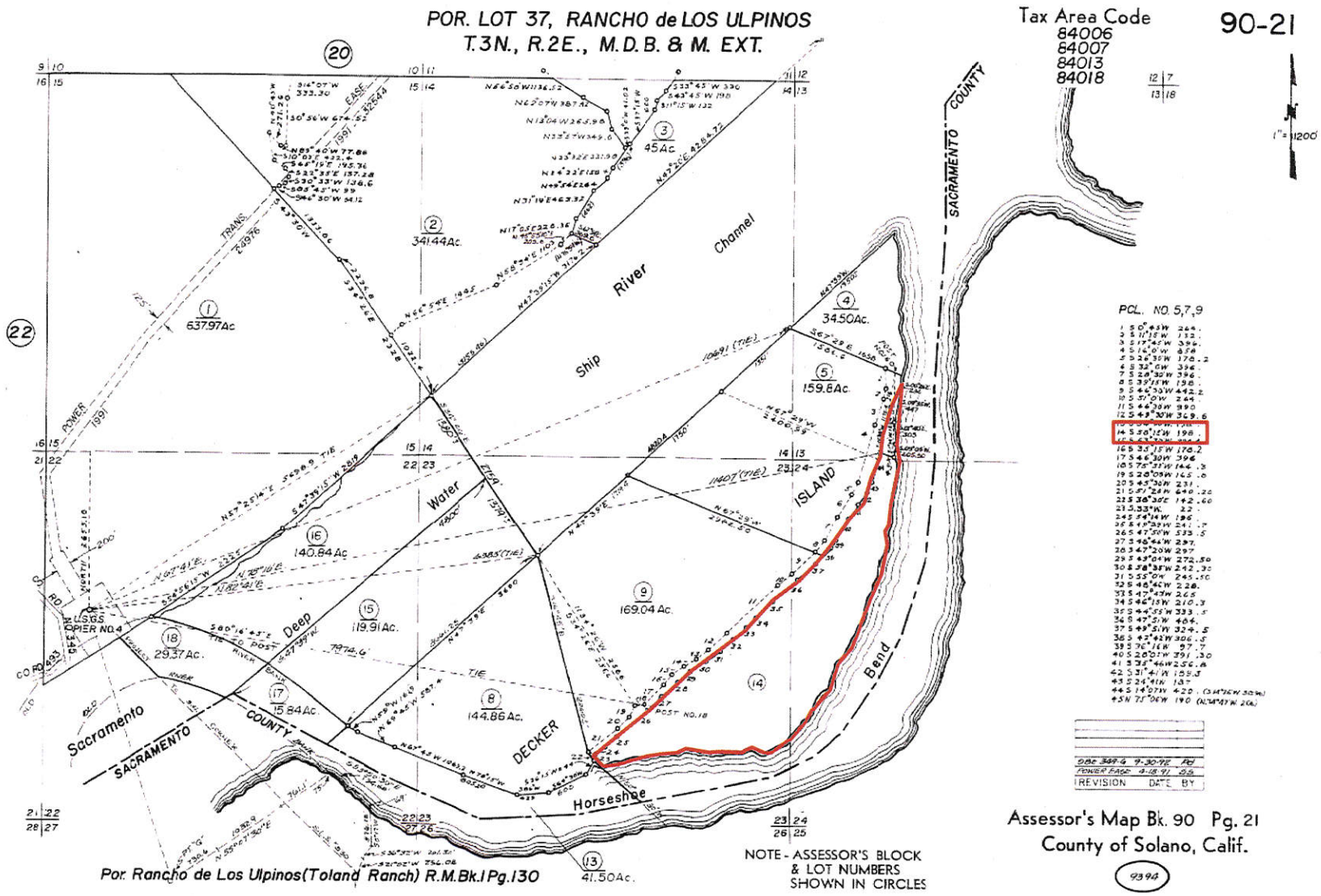


Figure 2: Parcel map for Decker Island. The Sacramento-Yolo Port District parcel is outlined.

Figure 3: Regional setting of Decker Island.

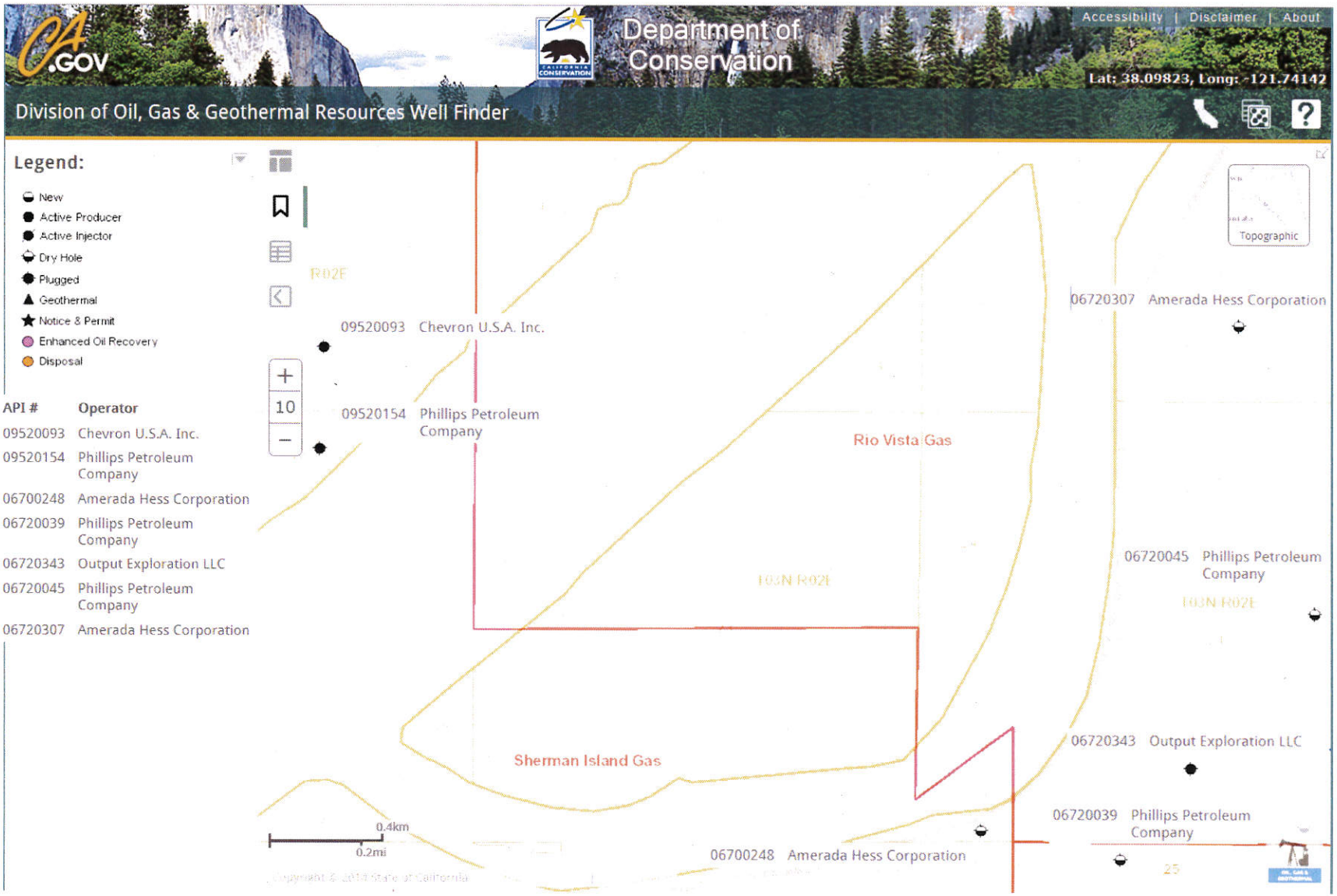


Figure 4: Location map for gas wells near Decker Island. The Rio Vista and Sherman Island Gas Fields are labeled.

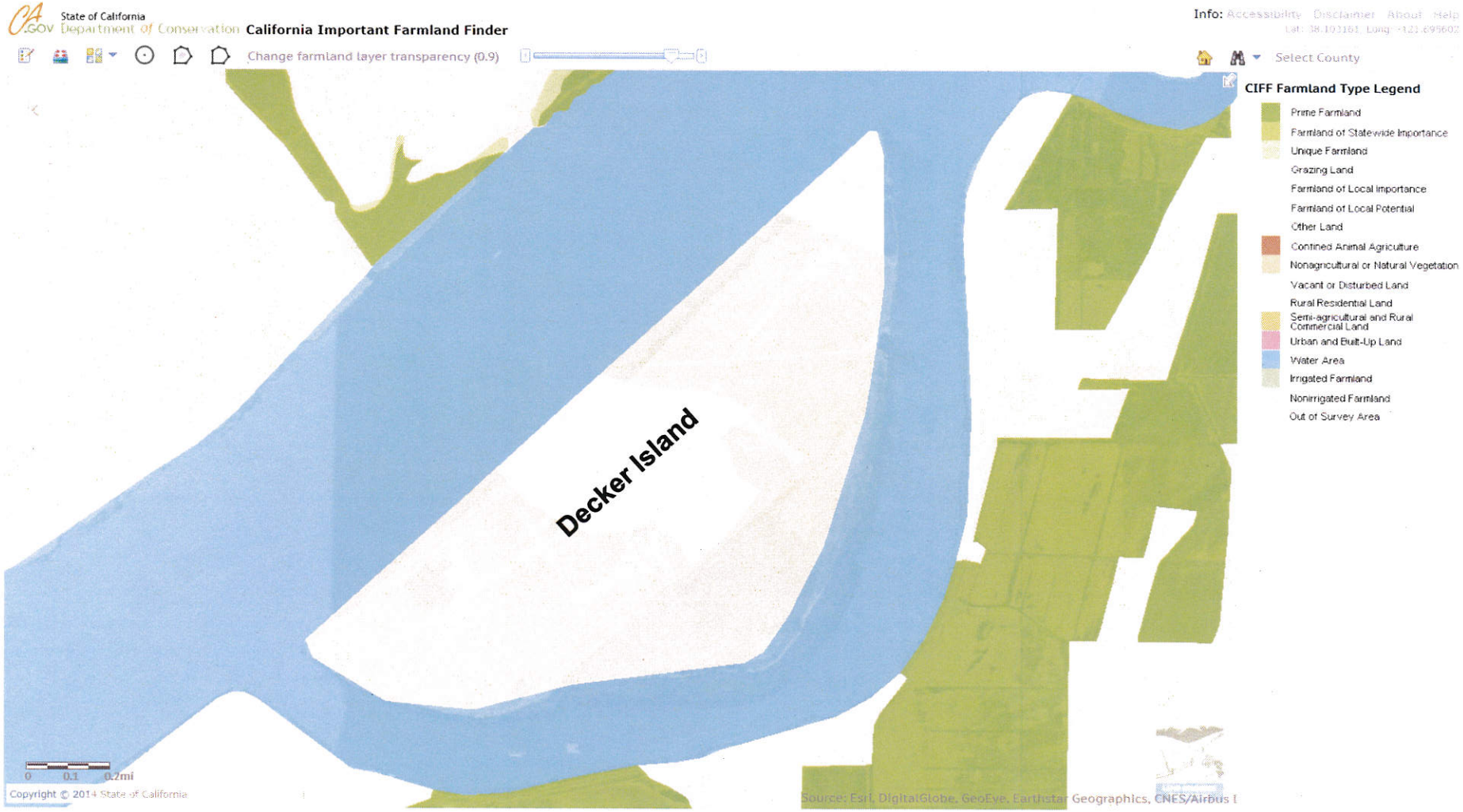


Figure 5: Location of Important Farmland near Decker Island.

Net Gas Production By Year (billions of cubic feet)

Largest Fields

Associated Gas	2014	2013	2012	2011	2010
Elk Hills	80.8	88.2	93.0	96.7	110.7
Buena Vista	11.0	8.4	5.0	2.3	3.2
Belridge, South	8.5	8.8	9.7	10.4	10.7
Lost Hills	7.3	9.0	8.5	8.0	8.0
Midway-Sunset	5.0	5.2	4.9	5.0	4.6

Largest Fields

Nonassociated Gas	2014	2013	2012	2011	2010
Rio Vista Gas	8.5	9.8	10.7	10.3	14.1
Willows-Beehive Bend Gas	4.3	5.3	7.7	8.9	10.4
Grimes Gas	4.1	5.0	8.0	10.1	9.2
Sutter Buttes Gas	2.5	3.1	4.1	5.4	4.2
West Grimes Gas	1.4	1.6	2.4	1.6	1.4

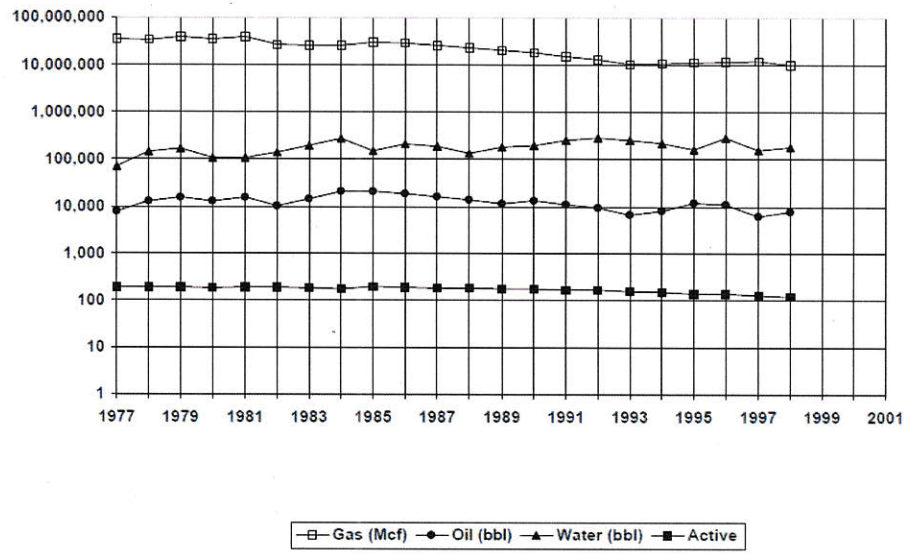
Note: Associated Gas is a form of natural **gas** which is found with deposits of petroleum, either dissolved in the oil or as a free "**gas** cap" above the oil in the reservoir. Non Associated Gas reserves are developed primarily to produce natural gas. There may or may not be condensate production together with the gas. Natural gas that is not in contact with significant quantities of crude oil in the reservoir.

Data from: California Department of Conservation, Division of Oil, Gas, and Geothermal Resources. Preliminary report of California oil and gas Production statistics. Sacramento, California. July 2014. Available online at ftp://ftp.consrv.ca.gov/pub/oil/annual_reports/2014/PR03_PreAnnual_2014.pdf

Figure 6: Net gas production by year for the largest fields in California. The Rio Vista Gas Field is highlighted.

Rio Vista Gas

Year	Gas (Mcf)	Oil (bbl)	Water (bbl)	Wells	
				Active	Idle
1977	34,667,479	7,811	70,839	195	27
1978	33,825,928	12,665	146,075	193	28
1979	38,886,256	15,486	166,555	193	26
1980	34,106,735	12,706	107,583	186	37
1981	38,350,952	15,289	105,100	189	36
1982	26,697,591	10,058	136,297	194	28
1983	25,504,026	14,362	197,288	186	47
1984	25,953,797	20,518	273,789	176	61
1985	29,581,068	20,684	149,736	199	40
1986	29,165,380	18,639	209,089	190	41
1987	25,166,583	15,813	187,922	184	45
1988	22,559,738	13,691	135,626	188	41
1989	20,124,623	11,408	178,796	181	51
1990	18,137,090	13,330	197,663	177	52
1991	15,094,851	10,826	253,097	170	56
1992	13,164,258	9,608	281,606	171	53
1993	10,495,063	6,744	252,274	161	59
1994	10,751,818	7,982	222,143	151	70
1995	11,020,308	11,939	158,252	140	83
1996	11,690,832	10,999	280,525	140	86
1997	11,839,631	6,314	153,796	131	96
1998	9,937,356	7,700	180,413	121	100



Data from California Department of Conservation, Division of Oil, Gas, and Geothermal Resources. Northern California Oil and Gas Fields Annual Production Data 1977-1998. Sacramento, California. 1999. Available online at ftp.consrv.ca.gov/pub/oil/annual reports/2014/PR03_PreAnnual_2014.pdf

Figure 7: Production records for the Rio Vista Gas Field from 1977 to 1988.

Sherman Island Gas

Year	Gas (Mcf)	Oil (bbl)	Water (bbl)	Wells	
				Active	Idle
1977	714,947	1,375	19,110	6	6
1978	520,997	1,090	11,081	5	7
1979	575,589	930	11,387	5	7
1980	497,018	1,564	11,403	6	5
1981	363,714	1,617	16,347	4	5
1982	127,325	129	9,103	2	6
1983	232,062	249	8,524	2	4
1984	147,181	21	4,738	2	2
1985	119,259	8	2,635	2	3
1986	112,473	26	1,782	4	1
1987	59,902	545	13	2	2
1988	39,018	0	187	2	2
1989	51,474	51	290	1	3
1990	38,645	197	392	1	3
1991	30,566	21	563	1	3
1992	36,106	5	533	1	3
1993	39,181	0	832	2	2
1994	53,183	0	2,125	1	1
1995	30,595	0	1,856	1	2
1996	250,436	0	1,556	2	1
1997	144,415	0	7,542	2	1
1998	23,015	0	5,023	2	1

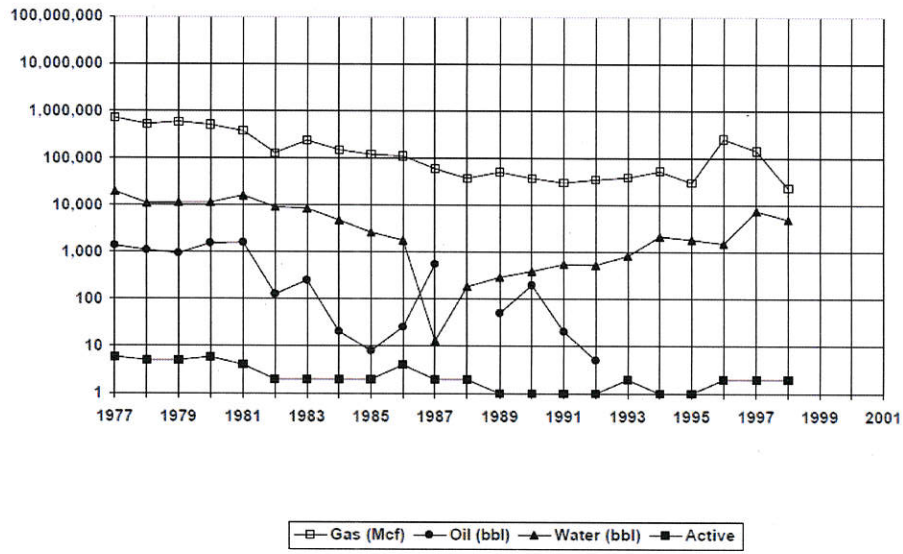


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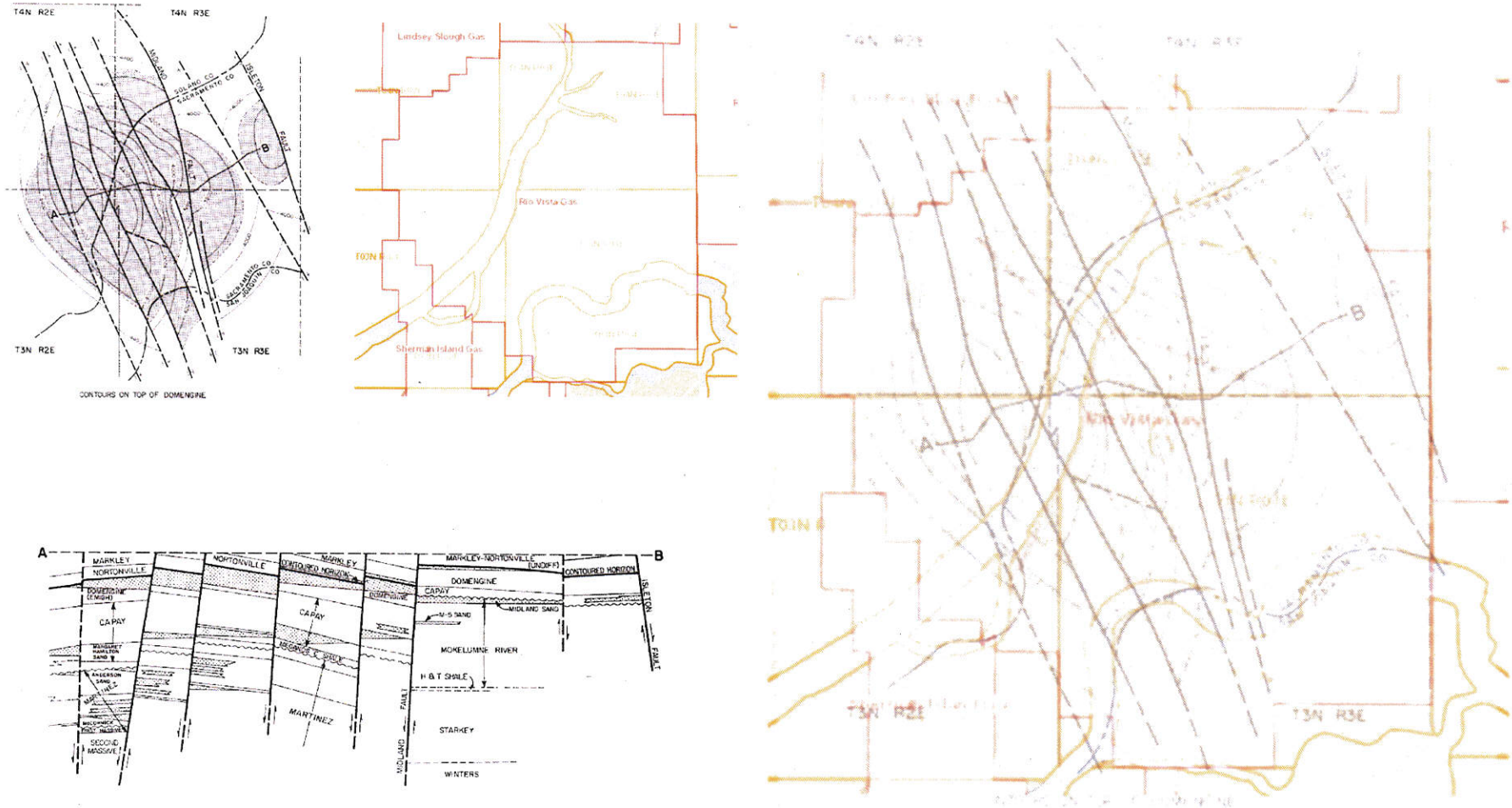
Figure 8: Production records for the Sherman Island Gas Field from 1977 to 1988.



Plan view and profile from California Department of Conservation, Division of Oil, Gas, and Geothermal Resources. California Oil and Gas Fields, Northern California, Sacramento, California, Fourth Edition 1982. Available online at ftp.consrv.ca.gov/pub/oil/publications/Datasheets/Dtasheet_vol_3.pdf

Figure 9: Rio Vista Gas Field near Decker Island. Plan and profile views and overlay.