Harvey55 SIRM Results

Introduction

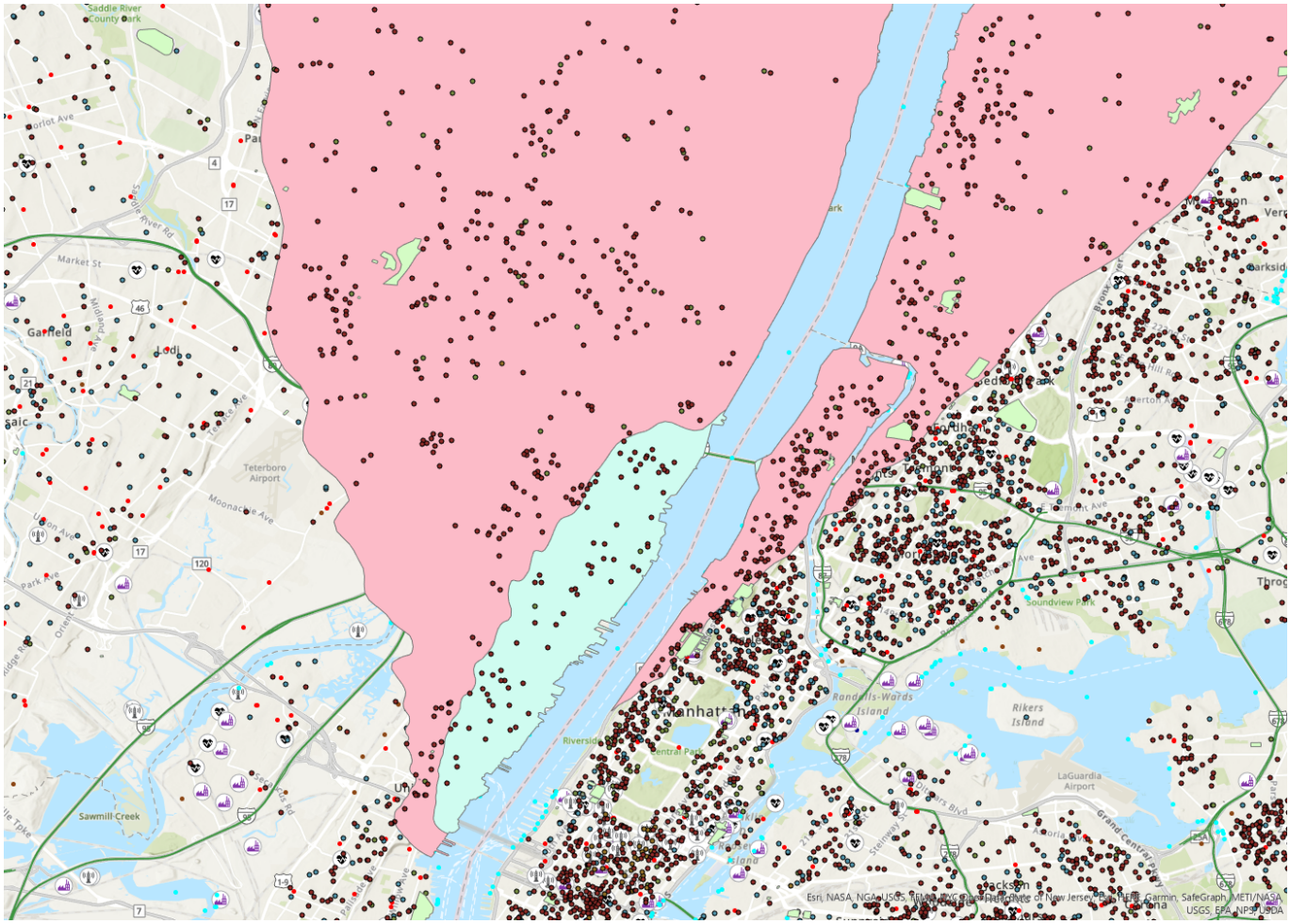
Large-scale chemical, biological, radiological, and nuclear (CBRN) incidents, whether a product of terrorism, war, or accidents, have the potential to damage core infrastructure assets.
In these situations, not only are directly affected areas not able to operate, but operations in other infrastructure sectors may not be able to operate without the services of the affected assets.

The Stochastic Infrastructure Remediation Model (SIRM) tool allows for a series of interconnected infrastructure sectors to be modeled and considers the realistic variability of the impact of a CBRN event.
The SIRM's mechanics are based on the Gillespie Algorithm of stochastically modeling chemical kinetic systems, with adjustments made to suit the modeling of infrastructure remediation after an event that incapacitates infrastructure sectors (e.g. a CBRN event).

The SIRM examines the interactions of 9 different infrastructure sectors: Water, Energy, Transportation, Communication, Government, Food/Agriculture, Emergency Services, Waste Management and Healthcare.
Based on the initial operating efficiency after the event, the model calculates an estimated time for recovery for each sector, averaged from a user-defined number of model runs (100).

The results below for the Harvey55 scenario were produced by a Python tool that performs the SIRM calculations.

A map of the scenario is depicted below



Initial Inputs

The initial set of post-event infrastructure operating efficiencies input in the tool are displayed below:

Infrastructure Sector	Initial Efficiency (%)	Initial Contamination
Water	100	30.0
Energy	50	0.0
Transportation	50	0.0
Communications	50	0.0
Government	50	0.0
Food & Agriculture	50	0.0
Emergency Services	50	0.0
Waste Management	50	0.0
Healthcare	50	0.0

The number and type of affected buildings/infrastructure :

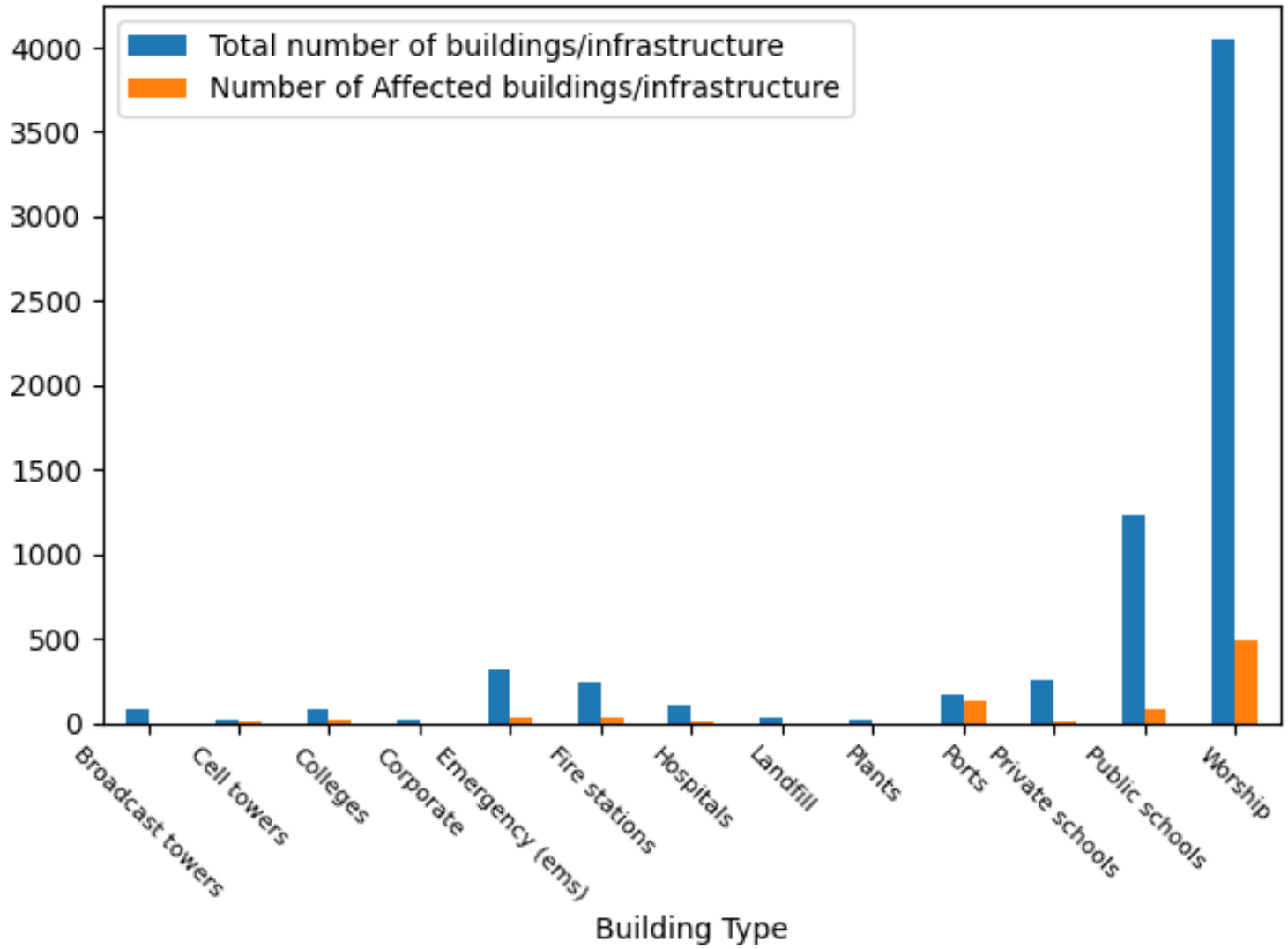
Based on the map information, the tool produces a list of affected buildings/infrastructure.
Some are affected by outages, while others may require decontamination.

Number of buildings/infrastructure requiring decontamination:

Number of affected buildings/infrastructure:
Broadcast towers : 2
Broad : 0
Cell : 0
Cell towers : 6
Colleges : 24
Corporate : 2
Emergency (ems) : 37
Fire stations : 41
Government : 0
Hospitals : 7
Industrial : 0
Landfill : 1
Plants : 2
Ports : 139
Private schools : 9
Public schools : 80
Wastewater : 0
Worship : 498

Total buildings/infrastructure in area:
Broadcast towers : 81
Broad : 17
Cell : 24

Cell towers : 22
Colleges : 83
Corporate : 17
Emergency (ems) : 318
Fire stations : 240
Government : 2
Hospitals : 112
Industrial : 2
Landfill : 29
Plants : 18
Ports : 174
Private schools : 263
Public schools : 1228
Wastewater : 0
Worship : 4045



Results

The SIRM tool outputs the following set of results, which are provided in this report:
1) The suggested prioritization of sector remediation
2) Various charts of the results
3) Requested sensitivity analyses

Estimated Infrastructure Sector Prioritization Based on Strength of Infrastructure Connections:

The first prioritization is based on how tightly linked an infrastructure is to other infrastructure sectors. The higher the connection strength, the more other infrastructure sectors are dependant on that infrastructure. Infrastructures with more dependancies will be prioritized in this ranking.

Infrastructure Sector	Connection Strength
Energy	4.54
Water and Wastewater Systems	3.23
Transportation Systems	3.0
Communications	2.08
Healthcare	1.23
Government Facilities	0.38
Food and Agriculture	0.31
Emergency Services	0.08
Waste Management	0.08

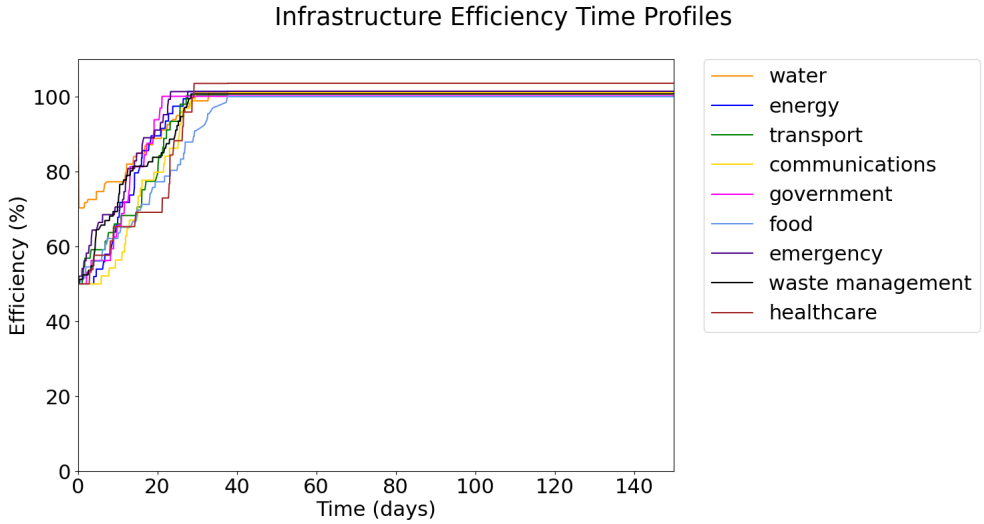
Estimated Infrastructure Prioritization Based on Median Recovery Time:

The second prioritization is based to the average calculated recovery time in days for each sector. Infrastructures with longer average recovery times will be prioritized in this ranking.

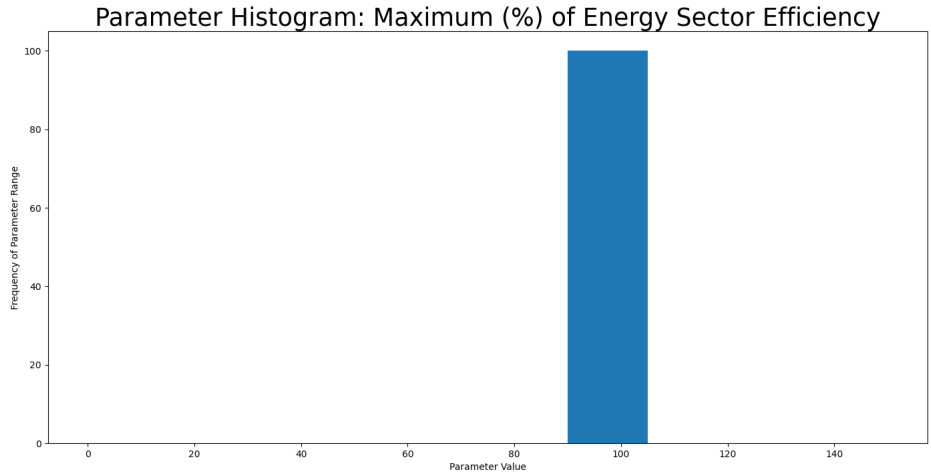
Infrastructure Sector	Recovery Time (days)
Waste Management	33.63
Water and Wastewater Systems	30.64
Food and Agriculture	30.18
Transportation Systems	29.4
Energy	27.83
Healthcare	27.28
Communications	26.61
Emergency Services	25.41
Government Facilities	23.27

Graphical Output and Interpretation

The graphs below represent requested outputs for various infrastructure sectors. The first graph charts the efficiency of each sector over time.



The following charts were also requested by the user of the tool.



Requested Sensitivity Analyses

The user also has the option of running sensitivity analyses on various inputs in the tool. The results of the requested sensitivity analyses are below.

No sensitivity analyses were requested by the user

Disclaimer: The results produced here are estimates and created through the use of the SIRM model.

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