Emergency water storage / supply

Charles Scawthorn

Professor of Infrastructure Risk Management (ret.)
Kyoto University

Guest Lecture, 21 Sept 2016
CE 150"**Wind and Water - Design for a Changing Environment**"

University of California, Berkeley

"Wind and Water - Design for a Changing Environment"

Alternative water supply for parks in the City of Berkeley.

(i) To reduce irrigation water demand (by use of state-of-the-art irrigation technologies and strategic landscaping decisions),

(ii) To supply water for irrigation from local water sources, targeting shallow groundwater,

(iii) **To incorporate emergency water storage / supply options into the water supply design to provide back-up to the City of Berkeley in the case of a major supply disruption (e.g. a major earthquake).**

Outline

- Self-introduction
- Design process
- Fire following earthquake
- Methods for potable water supply
- Cost
- Reference materials
- Discussion

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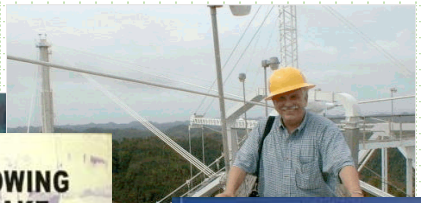
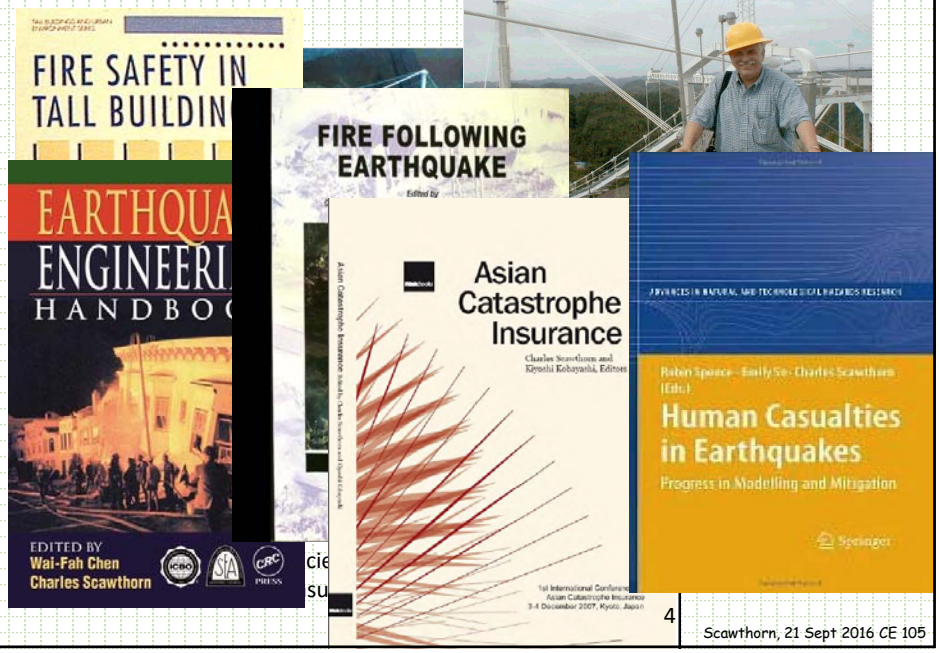
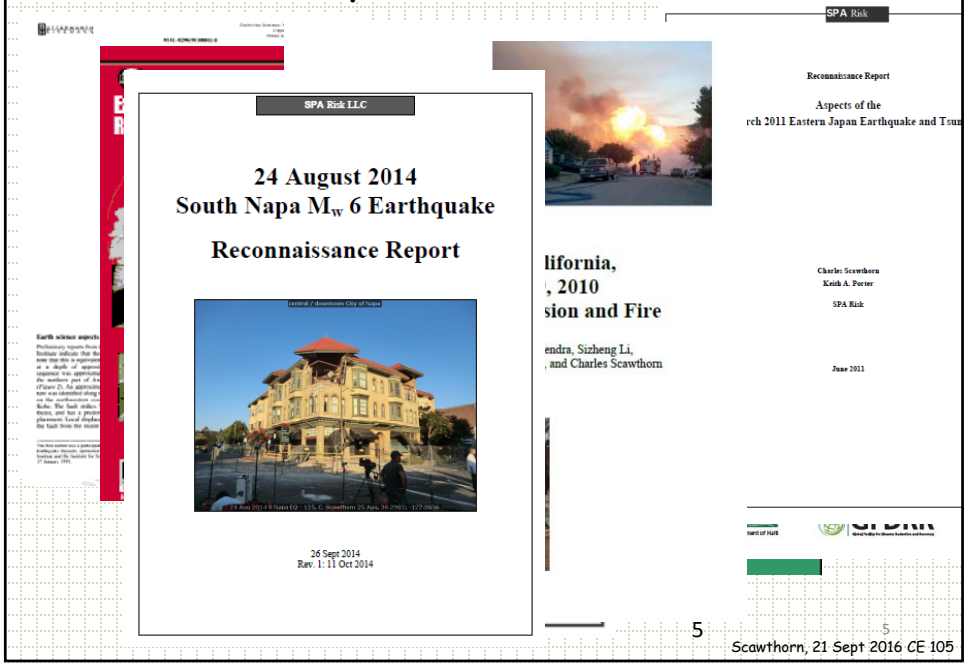




Disaster Responses / Investigations



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To incorporate emergency water storage / supply options into the water supply design to provide back-up to the City of Berkeley in the case of a major supply disruption (e.g. a major earthquake).

Design:

Capacity > Demand

(1) Demand: Need for water supply

Who needs the water?

Why: firefighting, potable supply, business/industry/irrigation

What: how much will they need? Of what quality?

When will they need it?

Where: sources / destinations?

How will it be furnished?

Client or Engineer

(Answers = Performance Criteria → Design Spec)

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Who needs the water?

how much will they need?

how much will they need? (cont.)

The Plan's Table 3 indicates the duration water will need to be furnished, and shows that about 50% of required water will be available (i.e., furnished via distribution system) at community distribution centers in 3~7 days, and about 80% in 2~4 weeks. Based on this, the Plan's approximate total demand can be estimated:

- 3~7 days: 1.35 to 1.8 mgd = 4~12.6 or a mean of about 8 million gallons
- 2~4 weeks: 0.7 to 0.9 mgd = 9.5~27 or a mean of about18 million gallons

for a range of 13.5~40 or mean total of 26 million gallons during the first month. This total is for general population needs only, and doesn't include water needs for small pets or in-patient care.

The total of 13.5~40 million gallons is less than the capacity of the underground 50-million gallon (MG) reservoir.

It is worth noting that the daily demand 1.8 million gallons is equivalent to 7,500 tons, or about 190 tanker truck loads. Alternatively, 1.8 million gallons is the capacity of only a few barges.

- That was for potable supply – kind of easy – just use guidelines
- Similar for hospitals
- Business and industry are kind of on their own (*don't have to be*)
- Firefighting?

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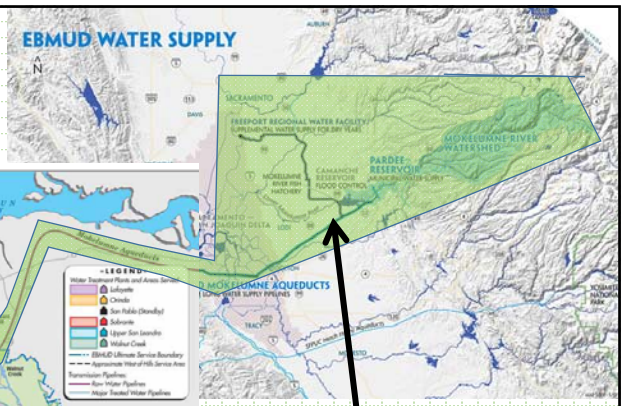
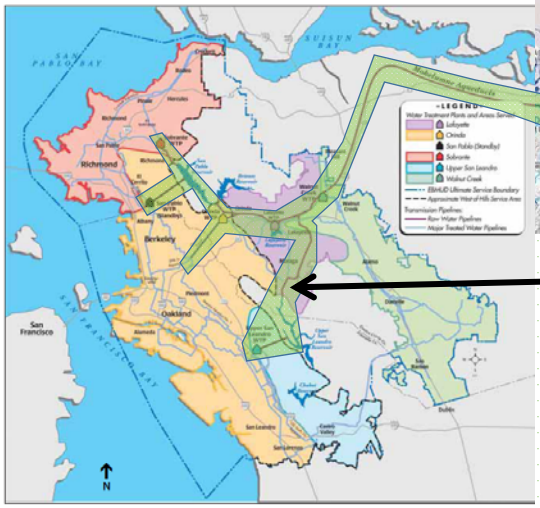
how much, where, when…? (cont.)





OK

The rest
– 'the last mile'
isn't

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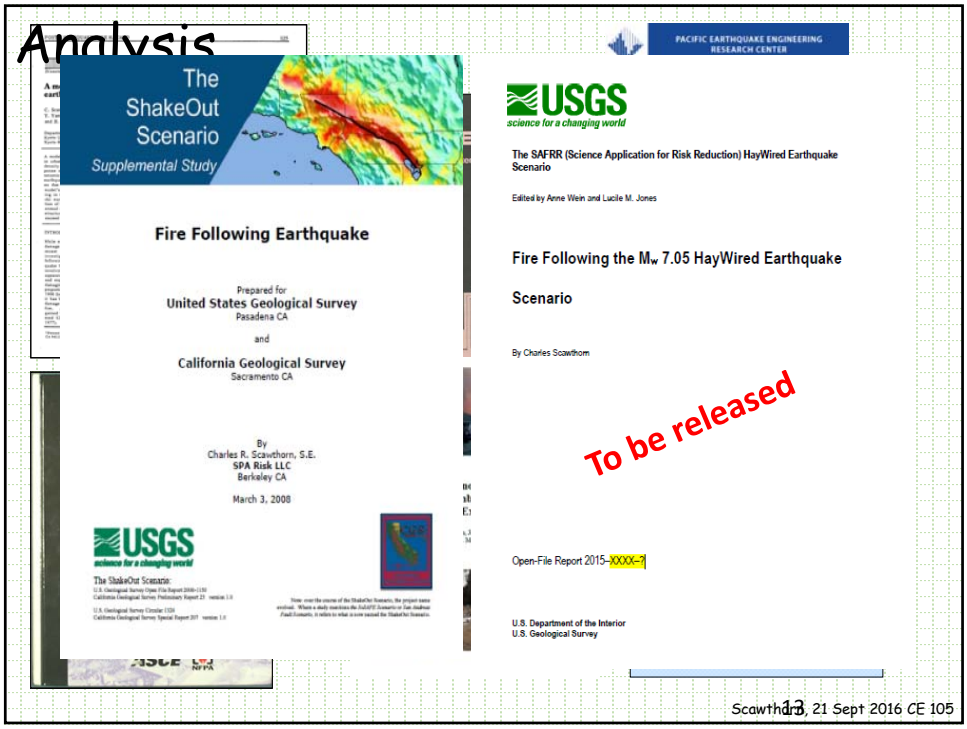
the last mile

Fire following earthquake – the problem


Analysis
The ShakeOut Scenario
Supplemental Study
Fire Following Earthquake
Prepared for
United States Geological Survey
Pasadena CA
and
California Geological Survey
Sacramento CA
By
Charles R. Scawthorn, S.E.
SPA Risk LLC
Berkeley CA
March 3, 2008
USGS
science for a changing world
PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER
The SAFRR (Science Application for Risk Reduction) HayWired Earthquake Scenario
Edited by Anne Wein and Lucile M. Jones
Fire Following the Mw 7.05 HayWired Earthquake Scenario
By Charles Scawthorn
To be released
Open-File Report 2015-XXXX-?
U.S. Department of the Interior
U.S. Geological Survey
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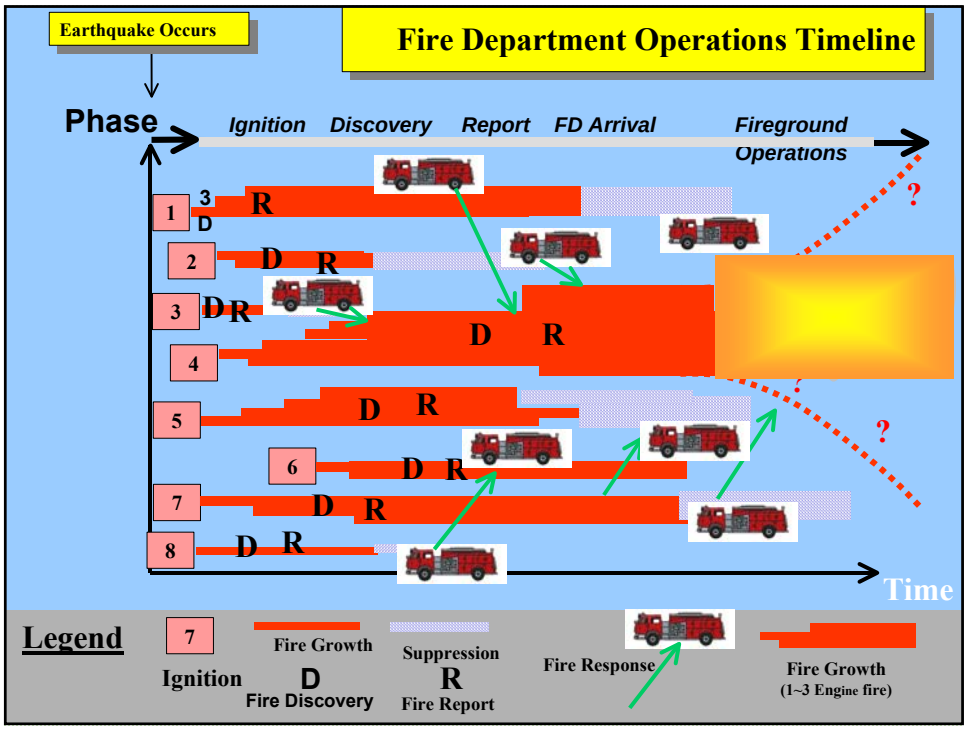
Earthquake Occurs
Fire Department Operations Timeline
Phase
Ignition
Discovery
Report
FD Arrival
Fireground Operations
1
2
3
4
5
6
7
8
D
R
?
Time
Legend
Ignition
Fire Growth
Fire Discovery
Suppression
Fire Report
Fire Response
Fire Growth
(1~3 Engine fire)

FFE modeling

- Stochastic process
- Ignition occurrence and fire spread | performance of gas and power systems
- Water supply | damage to distribution system
- Fire reporting | saturation of POTS, cellular and 911 systems
- FD decision-making | radio chatter, self-dispatching companies, overwhelmed EOC
- Other demands: USAR, hazmat…
- ….

Complex

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capacity of the 38 first line and 15 relief and reserve engines totaled 35,100 gpm. In summary, the department was rated by the National Board of Fire Underwriters (NBFU 1905) as efficient, well organized and, in general, adequate. For the factors noted above, however, the NBFU concluded that

…In fact, San Francisco has violated all underwriting traditions and precedent by not burning up. That it has not done so is largely due to the vigilance of the fire department, which cannot be relied upon indefinitely to stave off the inevitable.

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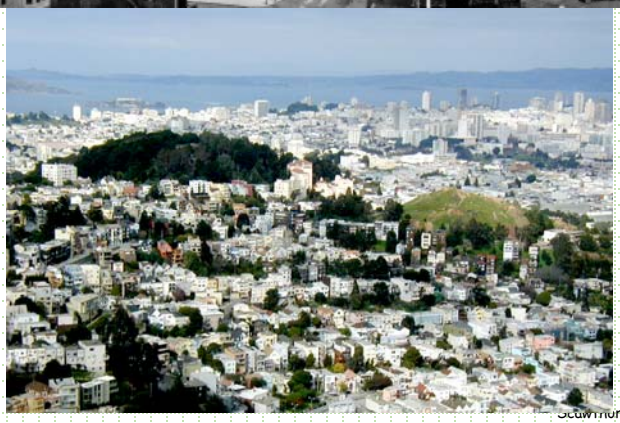
San Francisco Bay Area - *built to burn*



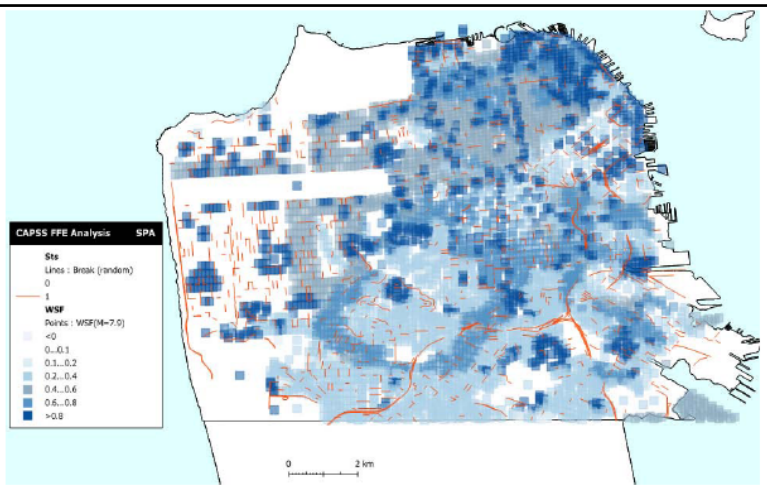


Figure 19 San Andreas Mw 7.9 event: example MWSS breaks overlaid on map of Water Supply Factor (WSF) for this scenario. WSF = 0 indicate no water (colored white), and 1 indicating completely adequate water (dark blue) – the darker the shade of blue the more adequate the water supply. Note that WSF is estimated based on all sources of water (MWSS, AWSS pipe network, cisterns, suction connections, etc). Presidio, Golden Gate and other parks not considered in the analysis.

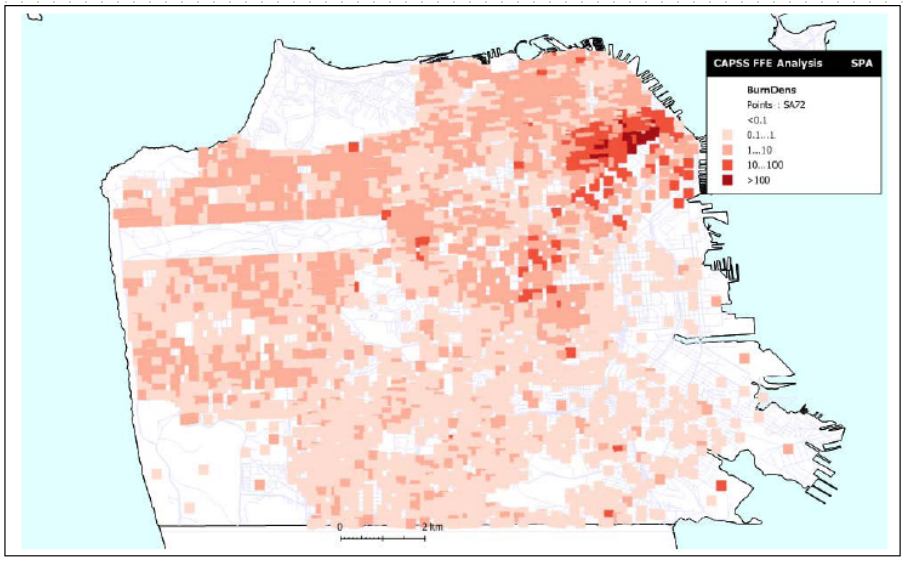


Figure 20 Distribution of Burn Density per block (millions $): (top) San Andreas Mw 7.9 Scenario; (bott.) San Andreas Mw 7.2 Scenario

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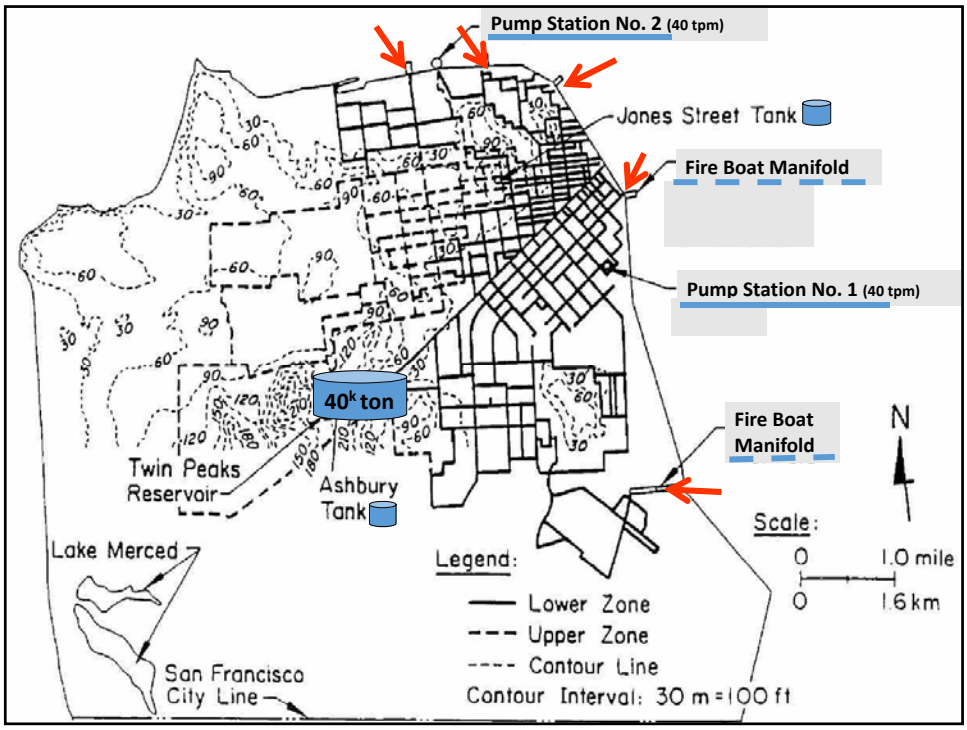

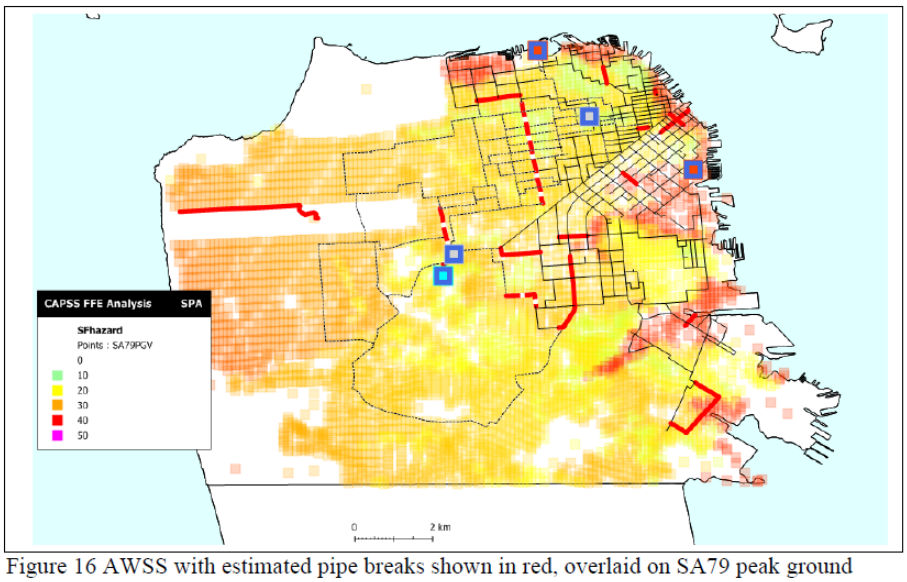

Figure 16 AWSS with estimated pipe breaks shown in red, overlaid on SA79 peak ground velocity. Note that the estimation of the pipe breaks is a random process, so that only the general distribution, and not specific locations, of breaks are meaningful.

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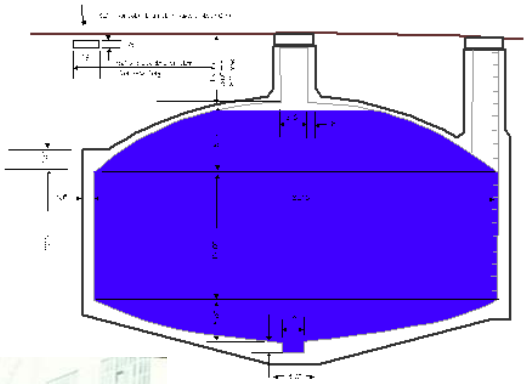
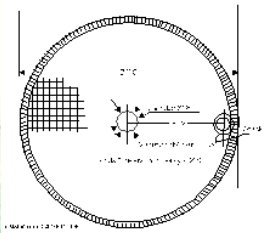
San Francisco Fire Department cistern (200 x 1 hr)





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Portable Water Supply Systems

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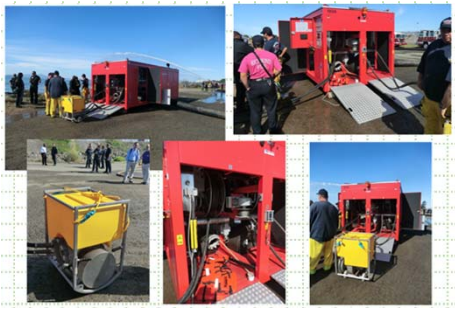
Demonstration



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Methods for emergency potable water supply

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Nagaoka WTP emergency pumping from Shinano River
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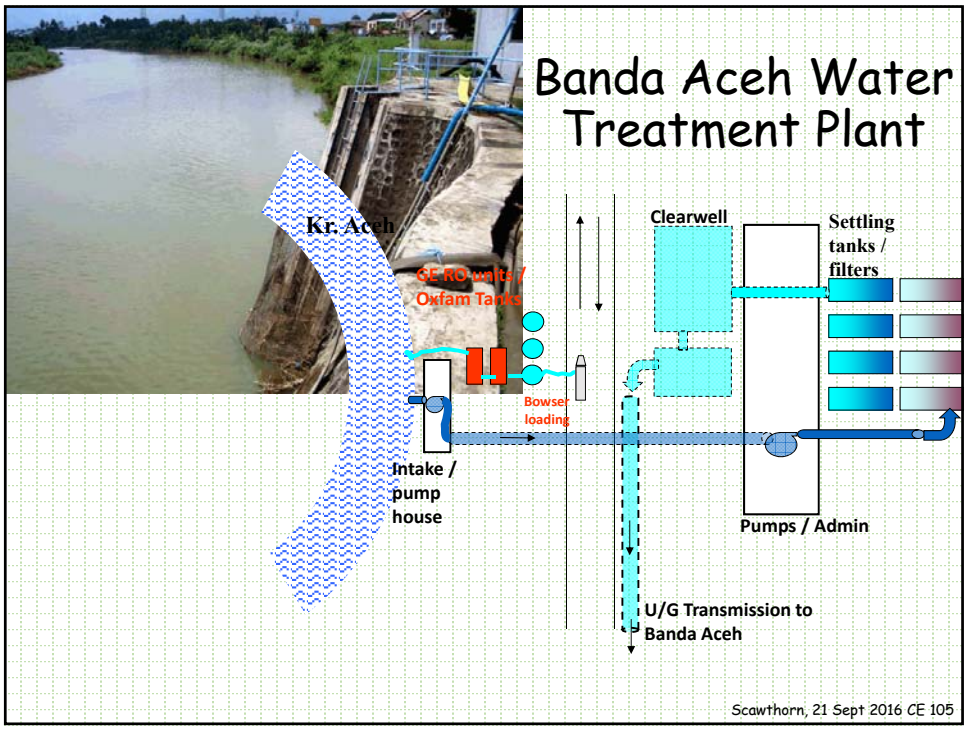
Banda Aceh Water Treatment Plant
Kr. Aceh
CE RO units / Oxfam Tanks
Bowser loading
Intake / pump house
Clearwell
Settling tanks / filters
Pumps / Admin
U/G Transmission to Banda Aceh
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Emergency Water Purification

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Emergency Water Purification - 2

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Emergency Water Purification - 3

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how much, where, when…?

Who	When (hours)	Quantity	Where	How
Firefighters	10^0			
Residents	10^1			
Hospitals	10^0			
Restaurants	10^1			
Business (selected?)	10^1			
Business (general)	10^2			
Industry	10^2			
Ag / irrigation	10^2			
Others ?				

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Cost

Table 6-1 Seismic Upgrade Programs, Various US Water Utilities

Utility	Population Served	Capital Cost	Cost Per Person
EBMUD	1,200,000	$240,000,000	$200
City of San Diego	1,200,000	$46,000,000	$40
Los Angeles	3,500,000	$1,000,000,000	$285
Contra Costa Water District	430,000	$120,000,000	$280
Portland, Oregon	800,000		$10
Seattle, Washington	1,300,000	>$20,000,000	$20
St. Louis, Missouri	650,000	$20,000,000	$30
Memphis, Tennessee	800,000	$20,000,000	$25
County of San Diego	2,400,000	$700,000,000	$290
San Francisco Public Utilities Commission	2,400,000	$1,300,000,000	$540
20 SFPUC Suburban Water Agencies	1,700,000	$45,000,000	$26

TCLEE. (2005). "Fire Following Earthquake." Scawthorn, C., J. M. Eidinger, A.J. Schiff (Editors), Technical Council on Lifeline Earthquake Engineering Monograph No. 26, American Society of Civil Engineers, Reston, 345pp.

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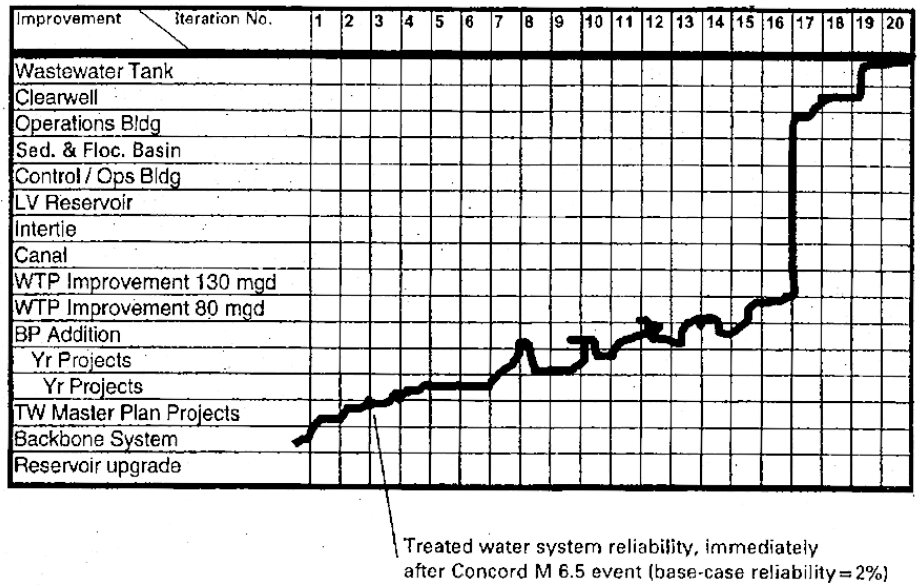
Actually, **LEAST COST** which, of course, depends on what you buy



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ATC 52-1

Here Today—Here Tomorrow: The Road to Earthquake Resilience in San Francisco

Potential Earthquake Impacts

ATC Applied Technology Council

Prepared for
San Francisco Department of Building Inspection
under the Community Action Plan for Seismic Safety (CAPSS) Project

SPA Risk

Analysis of Fire Following Earthquake Potential for San Francisco, California

Prepared by

Charles Scawthorn, S.E.
SPA Risk LLC
Berkeley CA 94708

for the

Applied Technology Council
On behalf of the

Department of Building Inspection
City and County of San Francisco

30 July 2010

Rev. 2: 9 November 2010

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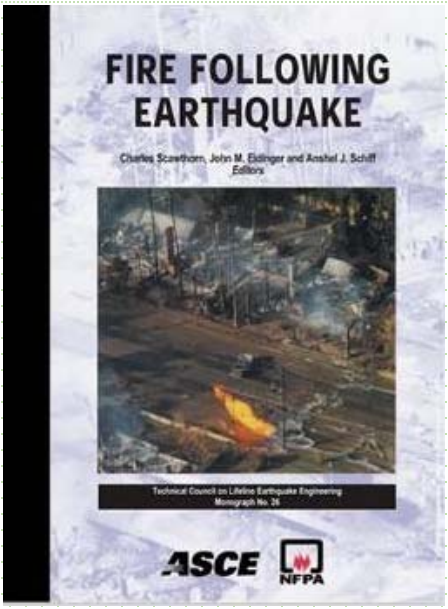

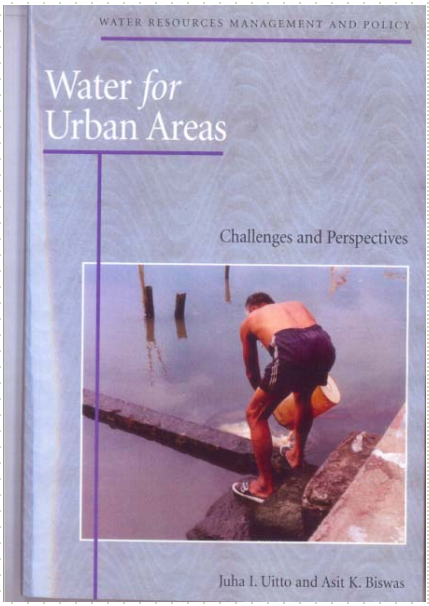

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Thank you

cscawthorn@berkeley.edu

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