



November 13, 2018

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, 2018 through September 30, 2018

A. Pipeline Operations

The Southeast Geysers Effluent Pipeline (“SEGEP”) has been in operation for 21 years and has delivered over 57.74 billion gallons of water at an average rate of 5,231 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, 2018 through September 30, 2018, the SEGEP Pipeline was in operation 98.4% of the time (**Figure 2**). Pipeline delivery rates have averaged 6.97 million gallons per day (MGD) or 4,843 gpm. There were several curtailments and shutdowns for maintenance work. Most notably NCPA voluntarily curtailed injection levels from the period May 25, through August 30, 2018 to test the reservoir response in steam production. Injection activities on the NCPA lease returned to normal following this test.

B. Observed Seismicity

Seismic Activity in the Southeast Geysers

The USGS recorded 66 seismic events of magnitude 1.5 and greater within the SE Geysers area from April 1, 2018 through September 30, 2018. This is a slight increase over the previous six month period (October 1, 2017 through March 31, 2017) which recorded 63 seismic events greater than magnitude 3.0. Historical trends and locations of the recent events are shown respectively in **Figures 3 and 4**. There were no seismic events greater than magnitude 3.0 in the Southeast Geysers during this same period.

In combination with the seismic activity, steam production for the Southeast Geysers area was 18.23 billion pounds mass for the past six months. This value is up slightly from the previous six

month period where 17.76 billion pounds was produced. Due to NCPA's curtailed injection test, water injection levels were down to 9.15 billion pounds of water injected. This compares with the 11.67 billion pounds of water injected from October 31, 2017 through March 31, 2018.

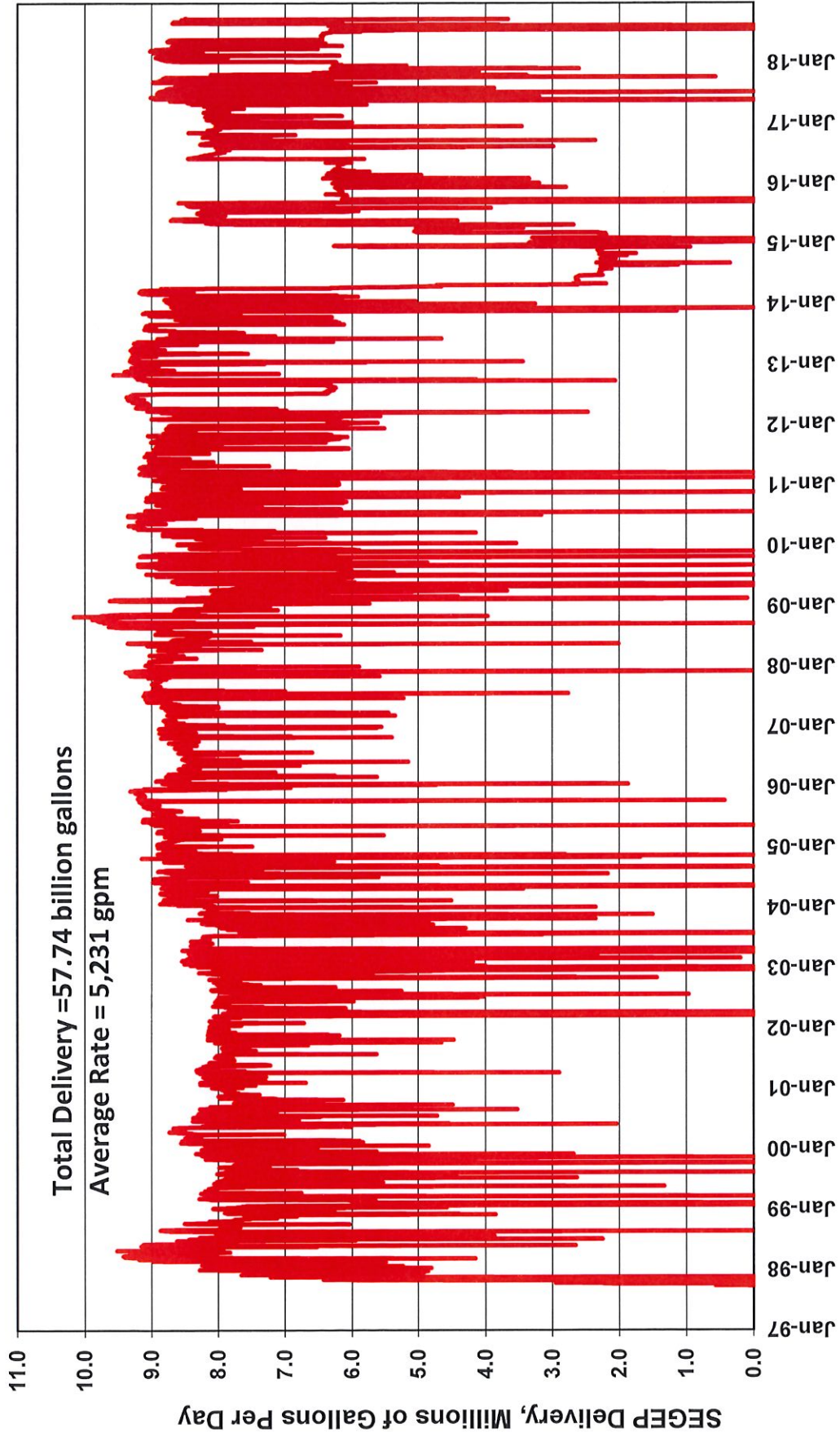
Figure 5 shows the historical changes in steam production, water injection and recorded seismicity within the Southeast Geysers area.

Seismic Activity in The Geysers (KGRA)

Within the Geysers geothermal field, there have been 355 events of magnitude 1.5 and greater recorded from April 1 through September 30, 2018. This amount is down from 375 events recorded from the previous six month period. There were 6 events of magnitude 3.0 or greater. The largest event was magnitude 4.19, which occurred on May 10, 2018. **Figure 6** shows the trends of seismic events for the Geysers since 2002 while **Figure 7** shows the location of the events for the last six months.

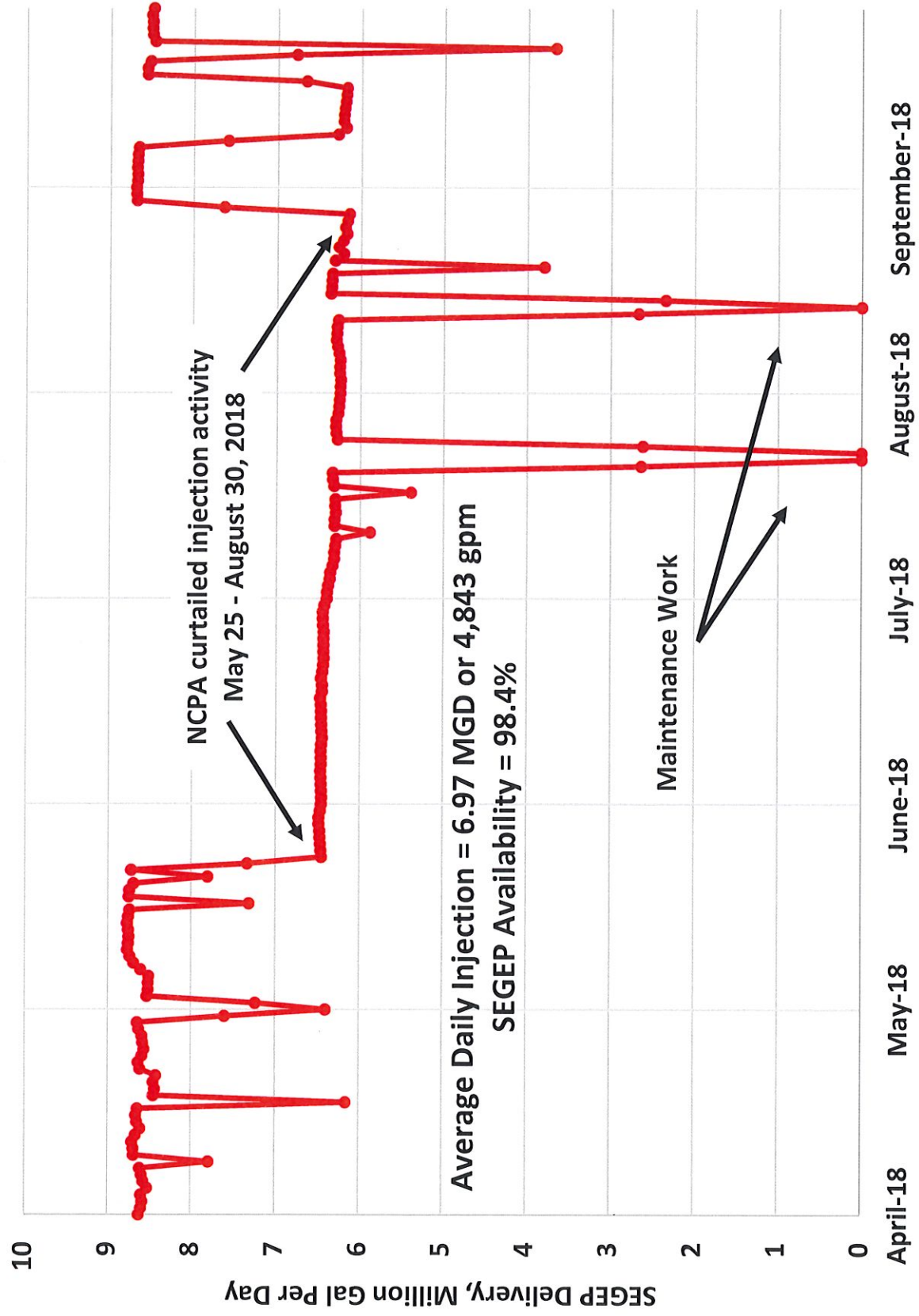
Ed Voge
Reservoir Engineer
NCPA Geothermal Facility

Historical SE Geysers Effluent Pipeline Deliveries to The Geysers
Figure 1



Southeast Geysers Effluent Pipeline Delivery

Figure 2



Southeast Geysers - Historical Seismic Activity

Magnitude > 1.5

Years 2002 - 9/30/2018

Figure 3

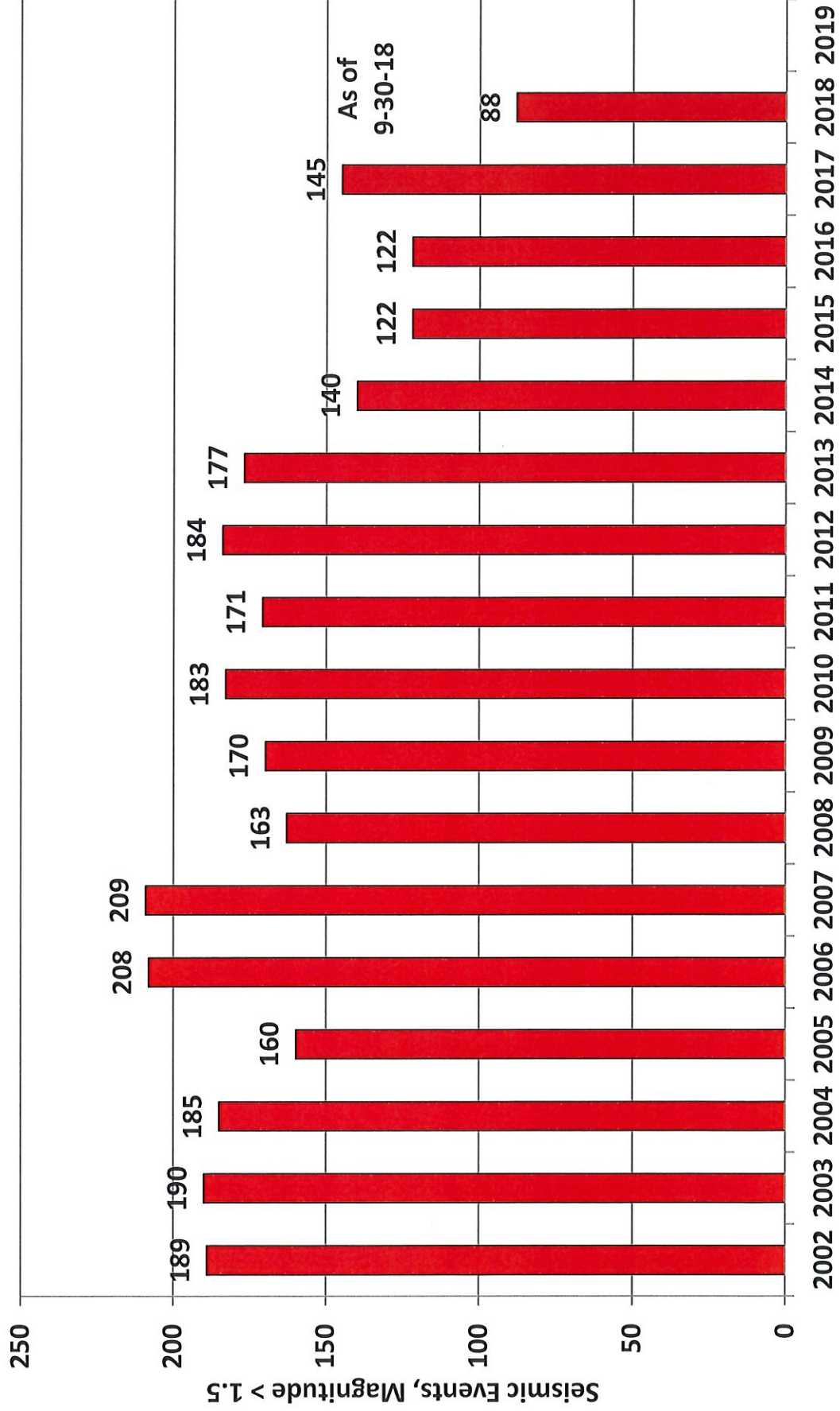
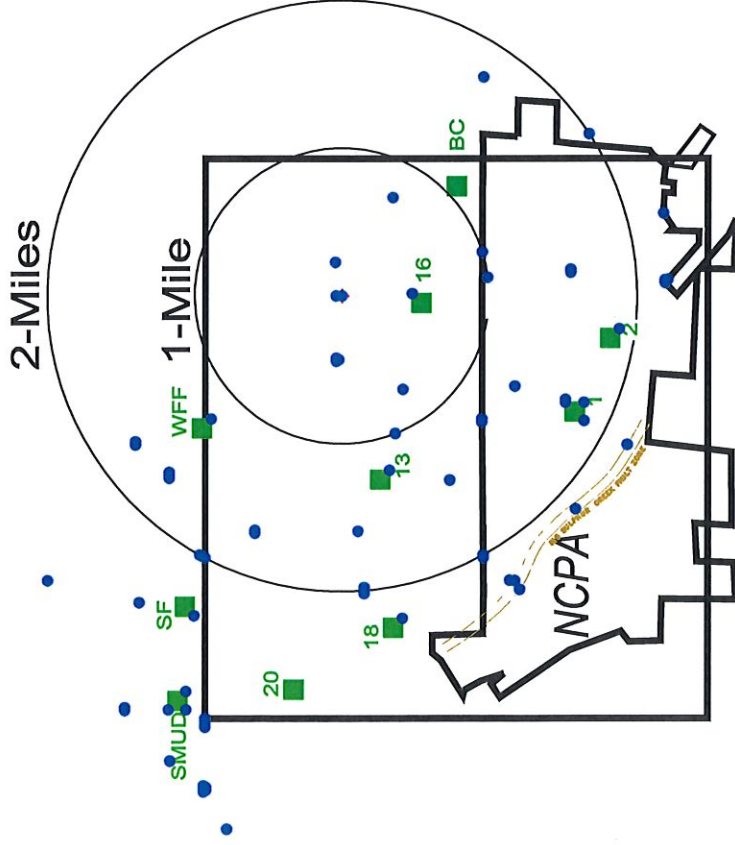


Figure 4



Radial distances are
from Anderson Springs
Strong Motion
Instrument

Apr. 1 - Sept. 30, 2018

Magnitude > 1.5 - 66 Events

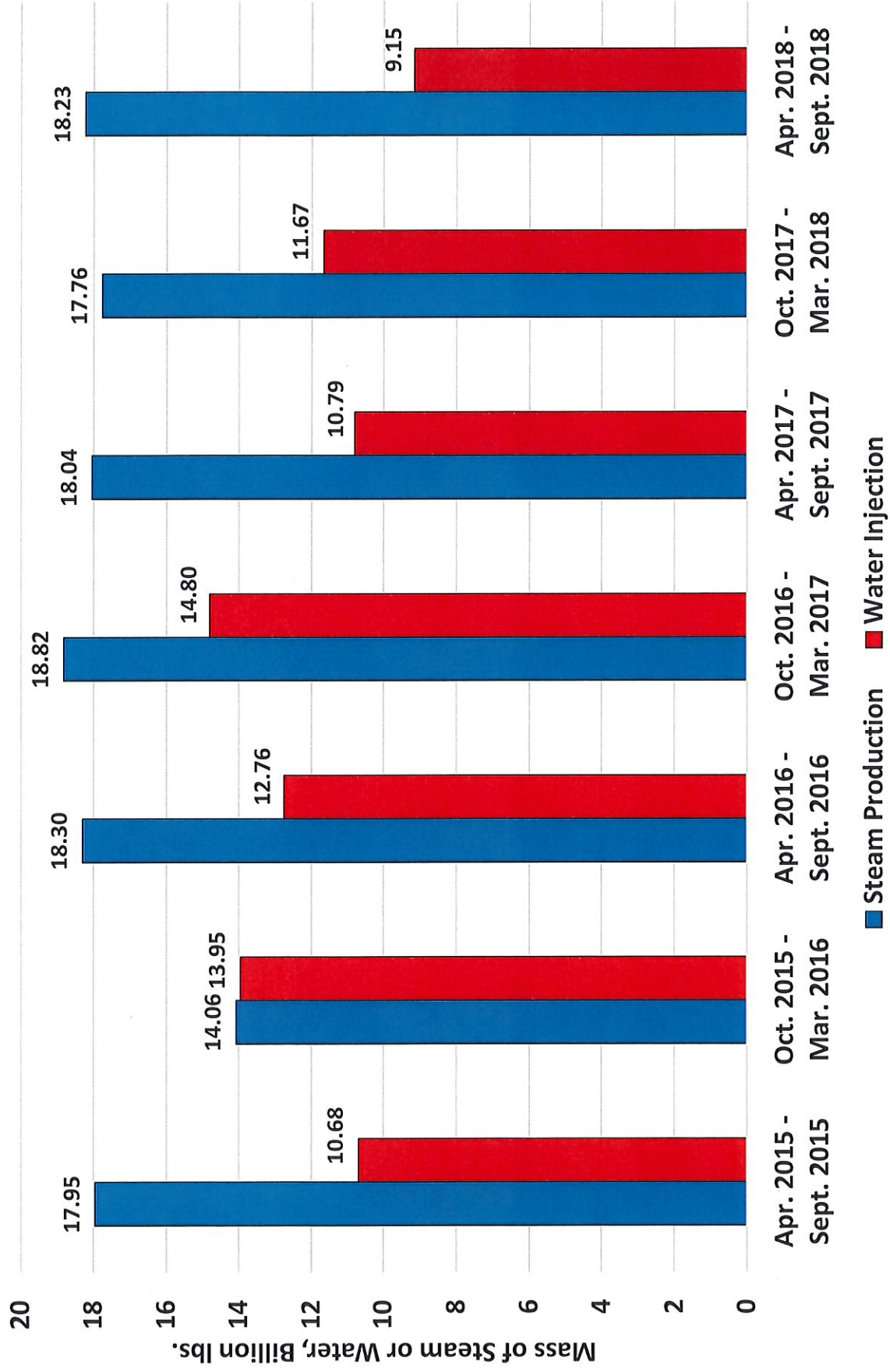
Magnitude > 3.0 - No Events

SOUTH EAST
GEYSERS
SEISMIC 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

Years 2002 - 9/30/2018

Figure 6

