

2019

California Earthquake Early Warning Business Plan Update

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Cal OES
GOVERNOR'S OFFICE
OF EMERGENCY SERVICES



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1 Introduction

This report follows the *Implementing Earthquake Early Warning in California: A Business Plan for the California Earthquake Early Warning System* (hereafter referenced as the original Business Plan) prepared for the California Governor's Office of Emergency Services (Cal OES) by the Blue Sky Consulting Group.

Senate Bill (SB) 438 (Hill, Chapter 803, Statutes of 2016) required Cal OES to produce an original Business Plan by February 1, 2018, an update by February 1, 2019, and an update annually thereafter. The updates must include:

- The overall progress of the implementation of the system.
- An update on funding acquired and expended.
- An update on contracts and requests for proposals.
- A summary of recommendations made by the California Earthquake Early Warning (CEEW) Advisory Board to Cal OES.

The original Business Plan outlined the steps toward fully realizing the CEEW as prescribed in SB 438. In order to advance the CEEW System beyond the current “test bed” or “beta” version, Cal OES sought to develop a business plan aimed at ensuring that a fully capable CEEW System is brought on-line as soon as possible. The original Business Plan contained a budget for one-time and ongoing costs for the system, a financing plan, a timeline and project plan, and a risk assessment for the overall project. The original Business Plan served as a guide to further develop the CEEW Program in order to ensure that Californians realize the benefits of the system as soon as possible while ensuring the long-term viability of the system through implementation of a stable ongoing financing mechanism.

In addition to the items required by SB 438, the Business Plan Update discusses how a funding strategy for ongoing CEEW Program operations will be approached. The original Business Plan outlined several key sectors that stand to benefit from the CEEW System. Cal OES will continue to work collaboratively with key sectors that stand to significantly reduce their earthquake damage risk as a result of incorporating the CEEW signal into their operations.

2 Progress of Earthquake Early Warning in California

Cal OES continues to develop and implement the Earthquake Early Warning System in California, in partnership with the members of the California Integrated Seismic Network (CISN) including: the United States Geological Survey (USGS), the California Geological Survey (CGS), the University of California, Berkeley (UC Berkeley), and the California Institute of Technology (Caltech) according to a jointly developed implementation framework and Business Plan timeline. Since Cal OES began working on Earthquake Early Warning in 2013, Cal OES has collaborated with other state entities and both private and non-profit organizations to ensure this life-saving capability benefits all Californians and our state's critical infrastructure.

Seismic Station Buildout

Cal OES is currently working with partner organizations to install all remaining seismic stations throughout the state. The focus of station installations is on Northern California as the Southern California Seismic Network is near completion. Cal OES is collaborating with the University of California Office of the President, California State University Chancellor's Office, California Department of Parks and Recreation, California Department of Forestry and Fire Protection, and California Department of Transportation to facilitate the installation of more than 50 new stations on state properties.

System Redundancy

To ensure robust communication capability and system redundancy, the Cal OES Public Safety Communication (PSC) Division is examining the feasibility and performance of transmitting seismic data over the state microwave. Fully leveraging this resource increases the redundancy of the network, is more cost effective than private microwave networks, and utilizes the same reliable network that already facilitates first responder communication throughout the state. Additionally, Cal OES is working with America's Public Television Stations (APTS), a national association representing Public Broadcasting Stations, on yet another transmission mechanism known as "datacasting" which uses extra bandwidth in digital television signals to distribute earthquake alerts.

Public Education

Working with the California Broadcaster's Association (CBA), within its Public Education Partnership Program, Cal OES has distributed radio public service announcements in major media markets throughout the state. These announcements are informing Californians about earthquake early warning and how to protect themselves and their families when an alert is received. To date, over 12,000 radio spots have aired. Additionally, Cal OES is incorporating earthquake early warning messaging into presentations at outreach events focused on seismic safety and broader emergency

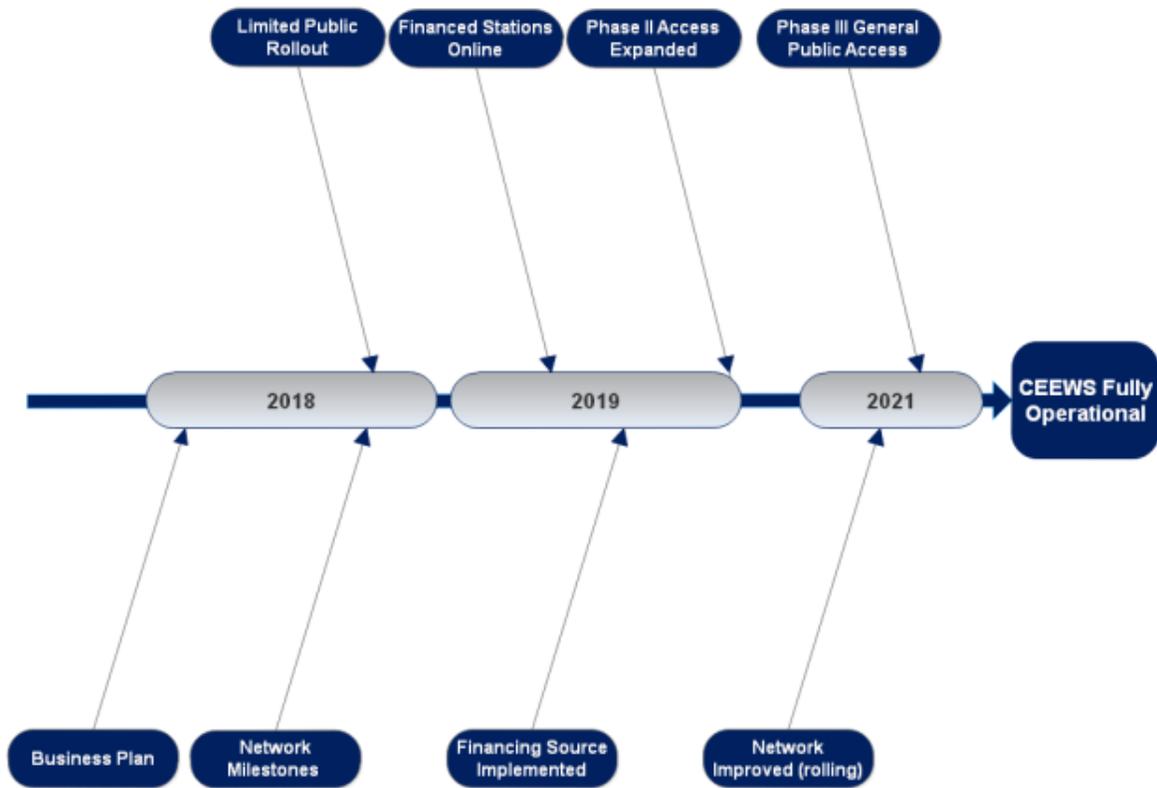
preparedness like Tsunami Preparedness Week, The Great Shakeout, and Cal OES' Preparedness Day.

Rollout Status

Another step in the transition from a beta or test mode to a fully operationalized system occurred in October 2018, when the system "opened for business." This step broadened the existing pilot programs to allow more sectors to participate and encouraged existing users to share best practices applicable to their sector. More details are included in the updates on system milestones in section 3 titled "Operationalizing the System throughout California."

3 Operationalizing the System throughout California

The original Business Plan outlined an implementation timeline through 2021, which included eight milestones. Many of the early milestones have been achieved as noted. Cal OES and its partners are on track to meet the remaining milestones in the Business Plan, which are also detailed in this section.



Milestone 1: Business plan

The original Business Plan was submitted to the Legislature in May 2018.

Milestone 2: Limited public rollout (Phase I public alert)

The original Business Plan stated that the CEEW System should be made available to the broadest group of institutional users possible by the end of 2018. In addition, the report stated that Cal OES should implement an education and outreach campaign designed to inform the public on the limitations of the system and the appropriate protective actions to take when the alert is received. Finally, the report stated that

additional steps are needed with USGS to ensure that the support foundation exists for a large rollout, including finalizing an MOU, providing the appropriate amount of end-user support, and completing final technical actions to support a widely distributed alert.

Prior to October of 2018, access to become a pilot and utilize the system was limited to a single project per designated sector. The limited rollout expanded access to allow any organizations that complete the application process to have access. As a result of this change, the City of Los Angeles launched a cellular phone application and Dignity Hospital at Northridge began sending audible alerts throughout their facility.

Milestone 3: Network development milestones

The original Business Plan stated that further technical steps were needed in parallel to an expanding rollout, including completing a telemetry plan and incorporating GPS data into the EEW signal.

Cal OES facilitated a series of meetings with CISN institutions to determine the feasibility of connecting seismic stations through the state microwave network instead of building new telecommunications towers. The result was a joint Telemetry Improvement Plan, which was completed in August of 2018 and determined that as much as 25% of the CEEW System could use the state microwave network to communicate real-time seismic data to the seismic laboratories instead of relying on cellular modems. In addition, Cal OES completed the first of two projects to connect the state microwave network to the seismological laboratories in Pasadena. The second project in Northern California is in progress and is estimated to be complete by June 2019.

Milestone 4: Already-financed stations fully online

The original Business Plan stated that the stations financed by the 2016-17 State General Fund should be online by June 2019. One hundred thirty (130) of the contracted 183 stations have been installed to date.

Milestone 5: Phase II access expanded beyond initial public rollout

The original Business Plan discussed concepts for an interim expansion of access to the signal beyond the initial public release. The report stated that this phase could focus on expanding access at large, public facilities, or move to statewide applications of public alerting tools. Further, the report stated the existing education and outreach campaign should be expanded to reach the target audience who would receive the alerts.

Since the original Business Plan was released, Cal OES has been working toward an expedited public rollout which coincides with the statewide seismic station build out. In addition, Cal OES is tracking lessons learned from the City of Los Angeles' cellular application release to expand access to individual alerts. Cal OES is working with UC Berkeley to operationalize the MyShake application for public alerting, and sent a test earthquake early warning through the Wireless Emergency Alert system on March 27, 2019. Assuming the tests are successful, the following dates are being proposed for an expanded public alert:

August 2019: Public alerting would begin through a statewide cellular phone application and Wireless Emergency Alerts in targeted geographical areas including the Bay Area and Southern California.

August 2020: Public alerting would be available for the Central and North Coasts.

August 2021: Public alerting would be available statewide.

At the same time, Cal OES is work with its Advisory Board members and directly with stakeholders to implement on-site alerting and automated applications for key sectors, including hospitals, schools, transportation, and utilities. To assist these sectors with the necessary investments to employ automated features, Cal OES is facilitating grant opportunities through the Federal Emergency Management Agency's Hazard Mitigation Grant Program.

Milestone 6: CEEW System financing source fully implemented

The original Business Plan stated that an ongoing funding source would be needed to maintain the CEEW System and expand access to the signal. Proposed financing components are outlined later in the plan under Long Term Funding Strategies on page 12.

Milestone 7: CEEW System network improved (rolling)

The original Business Plan stated that continuous improvement would be needed to elevate the CEEW System's performance. In addition to its public alerting capability, the UC Berkeley MyShake application has the potential to reduce the latency associated with detecting an earthquake and disseminating an alert by using accelerometers in phones. Cal OES is considering funding this research utilizing the 2018-19 General Fund from the State Budget, which would coincide with expanding public access to the signal.

Milestone 8: Phase III access expanded to general public

The original Business Plan stated that the final phase of alerting would be to expand access to mobile phones. Due to expedited work by UC Berkeley, the City of Los Angeles, and telecommunications providers, Cal OES is planning to advance this

deliverable as rapidly as possible. The 2019-20 Governor's Proposed budget includes \$7 million to contribute to a statewide education and outreach plan to ensure that the public is aware of the system's capabilities and limitations, as well as the proper protective actions to take when they receive an alert. These advancements make it possible to include public alerting via cellular phone in areas where the seismic network is built out in the summer of 2019, and continue to rollout to reach the statewide objective by the summer of 2021.

4 Funding Acquired and Expended

Cal OES received \$10 million General Fund in the 2016-17 State Budget for the CEEW Program. The funding was encumbered in contracts by June 2017. The funding is being used to purchase and install 183 seismic stations, create a connection for the CEEW System to the state microwave network, and run an initial public service announcement campaign. Cal OES received \$15 million General Fund in the 2018-19 State Budget for the CEEW Program. The funding is on track to be encumbered by June of 2019. The funds are being used to complete the statewide seismic station buildout, fund four staff members, and provide support to the CEEW Advisory Board.

The 2019-20 Governor's Budget includes a \$16.3 million set aside to complete activities outlined in the original Business Plan. This includes installing GPS stations, funding a complete public service announcement and outreach campaign, upgrading additional telemetry components, and administrative support.

5 Contracts and Requests for Proposals

2016-17 Funding

Cal OES allocated the initial \$10 million in funding to contracts for sensor installation, social science research, education and outreach efforts, research to improve telemetry and mass alert distribution, and consultation on the original Business Plan. The details about funding and contracts are included in Appendix A.

2018-19 Funding

Cal OES is currently in the planning phase for the \$15 million General Fund from the 2018-19 State Budget. The funding was allocated to complete the seismic station buildout and \$750,000 in ongoing funds for four staff members and provide support to the CEEW Advisory Board.

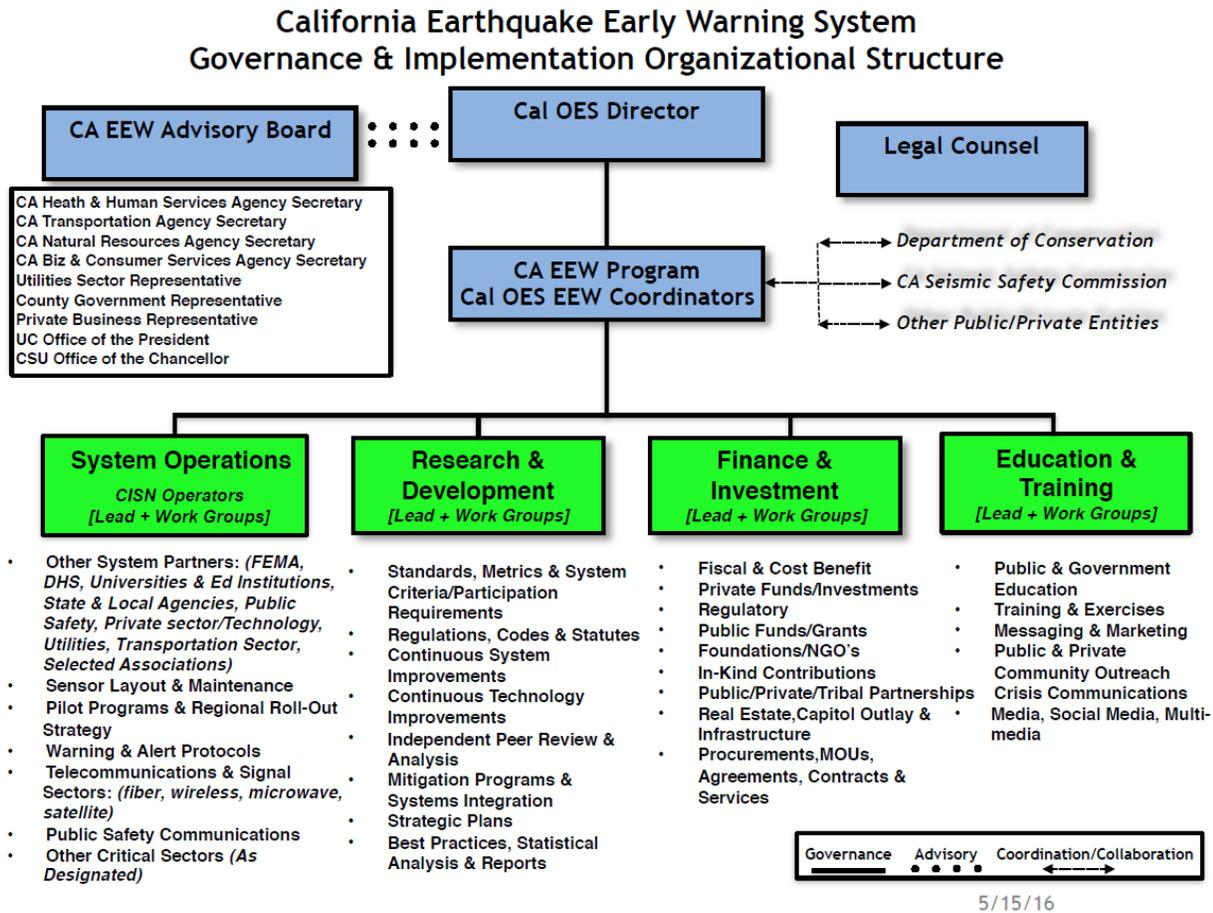
The cumulative experience gained within the program in the last two years guided the spending plan proposal for the new funding. Most notably, Cal OES posted a Request for Information (RFI) to solicit feedback on how to best complete the build out of the CEEW System. This step helped facilitate relationships with other state entities that had experience and interest in various components of the seismic network. Cal OES is pursuing new opportunities to co-locate fire cameras, seismic stations, and existing telecommunications equipment on sites to streamline and expedite station installation, site scouting, and land use agreements.

Interagency agreements are being negotiated among partners such as CGS, UC Berkeley, the Department of Water Resources (DWR), and the University of California, San Diego (UC San Diego). The interagency agreements are scheduled to be executed by June 2019.

Cal OES is also maximizing efficiencies and leveraging our extensive public safety communication expertise and internal capabilities. Cal OES PSC Division engineers are installing seismic stations, enhancing telemetry options available through the state microwave network, and developing innovative solutions to alert first responders and the public.

6 California Earthquake Early Warning Advisory Board

The Advisory Board held its initial meeting on June 22, 2017 and has held subsequent meetings on November 30, 2017, April 30, 2018, September 27, 2018, and March 7, 2019. Advisory Board members have made a number of recommendations about the development of the program during the meetings. The governance structure for the Earthquake Early Warning System:



Key Advisory Board policy focus areas include:

- Individual interaction with warnings: Through questions and discussion, members of the Advisory Board recommended the CEEW Program explore more social science subjects within the development of the system, specifically focusing on alert and warning. Additionally, members representing academic institutions suggested utilizing previously untapped resources within the state. Concerns about cellular phone network coverage continue to drive research into alternative distribution technologies.

Response: The CEEW Program entered into an interagency agreement with California State University at Fullerton to conduct a social science gap analysis, as well as a tone and visual messaging study. The program also continues to explore additional alert delivery methods like datacasting, cellular phone applications that can be utilized over Wi-Fi, and an increased focus on utilizing the State's microwave network.

- Finance: The Advisory Board focused on the contents of the original Business Plan on multiple occasions. Some of the most valuable comments were to ensure that future operation and maintenance costs were identified and the analysis used in the composition of proposed funding mechanisms be included within the original Business Plan. The Advisory Board also strongly recommended that the CEEW Program conduct a Benefit Cost Analysis for the system and recommended that the program be funded by industries that would reduce their earthquake risk the most.

Response: Cal OES adopted the recommendations from the Advisory Board into the original Business Plan. Cal OES is conducting a Benefit Cost Analysis for Earthquake Early Warning utilizing Hazard Mitigation Grant Funds which will be complete by April of 2020.

- Increasing end-users throughout California: Advisory Board members commented that streamlining the enrollment process with USGS and fully utilizing the sectors represented on the Advisory Board would help expand access and allow private sector partners to innovate. Further, members stated that many large systems would have never come to fruition if they waited until they were perfect to be released. Members recommended that the CEEW Program needs to also provide the public with guidance on how to notify users within their own communities, organizations, work sites, and homes, with the flexibility to make the information as directly applicable as possible.

Response: The CEEW Program and Legal staff are currently negotiating with USGS staff to streamline the enrollment process. Cal OES is commissioning a compendium to examine existing best practices and will use educational resources to provide public guidance to a wide variety of audiences.

7 Long Term Funding Strategy

The original Business Plan outlined \$16.4 million in ongoing funding to support operations and maintenance, telemetry, outreach and education, research and development, and program management. The sectors that most closely align with the benefit parameters outlined in the Original Business plan are utilities, transportation, and the general public (via cellular phones). The parameters included: capacity to generate needed funds, capacity to grow with the program, nexus to mitigated risk, inexpensive and efficient to collect, and ability to provide a stable source of funding. Within each sector, costs of this mitigation activity could be factored into existing safety and mitigation investments. It should be noted that EEW operation and maintenance costs will initially be lower due to the newer equipment requiring fewer repairs and then ramp up in later years.

Investor-Owned Utilities

Investor-owned utilities (IOUs), regulated by the California Public Utilities Commission (CPUC), represent the majority of utility customers in California and cover the most seismically active areas of the state. The major organizations include Pacific Gas and Electric, Southern California Gas, Southern California Edison, and San Diego Gas and Electric. IOUs currently invest in mitigation activities to reduce their risk to disasters and other threats. It is anticipated that a major earthquake will cause significant disruption to electric and natural gas systems. The CEEW System provides a mechanism for automated actions, such as de-energizing portions of the network ahead of earthquake shaking, as well as provide for workforce safety. These are critical advancements that will allow IOUs to more quickly restore operations and service to customers in the event of an earthquake.

Cal OES is working with the CPUC and IOUs to identify the necessary mechanisms to invest in ongoing operations and maintenance of the CEEW System.

Transportation

Passenger rail is a major beneficiary for earthquake early warning. Systems in Japan and other countries have been highly successful in this particular area. Here in California, the Bay Area Rapid Transit (BART) has for several years used the system to slow trains by 2 mph for every second of warning it receives. The risks from in-state passenger rail are the most likely to be mitigated and therefore have the greatest nexus to support earthquake early warning compared to other rail options.

Cal OES will work with the California Transportation Commission and local transportation boards to identify the necessary mechanisms to invest in the ongoing operation of the CEEW System.

Wireless Telecommunication

The vast majority of individuals will receive an earthquake early warning via cellular phone. People are likely to have their cellular phone with them wherever they go. There are approximately 42 million cellular phone accounts within California.

The State Emergency Telephone Number Account (SETNA) is collected and administered by Cal OES. Given the nexus to the CEEW System's ability to support first responders, the Federal Communications Commission has indicated that SETNA could fund a portion of ongoing maintenance and operations costs that align with alert distribution.

Path Forward

SB 494 created an Earthquake Safety Fund to be used for seismic safety and earthquake-related programs, including the CEEW System. Additional authority may be needed to receive and expend funds depending on the final method on which the funds are collected. As these options are being vetted, Cal OES may enter into contracts with IOUs and transportation agencies where they align with their current hazard mitigation goals.

This list of beneficiaries and associated investments are the priorities; Cal OES is committed to continue to work with all critical infrastructure providers to identify an expanded portfolio of potential investors to ensure a diverse and sustainable funding plan for the future.

8 Conclusion

Building a statewide earthquake early warning capability in California is complex and requires several building blocks in order to be effective and sustainable. These components include:

- Detection: A network of seismic stations must be installed, integrated into a network, and maintained through multiple partnering institutions.
- Alert generation: A central processing unit must take the data generated by the seismic stations to produce an alert.
- Alert distribution: An application, via an on-site tool, desktop, or cellular phone, must receive the signal and distribute an alert or generate an automated action.
- Governance: Public and private sector representatives must have oversight of the system development, deployment, and finances.
- Education: The public must be educated about the system and know the correct protective actions to take when an alert is distributed.
- Research and development: The state's leading experts in alert generation, system engineering, and technology must contribute their expertise to continuously improving the system.
- Deployment: Large sectors of society including health, education, and utilities must work in a coordinated fashion to integrate the alerts into their operations to protect staff and reduce earthquake damage risk.
- Finance: The program must be funded in order to continue delivering and improving the capability over time.

In 2013, SB 135 authored by Senator Padilla (Chapter 342, Statutes of 2013) stated that California will develop a statewide earthquake early warning system through a public-private partnership. Since 2013, California has taken important steps toward achieving this vision. A governance structure has been established, \$25 million has been contributed from the State General Fund, and work has advanced to the point where the public can receive the alert through cellular phones and other on-site applications. Further work remains; including establishing a sustainable ongoing financing mechanism and rapidly deploying end-user applications to ensure that Californian's have access to the CEEW alert.

Achieving a statewide deployment of end-user applications requires a collaborative approach with the concurrent federal effort led by USGS. Cal OES will continue to work with USGS to rapidly scale the reach of ShakeAlerts generated from the CEEW System. Cal OES has implemented a Unified Coordination Group with USGS to ensure that the system is evolving according to California's priorities. An MOU solidifying the roles and responsibilities is nearly complete with only a few remaining factors being negotiated.

Governor Newsom's proposed FY 2019-20 budget further emphasizes the commitment to operationalizing the CEEW System statewide. With California's leadership and collaboration among federal, local, private, and nonprofit organizations, the path toward realizing a statewide earthquake early warning capability is becoming a reality.

Appendix A

Spending allocations from the 2016-17 funding.

| Contractor | Quantity | Proposed Funding Allocation |
|---|--|--------------------------------------|
| System Operations: <i>Install seismic stations, increase telemetry, and improve system performance.</i> | | Total: \$6,484,000 |
| California Geological Survey | 6088-6: 70 Strong motion station upgrades | \$250,000 |
| Caltech | 6090-6: 10 New broadband stations | \$527,000 |
| United States Geological Survey | 6087-6: 70 New strong motion stations | \$3,145,000 |
| University of California, Berkeley | 6089-6: 33 New broadband stations | \$2,562,000 |
| Education and Training: <i>Build initial CEEW awareness campaign, define gaps, and conduct research on undefined objectives.</i> | | Total: \$2,261,000 |
| National Broadcasters Association | 6086-6: Public awareness campaign | \$2,138,000 |
| California Geological Survey | 6078-6: Outreach to science teachers to assist in warning development | \$40,000 |
| Cal OES Office of Public Information | Communication equipment | \$45,000 |
| California State University, Fullerton | 6038-6: Research by Dr. Michele Wood to identify research gaps | \$38,000 |
| Research and Development: <i>Focus on ways to improve system performance from time of signal detection to information dissemination.</i> | | Total: \$670,000 |
| American Public Television Stations | 6084-6: Purchase and install equipment to attach to PBS stations to test datacasting capabilities with EEW | \$170,000 |
| Cal OES Public Safety Communications | Demonstration project to connect stations to seismic laboratories over the state microwave network in northern and southern California | \$500,000 |
| Finance / Business Plan: <i>Complete business plan to guide funding decision.</i> | | Total: \$250,000 |
| Blue Sky Consulting | Research and production of the original Business Plan | \$250,000 |
| Staffing, operations and maintenance (6 months) | | \$335,000 |
| 2016-17 State General Fund Budget allocation | | Total: \$10,000,000 |

The original Business Plan outlined the remaining unfunded, one-time costs as of May 2018.

| CEEWS and CEEWP Components | Capitol/One-Time Cost (millions) |
|-------------------------------------|----------------------------------|
| Seismic stations | \$16.1 |
| GPS Stations | \$3.8 |
| Backbone telemetry | \$5.9 |
| Outreach and Education | \$6.9 |
| Subtotal | \$32.6 |
| Contingencies | \$4.9 |
| Subtotal | \$37.6 |
| Potential State General Fund | (\$15.75) |
| FY2018 Federal Fund | (\$5.5) |
| | \$16.4 |

The 2018-19 State General Fund Budget included \$15 million to complete the statewide seismic station build out and \$750,000 for CEEW Program staffing and CEEW Advisory Board support. Cal OES is negotiating interagency agreements with several state partners to complete the seismic station build out. In addition, the FY 2018 Federal Budget for the USGS included \$10 million to contribute toward California, Oregon, and Washington's seismic network components, of which approximately \$5.5 million would be targeted for California. Cal OES is working with USGS to ensure that all activities related to the CEEW System are on track to be encumbered.

The 2019-20 Governor's Budget includes a \$16.3 million set aside to complete any one-time activities, including adding GPS stations to the network, improving telemetry, and launching a statewide education and outreach campaign. If passed, Cal OES would work with CEEW Advisory Board partners to ensure that remaining funds achieve the goals outlined in the original Business Plan and this update.