HCAI/CSMIP

HOSPITAL INSTRUMENTATION

Annual Report

July 1, 2021 through June 30, 2022

HCAI Agreement No. 19-20042
(DOC No. 1019-033R)

California Strong Motion Instrumentation Program
California Department of Conservation
California Geological Survey

715 P Street, MS 1901
Sacramento, California 95814

October 1, 2022

Annual Report

HCAI/CSMIP Hospital Instrumentation by the

California Strong Motion Instrumentation Program

July 1, 2021 through June 30, 2022

I. INTRODUCTION

The California Strong Motion Instrumentation Program (CSMIP) of the California Geological Survey, Department of Conservation, performs installation, maintenance, and data recovery for strong motion instrumentation in hospitals through an interagency agreement with the Department of Health Care Access and Information (HCAI). Funding strong motion instrumentation of hospitals through the interagency agreement is in lieu of normal building-permit fee funding referenced in Chapter 8 of the Public Resources Code.

Hospital buildings have been instrumented under eleven Interagency Agreements: 89-0046 (DOC 1089-025R), 92-3187 (DOC 1092-541R), 95-6011 (DOC 1095-570R), 98-9034 (DOC 1098-701R), 01-2069 (DOC 1001-753R), 04-5072 (DOC 1004-790R), 07-7071 (DOC 1007-911R), 10-1266 (DOC 1010-930R), 13-4097 (DOC 1013-960R), 16-7415 (DOC 1016-990R) and 19-20042 (DOC 1019-033R). The first ten agreements extended from July 1989 through June 2019, each covering a period of three fiscal years. The eleventh and most recent interagency agreement 19-20042 (DOC 1019-033R) extends from February 3, 2020 to February 2, 2023. The eleventh contract was approved by the Department of General Services (DGS) on March 24, 2020. This Report covers activities performed between July 1, 2021 and June 30, 2022 (FY21-22).

The code requirements regarding the instrumentation of hospitals have recently been updated. Previously, the code stipulated that HCAI was responsible for subsidizing the maintenance of instrumentation installed at hospitals. With the updated requirements however, the code now requires hospital owners to pay for maintenance. This change is reflected in the most recent interagency agreement between HCAI and CSMIP. When CSMIP discovers maintenance issues with hospital instrumentation, the issues are reported to HCAI. HCAI then either authorizes CSMIP to address the issue or advises the hospital owner that they are responsible for addressing it. If CSMIP performs maintenance on instrumentation that the hospital owner has responsibility for, the hospital owner can be billed to recoup the cost of the work performed.

During FY21-22, CSMIP finalized the instrumentation plans for both the Miller Children's Hospital in Long Beach and the Presbyterian Intercommunity Hospital in Whittier. These two instrumentation projects are funded by HCAI and will be completed as part of the current interagency agreement. In addition, there was progress on various owner-funded hospital instrumentation projects. The instrumentation at the St. Bernardine Hospital in San Bernardino was completed, and CSMIP continued to provide technical guidance and assistance to the

general contractors and structural engineers on other instrumentation projects currently underway. In addition to new instrumentation projects, CSMIP upgraded the recorders at four existing instrumented hospitals: Twin Cities Hospital in Templeton, El Centro Regional Medical Center, Antelope Valley Hospital in Lancaster, and JFK Memorial Hospital in Indio. The instrumentation at these four hospitals was upgraded from obsolete SSA recorders to modern higher resolution recorders capable of real-time data streaming.

II. HOSPITAL INSTRUMENTATION STATUS

Hospital buildings with instrumentation underway are listed in Tables 1, 2, and 3. Like the other hospitals recently instrumented by the CSMIP, the new stations will have near-real-time data communication capability to allow the recorded motion to be automatically transmitted to the CSMIP servers after an earthquake where it will be automatically processed and made available for use in post-earthquake response by the HCAI and the hospital owners.

1) Type 1 - HCAI-Funded Regular Instrumentation of Hospitals (Table 1)

It was anticipated that the reference free-field station of the Santa Clara Valley Hospital (Replacement Bed Bldg. 1) in San Jose would be installed during FY21-22. However, delays in landscaping of the intended area have pushed installation of this free-field station to FY22-23. The instrumentation plans were finalized for both the Miller Children's Hospital in Long Beach and the Presbyterian Intercommunity Hospital in Whittier. The sensor marking visit to the Miller Children's Hospital occurred on April 21, 2022, and CSMIP is currently preparing for installation of these sensors. The sensor marking visit for the Presbyterian Intercommunity Hospital will be scheduled and installation will then occur during the current fiscal year (FY22-23). Equipment for instrumentation has already been purchased for each of these hospitals.

2) Types 2 and 3 - Owner-Funded Instrumentation of Hospitals with CSMIP Guidance and Assistance (Tables 2 and 3)

In addition to the hospital instrumentation funded under the HCAI/CSMIP contract discussed above, a significant component of CSMIP hospital instrumentation work involves detailed technical guidance and assistance with hospital instrumentation projects for which the owner absorbs the capital cost of instrumentation under HCAI regulations. These may be in new hospitals (Type 2), or in existing hospitals being retrofitted (Type 3). Six CSMIP-assisted hospital instrumentation projects of this type are currently underway, and one was recently completed.

CSMIP guidance and assistance in the instrumentation of hospitals includes the following steps:

1. Development of the sensor locations or review of the proposed sensor locations from the design structural engineer of record (SE), after study of the structural plans, to ensure enough sensors to characterize the building seismic response. An instrumentation planning meeting or conference call among the SE, architect of record, HCAI and CSMIP staff is held to discuss and develop consensus on sensor locations and number of sensors.
2. Establishment of the specific locations of all sensors, based on detailed study of the architectural plans by the design architect or SE. Sensor locations need to avoid conflict

with other non-structural components and sensors need to be accessible after they are installed.

3. Development of the comprehensive, detailed design of the system, called the Technical Specifications Letter (TSL), by CSMIP staff. The TSL is provided to the owner, HCAI, and the contractor, and is included in the plans. It specifies acceptable instruments and approved installation practices as well as details for the locations and interconnection of the components, to result in a well-installed project. The final instrumentation plans are approved by HCAI.
4. Sensor marking field visit by CSMIP staff with representatives of the owner, construction contractor and HCAI Inspector of Record. During this visit the actual sensor locations are approved and physically marked on the structural members. During the subsequent work by the contractor, CSMIP staff approves the submittals, assists with problems and issues as they arise.
5. Acceptance field testing of the completed instrumentation system, some months or years later, by CSMIP staff. If problems are found in the installation or operation, the contractor is called back in for repairs, followed by a repeat of tests. Once the installed system is accepted, HCAI is notified, and CSMIP takes on long-term maintenance of the instrumentation, as well as data recovery and processing, supported by HCAI.
6. CSMIP staff prepare sensor location diagram, building descriptions and photo for the building, which are made available at the Center for Engineering Strong Motion Data (CESMD) after the instrumentation is completed.

Type 2 Instrumentation Projects

These hospital buildings have base-isolation and/or energy dissipation devices or use an Alternate Method of Compliance (AMOC) in their design. These are required to have owner-paid instrumentation installed during construction per the California Building Code and HCAI regulations.

During FY21-22, the installation of the free-field station at the University Medical Center Replacement Hospital in Loma Linda was completed. The relative displacement sensors at the base of the building still need to be installed, which is anticipated to occur during FY22-23. The CSMIP staff requires the hospital owner to provide brackets and straps for the relative displacement sensor installations. At the Hollywood Presbyterian Medical Center Acute Care Services Replacement Building in Los Angeles the contractor is still coordinating the installation of the sensors with the equipment manufacturer; the buy-off of the instrumentation is anticipated to occur during FY22-23. For the Scripps Tower II in La Jolla and the Sharp Metropolitan Medical Center New Tower in San Diego the Technical Specifications Letters were completed. The updated plans, which include the TSL's, were then reviewed and approved by CSMIP. The instrumentation planning meeting was held for the UC Irvine Medical Center New Hospital. The structural engineer is updating the instrumentation plans based on the meeting discussion and will then provide the plans to CSMIP for use in preparing the TSL.

Type 3 Instrumentation Projects

These buildings are retrofitted under the Voluntary Seismic Improvement (VSI) regulations. Because of an AMOC design used in their retrofit, these buildings are required to be instrumented at owner expense. St. Bernardine Hospital in San Bernardino is the only Type 3 hospital instrumentation project of the current interagency agreement. During FY21-22 the instrumentation was installed and the buy-off completed at this hospital.

3) Outline of the Report

In Section III of this report, the previously instrumented hospital buildings for which ongoing maintenance was performed throughout FY21-22 are listed. In Section IV, the strong-motion records that were obtained during FY21-22 at instrumented hospitals and their reference free-field sites are listed. A total of 14 earthquakes with magnitude 3.0 or larger were recorded at instrumented hospitals. All recordings can be viewed online and downloaded at **www.strongmotioncenter.org**. The fiscal report is included in Section V.

A total of 83 hospital buildings have been instrumented in the HCAI/CSMIP project through the end of FY21-22. The locations of the 83 hospital buildings are shown on a probabilistic seismic hazard map in Appendix A. The hospital buildings and information about their structural systems are listed in the table in Appendix B. The number of strong-motion recorders at each building and the communication speed are also shown in the table as these will determine how quickly data can be recovered for application after earthquakes.

Table 1

Regular Hospital Buildings (Type 1)
Instrumented under HCAI/CSMIP Hospital Instrumentation Project

(HCAI Funded - HBSB Instrumentation Committee Recommended)

Hospital Name	CSMIP Sta. No.	HCAI Approval No.	Year Built	No. of Stories	No. of Sensors	Completion Date
Instrumentation Underway						
1. Long Beach – Miller Children's Hospital (Pediatric Impatient Addition)	14nnn	IL 050398	2009	4/0	15+FF	FY 22-23
Steel moment frames [Signed permit and plans received 7/2021; Sensor locations marked 4/21/2022; Installation scheduled for 11/2022] (To include a reference free-field station)						
2. Whittier – Presbyterian Intercommunity Hospital (Ed Shannon Tower)	14nnn	HL 000304	2005	4/1	18+FF	FY 22-23
Steel moment frames [Signed permit and plans received 8/2021; Instrumentation plan finalized 6/2022; Sensor marking to be scheduled] (To include a reference free-field station)						
3. San Jose – I280 & Sth Bascom	57612	--	--	--	3	--
Reference free-field for CSMIP Sta. 57537, **San Jose – Santa Clara Valley Hospital (Replacement Bed Bldg. 1)** Waiting to hear from the hospital's contactor to clear the blocked conduit.						

Table 2

New Hospital Buildings (Type 2) – Assisted Instrumentation Base-Isolated or Alternate Method of Compliance

(Owner-Funded with CSMIP Assistance and Guidance)

Hospital Name	CSMIP Sta. No.	HCAI Approval No.	Year Built	No. of Stories	No. of Sensors	Completion Date

Instrumentation Completed or Underway

1. Greenbrae (San Rafael) – Marin General Hospital Replacement Building

58M15	I 140004-21	ca. 2019	4/1	16+FF	2/13/2020

Special steel moment frames with SidePlate connections
[TSL completed 5/4/16; Sensor locations marked 11/2/2017; Buy-off 2/13/2020]
Reference free-field station: **San Rafael – Marin Hospital Grounds A**, CSMIP Sta. 58906

2. Loma Linda – University Medical Center Replacement Hospital

23M01	I 150010-36	ca 2020	16/2	42+FF	FY 22-23

Steel BRB and SidePlate moment frames isolated with triple pendulum bearings and viscous dampers.
[TSL completed 4/26/17; Sensor locations marked 9/6/2018, 4/11/2019 and 1/30/2020]
Reference free-field station: **Loma Linda – Barton & Anderson**, CSMIP Sta. 23702

3. Los Angeles - Hollywood Presbyterian Medical Center Acute Care Services Replacement Building

24nnn	I 17002-19-02	ca 2020	4/1	16	FY 22-23

Steel moment frames with SidePlate connections
[TSL completed 10/26/17; Sensor locations marked 5/6/2020]
(Pre-existing reference FF station: **Los Angeles – Vermont & Fountain,** CSMIP Sta. 24642)

4. Downey – Kaiser Hospital Tower Expansion

14689	I 160024-19-02	ca 2020	6/partial	16+FF	11/3/2020

Steel moment frames with SidePlate connections.
[TSL completed 5/24/18; Sensor locations marked 10/8/2019; Buy-off 11/3/2020]
Reference free-field station: **Downey – Imperial & Ardis**, CSMIP Sta. 14675

5. Marina Del Rey – Cedars-Sinai Medical Center Replacement Hospital

14nnn	I 180008-19-00	ca 2022	9/0	24+FF	FY 22-23

Steel moment frames with SidePlate connections.
[TSL completed 7/16/21]
(To include a reference free-field station)

6. La Jolla – Scripps Tower II

03nnn	tbd	ca 2024	8/1	18	FY 23-24

Steel moment frames with bolted SidePlate connections
[TSL completed 2/8/22]
(Pre-existing reference FF station: **La Jolla – I5 & Genesee,** CSMIP Sta. 03539)

7. San Diego – Sharp Metropolitan Medical Center New Tower

03nnn	I 210010-37-01	ca 2024	7/0	18+FF	FY 23-24

Steel moment frames with bolted SidePlate connections.
[TSL completed 5/31/22]
(To include a reference free-field station)

(Continued on next page)

Table 2 (continued)

New Hospital Buildings (Type 2) – Assisted Instrumentation Base-Isolated or Alternate Method of Compliance

(Owner-Funded with CSMIP Assistance and Guidance)

Hospital Name	CSMIP Sta. No.	HCAI Approval No.	Year Built	No. of Stories	No. of Sensors	Completion Date
8. Irvine – UC Irvine Medical Center New Hospital						
	13nnn	I 210005-30-03	ca 2024	7/0	nn+FF	FY 23-24
	Steel buckling restrained braced frames [Instrumentation planning meeting held 12/21/21] (To include a reference free-field station)					

Table 3

Existing Hospital Buildings (Type 3) – Assisted Instrumentation Voluntary Seismic Improvement (VSI) Projects

(Owner-Funded with CSMIP Assistance and Guidance)

Hospital Name	CSMIP Sta. No.	HCAI Approval No.	Year Design	No. of Stories	No. of Sensors	Installation Date
Instrumentation Completed						
1. San Bernardino – St. Bernardine Hospital (Central Tower)						
	23697	IL 082842-36	1972	6/0	12+FF	1/26/2022
	Steel moment frames (retrofit: add exterior steel frames with viscous dampers)					
	[TSL completed 12/1/16; Sensor locations marked 3/18/21; Buy-off 1/26/22]					
	Reference free-field station: **San Bernardino – St. Bernardine Hosp Grounds**, CSMIP Sta. 23727					

III. HOSPITAL INSTRUMENTATION MAINTENANCE

During FY21-22, CSMIP technical staff performed periodic maintenance of the strong-motion instrumentation installed in the 82 previously instrumented hospital buildings, 63 of which have an associated free-field instrument. With the addition of one newly instrumented hospital building, a total of 83 buildings will be maintained during the next fiscal year (FY22-23).

The 82 hospital buildings instrumented as of the beginning of FY21-22 (buildings with an associated reference free-field station are indicated by an *), are listed alphabetically by city below:

1. Alameda - Alameda Hospital *
2. Bakersfield - Kern County Hospital *
3. Berkeley - Alta Bates Hospital
4. Burlingame - Mills Peninsula Hospital *
5. Castro Valley - Sutter Eden Medical Center *
6. Colton - Arrowhead Regional Medical Center (base-isolated) *
7. Crescent City - Sutter Coast Hospital *
8. Downey - Kaiser Hospital Tower Expansion *
9. Downey - PIH Health Medical Center (VSI) *
10. El Centro - El Centro Regional Medical Center *
11. Encino - Encino Hospital (VSI) *
12. Escondido - Palomar West Medical Center, Central Plant
13. Escondido - Palomar West Medical Center, Main Tower *
14. Eureka - St. Joseph Hospital *
15. Fairfield - North Bay Medical Center *
16. Fremont - Kaiser Hospital *
17. Fremont - Washington Hospital (base isolated) *
18. Gilroy - St. Louise Hospital *
19. Greenbrae - Marin General Hospital Replacement Building *
20. Hemet - Hemet Valley Medical Center *
21. Indio - JFK Memorial Hospital *
22. Irvine - Kaiser Sand Canyon Hospital *
23. King City - Mee Hospital *
24. La Jolla - Scripps Memorial Hospital (VSI) *
25. La Jolla - UCSD Hospital *
26. La Jolla - UCSD Jacobs Medical Center
27. Lancaster - Antelope Valley Hospital *
28. Los Angeles - Children's Hospital
29. Los Angeles - Good Samaritan Hospital
30. Los Angeles - Hollywood Presbyterian Medical Center, Doctor's Tower (VSI)
31. Los Angeles - Hollywood Presbyterian Medical Center, South Wing (VSI) *
32. Los Angeles - LAC+USC Hospital D&T (base-isolated) *
33. Los Angeles - LAC+USC Hospital Inpatient Bldg
34. Los Angeles - MLK Hospital (base-isolated) *
35. Los Angeles - USC Hospital (base-isolated)
36. Los Angeles - USC Hospital Addition
37. Mammoth Lakes - Mammoth Hospital *

38. Moreno Valley - Riverside County Hospital *
39. Murrieta - Rancho Springs Medical Center *
40. Newport Beach - Hoag Hospital West Tower *
41. Newport Beach - Hoag Hospital East Tower (base-isolated)
42. Novato - Community Hospital *
43. Oakland - Kaiser Hospital
44. Ontario - Kaiser Hospital *
45. Oxnard - St. John's Medical Center *
46. Palm Springs - Desert Hospital
47. Palmdale - Palmdale Regional Medical Center *
48. Palo Alto - Lucile Packard Children's Hospital Stanford *
49. Redlands - Community Hospital (VSI) *
50. Riverside - Community Hospital (VSI) *
51. Salinas - Natividad Medical Center *
52. San Bernardino - Community Hospital *
53. San Diego - Sharp Memorial Hospital (VSI) *
54. San Diego - UCSD Medical Center *
55. San Francisco - CPMC Cathedral Hill Hospital
56. San Francisco - General Hospital (base-isolated) *
57. San Francisco - Kaiser Hospital
58. San Francisco - St. Luke's Hospital
59. San Francisco - UCSF Hospital *
60. San Francisco - UCSF Mission Bay Hospital *
61. San Jose - O'Connor Hospital *
62. San Jose - Santa Clara Valley Hospital Bed Bldg 1
63. San Jose - Santa Clara Valley Hospital Bldg K
64. San Pedro - Providence LCOM Medical Center Bldg 1T (VSI) *
65. San Pedro - Providence LCOM Medical Center Bldg 2 (VSI)
66. San Rafael - Marin General Hospital West Wing *
67. Santa Ana - Orange County Global Med Center (VSI) *
68. Santa Barbara - Cottage Hospital *
69. Santa Clara - Kaiser Hospital *
70. Santa Maria - Marian Hospital *
71. Santa Monica - St. John's Hospital (base-isolated) *
72. Santa Rosa - Kaiser Hospital *
73. Simi Valley - Simi Valley Hospital *
74. Stanford - 7-story Hospital (base-isolated) *
75. Stanford - University Hospital *
76. Sylmar - Olive View Hospital *
77. Templeton - Twin Cities Hospital *
78. Torrance - Providence LCOM Medical Center (VSI)*
79. Valencia - Mayo Hospital *
80. Ventura - Community Memorial Hospital *
81. Ventura - Ventura County Hospital *
82. Walnut Creek - Kaiser Hospital

In addition to periodic maintenance, CSMIP upgraded the recorders at the following four hospitals: Twin Cities Hospital in Templeton, El Centro Regional Medical Center, Antelope

Valley Hospital in Lancaster, and JFK Memorial Hospital in Indio. The instrumentation at these four hospitals was upgraded from obsolete SSA recording systems to modern higher resolution recorders capable of real-time data streaming.

CSMIP also performs monitoring and data recovery for the code-type instrumentation systems (three tri-axial accelerographs) in the following four hospitals without charge to HCAI:

1. Los Angeles – White Memorial Hospital (7-story)
2. Pasadena – Huntington Memorial Hospital (7-story)
3. Downey – Kaiser Hospital (6-story)
4. Los Angeles – Kaiser LAMC Sunset Hospital (7-story)

IV. STRONG-MOTION RECORDS FROM HOSPITALS

From July 1, 2021 to June 30, 2022 a total of 14 earthquakes with magnitude 3.0 or larger were recorded at the instrumented hospitals. The hospitals, and the maximum accelerations recorded at the hospital buildings (base and superstructure) and at their reference free-field stations (ground), are listed below for these earthquakes.

M6.0 Antelope Valley Earthquake of July 08, 2021

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Mammoth Lakes – Mammoth Hospital (Sta. 54331)	1-story steel chevron braced frames	106.8	--	1.0	5.4

M4.0 Pinnacles Earthquake of August 31, 2021

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
King City – Mee Hospital (Sta. 47231)	2-story steel eccentrically braced frames	41.5	1.4	0.7	2.0

M3.6 Thousand Oaks Earthquake of September 13, 2021

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Simi Valley – Simi Valley Hospital (Sta. 24104)	2-story steel moment frames	15.6	--	0.7	2.3

M4.3 Carson Earthquake of September 17, 2021

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Moreno Valley – Riverside County Hospital (Sta. 13213)	3-story steel moment frames	99.2	0.6	0.4	1.8
Torrance – Providence LCOM Hospital (Sta. 14529)	1-story reinforced concrete shear walls	8.7	7.7	2.6	6.8

San Pedro - Providence LCOM Hospital Bldg 1T (Sta. 14535)	5-story steel moment frames and x-braced frames	11.0	4.5	3.6	7.7
Los Angeles – MLK Hospital (Sta. 14724)	5-story steel chevron braced and moment frames	10.4	7.7	5.4	11.4
Santa Monica – St. John's Hospital (Sta. 24202)	5-story concentrically braced steel frames (base isolated)	29.8	--	0.7	2.2
Los Angeles – LAC+USC Hospital IP Bldg (Sta. 24248)	9-story concentrically braced steel frames	25.6	No FF	1.4	1.9
Los Angeles – LAC+USC Hospital D&T Bldg (Sta. 24250)	6-story eccentrically braced steel frames	25.7	2.2	1.4	1.3

M3.6 East Los Angeles Earthquake of October 24, 2021

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Los Angeles – LAC+USC Hospital IP Bldg (Sta. 24248)	9-story concentrically braced steel frames	4.6	No FF	3.9	4.8
Los Angeles – LAC+USC Hospital D&T Bldg (Sta. 24250)	6-story eccentrically braced steel frames	4.6	3.8	3.5	2.2

M3.9 San Ramon Earthquake of November 17, 2021

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Alameda – Alameda Hospital (Sta. 58396)	3-story steel moment frames	25.3	--	0.7	4.8

M3.9 Anza Earthquake of January 12, 2022

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Indio – JFK Hospital (Sta. 12759)	1-story plywood shear walls	32.6	1.8	1.3	4.5

M3.3 South Gate Earthquake of February 1, 2022

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Los Angeles – LAC+USC Hospital IP Bldg (Sta. 24248)	9-story concentrically braced steel frames	12.0	No FF	0.7	1.4

M4.0 Santa Paula Earthquake of February 27, 2022

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Ventura – Community Memorial Hospital (Sta. 25594)	6-story steel concentrically braced frame	20.0	2.5	0.6	2.8

M3.9 Round Valley Earthquake of March 30, 2022

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Mammoth Lakes – Mammoth Hospital (Sta. 54331)	1-story steel chevron braced frames	41.1	--	0.5	2.6

M4.1 Rio Dell Earthquake of April 4, 2022

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Eureka – St Joseph Hospital (Sta. 89770)	4-story concrete shear walls	33.3	--	0.8	2.5

M3.4 Toms Place Earthquake of May 21, 2022

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Mammoth Lakes – Mammoth Hospital (Sta. 54331)	1-story steel chevron braced frames	18.6	--	0.6	2.5

M4.1 Bay Point Earthquake of June 2, 2022

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Walnut Creek – Kaiser Hospital (Sta. 58199)	3-story steel moment frames	21.0	No FF	0.8	2.5
Alameda – Alameda Hospital (Sta. 58396)	3-story steel moment frames	41.0	--	0.4	4.0
Fairfield – NorthBay Medical Center (Sta. 68032)	3-story steel EBF and moment frames	20.8	4.8	3.7	6.2

M3.0 Mammoth Lakes Earthquake of June 20, 2022

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Mammoth Lakes – Mammoth Hospital (Sta. 54331)	1-story steel chevron braced frames	7.0	--	0.3	2.1

The strong-motion records are made available rapidly after an earthquake by the CSMIP Strong-motion Automated Recovery and Analysis (SARA) system, and posted in the Internet Quick Reports at the web site of the Center for Engineering Strong Motion Data (CESMD), at **https://www.strongmotioncenter.org**.

The largest earthquake recorded by an instrumented hospital during FY21-22 was the M6.0 Antelope Valley earthquake of July 8, 2021. This earthquake was recorded by only one hospital station which is located at an epicentral distance of approximately 107 kilometers. The largest acceleration recorded at the 1-story Mammoth Hospital in Mammoth Lakes from this earthquake was 0.054 g. This acceleration was recorded at the penthouse roof level of the building which experienced amplification of approximately 2.25x the acceleration recorded at the roof level. Significant amplification of acceleration at the penthouse roof level has been observed in records

of other hospital buildings in previous earthquakes. The accelerations recorded in the building are plotted in Figure 1.

The largest acceleration recorded by an instrumented hospital during FY21-22 is from the MLK Hospital in Los Angeles during the M4.3 Carson earthquake of September 17, 2021. The building is located 10.4 km from the earthquake epicenter. It is a 5-story base isolated structure with a concrete shear wall lateral force resisting system from the basement to the second floor, and a combination of perimeter moment and braced steel frames above the second floor. The peak acceleration recorded at the building during this event was 0.11 g in the reference east direction of the building at the roof level. The building experienced some amplification of acceleration along its height in the reference east direction; however, there was essentially no amplification in its reference north direction. The acceleration records for the reference north and reference east directions of the building are shown in Figures 2 and 3, respectively.

V. FISCAL REPORT

The current contract was executed on March 24, 2020, around the time that COVID pandemic restrictions started. Because of the field work limitations and challenges with COVID, such as access to the hospitals, the major repairs and new instrumentation projects of the hospitals that were planned for FY19-20 and FY20-21were postponed.

A summary of the budget and expenditures is as follows:

Total amount of Agreement (March 24, 2020 - February 2, 2023)		$1,133,700.00
1)	Budgeted for FY19-20	$377,900.00
	Expended March to June 2020	$17,256.69
	Remaining amount from Year 1	$360,643.31
2)	Budgeted for FY20-21	$377,900.00
	Expended in FY20-21	$177,285.79
	Remaining amount from FY20-21	$200,614.21
3)	Budgeted for FY21-22	$377,900.00
	Expended in FY21-22	$377,900.00

In addition, CSMIP has already spent $143,068.19 of the previous years' budget on the postponed projects from FY19-20 and FY20-21 and plans to spend additional remaining budget on new instrumentation. Currently, HCAI and CSMIP are working on an amendment for the contract to allow CSMIP to spend the remaining budget on the contract.

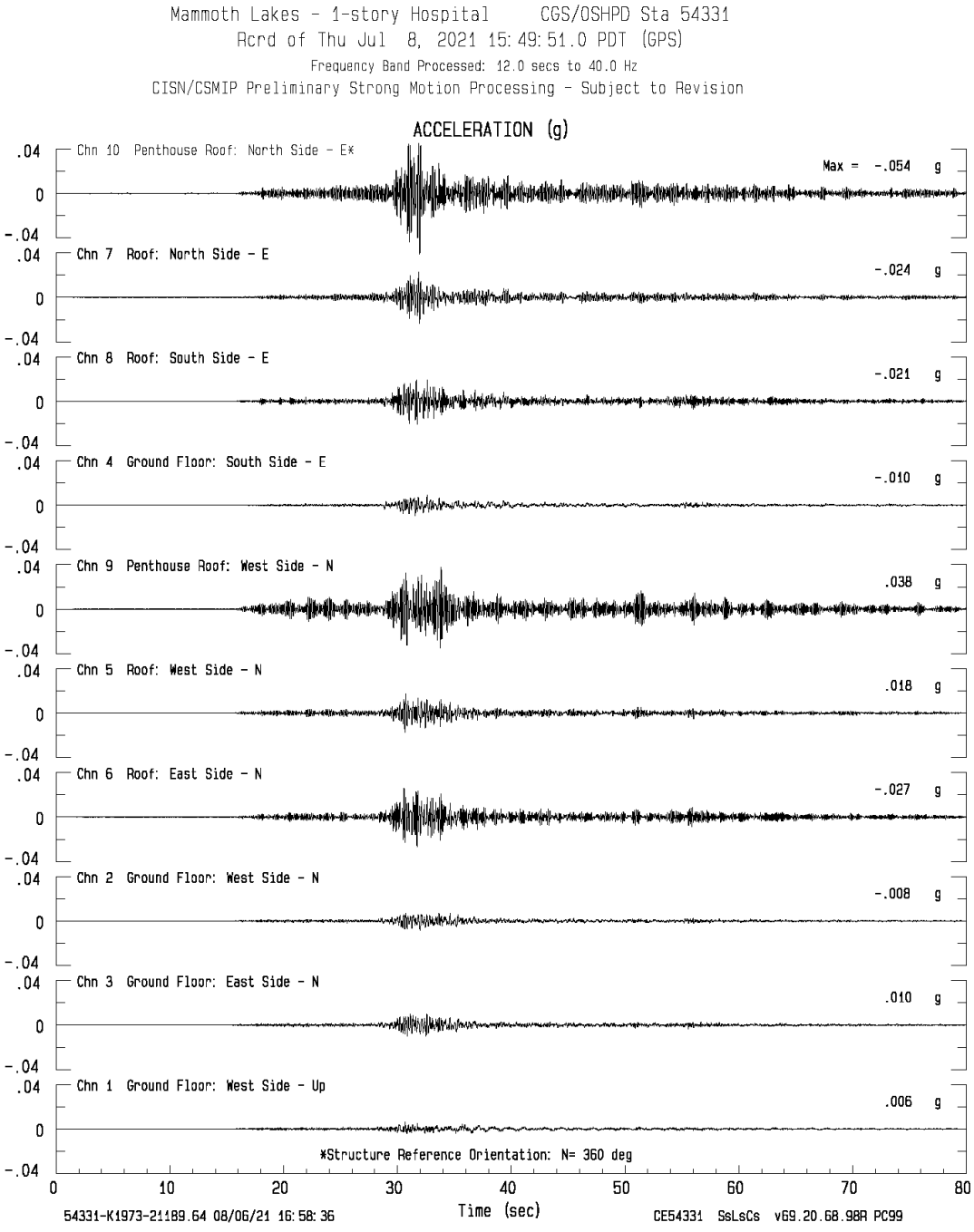


Figure 1. Accelerations recorded at the Mammoth Hospital in Mammoth Lakes during the M6.0 Antelope Valley earthquake of July 8, 2021.

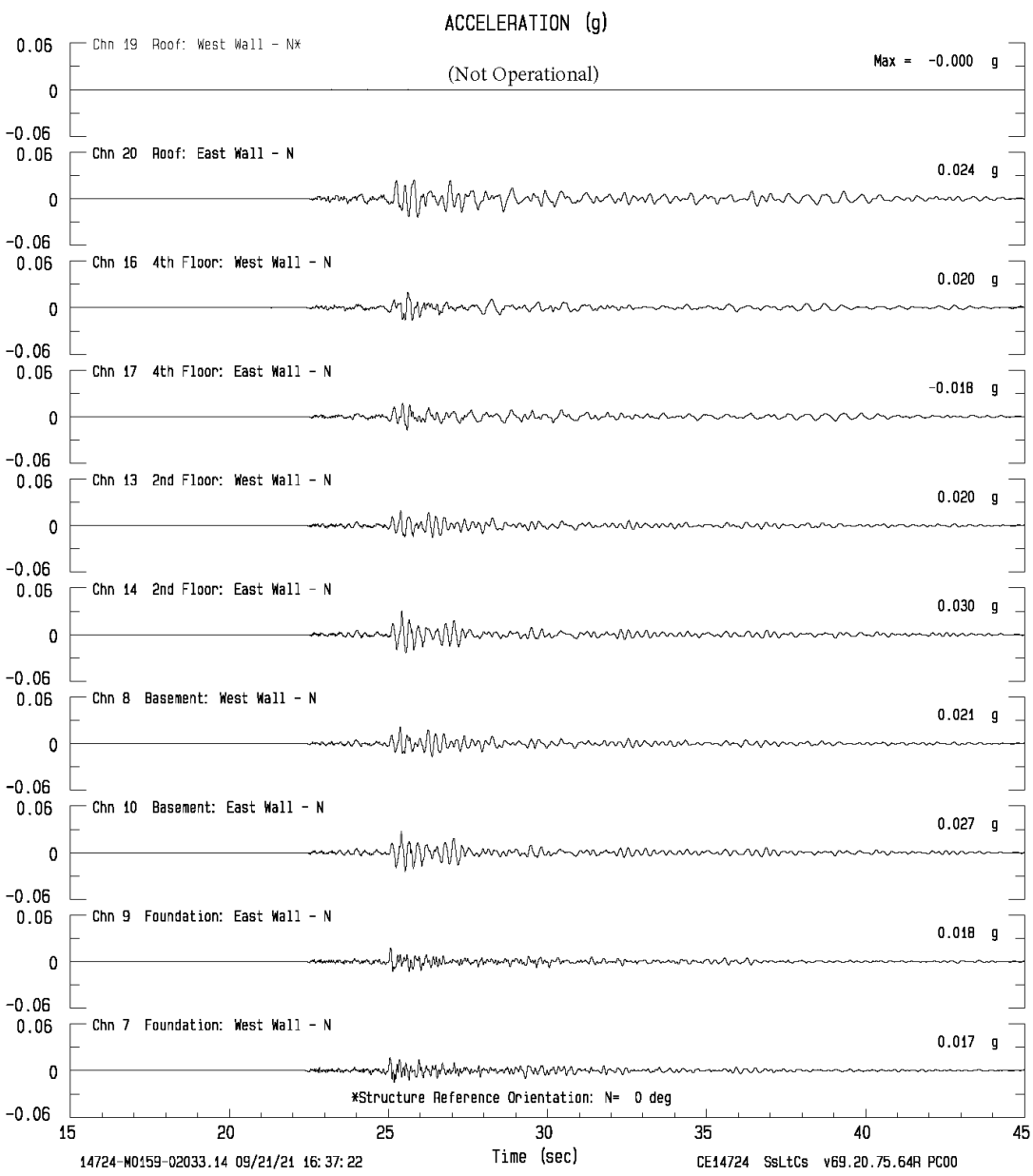


Figure 2. Accelerations recorded in the reference north direction at the MLK Hospital in Los Angeles during the M4.3 Carson earthquake of September 17, 2021.

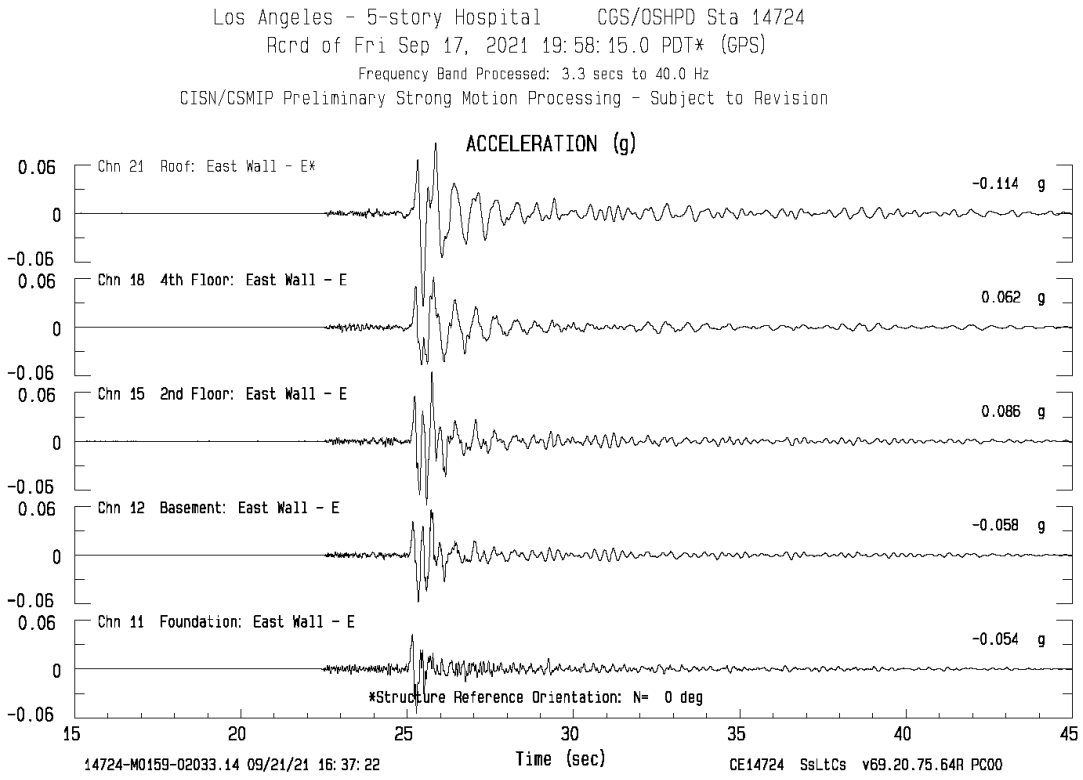
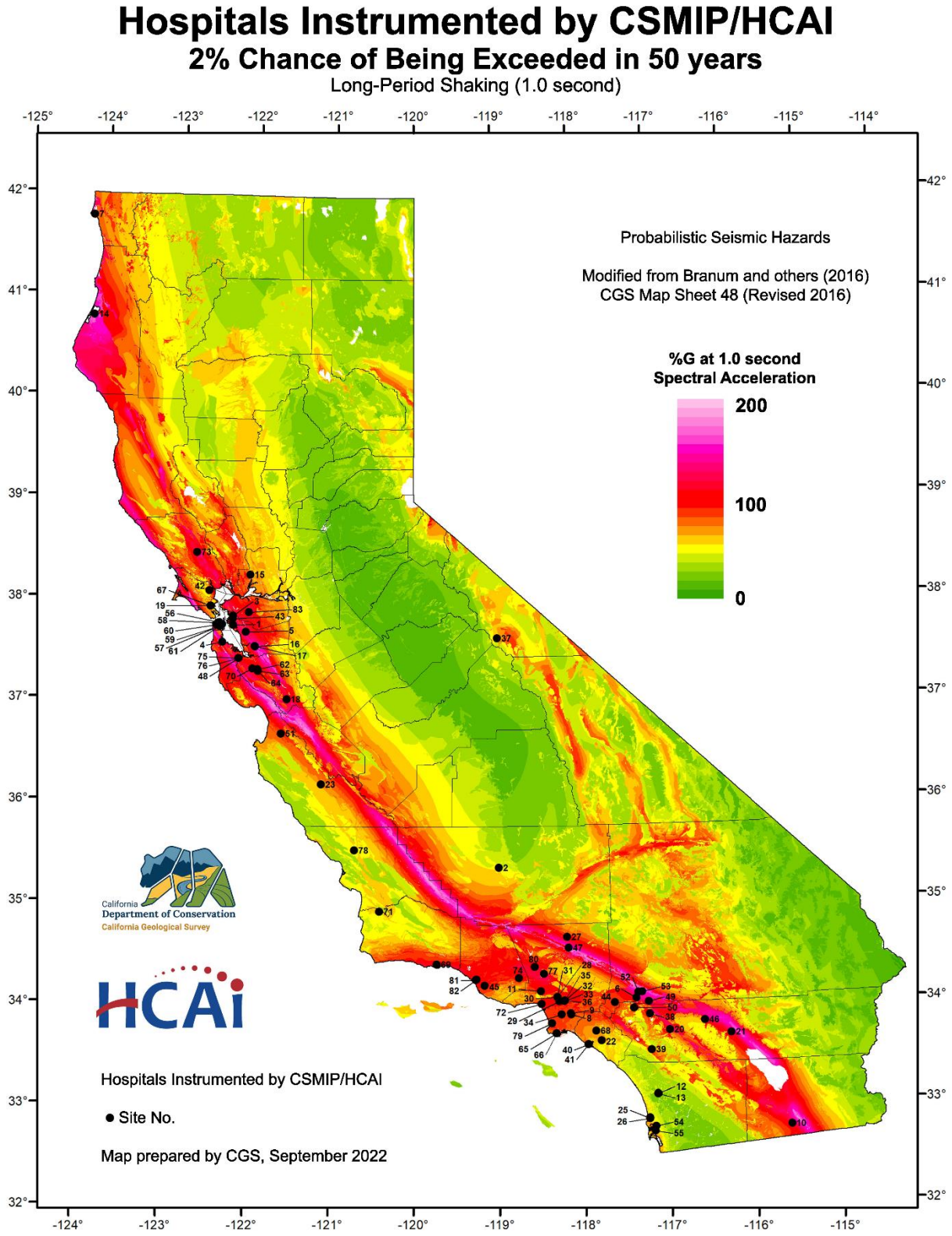


Figure 3. Accelerations recorded in the reference east direction at the MLK Hospital in Los Angeles during the M4.3 Carson earthquake of September 17, 2021.

Appendix A


Hospitals Instrumented by CSMIP/HCAI
2% Chance of Being Exceeded in 50 years
Long-Period Shaking (1.0 second)
Probabilistic Seismic Hazards
Modified from Branum and others (2016)
CGS Map Sheet 48 (Revised 2016)
%G at 1.0 second
Spectral Acceleration
200
100
0
California
Department of Conservation
California Geological Survey
HCAI
Hospitals Instrumented by CSMIP/HCAI
● Site No.
Map prepared by CGS, September 2022

Appendix B

BUILDINGS INSTRUMENTED BY CSMIP/HCAI 10/1/2022

Site No. on Map	CSMIP Sta. No.	Station Name	No. of Stories	No. of Sensors	No. of Rcrdrs	Recov. Speed	FEMA-310 Bldg Type	SMIAC Bldg Type
1	58396	Alameda - Alameda Hospital	3/0	12+FF	1	M	S1L	K1
2	34234	Bakersfield - Kern County Hospital	4/1	12+FF	1	L	C2M	H2b
3	58496	Berkeley - Alta Bates Hospital	2/1	12	1	L	S2L	I1c
4	58390	Burlingame - Mills Peninsula Hospital (isolated)	6/0	27+FF	1	M	IM	Q2
5	58494	Castro Valley - Sutter Eden Medical Center	6/1	19+FF	1	M	S2M	I2a
6	23788	Colton - San Bernardino Co. Med. Center (isolated)	6/0,4/0,2/0	27+FF	2	L	IM	Q2
7	99261	Crescent City - Sutter Hospital	1/0	10+FF	1	L	S2L	I1c
8	14689	Downey - Kaiser Hospital Tower Expansion	6/partial	16+FF	1	M	S1M	J2b
9	14646	Downey - PIH Health Hospital (VSI)	4/1	12+FF	1	M	C2M	G2b
10	01699	El Centro - Community Hospital	1/0	12+FF	4	VL	S2L	I1b
11	24648	Encino - Encino Hospital (VSI)	4/1	12+FF	1	H	RM2M	F2a
12	13476	Escondido - PMC West Hospital Central Plant	2/0	6	1	M	C2L	H1f
13	13473	Escondido - PMC West Hospital (Main Tower)	11/1	12+FF	1	M	S1H	K3a
14	89770	Eureka - St. Joseph Hospital	4/1	11+FF	1	L	C2M	G2d
15	68032	Fairfield - NorthBay Medical Center	3/0	12+FF	1	L	S2L	I1d
16	57301	Fremont - Kaiser Hospital	2/0	15+FF	1	L	S1L	K1
17	57643	Fremont - Washington Hospital (isolated)	3/1	24+FF	1	M	IL	Q1
18	57200	Gilroy - St. Louise Hospital	2/0	10+FF	1	L	S1L	K1
19	58M15	Greenbrae - Marin General Hospital Replacement Building	4/1	16+FF	1	H	S1M	J2b
20	12267	Hemet - Valley Hospital	4/1	10+FF	1	L	C2M	G2d
21	12759	Indio - JFK Hospital	1/0	8+FF	2	VL	W1	A1
22	13439	Irvine - Kaiser Sand Canyon Hospital	6/partial	15+FF	1	M	S2M	I2b
23	47231	King City - Mee Hospital	2/0	10+FF	1	L	S2L	I1c
24	03538	La Jolla - Scripps Memorial Hospital	7/1	12+FF	1	M	S1M	J2b
25	03233	La Jolla - UCSD Hospital	2/0	16+FF	1	L	S1L	J1b
26	03593	La Jolla - UCSD Jacobs Medical Center	10/2	24	1	M	S1H	K3a
27	24609	Lancaster - Antelope Valley Hospital	5/0	12+FF	3	VL	S1M	K2
28	24397	Los Angeles - Childrens Hospital	7/1	12	1	L	S1M	K2
29	24713	Los Angeles - Good Samaritan Hospital	8/1	15	5	VL	S2H	I3b
30	24662	Los Angeles - Hollywood Presbyterian MC S. Wing (VSI)	4/1	12+FF	1	M	C2M	H2b
31	24682	Los Angeles - Hollywood Presbyterian MC Drs Tower (VSI)	10/2	15	1	M	S1H	J3b
32	24250	Los Angeles - LAC+USC Hospital D&T Bldg (isolated)	6/0	20+FF	2	L	IM	Q2
33	24248	Los Angeles - LAC+USC Hospital IP Bldg	9/0	12	1	L	S2H	I3b
34	14724	Los Angeles - MLK Hospital (isolated)	5/1	21+FF	2	L	IM	Q2
35	24605	Los Angeles - USC Hospital (isolated)	7/1	24	7	VL	IH	Q3
36	24260	Los Angeles - USC Hospital Addition	9/1	12	1	L	S2H	I3b
37	54331	Mammoth Lakes - Mammoth Hospital	1/0	10+FF	1	L	S2L	I1b
38	13213	Moreno Valley - Riverside County Hospital	3/1	12+FF	1	L	S1L	K1
39	13601	Murrieta - Rancho Springs Medical Center	2/0	9+FF	1	M	C1L	L1
40	13291	Newport Beach - Hoag Hospital East Tower (isolated)	7/1	27	5	VL	IM	Q3
41	13589	Newport Beach - Hoag Hospital West Tower	11/0	18+FF	2	L	C2H	H3a
42	68430	Novato - Community Hospital	2/0	12+FF	1	M	S2L	I1b
43	58590	Oakland - Kaiser Hospital	12/1	18	1	M	S2H	I3b
44	23416	Ontario - Kaiser Hospital	5/partial	18+FF	1	M	S2M	I2b
45	25949	Oxnard - St. Johns Hospital	4/1	16+FF	1	L	S1M	K2
46	12299	Palm Springs - Desert Hospital	4/1	13	1	L	S1M	K2
47	24457	Palmdale - Palmdale Regional Hospital	5/0	16+FF	1	M	C2M	H2d
48	58604	Palo Alto - Lucile Packard Childrens Hospital Stanford	6/2	21	2	M	S2M	J2a
49	23548	Redlands - Community Hospital (VSI)	2/1	9+FF	1	M	C2L	H1c
50	13633	Riverside - Community Hospital (VSI)	6/1	12+FF	1	M	C2M	G2e
51	47796	Salinas - Natividad Medical Center	3/0	15+FF	1	L	S2L	I1b

Appendix B

BUILDINGS INSTRUMENTED BY CSMIP/HCAI 10/1/2022

Site No. on Map	CSMIP Sta. No.	Station Name	No. of Stories	No. of Sensors	No. of Rcrdrs	Recov. Speed	FEMA-310 Bldg Type	SMIAC Bldg Type
52	23634	San Bernardino - Community Hospital	5/0	12+FF	1	M	S1M	K2
53	23697	San Bernardino - St. Bernardine Medical Center	6/0	12+FF	1	H	S1M	J2a
54	03546	San Diego - Sharp Memorial Hospital (VSI)	8/1	15+FF	1	M	C2H	H3b
55	03743	San Diego - UCSD Hospital	11/1	12+FF	4	VL	C1H	M3
56	58640	San Francisco - CPMC Cathedral Hill Hospital	12/2	24	1	H	S1H	K3a
57	58574	San Francisco - General Hospital (isolated)	7/2	24+FF	2	M	IM	Q2
58	58718	San Francisco - Kaiser Hospital	6/0	18	6	VL	C2M	H2d
59	58649	San Francisco - St. Luke's Hospital	6/1	16	1	M	S2M	I2b
60	58257	San Francisco - UCSF Hospital	15/1	16+FF	1	L	U	U
61	58572	San Francisco - UCSF Mission Bay Hospital	6/0	18+FF	1	M	S2M	I2b
62	57594	San Jose - O'Connor Hospital	5/0	16+FF	4	VL	S2M	I2c
63	57495	San Jose - Santa Clara Valley Hospital (Bldg K)	4/1	15	1	M	S1M	K2
64	57537	San Jose - Santa Clara Valley Hospital (Bed Bldg 1)	7/1	20+FF	1	M	S1M	K2
65	14535	San Pedro - Providence LCOM Hosp (Bldg 1T) (VSI)	5/partial	12+FF	1	M	S2M	I2d
66	14536	San Pedro - Providence LCOM Hosp (Bldg 02) (VSI)	4/1	12	1	M	C2M	H2d
67	58755	San Rafael - Marin General Hospital	5/1	12+FF	1	L	S1M	J2b
68	13611	Santa Ana - Orange County Global Medical Center (VSI)	1/0	6+FF	1	M	S2L	I1a
69	25777	Santa Barbara - Cottage Hospital	3/1	9+FF	3	VL	C2L	H1e
70	57251	Santa Clara - Kaiser Hospital	3/1	18+FF	1	L	S2L	I1b
71	26470	Santa Maria - Marian Hospital	4/partial	12+FF	1	M	S2M	I2c
72	24202	Santa Monica - St. John's Hospital (isolated)	5/1	24+FF	2	L	IM	Q2
73	68669	Santa Rosa - Kaiser Hospital	4/1	13+FF	5	VL	S1M	K2
74	24104	Simi Valley - Simi Valley Hospital	2/1	12+FF	1	L	S1L	K1
75	58623	Stanford - 7-story Hospital (isolated)	7/1	34+FF	1	M	IM	Q2
76	58055	Stanford - University Hospital	3/1	12+FF	1	L	S1L	K1
77	24514	Sylmar - Olive View Medical Center	6/0	13+FF	1	L	UM	R
78	36695	Templeton - Twin Cities Hospital	1/0	9+FF	3	VL	W1	A1
79	14529	Torrance - Providence LCOM Hospital (VSI)	4/2	21+FF	2	M	C2M	H2d
80	24344	Valencia - Mayo Hospital	2/partial	12+FF	1	M	S1L	K1
81	25594	Ventura - Community Memorial Hospital	6/1	24+GA	2	M	S2M	I2b
82	25744	Ventura - County Hospital	4/1	12+FF	3	VL	C2M	H2b
83	58199	Walnut Creek - Kaiser Hospital	3/1	16	1	L	S1L	K1