Debris Management Site Assessment

A project review from City of Philadelphia

Agenda

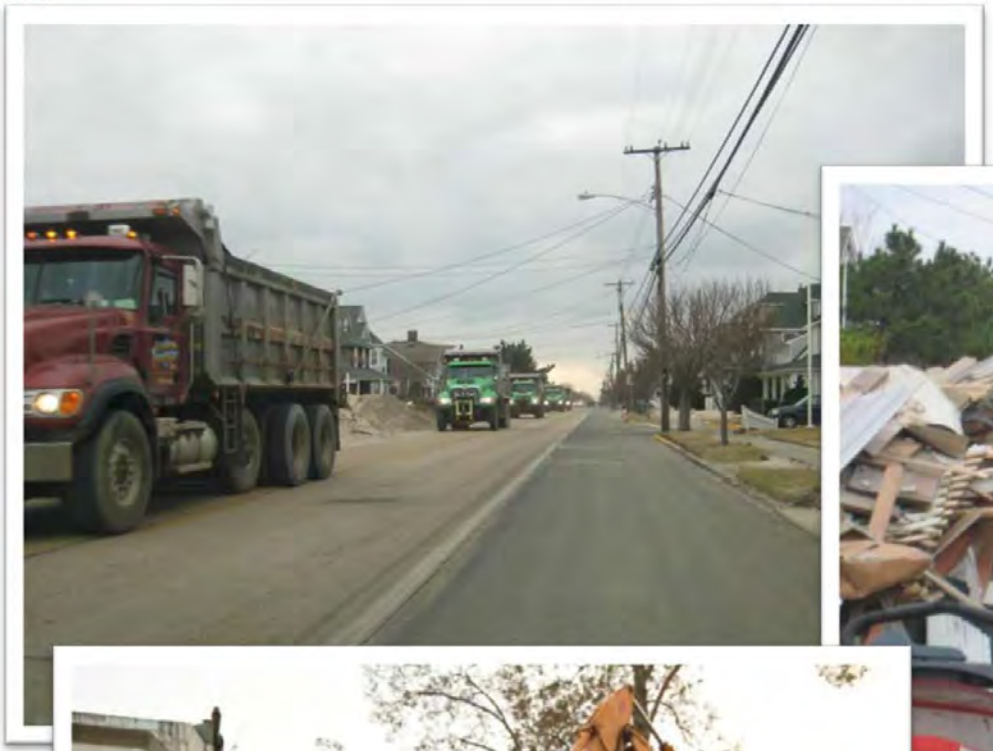
- What is debris?
- Why does it matter?
- City of Philadelphia
  - Debris Planning
  - Dewberry Project
    - Debris forecasts
    - DMS site analysis
      - Environmental review
      - Field visits
      - Site suitability
- Next steps

What is Debris?

- “Items and materials broken, destroyed, or displaced by a natural or man-made Federally declared disaster.
  - Examples of debris include, but are not limited to, trees, construction and demolition material, and personal property.”

    FEMA 325 – Debris Management Guide

Debris Removal and Sites



Debris Removal and Sites

Source: USACE

Why Emphasis on Debris?

- High disaster-related debris costs
  - 2011 OIG Report: $8 billion on debris removal
  - 15% of all disaster related costs over the past 10 years
  - Almost 50% for debris from some hurricanes
- Recurring problems
  - Eligibility determination
  - Questionable contractors
  - Questionable contracting procedures
  - Inadequate contract monitoring
  - Obligating/de-obligating large amounts of funding

City of Philadelphia

- Recent debris events: Snow, Irene/Lee, Sandy
- Low Public Assistance recoupment rate
- City's first Debris Management Plan
- Key Challenges
  - Coordination/Decision-Making
  - Contracts
  - DMS identification & operations
    - Where? Who? How? When?

City of Philadelphia

- Debris forecasts
  - Data gathering
  - Scenarios and results
- Suitability for storing debris after an event

Dewberry

Data Gathering

- Data collected included
  - Water/sewer
  - Contamination sites
  - Critical facilities
  - Land use
  - Boundaries
  - Building footprints
  - Landfill locations
  - Historical areas
  - Impervious surfaces and soil types
  - Historical storm data
  - Environmental constraints
  - Bridges
  - Permits
  - Elevation data from LiDAR
  - Vegetative cover
  - Floodways and neighborhoods that have historically flooded

Debris Forecasts

- Review scenarios for ice, flood, hurricane
  - Discuss formulas
  - Methodology
  - Results
- Two types of debris we are forecasting:
  - Construction and Demolition (C&D)
  - Vegetative

Debris Scenario - Ice

- Ice Storm with 1” of ice generated
  - Heavy impact on vegetation
  - Wind is factored in to the scenario to increase impact
  - Scenario validation
    - 1” thickness could cover city
    - 50-year event

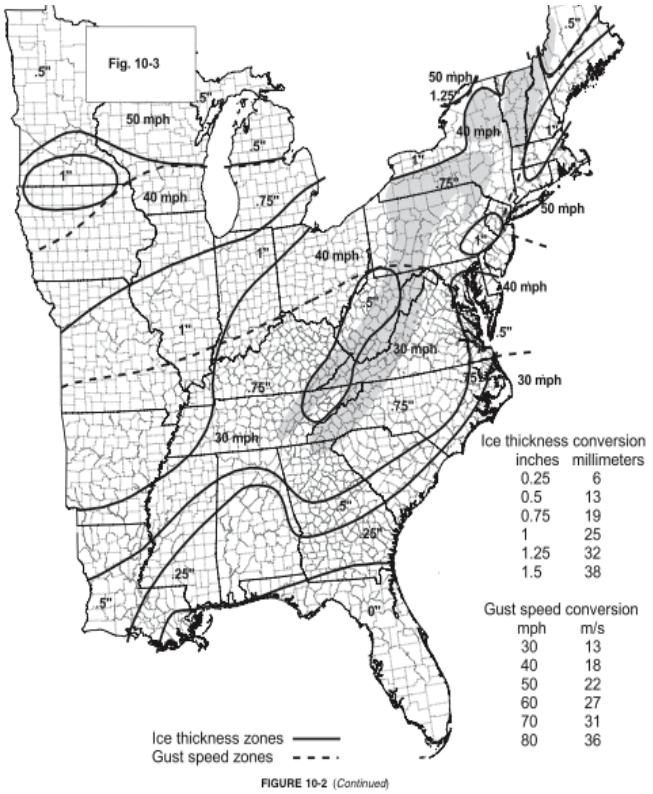


FIGURE 10-2 (*Continued*)

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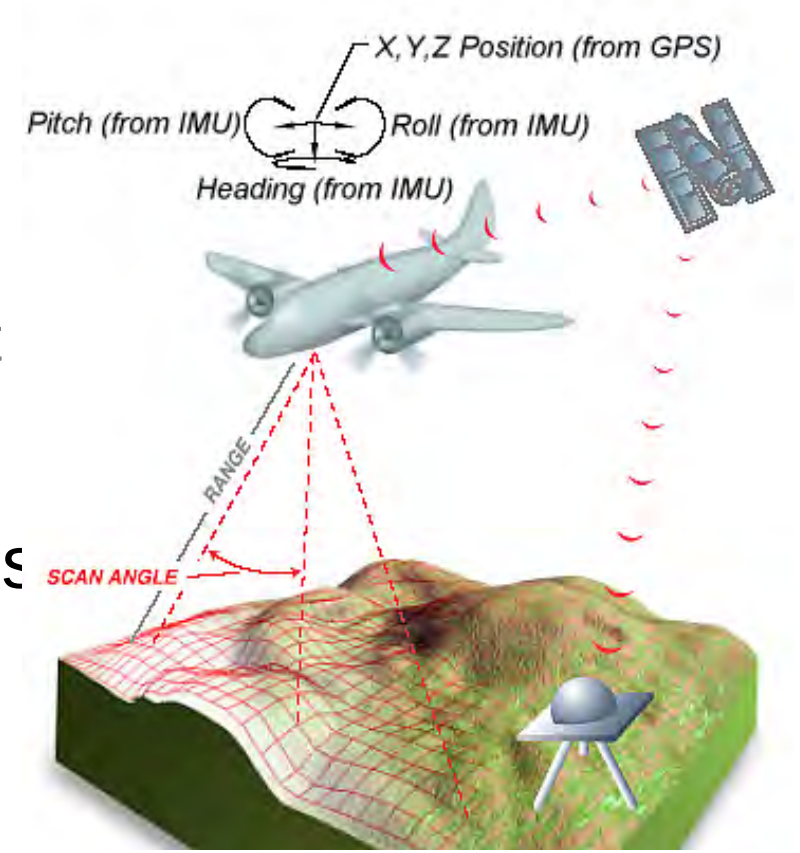
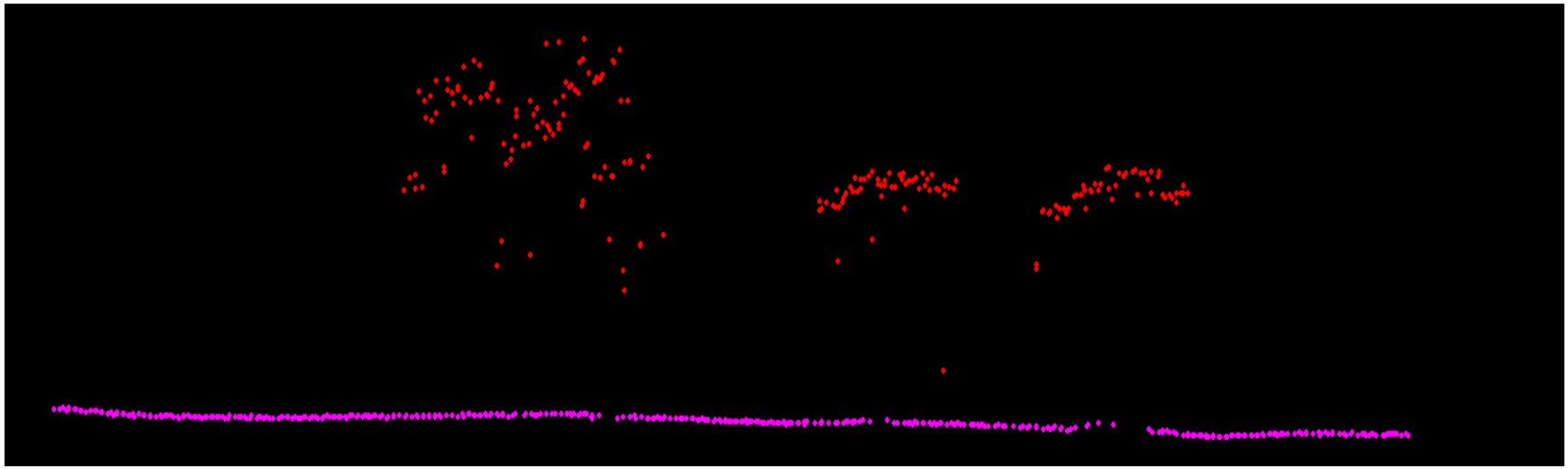
Methodology - Ice

- LiDAR system has three main components
  - GPS
  - Inertial Measurement Unit
  - Laser Scanner
- Measures range distances
  - Based on time between emissions, reflection, and receive time

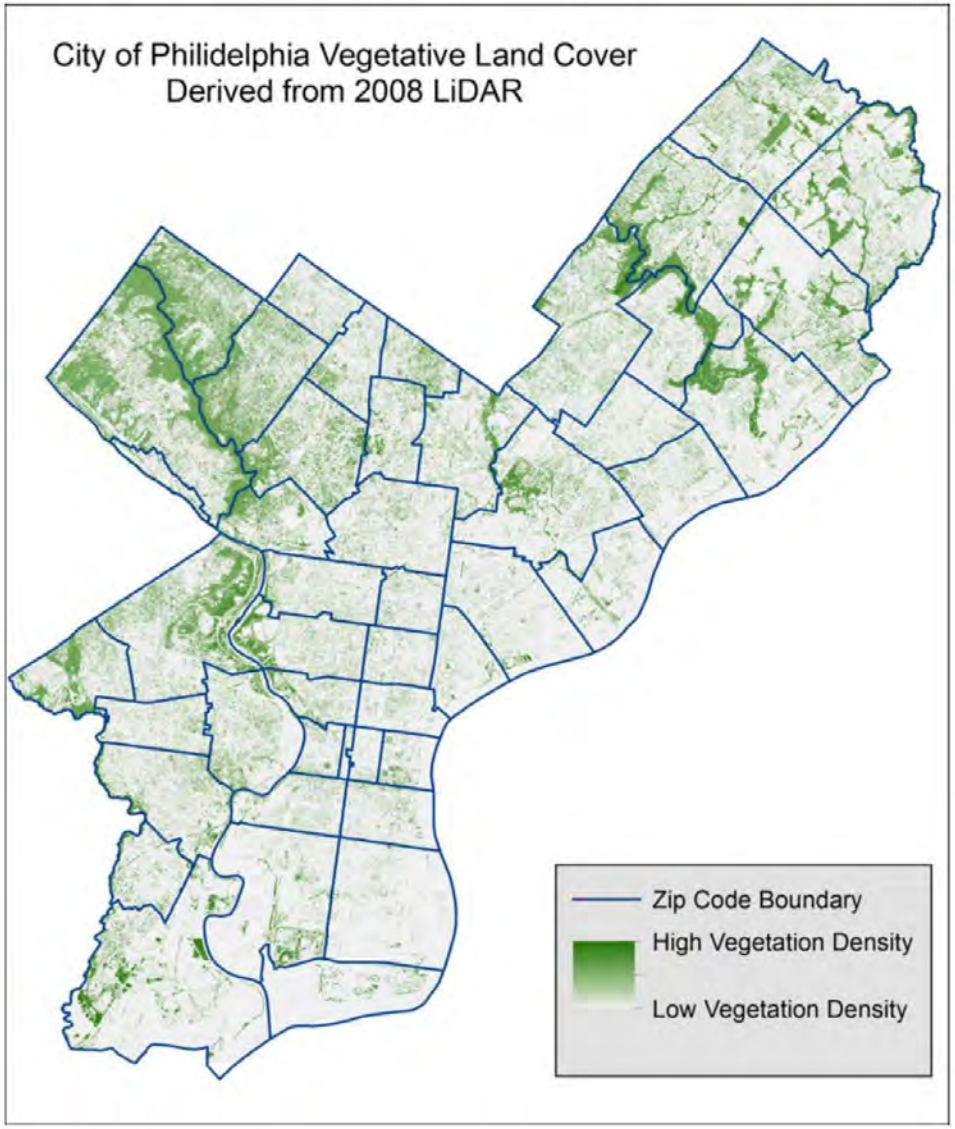


Methodology - Ice

- Every LiDAR point is classified with a number
  - Typically points are classified 1 through 12 based on ASPRS standards
    - Class 4 = vegetation



Methodology - Ice

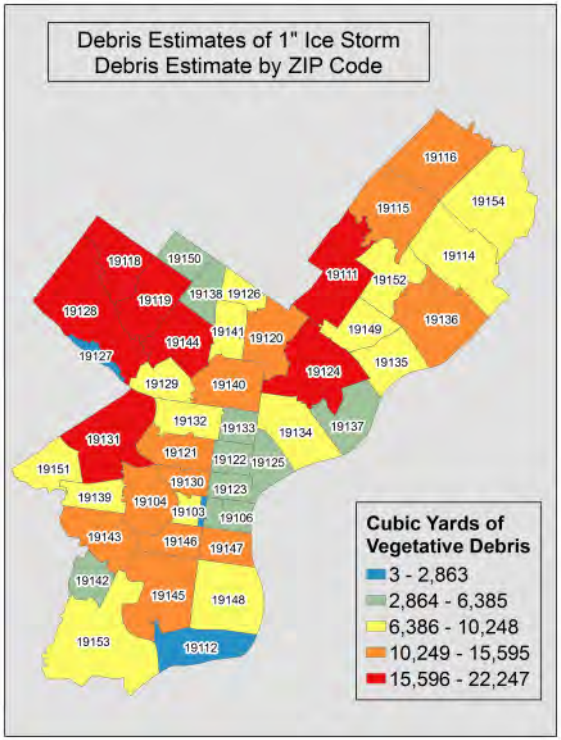


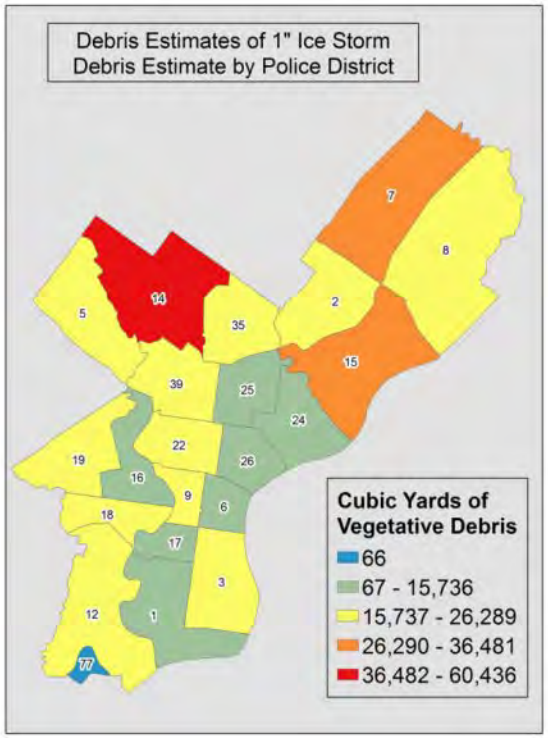
Methodology - Ice

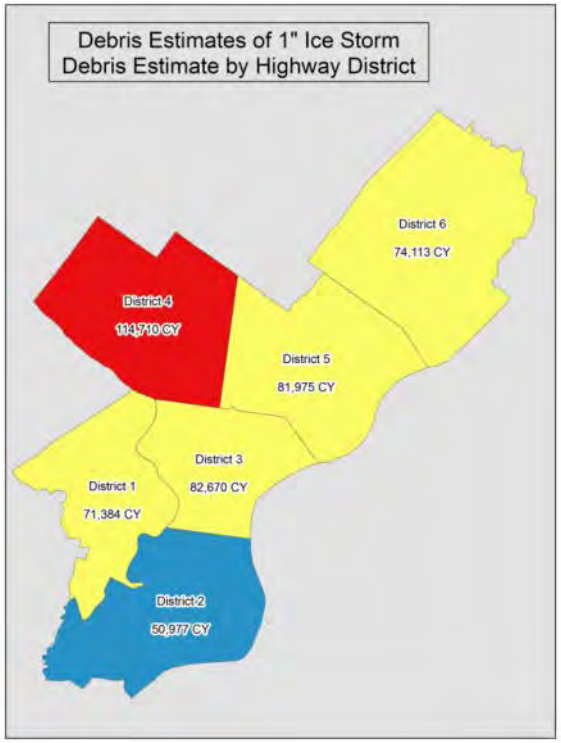
- Selected roads that were within a 22 feet buffer of vegetation
- Determined vegetation density for each road segment (none, low, medium, medium high, high) based on LiDAR for the road segment
- Applied vegetation density factor to length of road segment
  - Less vegetation density = less debris
  - More vegetation density = more debris

Results - Ice

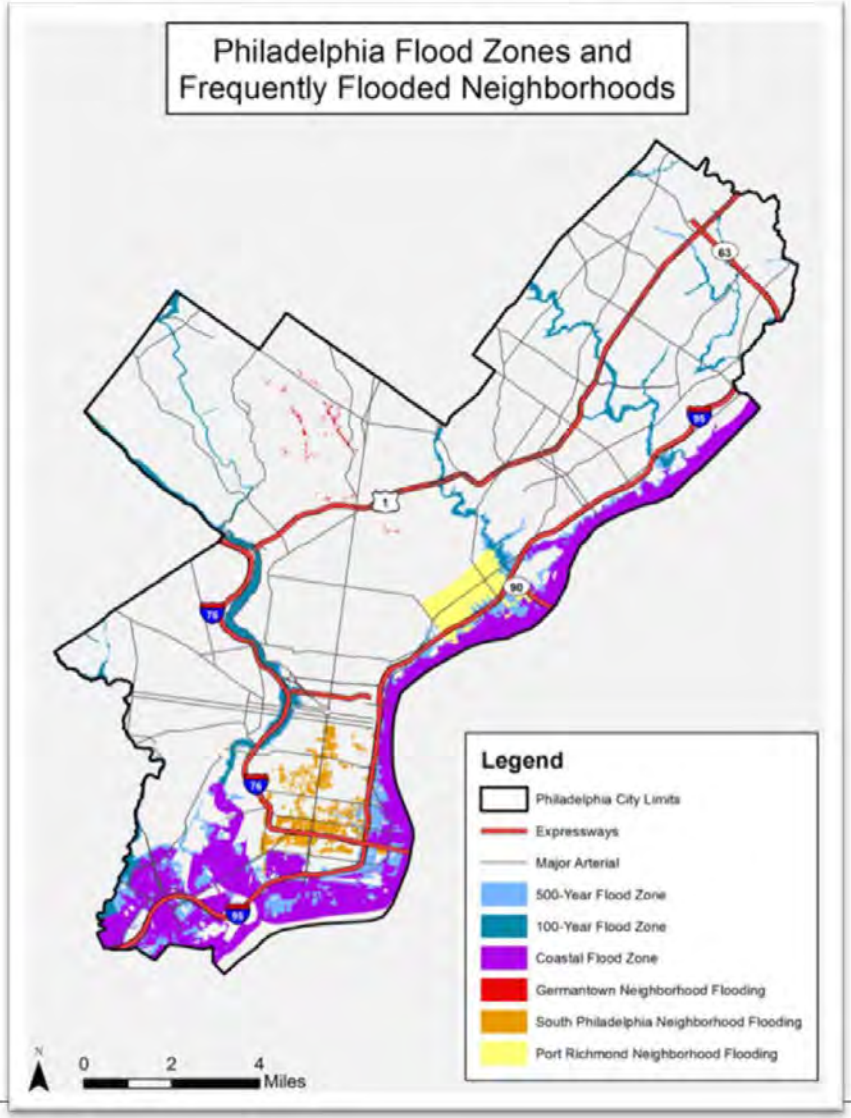
- Debris Estimation = 476,000 cubic yards of vegetative debris







Debris Scenario - Flood



Debris Scenario – Formula

- Hazus flood model
- FEMA's Modeling Task Force streamlined model
- Vegetation density

Debris Scenario – Formula

$$\frac{(Fi+S+Fo)\times SqFt}{1000} = \_\_\_\_ \text{ tons of debris}$$

- Where:
  - Fi = total debris related to finishes generated based on the structure type and given flood depth
  - S = total debris related to structural components generated based on structure type and given flood depth
  - Fo = total debris related to the foundation generated based on the structure type, foundation type, and given flood depth
  - SqFt = total square footage of the structure

Debris Scenario- Formula

- FEMA's Modeling Task Force streamlined model
  - Classifies level of damage based on depth of flooding or a visual inspection, then applies debris quantity values as provided in Hazus Model

Occupancy Type	Damage Classification	Depth of Flooding (feet)	Debris Weight (tons/1,000 square feet)			
			Finishes	Structure	Foundation Type	
					Footing	Slab-on-Grade
Res 1	Affected	0 – 2	2.05	0	0	0
	Minor	2 – 5	4.1	0	0	0
	Major	5 +	6.8	0	0	0
	Destroyed	Visual Inspection Only	6.8	6.5	12	25

Debris Scenario- Formula

- Vegetative Debris
  - To determine vegetative debris, the average vegetation density factor of each parcel as determined by the vegetative density raster was multiplied by the debris generated for that parcel from the Hazus/MOTF model.

Methodology – Flood

- OPM data provided:
  - Square footage
  - Occupancy type
  - Basement (where available)
  - Foundation – assumed a standard foundation
- Developed a 500-year water surface elevation
  - Used 100-year cross section elevations extended to 500 year boundary
  - Used static Base Flood Elevations for coastal
  - Included most recent coastal flood zones

Methodology – Flood

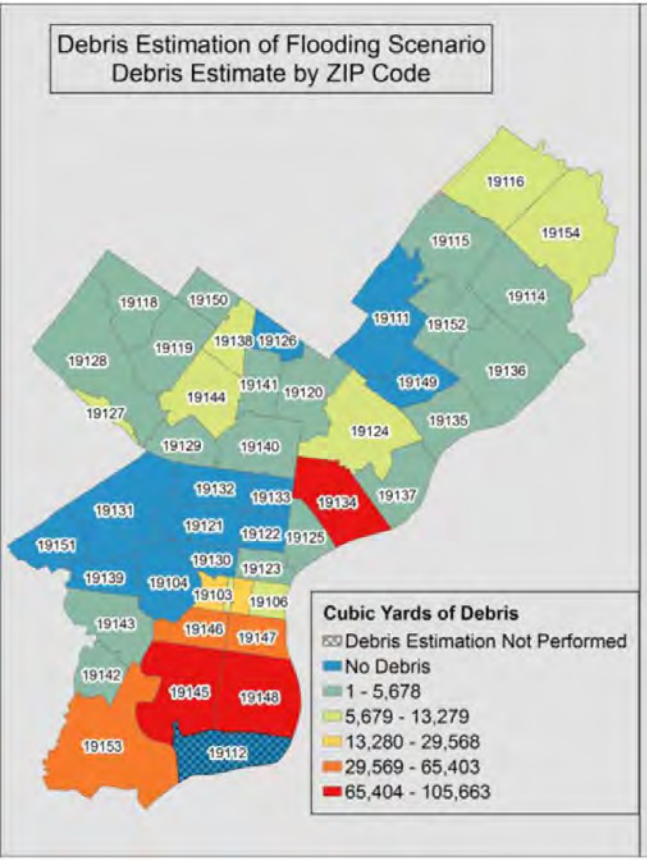
- Parcels were attributed with elevation of flood grid and bare-earth elevation created from the LiDAR
  - Potential flood level = (Flood elevation) – (bare earth elevation)
- Neighborhoods that historically flood were assigned an affected level of damage
  - Debris amounts based on level of damage and square footage of structure on data

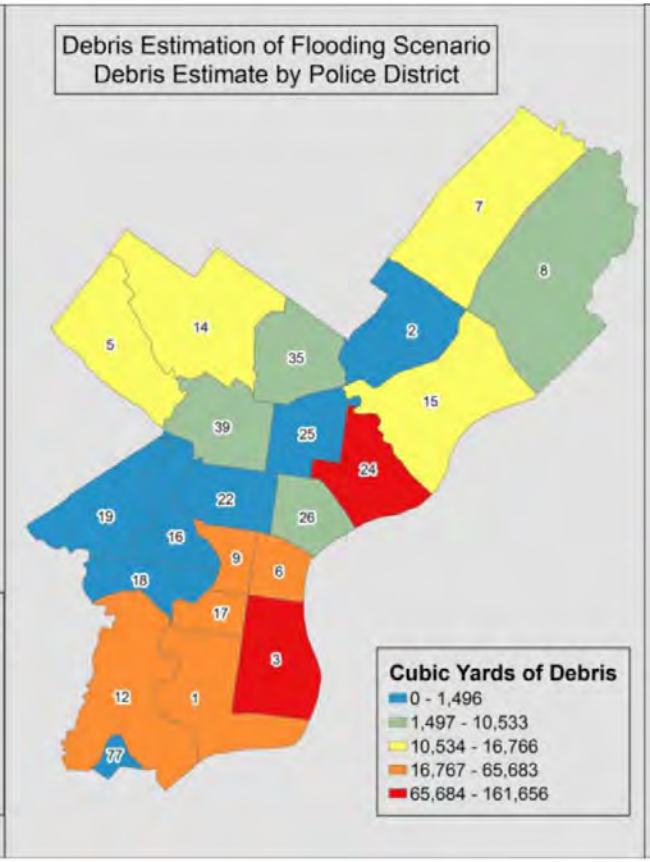
Results – Flood

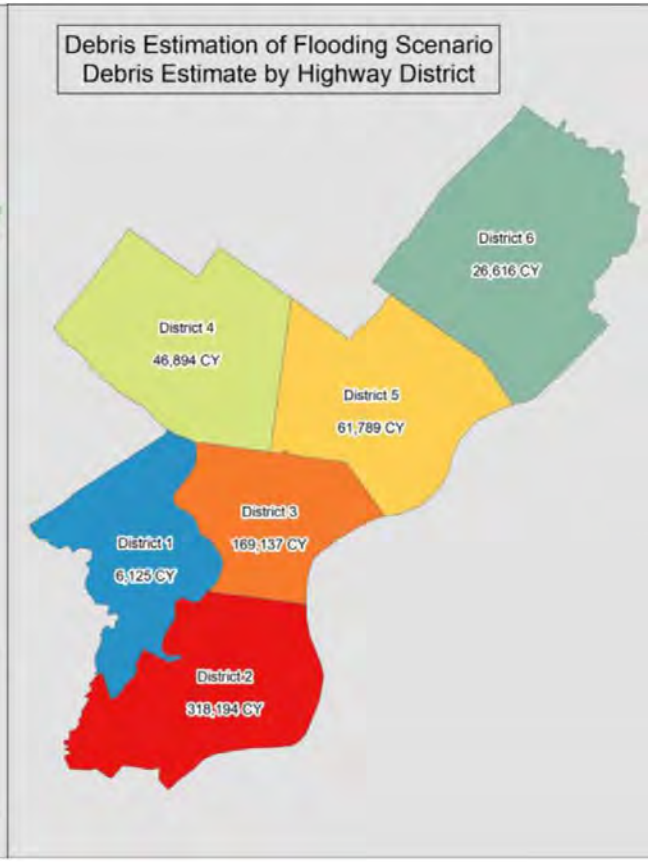
- Debris types
  - C&D – from the structures impacted
  - Vegetation – determined by a vegetation density variable for each structure

Debris Estimates for the Flooding Scenario			
Debris Type		**Cubic Yards Debris**	**Debris Tons**
C&D Debris	FEMA Eligible	451,288	108,309
	Non-FEMA Eligible	143,338	34,401
Vegetative	FEMA Eligible	27,996	6,719
	Non-FEMA Eligible	6,133	1,472
Total		628,755	150,901

Results – Flood



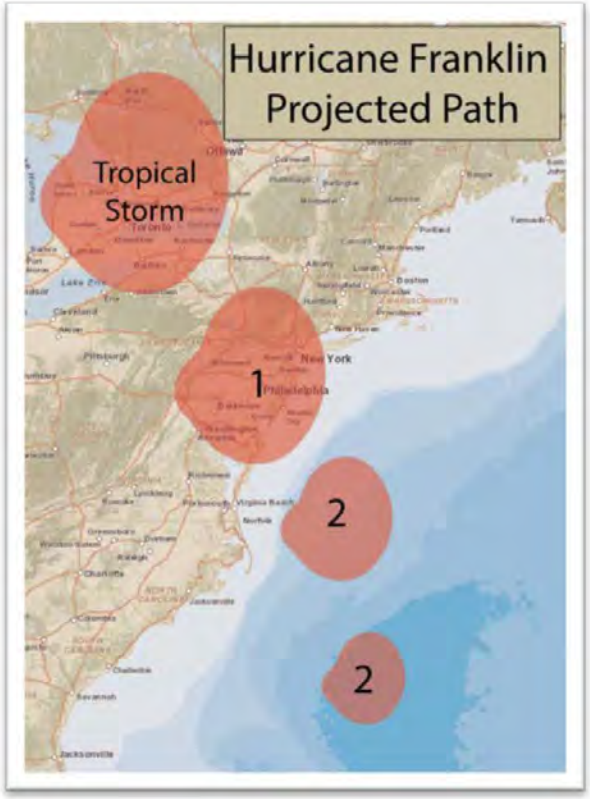


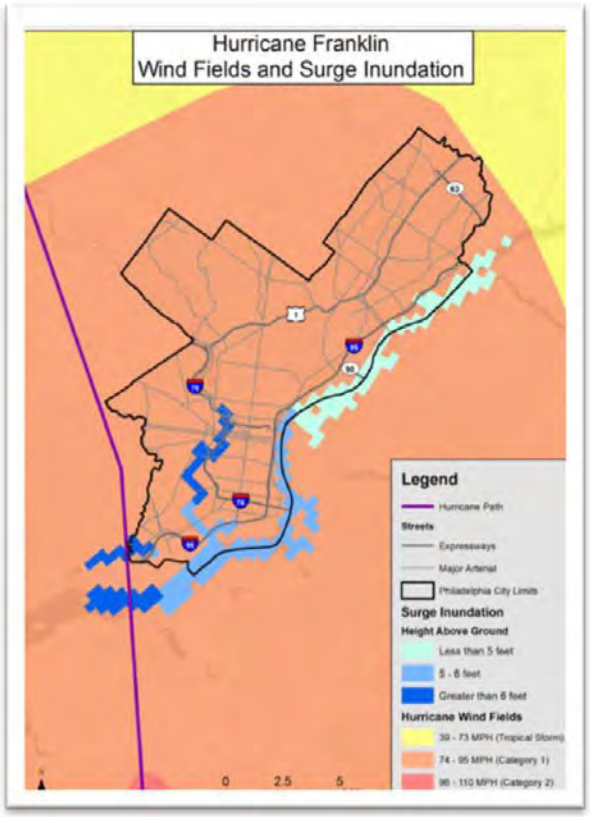


Debris Scenario - Hurricane

- Category 1 Hurricane
  - Tracking up the Delaware Bay
  - Right quadrant impact on Philadelphia
  - Relatively fast moving storm
  - Winds sustained 65 mph+ and gusts 85 mph+
  - Storm is of hybrid nature of Hazel or Sandy

Debris Scenario - Hurricane





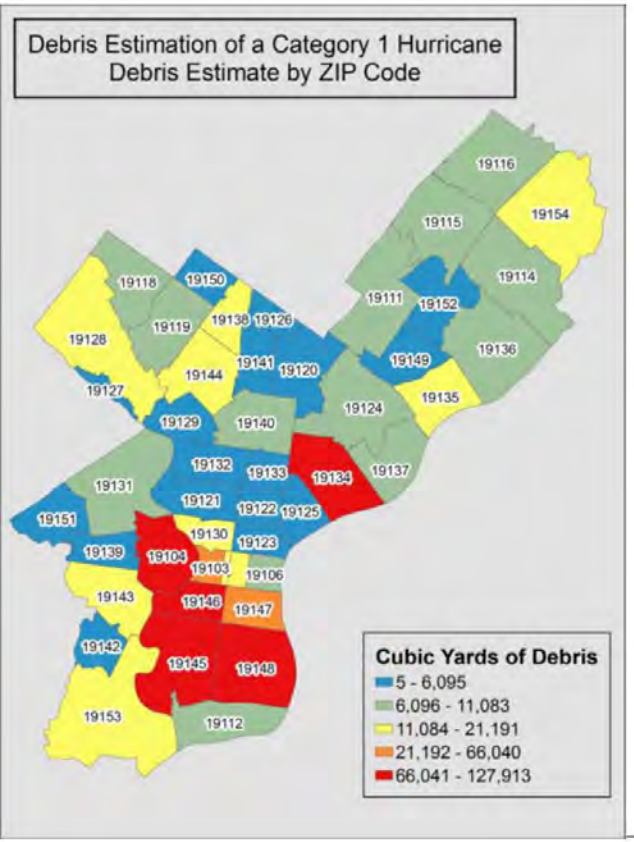
Methodology – Hurricane

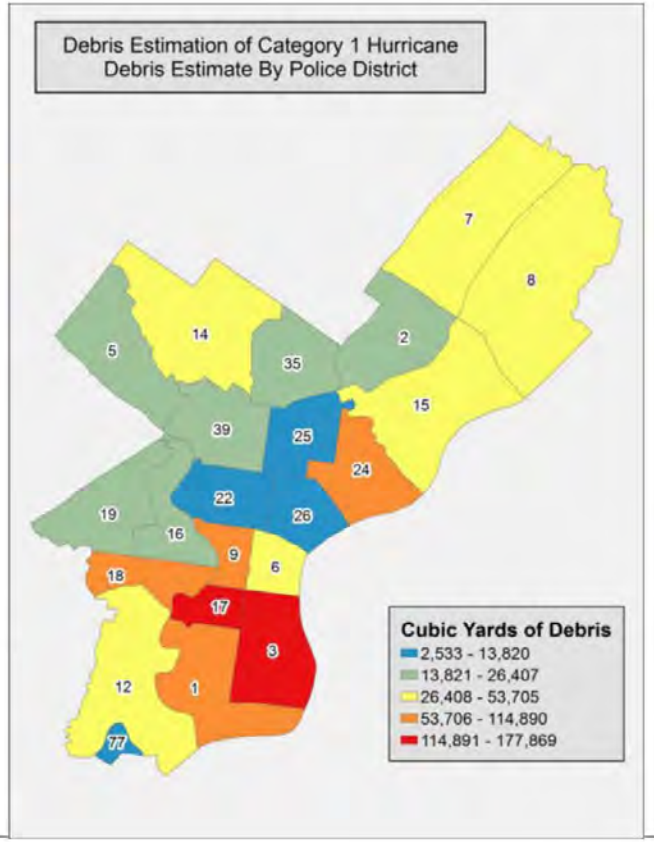
- Flood damage:
  - Surge - SLOSH to determine surge extent
  - Historically flooded neighborhoods
  - Coastal areas
- Use LiDAR and wind fields to determine vegetative debris

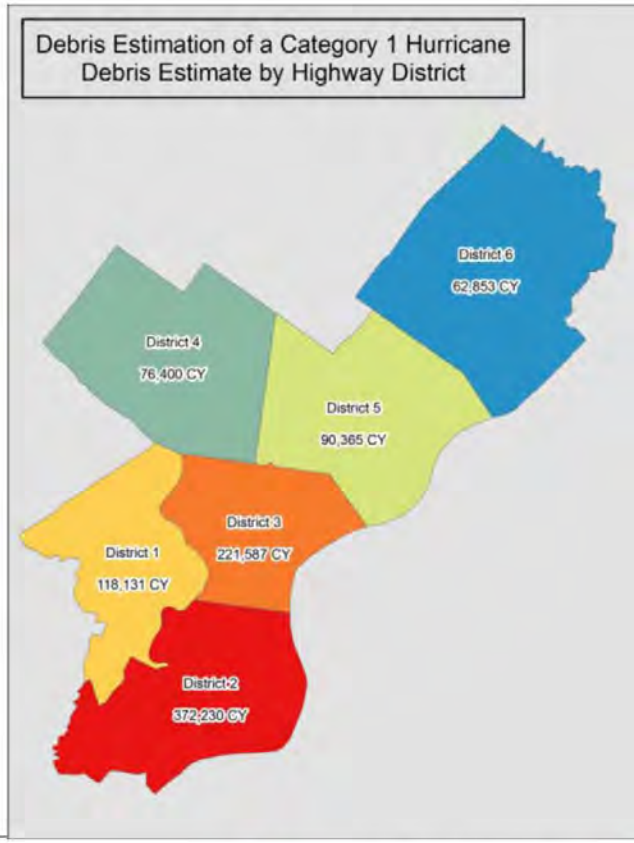
Results – Hurricane

Debris Estimates for a Category 1 Hurricane			
Debris Type		**Cubic Yards Debris**	**Debris Tons**
C&D Debris	FEMA Eligible	531,326	127,518
	Non- FEMA Eligible	156,179	37,483
Vegetative	FEMA Eligible	40,139	9,634
	Non- FEMA Eligible	213,921	51,341
Total		**941,565**	**225,976**

Results – Hurricane







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Debris Forecasts

Design Event	Debris Volume Forecast			
	Debris Type	FEMA Eligible Volume (CY)	Non-FEMA Eligible Volume (CY)	Total (CY)
1" Ice Storm	C&D	0	0	0
	Vegetative	475,829	0	475,829
	Total	**475,829**	**0**	**475,829**
500-Year Flood	C&D	451,288	143,338	594,626
	Vegetative	27,996	6,133	34,129
	Total	**479,284**	**149,471**	**628,755**
Category 1 Hurricane	C&D	531,326	156,179	687,505
	Vegetative	40,139	213,921	254,060
	Total	**571,465**	**370,100**	**941,565**

Site Suitability

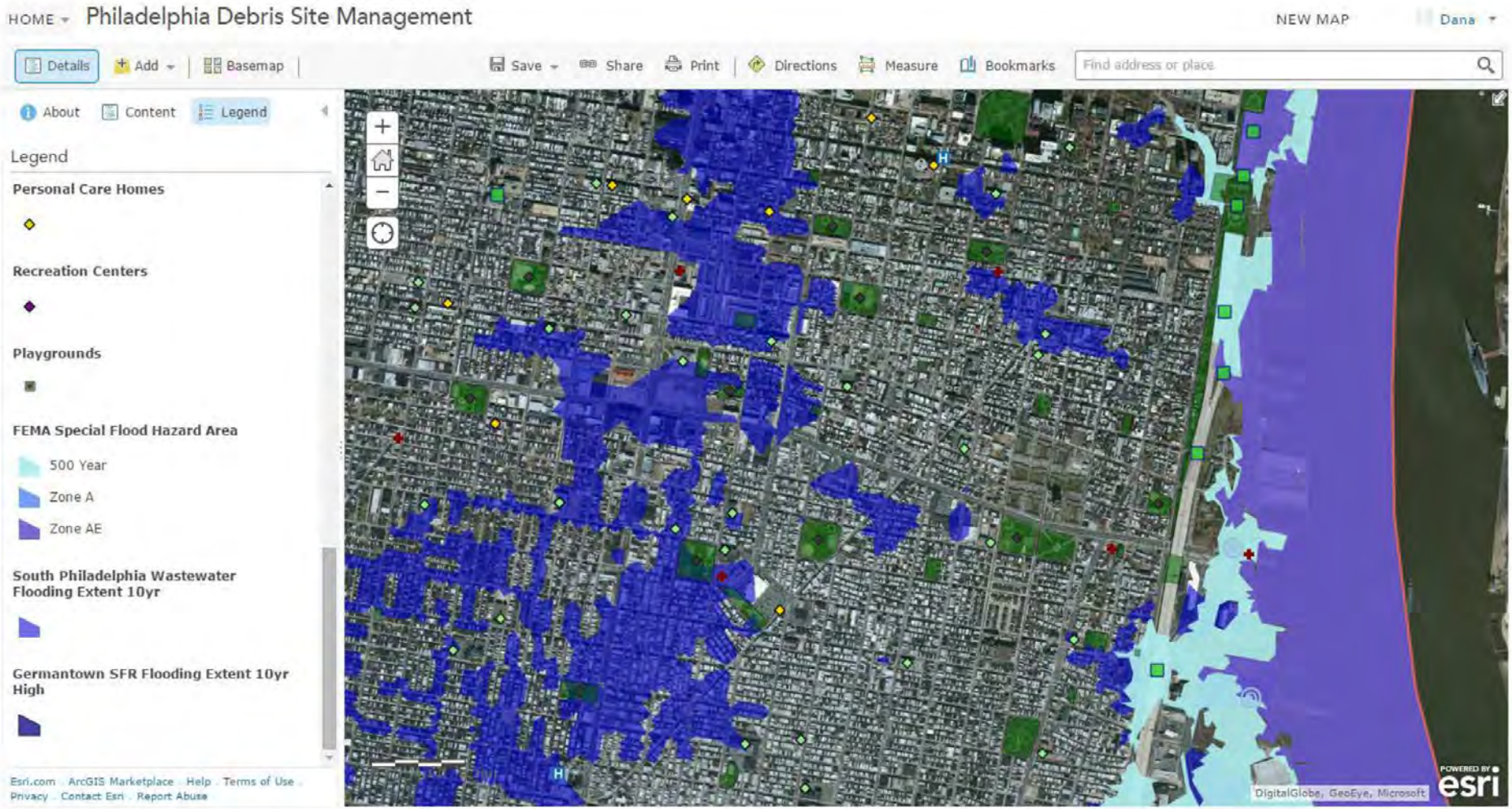
- Estimates and capacity
- Environmental review
- Field visits
- Suitability matrix

Estimates and Capacity

Good news!!!

For these scenarios, the City has space to store debris

Environmental Review



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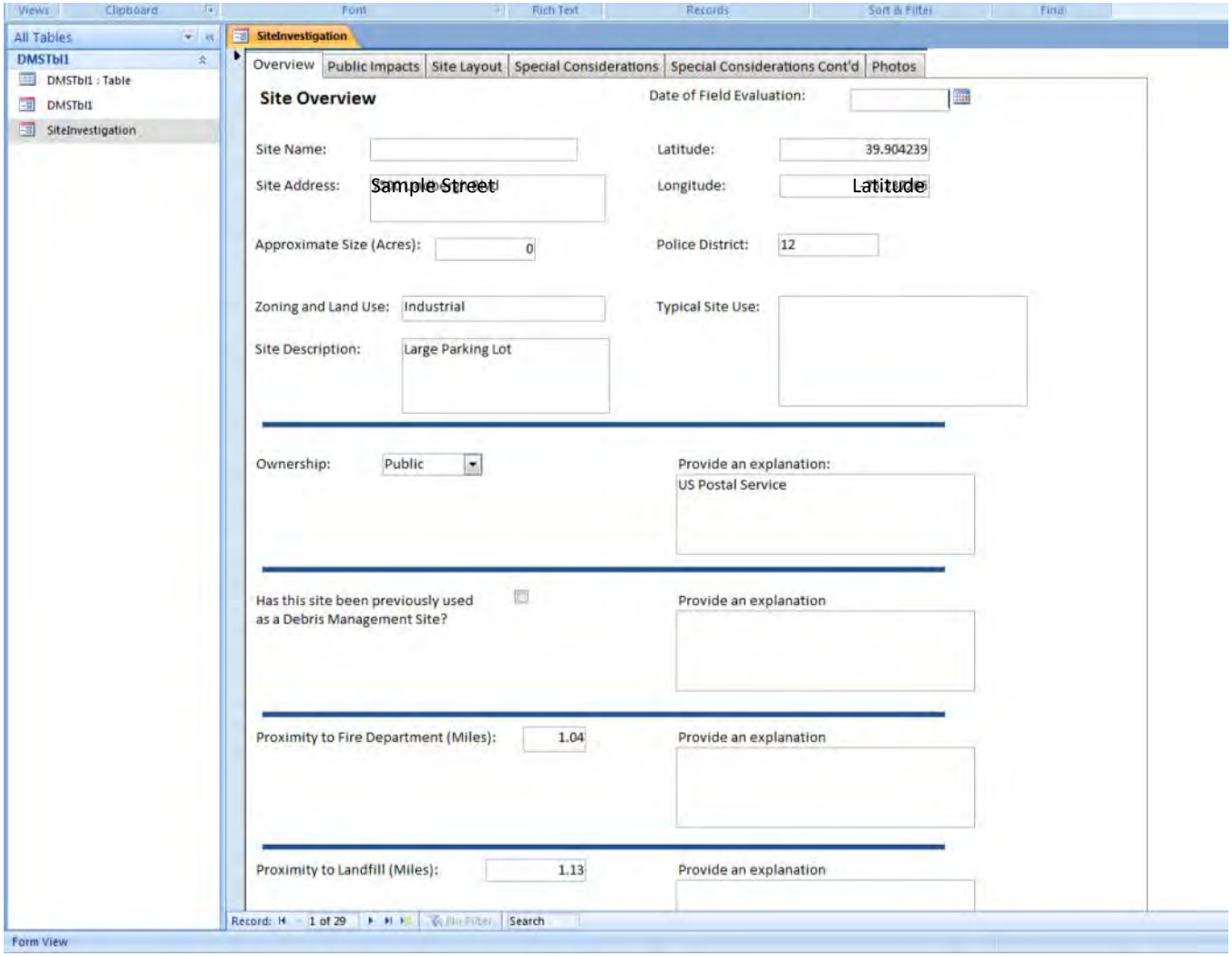
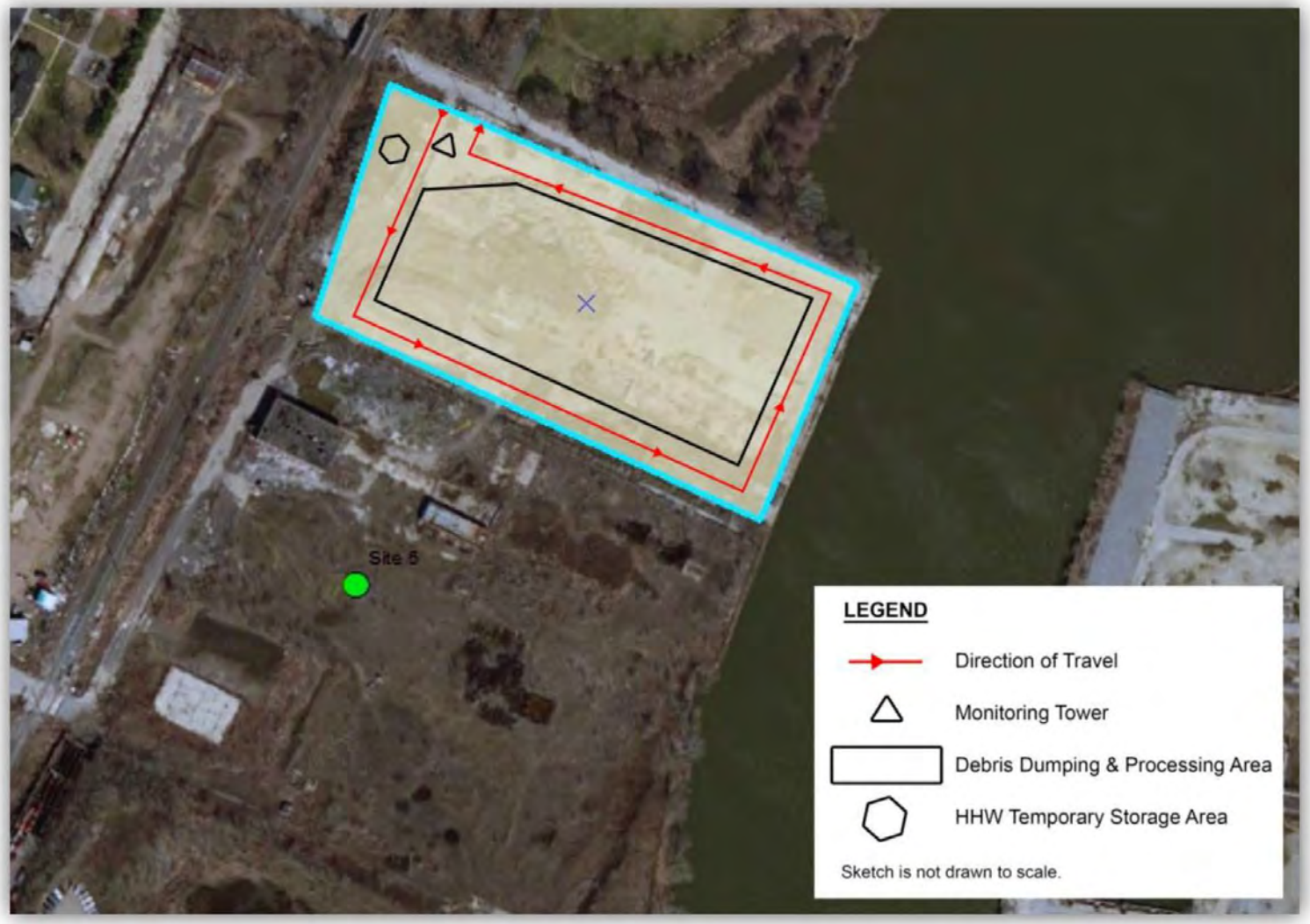
Field Visits

- 29 Site investigations conducted 6/23 – 6/27/14
- Data collected
  - General site information
  - Public impacts
  - Site layout
  - Special considerations
- Photographs
- Preliminary site sketches

Site Form and Tablet



Site Sketches



Site Suitability

- Sites were rated against 7 criteria
  - Proximity to forecasted debris volumes
  - Size
  - Ease of use
  - Ownership
  - Public impacts
  - Site layout
  - Special considerations
- Each criterion was assigned a rating of Good (10 points), Fair (6 points), Poor (3 points)

Site Suitability – Criteria Weighting

Category	Weighting
Proximity to Debris	15%
Size	15%
Ownership	10%
Existing Use	10%
Public Impacts	20%
Site Layout	15%
Special Considerations	15%
Total	100%

Next Steps

- Recommendations (~20)
- Key issues for the City
  - Operationalizing the study
  - Site approval
  - Pre-permitting
  - Traffic impacts
  - Cross-functional planning
  - Capabilities assessment
  - Contracts
  - Regional planning

Thank You

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