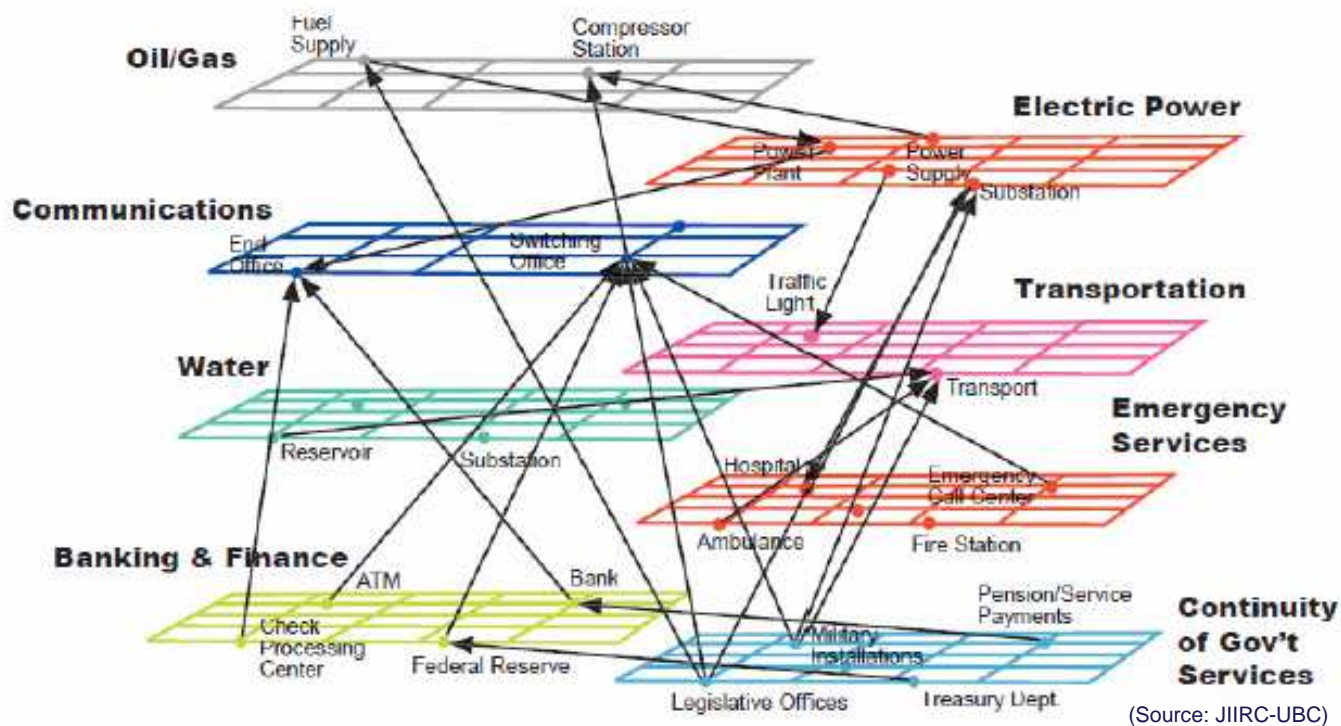


CCSF Lifelines Council Interdependency Study – The Final Stretch



Lifelines Council Meeting #11

April 4, 2013

Interdependency Study Goals (Near-term 2 – 5 years)

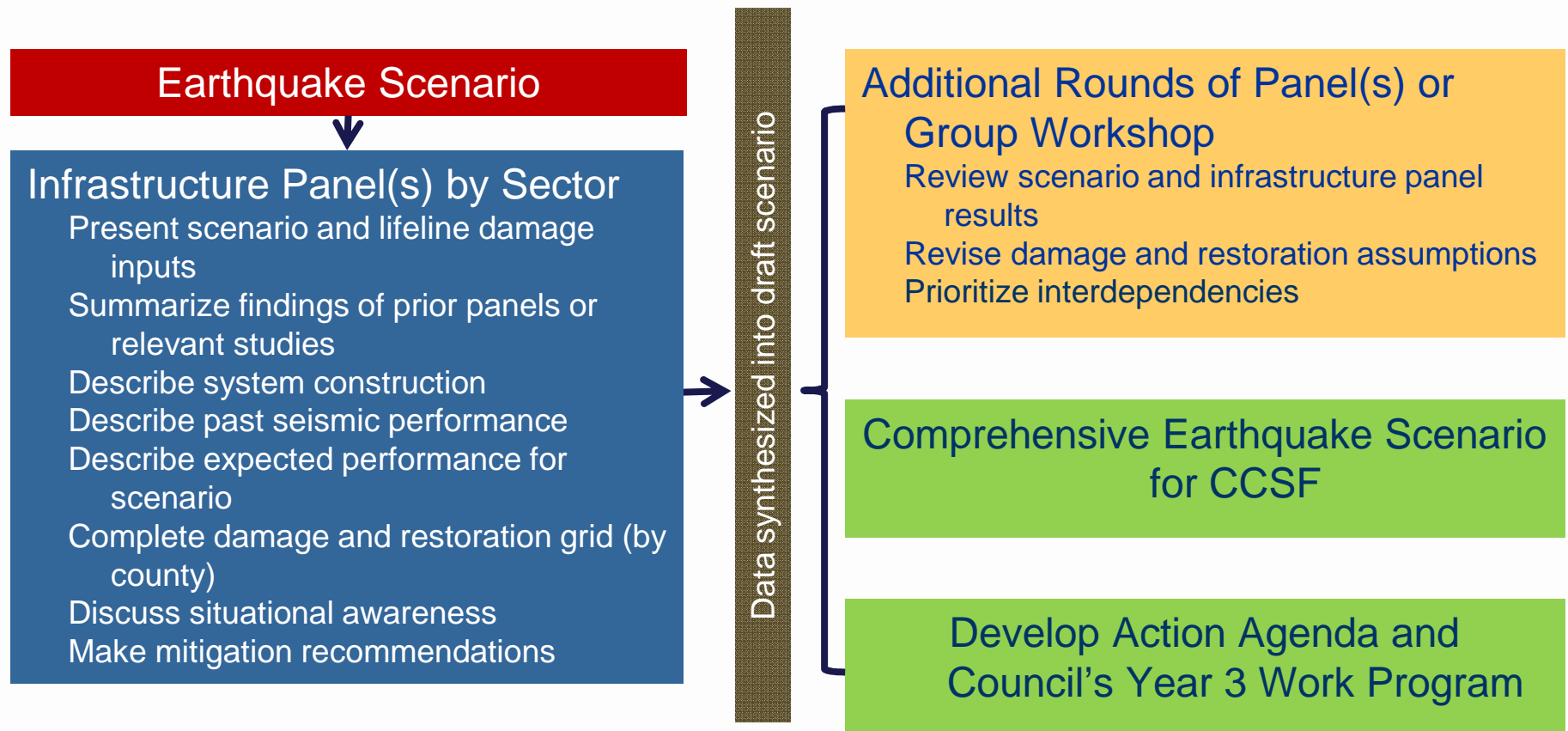
- Build a workable understanding of system interdependencies, and consequences of existing conditions ,to help expedite response and restoration planning among agencies
- Identify key assets and restoration priorities/schemes to prioritize post-disaster restoration and reconstruction activities for the city, and ultimately the region
- Develop a collective set of lifelines performance expectations under current conditions

Interdependency Study Progress to Date and Next Steps

- √ Design study, select scenario, and develop discussion guide (April – October 2011)
- √ Pilot testing of scenario and finalize discussion guide (Nov 2011 –Jan 2012)
- ☐ Infrastructure operator and panel discussions (January 2012 – Spring 2013)
- ☐ Synthesize discussions into integrated scenario and interdependency insights; operator review and approval (late Spring 2013)
- ☐ Presentation to the Lifelines Council and other groups, as appropriate (Summer 2013)

Lifelines Council Interdependency Study Approach

(modeled after Chang et al (Vancouver) and Porter et al (Southern California))

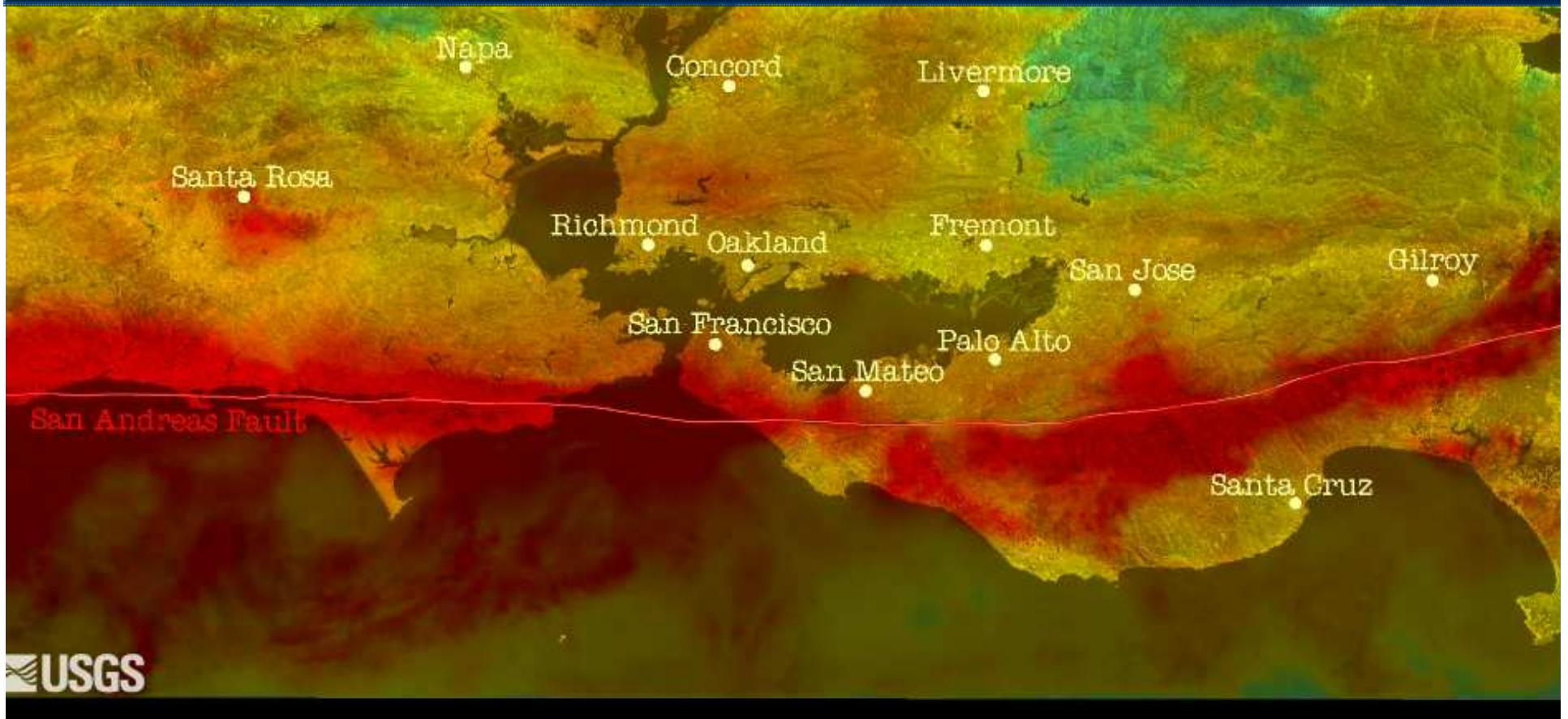


M7.9 San Andreas Earthquake Scenario affecting 19-counties in Northern California

(EERI, Charles A. Kircher et al. 2006)

Time=75.0 s

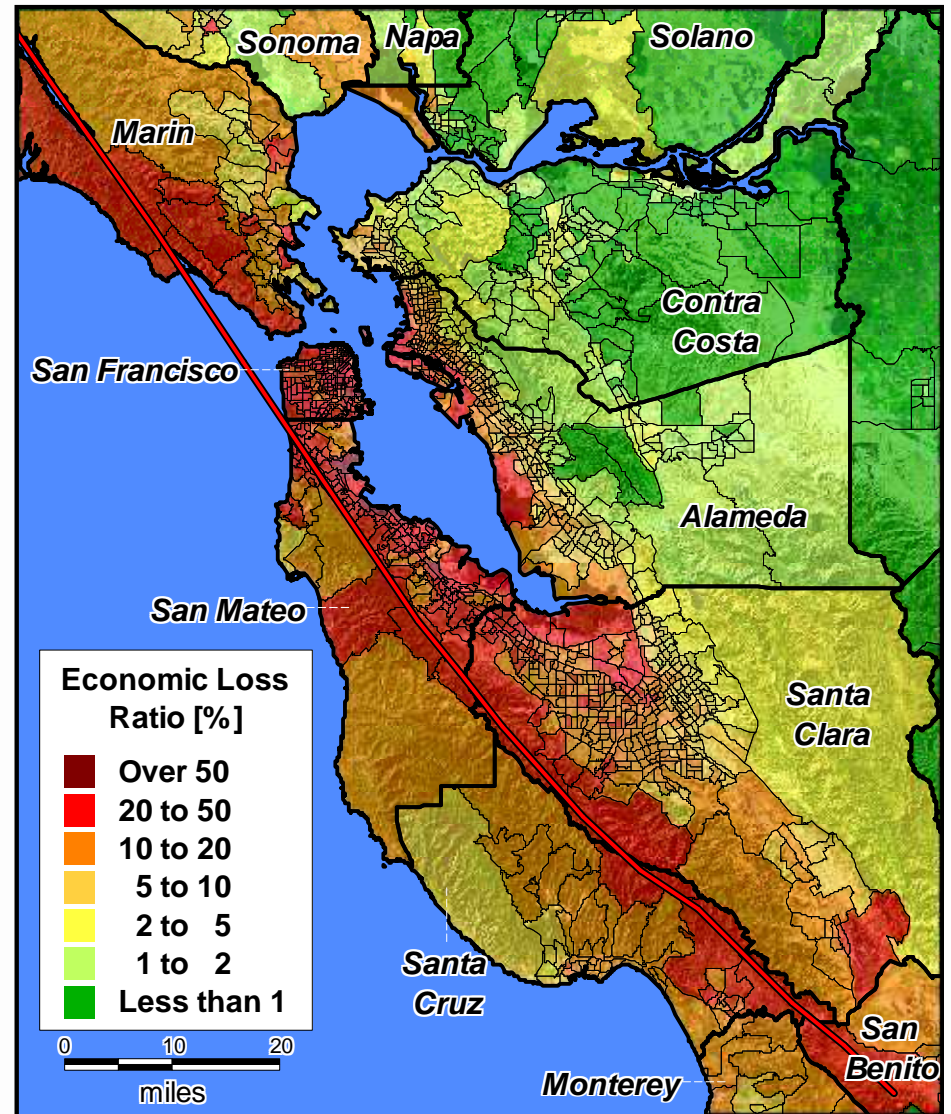
I II III IV V VI VII VIII IX X
Shaking Intensity



Total Direct Economic Loss

Direct Economic Building Loss due Ground Shaking/Failure (M7.9)	
County	Loss Ratio
Alameda	7.4%
San Francisco	25.9%
San Mateo	24.6%
Santa Clara	11.9%
Other Counties	2.7%
All 19 Counties	9.0%

- Fire - Plus 5% - 15%
- Lifelines - Plus 5% - 15%
- Total Loss: **\$150 billion**



Progress of Interdependency Interviews

(April 2013)

(Completed)

Regional Roads	Local Roads
Electricity	Telecom
Gas	
Water	Auxiliary Water
Wastewater	
Municipal Transit and Rail	
Port and Airport	
Fuel	(Scheduled or Yet to be Completed)

Roads (Regional + Local)

Redundancy ensures regional functionality, but the level of service will be significantly impacted.

Primary regional access routes from the south – El Camino, 101, and 280.

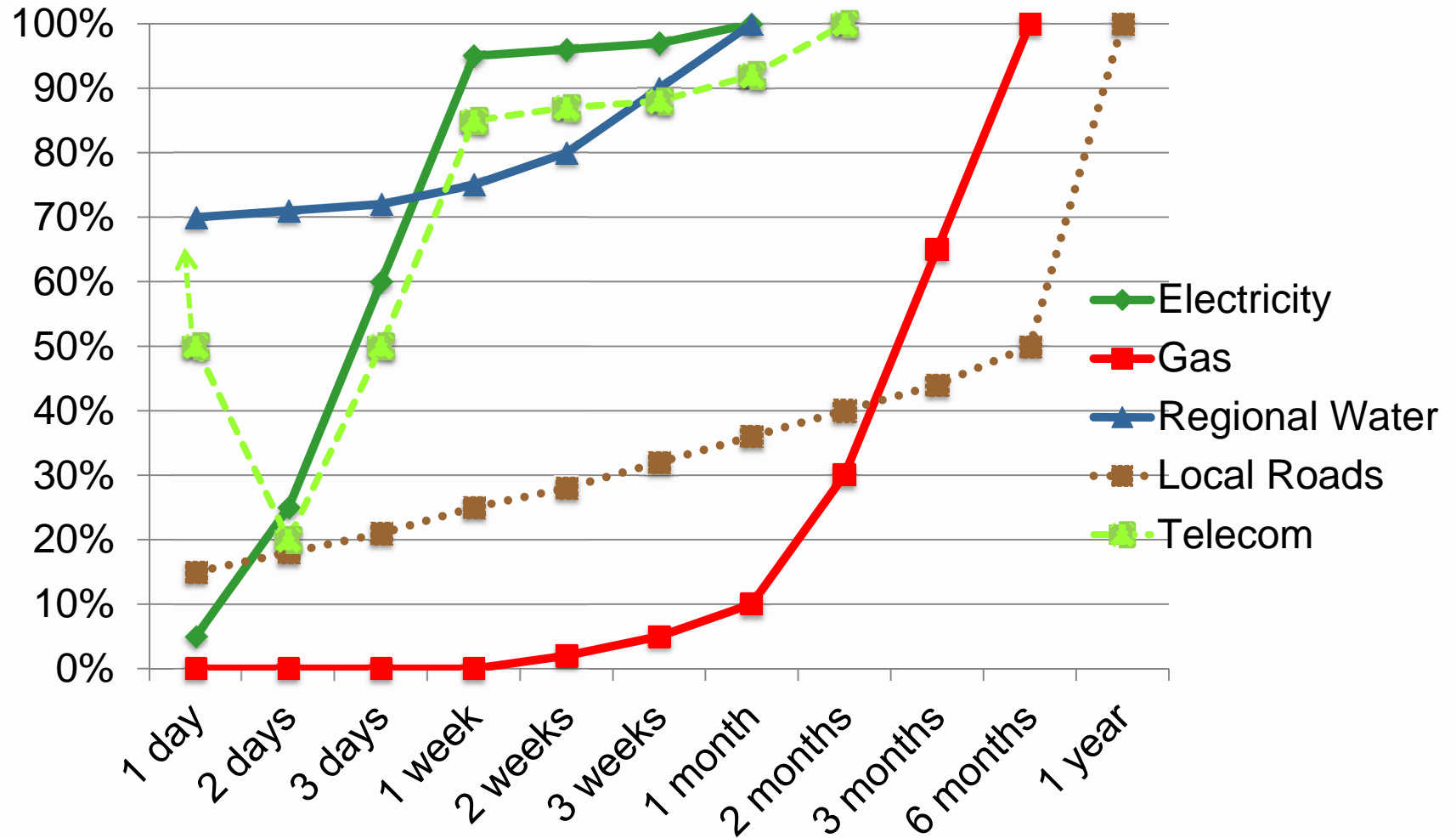
City road clearance focus first on access for emergency response, areas needing assistance (hospital, fire and police), then supply routes – most likely starting from the south.

Road clearance and repair could take a year. Full reconstruction would take longer.

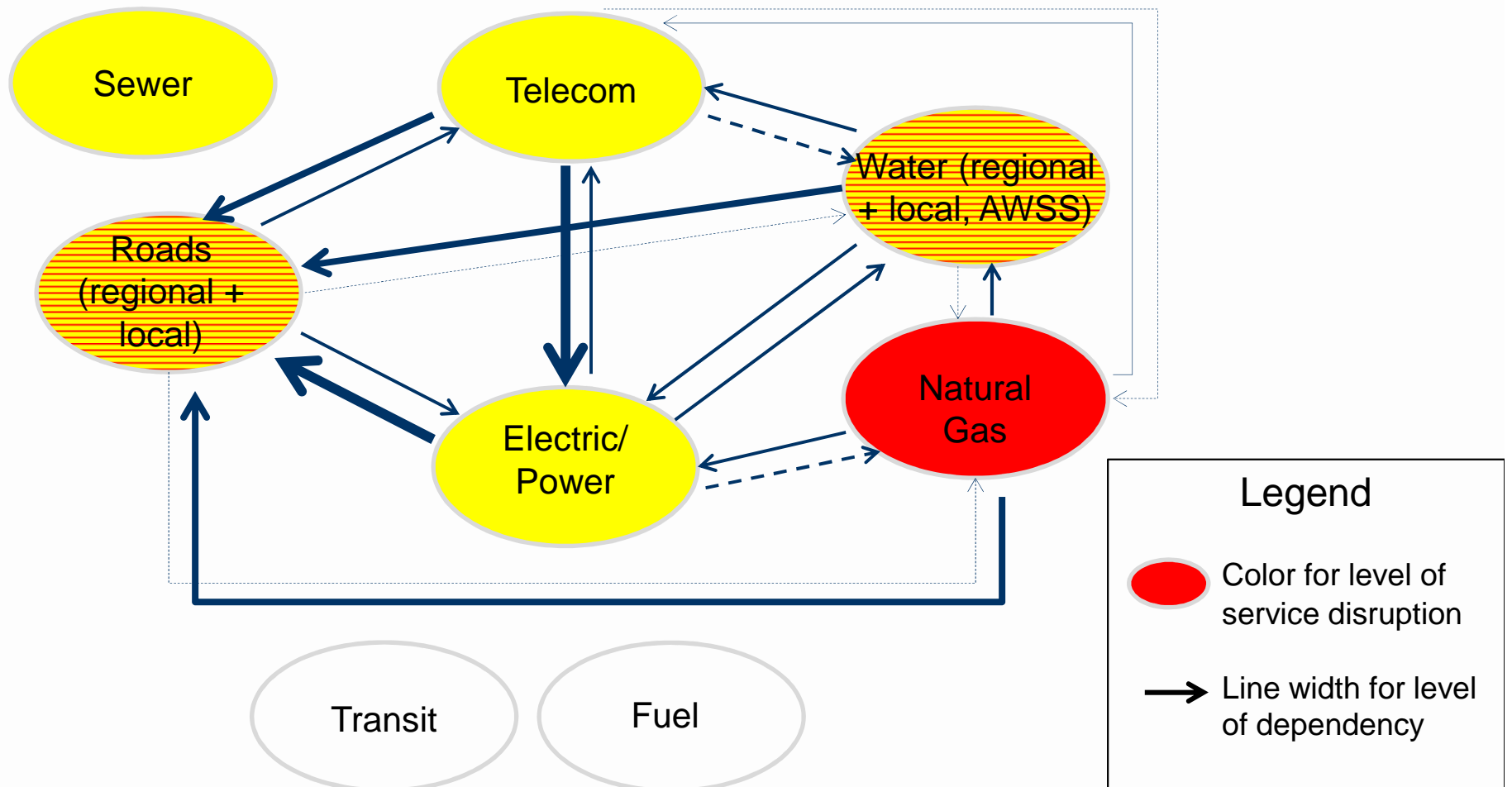
Image © 2012 TerraMetrics
© 2012 Google
Data LDEO-Columbia NSF, NOAA
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

System Restoration

(Progress Report ; January 2013)



Lifeline Interdependencies in San Francisco (Progress Report ; April 2013)



Critical Interactions among San Francisco Lifelines (Progress Report ; April 2013)

(Yao et al 2005, based on Kameda, Nojima, 1992; Scawthorn 1993; and others)

- **Functional disaster propagation, and cascading interactions**, due to failure of interdependence among lifelines
 - Roads (regional + local) and most operators
 - Electricity and telecommunications, and most operators
- **Collocation and restoration interaction**, physical disaster propagation among lifeline systems
 - Underground water failures impacting underground electricity and gas
 - Roads (local) and buried infrastructures such as sewers
- **General interaction**, between internal components of a lifeline system
 - Electrical substation failure
 - Water turnout failures
 - Loss of generator power

Study Insights/Issues

(Progress Report ; April 2013)

- Resilience (Level of Service) standards vary considerably among systems, and so will likely restoration times
- Range of system conditions/restoration characteristics: older vs. newer, fixed vs. flexible, reliable vs. sensitive, smart vs. not-so-smart, complex and inter-related vs. independent
- Restoration priorities and communications/ decisions will come from varying management organizations/levels: national, state/region EOC, city of SF EOC, and system DOCs
- Common concerns about system restoration – access, credentialing and basic services for personnel, mutual aid/resources, communications, temporary staging/equipment storage areas
- Critical “choke” points affecting city’s resilience – no local power generating source and limitations of generators/fuel, older buried and ‘less smart’ distribution systems (e.g. gas, water, sewer)

Details on Next Steps

- Infrastructure operator and panel discussions:
 - ✓ PG&E (electric and gas), Caltrans (regional roads), SFPUC (water), SFDPW (city roads and debris), Verizon, ATT and Comcast (telecom)
 - ✓ SFPUC (wastewater), (power), and (auxiliary water)
 - MUNI
 - Port/airport operators
 - Fuel operators
- Develop integrated scenario and interdependency insights (late Spring 2013)
- Operator review and approval (late Spring 2013)
- Presentation to the Lifelines Council and other groups, as appropriate (Summer 2013)