State of California
Seismic Safety Commission

Memo

To: Commissioners

From: Richard McCarthy
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Subject: Update on Phase II Project: "Agricultural Vulnerability to Seismic Risk in California and Potential for Mitigation of Economic Damage"

Background

The University of California Agricultural Issues Center (Center) completed its Phase I report to the Commission "Earthquake and California Agriculture: Where are the Vulnerabilities?"

The Center is now in the process of defining a scope of work for a Phase II study on this issue. Attached for Commissioner review is a description of some of the issues that are now being considered to be included in a Phase II study for the Commission.

Recommendation

Staff recommends that Commissioners read over the attached material and as questions after the Center representatives make their presentation. The Center will incorporate Commission direction into a proposal that will be presented at the April Commission meeting.

Agricultural Vulnerability to Seismic Risk in California and Potential for Mitigation of Economic Damage

UC Agricultural Issues Center in collaboration with UCLA and UC Davis

February 4, 2014

This document highlights important research to deepen our understanding of seismic vulnerabilities and California agricultural and contributions to mitigate potential economic and broader losses.

We concluded our final report on our initial study *Earthquakes and California Agriculture: Where are the Vulnerabilities?* as follows: "This study has raised many issues and stressed the linkage from farms to distribution and processing. It has highlighted where vulnerabilities may lie in California agriculture and laid the foundations for further analysis of engineering and economic issues and especially the interaction among the two."

Several important issues that warrant future research related to the seismic vulnerability of agricultural infrastructure and potential mitigation of damages.

1. ***Develop fragility functions for components commonly used in agricultural systems.*** Many agricultural systems, such as milk production equipment at dairies, are complex and vulnerable to seismic risk, but we know relatively little about the vulnerability. Development of fragility functions could proceed empirically, by gathering information about the seismic performance of agricultural facilities that have experienced past earthquakes. In some cases, where specific components are deemed crucial, but inadequate information is available, shake table testing could help shed light on the seismic performance.

2. ***Identify crucial pieces of infrastructure that could result in significant economic damage to agriculture in California.*** Local farmers and ranchers bear responsibility for the seismic performance of on-site equipment and systems utilized in their business operation, but they often have little influence over other important infrastructure that is crucial to their business operation. An example is the siphon that carries All American Canal water over the New River in Calexico, CA. Many farmers rely upon this irrigation water, and failure of this component of the irrigation system could have significant adverse consequences. Other examples include port facilities, rail lines (potentially susceptible to landslides, surface fault rupture, and liquefaction-induced ground failure), the electrical grid, and water distribution infrastructure. A particularly important and relevant piece of water distribution infrastructure is the Sacramento-San Joaquin Delta, which serves as the hub of California's water delivery system. An earthquake in the Delta could cause multiple simultaneous levee breaches that would draw saline water into the Delta, thereby halting water delivery. Delta water is the key

source for many farmers in the western San Joaquin Valley, and disruption to this system could have disastrous consequences for California agriculture and the economy.

3. ***Review the California and international evidence on effects of earthquake damage on agriculture to reveal vulnerabilities and economic relationships in California.*** For example:

- Evaluate information on the seismic events on the South Island of New Zealand that affected the pasture-based dairy industry and a 2012 earthquake in Italy that affected the wine industry (Ricci 2012)
- Review carefully the engineering and economic analysis to consider the vulnerabilities in the Sacramento-San Joaquin Delta region based on the work of Lund and others
- Deepen our understanding of the agricultural consequences of the 2010 earthquake in Northern Mexico
- Study in detail the vulnerabilities and economic relationships in the wine industry highlighted by the August 2014 Napa earthquake

4. ***Focus detailed attention on the dairy and wine industries from the farm through processing and marketing.*** These industries are important in California agriculture--dairy is the largest by farm revenue, and wine and grapes are the largest integrated crop industry. Both have activities in areas of high seismic activity.

- Concentrate on Northern San Joaquin Valley dairies that may be vulnerable to local shock affecting farms and nearby processing facilities. Develop scenario applicable to specific dairy farm characteristics to assess potential seismic damages in detail with realistic data. The dairy farming industry depends on regular shipments of feed, electricity with no disruption, and daily movement of milk. Refrigeration is crucial for food safety. The dairy processing industry handles deliveries of milk that must be processed with no delay. We will work closely with dairy farms and processors on assessing engineering vulnerabilities and planning for economic viability in case of disruption due to seismic events.
- Concentrate on coastal vineyards for the wine industry analysis. The wine industry requires timely processing, cooling and storage to maintain product quality and reputation of coastal vineyards that are most vulnerable to seismic activity. We will develop scenarios applicable to specific coastal wine grape farm and winery characteristics to assess potential seismic damages. There is vulnerability to temporary disruption at key periods of harvest and processing.

5. ***Focus attention on the fruit and vegetable crop industries in the Central Coast and Southern California.*** Very high value per acre crops, such as berries,

avocados and fresh produce are extremely vulnerable to disruption that delay delivery. We will work closely with firms that produce and distribute these crops.

6. ***Assess the potential economic losses associated with crop or pasture land that could suffer long term damage as observed in the April 4, 2010 earthquake in Baja.*** This involves assessment of the likelihood and extent of liquefaction and other damage and the capitalization of those effects in terms of lost productivity, land rents and asset values. The impacts vary significantly by regions. Farmland prices vary from less than $1,000 per acre for pasture with no access to irrigation to more than $100,000 per acre for land suitable for production of high-priced wine grapes. A range of $4,000 to $40,000 per acre of cropland is common depending on the crops most suited to the micro-climate and land qualities.

7. ***Develop economic assessment of agricultural vulnerabilities raised by seismic risk to infrastructure in the Sacramento-San Joaquin Delta.*** Local agriculture in the Delta is economically important locally. But the economic viability of the huge agricultural industry south of the Delta depends on the infrastructure for water conveyance through the Delta. The Valley itself is less subject to Seismic activity. But, about billions in economic activity and millions of jobs depend on vulnerable delivery of irrigation water through the Delta. We can build on previous studies, but no full engineering or economic analysis is available.

8. ***Develop sets of overall vulnerabilities by industry and region to share with stakeholders throughout the state.***

9. ***Develop sets of mitigation measures that could be employed by stakeholders in industry and public service providers.*** This is particularly important because those currently available, such as those listed by the U.S. EPA from sources around the country, are not adequate for California conditions.

10. ***Use data developed above to derive an overall assessment of the most vulnerable parts of California agriculture in terms of potential economic losses on the farms and ranches, for workers and other agricultural services and for local economies and consumers.***

Our team includes seismic engineers, agricultural economists and specialists in California agriculture. We will work with farmers, agricultural leaders and those with agricultural infrastructure expertise. We will also draw on students at UC Davis and UCLA for research assistance.

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