



Nov 9, 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 April 1 2017 through Sept 30, 2017

A. Pipeline Operations

The Southeast Geysers Effluent Pipeline (“SEGEP”) has been in operation for over 20 years and has delivered over 55 billion gallons of water at an average rate of 5,235 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 April 1, 2017 through Sept 30, 2017, the SEGEP Pipeline was in operation 95.4% of the time (**Figure 2**). Pipeline delivery rates have averaged 7.6 million gallons per day (MGD) or 5,291 gpm. There were multiple pipeline outages due mechanical and electrical issues. Flow was restricted to lake water and a 2 pump string for a period of 2 weeks for annual maintenance.

In this reporting period, 53% of the water delivered by the pipeline was treated effluent and the remaining 47% was Clearlake water. Due to heavy winter rains, 100% of delivery was treated effluent at the start of this period. (**Figure 3**). 45.5% of the SEGEP water was utilized by NCPA while Calpine received 55.5% (**Figure 4**).

B. Observed Seismicity

Seismic Activity in The Geysers (KGRA)

Within the Known Geothermal Resource Area (KGRA) of The Geysers geothermal field, there have been 337 events of magnitude 1.5 and greater recorded, down from the 377 events during the previous 6-month period. There were 4 events of magnitude 3.0 and greater, down from 7 events of the previous 6 months. The largest event was magnitude 3.98, occurring April 30, 2017. The event was located to the north west of Anderson Springs approximately 4.6 miles (Figure 5). 515 seismic events greater than magnitude 1.5 have occurred by Sept 30 this year.

(**Figure 7**) 687 events are projected by year-end. This would be a decrease from 804 events recorded in 2016.

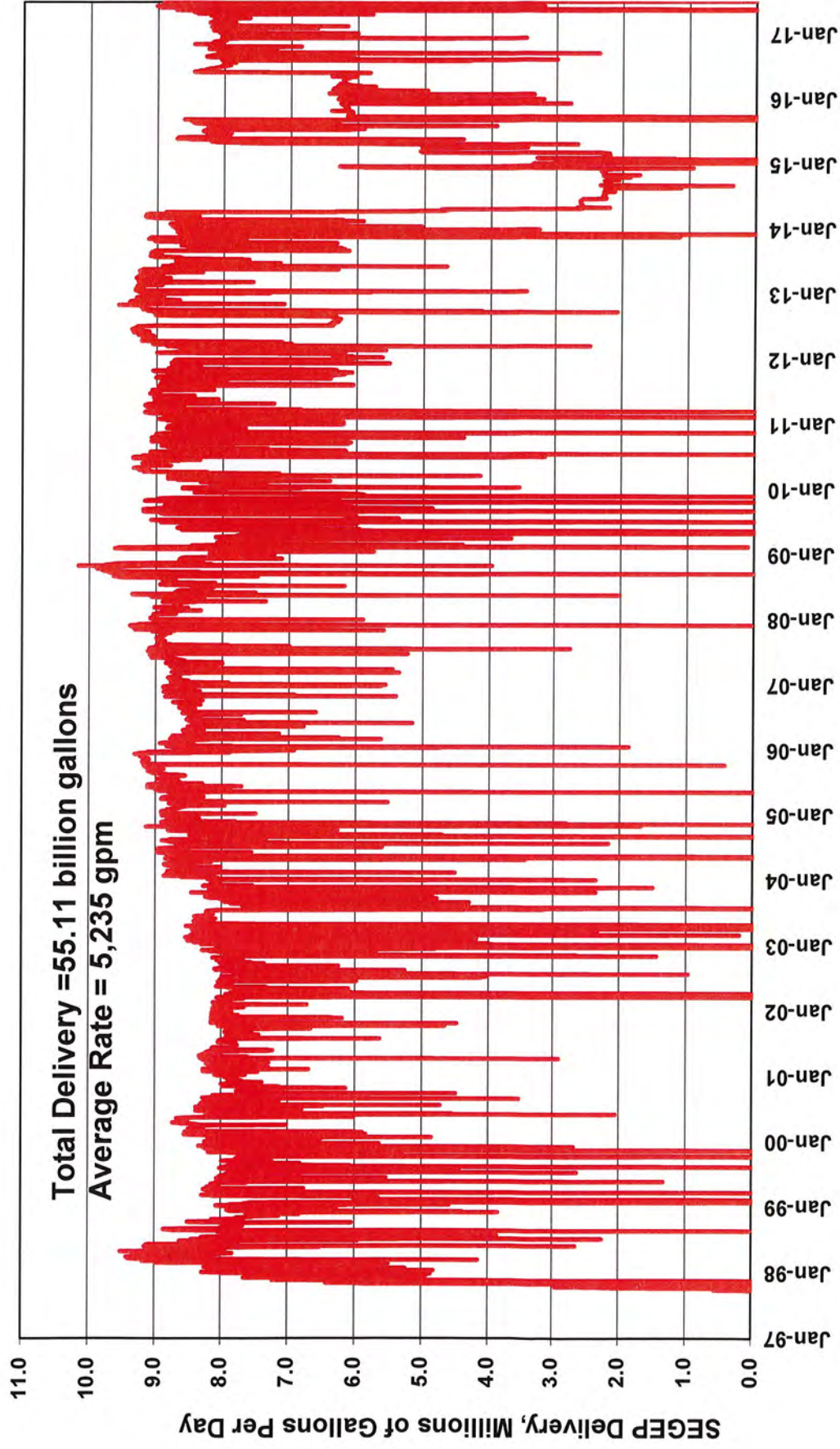
Seismic Activity in the Southeast Geysers

The USGS recorded 64 seismic events of magnitude 1.5 and greater within the SE Geysers area from April 1, 2017 through Sept 30, 2017. 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 3.73 approximately 1.5 miles west of Anderson Springs. This event occurred April 17, 2017.

During this period, seismic activity between magnitudes 1.5 and 3.0 in the Southeast Geysers averaged 10.7 events per month. This level of activity is down slightly from an average of 11.7 events per month for the previous 6-month period. 103 seismic events greater than magnitude 1.5 have been recorded by Sept 30 this year. 137 events are projected for this year. This is an approximately 11% increase from last year. (**Figure 8**).

Les Drake
Geologist
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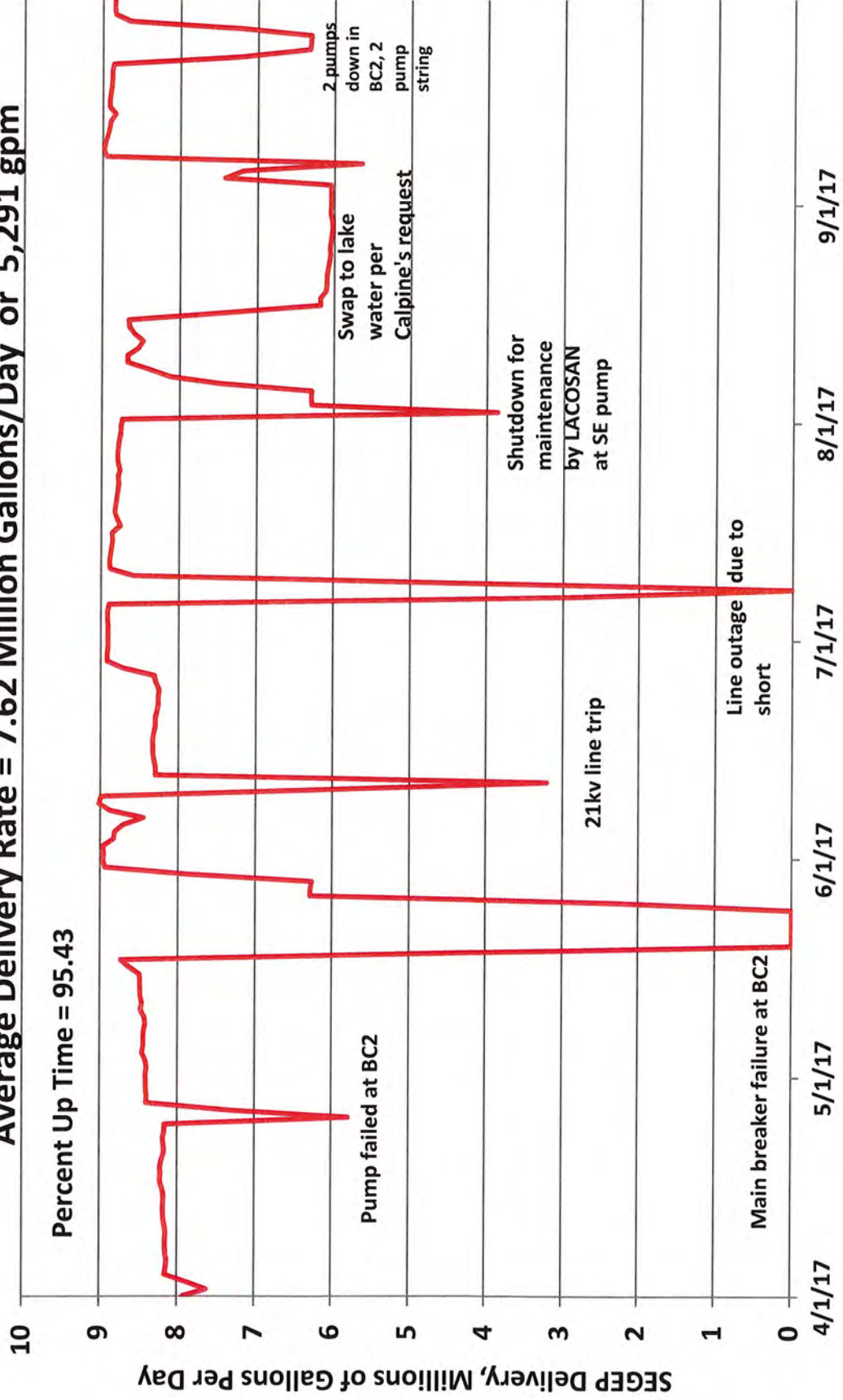
Historical SE Geysers Effluent Pipeline Deliveries to The Geysers Figure 1



Southeast Geysers Effluent Pipeline Delivery

Figure 2

Average Delivery Rate = 7.62 Million Gallons/Day or 5,291 gpm

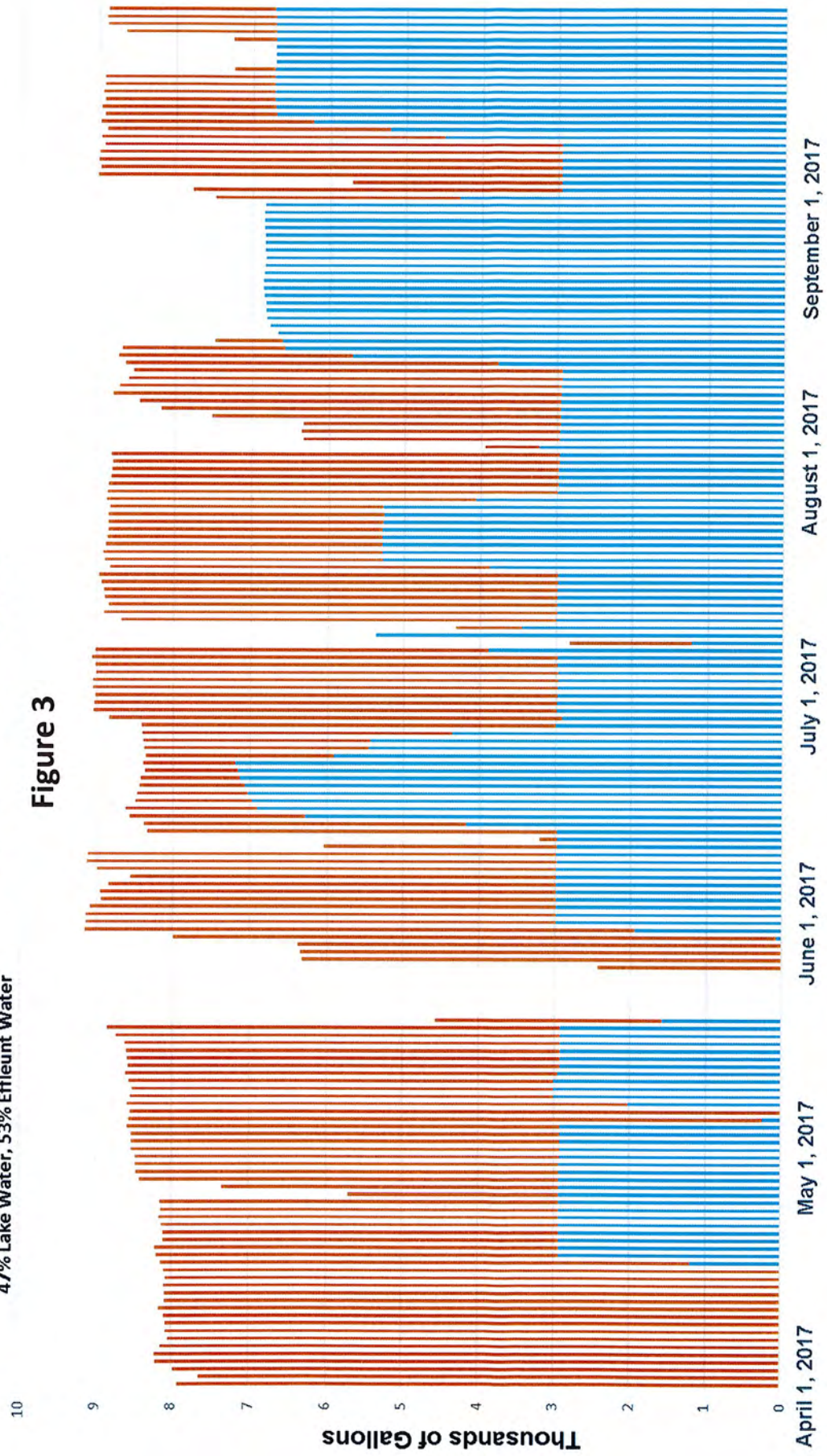




Daily SEGEP Delivery Lake & Effluent Water

■ Lake Water ■ Effluent Water
47% Lake Water, 53% Effluent Water

Figure 3





Daily SEGEP Delivery NCPA And Calpine

■ NCPA ■ Calpine
45.5% NCPA, 55.5% Calpine

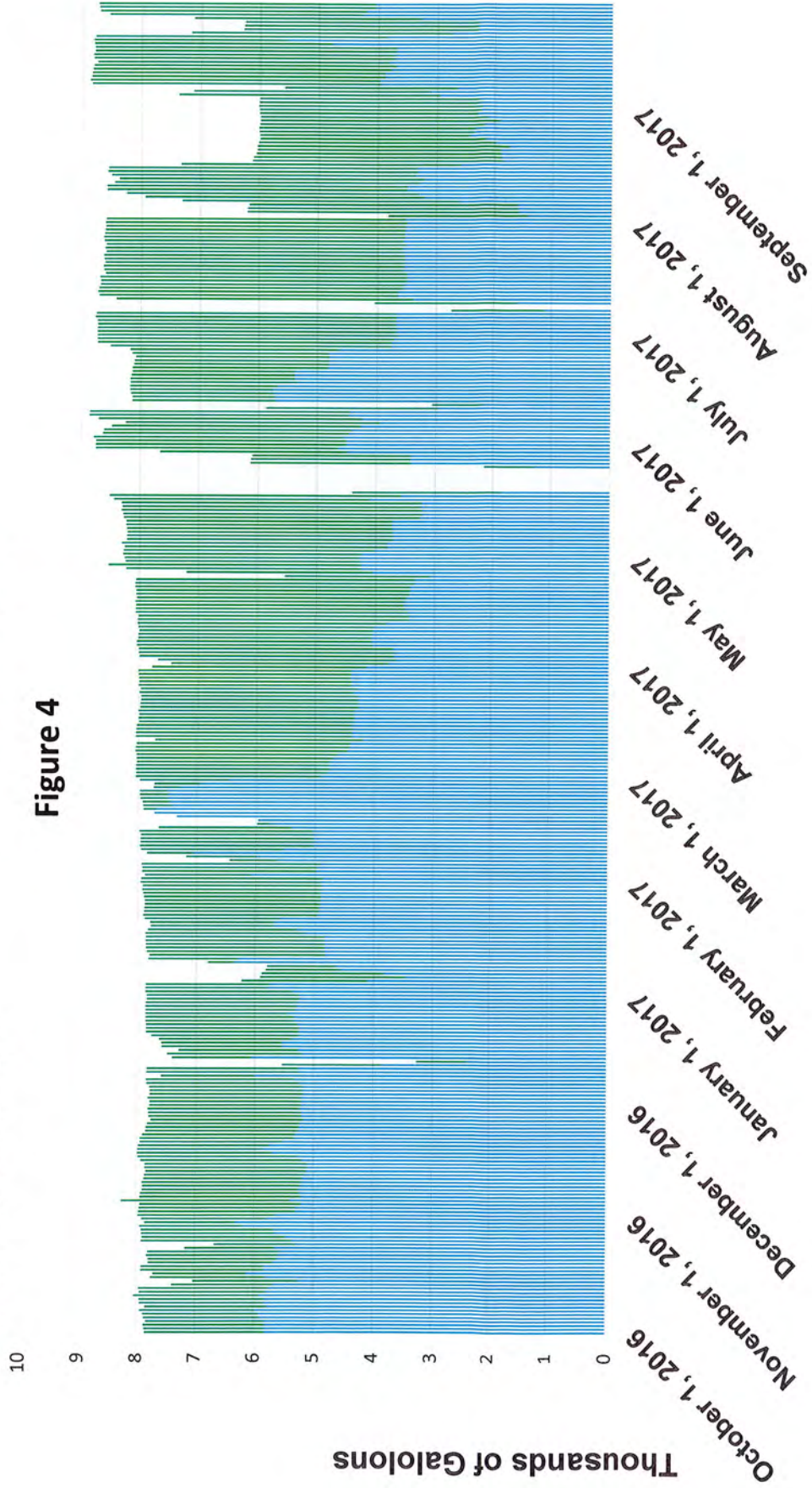


Figure 5

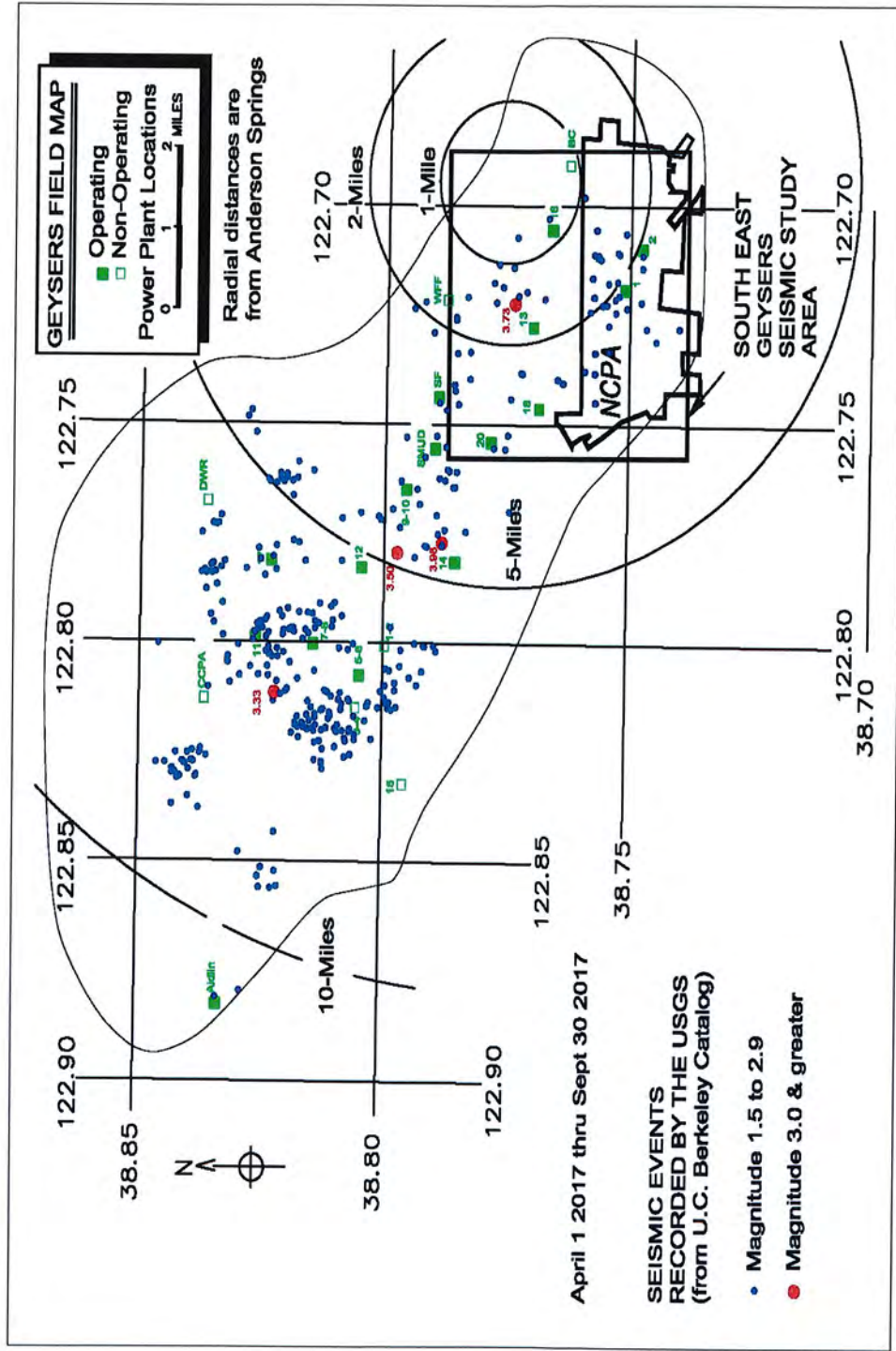
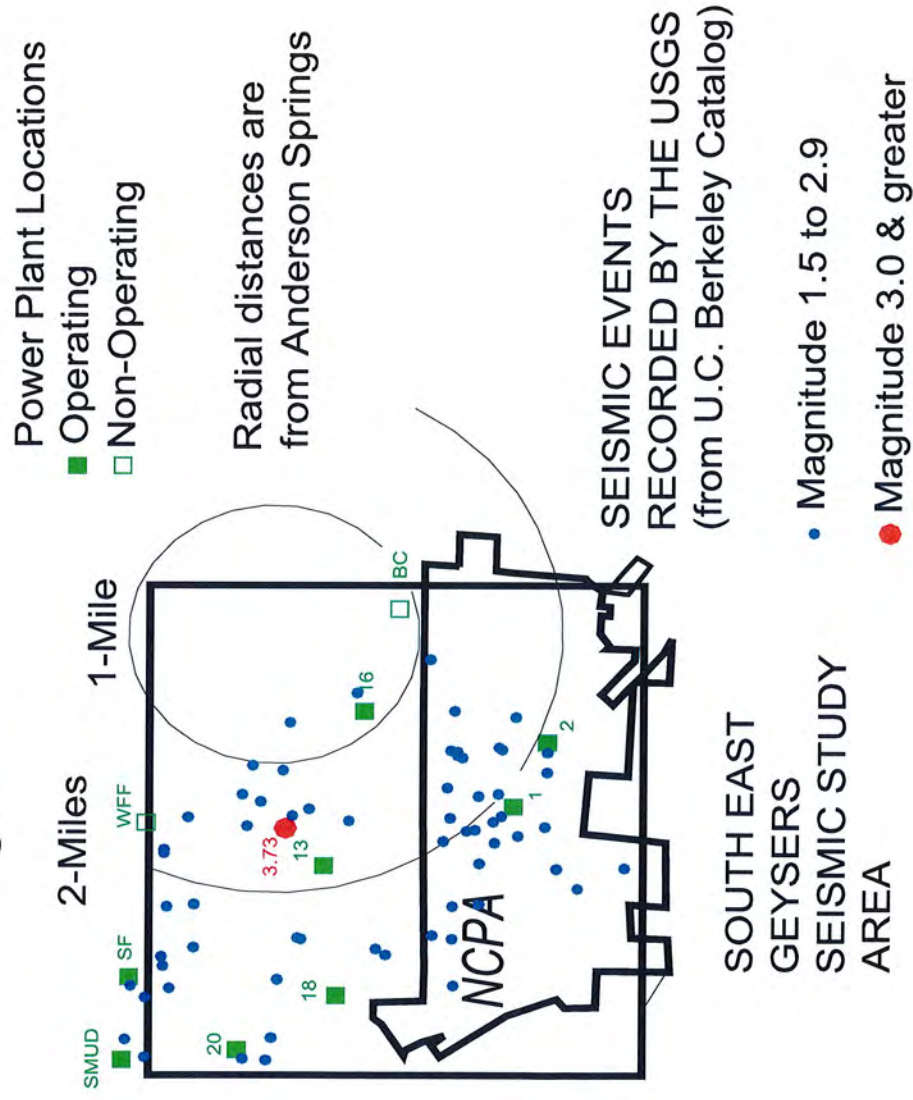


Figure 6

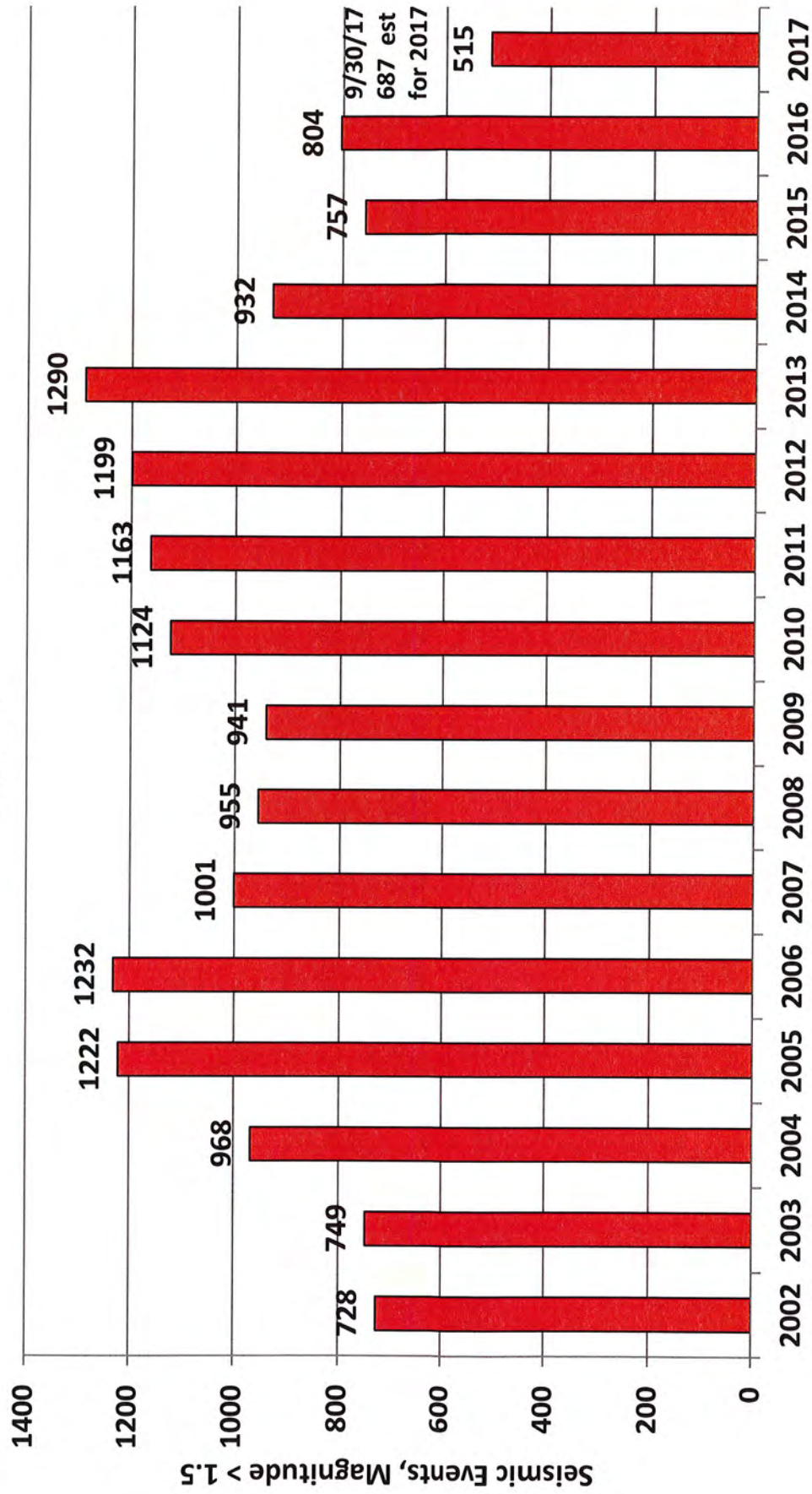


The Geysers (KGRA) - Historical Seismic Activity

Magnitude > 1.5

Years 2002 - 2016

Figure 7



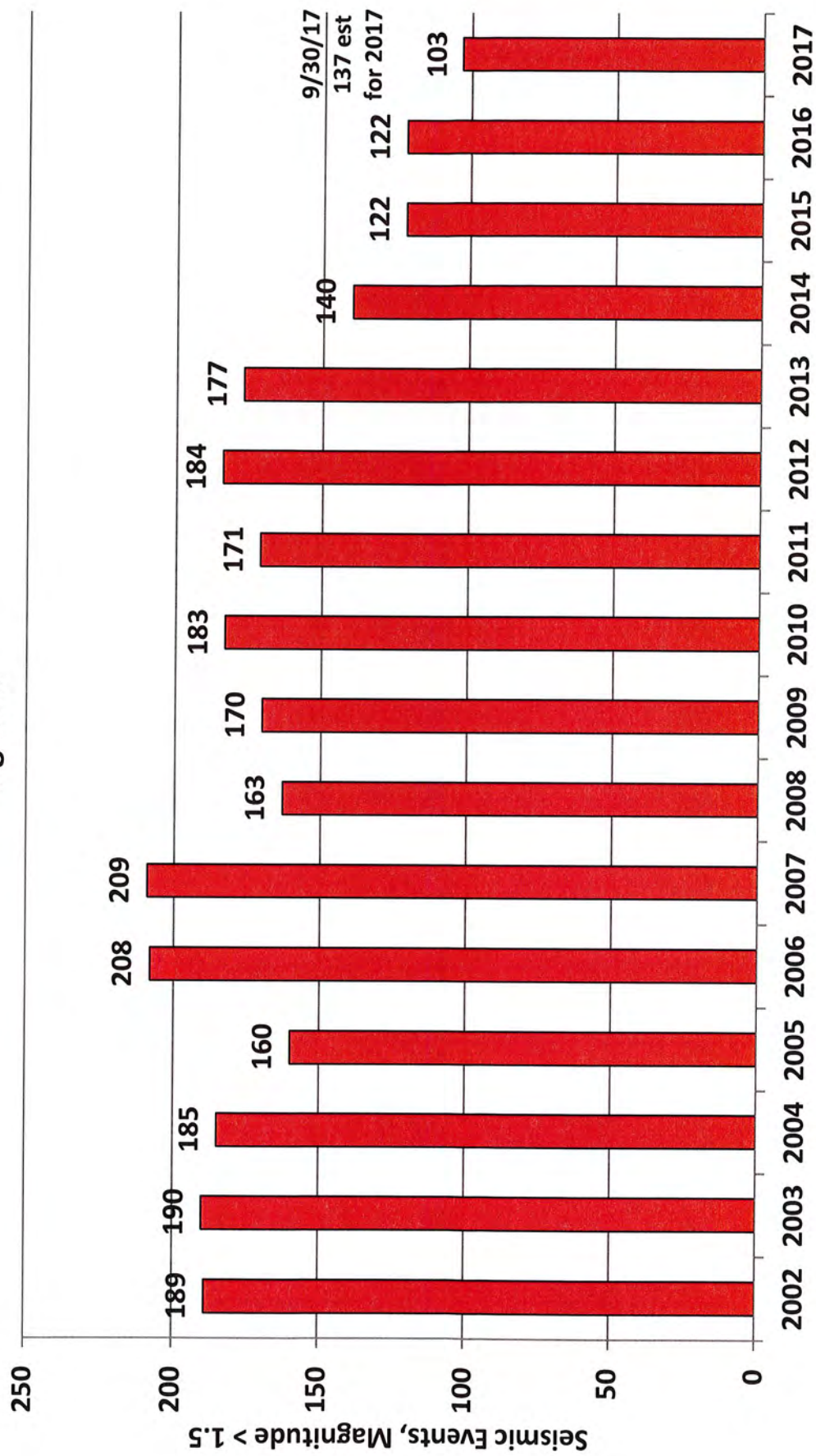


Southeast Geysers - Historical Seismic Activity

Magnitude > 1.5

Years 2002 - 2016

Figure 8



Summary

South East Geysers, April 1, 2017 – Sept 30, 2017

- **Average SEGEP injection – 7.62 million GPD**
- **The pipeline has been in operation 95.4% of this interval.**
- **There were multiple equipment outages and a period of flow reduction for annual maintenance.**
- **Total SE Geysers water injection totaled 10.8 billion lbs.**
- **Total SE Geysers steam production totaled 18.04 billion lbs.**
- **Seismic activity was down slightly from the previous 6 months in the South East Geysers.**
 - **64 seismic events during the last 6 months magnitude 1.5 or greater, compared to 71 events the previous 6 months.**
 - **1 seismic event with magnitude 3.73**