

California

The State of California needs a variety of elevation products at different quality levels, generally coincident with several major land uses and land covers, to serve a number of functional areas. The California coastal zone was seen to have the need for the highest level of data—QL1. This is due to an ever-changing coastline, climate change, large urban populations, geological hazards, infrastructure concentration, and a wide variety of habitat and land cover to analyze. Related functional areas include flood risk mapping, climate change adaptation and modeling, urban and regional planning, and habitat inundation and restoration. The next level of quality concerns the California Central Valley, which needs QL2. The Central Valley is a very flat area with little relief that is subject to both flooding and subsidence, and land use changes that can alter the terrain. Thus a higher level of data is needed. Functional areas include flood risk mapping and assessment, urban and regional planning, wetland mapping, habitat assessment, hydrography mapping, and sea level rise modeling (some parts of the Central Valley are considered coastal). QL3 data were recommended for the remainder of the State, conforming to the scrub and woodlands along with the desert land covers. Between the vegetated (scrub and forest) and desert regions, the vegetated lands were judged to have a greater need for higher resolution elevation data. However, there were enough general statewide functional areas, such as regional planning and infrastructure, along with an increased importance on renewable energy development and utilities to warrant QL3 data for the arid regions. The scrub and forested portions of the State support numerous functional areas, such as fire hazard assessment and investigation, vegetation and forest mapping, and canopy structure and modeling. Regardless of area, State agencies frequently work in these functional areas with the cooperation and coordination of municipal, local, and regional organizations.

Several major points concerning use of elevation data, beyond the general elevation need described above need to be noted. These include elevation data used for modeling and sampling, the need for rapid data production when required, the benefits of collecting high quality imagery with lidar, and the continued use of photogrammetry for detailed infrastructure planning.

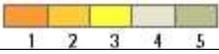
For general forest mapping and canopy modeling, a moderate elevation quality level is required. However, there is a need to obtain data samples at a higher quality level to aid in model building. When and where the samples are needed cannot be shown in the study but this occasional need for small areas of higher quality data needs to be noted. Plus the planned use of elevation data for modeling purposes rather than just mapping needs to be documented.

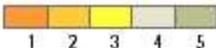
State agencies also need a means to gather elevation data rapidly in case of an emergency or for site-specific applications. These datasets may have a higher unit cost or a rapid turnaround time but the need is present. The California Department of Transportation determined the value of collecting imagery in conjunction with elevation so that a better record of ground features can be seen, especially in gathering higher quality elevation data. The agency will also continue to use photogrammetric methods for elevation data gathering in support of infrastructure projects even if elevation data of the highest quality level become available. The need for photogrammetrically generated elevation data and their specialized application need to be taken into account.

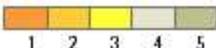
State Functional Activities

Program: Coastal Planning; Delta Levees; Agriculture and Precision Farming	Business Use: 14. Flood Risk Management
 <p>Quality Level:</p> <p>1 2 3 4 5</p> <p>Update Frequency: 6–10 years</p> <p>Bathymetric Data: Yes</p> <p>Tide-Coordinated: Yes</p> <p>Data Outside State Needed: No</p>	<p>Flood Risk Mapping and Flood Assessment: Primary flood risk mapping activities that require elevation data or for which better elevation data would improve functional activities:</p> <ul style="list-style-type: none"> • identification of low lying areas vulnerable to sea level rise • information about the hydrological processes that occur at a regional scale • characterization of existing shoreline protection devices which will further assist with climate change adaptation planning • assessment of levees
	<p>Estimated Annual Operational Benefits: Major; dollar value not reported Improved operational mapping and defensible science-based decisionmaking for planning purposes, monitoring, restoration, and protection.</p>
	<p>Estimated Annual Customer Service Benefits: Major; dollar value not reported Improved transparency, improved public safety, improved emergency response time, improved water availability, and quality.</p>
	<p>Estimated Strategic Benefits: Major Improved preservation of life and property.</p>

Program: Cost Recovery; Fire Protection	Business Use: 16. Wildfire Management, Planning, and Response
 <p>Quality Level:</p> <p>1 2 3 4 5</p> <p>Update Frequency: Event driven—Needs not met by a cyclic data acquisition program</p> <p>Bathymetric Data: No</p> <p>Tide-Coordinated: No</p> <p>Data Outside State Needed: Yes, buffer outside to eight-digit hydrologic unit code (HUC) watershed boundary.</p>	<p>Fire Response, Fire Behavior Modeling, Post-Fire Damage Assessment and Litigation: Primary fire-related activities that require elevation data or for which better elevation data would improve functional activities are grouped into three categories:</p> <ul style="list-style-type: none"> • preburn statewide QL5: used for assessment in most areas in California (excluding the Central Valley and southeast deserts) • preburn statewide QL3: used for determining canopy, vegetation structure, developing fire behavior models (excluding the Central Valley and southeast deserts); • postburn QL1: used for structure and habitat damage assessment; remediation by response teams; litigation and cost recovery; identifying slopes likely to experience landslide or debris flows <p>The California Department of Forestry and Fire Protection (CalFire) makes use of 1-m digital elevation data for most of the fire work currently done in the State. Event-driven collection is critical for subsequent possible loss of life and property due to landslides and debris flows in burned areas, and also for litigation/cost recovery purposes.</p>
	<p>Estimated Annual Operational Benefits: Major; \$16,000,000 Increased successful litigation; improved postfire vulnerability assessment (landslides and debris flows) to minimize loss of life and property.</p>
	<p>Estimated Annual Customer Service Benefits: Major; dollar value not reported Likely increased protection of life and property.</p>
	<p>Estimated Strategic Benefits: Major Benefits description not reported.</p>

Program: Ecosystem Assessment and Evaluation; Ecosystem Conservation; Coastal Planning; and Fire and Resource Assessment	Business Use: 4. Coastal Zone Management
 <p data-bbox="186 1033 600 1087"> Quality Level:  </p> <p data-bbox="186 1087 646 1192"> Update Frequency: 4–5 years Bathymetric Data: Yes Tide-Coordinated: Yes Data Outside State Needed: No </p>	<p data-bbox="657 247 1455 277"> Coastal Planning and Resource Management; Sea Level Fluctuation; Climate Change </p> <p data-bbox="657 277 1455 352"> Adaption; Habitat Assessment and Purchase; Effects on Oceans: Primary coastal-related activities that require elevation data or for which better elevation data would improve functional activities include: </p> <ul data-bbox="682 357 1455 682" style="list-style-type: none"> • monitoring of marine protected areas • improved models for climate change variability • characterization of shoreline protection devices, which assist with climate change adaption planning • improved models for tsunami behavior upon coastlines • improved storm and tsunami readiness • improved sediment movement modeling • management of forest watersheds within coastal zones • planning for restoration projects and fish passage improvement (coastal stream, beach, water diversions) • revision of wetland inventory maps • mosquito abatement programs <p data-bbox="657 682 1455 781"> Some of the work identified within the coastal-focused functional activities is performed for benefit of and jointly with local coastal counties and communities, so this functional area needs further expansion into more specific local functional activities. </p> <p data-bbox="657 787 1455 919"> Estimated Annual Operational Benefits: Major; dollar value not reported High-quality elevation data will result in more defensible sea level rise estimates and better planning decisions for coastal communities. State agencies such as the Ocean Protection Council and Coastal Conservancy have a mission-critical need to provide the best scientifically based scenarios for effects along the coast. </p> <p data-bbox="657 924 1455 997"> Estimated Annual Customer Service Benefits: Major; dollar value not reported Improved access to tailored information products is a key ideal for the future. Improved access to public beaches and trails. </p> <p data-bbox="657 1003 1455 1192"> Estimated Strategic Benefits: Major These data are needed to fuel the science, and the science in turn will help to more effectively inform the public. The State is currently working off so many rough estimations of sea level rise that, politically and socially, the process has ultimately been a disservice. More defensible science needs to be part of the sea level rise story, as well as tools needed for effective planning and decision support would be provided to local governments. </p>

Program: Highway Design; Hydraulics; State Transportation	Business Use: 21. Infrastructure and Construction Management
 <p>Quality Level: </p>	<p>Roadway, Culvert, and Bridge Design; Hydrologic Modeling; Intrastate, Interstate, and Regional Transportation Modeling and Planning: Primary infrastructure-related activities that require elevation data or for which better elevation data would improve functional activities include:</p> <ul style="list-style-type: none"> • road design and engineering • hydraulic modeling for better design of structures (bridges and culverts) to accommodate runoff and flooding from big rain events • assessment of effects of sea level rise on California’s infrastructure • assessment of climate-induced ecological effects of fire, heat, and hydrologic changes • assessment of public health effects of altered hydrology, inundation, and heat • transportation planning (highway, transit, high-speed rail, rail, air) <p>Work contained in this functional area reflects preliminary findings for regional and local functional activities and will be further expanded to include regional, county, and urban jointly performed functions. This functional area also needs further development for public utilities, telecommunications, alternative energy deployment, high speed rail initiatives, and other areas of State work.</p>
	<p>Estimated Annual Operational Benefits: Major; dollar value not reported Having data available for the entire State would reduce or eliminate the need to acquire and pay for such data on a project by project basis. Better hydraulic modeling.</p>
	<p>Estimated Annual Customer Service Benefits: Moderate; dollar value not reported Having elevation data available would minimally improve the ability to do pre-design work, and to design projects somewhat more quickly.</p>
	<p>Estimated Strategic Benefits: Moderate A statewide elevation dataset would facilitate communication and interoperability between State, regional, and local transportation organizations. This will result in time and cost savings in project planning, approval and delivery. Working from a shared common elevation dataset will foster cooperation at all levels of government. It will allow for consistent decisionmaking resulting in cohesive implementation in the areas of hydrology, storm water runoff, sea level rise and climate change, and solar policy. It will facilitate enhanced educational opportunities in K-12 and higher geospatial sciences.</p>
	<p>Update Frequency: 2-3 years</p> <p>Bathymetric Data: Yes</p> <p>Tide-Coordinated: Yes</p> <p>Data Outside State Needed: No</p>

Program: California Land Cover Mapping and Monitoring Program	Business Use: 5. Forest Resources Management
 <p>Quality Level: </p>	<p>Forest Mapping and Vegetation Assessment: Vegetation composition and structure mapping, forest mapping, and habitat assessment. Activities revolve around updating various vegetation mapping extents, which in turn are used to assess habitat, wildlife, and forest cover and fuel loads. Vegetation mapping is strongly tied to land use and land cover mapping (such as The National Land Cover Database) so that land cover change data could be used to guide where detailed vegetation and habitat analysis should be performed.</p>
	<p>Estimated Annual Operational Benefits: Major; dollar value not reported Detailed information on canopy is critical though forest and vegetation mapping covers large areas and highest point cloud densities not necessary.</p>
	<p>Estimated Annual Customer Service Benefits: Major; dollar value not reported Pared down cloud could help a lot for improving quality of vegetation structure mapping. Good vertical range of canopy structure is more important than digital elevation data density.</p>
	<p>Estimated Strategic Benefits: Major Public safety benefit of improved vegetation structure maps for fire threat could be major. Mapping of late seral and old growth might also be improved for environmental benefits. One near-future application is carbon credit modeling, where details on vegetation mass and location will be critical.</p>
	<p>Update Frequency: 4-5 years</p> <p>Bathymetric Data: No</p> <p>Tide-Coordinated: No</p> <p>Data Outside State Needed: Yes, cover watersheds extending beyond State boundary.</p>

Program: Fish Passage Improvement; Delta Habitat and Conservation/Conveyance Plan; Bay-Delta Conservation Plan; FloodSAFE	Business Use: 3. River and Stream Resource Management
 <p>Quality Level:</p> <p>1 2 3 4 5</p>	<p>Inland Water Mapping and Stewardship: This functional area concerns general hydrographic and watershed mapping. Coastal and near-coastal hydrographies are in separate functional areas. General hydrographic mapping includes stewardship of NHD, which is being performed by several organizations now and will be more likely to join the effort. Support watershed assessments and evaluate resource management issues in riparian areas.</p> <p>Estimated Annual Operational Benefits: Major; dollar value not reported Elevation data already needed for watershed and hydrography work. New data will benefit watershed delineation and also location of hydrography for mapping.</p> <p>Estimated Annual Customer Service Benefits: Major; dollar value not reported Enhanced elevation data would be available to stewardship organizations at State and local levels updating the NHD. Elevation is very useful as accompanying dataset in determining changes to hydrography.</p> <p>Estimated Strategic Benefits: Major Lidar would benefit the generation of NHD line work and other alternative methods for NHD improvement.</p>
Update Frequency: Not reported	
Bathymetric Data: Yes	
Tide-Coordinated: Yes	
Data Outside State Needed: Yes, need data for watersheds extending into adjacent States and Mexico.	

Program: Seismic Hazards Zonation Program; Regional Geologic Mapping	Business Use: 9. Geologic Resource Assessment and Hazard Mitigation
 <p>Quality Level:</p> <p>1 2 3 4 5</p>	<p>Geologic Mapping: Geologic applications concerning elevation fall into two groups—general geologic mapping as a base map resource and mapping and modeling of geologic and seismic hazards. General geologic mapping concerns an ongoing need to generate geologic maps across the State as needed. This also supports related applications such as stream channel analysis, water supply source, erosion control, and coastal mapping (sediments, fluvial migration, and coastal terrace elevations). Geologic and seismic hazards are primarily concerned with mapping landslides, faults, and regions affected by seismic hazards (liquefaction, earthquake-induced landslides, and tsunami inundation zones). There are also special coastal geologic hazards to consider including beach morphology studies, monitoring bluff erosion rates and probabilities of failure, and coastal fault mapping. Data are used for modeling in addition to mapping feature locations.</p> <p>One major note regarding geology and elevation data concerns update frequency. While general elevation update frequency varies by application, should a major earthquake occur then new elevation data will be needed as soon as possible to help assess changes to terrain and elevations.</p> <p>There are a number of geologic map products available in California though many are concentrated where population is greatest and best base map data exist. Enhanced elevation datasets will help make it easier to develop maps as needed throughout the State.</p>
Update Frequency: 4–5 years	<p>Estimated Annual Operational Benefits: Major; \$50,000</p> <p>For geologic mapping, elevation data provide the ability to measure some geomorphic features in the office rather than through field surveys, which saves time. It has not been cost-effective to obtain lidar data for small project areas, but a larger amount of money to purchase lidar for larger areas has not been available. Geologic project work tends to be focused on relatively small land areas dispersed across the State but most often near populated areas, forested areas, or State park lands and often related to geologic hazards or economic aspects. Improved elevation data will result in higher accuracy of erosion hazard model products.</p>
Bathymetric Data: Not reported	<p>For geologic and seismic hazard mapping, elevation data in general offer improved accuracy of landslide hazard models, the Alquist-Priolo Earthquake Fault Zone model, and tsunami inundation zone models. Uniform elevation data lead to increased uniformity of map products. Cleaner elevation data without edge effects would reduce time needed to correct artifacts, but higher resolution data may increase model processing time (net effect unknown). Higher accuracy data would greatly help support the regulatory function of the hazard zone maps. Enhanced elevation also increases uniformity in analyses for slope calculations and base map generation.</p>
Tide-Coordinated: Not reported	<p>Estimated Annual Customer Service Benefits: Moderate; dollar value not reported</p> <p>More accurate erosion hazard maps are more useful to customers when making decisions about their property. Enhanced elevation would allow for these maps to be produced wherever needed. In general, higher accuracy elevation results in greater map accuracy which produces a higher confidence in product. Having a better statewide elevation base may allow State products to better match the base maps in use by different counties.</p>
<p>Data Outside State Needed: Yes, buffer appropriate to mapping faults or other geologic features into adjacent States and Mexico.</p>	<p>Estimated Strategic Benefits: Major</p> <p>For both general geologic mapping and seismic hazards mapping, elevation allows for more accurate mapping of landslides and other geomorphic features, resulting in an increased level of public safety. Environmental benefits include more effective protection of water sources from sedimentation through more accurate predictive modeling of erosion potential. Enhanced elevation would permit more accurate mapping for project areas across the State. Better products increase interagency cooperation through increased appreciation of products from partner agencies. Enhanced elevation data would make it possible to construct more accurate tsunami hazard zone maps and new maps for areas where they currently do not exist. This would be a great benefit to public safety and to the land use and maritime planning communities. Increased interagency cooperation through increased appreciation of products from partner agencies.</p>

Program: Strategic Growth Council Integrated Resource Planning and Decision Support	Business Use: 22. Urban and Regional Planning
 <p>Quality Level:</p> <p>1 2 3 4 5</p>	<p>Land Use Planning: The urban and regional planning functional area includes long-term sustainable economic and environmental planning, land use planning, flood risk mapping, and climate change adaptation. In California, particular attention can be paid to the coastal region which combines a coastline that is always affected by environmental and economic change with the large urban population base. A large component of urban and regional planning is based on land use and land cover data and a major input to that is elevation. Changes in elevation, combined with a move to higher accuracy data, can signal changes affected planning decisions, especially along the coast.</p> <p>Estimated Annual Operational Benefits: Major; dollar value not reported Elevation data are used to identify low lying areas vulnerable to sea level rise. The data also provide information about the hydrological processes occurring at a regional scale. Improved elevation data are essential for assessing many effects of sea level rise on California's infrastructure, on climate-induced ecological effects of fire, heat, and hydrologic changes, and on public health effects of altered hydrology, inundation, and heat. Ideally, these new data will also characterize existing shoreline protection devices, which will further assist with climate change adaptation planning efforts.</p> <p>Estimated Annual Customer Service Benefits: Major; dollar value not reported Ideally, new data will also characterize existing shoreline protection devices, which will further assist with climate change adaptation planning.</p> <p>Estimated Strategic Benefits: Major Elevation data are critical in furthering understanding of the coastal zone and its multiple uses. Higher resolution and future elevation data will be critical in improving this understanding and providing more details for coastal change.</p>
Update Frequency: 6–10 years	
Bathymetric Data: Yes	
Tide-Coordinated: No	
Data Outside State Needed: Not reported	

Local Functional Activities

County Government—Los Angeles County	
Program: LA County Enterprise GIS Program	Business Use: 14. Flood Risk Management
Functional Activity: Flood risk and tsunami mapping	
Quality Level: QL1 elevation data from lidar	Estimated Annual Operational Benefits: Moderate; dollar value not reported The county provides elevation data to programs within the county that use it for analyses. Reduced work in the field by county staff.
Update Frequency: 4–5 years	Estimated Annual Customer Service Benefits: Moderate; dollar value not reported Updated information would be useful to expand the analytical capabilities since existing information is in older formats. The county government has been able to develop a number of derived products (raster buildings, solar models, tree canopy models) from existing data.
Bathymetric Data: Yes	Estimated Strategic Benefits: Major More recent information would help. Elevation data are used for flood modeling, fire fighting, and infrastructure planning.
Tide-Coordinated: No	
County Government—Marin County	
Program: Community Development Agency (County of Marin); MarinMap (local agency consortium)	Business Use: 3. River and Stream Resource Management
Functional Activity: Delineation of protected stream reaches	
Quality Level: QL1 elevation data from lidar	Estimated Annual Operational Benefits: Not reported; \$60,000 As of 2009, the creek mapping progress was on track to provide fair detail countywide by 2019. Now, using terrain-derived hydrologically enforced flow lines, the county is reviewing a draft of complete countywide flow lines below 1,000-square-meter (m ²) catchments (40,000 kilometers of candidate flow-line features in the 1,300-square-kilometer (km ²) county). The countywide draft has been prepared for review at a cost of about \$15,000 in 4 months, a very significant time savings and a large improvement in both detail and quality. To the extent that full-waveform lidar might better refine bare-Earth surface through moderately dense tree canopy, the county should be able to position surface flow line features through important areas that are inaccessible due to private ownership. More accurate and defensible creek locations help the county to effectively enforce project setback and review requirements. Accurate creek locations that are not contested could save applicants some project costs related to topographic mapping of project and adjacent parcels.
Update Frequency: 4–5 years	Estimated Annual Customer Service Benefits: Major; dollar value not reported Project applicants will be able to review online the mapped location of protected creek features in advance of a visit to the planning office. Catchments 1,000 m ² (0.25 acre) in area have proved useful to inform analysis of proposed construction projects that might increase mud and debris flow to downhill parcels—not always in a straight line. Being able to predict the affected pathways based on surface flow can help with planning and project notification requirements. By deriving creek locations from modeled surface flow lines that are both parcel-scale precise and accurate, creek setbacks will be consistently enforceable countywide. Field visits will be reduced, and the time required to determine creek setback requirements on projects will be known as soon as the project appears, since they will have been precomputed countywide.
Bathymetric Data: Yes	Estimated Strategic Benefits: Moderate Urban- and rural-area creek maps that are highly detailed and accurate serve to reduce project costs and also engage public awareness of the creeks in their midst. Whether as urban flood channel, anadromous fish habitat, attractive natural feature, or recreational site, more mapped creek detail leads to more creek interaction and appreciation. Improved runoff calculations from surface flow line modeling are being used by public works engineers to inform storm drain capacity issues. Improved flood plain delineation reduces the burden on local agencies to file letters of map amendment, revision, and change with regard to digital FIRMs, because FEMA and the local agency are sharing a common surface model when estimating inundation extent. More accurate flood plain mapping helps local agency public works directors and saves local funds.
Tide-Coordinated: No	

County Government—Marin County	
Program: Community Development Agency (County of Marin); MarinMap (local agency consortium)	Business Use: 22. Urban and Regional Planning
Functional Activity: Parcel slope analysis	
Quality Level: QL2 elevation data from lidar	Estimated Annual Operational Benefits: Not reported; \$35,000 For the specific activity of parcel slope, a parcel average slope (based on contour length) and parcel slope statistics (from the DEM) can be summarized countywide. For each planning occurrence where these data are used, 2 hours of staff time is saved. Improved DEM would provide minor cost savings for parcel slope usage; accurate stream location is a major improvement to mission compliance for creek protections.
Update Frequency: 6–10 years	Estimated Annual Customer Service Benefits: Major; dollar value not reported For rural areas, improved (or in many areas, first-time) lidar coverage will greatly increase the accuracy of the existing terrain model. The terrain has supported a significantly enhanced topographic base map at 1:1,200 scale that is most relevant to the parcel-centric concerns of most applicants for permits at the Community Development Agency.
Bathymetric Data: No	Estimated Strategic Benefits: Moderate Where new lidar data refines rural areas, accurate delineation of stock ponds, vernal pools, and tidal wetlands will increase the ability to protect natural resources. This is a derivative of terrain that will please both the public and the County Board of Supervisors. Local schools are pleased to see their context in detailed topographic mapping, and the public will be realizing the benefits as the new base maps are more widely released. Community planning projects use topographic base maps when considering redevelopment areas. Improved emergency planning support pleases the County Board of Supervisors.
Tide-Coordinated: No	

County Government—Monterey County	
Program: Monterey Peninsula Water Management District—Mitigation Program	Business Use: 3. River and Stream Resource Management
Functional Activity: Hydrologic modeling	
Quality Level: QL1 elevation data from lidar	Estimated Annual Operational Benefits: Moderate; dollar value not reported Ability to define hydrologic feature and develop a comprehensive surface and subsurface model. Also useful for planning and natural resource projects.
Update Frequency: 4–5 years	Estimated Annual Customer Service Benefits: Moderate; dollar value not reported Do not know. These data are being used for the modeling project and provide more realistic predictive forecasts and scenario analyses.
Bathymetric Data: Yes	Estimated Strategic Benefits: Moderate Do not know. Provides an ability to leverage information with orthoimagery data collection, watershed analysis, and natural resource monitoring.
Tide-Coordinated: No	