

May 8, 2017

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 October 1 2016 through March 31, 2017

### **A. Pipeline Operations**

The Southeast Geysers Effluent Pipeline (“SEGEP”) has been in operation for over 19 years and has delivered almost 54 billion gallons of water at an average rate of 5,233 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 recent six-month period of October 1, 2016 through March 31, 2017, the SEGEP Pipeline was in operation 99.5% of the time (**Figure 2**). Pipeline delivery rates have averaged 7.5 million gallons per day (MGD) or 5,505 gpm. There was one pipeline outage due to a failed pressure switch and reductions in pump rates due to abundant precipitation.

In this reporting period 65% of the water delivered by the pipeline was treated effluent and the remaining 35% was Clearlake water. Due to the heavy rains, 100% of delivery was treated effluent after January 10. (**Figure 3**) Approximately 69% of the SEGEP water was utilized by NCPA while Calpine received 31% (**Figure 4**). While still below historical levels, Calpine slowly increased the percentage of water it received over the period.

### **B. Observed Seismicity**

#### Seismic Activity in The Geysers (KGRA)

Within the Known Geothermal Resource Area (KGRA) of The Geysers geothermal field, there have been 377 events of magnitude 1.5 and greater recorded by the USGS for the past six months. There were 7 events of magnitude 3.0 and greater, the same as the previous 6 months. The largest event was magnitude 5.01, occurring Dec 14, 2016. The event was located in the North West Geysers approximately 8.6 miles from the Anderson Springs Strong Motion

instrument (Figure 5). 804 seismic events greater than magnitude 1.5 occurred in 2016. (Figure 7) This is an increase from 757 events recorded in 2015.

#### Seismic Activity in the Southeast Geysers

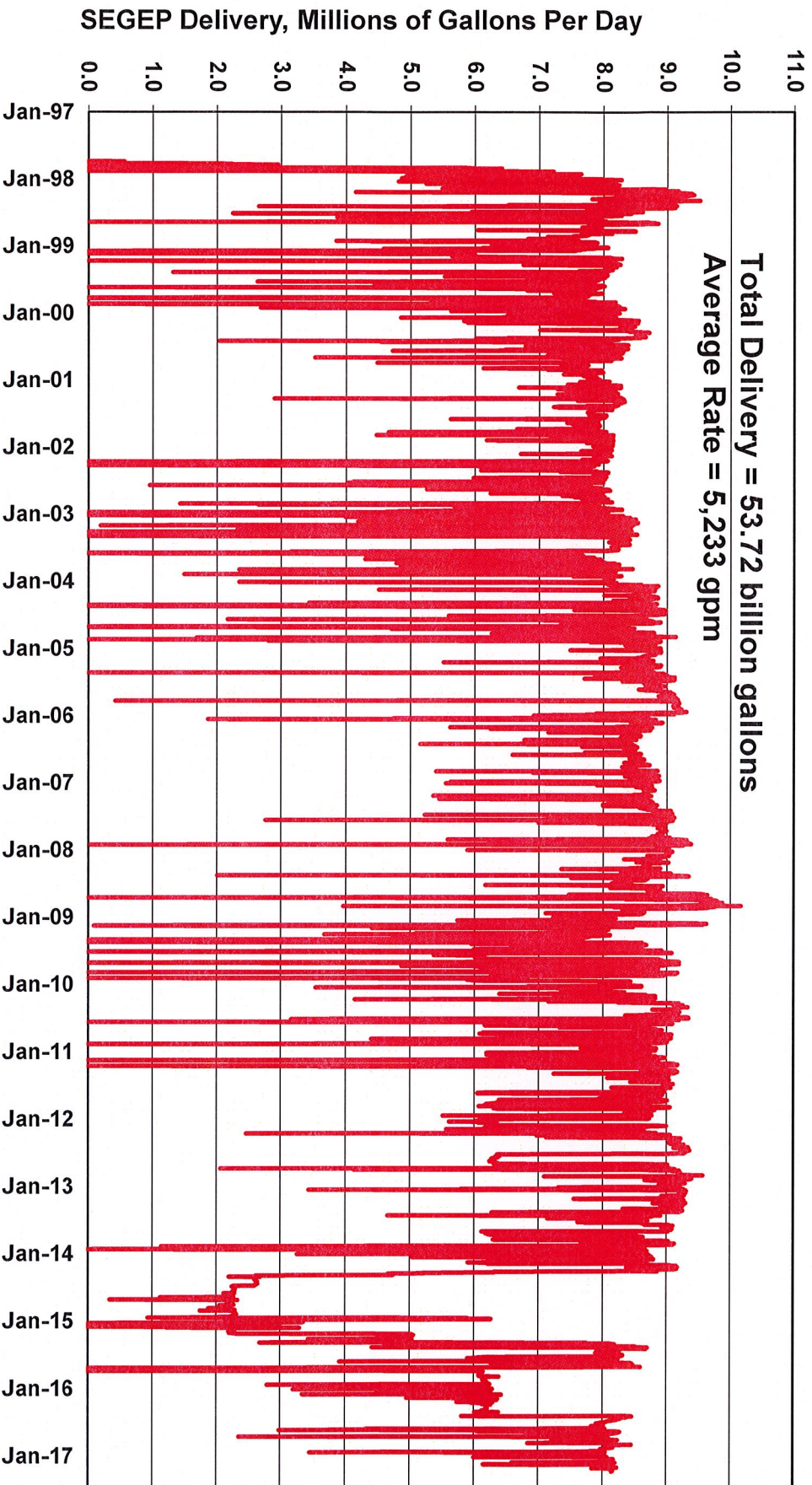
The USGS recorded 71 seismic events of magnitude 1.5 and greater within the SE Geysers area from October 1, 2016 through March 31, 2016. Their locations are shown in **Figure 6**. During this period, there was one seismic event in the area equal to or greater than magnitude 3.0. This was an event of magnitude 3.33 near the southeast corner of the area, on the NCPA lease. This event occurred November 11, 2016.

During this period, seismic activity between magnitudes 1.5 and 3.0 in the Southeast Geysers averaged 11.7 events per month. This level of activity is up from an average of 7.6 events per month for the period of April 1, 2015 through September 30, 2016. 122 seismic events greater than magnitude 1.5 were recorded in 2016. This is the same number of events as 2015 (**Figure 8**).

Les Drake  
Geologist  
NCPA Geothermal Facility



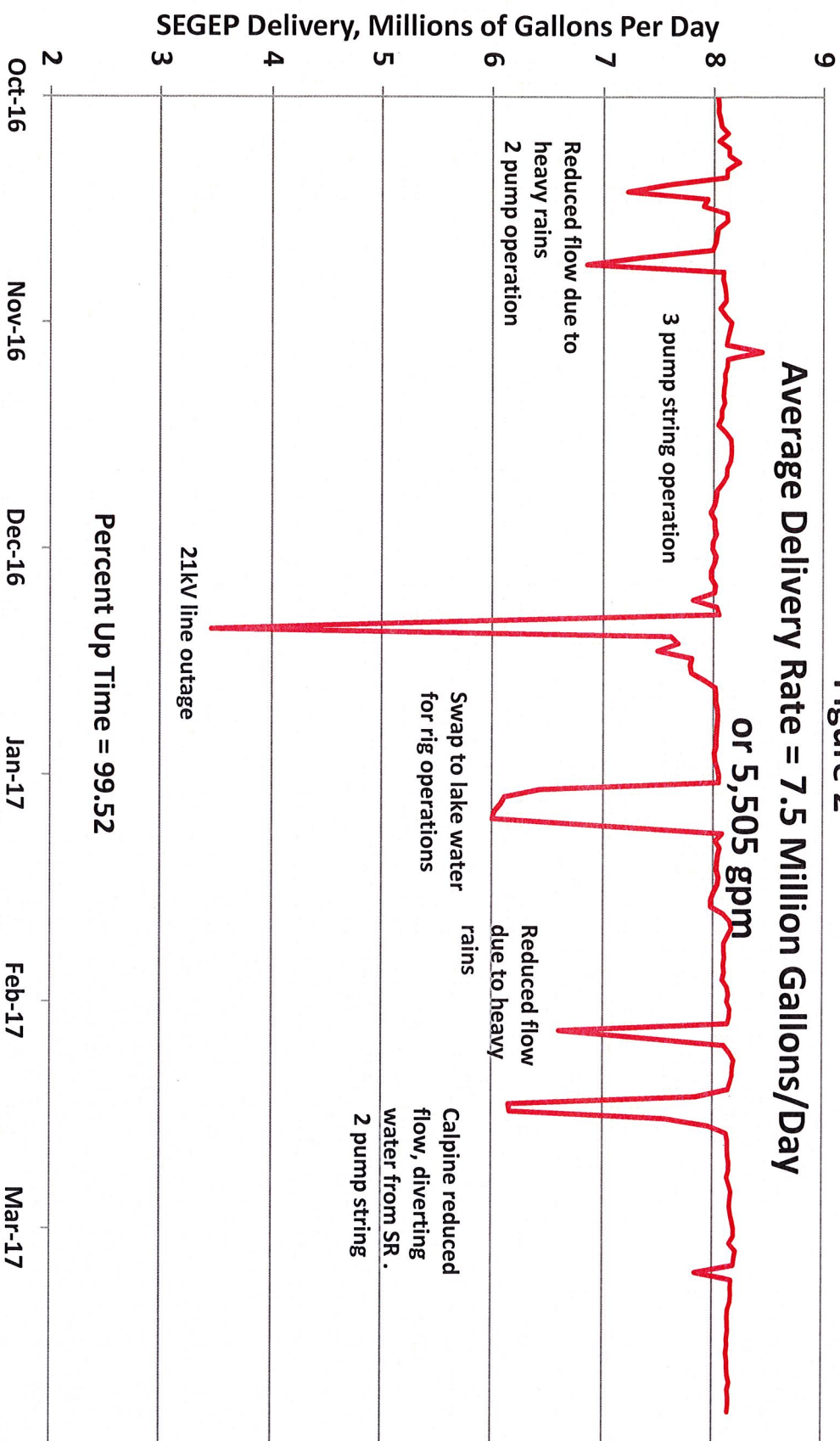
Historical SE Geysers Effluent Pipeline Deliveries to The Geysers  
Figure 1





## Southeast Geysers Effluent Pipeline Delivery Oct 1, 2016 through March 31, 2017

Figure 2



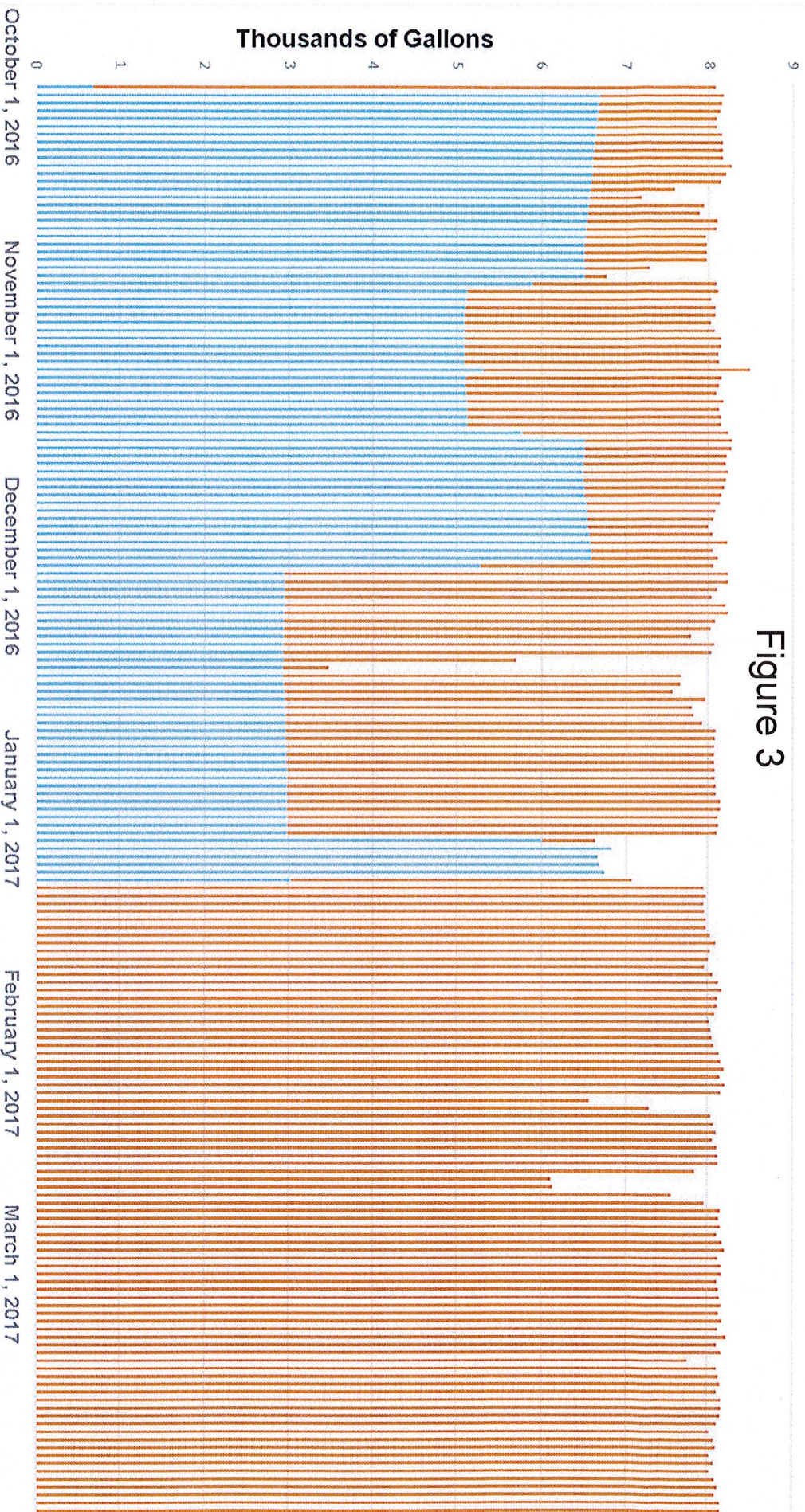




■ Lake Water ■ Effluent Water

**Daily SEGEP Delivery  
Lake & Effluent Water**

Figure 3







■ NCPA ■ Calpine

### Daily SEGEP Delivery

### NCPA And Calpine

Figure 4

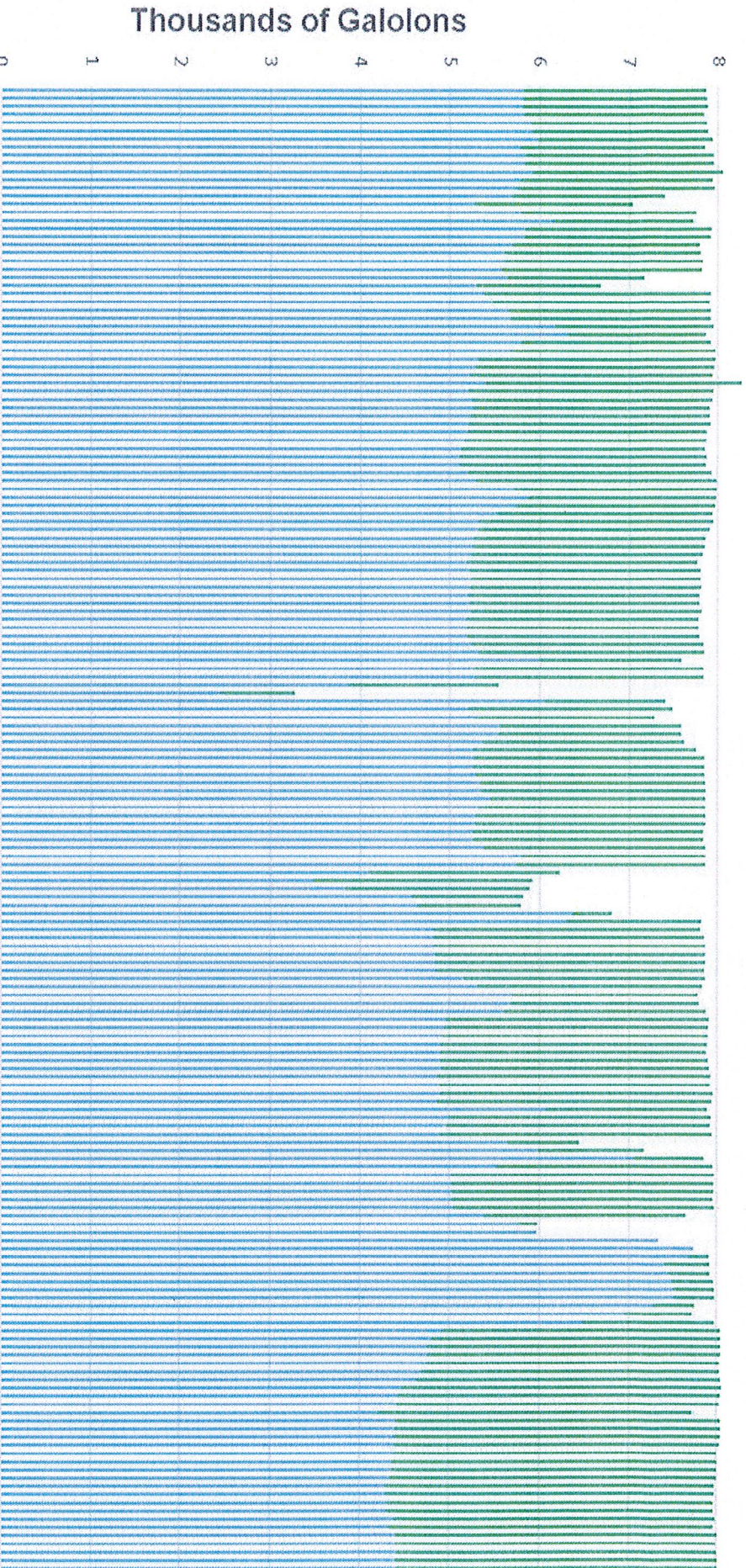




Figure 5

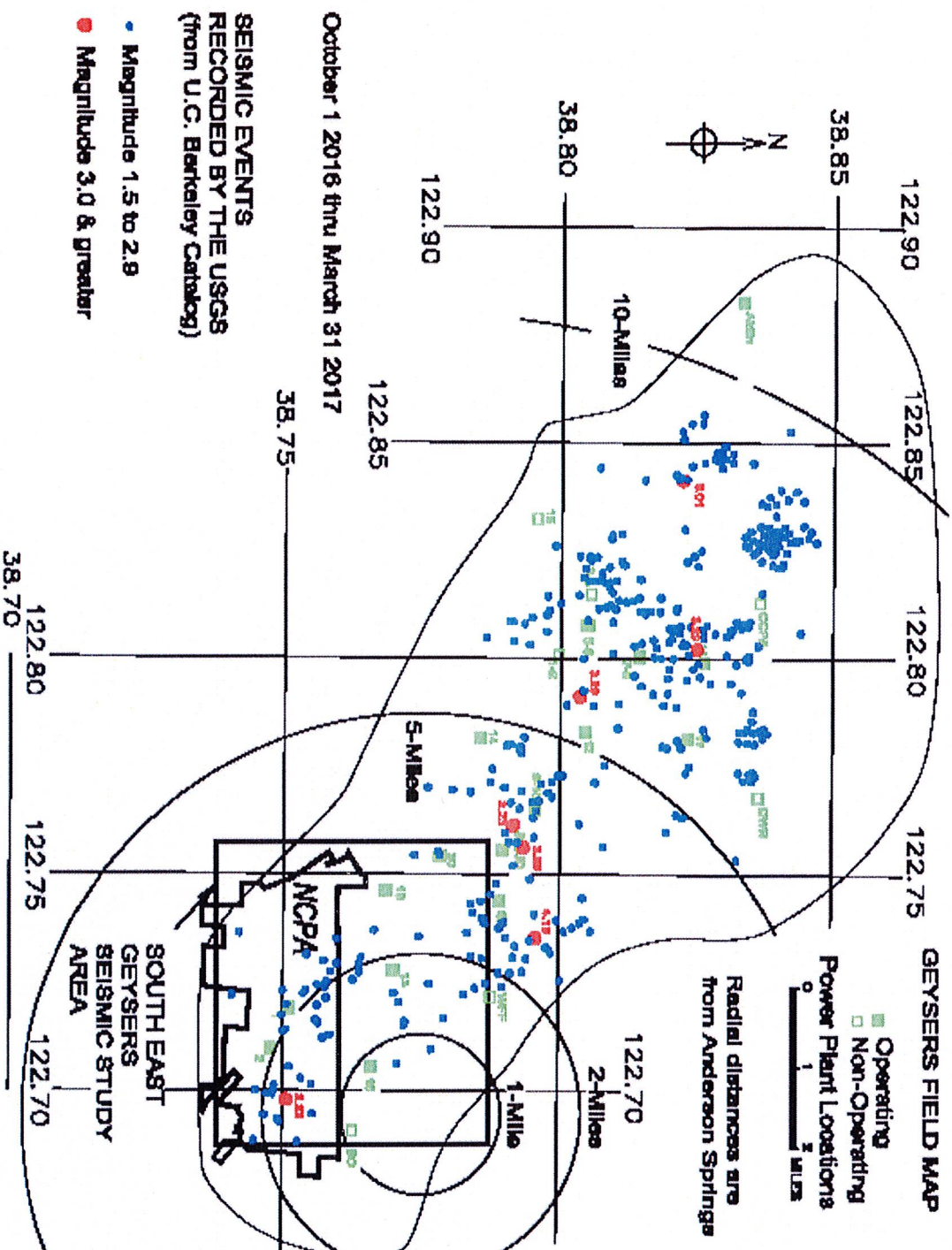
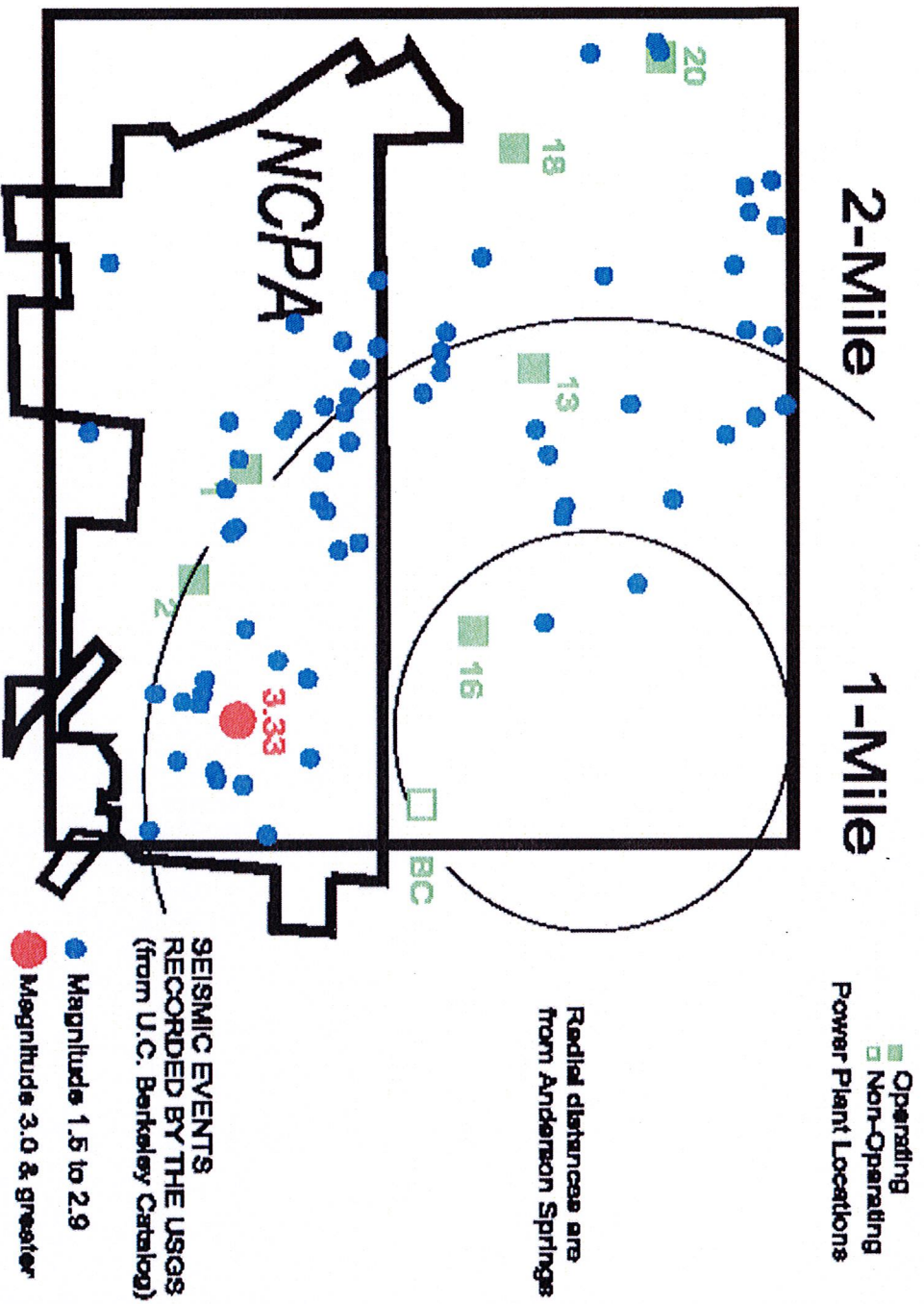


Figure 6

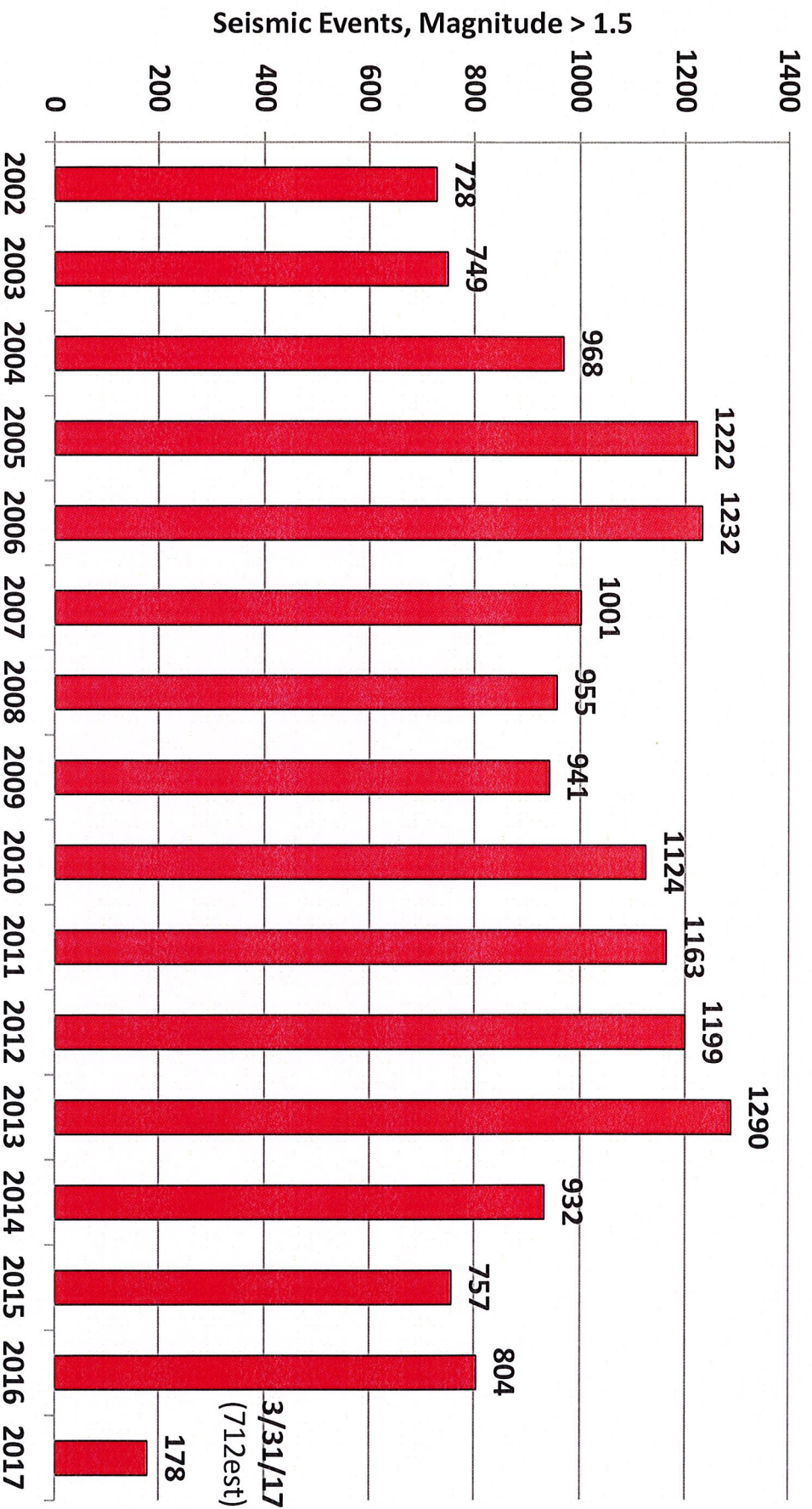




## The Geysers (KGRA) - Historical Seismic Activity

Magnitude > 1.5  
Years 2002 - 2016

Figure 7



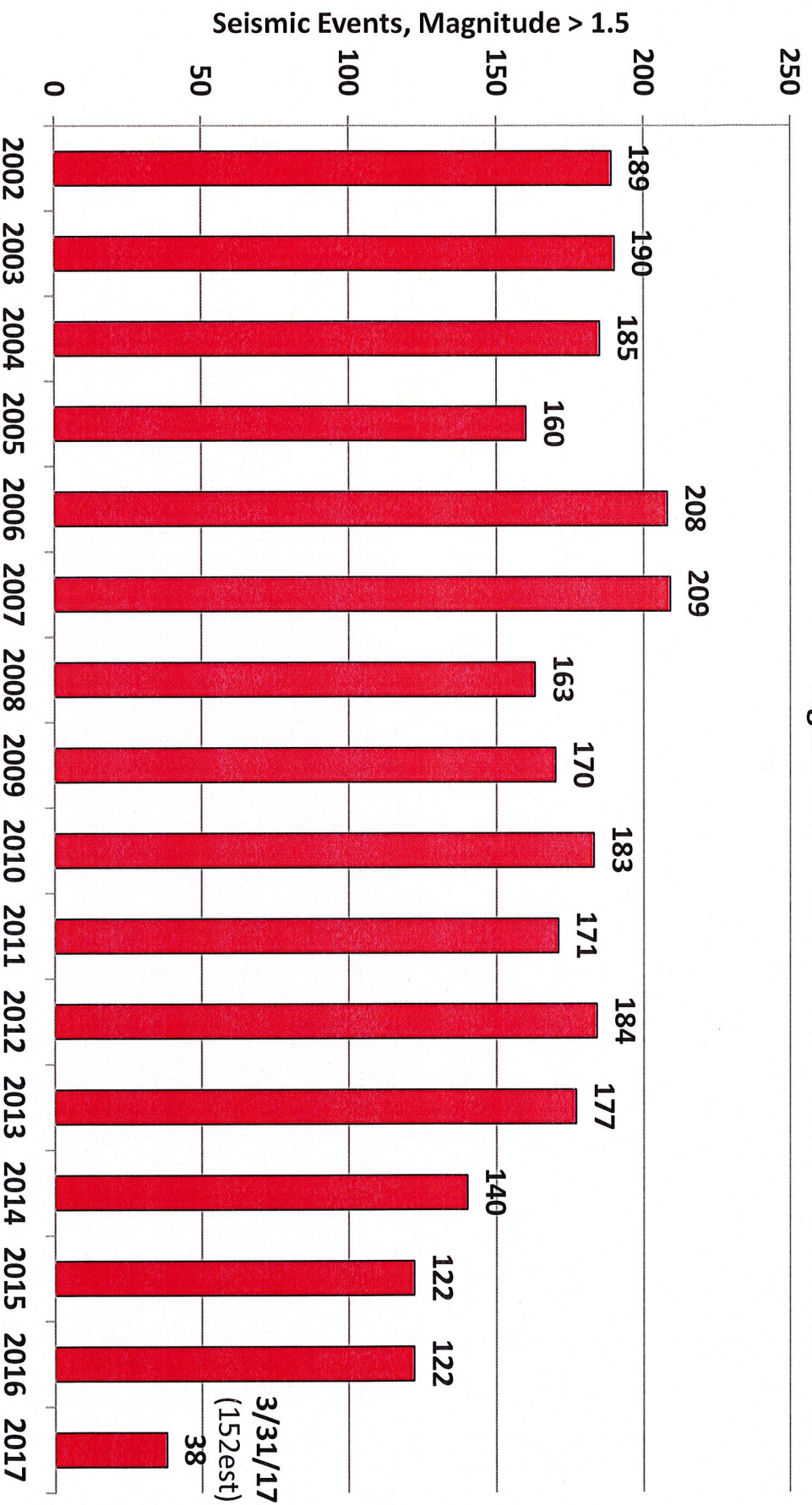


## Southeast Geysers - Historical Seismic Activity

Magnitude > 1.5

Years 2002 - 2016

Figure 8





## **Summary**

### **South East Geysers, Oct 1, 2016 – March 31, 2017**

- **Average SEGEP injection – 7.5 million GPD**
- **The pipeline has been in operation 99.5% of this interval.**
- **There were weather related reductions and 1 brief maintenance outage.**
- **SEGEP water injection totaled 12.04 billion lbs.**
- **Seismic activity was up from the previous 6 months in the South East Geysers.**
  - **71 seismic events during the last 6 months magnitude 1.5 or greater, compared to 46 events the previous 6 months**
  - **1 seismic event with magnitude 3.33**