

November 9, 2020

To: Members of the Seismic Monitoring Advisory Committee,
Southeast Geysers Effluent Pipeline Project (SEGEP)

Fm: Northern California Power Agency

Re: SEGEP Operation and Seismicity Report for April 1 through September 30, 2020

A. Pipeline Operations

The Southeast Geysers Effluent Pipeline (“SEGEP”) has been in operation since 1997 and has delivered 62.06 billion gallons of water at an average rate of 5,145 gpm to the South East Geysers steam field for injection. **Figure 1** illustrates the daily delivery rates since the beginning of the project.

During the six-month period from April 1 through September 30, 2020, the SEGEP Pipeline was in operation 95.6% of the time (**Figure 2**). Pipeline delivery rates have averaged 5.65 million gallons per day (MGD) or 3,924 gpm. There were a number of reductions in flow due to pipeline trips, maintenance, or PG&E Public Service Power Shut-Off events (PSPS).

B. Observed Seismicity

Seismic Activity in the Southeast Geysers

The USGS recorded 50 seismic events of magnitude 1.5 and greater within the SE Geysers area from April 1 through September 30, 2020. This is up from 40 seismic events over the previous six-month period (October 1, 2019 through March 31, 2020). Historical trends and locations of the recent events are shown respectively in **Figures 3 and 4**. There were two magnitude 3.0 or greater seismic events in the Southeast Geysers during this reporting period.

In combination with the seismic activity, steam production for the Southeast Geysers area was 18.29 billion pounds mass for the past six months. This value is up 36.7% from the previous six-month period where 13.38 billion pounds was produced. The reason for the increase in steam production is that a number of power plants were down for an extended period of time due to the Kincade Fire which occurred in late October 2019.

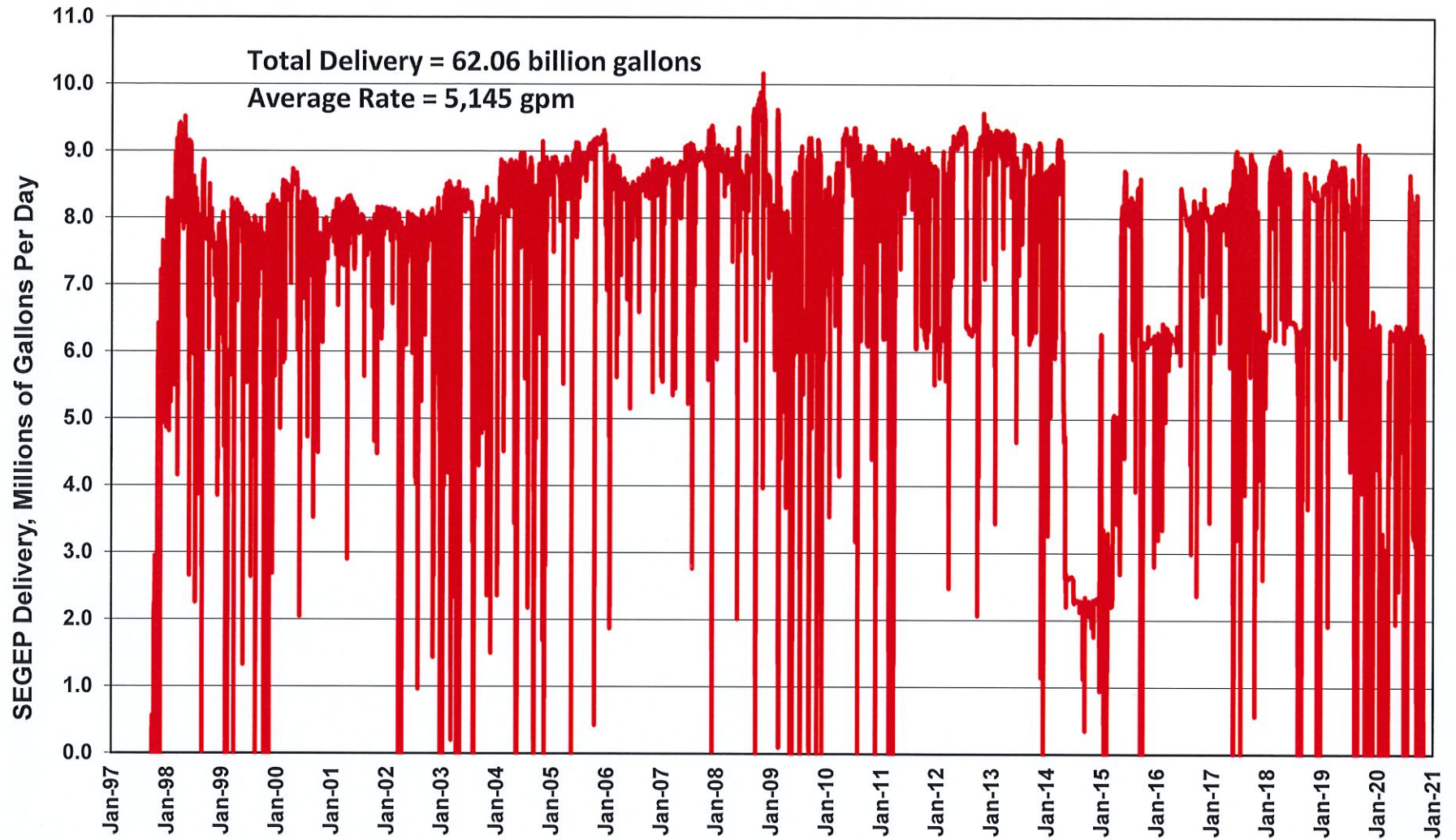
The amount of water injected into the Southeast Geysers reservoir was 7.97 billion pounds. This compares with the 8.32 billion pounds of water injected from October 1, 2019 through March 31, 2020. **Figure 5** shows the historical changes in steam production, water injection and recorded seismicity within the Southeast Geysers area.

Seismic Activity in The Geysers (KGRA)

Within the Geysers geothermal field, there have been 309 events of magnitude 1.5 and greater recorded from April 1, 2020 through September 30, 2020. There were three events of magnitude 3.0 or greater. The largest event was magnitude 3.97, which occurred on July 5, 2020. **Figure 6** shows the trends of seismic events for the Geysers since 2010 while **Figure 7** shows the location of the events for the last six months.

Ed Voge
Reservoir Engineer
NCPA Geothermal Facility

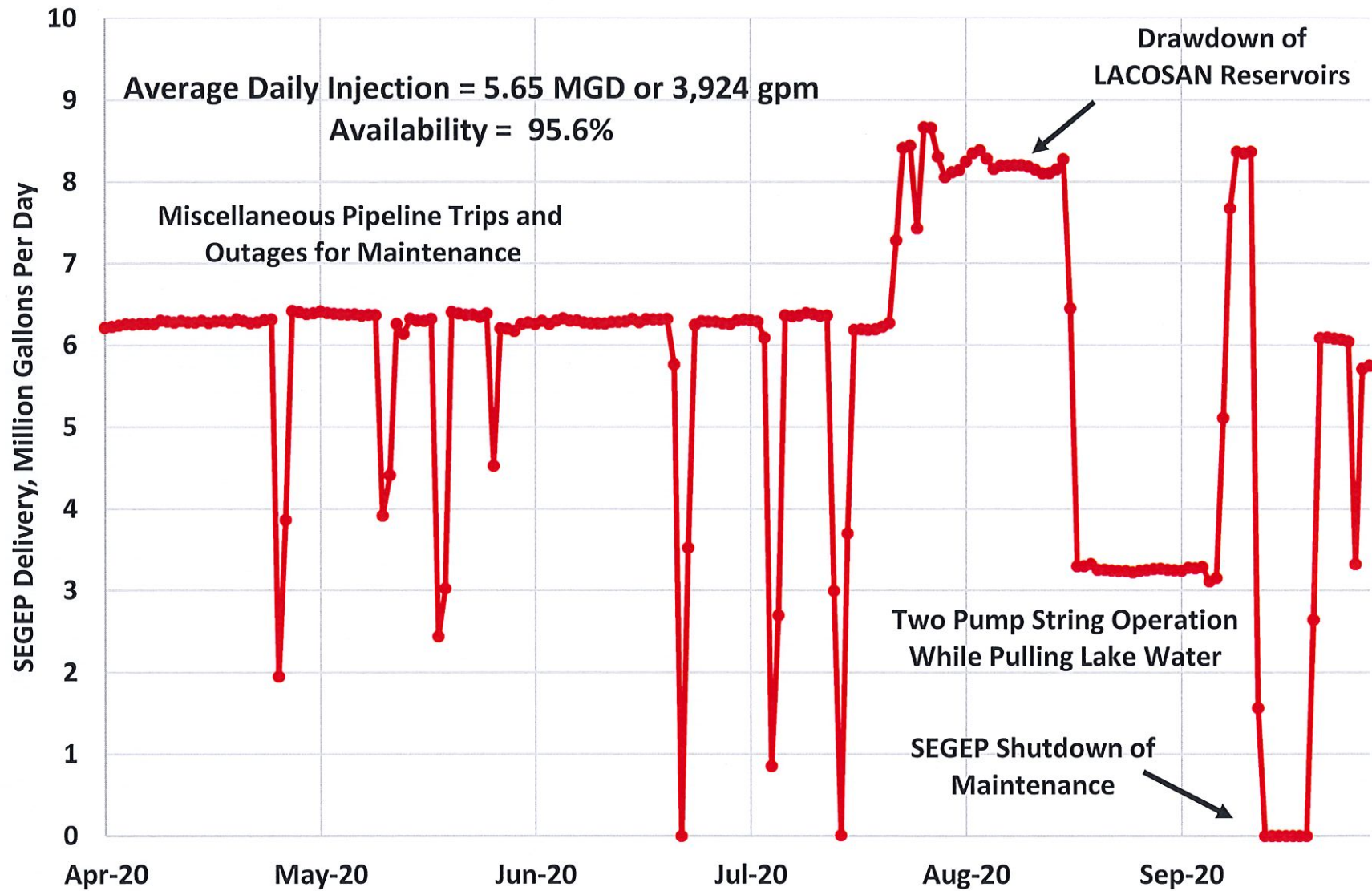
Historical SE Geysers Effluent Pipeline Deliveries to The Geysers
Figure 1



Southeast Geysers Effluent Pipeline Delivery

April 1 - September 20, 2020

Figure 2



Southeast Geysers - Historical Seismic Activity

Magnitude > 1.5

Figure 3

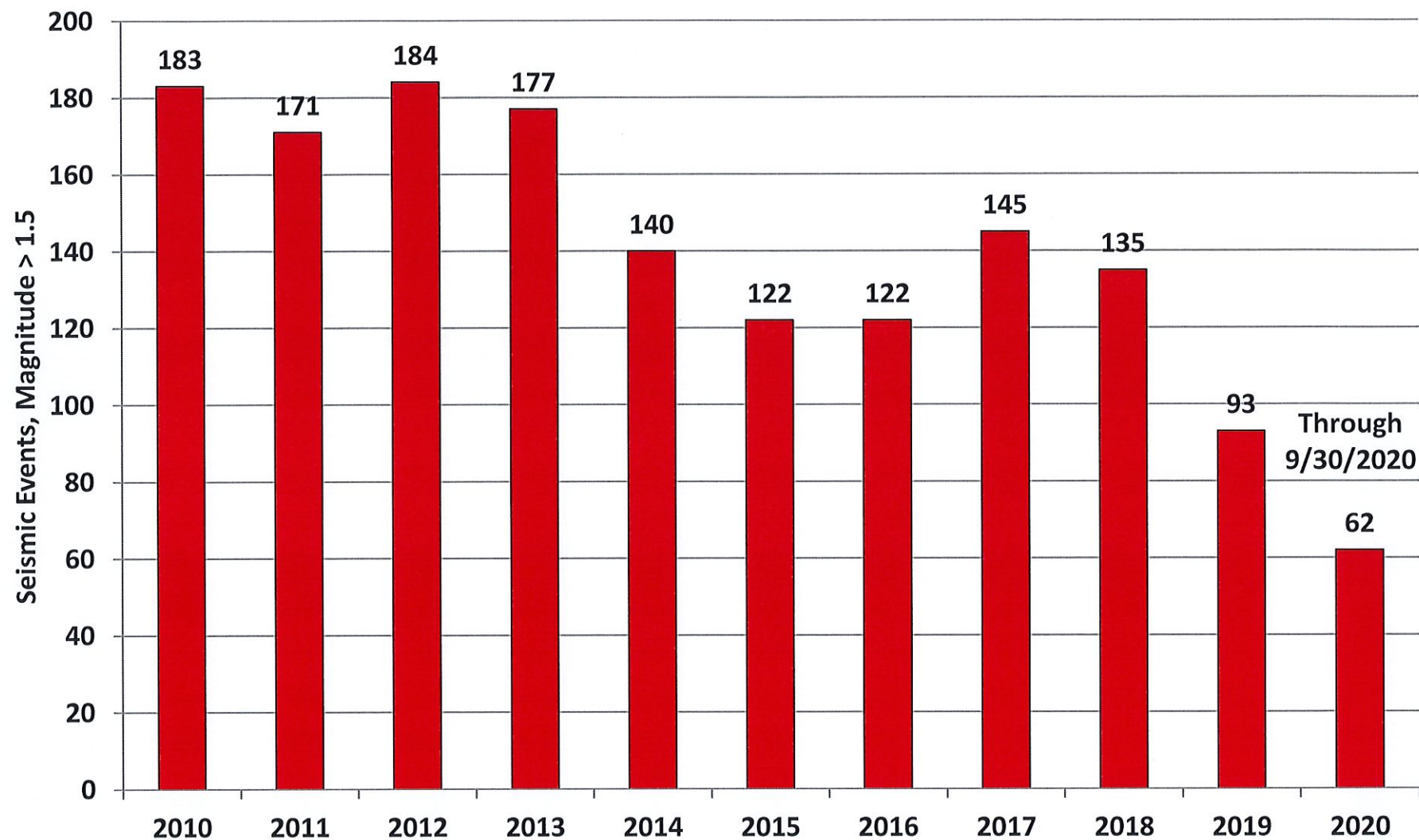
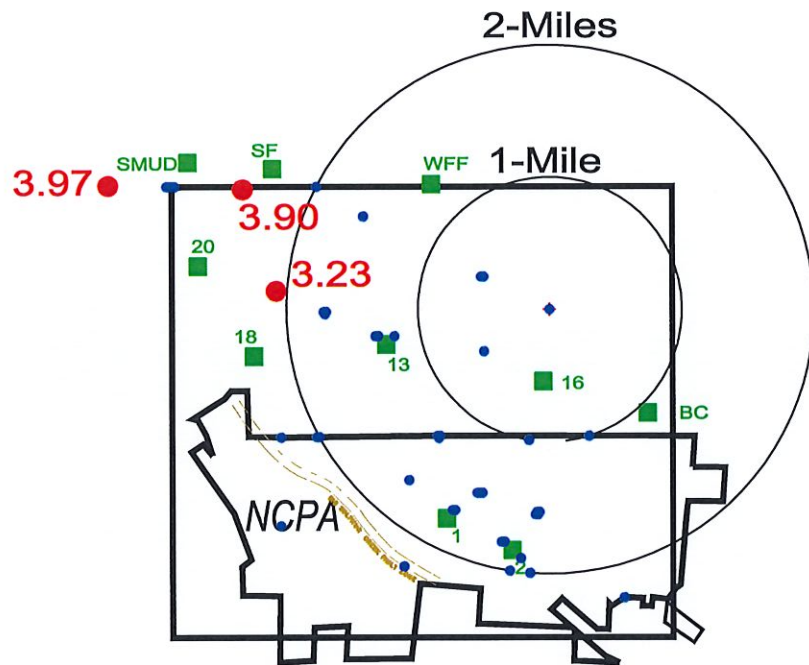


Figure 4



SOUTH EAST
GEYSERS
SEISMIC STUDY
AREA

Radial distances are
from Anderson Springs
Strong Motion
Instrument

Apr. 1 - Sept. 30, 2020

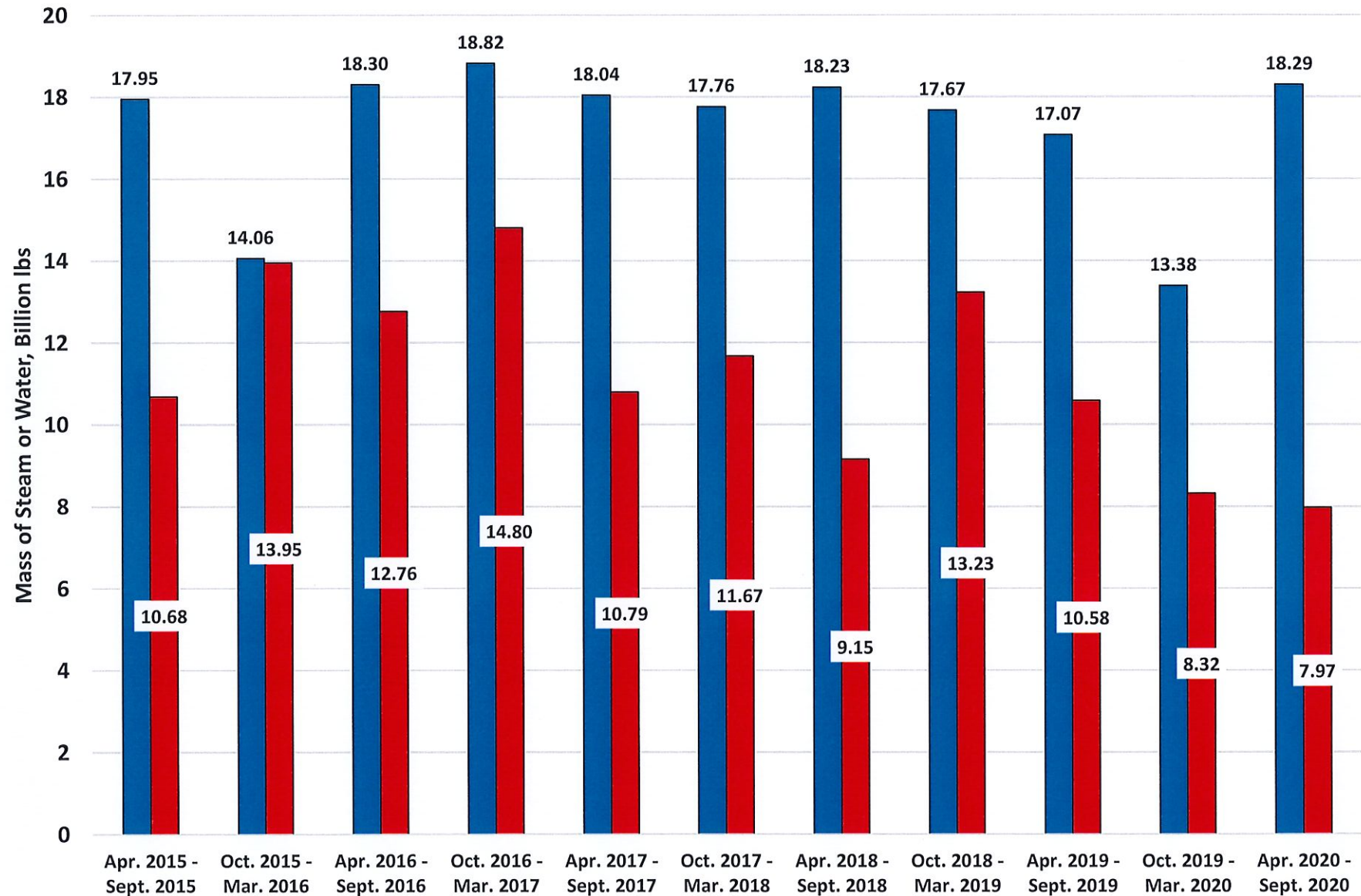
Magnitude > 1.5 - 50 Events

Magnitude > 3.0 - 2 Events

With One Event Outside Study Area

SEISMIC EVENTS
REPORTED BY THE USGS
(from U.C. Berkeley Catalog)

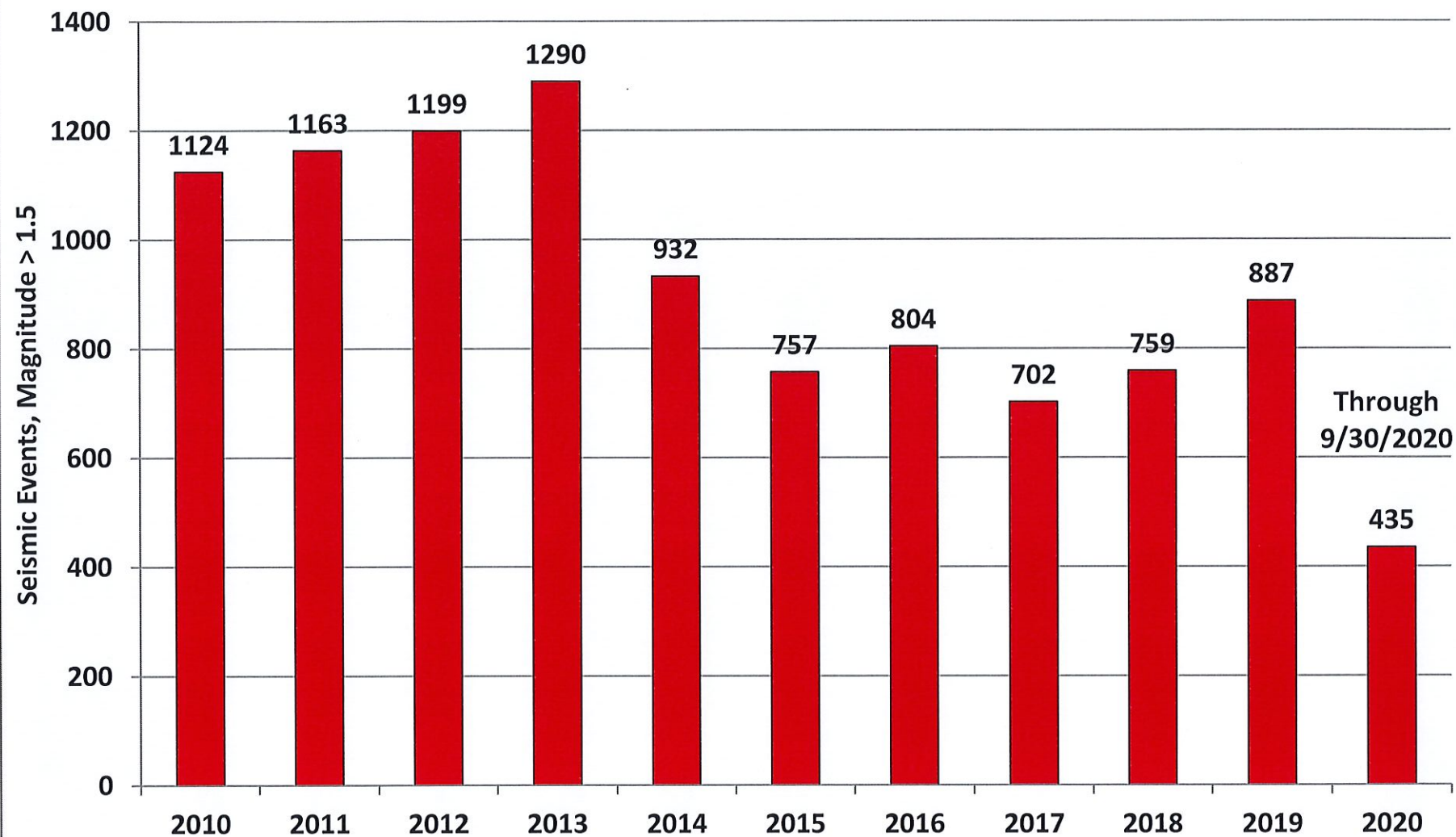
SE Geysers Production and Injection
Figure 5



The Geysers (KGRA) - Historical Seismic Activity

Magnitude > 1.5

Figure 6





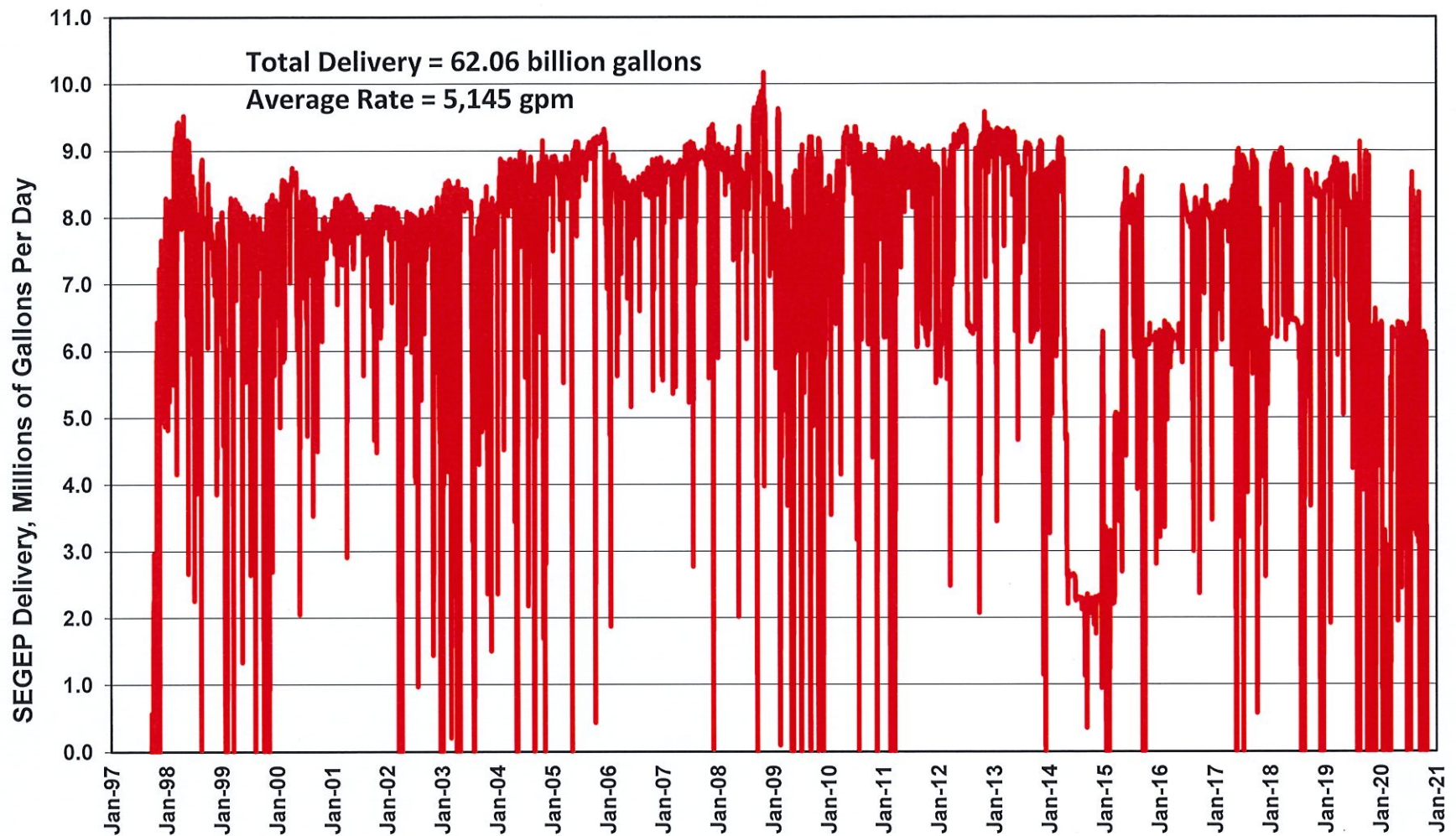
SMAC Report – Fall 2020

Ed Voge
Reservoir Engineer
November 9, 2020



Historical SE Geysers Effluent Pipeline Deliveries to The Geysers

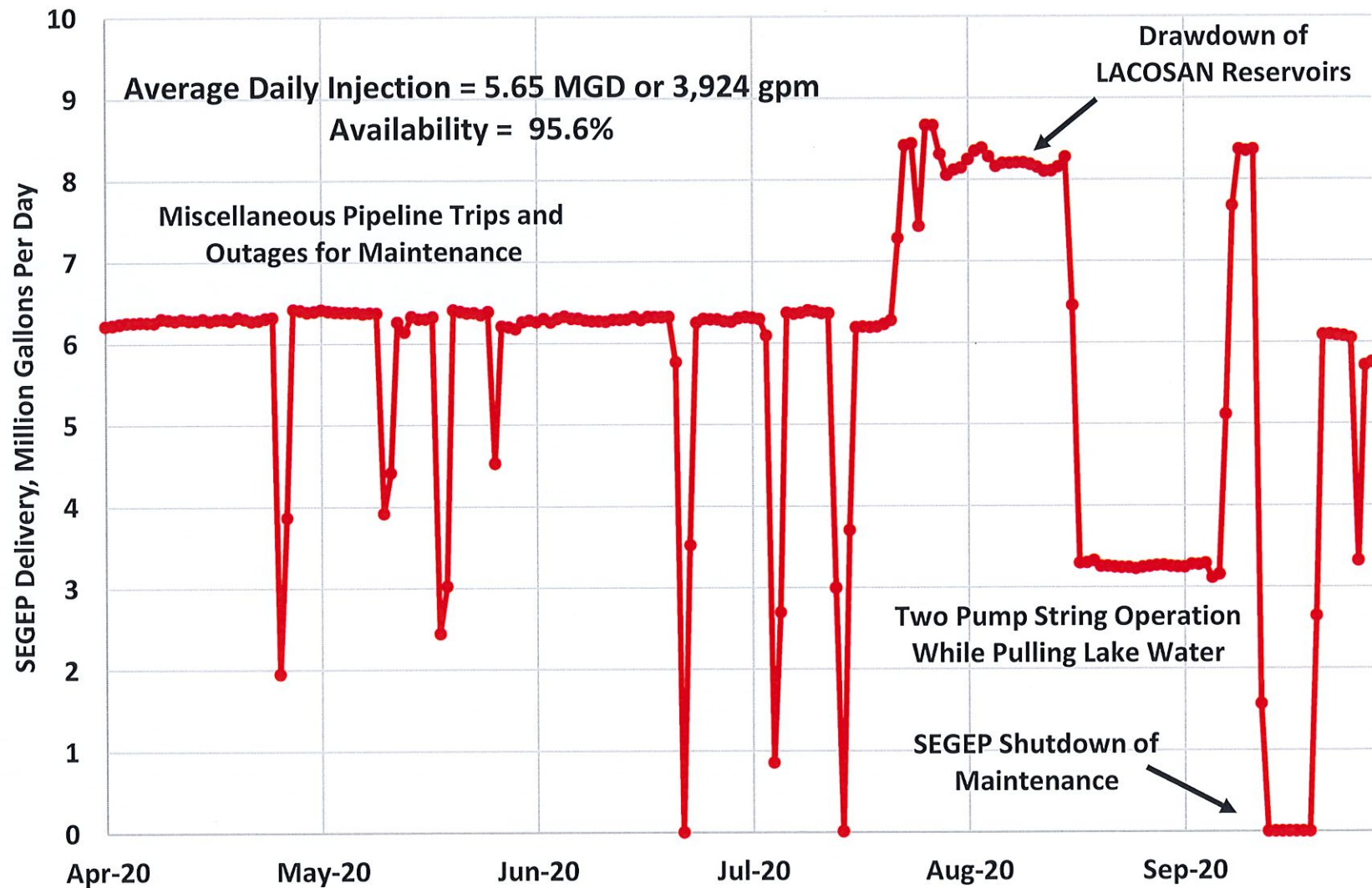
Figure 1



Southeast Geysers Effluent Pipeline Delivery

April 1 - September 20, 2020

Figure 2



Southeast Geysers - Historical Seismic Activity

Magnitude > 1.5

Figure 3

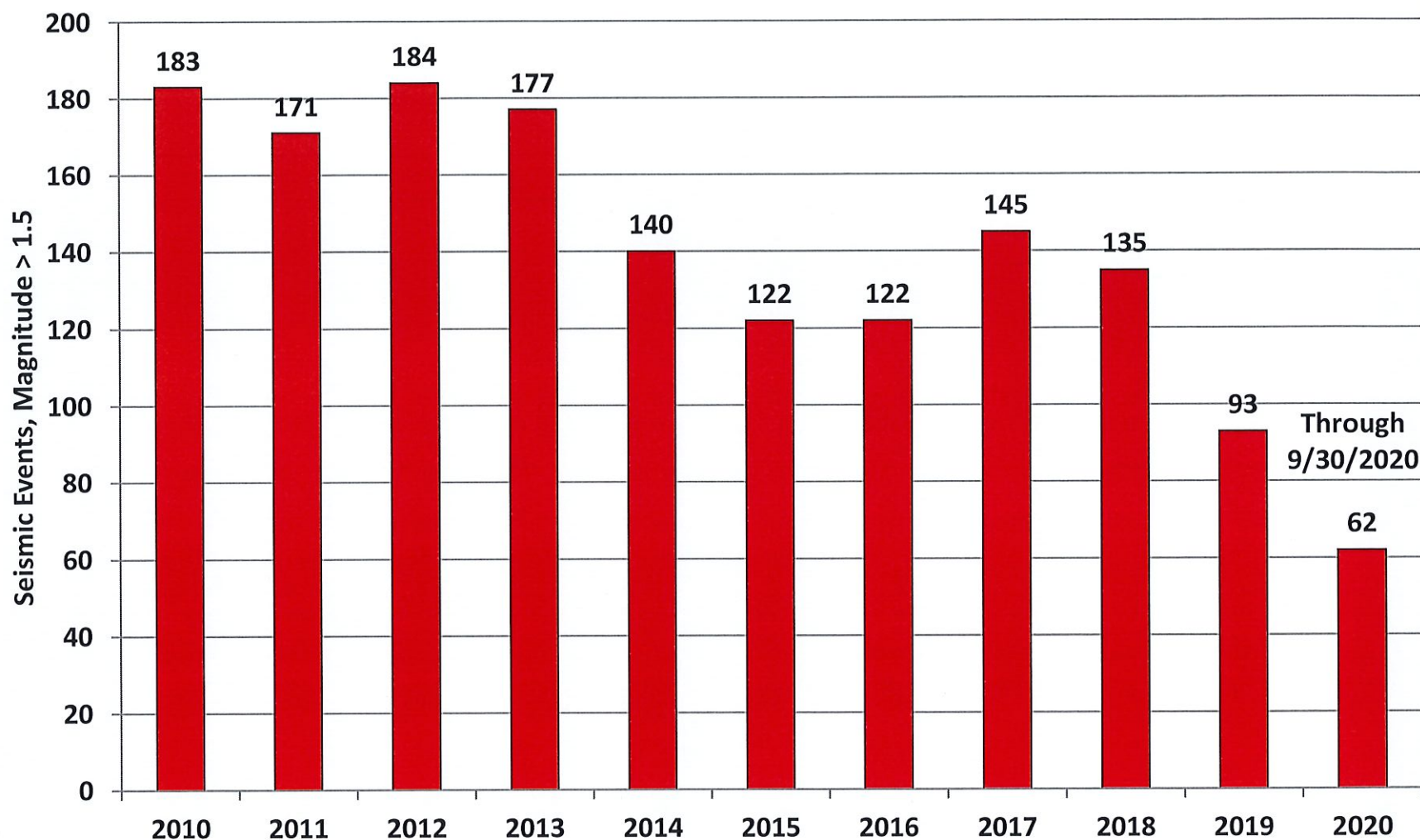
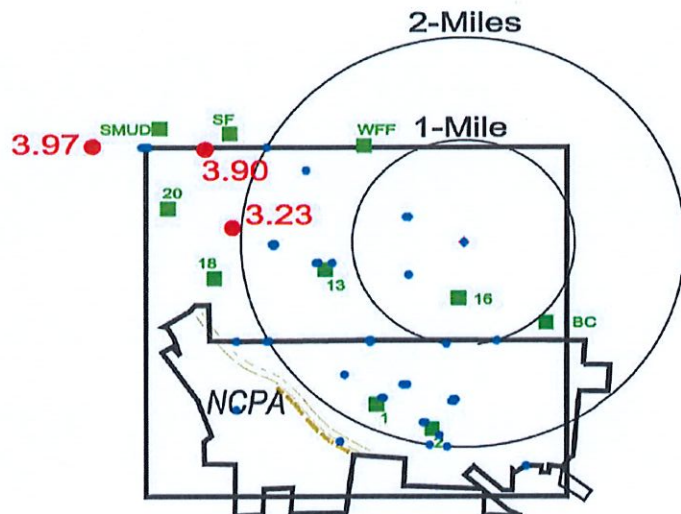


Figure 4



Radial distances are
from Anderson Springs
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Apr. 1 - Sept. 30, 2020

Magnitude > 1.5 - 50 Events

Magnitude > 3.0 - 2 Events

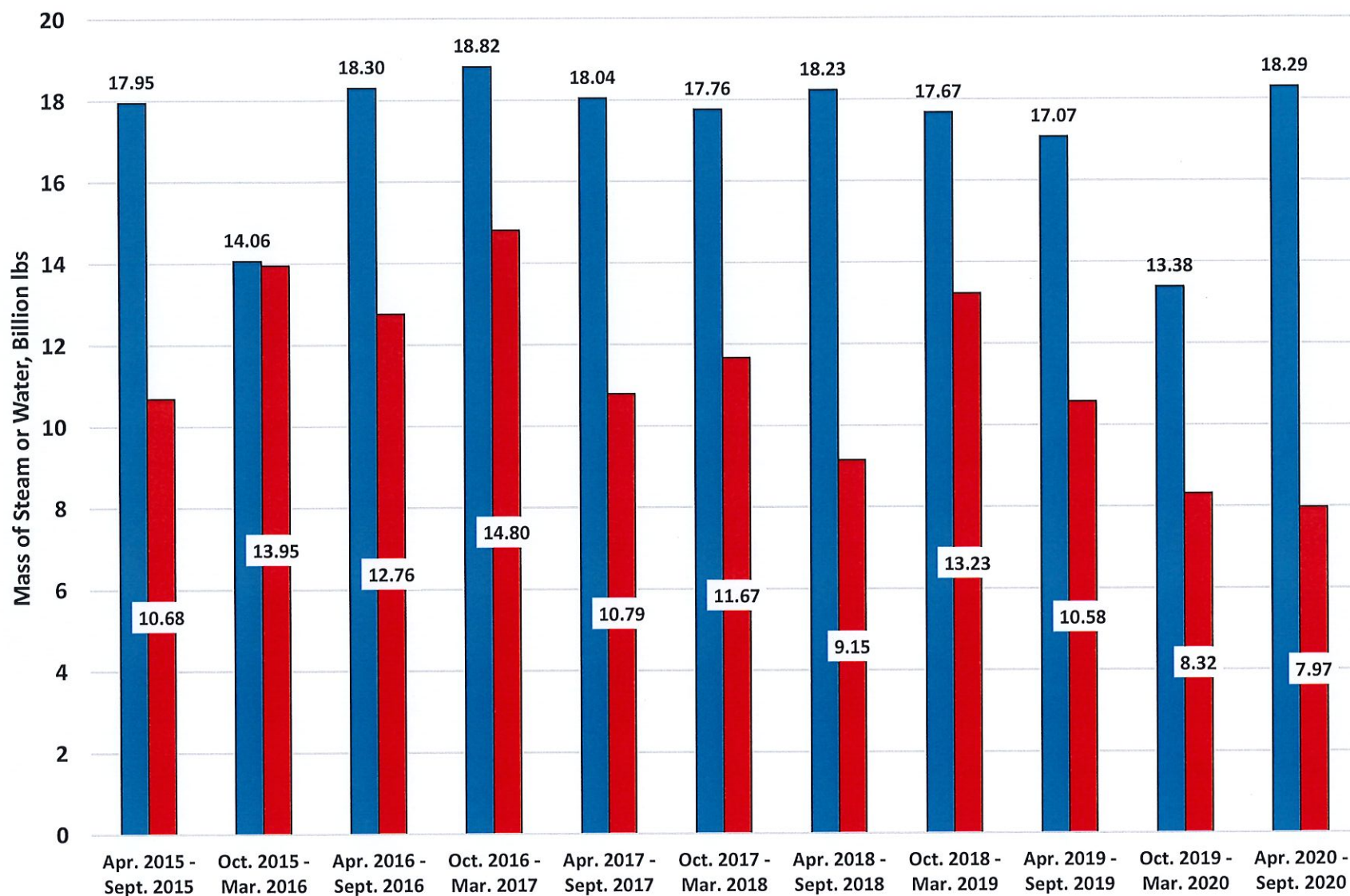
With One Event Outside Study Area

SOUTH EAST
GEYSERS
SEISMIC STUDY
AREA

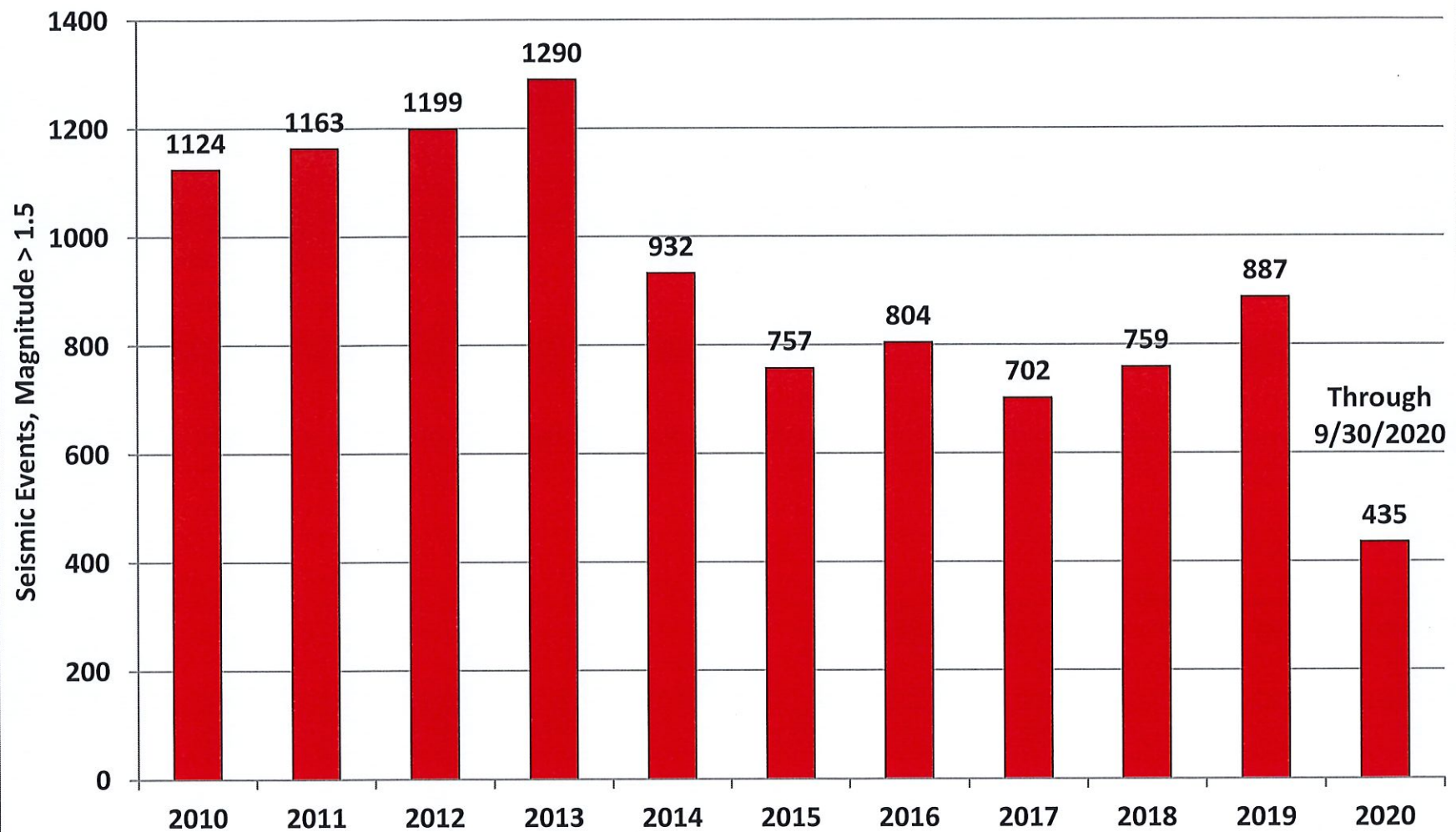
SEISMIC EVENTS
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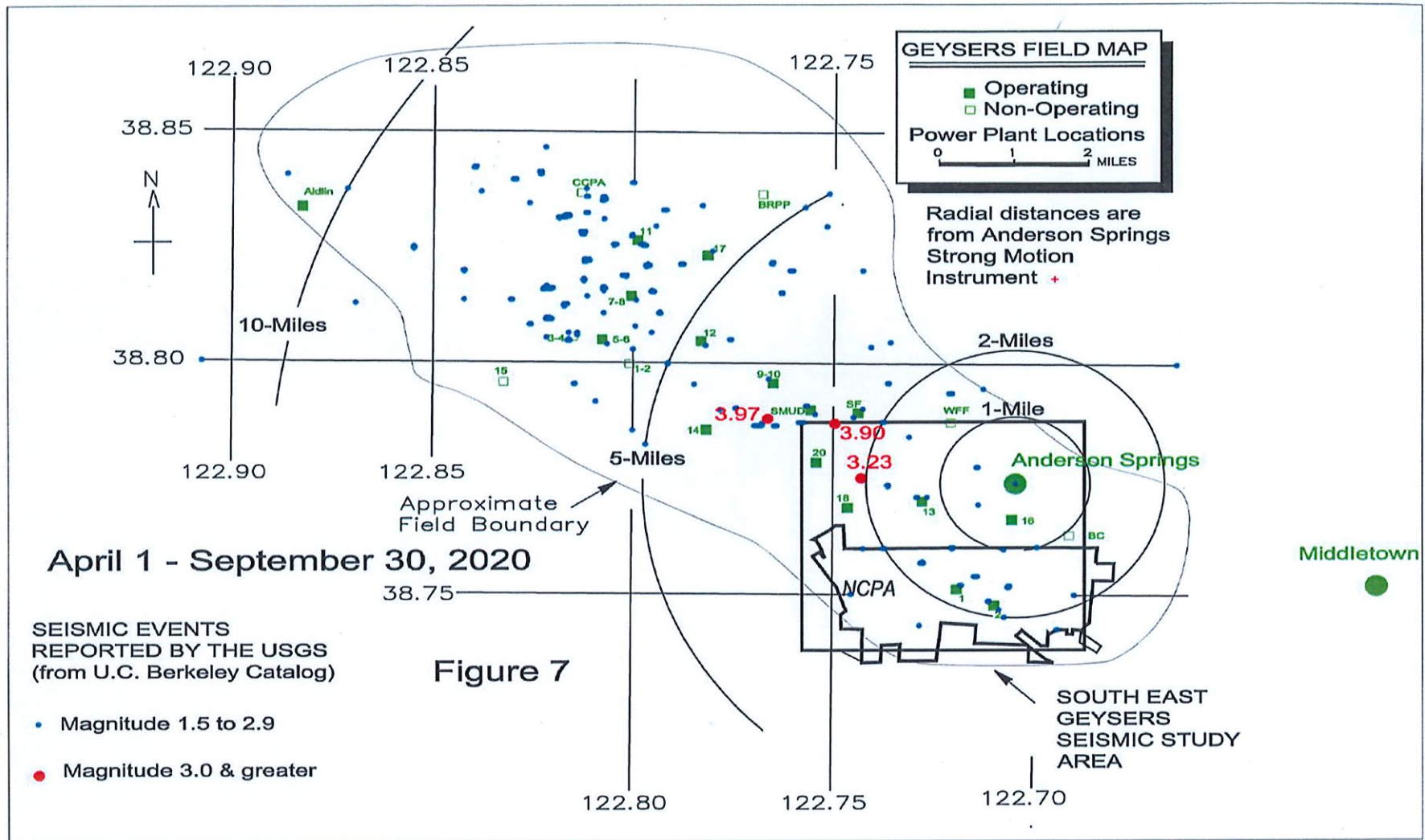
SE Geysers Production and Injection

Figure 5



The Geysers (KGRA) - Historical Seismic Activity Magnitude > 1.5 Figure 6





Summary

- **SEGEP Operation**
 - Injection Rate – 5,145 gpm
 - Pipeline availability – 95.6%
 - Several outages due to pipeline trips, maintenance, & PSPS events
- **Southeast Production & Injection**
 - Production – 18.29 Glbs
 - Injection – 7.97 Glbs
- **Seismic Activity – SE Geysers**
 - 50 Events > Magnitude 1.5
 - 2 Events > Magnitude 3.0
- **Seismic Activity – Geysers**
 - 309 Events > Magnitude 1.5
 - 3 Events > Magnitude 3.0
 - Highest Event – Magnitude 3.97