Application of Fukushima-Derived Radiological Cleanup Metrics for Assessing Decontamination Feasibility in the United States

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Outline

1. Why CBRN waste issues are important
2. WEST description & methodology
3. WEST updates
4. Case study: Fukushima Hirono Town
5. Case study: WARRP & Liberty RadEx waste estimates using Fukushima Decontamination Metrics
6. Summary

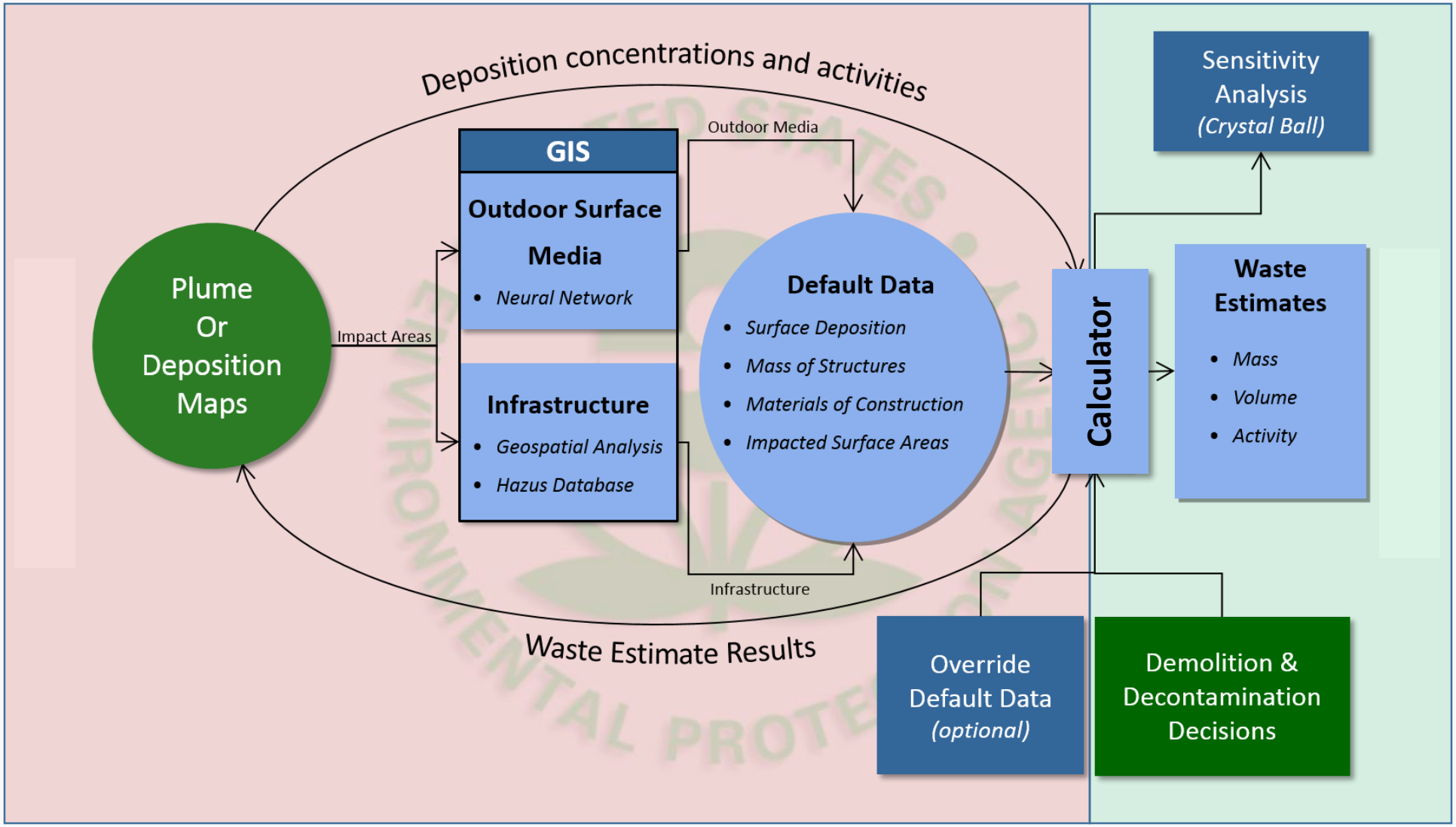
Impact

Wide Area Recovery and Resiliency Program (Denver Metro Area)

WEST: Description

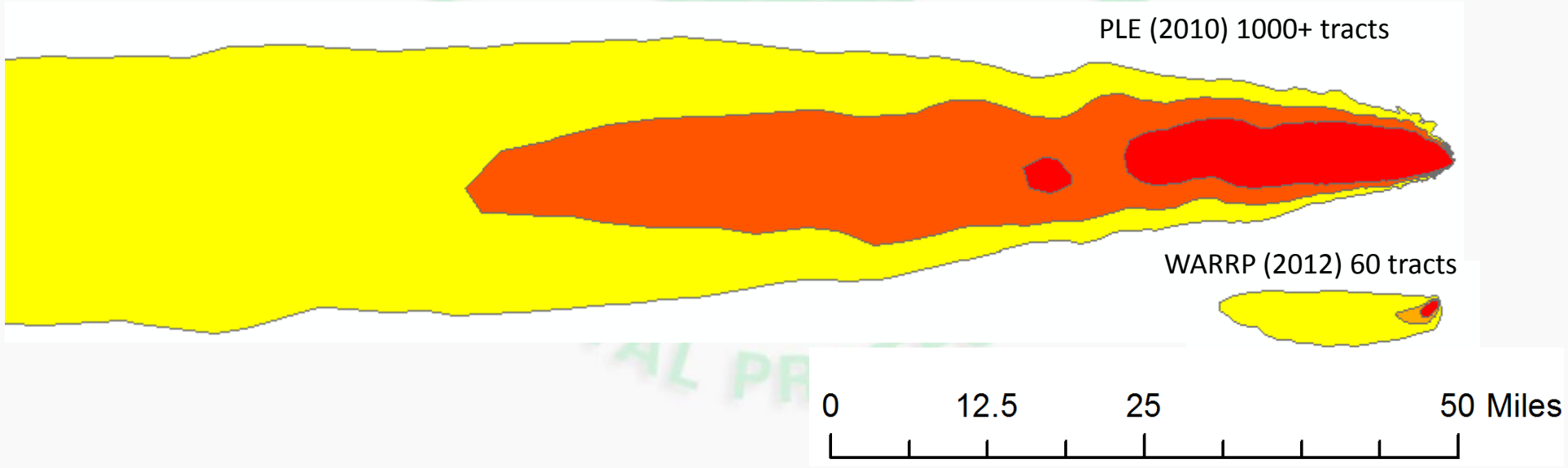
- GIS-based tool that can assist in planning/preparedness activities at all levels of government
  - Decontamination & restoration timeline
  - Decisions need to be made early
- Waste Estimation Support Tool (WEST) Facilitates
  - First-order estimate of waste quantity and activity
  - Potential triage/staging/storage/disposal options
  - Impact of decontamination strategies on waste generation
  - Impact of WM strategies on decontamination decisions
  - Starting point for policy discussions

WEST: Methodology



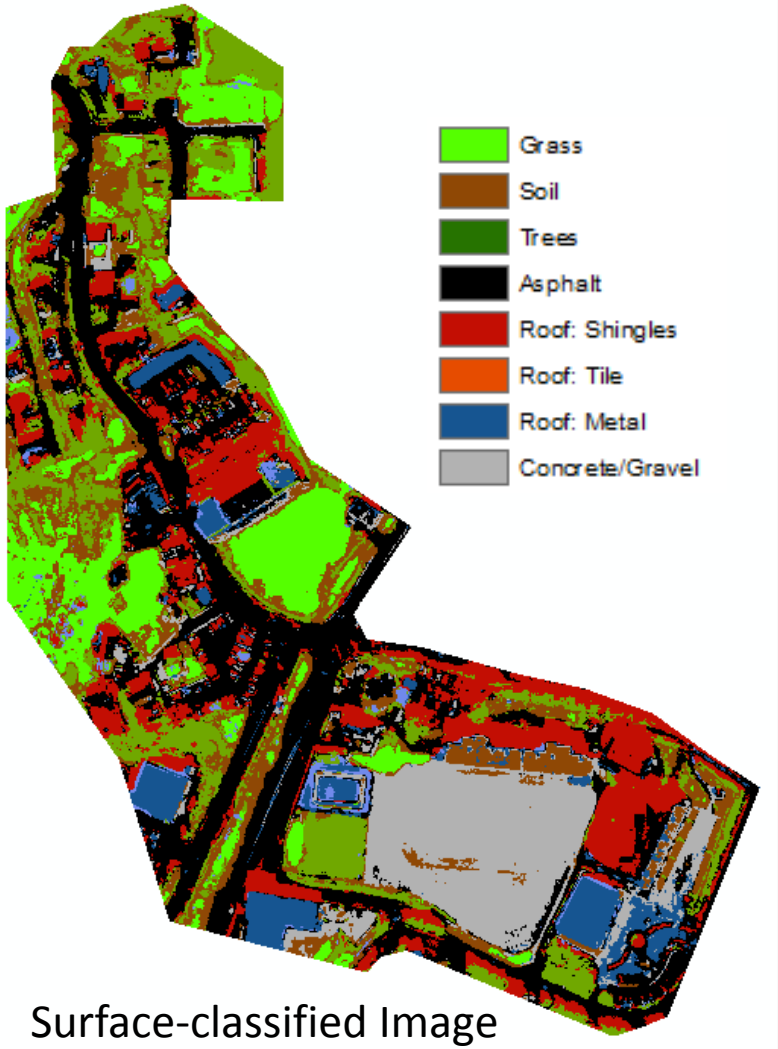
Updates: Platform

- Current WEST platform is built on a VBA-based Excel spreadsheet, ArcGIS plug-in (Python), Hazus (Full Install), and external apps
- Had inherent limitations
  - Excel limit size of scenario (limited to 250-300) census tracts
  - Distribution and installation difficult due to leapfrogging versions of Hazus and ArcGIS
- New WEST version uses ArcGIS plug-in (Python) and Waste Estimator built in MS Access, only need Hazus infrastructure data



Updates: Imagery Analysis

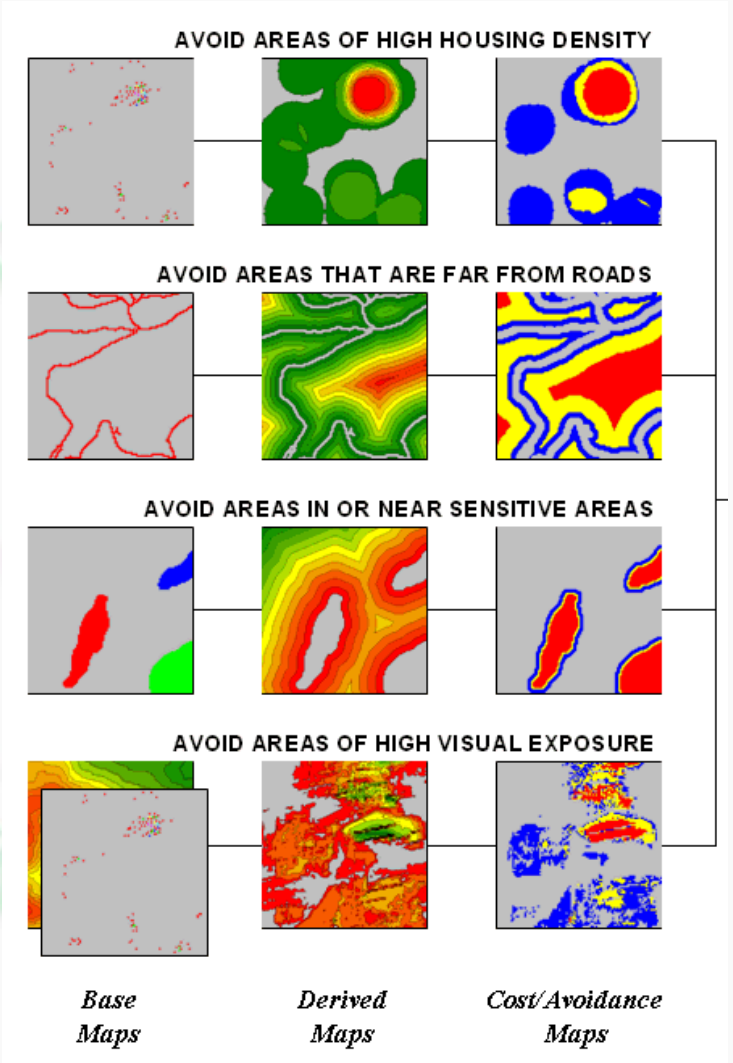
Satellite Image

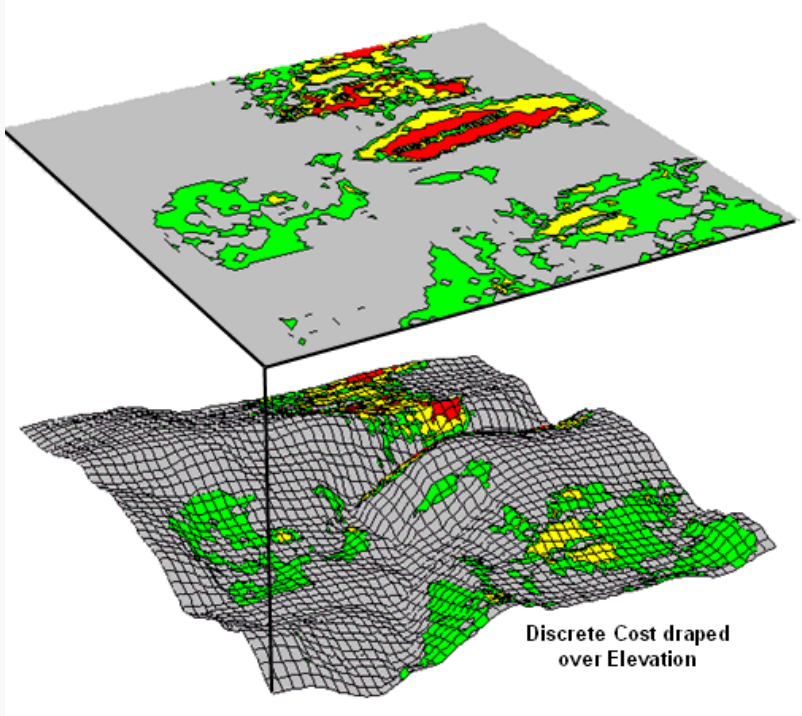


Surface-classified Image

Updates: Logistics/Site Analysis

- Use GIS to:
  - Identify most optimal routes
  - Make recommendations on where to locate, expand, or consolidate waste staging and temporary storage locations
  - Impacts of waste quantity and generation rate





Updates: Additional Waste Parameters

- Vegetation and vehicles are likely key components of waste streams
- Developing new methods (remote sensing) and leveraging pre-existing models

Decontamination Metrics


Topsoil stripping (mechanical digger)


Manual topsoil stripping


Thin layer topsoil stripper


Reversal tillage with plough


Fixation agent application


Solidified soil separation and recovery machine

Reference	Forest-1
Land use type	Forest
Surface	Ground
Topography	Flat
Decontamination method	Manual removal of litter and humus
Content	Removal of litter and humus (manual), vacuum collection, packaging and transportation
Decontamination method outline	Initially litter and humus are gathered manually with rakes before being collected with a vacuum tanker and then packed into flexible bags. Waste bags are transported to temporary storage by truck.


Manual removal of humus and litter


Packing into flexible waste bags

Machinery required	Vacuum tanker (sucking force 100 m^3 h^{-1}), truck with loader crane
	arget areas: flat forest ground
	laximum vacuum distance is 100 m
rea decontaminated (1 person day)	50 m^2
Volume of waste generated	20-90 l m^{-2}
Waste type	Litter, humus
Volume of water used	—
Collection method	—
Collection rate	—
DF	1.1-10
Gamma dose rate reduction	5-90%
tion cost, area > 1000 m^2)	530 Yen m^{-2}

ine the required stripping depth before beginning decontamination

is important to minimise variability of decontamination level due to a

acuum tankers to prevent secondary contamination.
ch as litter and dead branches should be collected separately from
tion purposes.

Media Type	Decon Tech	Source
Soil	Excavation/Physical Removal - Machine Assisted	JAEA
	Excavation/Physical Removal - Manual Removal	JAEA
	Excavation/Physical Removal with Solidification Agent - Machine Assisted	JAEA
	Reversal Tillage	JAEA
	Soil Inversion	JAEA
Streets - Asphalt	Excavation/Physical Removal - Machine Assisted	JAEA
	Foam/Rinse	EPA
	Grinding	EPA
	Grit Blasting	EPA
	Low Volume Foam/Rinse	EPA
	Media Blasting (Dry Ice)	JAEA
	Media Blasting (Sand)	JAEA
	Media Blasting (Shot)	JAEA
	Polymer/Gel	EPA
	Road Sweeper	JAEA
	Strippable Coating	EPA
	Ultra-High-Pressure Washing	JAEA
	Water Blasting	EPA
Streets/Sidewalks - Concrete	Abrasion	JAEA
	Foam/Rinse	EPA
	Grinding	EPA
	Grit Blasting	EPA
	High-Pressure Washing	JAEA
	Low Volume Foam/Rinse	EPA
	Media Blasting (Shot)	JAEA
	Polymer/Gel	EPA
	Strippable Coating	EPA
	Ultra-High-Pressure Washing	JAEA
	Water Blasting	EPA

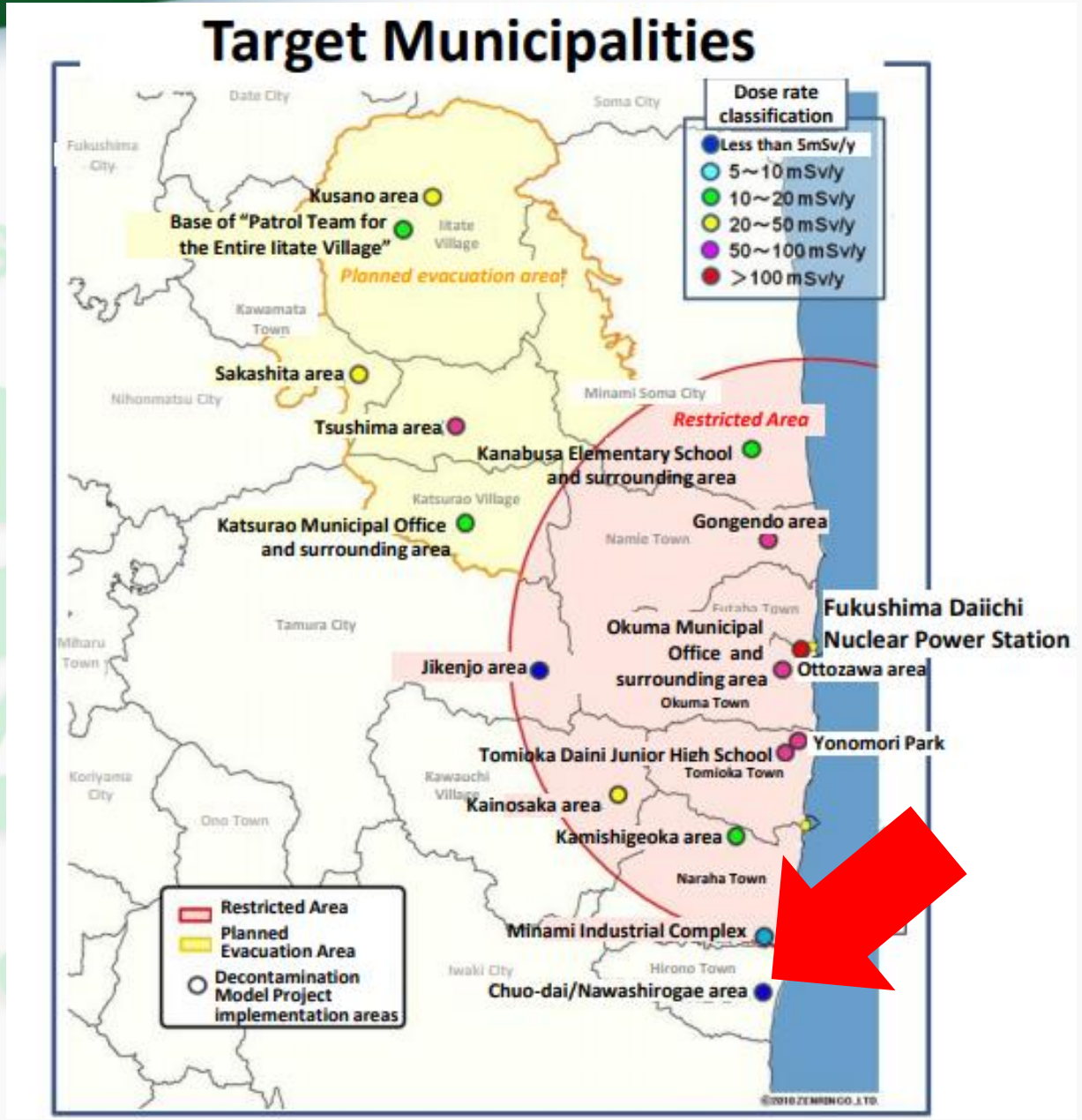
Implement Technologies

Document/Collect Metrics

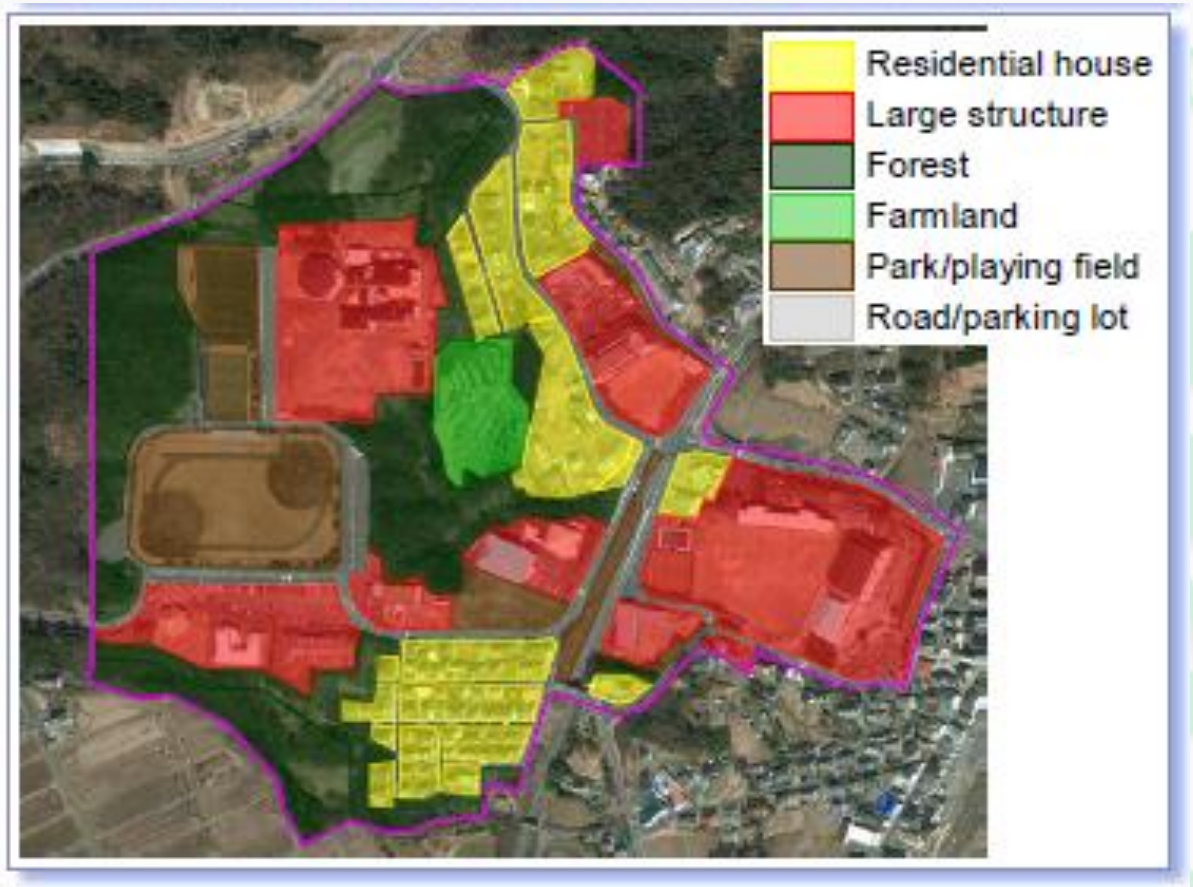
Scale Using Models/Decision Tools

Case Study: Hirono Town

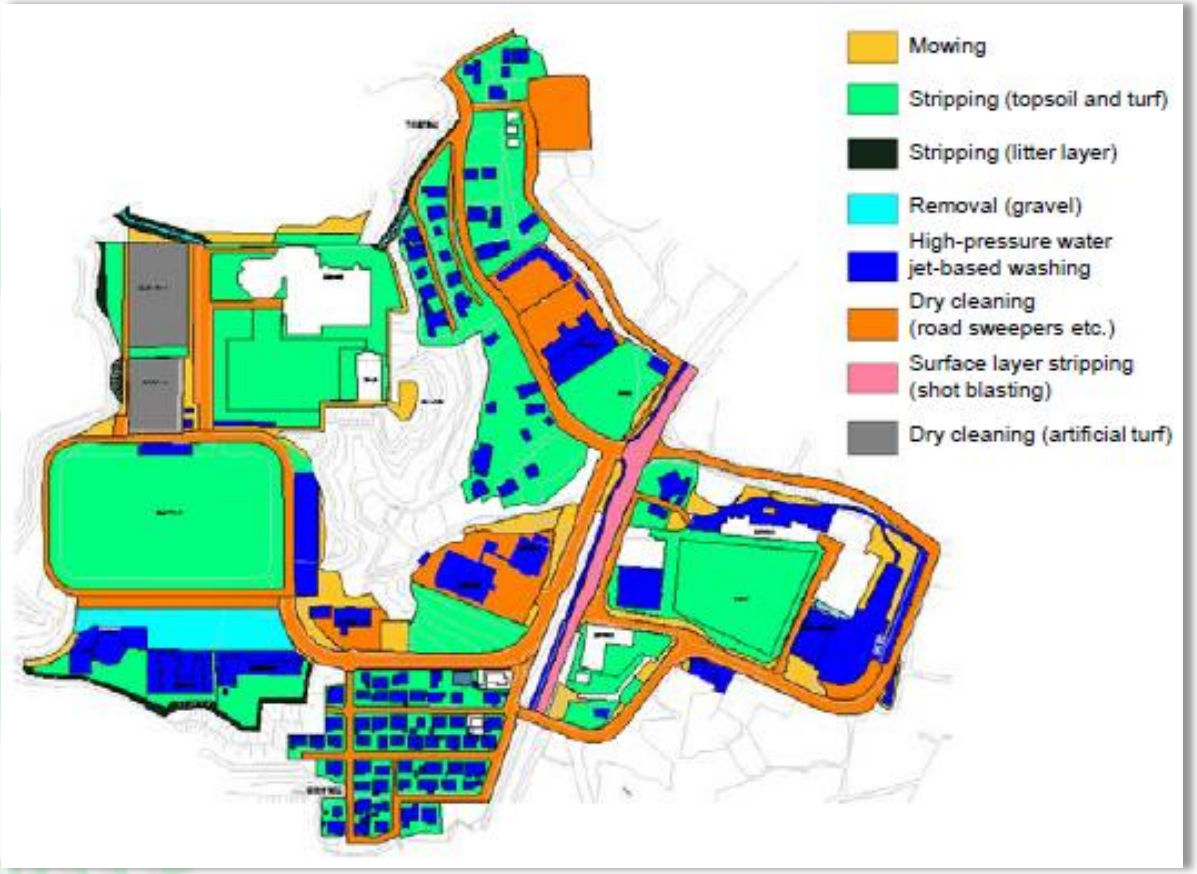
- Fukushima serves as an opportunity to ground test results and add new decontamination technologies
- Japan conducted “Decontamination Model Project”
- A series of towns were selected to test decon technologies
- NHSRC selected Hirono town as testbed
- Infrastructure and surface media information were collected using EPA tools



Case Study: Hirono Town

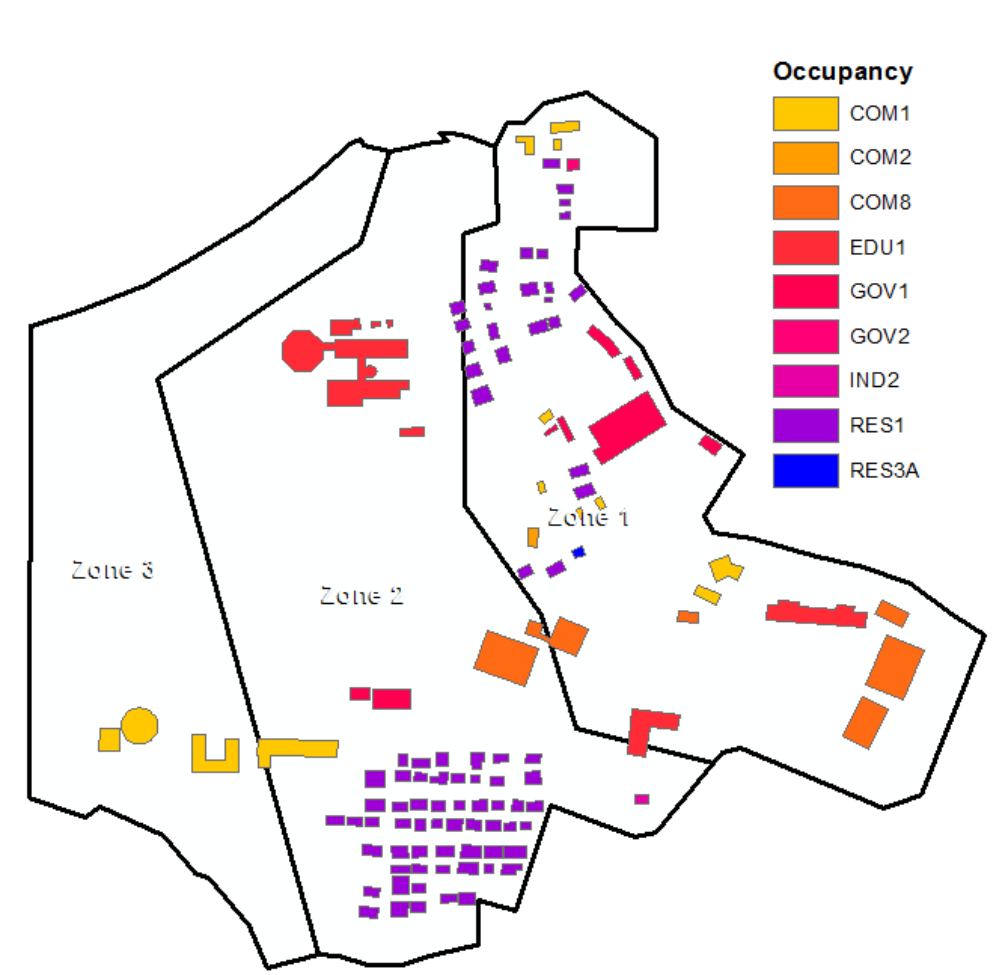


Site selection & infrastructure

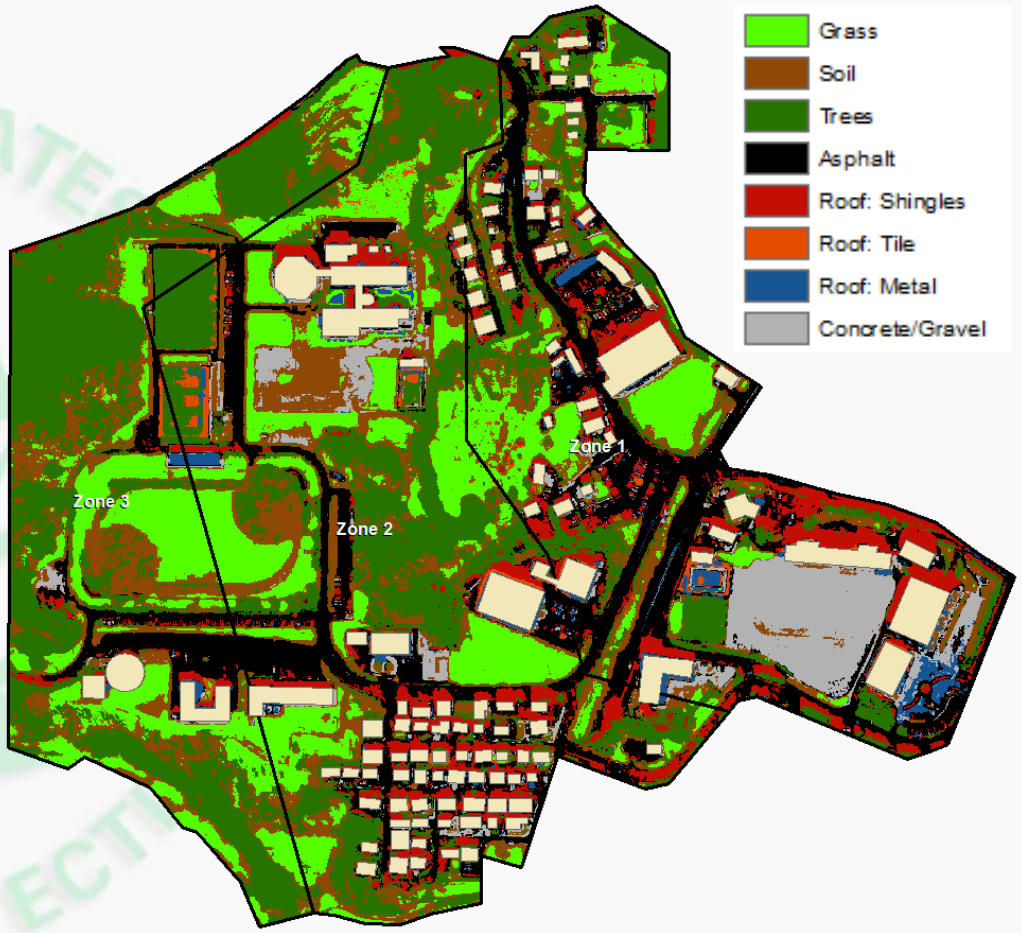


Decontamination Selection

Case Study: Hirono Town



WEST: Site selection & Infrastructure



WEST: Surface Selection/Decon

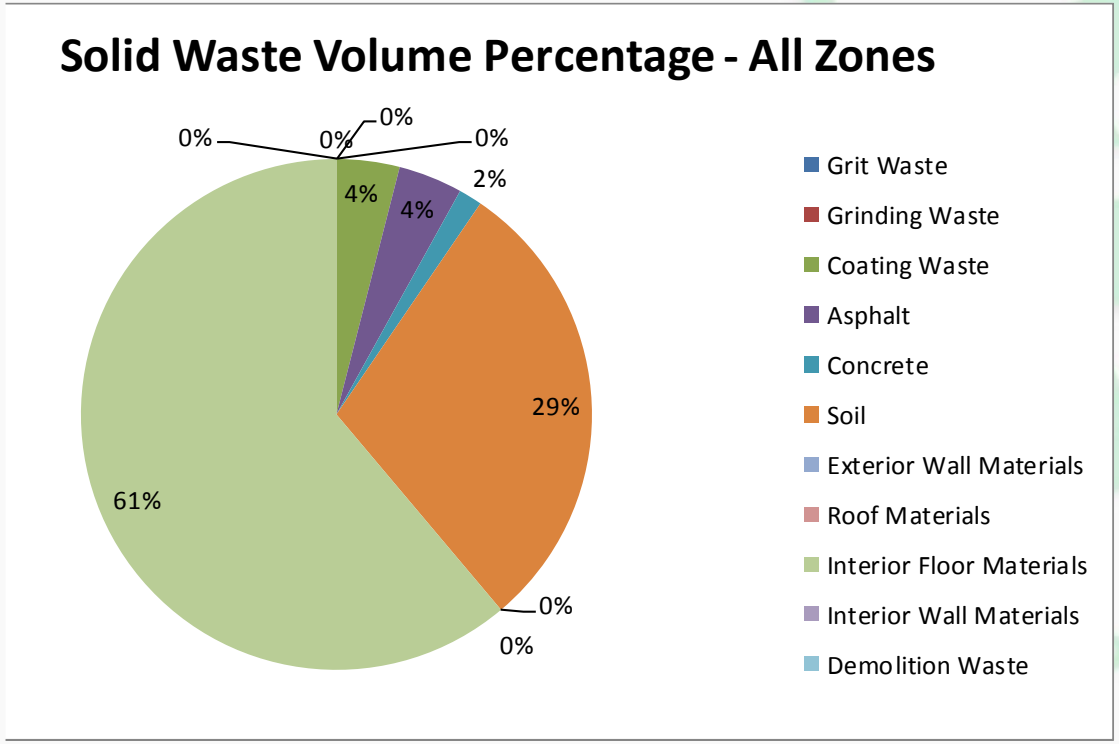
Case Study: Hirono Town

Decontamination Approach

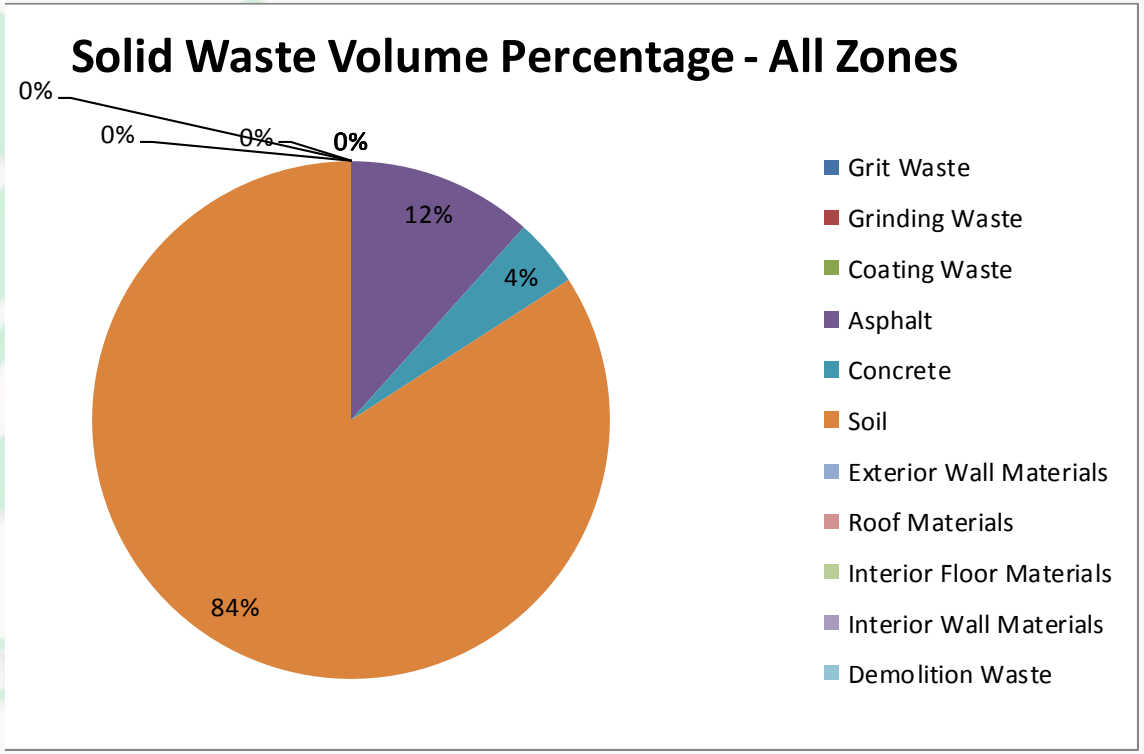
Surface	Decon Method	Decon Method Distribution
Soil	Stripping (turf)	62%
Concrete	Removal (gravel)	6%
Asphalt	Dry Cleaning	33%
Roof	Pressure Wash	100%
Interior Walls	*Strippable Coating*	*100%*
Interior Floors	*Excavation/Physical Removal*	*100%*

Case Study: Hirono Town

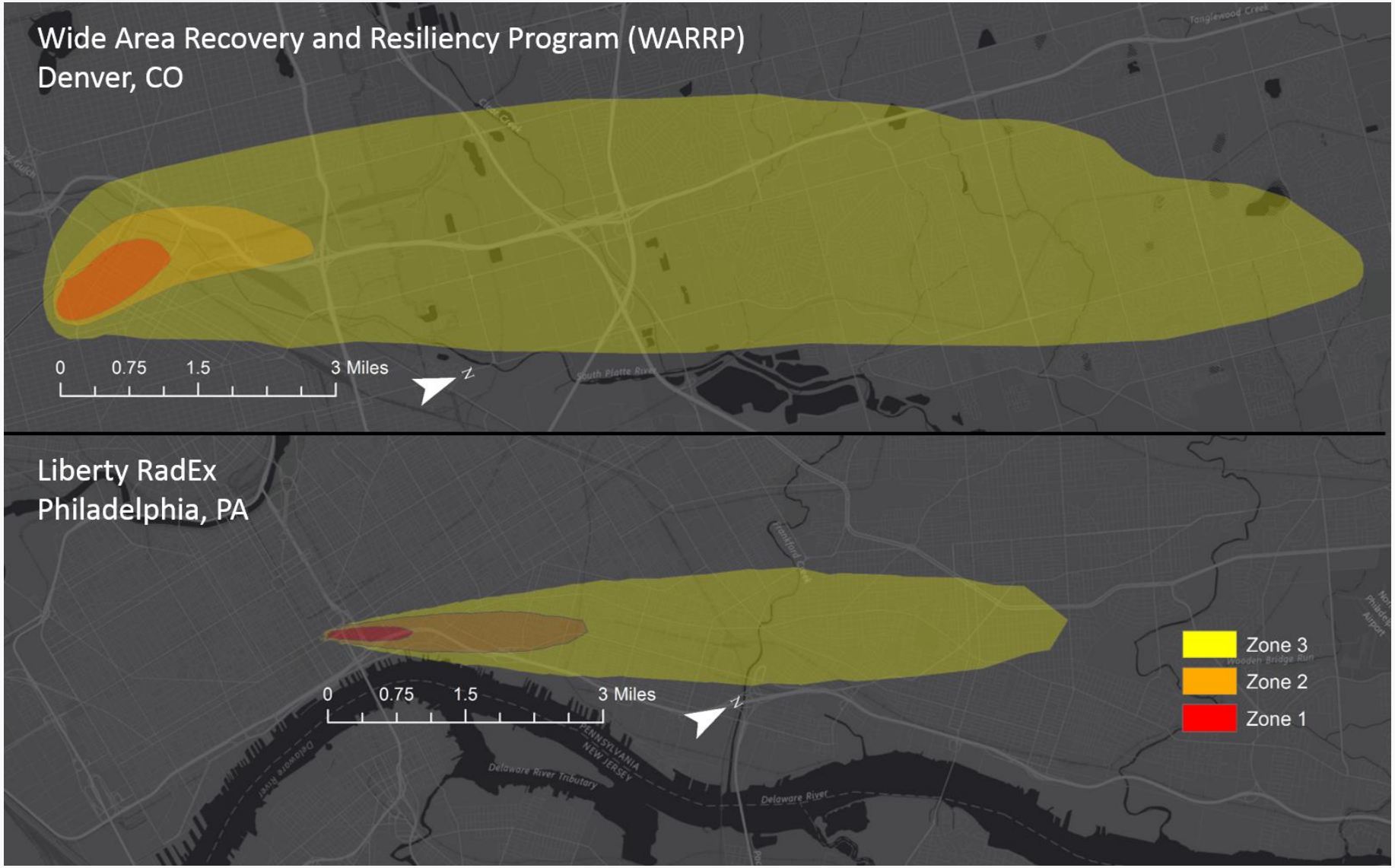
Outdoor decon (only):
Solid waste: 1.48E+04 metric tons
Liquid waste: 1.52E+02 m3



Outdoor & indoor decon:
Solid waste: 1.51E+04 metric tons
Liquid waste: 1.52E+02 m3



Case Study: WARRP & Liberty RadEx



Case Study: WARRP & Liberty RadEx

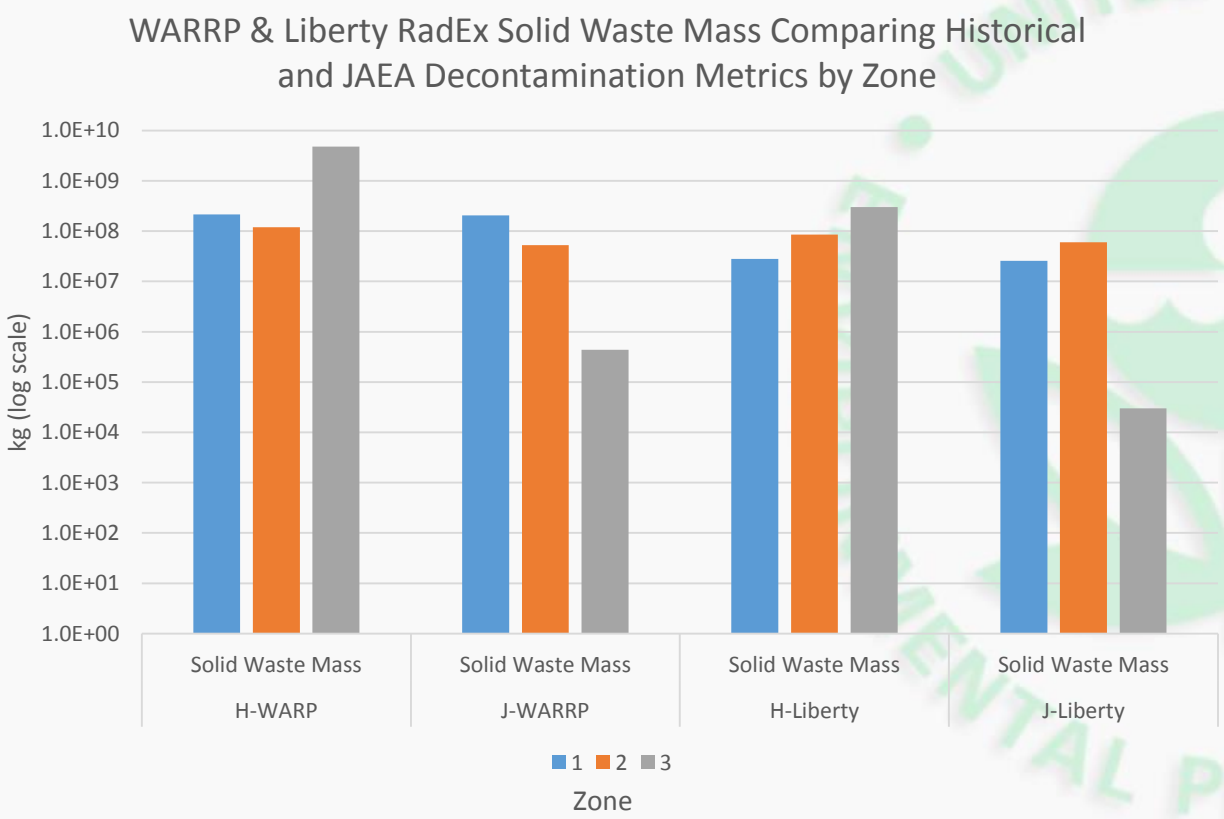
JAEA Decontamination Approach

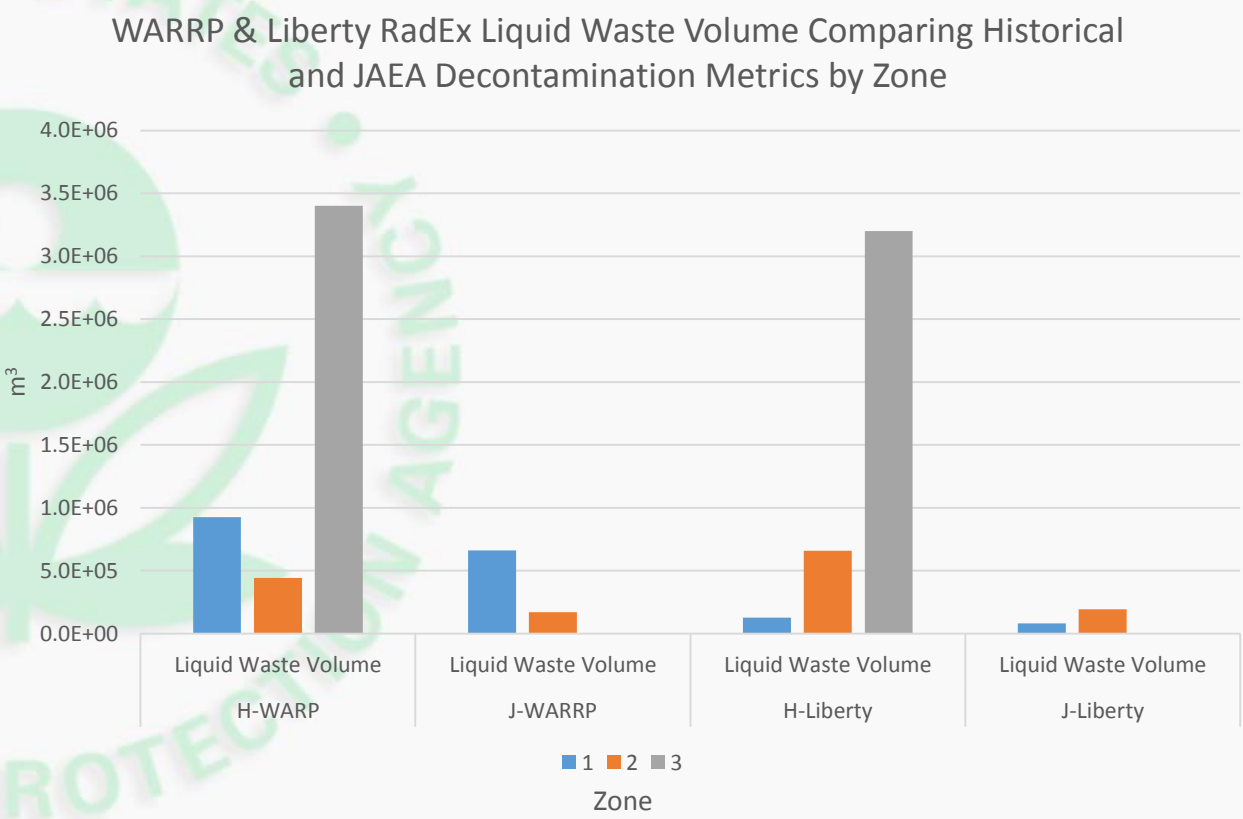
Surface	Decon Type	Zone 1 (%)	Zone 2 (%)	Zone 3 (%)
Exterior Walls, Excluding Roofs	Surface Brushing	100%	100%	100%
Interior Floors	None	None	None	None
Interior Walls, Including Ceilings	None	None	None	None
Roofs	Brushing & High-Pressure Washing	100%	100%	100%
Soil	Excavation/Physical Removal - Machine Assisted	100%	100%	100%
Streets - Asphalt	Excavation/Physical Removal - Machine Assisted	90%	50%	0%
	Road Sweeper	10%	50%	100%
Streets/Sidewalks - Concrete	Abrasion	100%	50%	25%
	Ultra-High-Pressure Washing	0%	50%	75%

Historical Decontamination Approach

Surface	Decon Type	Zone 1 (%)	Zone 2 (%)	Zone 3 (%)
Exterior Walls, Excluding Roofs	Water Blasting	100%	100%	100%
Interior Floors	None	None	None	None
Interior Walls, Including Ceilings	None	None	None	None
Roofs	Water Blasting	100%	100%	100%
Soil	Excavation/Physical Removal - Machine Assisted	100%	100%	100%
Streets - Asphalt	Excavation/Physical Removal - Machine Assisted	90%	25%	0%
	Grinding	10%	50%	50%
	Water Blasting	0%	25%	5%
Streets/Sidewalks - Concrete	Grinding	100%	50%	25%
	Water Blasting	0%	50%	75%

Case Study: WARRP & Liberty RadEx





J= JAEA
H= Historical

Summary

- Methodology presented here is not limited to waste estimation
- Improvements to decon technologies can have significant impacts on the waste stream
- Operational (field > lab) data represents the most optimal source of information
- OCONUS cultural norms and/or laws/regulations may impact how results are reported
  - i.e., Fukushima waste totals often exclude indoor materials

Disclaimer

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Thank You

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