

Sandia's History











Hey 15, 194

Dear Mr. Whlesn:

I am informed that the Atomic Reargy Consisting intends to ass that the Said Telephone Laboratories accept under contract and Albaparque, New Mexico.

exceptional service in the national interest.

the national interest.

I hope that after you have heard more to detail from the Memile Theogy Commission, your expaniention will find it possible to minutes this task. In my spinion you have here in apportunity to render an exceptional service in the mational interest.

I am writing a similar mote first to fir. C. E. Sunday.

Mary slacerely yours

Mr. Lercy A. Wilson, Trustdenk, Insertent Telephone and Teleproph Company, 155 Broadway, Sew York 7, S. Y.







Sandia's Technical Diversity

Based in Albuquerque, New Mexico, Sandia National Laboratories' expertise in modeling derives from our mission to support the Department of Energy's National Nuclear Security Complex





Energy

Cyber

Science & Technology









NISAC History & Mission

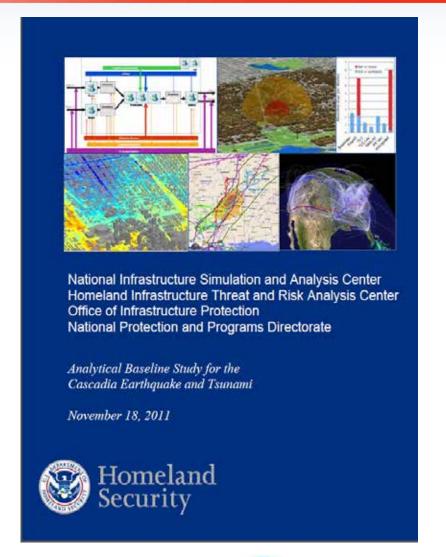
- n Patriot Act identified NISAC as the center for Critical Infrastructure Interdependency Modeling, Simulation, and Analysis.
- Provide a common, comprehensive view of U.S. infrastructure and its response to disruptions.
- Operationally-tested DHS rapid-response capability.
 - 24/7 crisis action analysis
 - Jointly executed by Sandia and Los Alamos National Laboratories





Consequence Analysis

- A meteor impact in or near a major urban area would have significant impact on the residents and infrastructure in the surrounding region
- Here we present infrastructure analysis techniques as applied to a different but analogous scenario: a major earthquake



Background

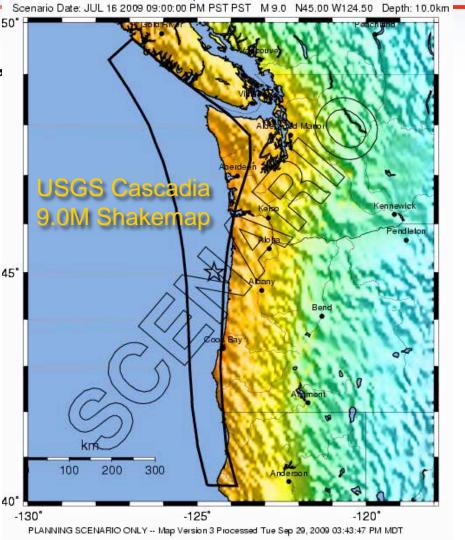
- The Cascadia Subduction Zone extends north and south more than 800 miles on the eastern edge of the Pacific Plate
- The Tohuku event off the coast of Japan resulted from an earthquake on the subduction zone on the western edge of the Pacific Plate
- In 1700 the Pacific Northwest experienced an earthquake and tsunamithat rivals the recent incident off of the coast of Japan
- A catastrophic earthquake of this magnitude along the coast of Oregon and Washington is estimated to occur every 500 years and would impact the US from Northern California to Alaska
- In 2011, NISAC performed a study of the potential impacts of such an event on population, infrastructure, and the economy on behalf of DHS

Overview of the Analytic Approach

- A US Geological Survey 9.0 Magnitude ShakeMap (2009)
 was used to drive the earthquake impacts
- The NOAA Pacifex 11 Tsunami exercise run were employed to provide a basis for the offshore wave heights
- Both the direct earthquake impacts and the surge zones were used to assess the impacts:
 - Impacts on population
 - Direct impacts on infrastructure
 - Cascading impacts on infrastructure
 - Economic effects

The Earthquake Scenario

- ShakeMap is a USGS rapid response tool to portray the extent, intensity, and variation of ground shaking in an affected region
- Scenario affects Oregon, Washington, Northern California, and British Columbia
- Resulting tsunami affects the entire Pacific shoreline, including Alaska
- Assume single major tremor 9.0M
 - No significant aftershocks
 - No additional earthquakes triggered along secondary faults



Results: Impacts on Population

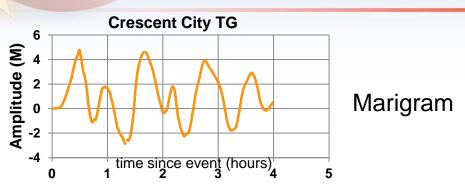
Ground Shaking Population Impacts

	State	Fatalities	i In	juries	Comments
•	CA	751	774	primar	ily in Crescent City
•	OR	52	190	most ir	n Cannon Beach
•	WA	540	1,151	most ir	n Westport

Tsunami Population Impacts (for modeled sites only)
 State Fatalities Injuries Comments

•	CA	47	1,045	
•	OR	674	14,109	Coos County hardest hit in OR
•	WA	411	9,508	King County hardest hit overall

Results: Tsunami Damage



- Damage state described via
 - Building Stability map
 - Flood inundation map
- Building Stability
 - 5 zones described: Poorly Constructed, Well Built Timber, Well Built Masonry, Concrete, Large Concrete
- Max inundation depth
- Deaths and injuries

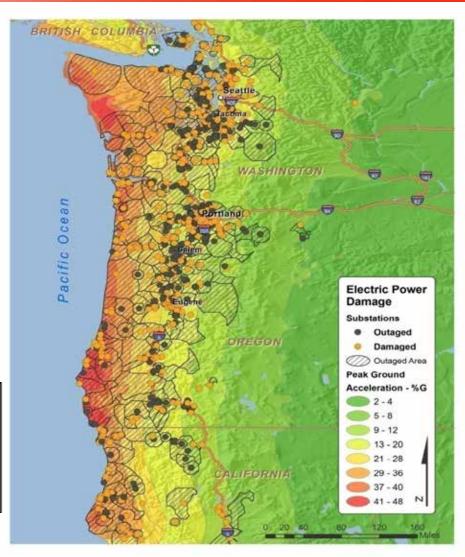




Electrical Power

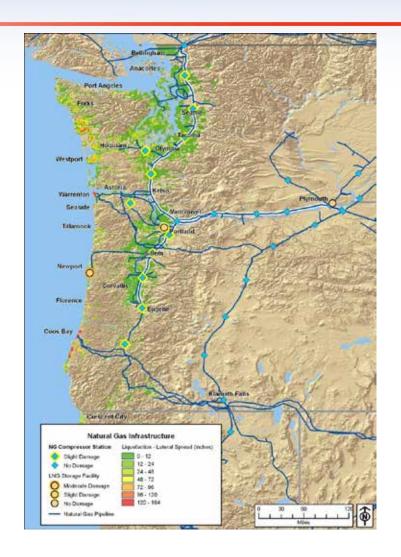
- Electric power asset damage can create outages in the power grid
- On average the electric system loses 6 GW of generating capacity and 11GW of demand (out of 170GW)
- Seattle, Tacoma, Portland, Vancouver Island and all other cities within 100 miles of the Pacific coastline will experience blackout
- Services restored in 1-7+ days

Damage State	Electric Generation		<u>Substations</u>	
	<u>Damage</u>	<u>Lost</u> gigawatts	<u>Damage</u>	Outaged
None/Slight/Outaged	<u>38</u>	2.5	2033	<u>418</u>
<u>Moderate</u>	<u>106</u>	2.7	<u>486</u>	<u>n/a</u>
<u>Extensive</u>	<u>12</u>	0.3	<u>144</u>	<u>n/a</u>
<u>Complete</u>	3	<u>0.1</u>	<u>16</u>	<u>n/a</u>



Natural Gas

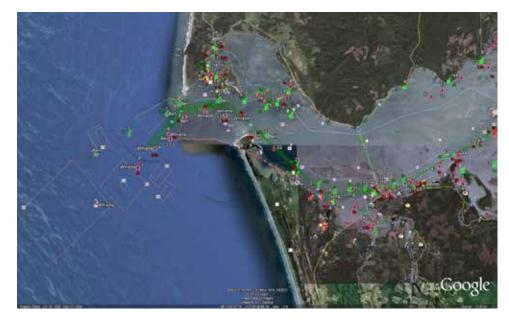
- May impact backbone transmission line serving western WA and OR
- Only about 1/3 of households heat with natural gas (NG) in WA and OR
- Most homes use electricity for heating
- NG is used for power generation in the area, but most power generation in the region is hydroelectric
- NG issues unlikely to cause any power generation shortages for the grid



Ports & Maritime Infrastructure

- Major port facilities slight damage
- Tsunami closes

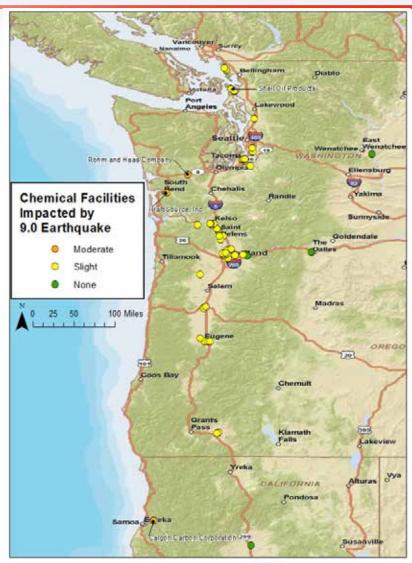
 navigation from
 Columbia to Pacific
 - Sedimentation
 - Channel Debris
 - Loss of navigation aides
 - Major path for export grains



Locations of navigation infrastructure at the mouth of the Columbia River

Chemical

- No expected tsunami impacts
- No facilities are expected to receive complete or extensive damage
- 3 facilities expected to receive moderate damage, including Rohm and Haas in Elma, WA, potential national supply chain impacts
 - Only domestic producer of potassium borohydride
 - One of two domestic producers of sodium borohydride
- 50 facilities expected to receive slight damage with no national or regional supply chain impacts



Restoration of Key Infrastructure Sectors

Time Frame	Activity
	Search and rescue in damage zone, focused on damaged facilities with susceptible populations (e.g., hospitals, nursing homes)
	Transport of emergency response surge capacity through major airports (SeaTac, Portland International) as staging areas for reaching more affected zones (by open roads, helicopter, seaplane), including fire suppression equipment to replace that destroyed by structural failure
lmmediate	Identification and clearance of paths from areas with functional public health and infrastructure to damage zone
Immediate Aftermath	Evacuation of injured from damage zone to working medical facilities
Aiteimath	Movement (to outpatient facilities) or discharge of ambulatory patients at hospitals in areas with functional public health facilities and infrastructure to clear bed space and shorten transportation times
	Repair of transportation routes (truck, rail) to minimally damaged port facilities near damage zone
	Coordination of truck and rail transport of POL (especially diesel fuel for emergency services vehicles and backup generators) from functional terminals/refineries to damage area and its perimeter
	Identification of shelter/housing for key transportation workers and housing/evacuation for their families, to support operational flow of port facilities supporting recovery effort
Second Stage	Evacuation of those lacking structurally sound housing or infrastructure resources from the damage area, especially those lacking means of home heating
	Repair of POL pipeline and terminal facilities to restore flows beyond the damage area. Rerouting of refined product from other western refineries as capacity allows by rail to undamaged areas
The second second	Community-centric restoration of infrastructure:
Long-term	 Basic Infrastructure (water, power, fuels, commodity supplies) Public Services (fire, police, schools)

Economic Impacts

Total impact of \$49 Billion

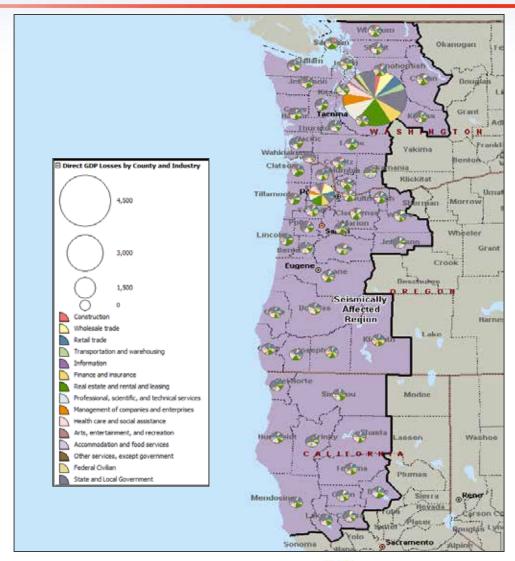
CA: \$1 Billion

• OR: \$19 Billion

WA: \$29 Billion

Sectors with greatest economic impact:

- Telecommunications
- Waterborne Transportation
- Transportation Fuels
- Electric Power is a strong driver of impacts in other sectors



Coupling NISAC Expertise for NEO Impact Analysis

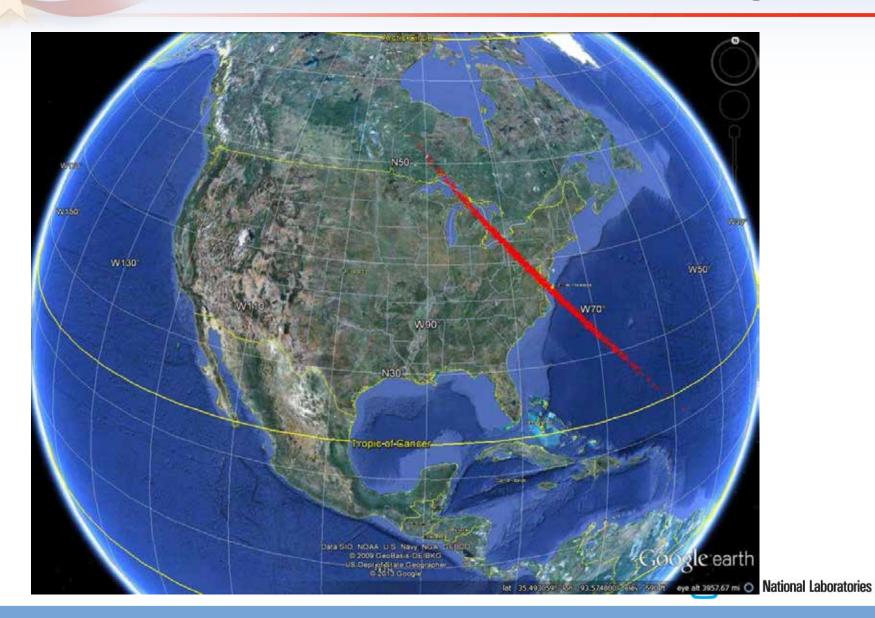
16 Critical Infrastructure Sectors



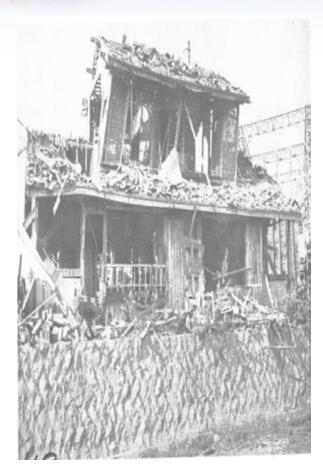
Sandia Community Works Together to Solve Non-Traditional Problem Sets

- National Infrastructure Simulation & Analysis Center in support of Department of Homeland Security
 - Simulation/Modeling and Analysis of for critical infrastructure
 - Assists decision makers with infrastructure protection, mitigation and response
- Mark Boslough Physicist in Discrete Math and Complex Systems
 - Using nuclear weapons airburst data and scaling laws
 - Model collisional airburst and compare to nuclear airbusts
- Model of Area impacted by Asteroid
 - Calculating risk to infrastructure due to impact

With Advanced Warning



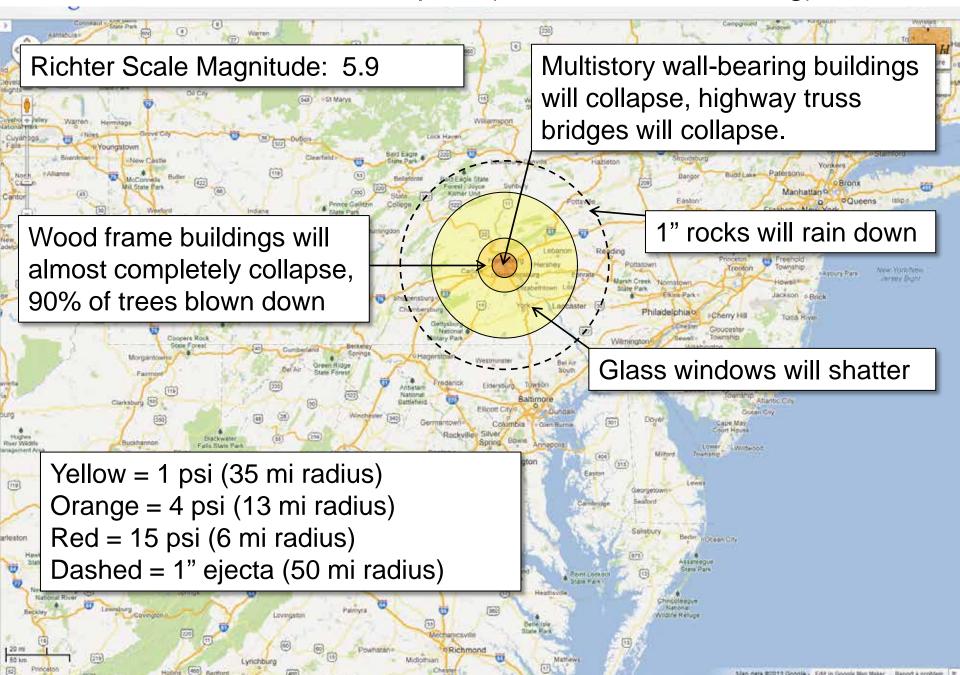
Damage Could be Immense



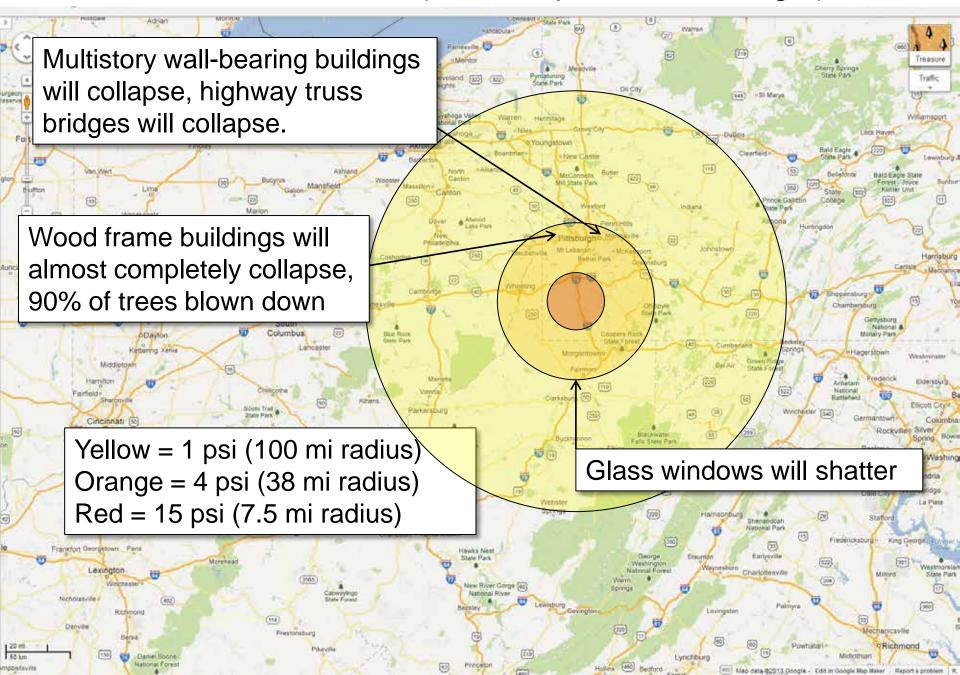
Wood-Frame Building 1.0 mile from ground zero at Hiroshima. Source: Samuel Glasstone; Phillio J. Dolan, The Effect of Nuclear Weapons". U.S. DoD & U.S. DoE, 3rd edition, 1977.

- Impact: Crater diameter 2.1 km (1.31 miles)
- Impact Depth: 595 meters (1470 feet)
- Seismic effects: 5.9 Richter magnitude scale
- The most extreme damage from a airburst occurs at 42000 ft
- If the impact is offshore can expect tsunamis of 40 feet locally and 10 feet over hundreds of miles of coastline

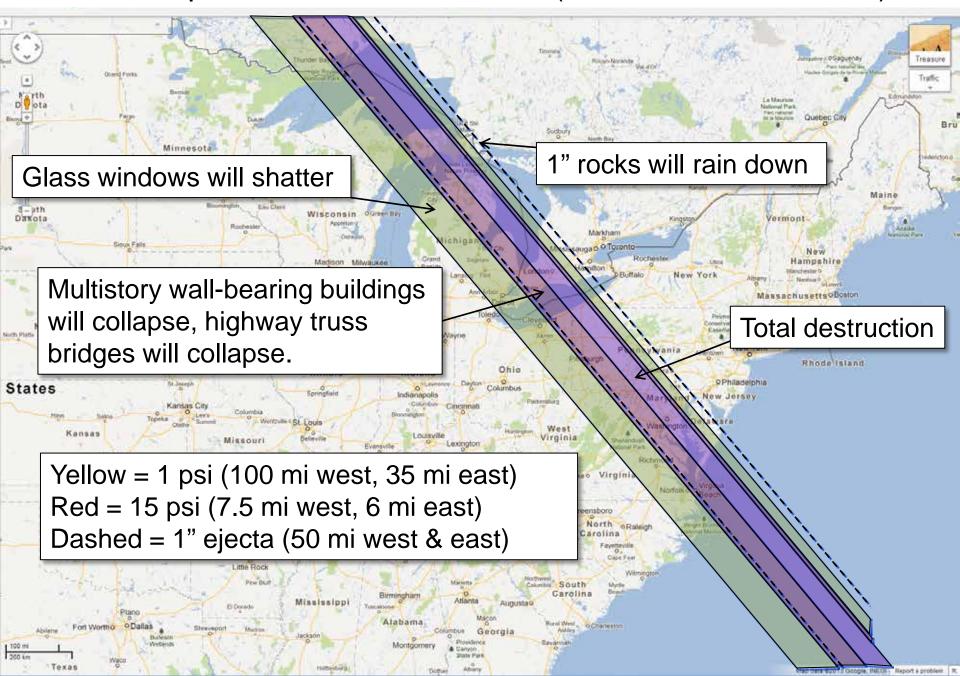
Worst-case land impact (200-Mt crater-forming)



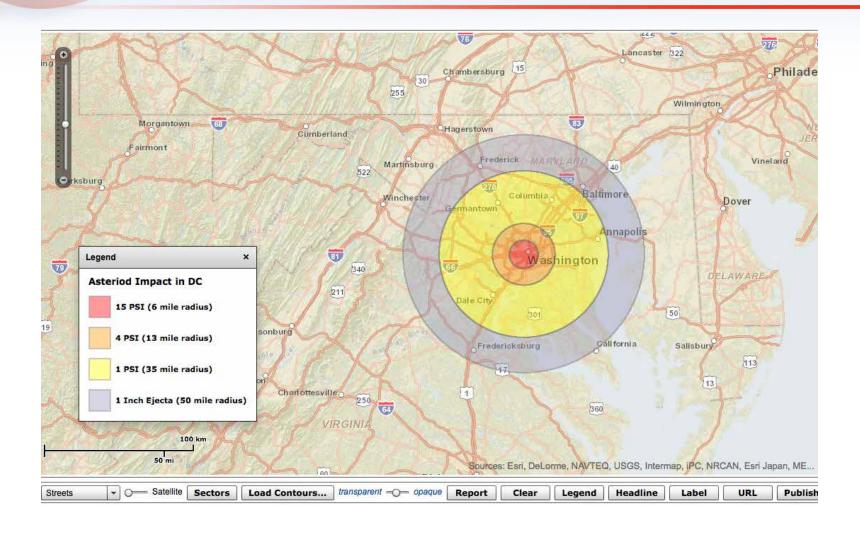
Worst-case airburst (200-Mt optimal burst height)



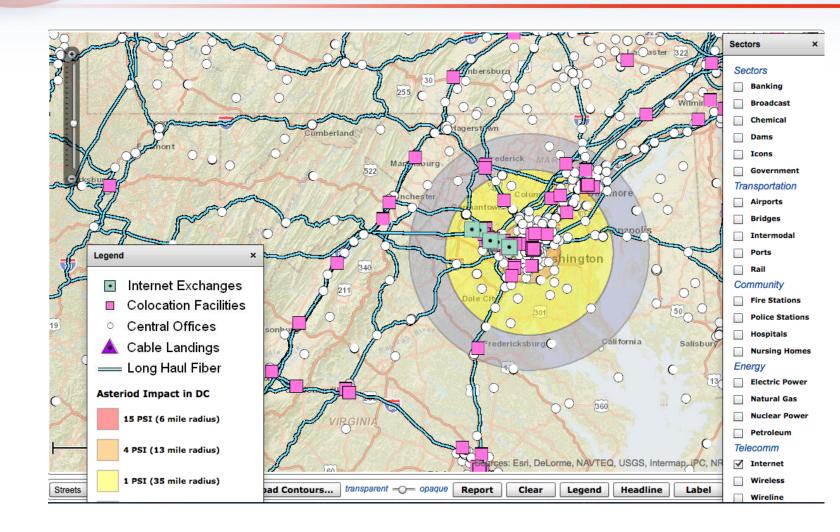
Zone of potential total destruction (crater and/or firestorm)



FASTMap Situational Awareness



Internet Infrastructure



FASTMap Reporting Capability

Statistics Report

Table of Contents

Internet Exchanges

Colocation Facilities

Central Offices

Cable Landings

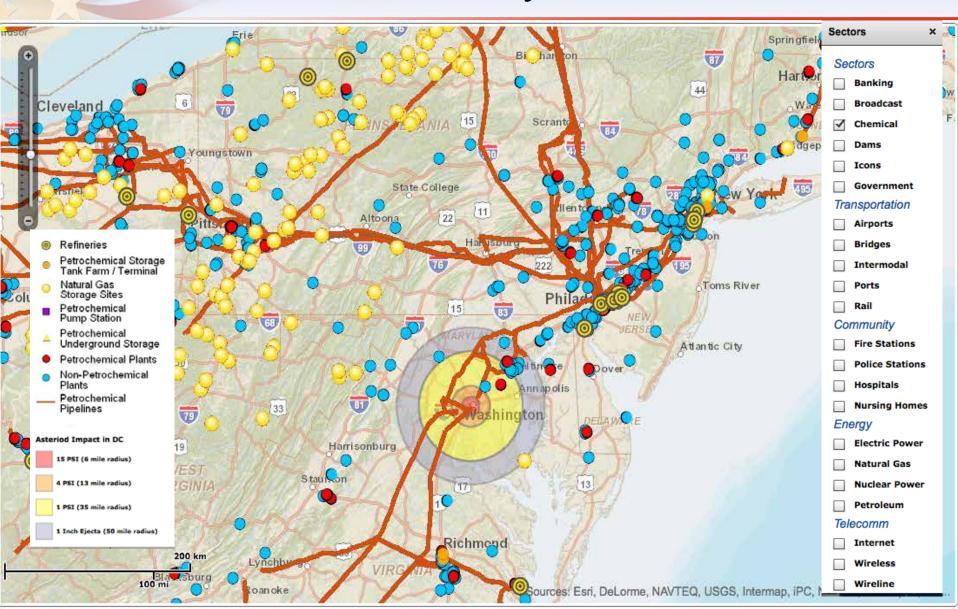
Data Sources

Internet Exchanges

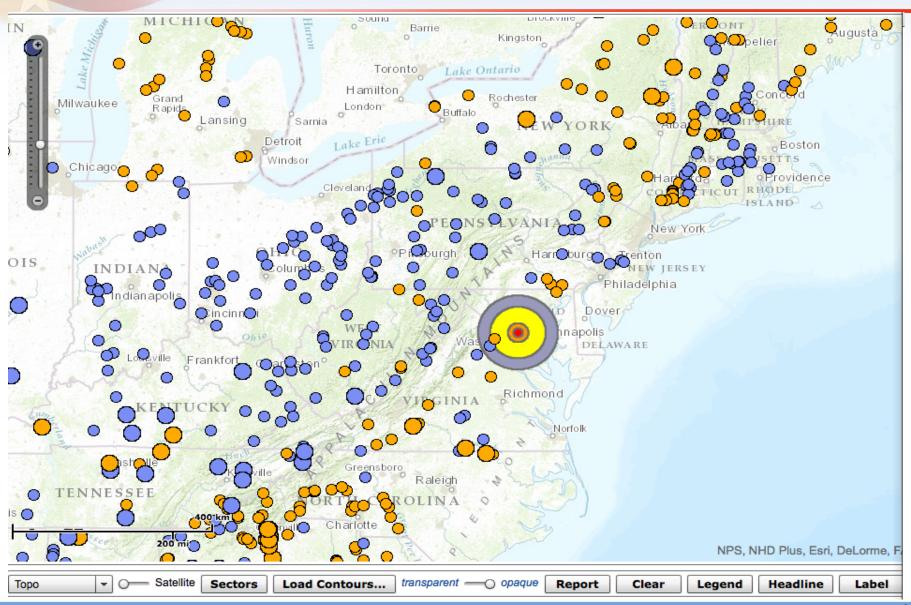
Summary of Internet Exchanges			
Internet Exchanges	Total (Exchanges)		
4 PSI (13 mile radius) Damage Zone	4		
1 PSI (35 mile radius) Damage Zone	4		
All Zones	8		

Internet Exchanges List Damage Zone: 4 PSI (13 mile radius) URL Name Address City State Lat Lon MAE East 1945 Gallows Rd Vienna VA 38.909308 -77.223076 http://www.mae.net /fac/mae-east.htm MAE East 8100 Boone Blvd Vienna VA 38.913223 -77.225877 http://www.mae.net /fac/mae-east.htm VA. Switch and Data/PAIX 8100 Boone Blvd Vienna 38.913223 -77.225877 http://www.switchanddata.com

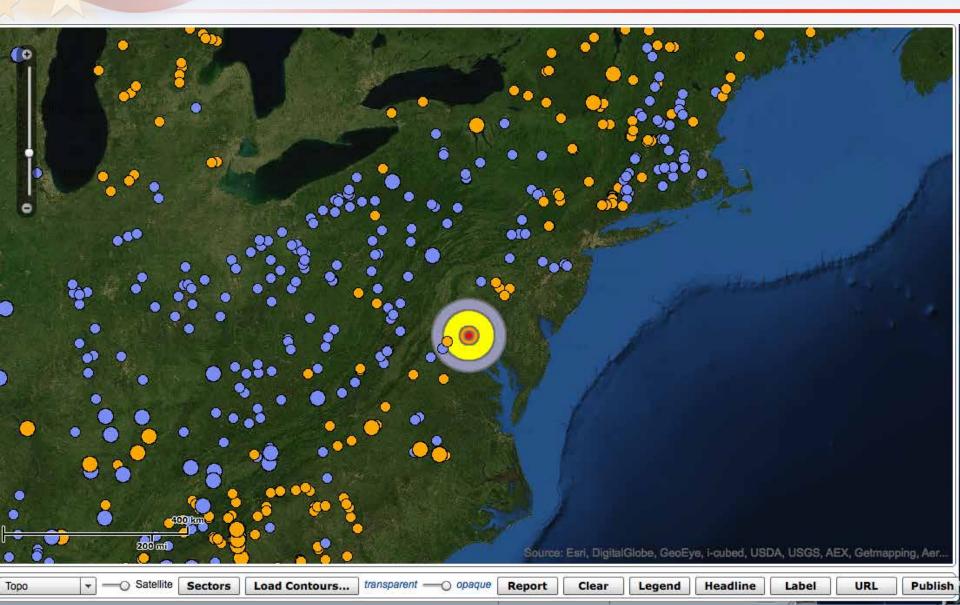
Chemical Facility Infrastructure



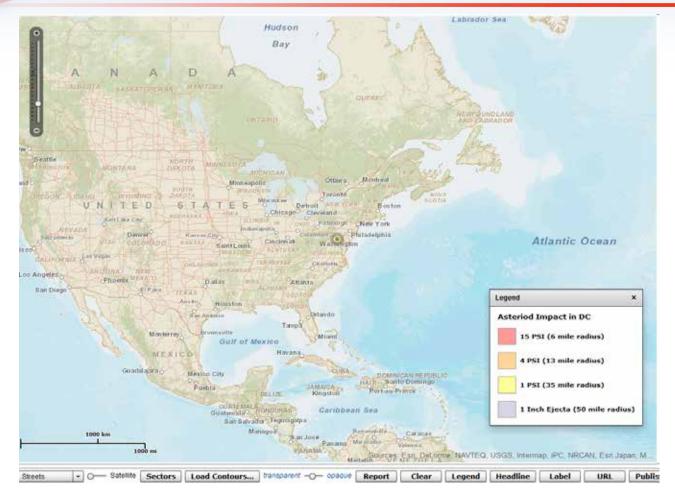
Topographical View Dams



Satellite View Dams



What are the Expected Effects of the Impact



FastMAP



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