Using Stormwater Models to Inform Recovery Efforts Following a Wide-Area Contamination Incident

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Contaminant Fate & Transport

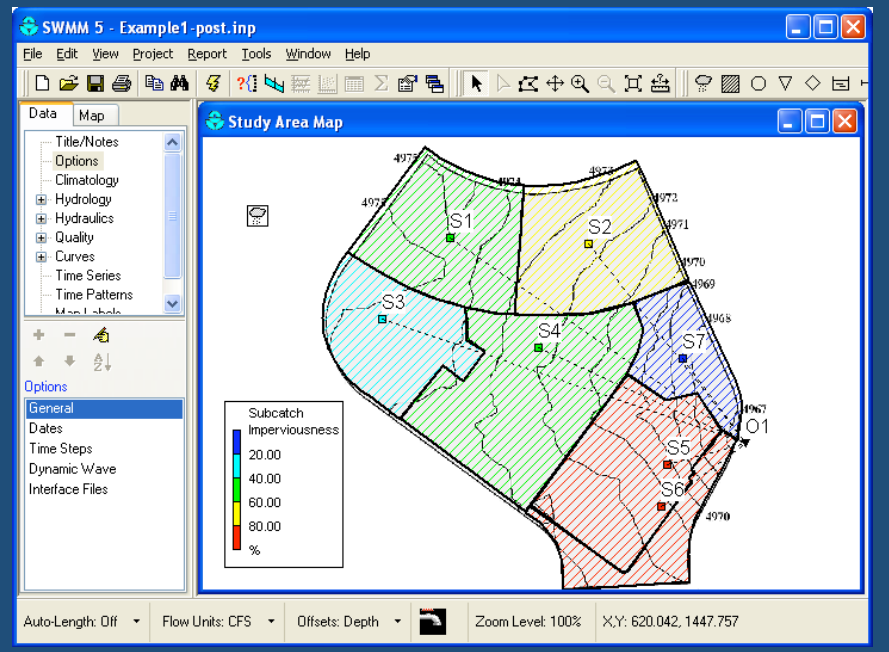
- Challenges:
  - CBR can be hard to detect
  - Dynamic systems, especially urban areas
  - Remediation may take years
- Need: dynamic contaminant mapping during response and recovery
  - ✓Site characterization
  - ✓Developing sampling plans
  - ✓Determining waste staging areas
  - ✓Resource allocation
  - ✓*Emergency Planning*


https://static01.nyt.com/images/2019/01/02/nyregion/02vision/merlin_138832818_f2207daa-7e7a-4957-9ab1-18941b775032-articleLarge.jpg?quality=75&auto=webp&disable=upscale

https://si.wsj.net/public/resources/images/BN-SN350_2QJmv_OR_20170317072645.jpg?width=620&height=423

Fate & Transport Modeling

- Adapting US EPA's Stormwater Management Model (SWMM) for modeling needs
  - Public domain hydrologic & hydraulic model
  - Single event or extended period stormwater runoff quantity and quality
  - Used widely in USA and globally
- Enhancements for contamination mapping:
  - Open Water Analytics SWMM5 API and PySWMM (Python wrapper)
  - 2D modeling for finer spatial resolution (PCSWMM)



SWMM Graphical User Interface

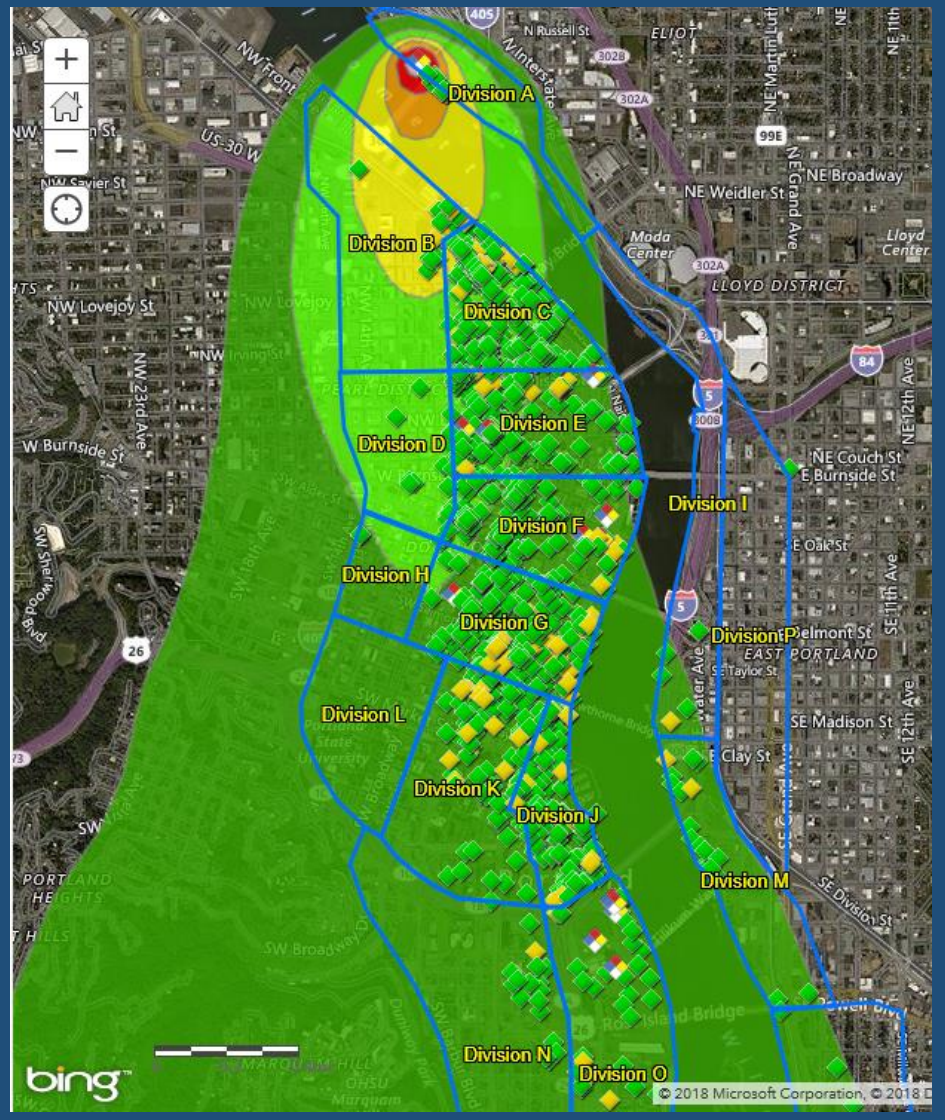
https://github.com/OpenWaterAnalytics

pyswmm.readthedocs.org

Case Study: Portland Asbestos Fire

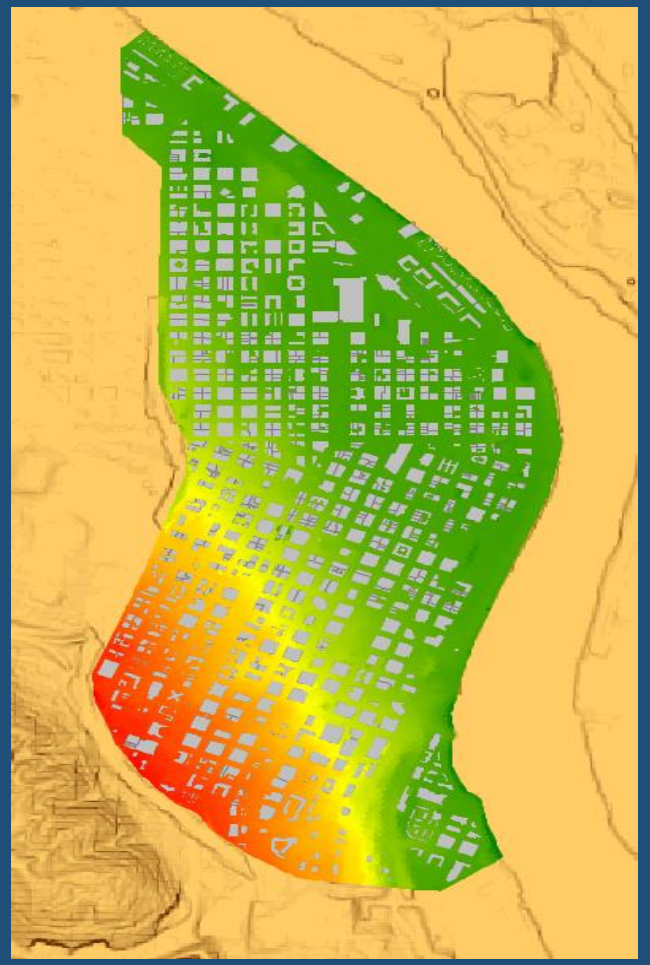
Case Study: Portland Asbestos Fire

- Building materials contained asbestos
- Recognized asbestos-containing ash had spread far from site of fire
- EPA provided support to Oregon Department of Environmental Quality
- FEMA's Interagency Modeling and Atmospheric Assessment Center (IMAAC) generated HPAC air plume model
- Demonstrated challenges of a wide-area contamination incident

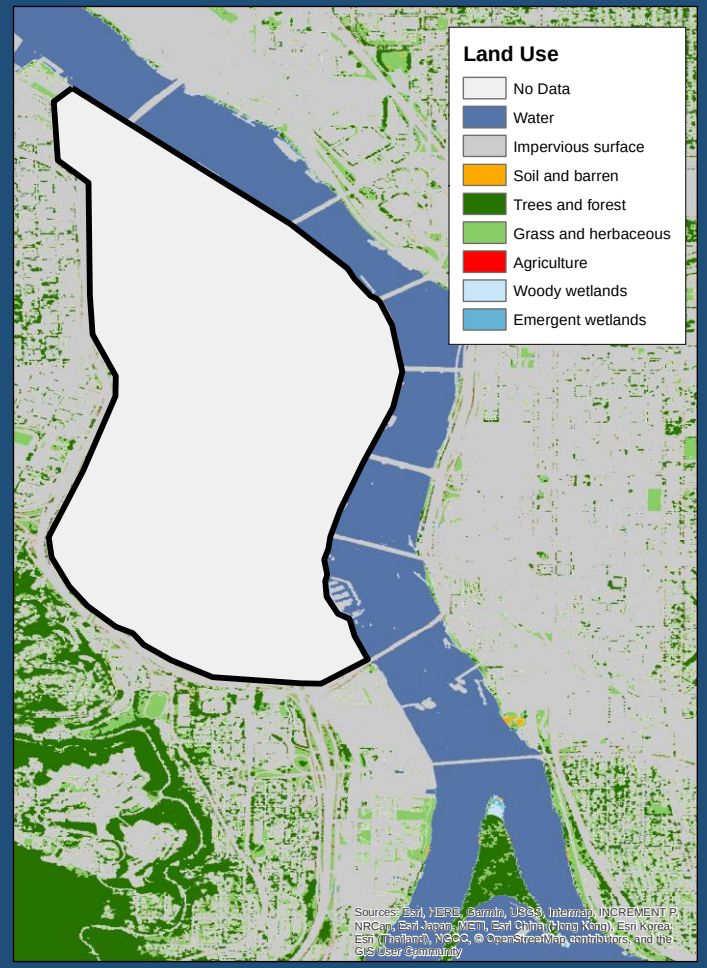


Developing Overland Flow Model

- Define model boundary
- Cell shape/resolution
- GIS data needed:
  - ✓land use/land cover
  - ✓building footprints
  - ✓roads
  - ✓critical infrastructure
- Digital elevation model
- Washoff equations and parameterization



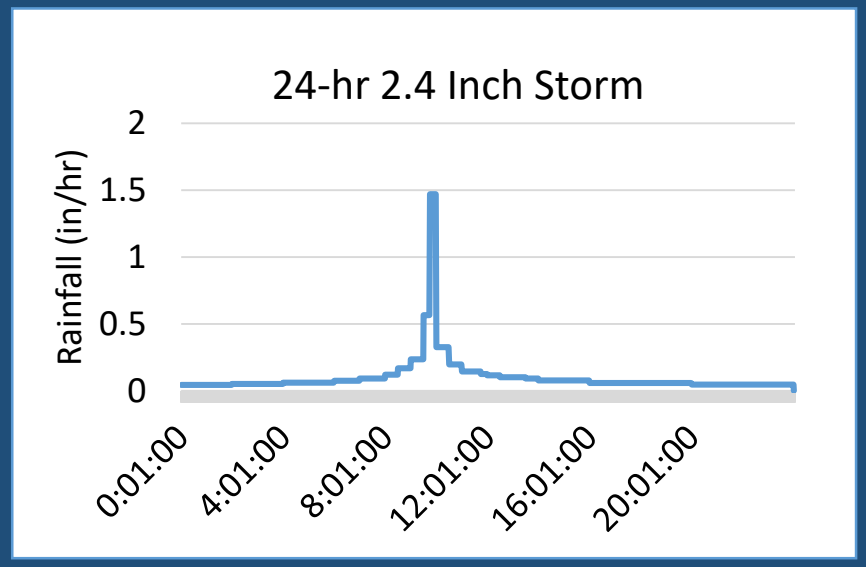
2D model cell elevations

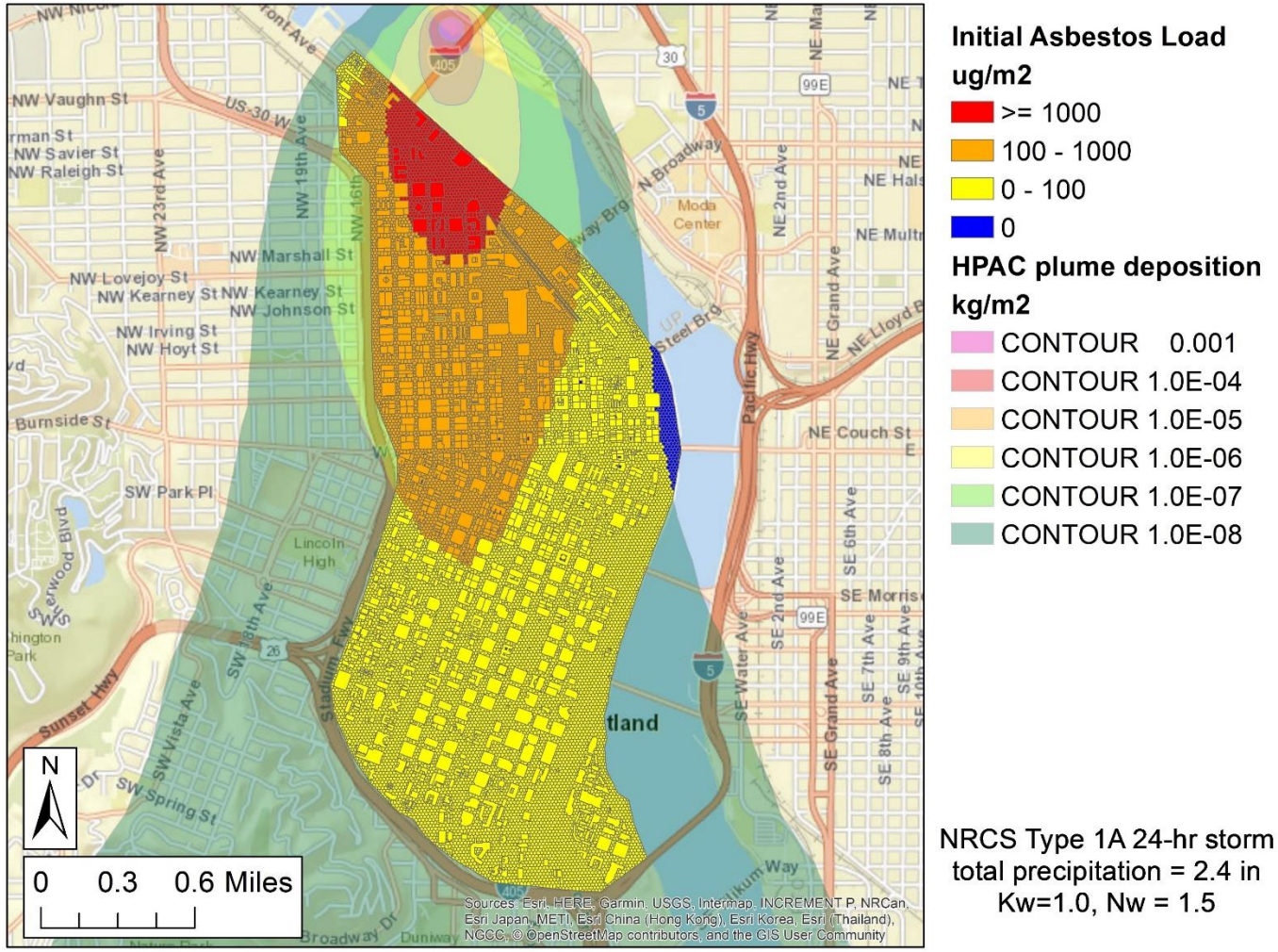


EnviroAtlas meter-scale land use data

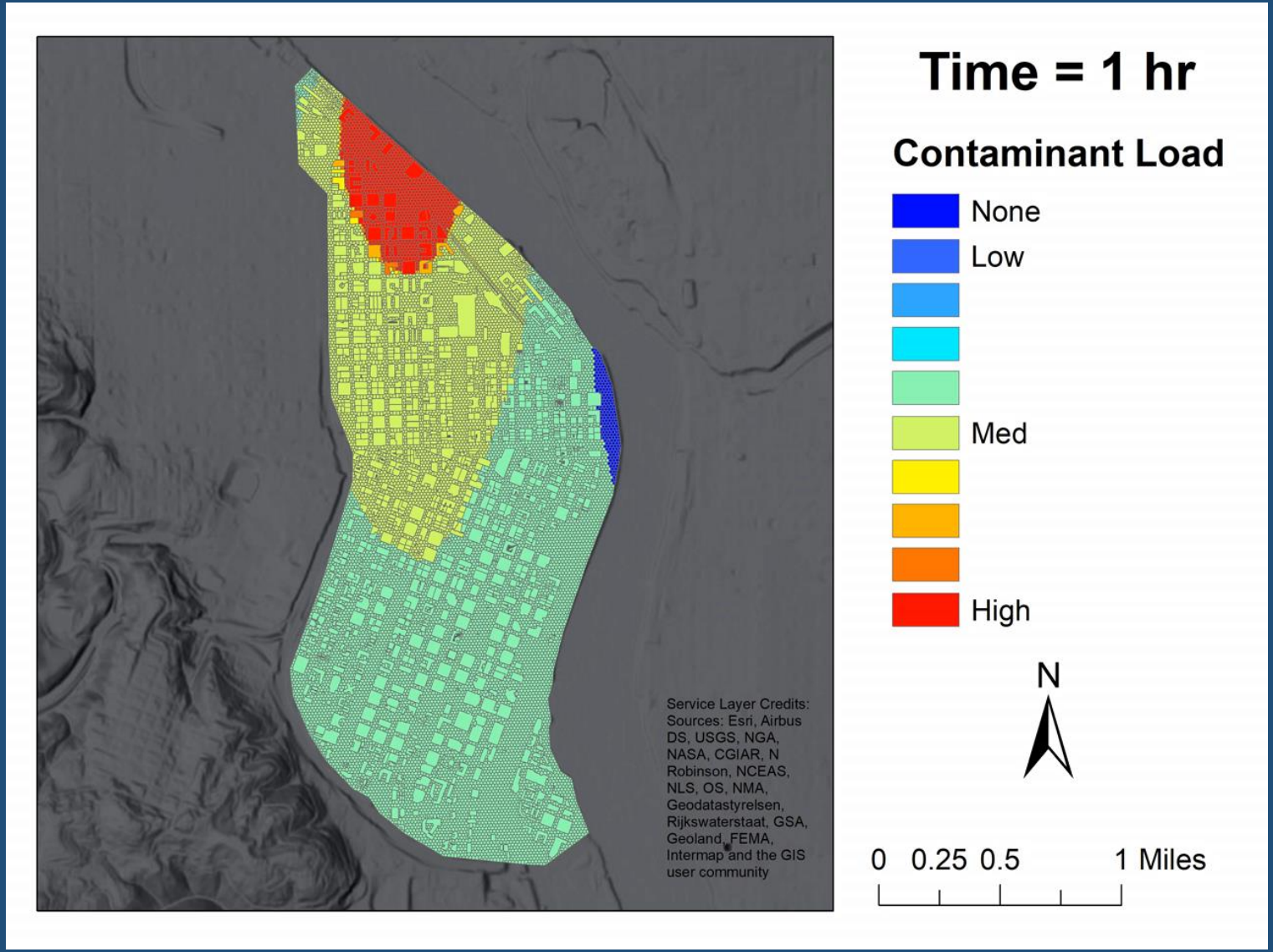
Initial Model Conditions

- Overlay IMAAC plume
- Exponential washoff equation (must define parameter values)





Surface Contamination



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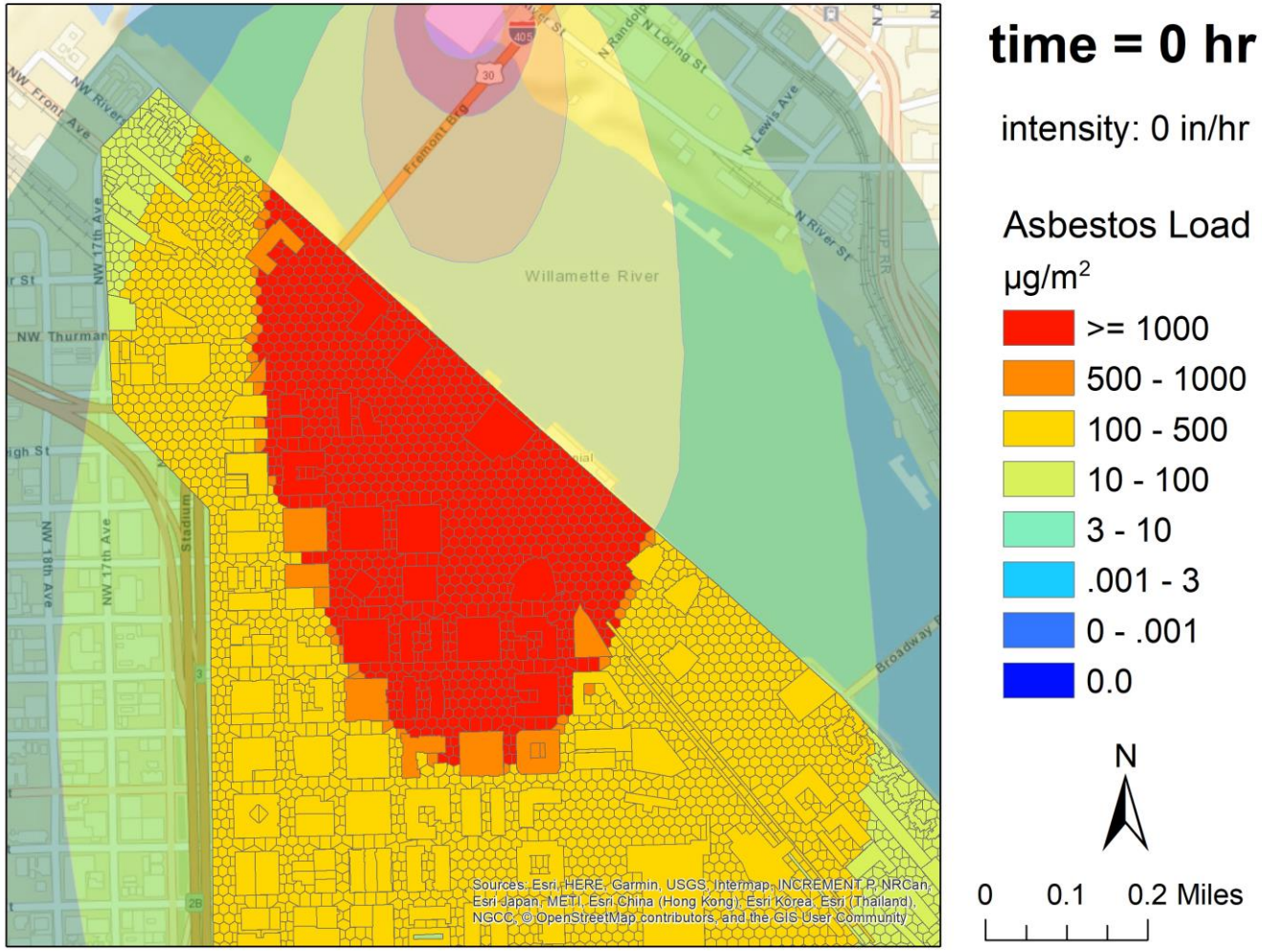
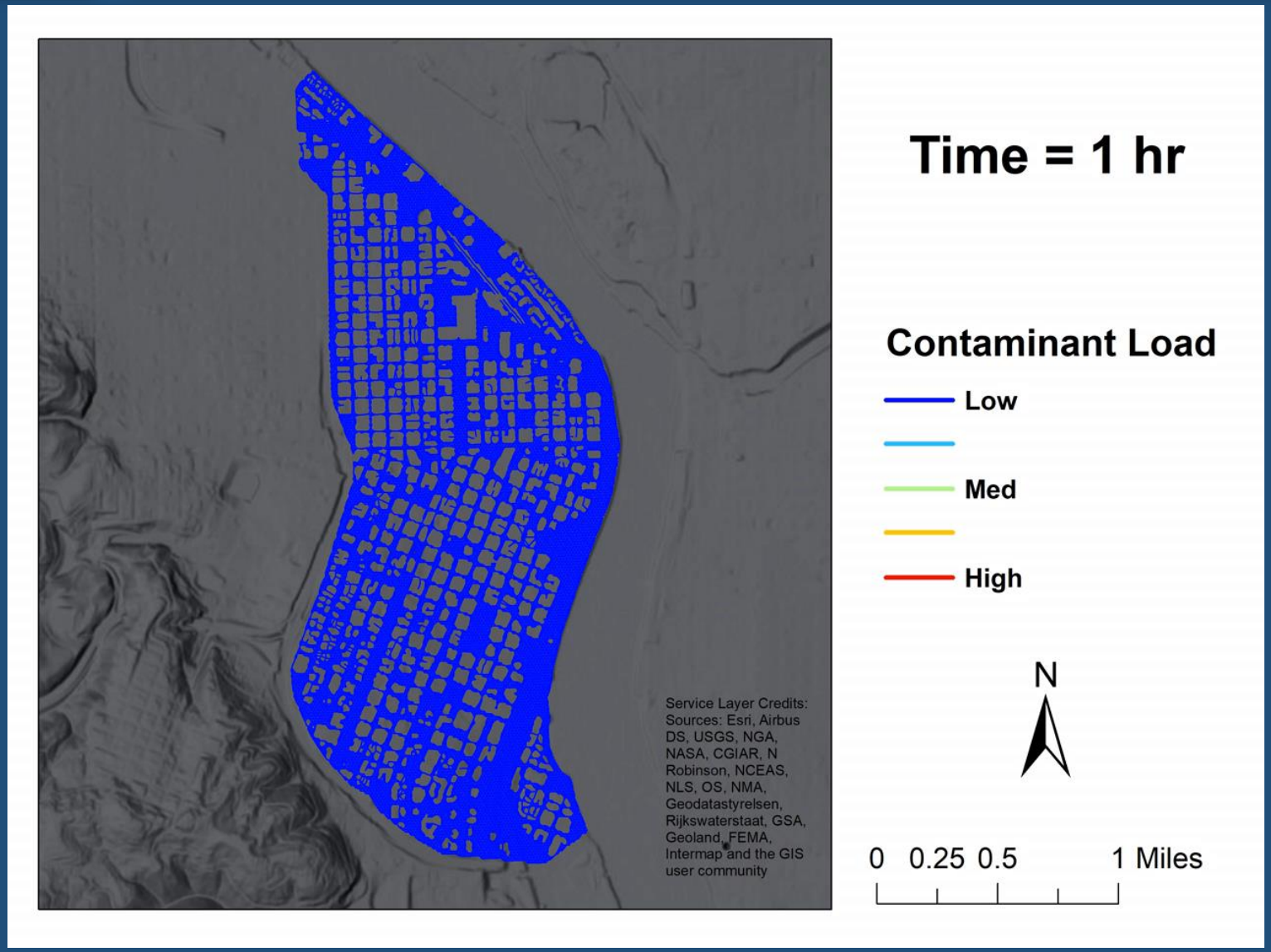
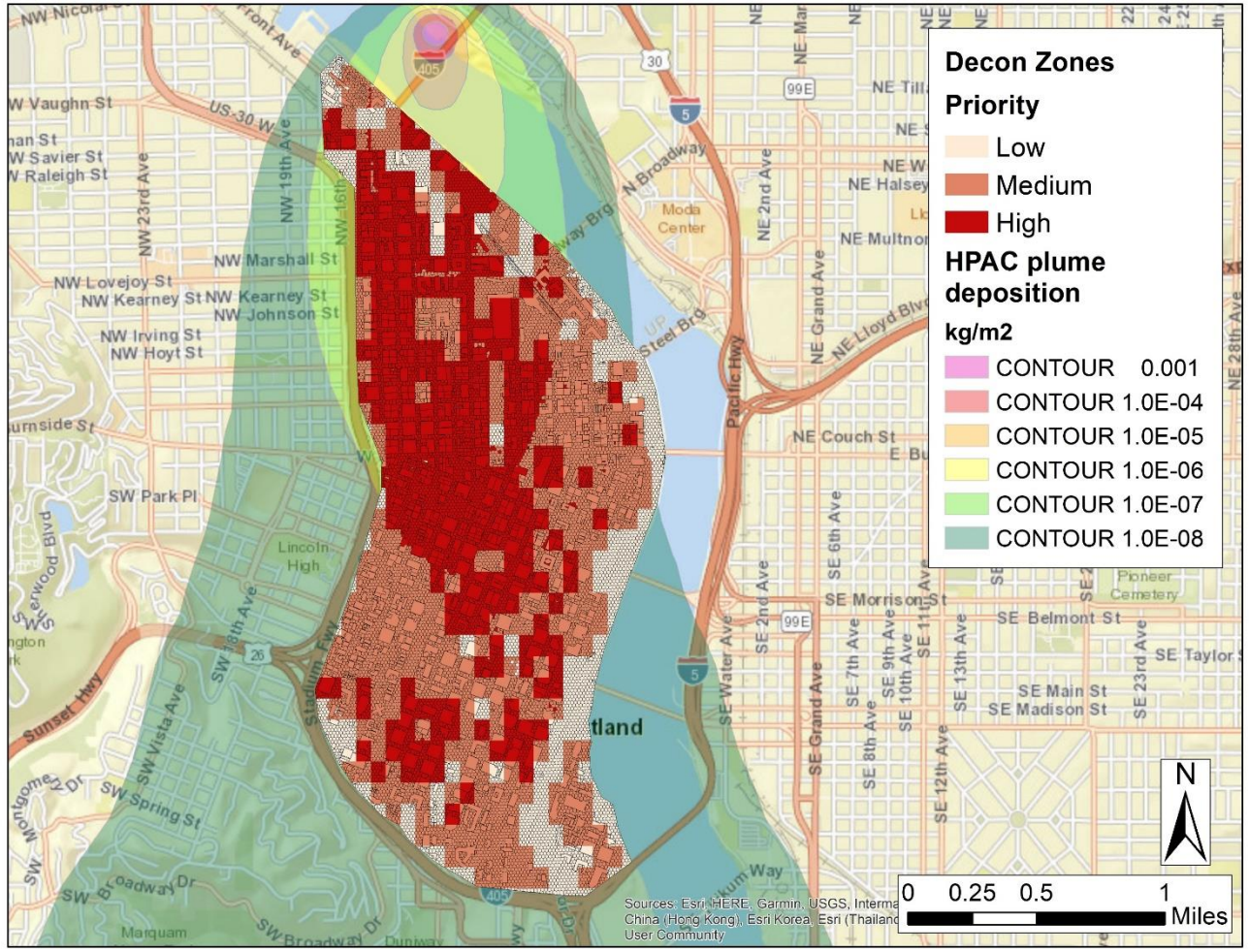


Overland Flow Contamination



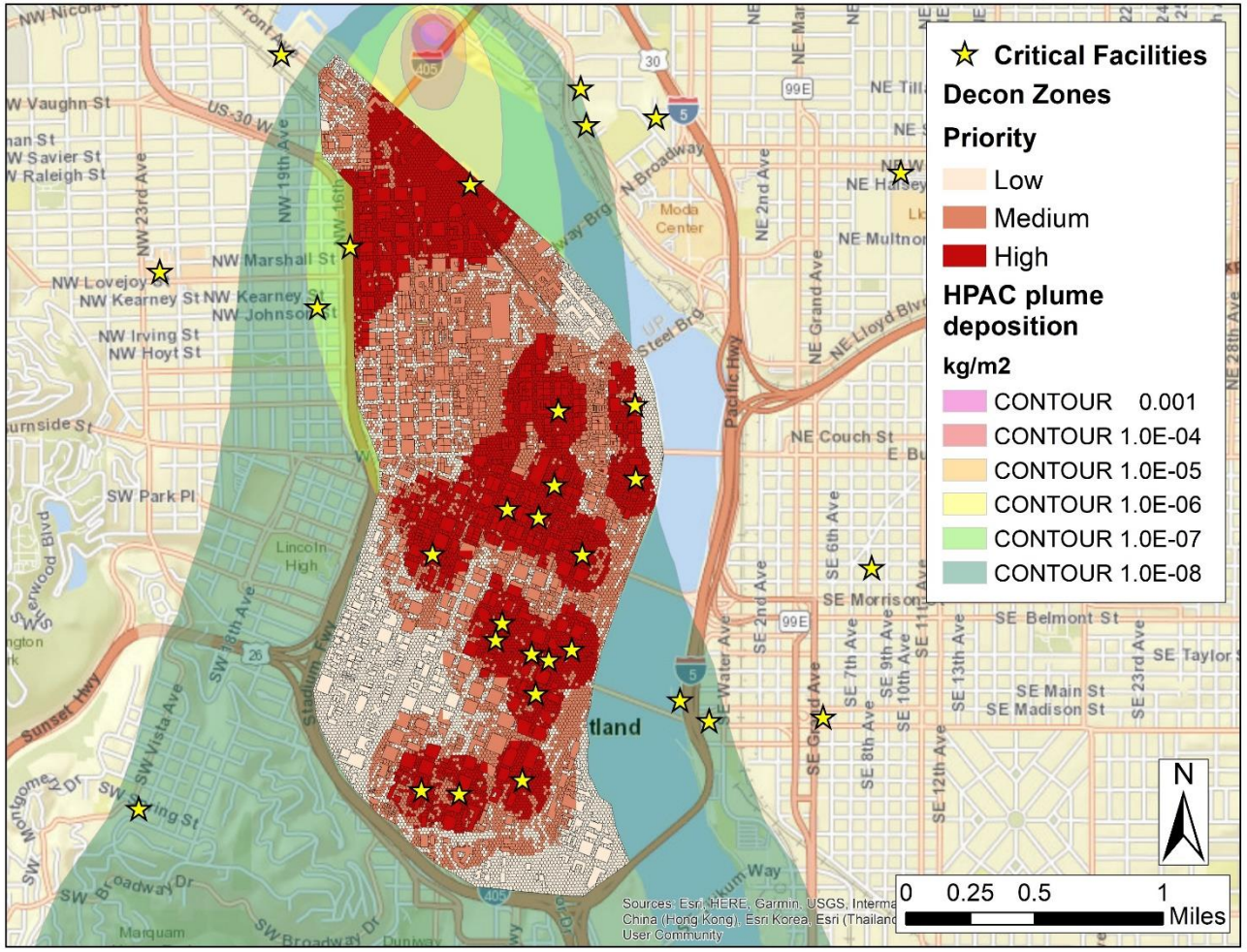
Planning for Response & Recovery

- Combine contamination maps with additional data for planning and prioritization
  - Population data



Planning for Response & Recovery

- Combine contamination maps with additional data for planning and prioritization
  - Population data
  - Critical facilities
- Dynamic, flexible support that can evolve over time
- Model different scenarios

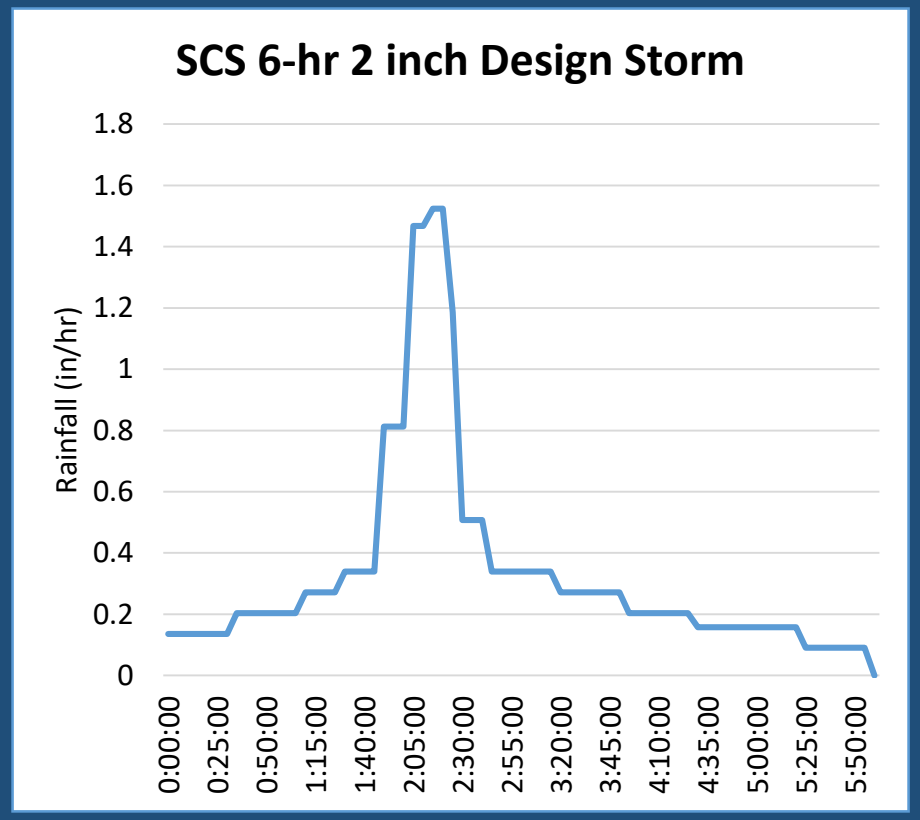


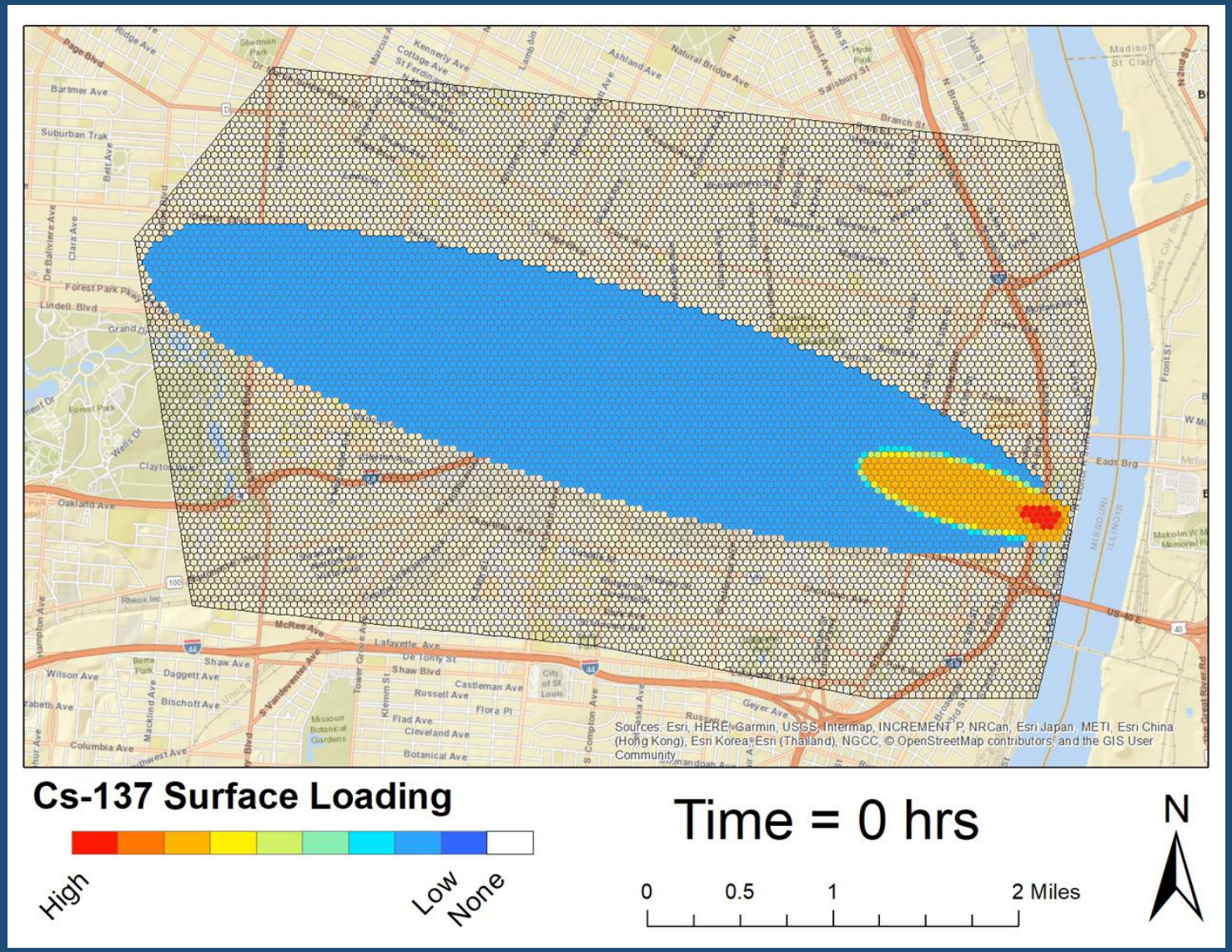
Case Study – St. Louis

- Large-scale hypothetical radiological incident resulting from a radiological dispersal device (RDD)
- RDD contained 2,300 curies of cesium-137 (as cesium chloride)
- Dispersed over approximately 4 square miles via a 3,000 lb truck bomb

Case Study – St. Louis

Model domain larger than initial deposition plume





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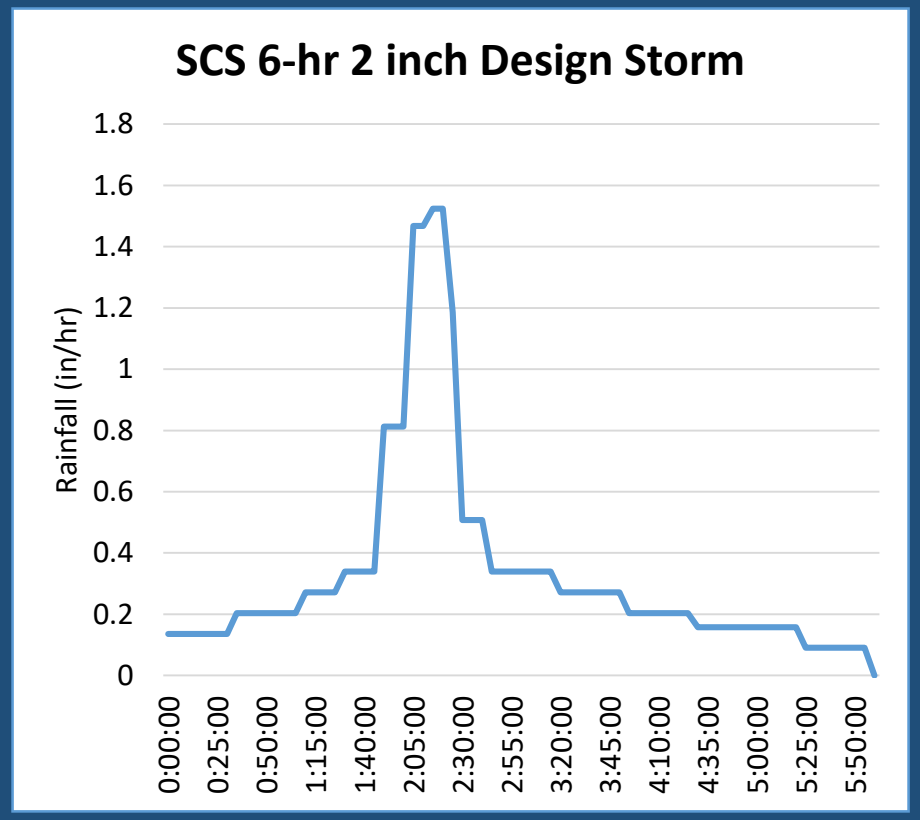
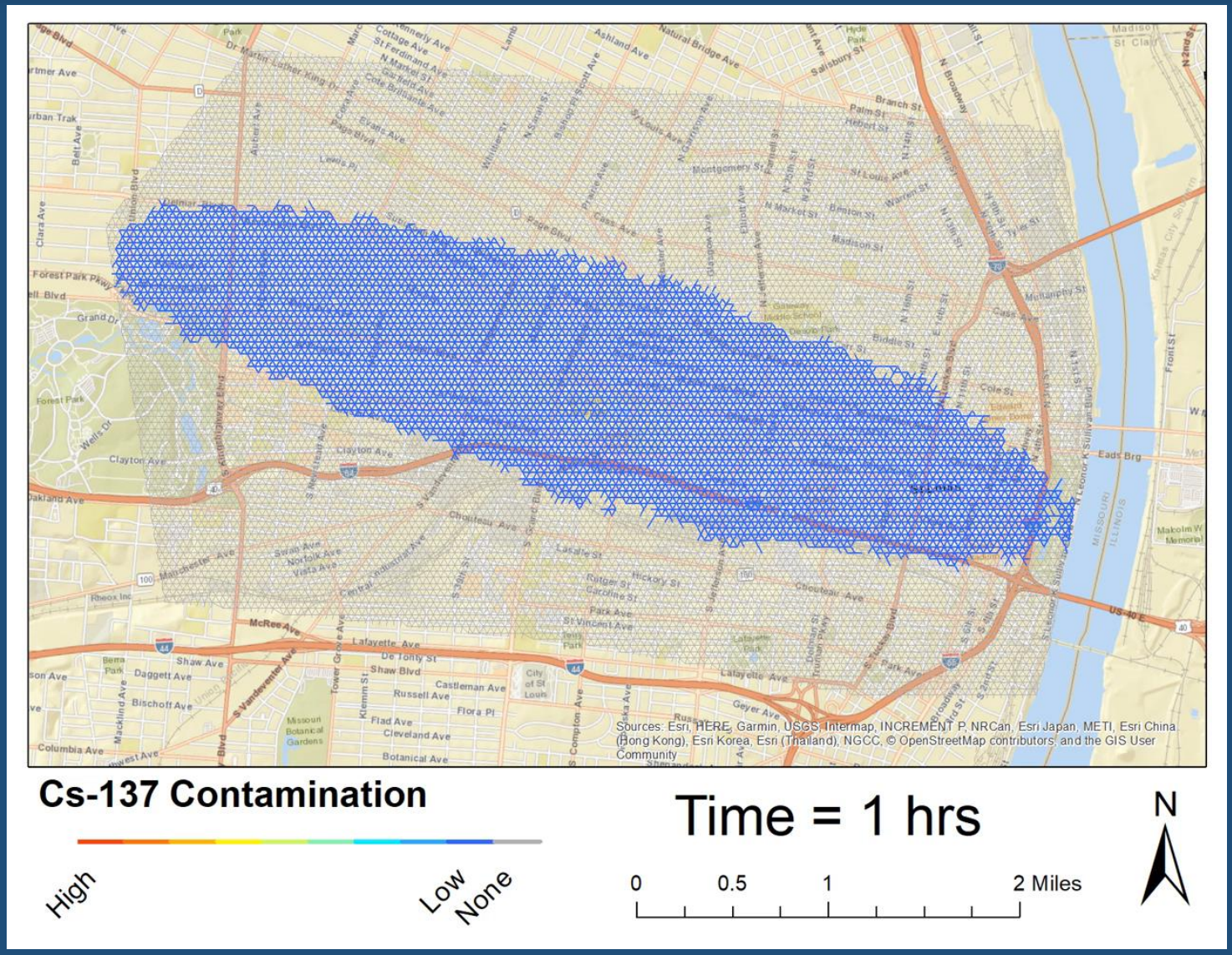


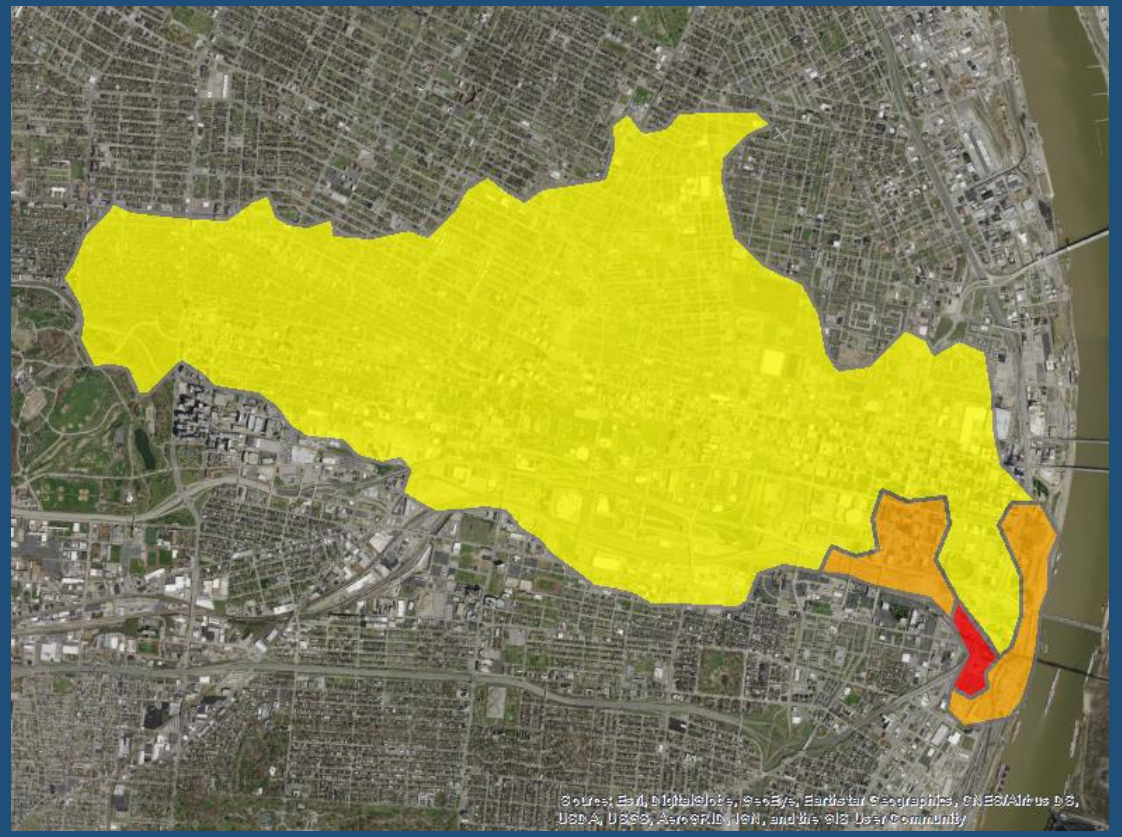


Case Study – St. Louis

Initial Deposition

4 mi²

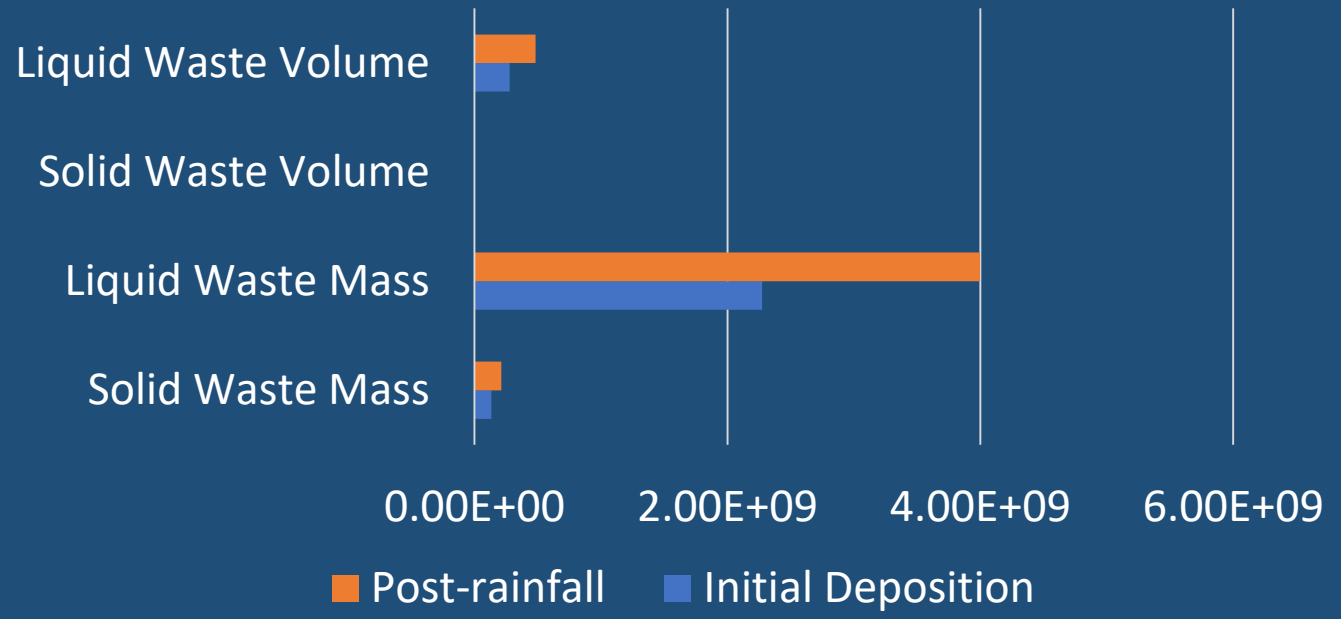
Post-Rainfall



7 mi²

Fate & Transport Impacts

- Waste Estimation Support Tool (WEST) is a GIS-based tool designed to assist in planning and preparedness
- Facilitates waste estimates, planning for staging and storage, assessing strategies



Results	Units	Initial Deposition	Post-Rainfall
Solid Waste Mass	lb	1.34E+08	2.11E+08
Liquid Waste Mass	lb	2.28E+09	4.00E+09
Solid Waste Volume	ft^3	1.69E+06	2.45E+06
Liquid Waste Volume	gal	2.79E+08	4.84E+08

Next Steps

- Constrain CBR agent washoff representation and parameterization
- Link overland flow models to pipe network
- Sensitivity analyses
- Case studies

EPA Urban Watershed Facility Edison, NJ

26 ft. tall indoor rainfall simulator for washoff studies

Questions?

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