DELTA VISION
FOUNDATION

DELTA LEVEES ROUNDTABLE

California Chamber of Commerce

March 1, 2012

Agenda

- Delta Risks and Consequences (45 minutes)
  - Moderator: Raymond Seed
- Protecting Lives, Property, and Critical Infrastructure (1 hour)
  - Moderator: Mike Chrisman
- Strategic Levee System: Advancing Near-term Levee Actions (2 hours)
  - Moderator: Sunne Wright McPeak

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DELTA RISKS AND CONSEQUENCES

Raymond Seed, DVF
Michael Mierzwa, DWR
Robert Pyke, DPC
Greg Gartrell, CCWD
Jay Lund, UC Davis

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DVF Roundtable Discussion: Delta Levees

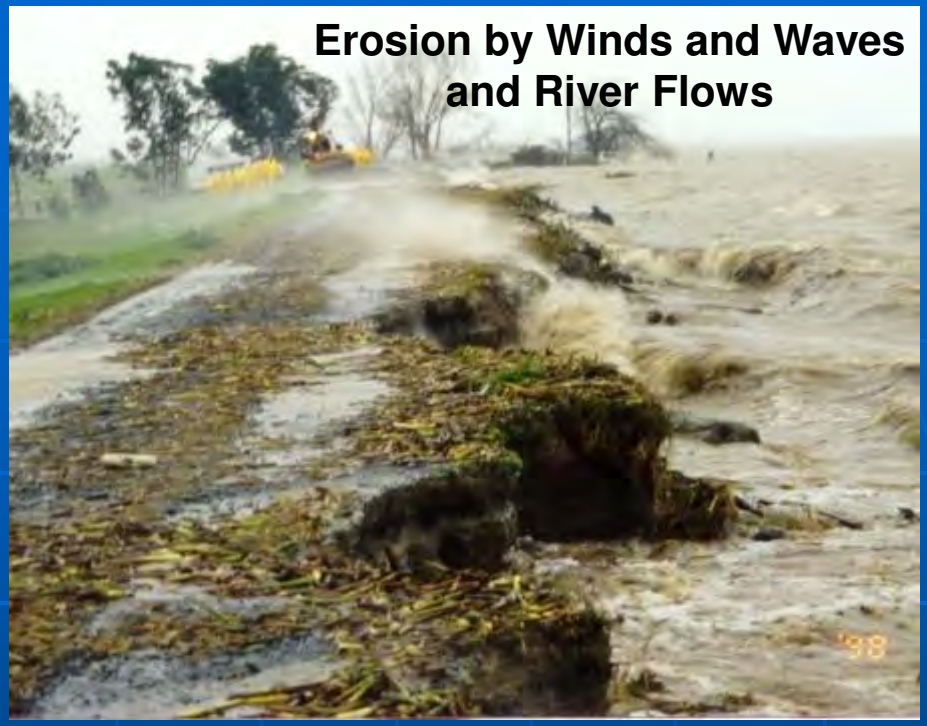
Session 1 – Risks and Consequences
Session 2 – Protecting Lives, Property, and Critical Infrastructure
Session 3 – Strategic Levee System: Securing Water Supplies and Ecosystem Resources

Dr. R. B. Seed

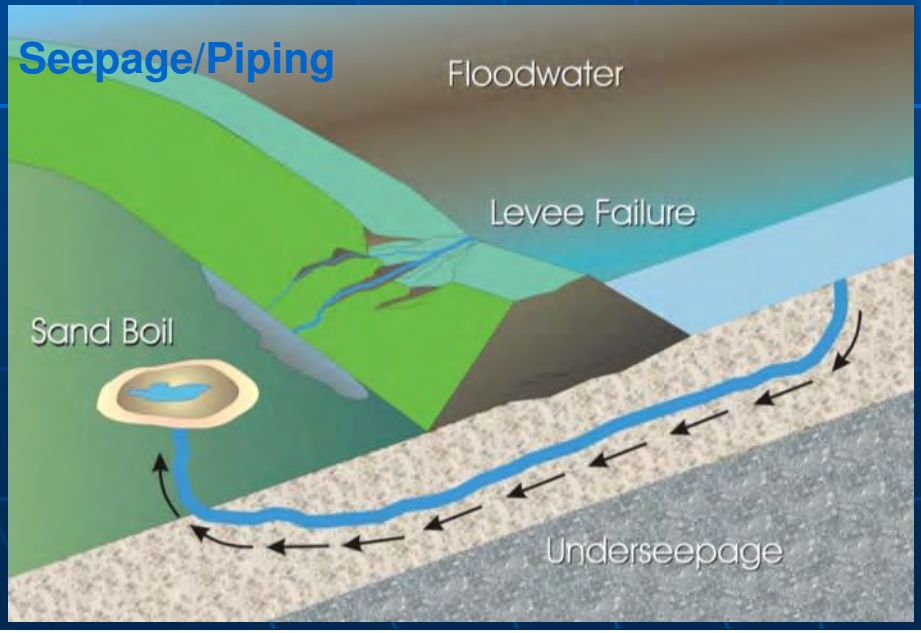
	Non-Seismic Levee Fragility	Seismic Levee Fragility
Land Side Risk	Lives, Property, Agriculture, Critical Infrastructure, etc.	
Water Side Risk	Ecosystems & Water Supply	

Overtopping Failures

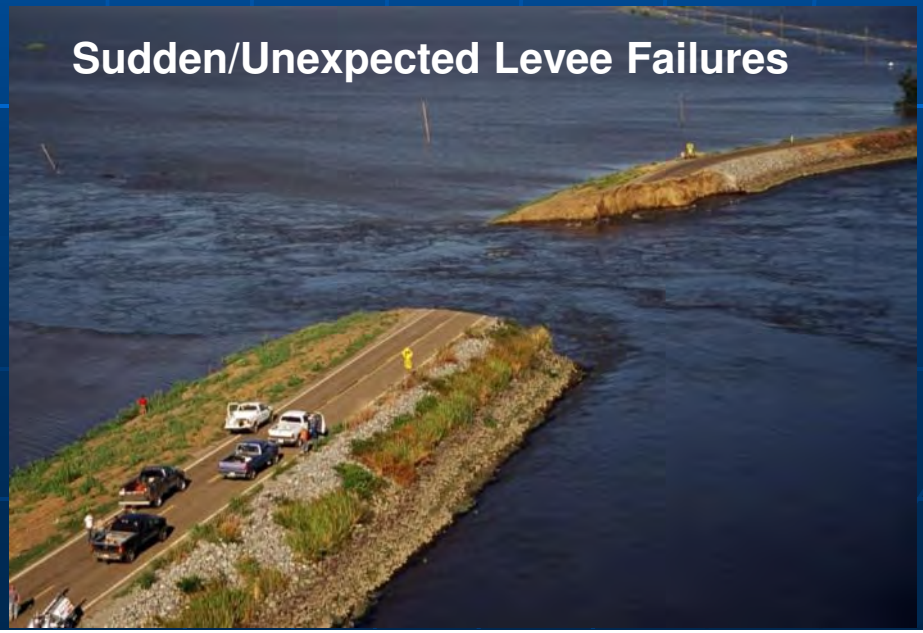
Erosion by Winds and Waves and River Flows



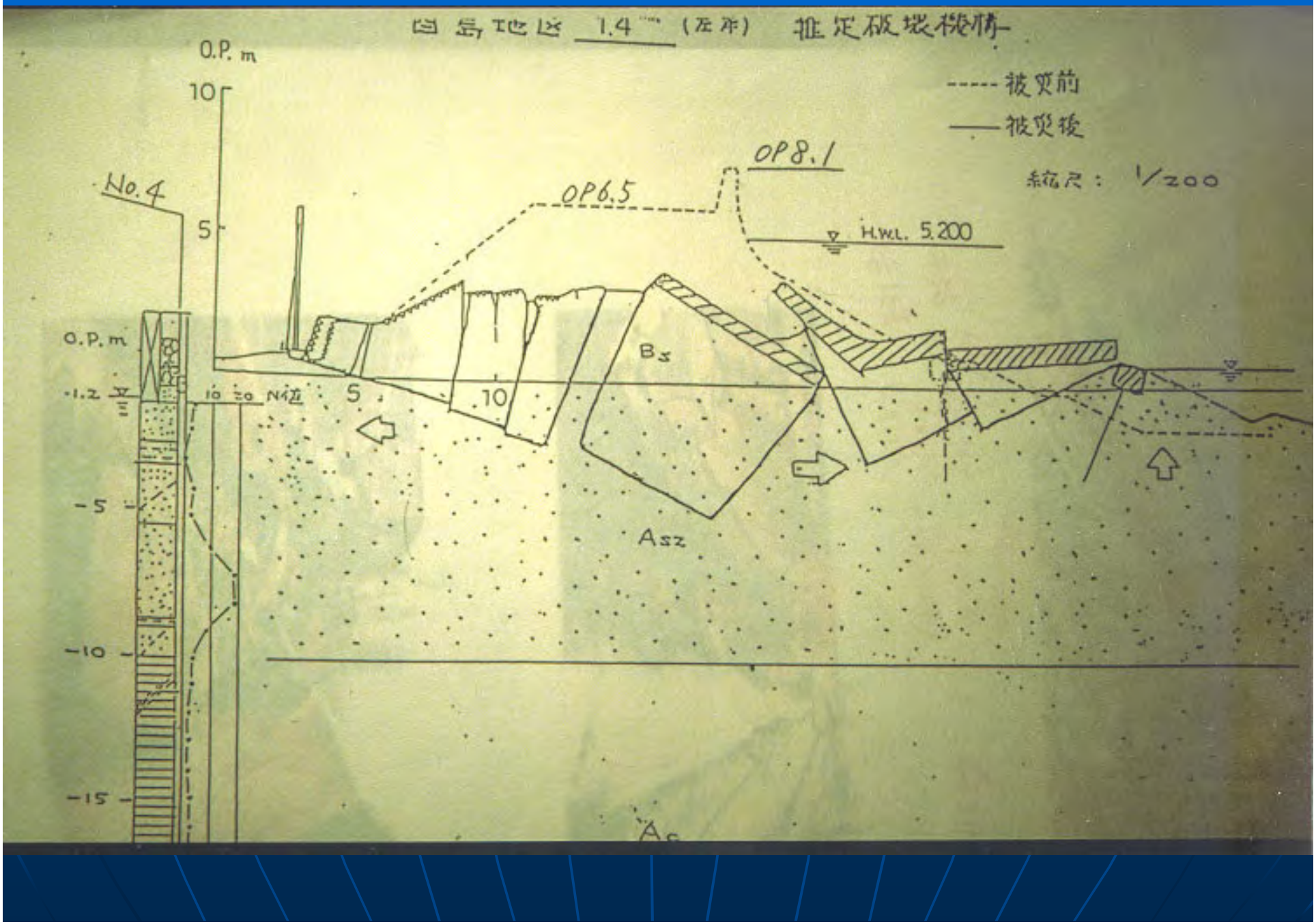
Seepage/Piping

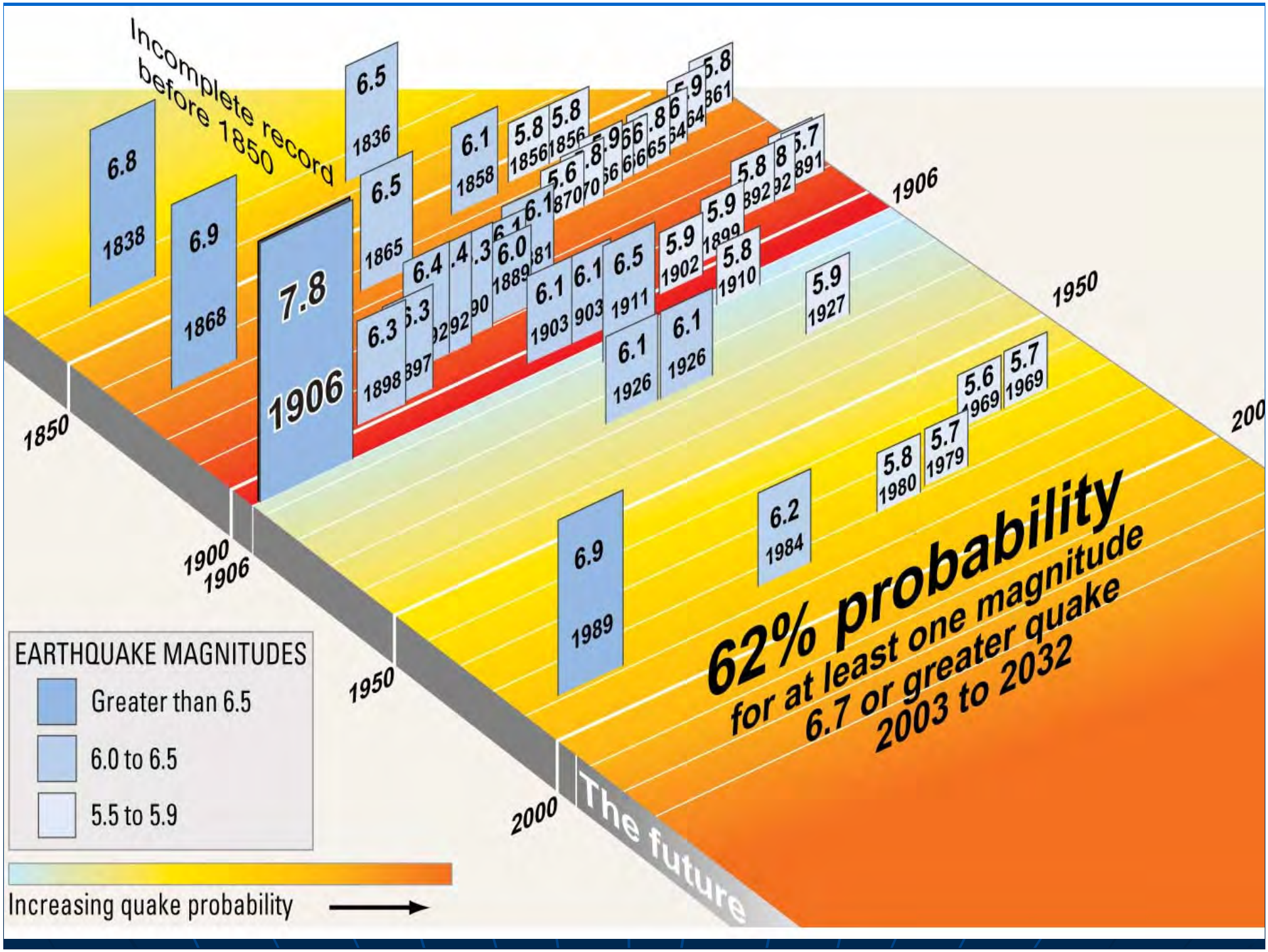


Sudden/Unexpected Levee Failures




新淀川の堤防も崩れた。18日朝現
も1900人以上の負傷者が出ている
西島）


白島地区 1.4㎞ (左岸) 推定破壊機構
O.P. m
10
5
-----被災前
——被災後
縮尺： 1/200
No.4
OP8.1
OP6.5
H.W.L. 5.200
O.P. m
-1.2
10 20 N値
5
10
Bs
-5
Asz
-10
-15
Ac


Incomplete record before 1850
6.8 1838
6.9 1868
7.8 1906
6.5 1836
6.5 1865
6.1 1858
5.8 1856
5.8 1856
6.3 1898
6.0 1889
6.1 1903
6.1 1903
6.5 1911
6.1 1926
6.1 1926
5.9 1902
5.9 1899
5.8 1910
5.9 1927
5.6 1969
5.7 1969
5.8 1980
5.7 1979
6.2 1984
6.9 1989
1850
1900
1906
1950
2000
1906
1950
200
The future
62% probability
for at least one magnitude
6.7 or greater quake
2003 to 2032
EARTHQUAKE MAGNITUDES
Greater than 6.5
6.0 to 6.5
5.5 to 5.9
Increasing quake probability

	Non-Seismic Levee Fragility	Seismic Levee Fragility
Land Side Risk	Lives, Property, Agriculture, Critical Infrastructure, etc.	
Water Side Risk	Ecosystems & Water Supply	

DELTA RISKS AND CONSEQUENCES

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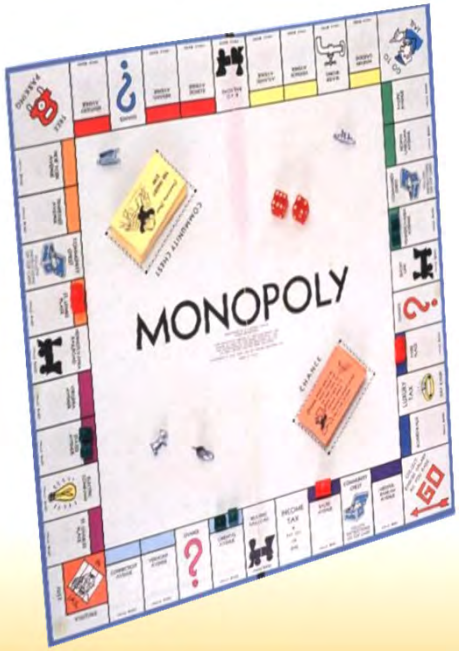
FloodSAFE CALIFORNIA

Risk & Uncertainty in Decision Making in the Sacramento-San Joaquin Delta



Delta Vision Foundation Roundtable: Risks & Consequences

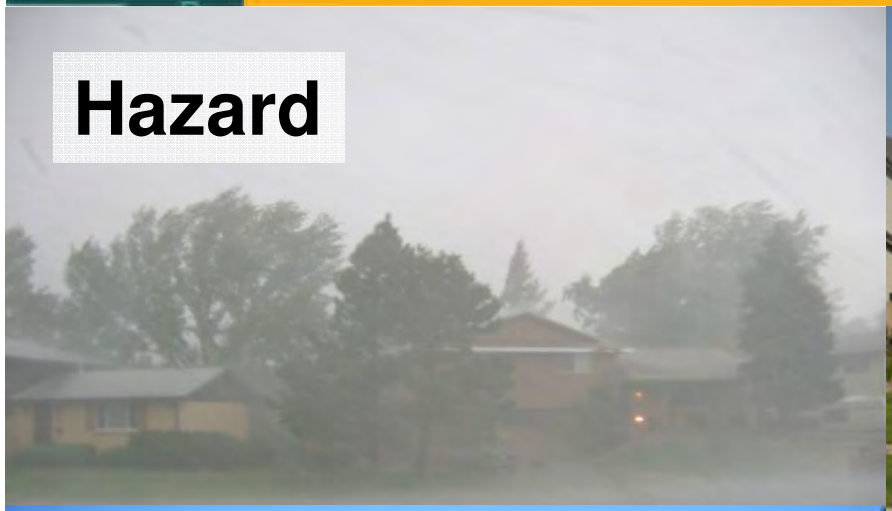
March 1, 2012

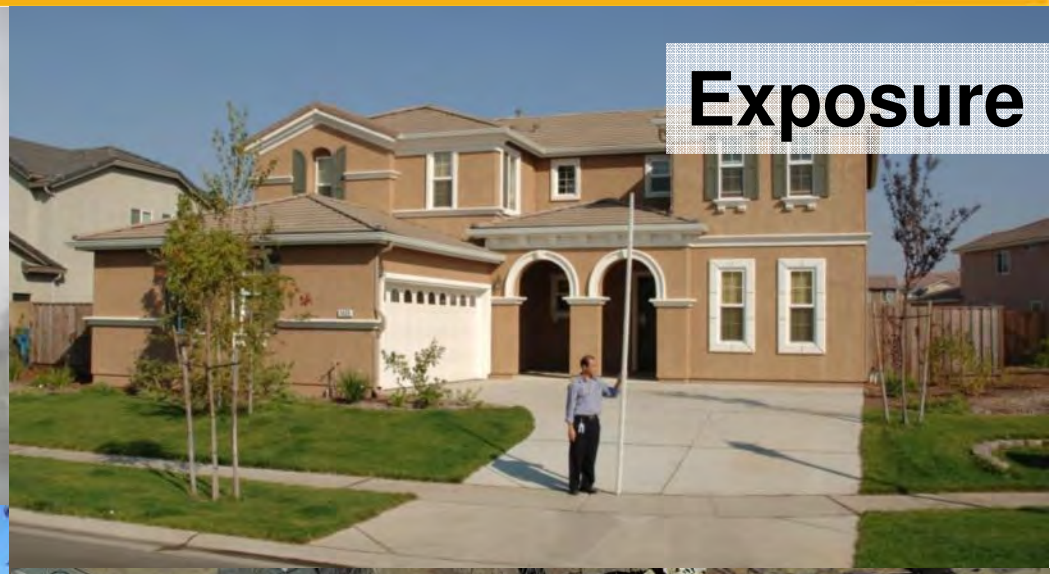
Michael Mierzwa, P.E.

California Department of Water Resources

PUBLIC SAFETY ENVIRONMENTAL STEWARDSHIP ECONOMIC STABILITY

Risk = Hazard + Exposure + Performance + Consequences





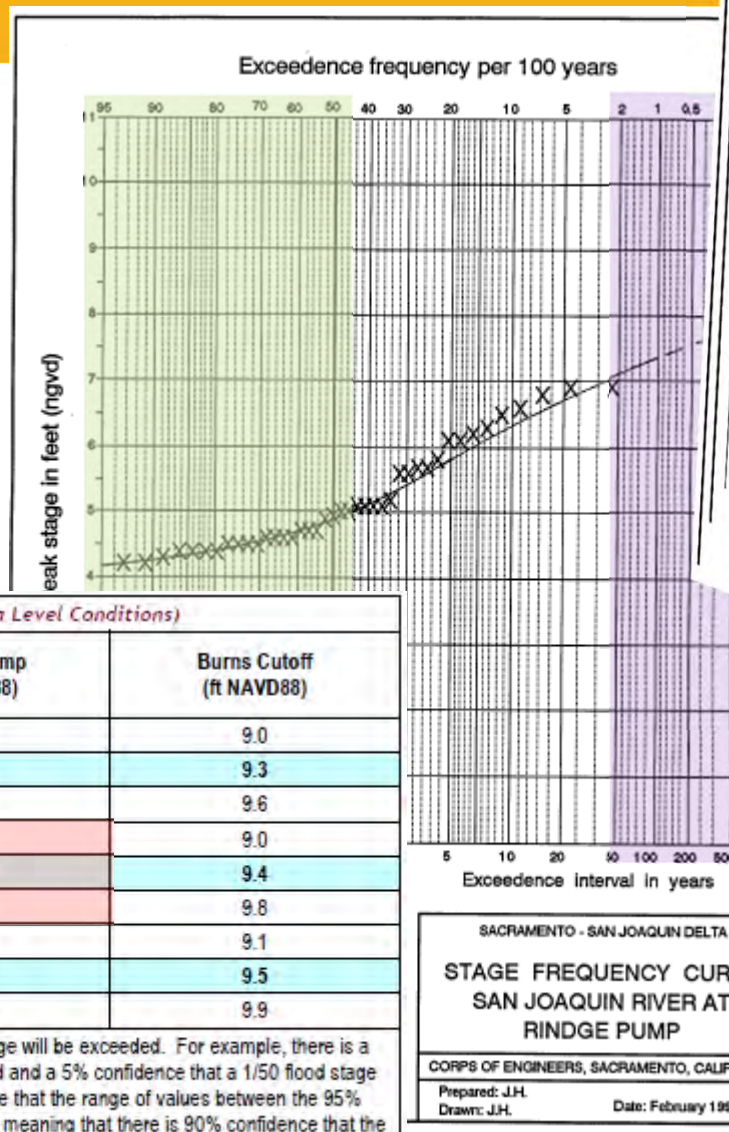
Hazard

SJAFCA
San Joaquin Area FLOOD CONTROL Agency

San Joaquin River Delta
Base Flood Elevation Refinement
Stage Frequency Analysis

Rindge Pump Gage Station (B95620)
Burns Cutoff Gage Station (B95660)

September 2, 2010



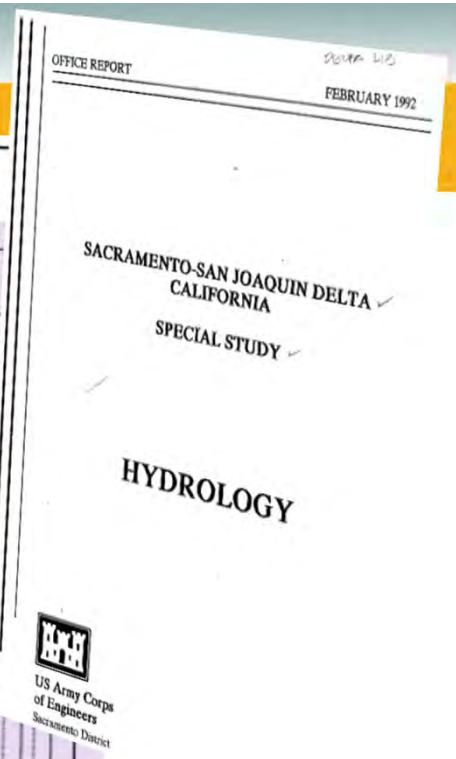
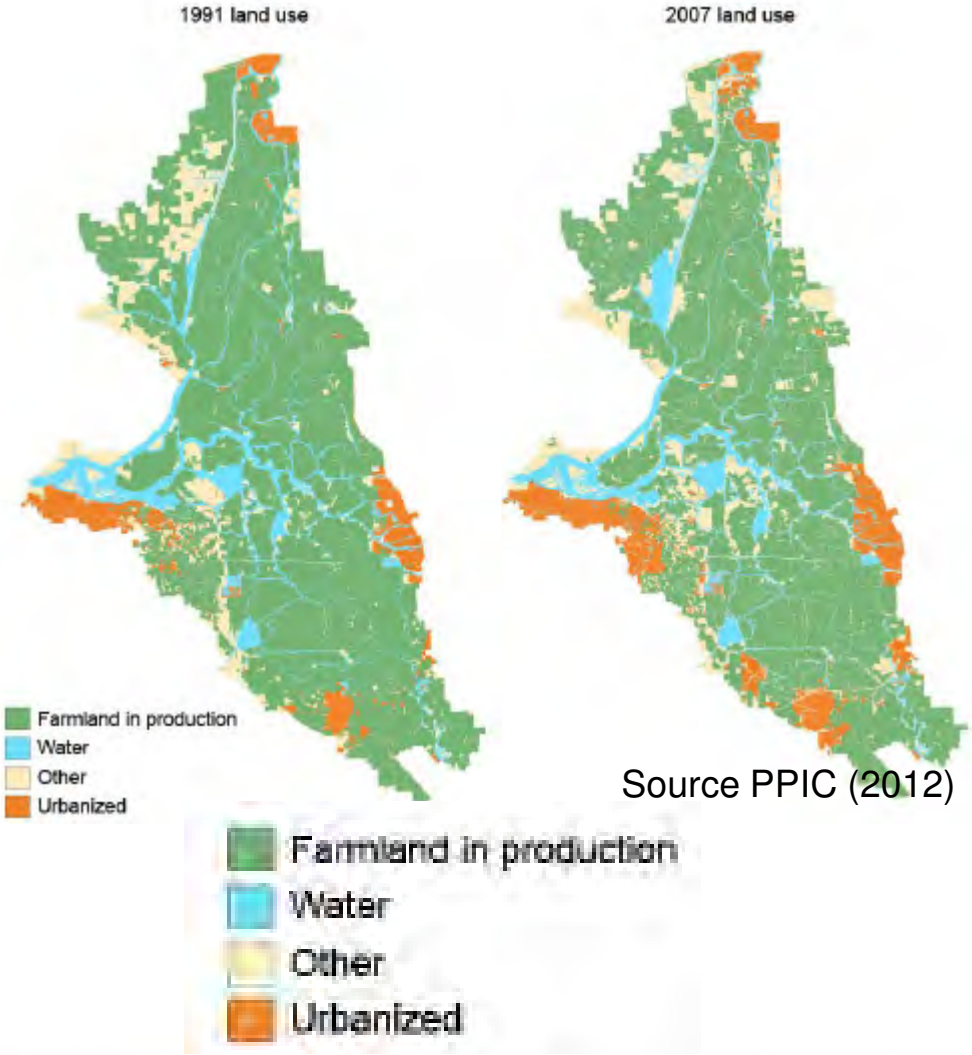


Table 3 - Stage Frequency Analysis Results (WY 2009 Sea Level Conditions)

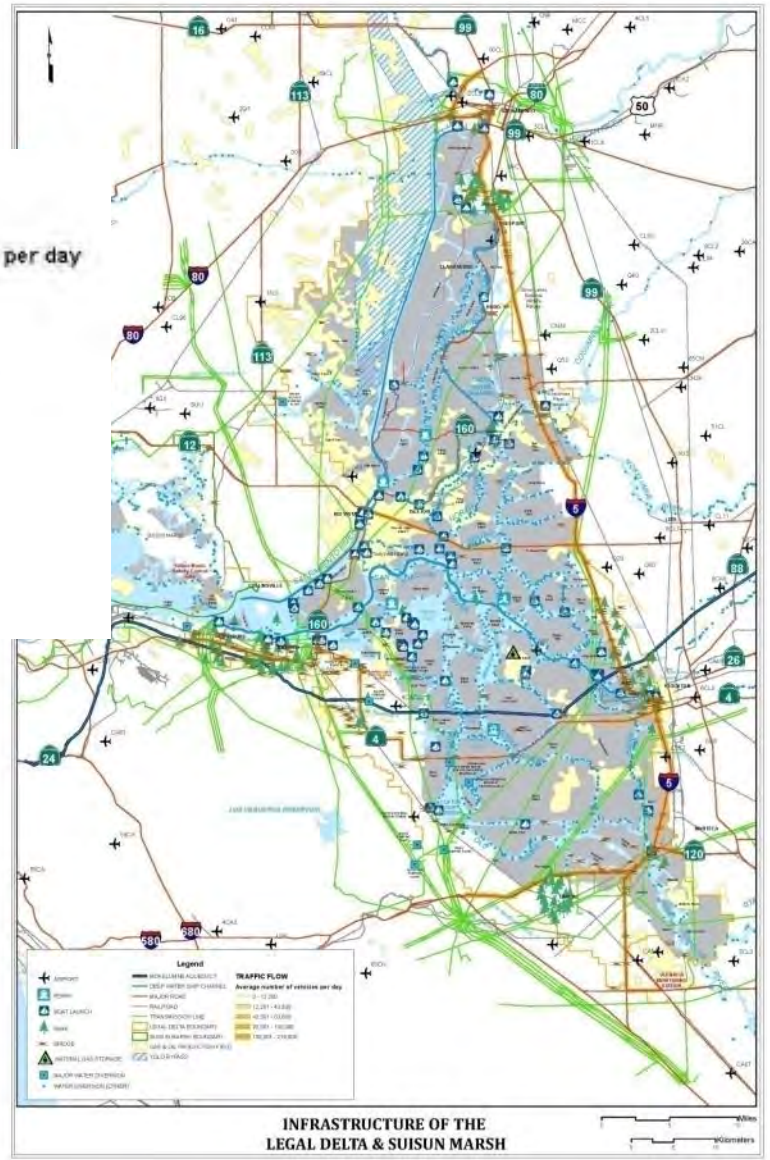
Annual Exceedance Probability	Confidence Limit(1)	Rindge Pump (ft NAVD88)	Burns Cutoff (ft NAVD88)
1/50	95%	8.9	9.0
	50%	**9.3**	**9.3**
	5%	9.7	9.6
1/100	95%	9.1	9.0
	50%	**9.4**	**9.4**
	5%	9.8	9.8
1/200	95%	9.2	9.1
	50%	**9.6**	**9.5**
	5%	10.0	9.9

(1) The confidence limit represents the percent confidence the stage will be exceeded. For example, there is a 95% confidence that a 1/50 flood stage of 8.9 ft would be exceeded and a 5% confidence that a 1/50 flood stage of 9.7 ft would be exceeded at the Rindge Pump gage station. Note that the range of values between the 95% and 5% confidence limits represents the 90% confidence interval – meaning that there is 90% confidence that the given flood stage will occur between the two values.

Exposure



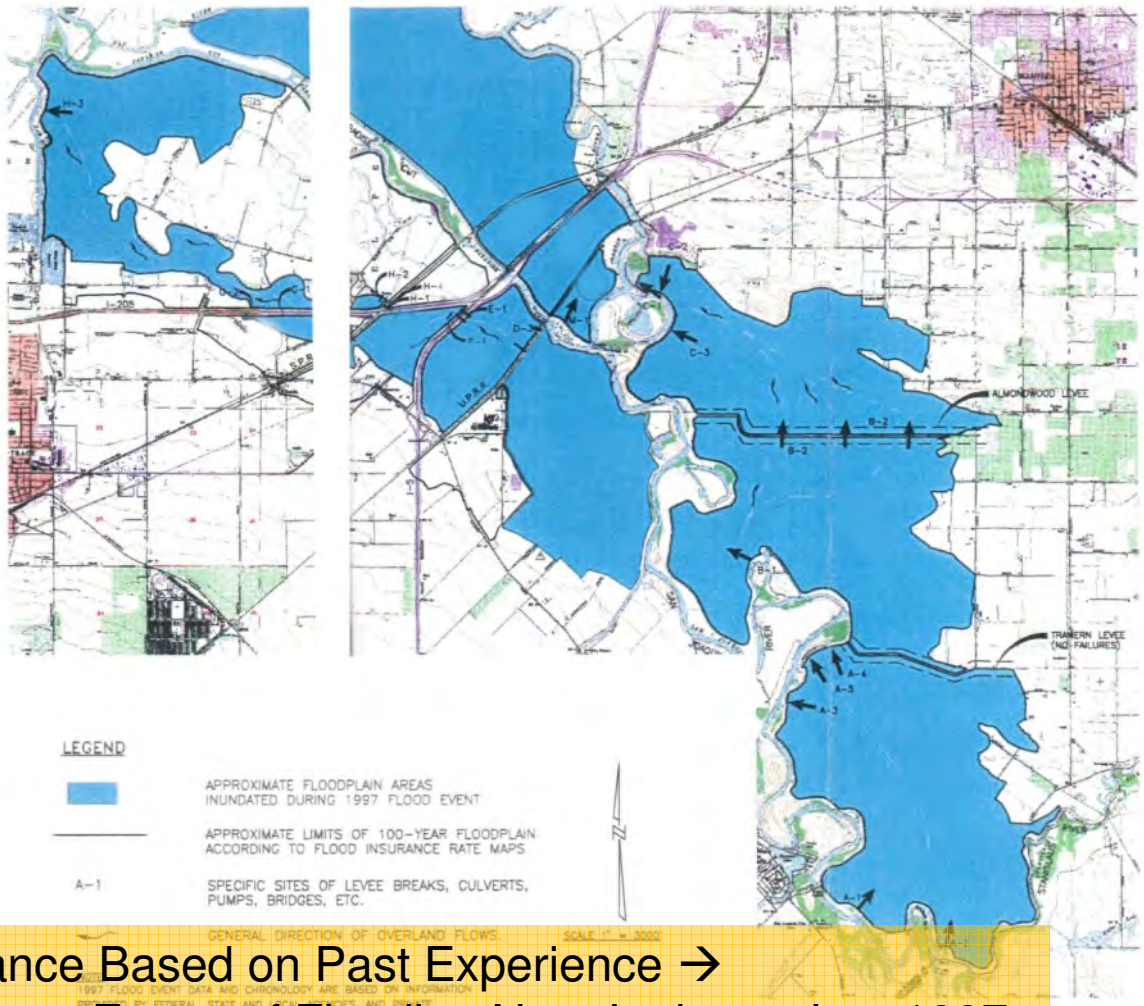
Source PPIC (2012)



Source DWR (2012)

Performance

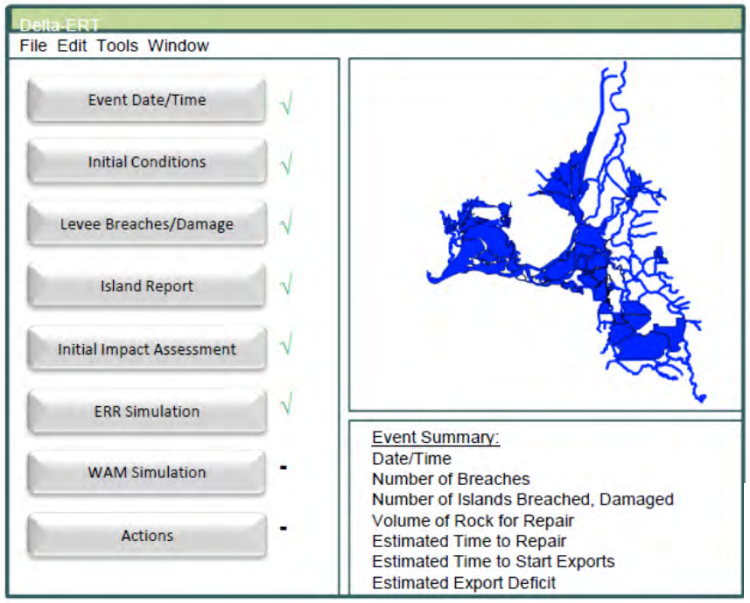
FLOOD RISK ELEMENTS	STATE AGENCIES			
	DWR	CALEMA	CVFPB	CDFG
Channel Capacity	■		●	●
Seepage	■		●	
Erosion	■		●	●
Encroachments	■		■	
Vegetation	■		●	■
Stability and Seismic Loadings	■		●	
Management of Floodplains	■		●	●
Responding to Flood Emergencies	■	■	●	●
FLOOD SYSTEM IMPROVEMENT INITIATIVES	■		■	

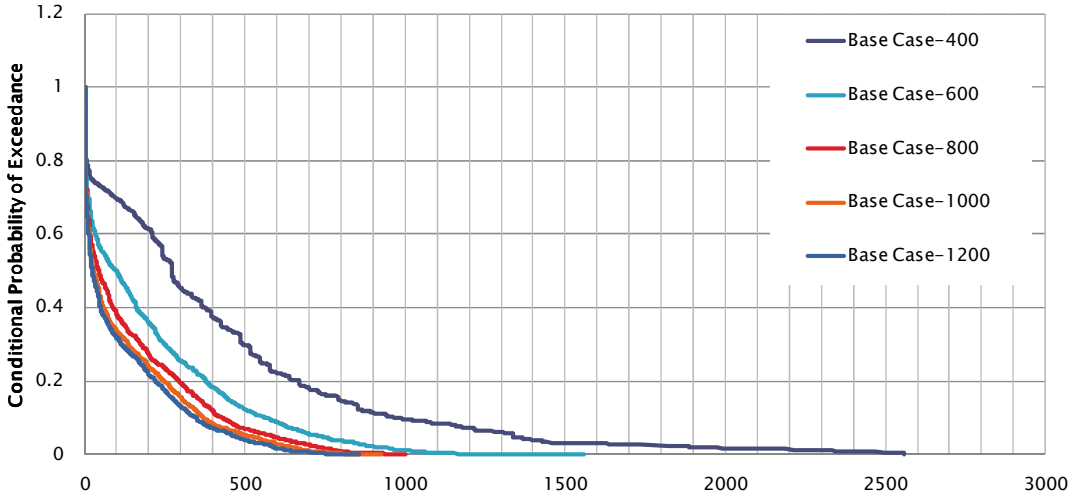


We Assume Future Performance Based on Past Experience →
EXAMPLE: Estimated Maximum Extent of Flooding Near Lathrop: Jan. 1997

Consequences

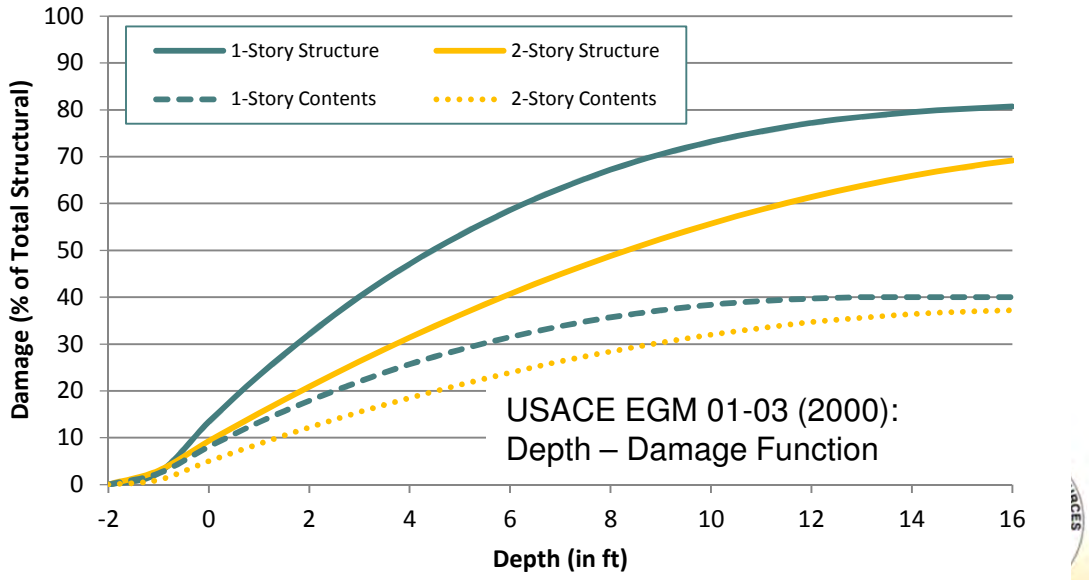
Example of Systemwide Consequences:
Salinity





Example of Site-Specific Consequences:

- ✓ People
- ✓ Structures
- ✓ Contents
- ✓ Crops



mmierzwa@water.ca.gov

DELTA RISKS AND CONSEQUENCES

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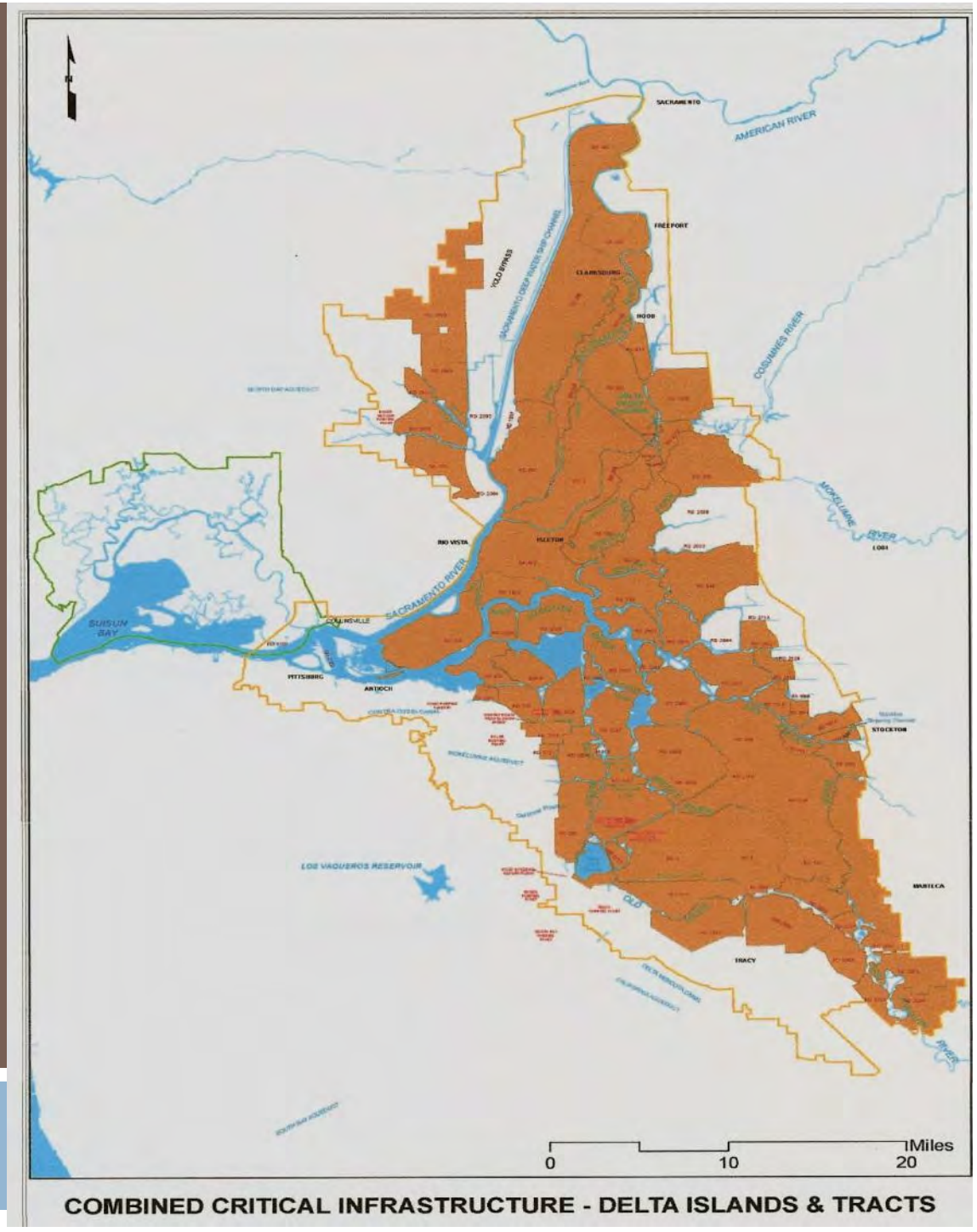
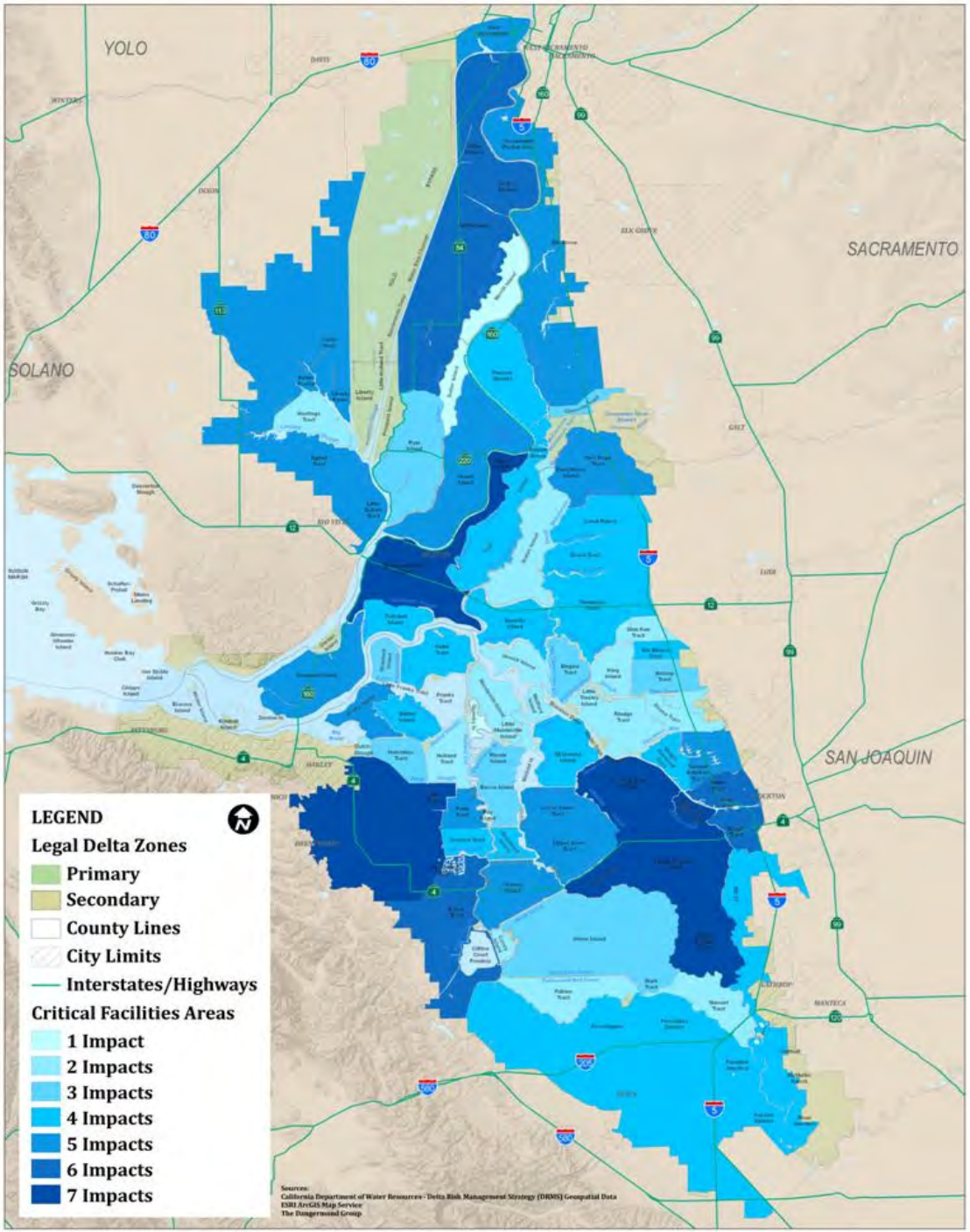
ECONOMIC SUSTAINABILITY PLAN FOR THE SACRAMENTO-SAN JOAQUIN DELTA

Delta Protection Commission
Approved October 25, 2011
Revisions accepted January 26, 2012

Presentation to the Delta Stewardship Council
February 9-10, 2012

For high-resolution graphics and further details: forecast.pacific.edu/desp.html


SACRAMENTO
AMERICAN RIVER
FREEPORT
CLARKSBURG
HOOD
YOLO BYPASS
SACRAMENTO DEEP WATER SHIP CHANNEL
COSUMNES RIVER
MOKELUMNE RIVER
LODI
RIO VISTA
ISLETON
SACRAMENTO RIVER
SUISUN BAY
COLLINSVILLE
PITTSBURG
ANTIOCH
STOCKTON
LOS VAQUEROS RESERVOIR
MANTECA
TRACY
OLD
RIVER
0
10
20
Miles
COMBINED CRITICAL INFRASTRUCTURE - DELTA ISLANDS & TRACTS


YOLO
SACRAMENTO
SOLANO
SAN JOAQUIN
LEGEND
Legal Delta Zones
Primary
Secondary
County Lines
City Limits
Interstates/Highways
Critical Facilities Areas
1 Impact
2 Impacts
3 Impacts
4 Impacts
5 Impacts
6 Impacts
7 Impacts
Sources:
California Department of Water Resources - Delta Risk Management Strategy (DRMS) Geospatial Data
ESRI ArcGIS Map Service
The Dangermond Group


BUICK

DELTA RISKS AND CONSEQUENCES

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Delta Vision Foundation Roundtable
Delta Levees

March 1, 2012

CONTRA COSTA WATER DISTRICT

Delta Flood Risks for Urban Water Users

- Seismic: Disruption of water supplies for months
  - For Bay Area Agencies, direct seismic damage will be the priority
  - Loss of Delta supply mitigated by local storage and interties
- Flooded islands of any cause
  - Damage to facilities in flood-prone areas
  - Mitigated by proper design of facilities
  - Mitigated by treatment (additional costs)

CONTRA COSTA WATER DISTRICT

Some of what we "knew" is wrong

A seismic event is not the end of the Delta water supplies; recovery can be rapid, if we plan ahead

Delta Island flooding from ***floods*** need not directly affect water supplies (it can affect treatment)

Leaving islands flooded does not stop Delta water supplies

Sea level rise (SLR) does not mean the end of Delta exports

BUT, failure to act now can result in much worse consequences from all these scenarios

CONTRA COSTA WATER DISTRICT

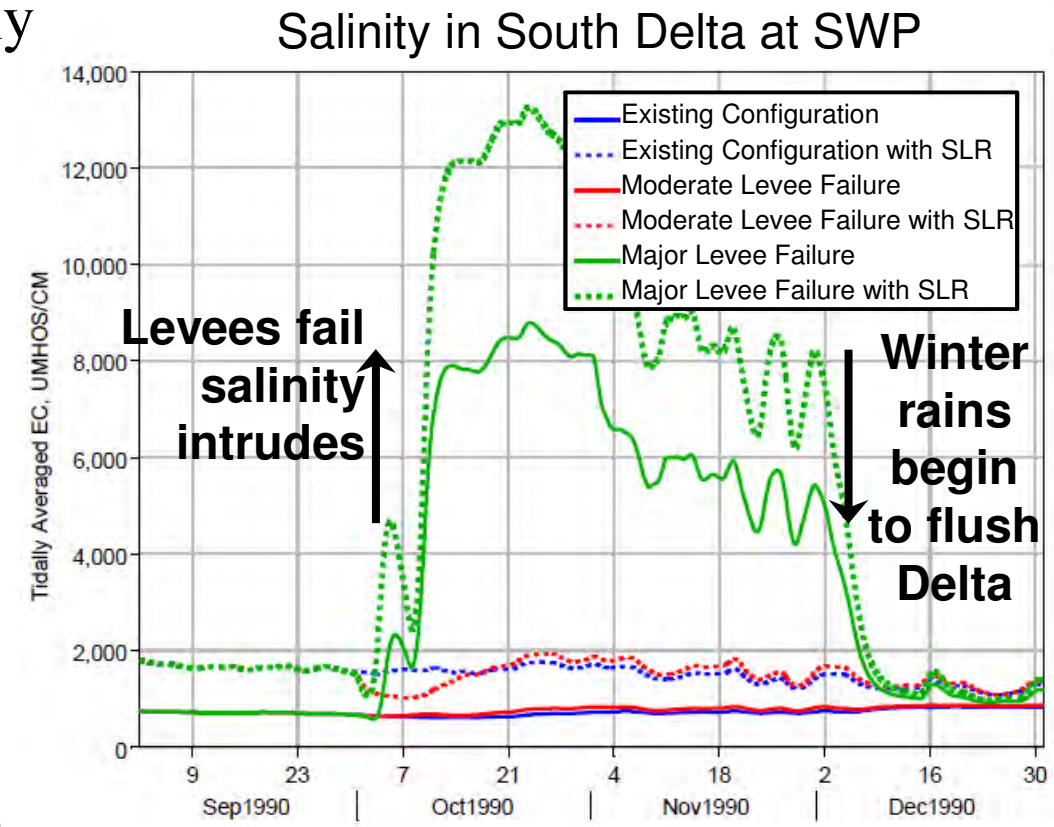
When Levees Fail… ?

When Delta levees fail, won't seawater rushing into the Delta end exports for years or forever?

- No, not according to the BDCP studies.
- Levee failures during a **flood**: the islands fill with floodwaters, seawater does not rush in.
- Following massive seismic levee failures in a dry year, BDCP studies indicate:
  - South Delta salinity peaks quickly, but seawater can flush out when the winter rains enter the Delta.
  - If islands remain flooded (i.e. levees not repaired), South Delta salinity could be even less than existing channel configuration.

Seismic Levee Failure: Increased South Delta Salinity can resolve quickly

- Salinity increases abruptly after levee failure, especially for the major Hayward fault scenario (green lines).
- Salinity goes back to pre-failure levels within several months—***in a critically dry year*!**
- Why? Winter flows flush out the salt (even in a dry year with exports)!



Notes:

1 SLR = Sea Level Rise of 140cm, the maximum rise forecast for 2100.
2 Existing Channels includes BDCP tidal marsh restoration of 65,000 acres
3 Moderate Levee Failure = 3 western Delta islands plus Grizzly Island
4 Major Levee Failure = DRMS Hayward scenario, with 13 islands flooded

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March 2012

A word of caution …
BDCP studies of levee failure are limited

- Assumptions are designed for worst case scenario:
  - Levee failures were simulated *during the worst 6-year drought* in the last 70 years.
  - Sea Level Rise of 140 cm is a 2100 estimate (current rate is 3.2 cm/decade).
  - Assumes all islands remain flooded, but some islands would likely be reclaimed.
- Only considers salinity, but massive levee failure will create other issues that must be addressed, including, but not limited to:
  - infrastructure (e.g. highways, electrical lines, gas mains) will need repair.
  - other water quality problems may arise (e.g. algae may bloom in the flooded islands)

In any event, action is needed now to reduce the consequences.

What is needed now

Emergency Response Planning:

- How to react to a multi-levee failure in dry conditions
- Optimal way to deal with seawater intrusion

Key levee improvements:

- Regardless of Delta "fix", infrastructure and south Delta diversions will be necessary for the next 20 to 50 years
- Protect infrastructure, make recovery shorter and less costly

Long term plan and implementation for long term problems (SLR)

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Data Sources

- BDCP Presentations to Steering Committee on July 29, 2010
  - Usage of large facility
  - Salinity Response to Delta Levee failures

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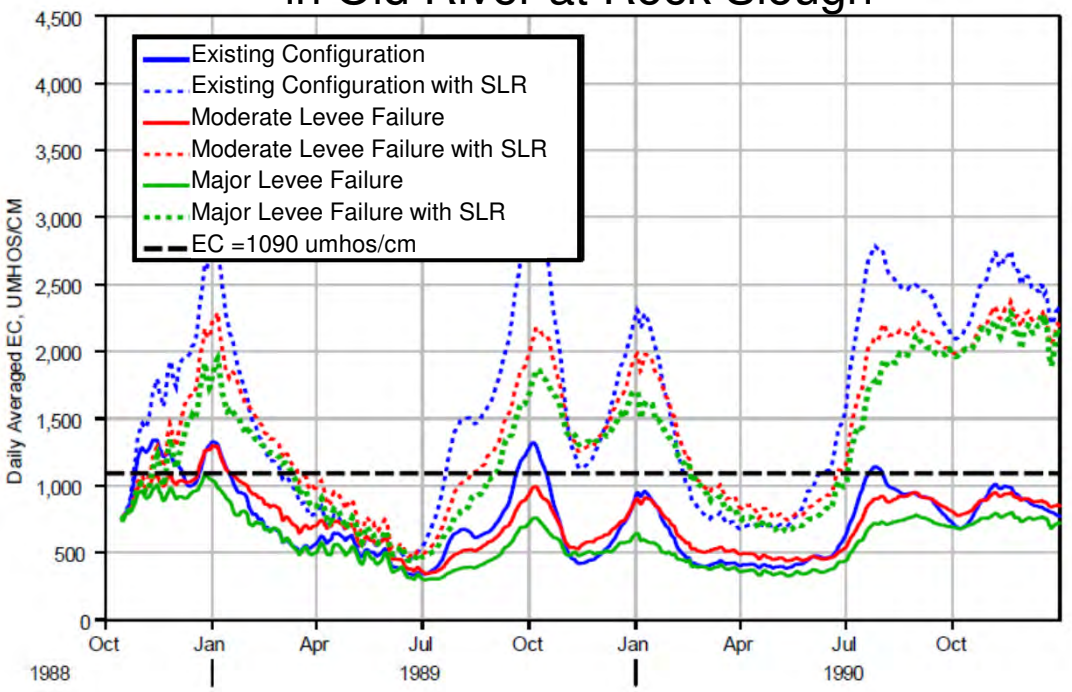
Flooded Islands Dampen the Tides and Reduce Salinity Intrusion

- If Delta levees are not repaired after failure, salinity would be lower than the existing channel configuration (green line is consistently lower than blue line)

- Sea Level Rise (SLR) of 140cm, with vertical sea walls and no levee overtopping could substantially increase salinity (dashed lines), but the flooded islands would still reduce salinity relative to no levee failures.

Salinity in Central Delta
in Old River at Rock Slough



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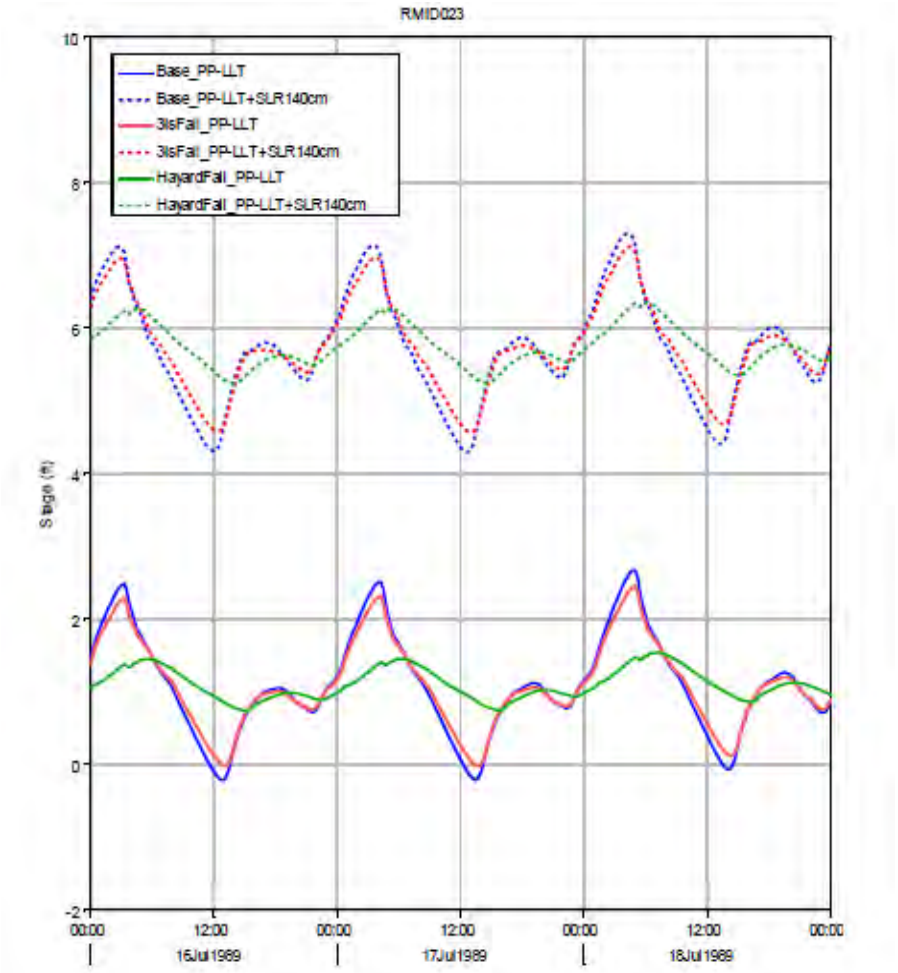
Flooded Islands Dampen the Tides and Reduce Salinity Intrusion

- Flooded islands and tidal marsh restoration can dampen the tides
- Reduced tidal amplitude reduces seawater intrusion



CONTRA COSTA WATER DISTRICT

March 2012

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DELTA VISION FOUNDATION

Delta Levee Issues and Analysis

Jay R. Lund

Department of Civil and Environmental Engineering

University of California, Davis

http://cee.engr.ucdavis.edu/faculty/lund/

Subsided Delta Island Failures

1. Since 1980, Mildred, Liberty and Jones failed; only Jones fixed

2. Recognized problem since 1931 Water Plan

3. 1978, 1983, 1990, 2008, 2010 analyses show problems

Franks Tract

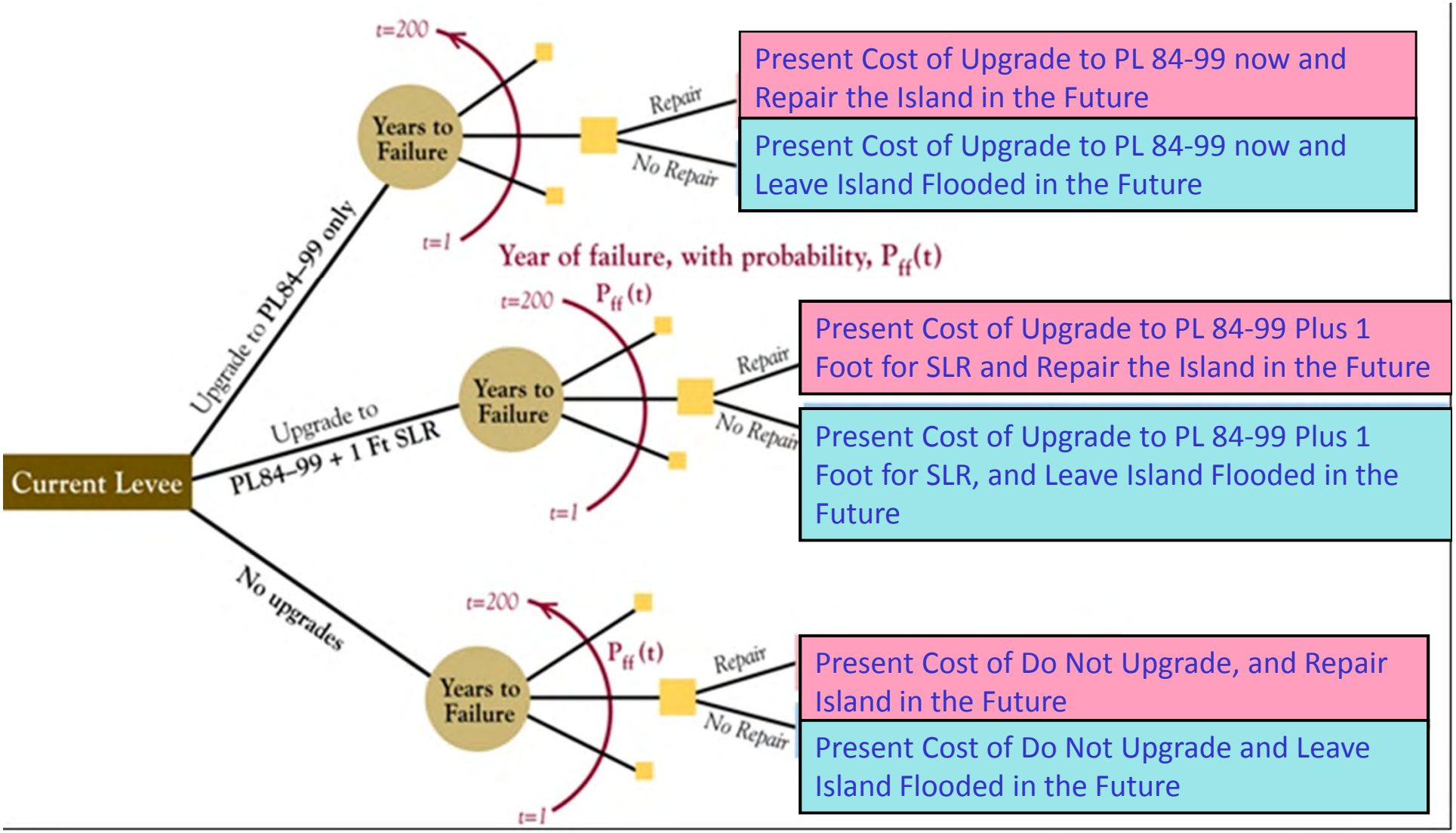
Risk Analysis

Risk = sum consequences x likelihood

Combines costs, benefits, & likelihoods

Dutch flood standard approach

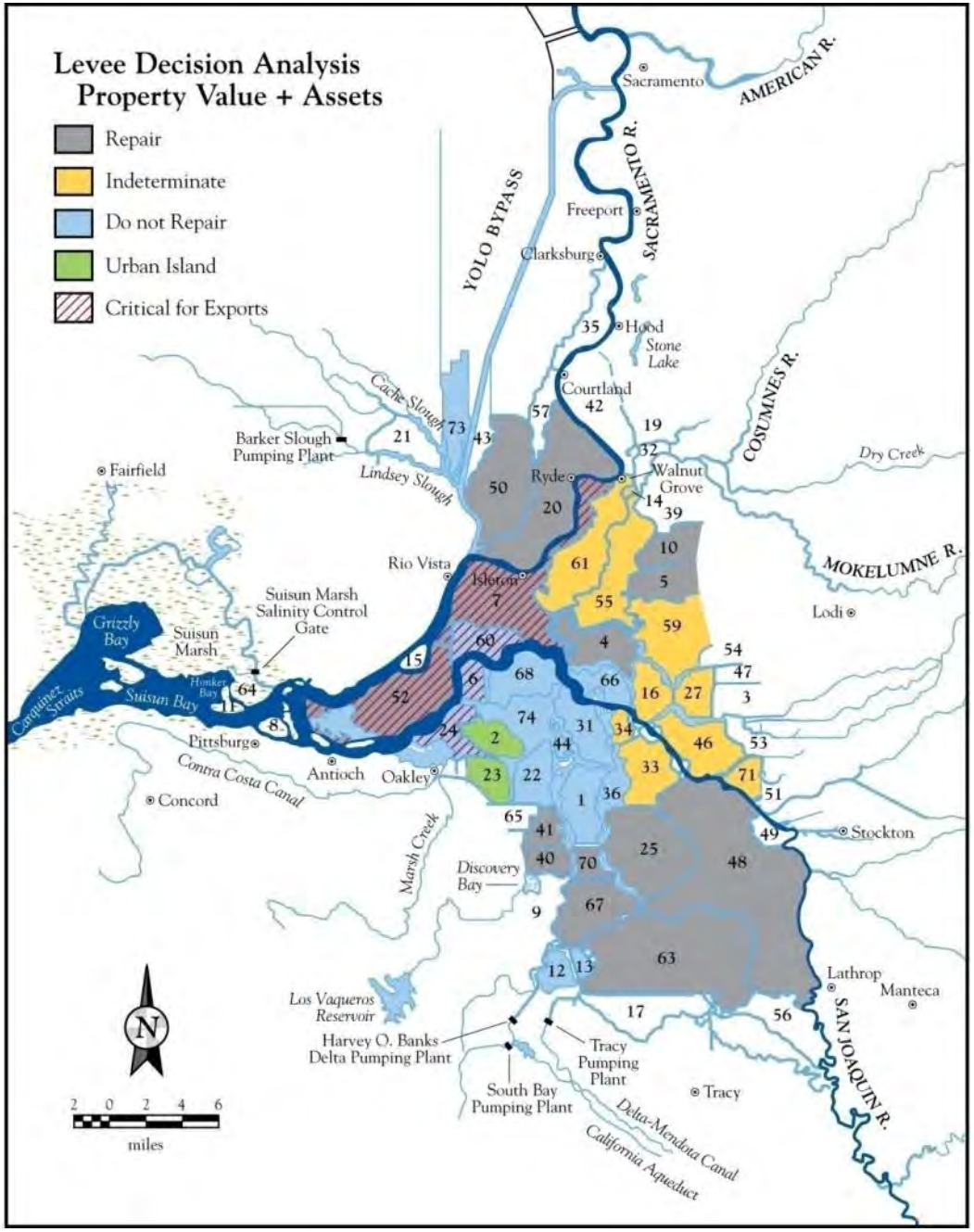
Risk Analysis: Levee Decision Tree



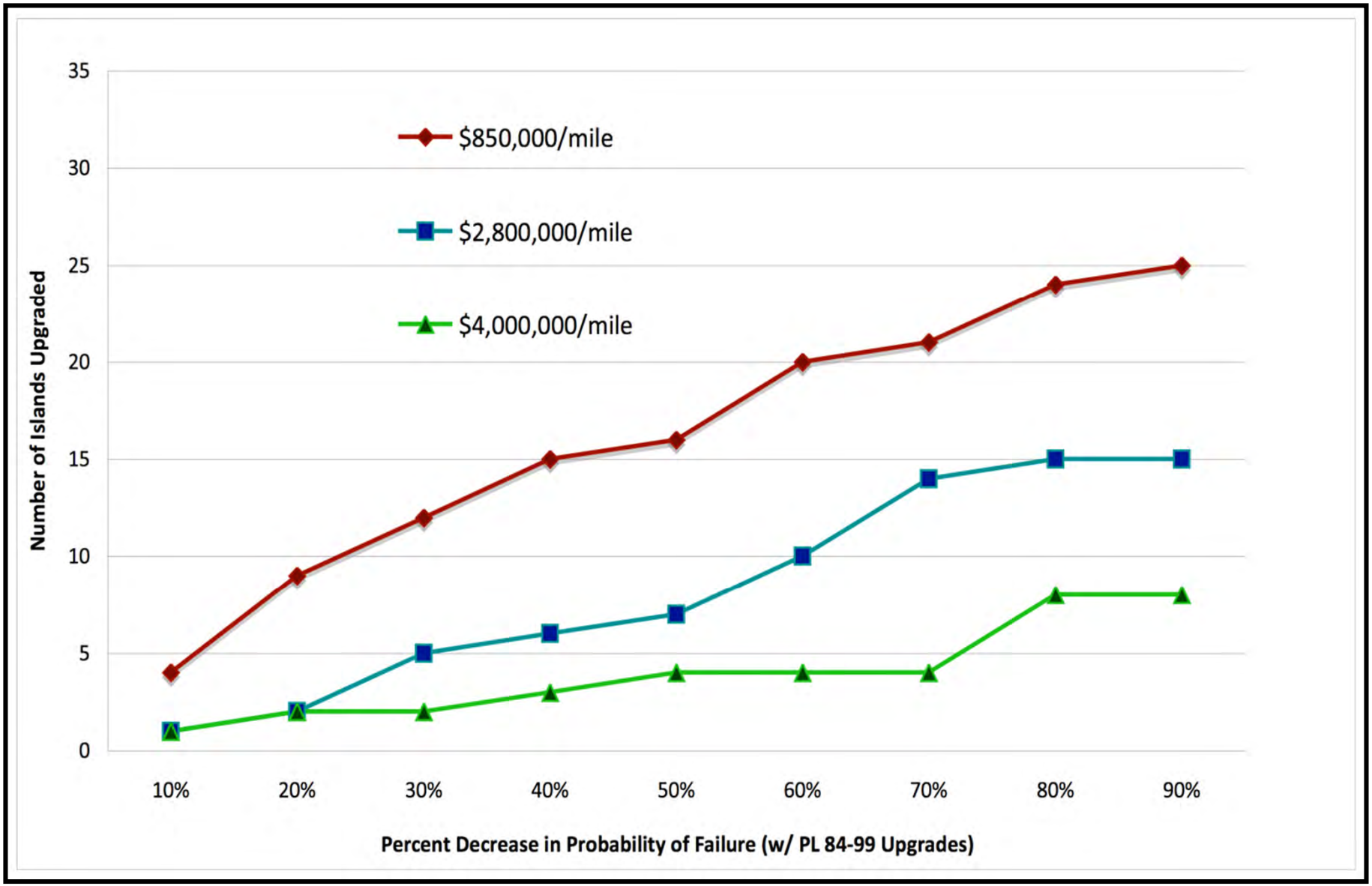
Results

10 - 19 islands not economically worth repairing after flooding.

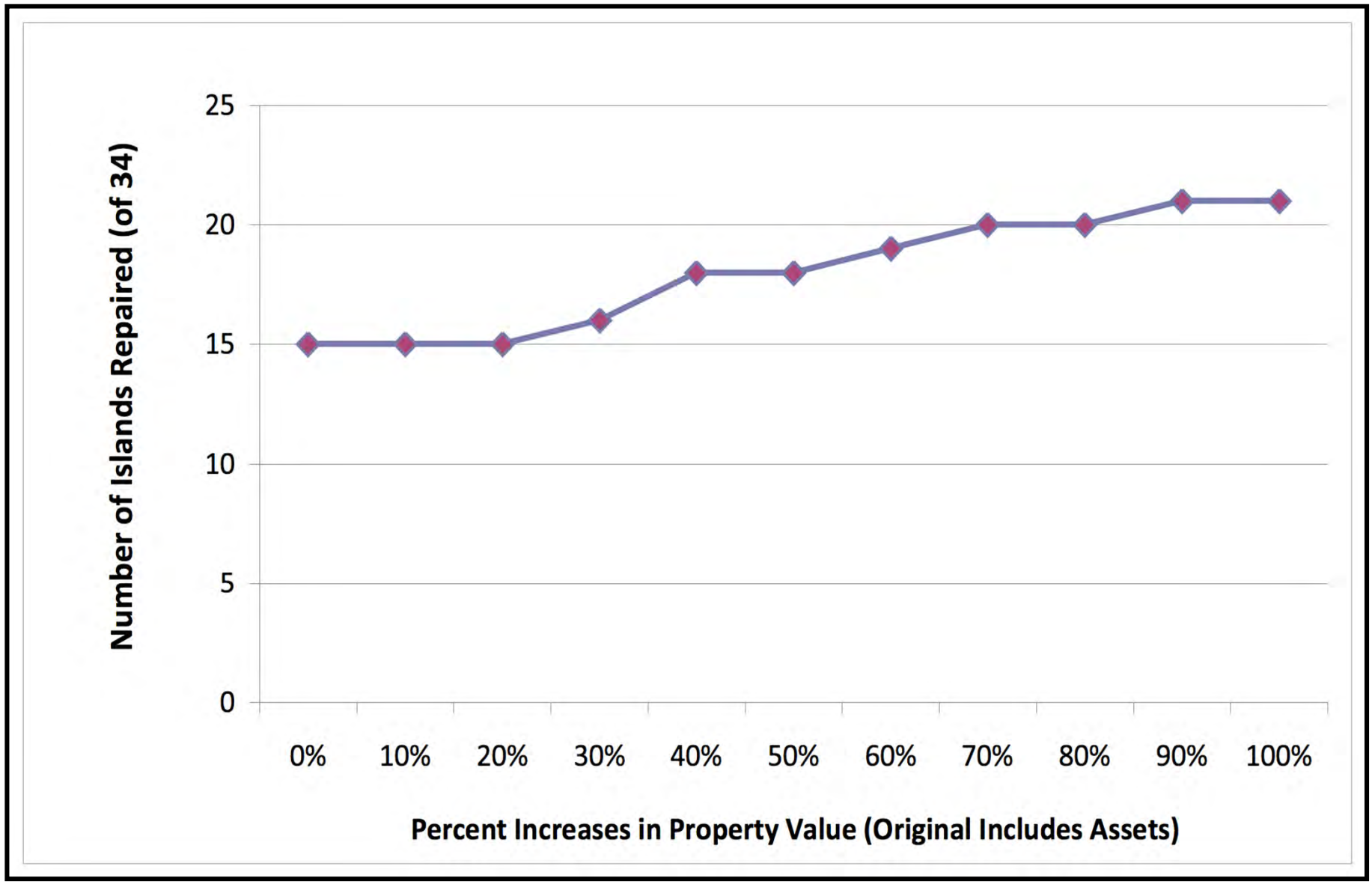
Major upgrades not economical for *any* of 34 subsided islands.



What if Upgrades Are Cheaper and/or More Effective?



What If Island Values Are Higher?



Levees and the Ecosystem

Rip-rapped levees are un-natural habitat

Current islands probably not ideal for the ecosystem

How to make it better?

Policy Issues

- Diminishing state and federal funding
- Need to prioritize
- Need disinterested analysis
- Need to prepare for the future

Further Reading

Duncan, J.M. and W.M. Houston (1983), "Estimating Failure Probabilities for California Levees," *Journal of Geotechnical Engineering* (ASCE), Vol. 109, No. 2, February, pp. 260-268.

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