



May 12, 2014

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 through March 31, 2014

### **A. Pipeline Operations**

The Southeast Geysers Effluent Pipeline ("SEGEP") has been in operation for over 16 years and has delivered approximately 47.8 billion gallons of water at an average rate of 5,479 gpm to The Geysers steam field for injection. **Figure 1** illustrates the daily delivery rates since the beginning of the project.

During the more recent six month period of October 1, 2013 through March 31, 2014, the SEGEP Pipeline has been in operation almost every day (**Figure 2**). Pipeline delivery rates have averaged 7.87 million gallons per day (MGD) or 5,462 gpm. There was a period of reduced flow averaging 4,322 gpm during a two week period in February 2014. The reduced flow was due to a damaged LACOSAN pump at the Southeast Treatment Facility. The other periods of reduced flow were short interruptions of pumping for routine maintenance and power line switching.

### **B. Observed Seismicity**

#### Seismic Activity in the Southeast Geysers

The USGS recorded a total of 97 seismic events of magnitude 1.5 and greater within the SE Geysers area from October 1, 2013 through March 31, 2014. Their locations are shown in **Figure 3**. During this period, there was one seismic event in the area greater than magnitude 3.0. The event occurred on October 28, 2013 within the NCPA lease and was a magnitude 3.25. In terms of peak ground acceleration (% of gravitational acceleration), the event was 8.8% or a magnitude V on the Modified Mercalli Intensity scale.

Regarding seismic activity between magnitude 1.5 and 3.0, the Southeast Geysers averaged 16.1 events per month. This level of activity is up from an average of 14 events per month for the period of April 1, 2013 through September 30, 2013. Overall, there were 192 seismic events greater than magnitude 1.5 in year 2013. This compares with 195 events in year 2012 (**Figure 4**).

In combination with the seismic activity, steam production for the Southeast Geysers area was 19.05 billion pounds mass for the past six months. This value is down slightly from the previous six month period where 20.18 billion pounds was produced. Water injection levels were up by approximately 12% with 13.8 billion pounds of water injected. This compares with the 12.33 billion pounds of water injected from October 1, 2012 through March 31, 2013. **Figure 5** shows the historical changes in steam production, water injection and recorded seismicity within the Southeast Geysers area. In general, seismic activity and steam production were lower while water injection was slightly higher when compared to values from the previous six month period.

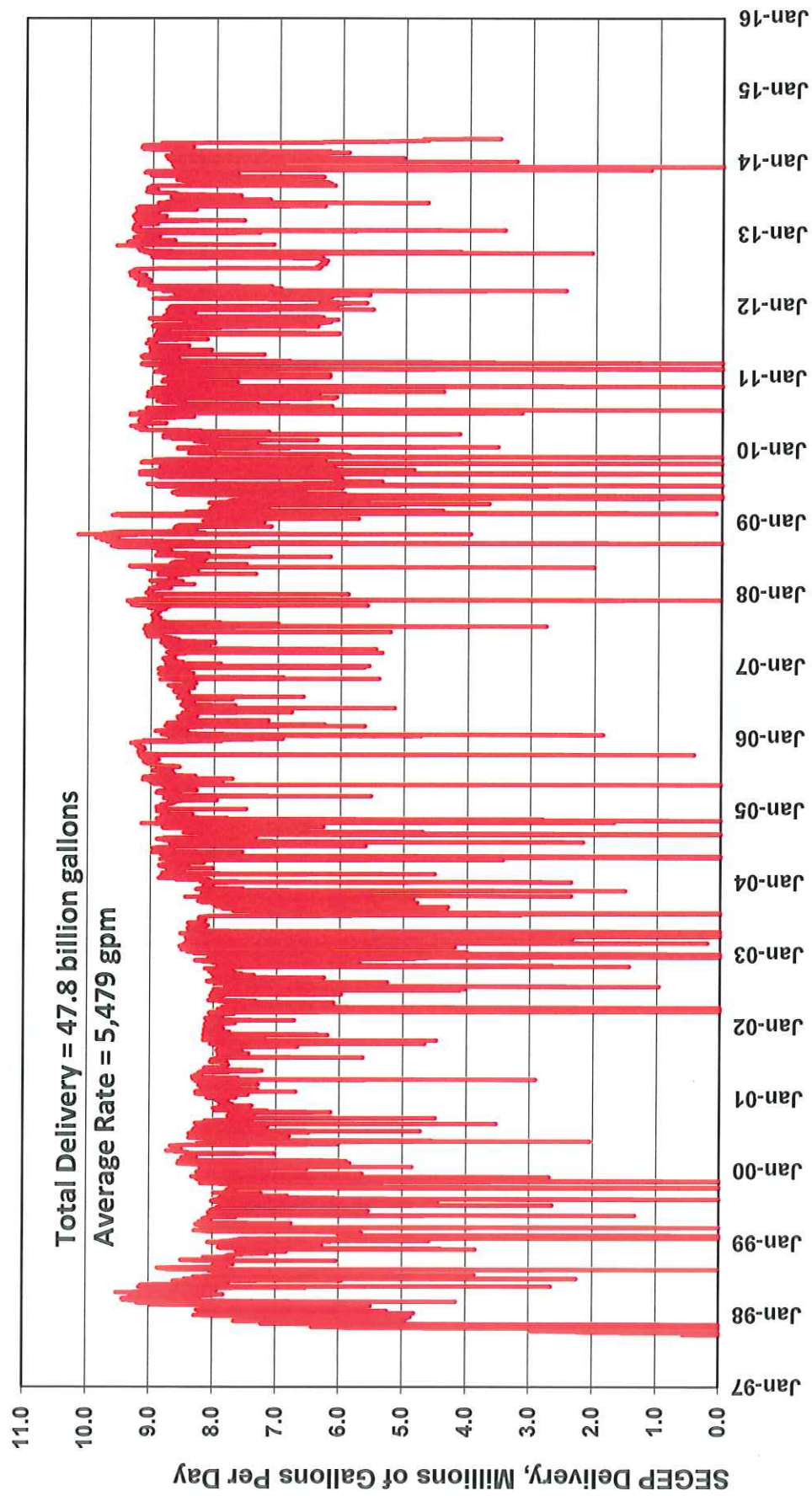
#### Seismic Activity in The Geysers (KGRA)

Within the Known Geothermal Resource Area (KGRA) of The Geysers geothermal field, there have been 690 events of magnitude 1.5 and greater recorded by the USGS for the past six months. There were 7 earthquake events of magnitude 3.0 and greater. The largest event was a magnitude 4.53 occurring on January 12, 2014 in the central Geysers and located about 6.7 miles from the Anderson Springs instrument (**Figure 3**). For year 2013, the cumulative total of earthquake events greater than 1.5 was 1,342 (**Figure 6**). This is up from 1,262 events recorded in 2012.

Ed Voge  
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Figure 1

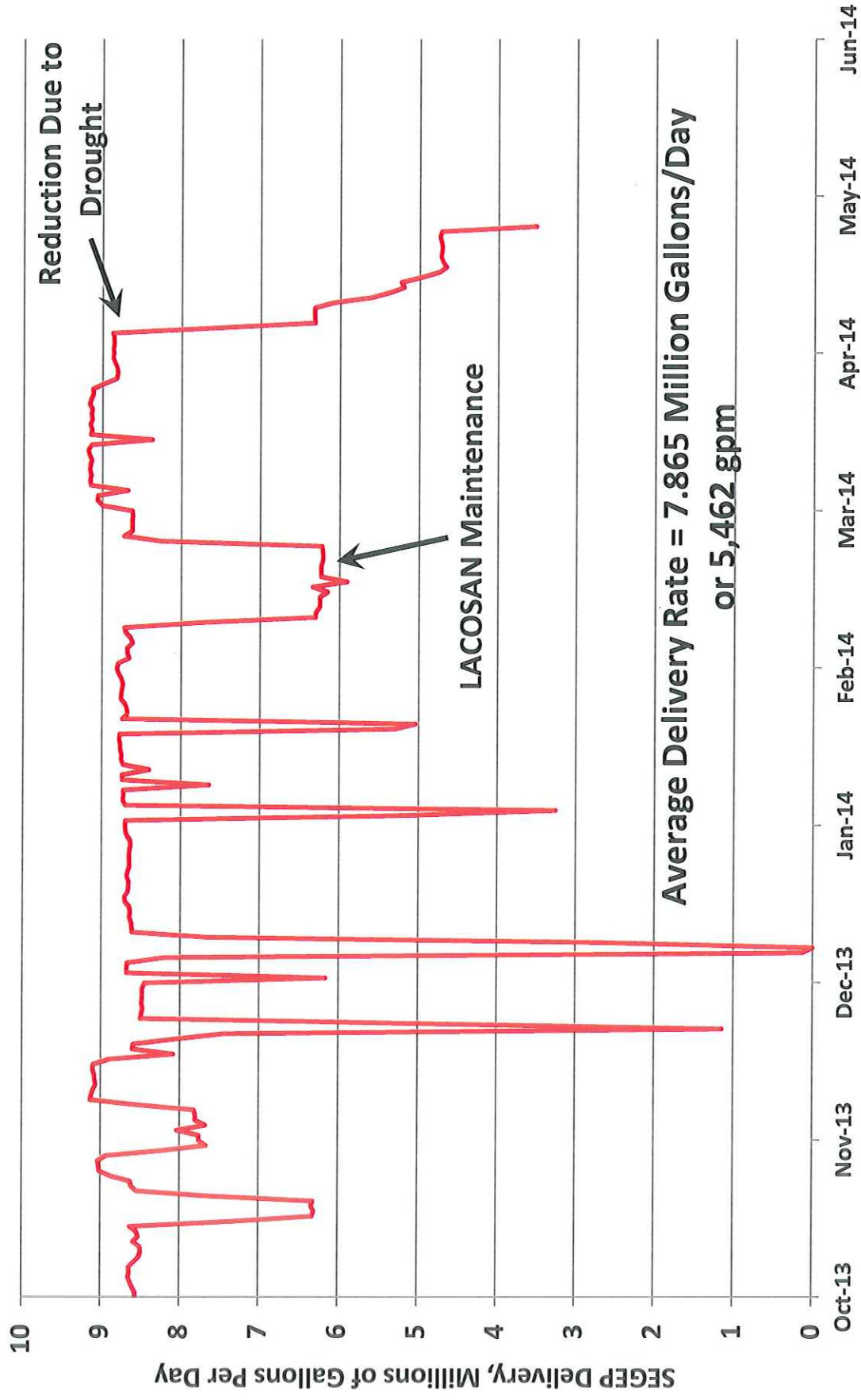
# Historical SE Geysers Effluent Pipeline Deliveries to The Geysers





# Southeast Geysers Effluent Pipeline Delivery October 1, 2013 through April 30, 2014

Figure 2





# Southeast Geysers - Historical Seismic Activity

Magnitude > 1.5

Years 2002 - 2014

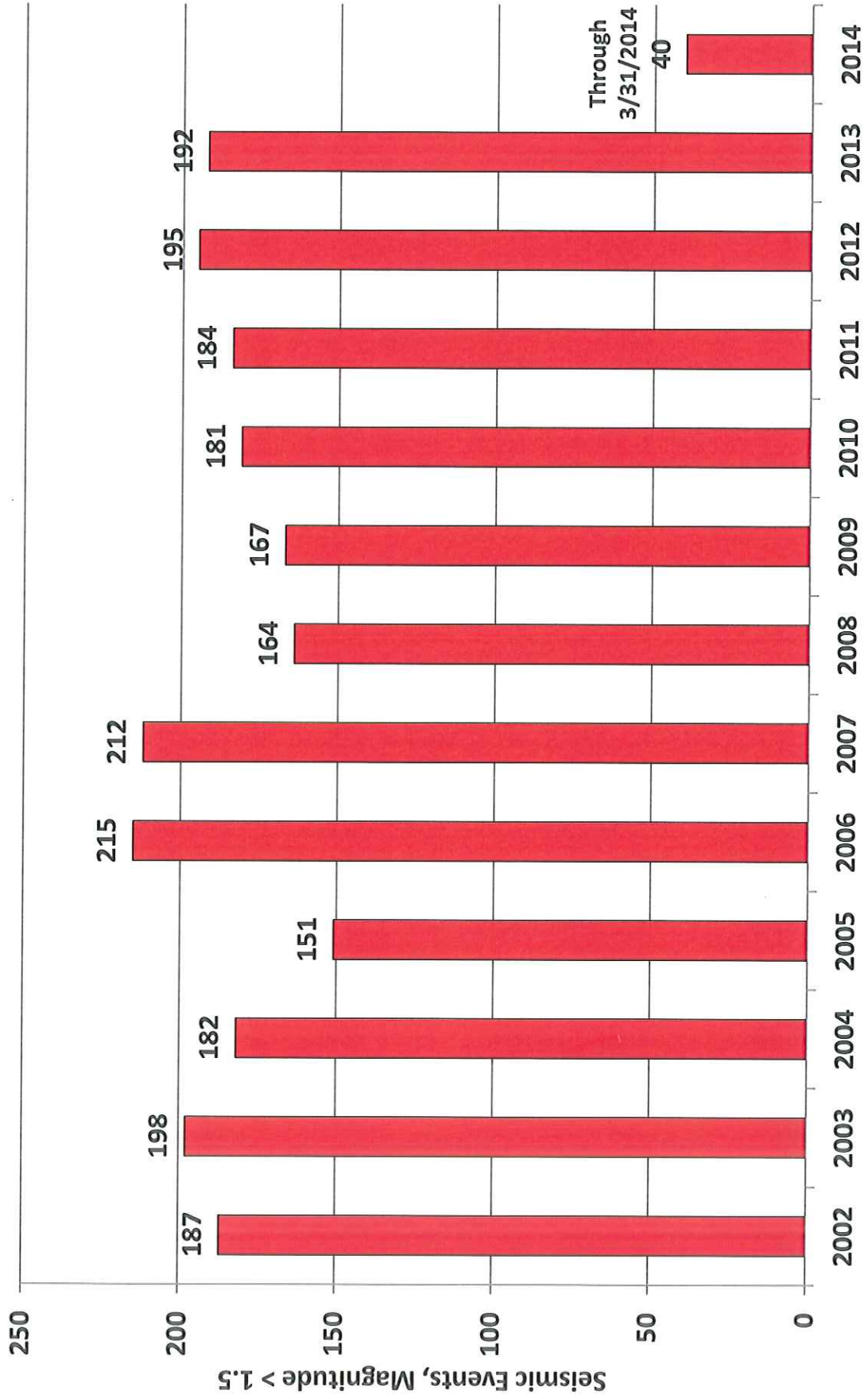
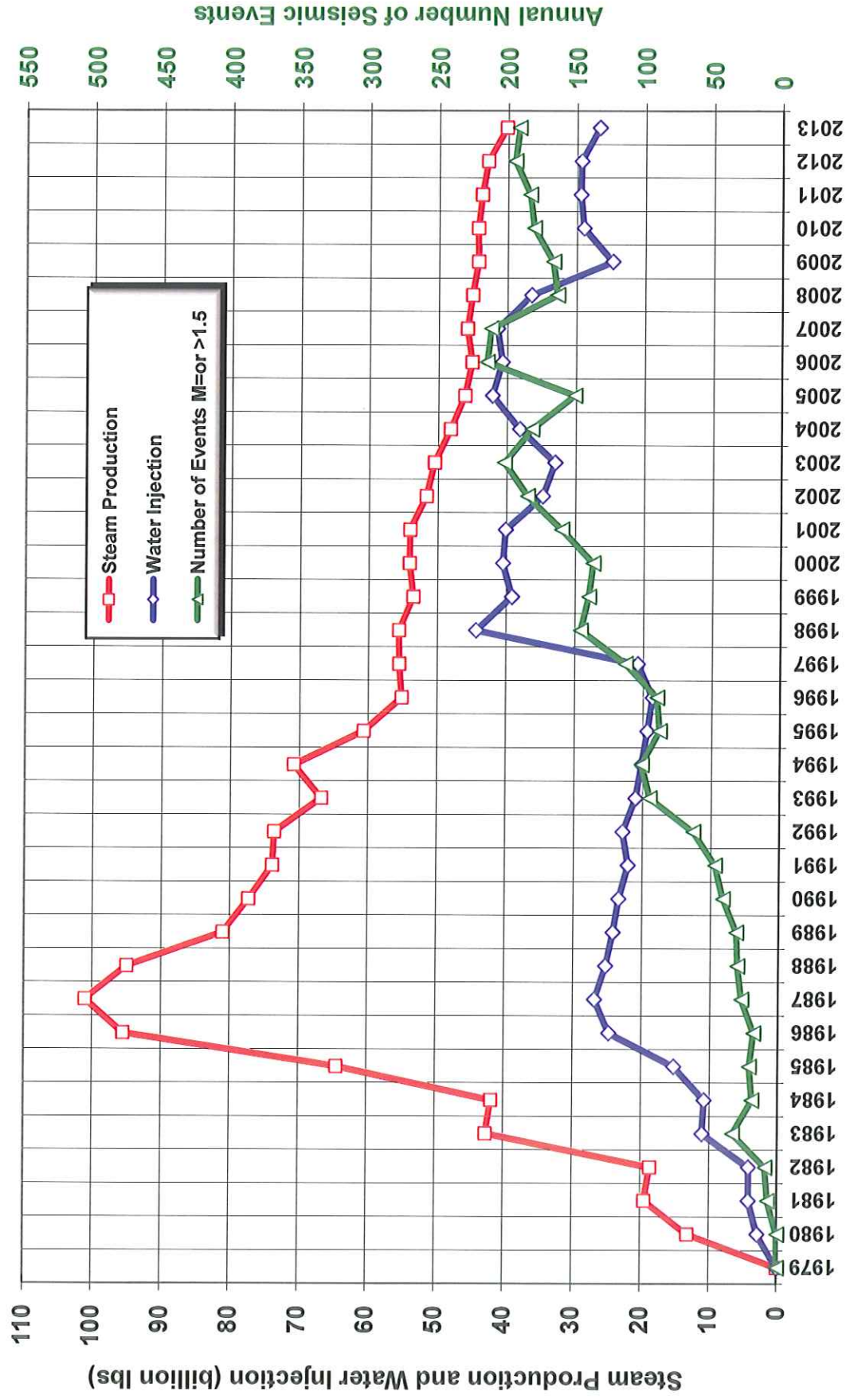


Figure 4



Figure 5

Comparison of Annual Steam Production, Water Injection and Recorded Seismicity in the SE Geysers Area



# The Geysers (KGRA) - Historical Seismic Activity Magnitude > 1.5 Years 2002 - 2014

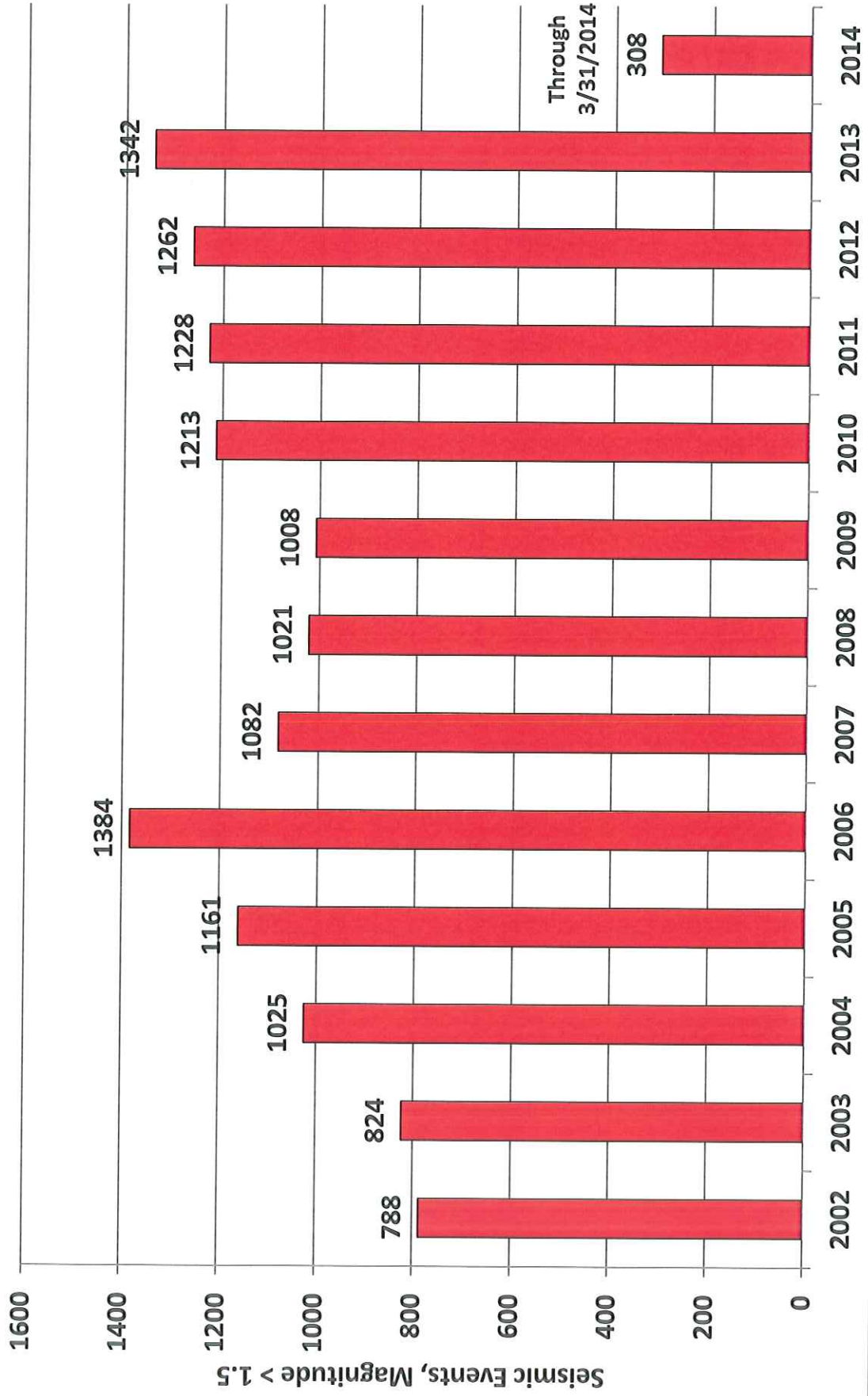


Figure 6





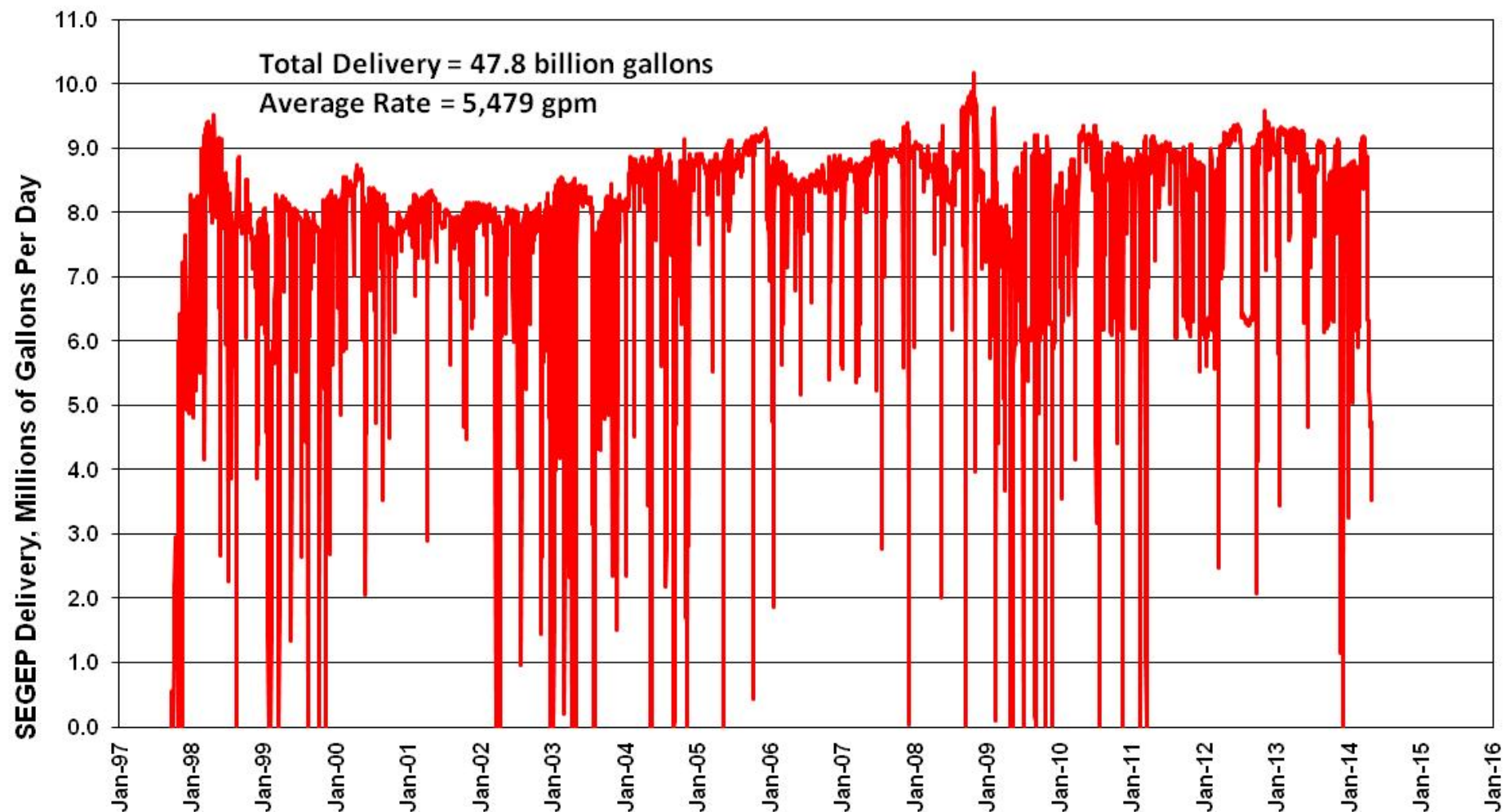
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# **2014 SMAC Meeting**

***May 12, 2014***

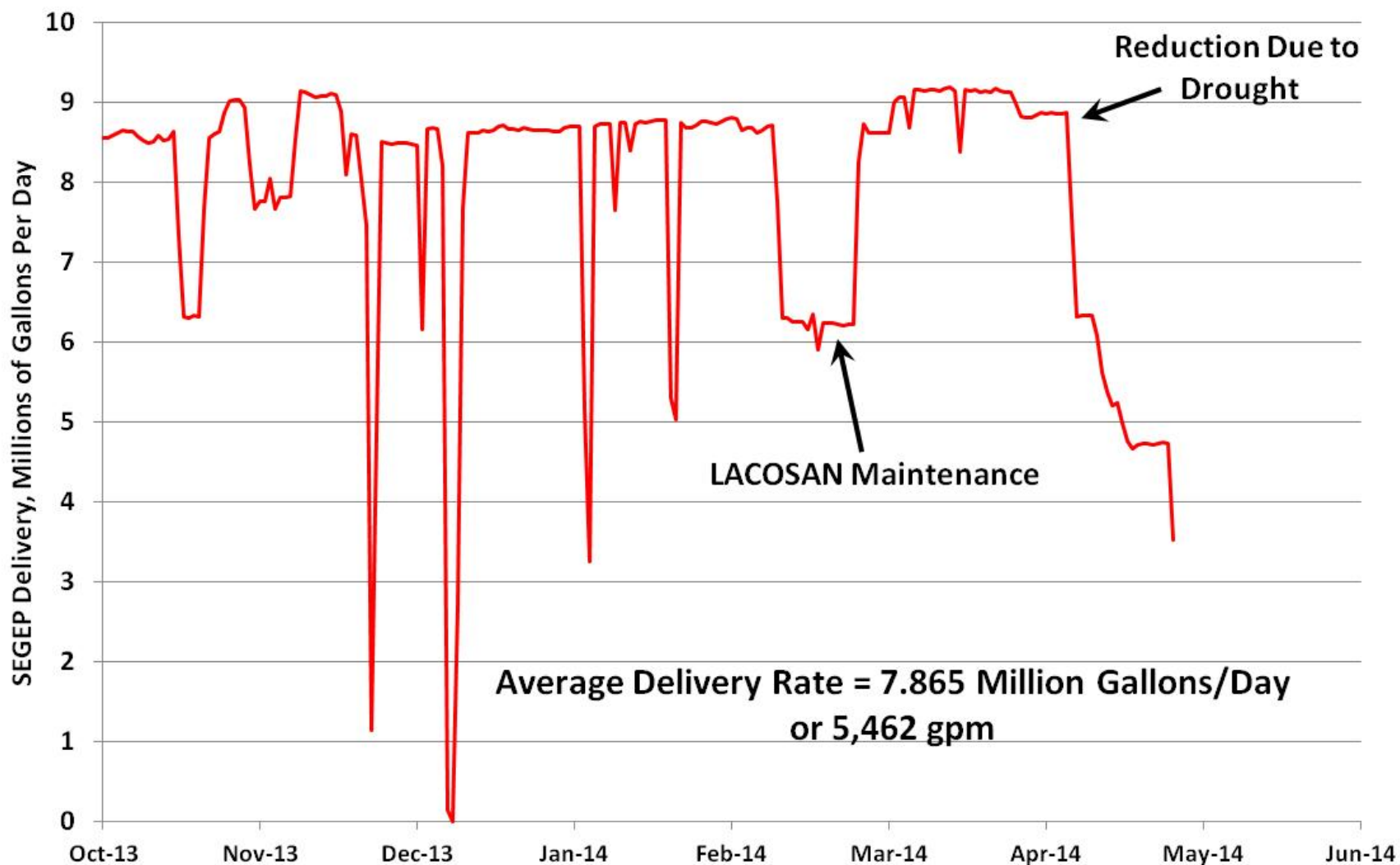


## Historical SE Geysers Effluent Pipeline Deliveries to The Geysers



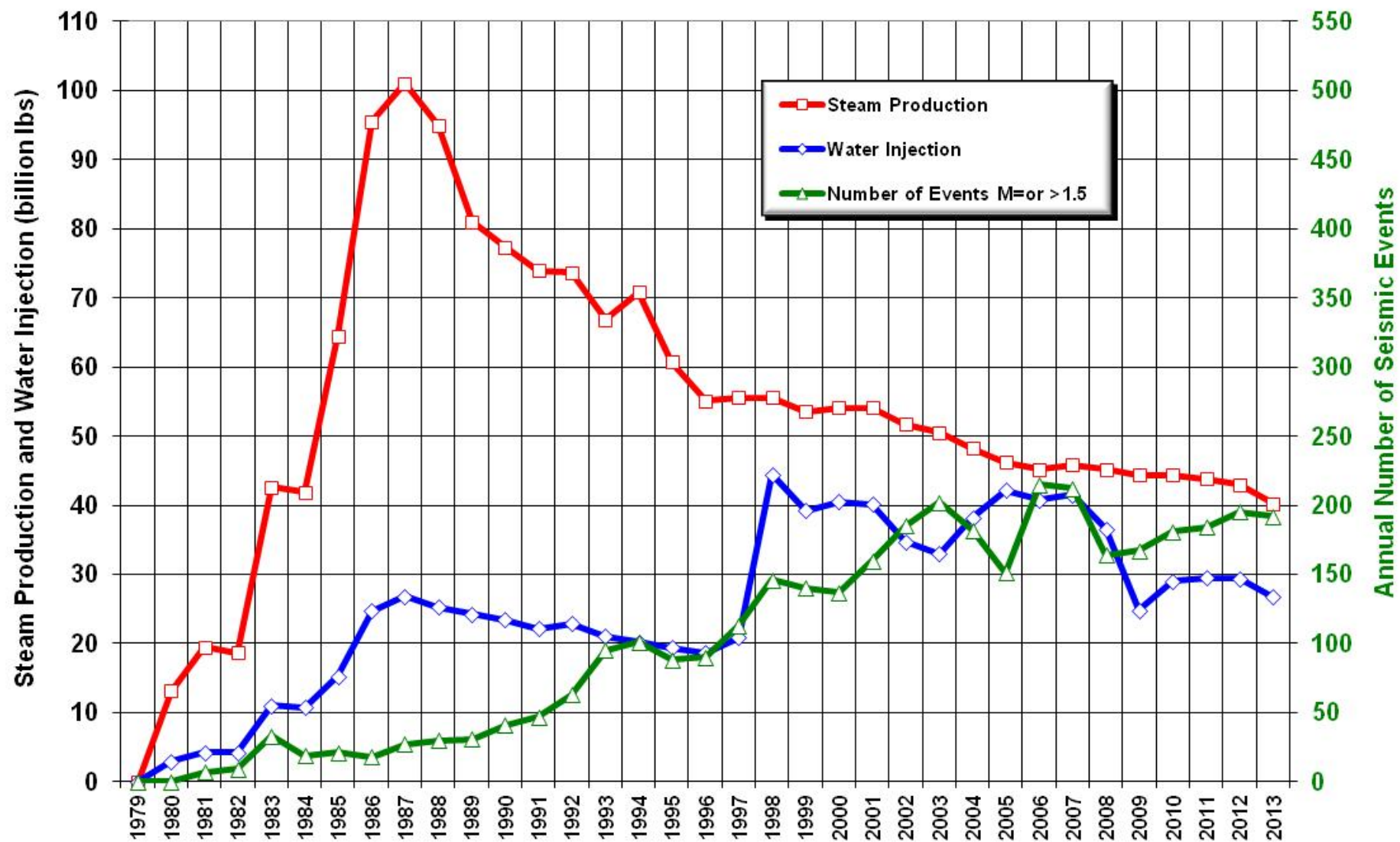
## Southeast Geysers Effluent Pipeline Delivery October 1, 2013 through April 30, 2014

Figure 2

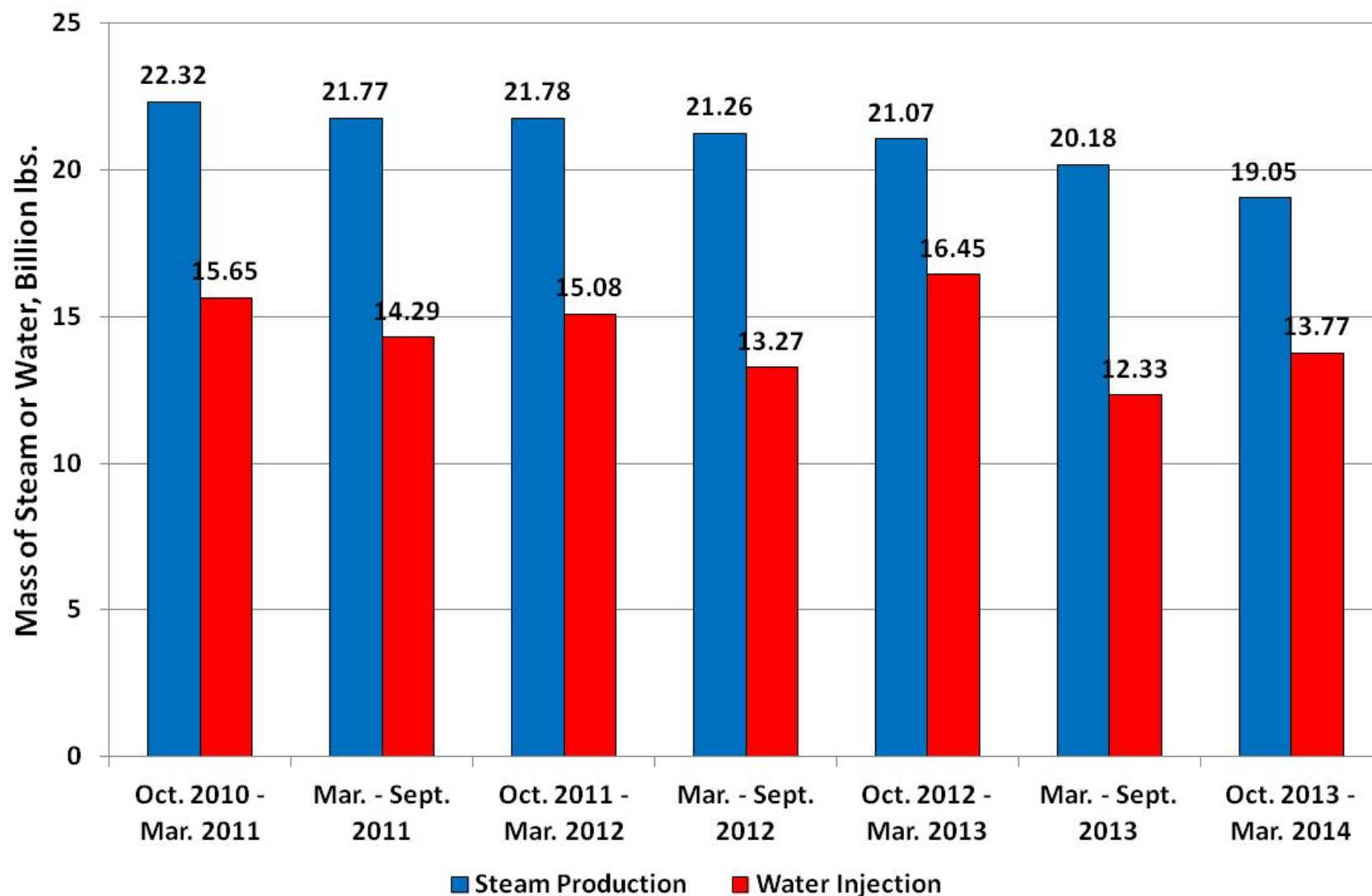


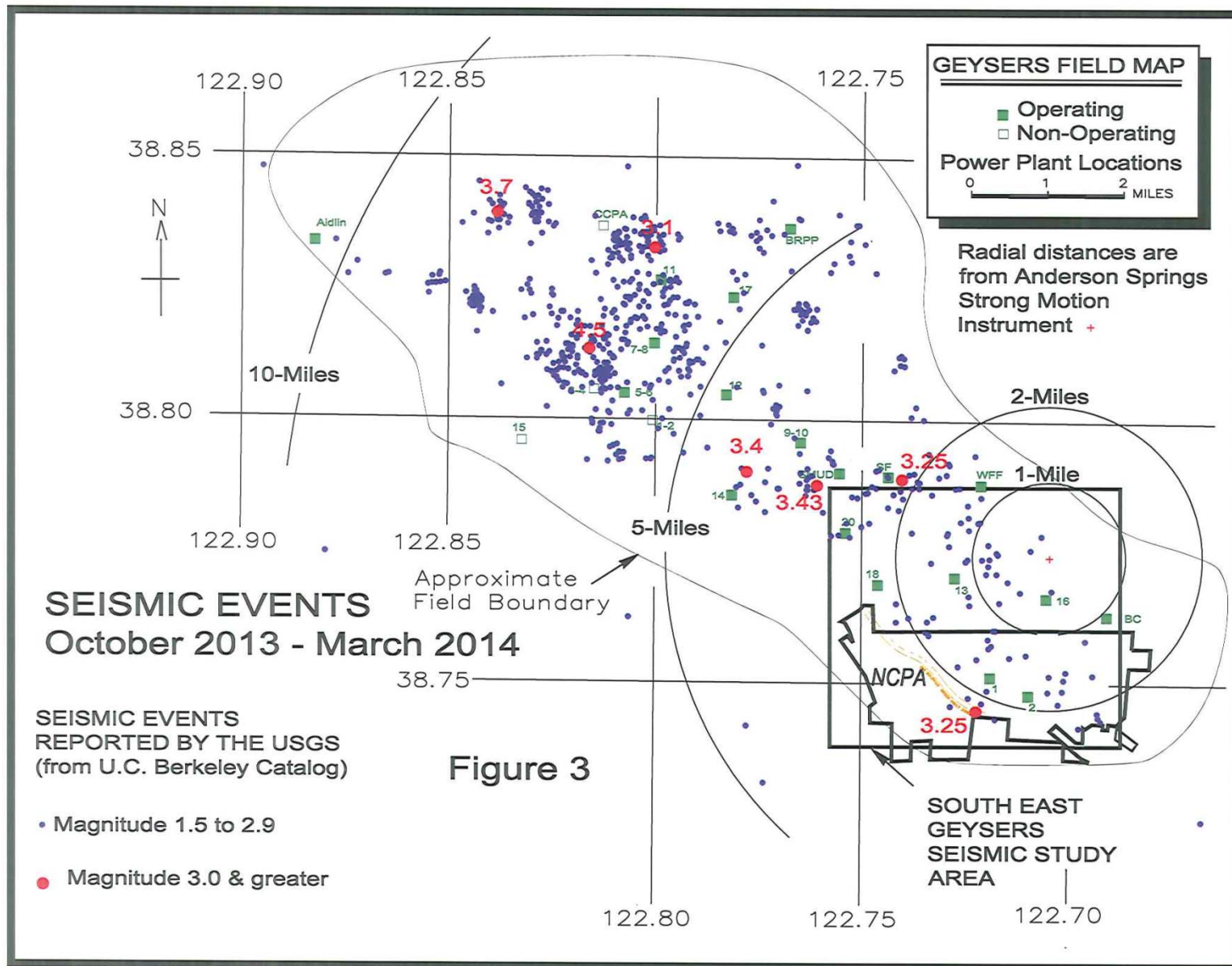


### Comparison of Annual Steam Production, Water Injection and Recorded Seismicity in the SE Geysers Area



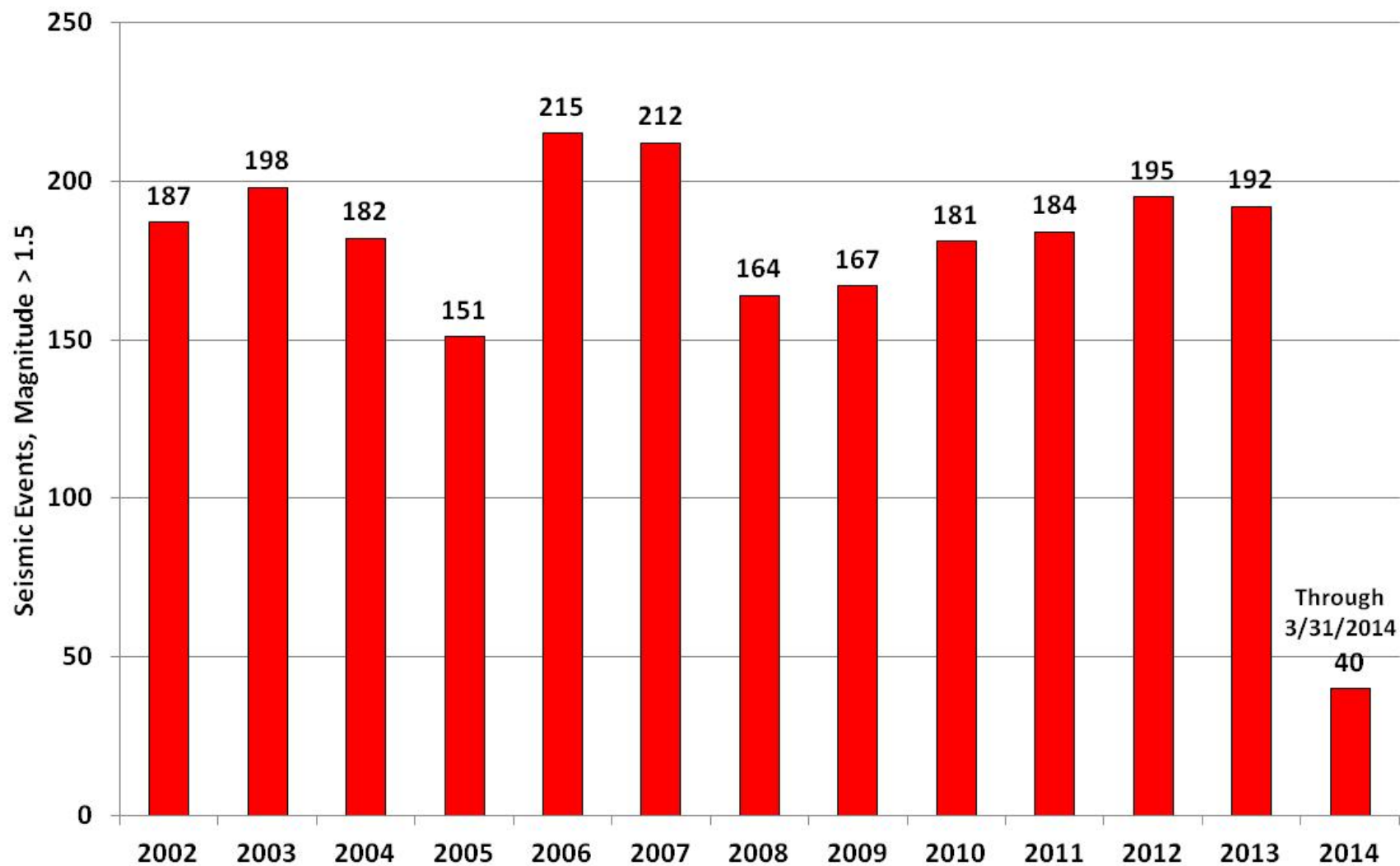
SE Geysers Production and Injection  
Figure 5A



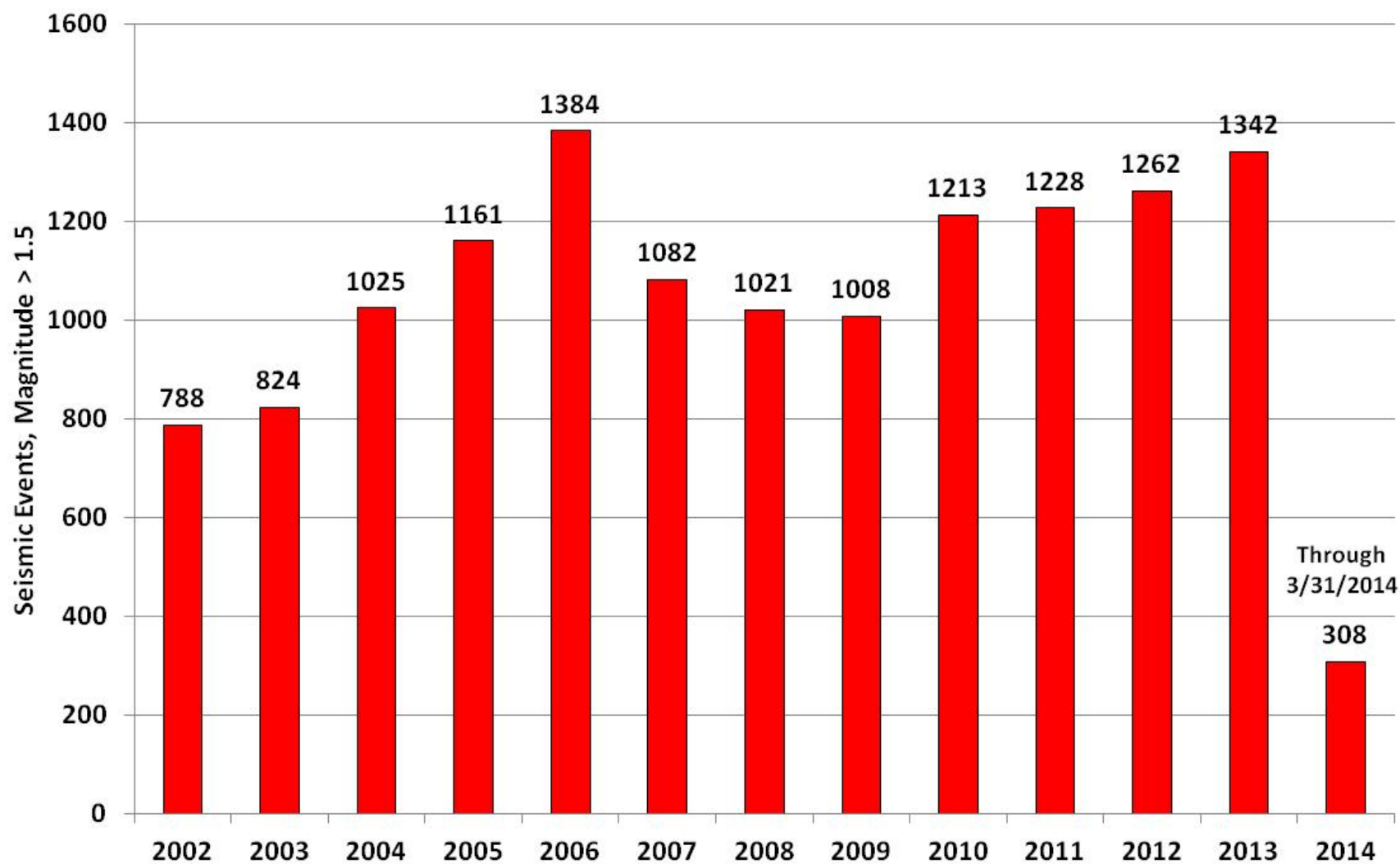




# **Southeast Geysers - Historical Seismic Activity** **Magnitude > 1.5** **Years 2002 - 2014**



# The Geysers (KGRA) - Historical Seismic Activity Magnitude > 1.5 Years 2002 - 2014



## **Summary**

- **Average SEGEP injection - 7.87 million GPD**
- **Two periods of reduced flow**
  - **February 2014 – LACOSAN repairs**
  - **April 2014 – Reduced flows due to drought**
- **Steam production is down from previous 6 months.**
- **Water injection and seismic activity are slightly up from the previous 6 months.**



## **Summary**

- **In Southeast Geysers, October 1, 2013 – March 31, 2014**
  - **97 Seismic events with magnitude 1.5 or greater**
  - **One seismic events - magnitude > 3.0**