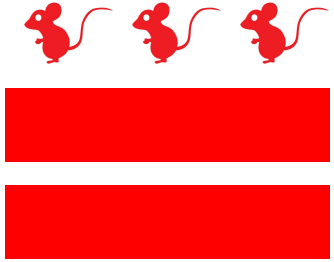


RATScreener

A Vermin Inspection Optimization Tool for Washington, DC

Henry Feinstein, Kate Tanabe, and Shengao Yi
MUSA 801 Practicum

Our Client

THE LAB @ DC

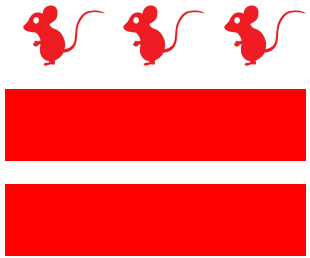
Consults and provides government agencies with:

- Randomized evaluation
- Predictive modeling
- Resident-centered design
- Administrative data analysis

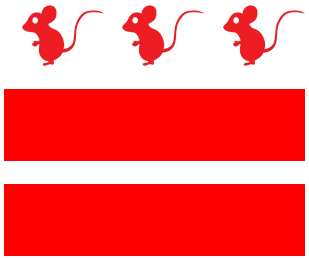
Team RATScreener

- Henry Feinstein - App Development
- Kate Tanabe - Project Management
- Eric Yi - Modeling & Markdown

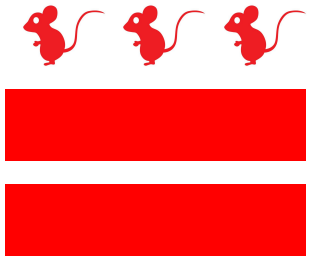
Use Case



Develop a vermin inspection optimization tool to increase efficiencies within the DC Health Department by **prioritizing inspection requests based on the likelihood of rat detection on a given block**



The Problem



Rodent infestations are costly to cities

- Sanitation problems
- Structural and property damage
- Power outages, internet blackouts, and electrical fires
- Public health risks

In 2021, DC's 311 Service received over 12,000 requests for rodent inspection...

DC has 8 vermin inspectors

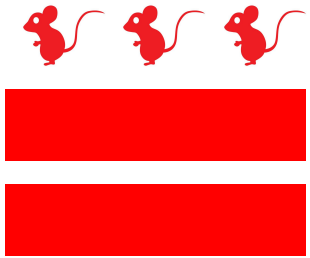
Business as usual approach:

- Limited number of inspectors
- Relies on professional knowledge and ad hoc decision-making
- No formal inspection prioritization
- Outdated processes

46%

Percent of DC 311 Requests for rodent inspection that actually detect rat activity

The Solution

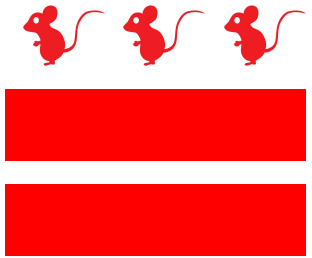


RATScreener

Rodent **A**lgorithmically **T**argeted **Screener**

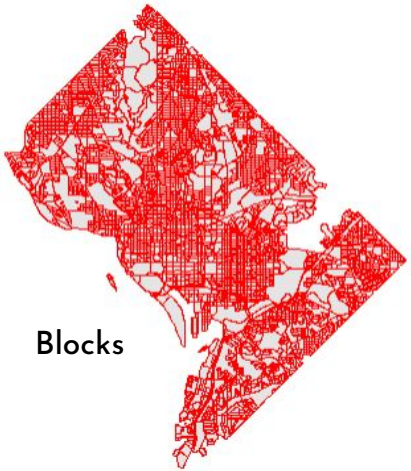
- Predictive model and web app
- Estimates the probability of rat detection in a given area based on spatial, historic, and built environment data
- Allows for more targeted and efficient inspections

RATSceener



RATScreener Overview

Unit of analysis



Blocks

Data

11,000 requests for rodent inspections from 2015 to 2018

100 field validation test points

Externally collected data

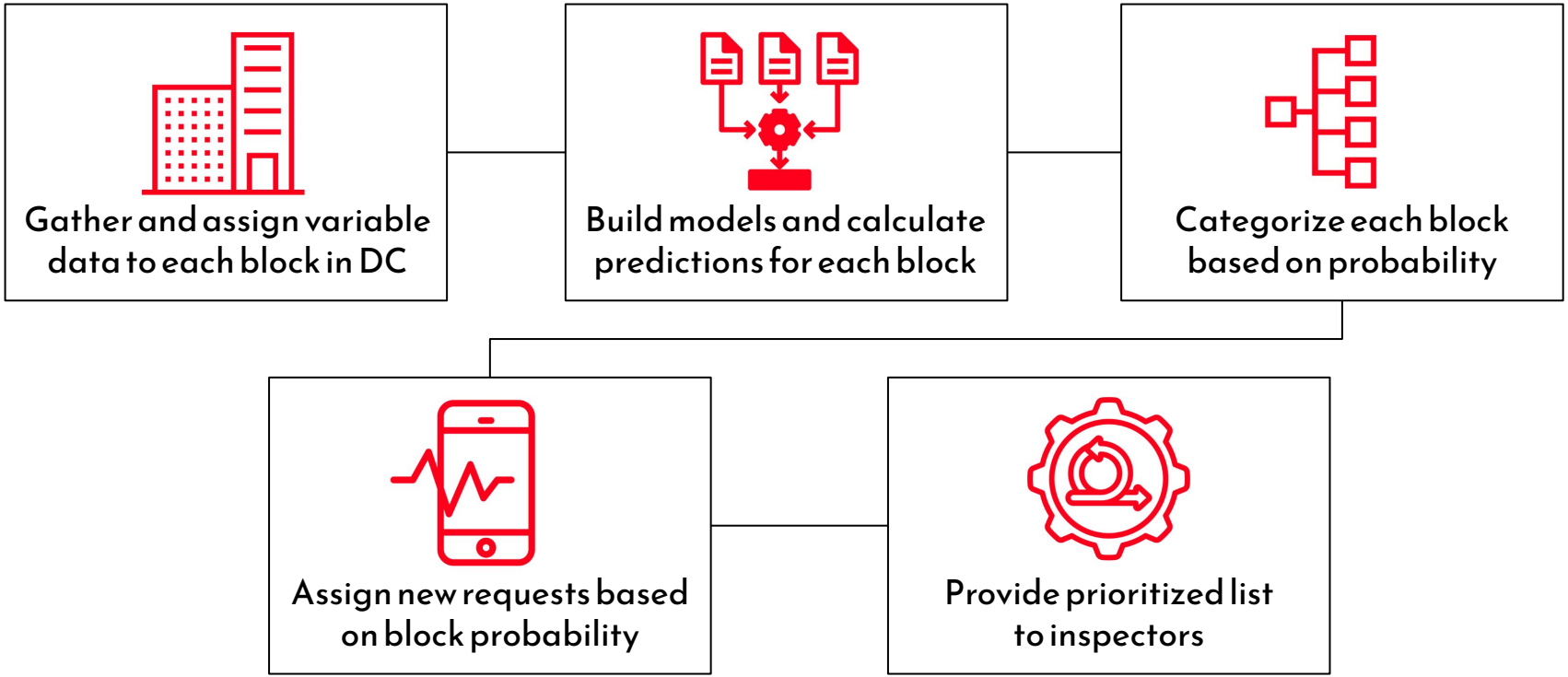
Result

Enhance DC's municipal rodent management program

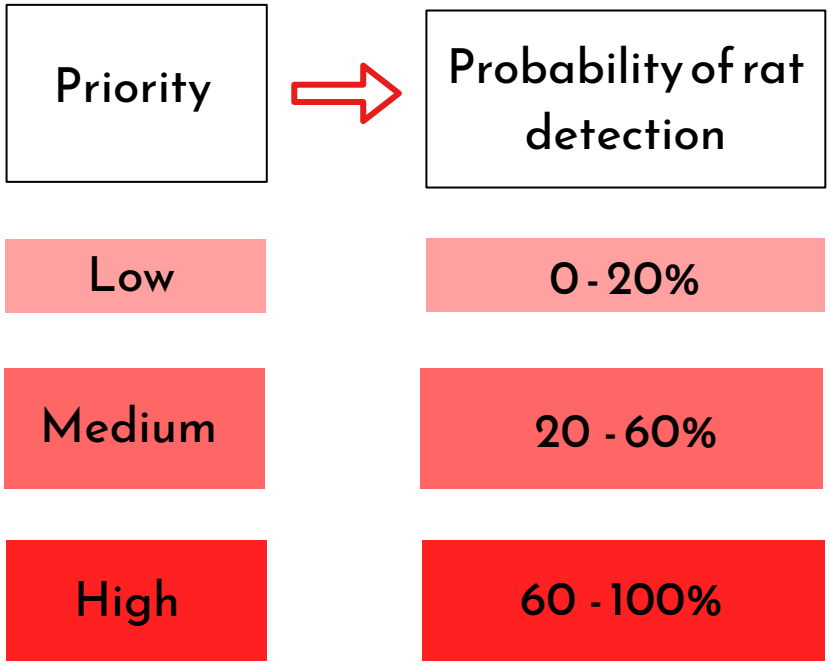
Help inspectors prioritize requests

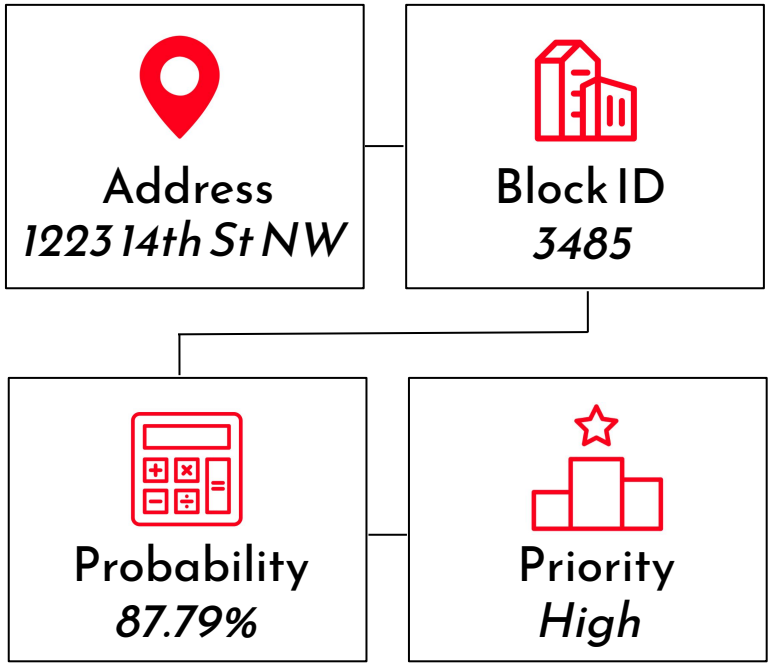
Save money, time, and resources

RATScreener Process

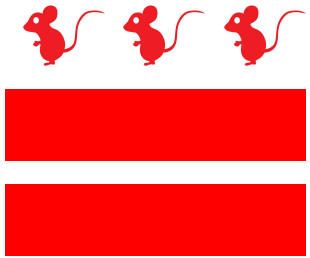


RATScreener Outcomes



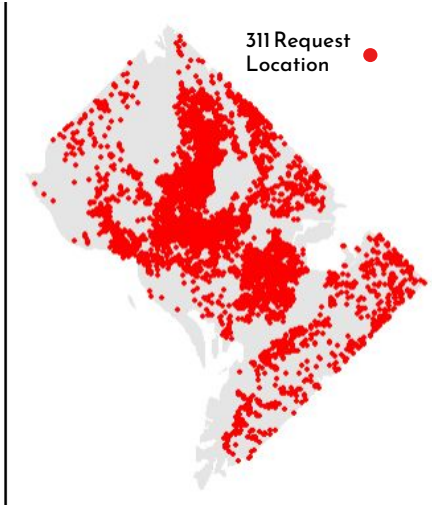


Exploratory Analysis



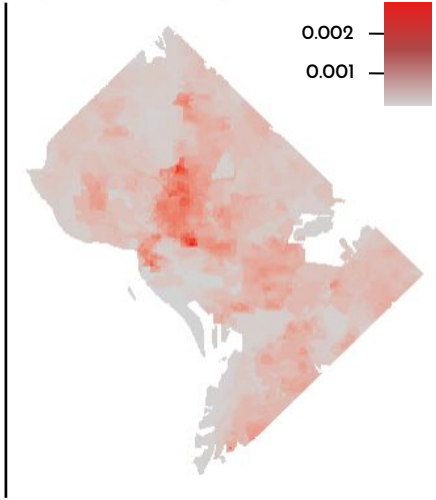
RATScreener

Rat Inspection Requests



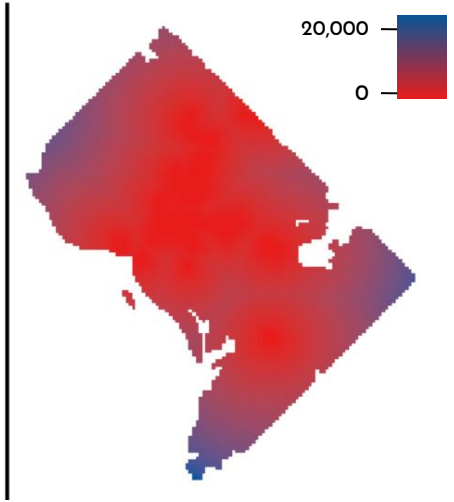
2015 - 2018

Population Density By Block



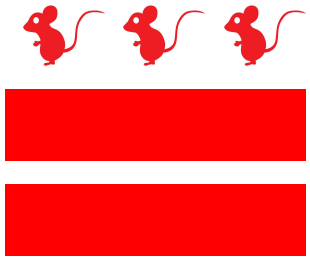
People per square foot

Distance to Hotspot by Block



Feet, Hotspot p-value = 0.001

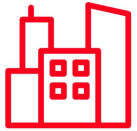
Feature Selection



RATScreener Features

Spatial

- Nearest instances of rat detection
- Distance to rat detection hotspots



Built Environment

- Storm drains
- Sewer grates
- Trash cans
- Impervious surfaces
- Zoning
- Residents per unit

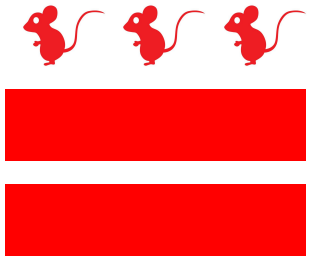
Historic

- Rats detection history
- Infrastructure issue requests
- Missed trash pick up requests
- Construction permits

Climate

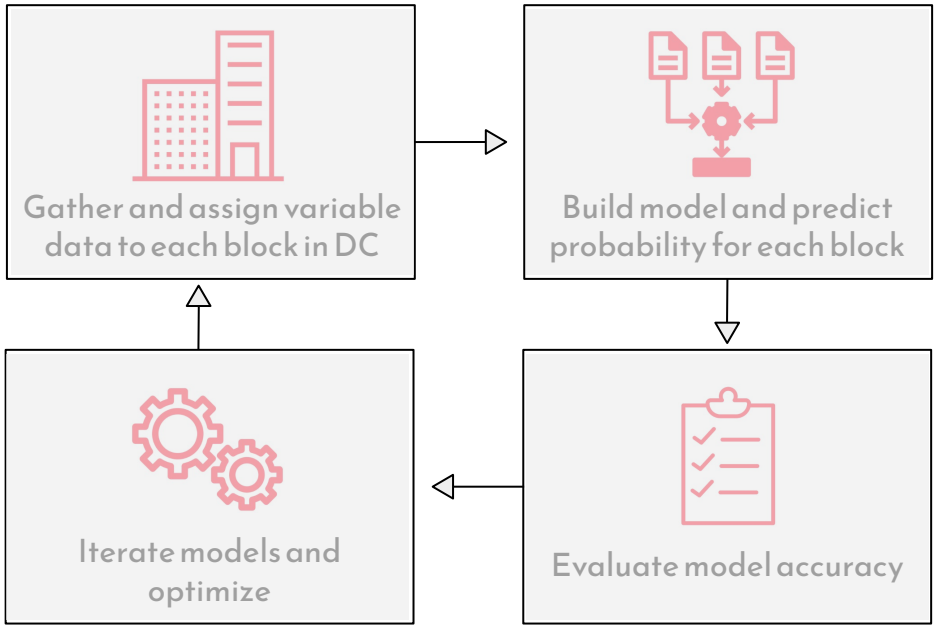
- Temperature
- Season
- Wind

Modeling



RATScreener Models

Modeling Process

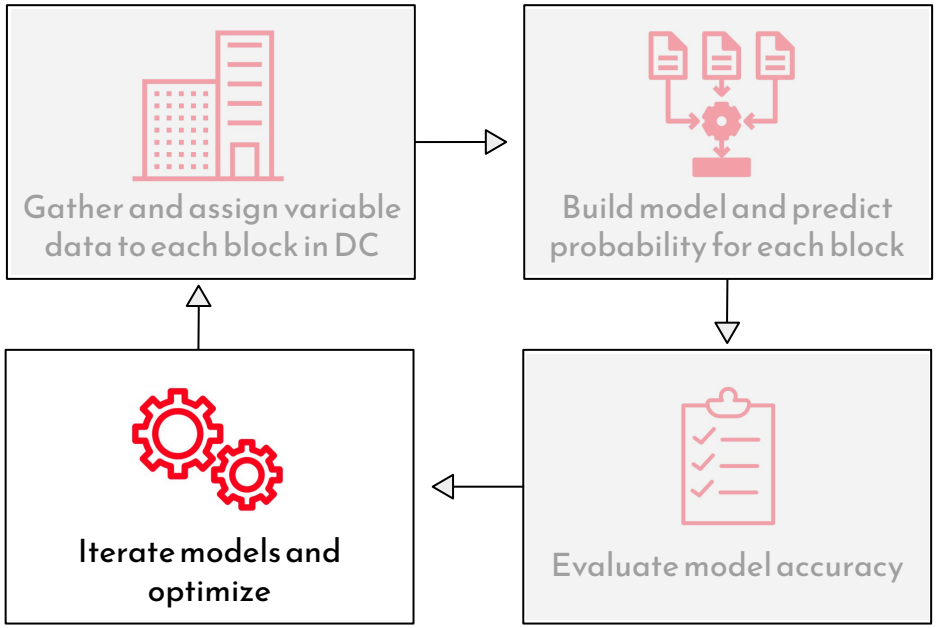


Accuracy:

$$\frac{\text{Correctly predicted blocks}}{\text{Total blocks}} = \%$$

RATScreener Models

Modeling Process

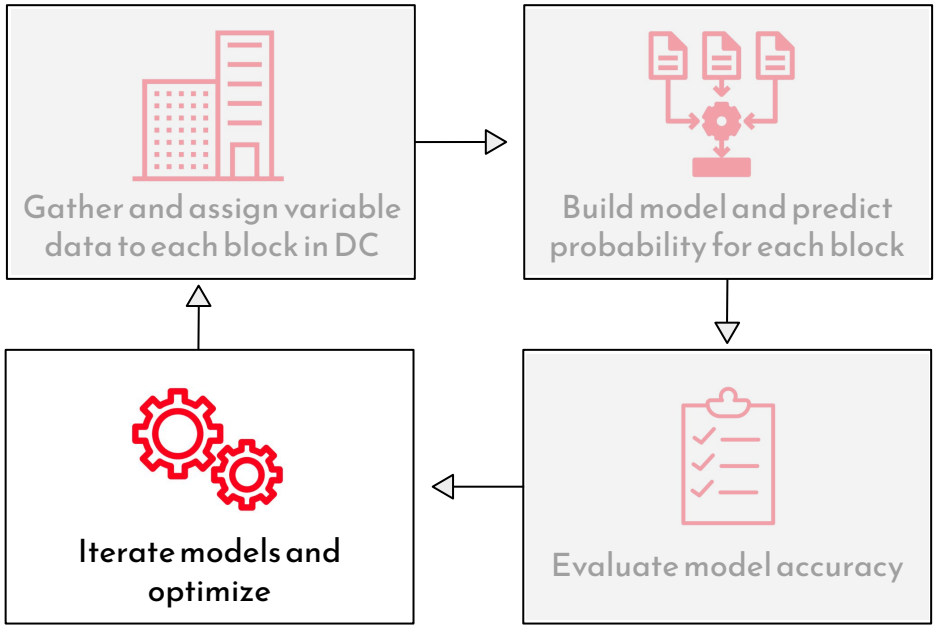


Optimization:

- Conduct cost-benefit framework
- Identify optimal threshold (rat detection probability %)
- Apply threshold and improve model performance

RATScreener Models

Modeling Process



Cost-benefit Framework:

Accurate rat detection

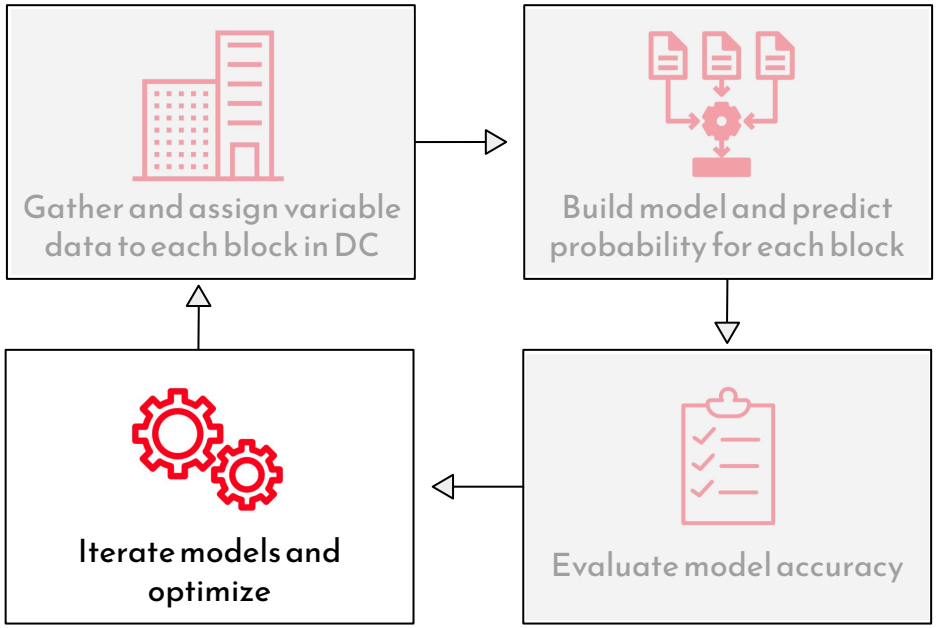
Inspection, treatment, and personell costs + Avoided infrastructure and public health issues

Inaccurate rat detection

Deffered infrastructure maintenance + Undetected infestation impacts on health + Lost time & personnel costs

RATScreener Models

Modeling Process



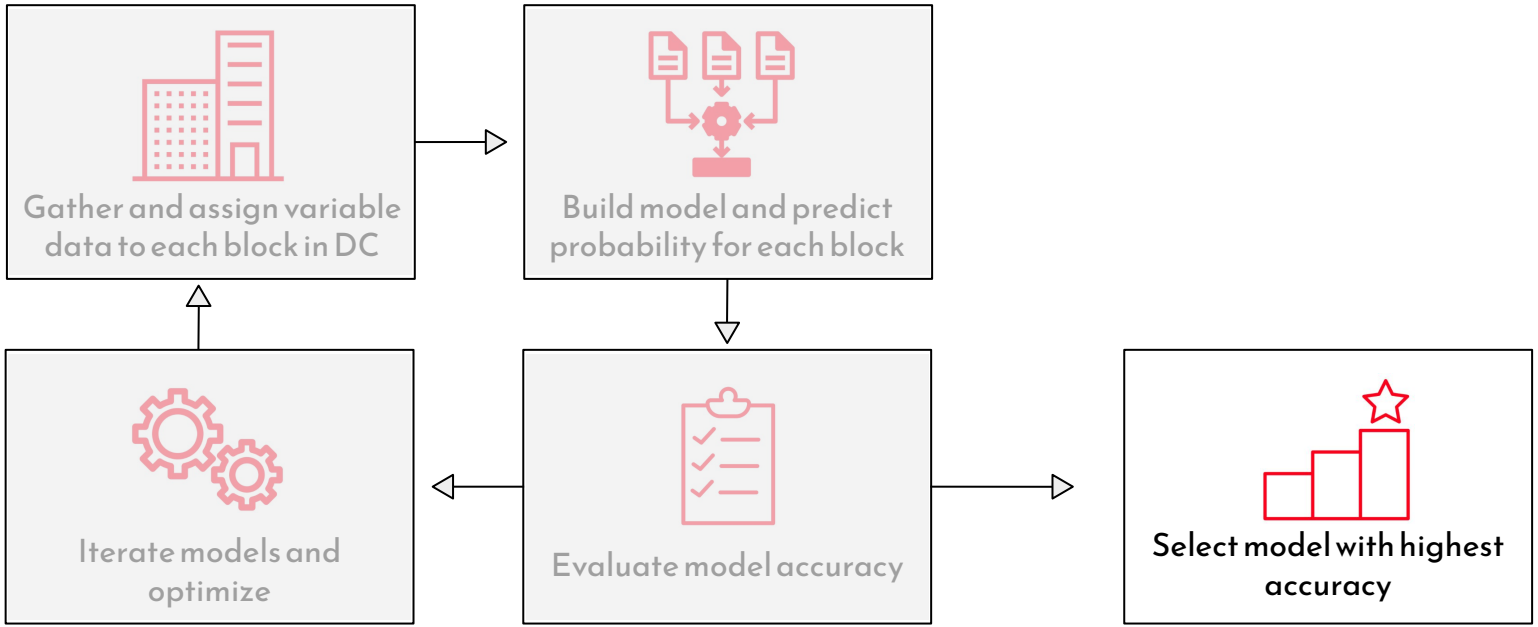
Optimal Threshold: 20%

Inspection, treatment, and personell costs	Lost time & personnel costs
Deffered infrastructure maintenance	Undetected infestation impacts on health

Avoided infrastructure damange
Avoided public health issues

RATScreener Models

Modeling Process

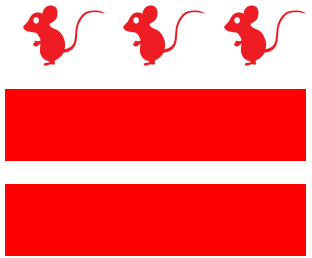


RATScreener Models

Model Selection

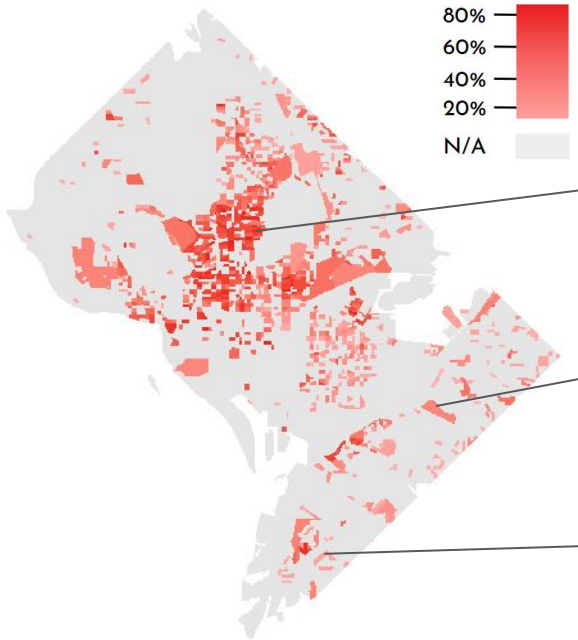
Model	Predicts	Overall Accuracy
Support Vector Machine	Probability %	72%

Predictions



RATScreener Models

Predicted Probability of Rat Detection

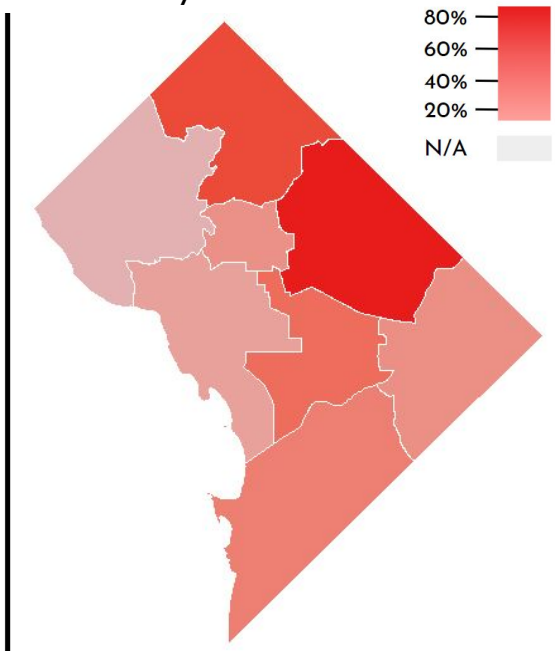


High Priority
28% of blocks

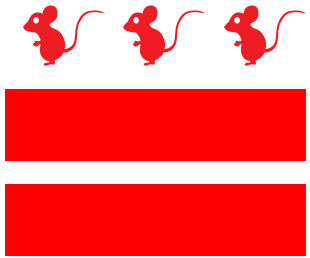
Med Priority
47% of blocks

Low Priority
25% of blocks

Average Predicted Probability of Rat Detection by Ward

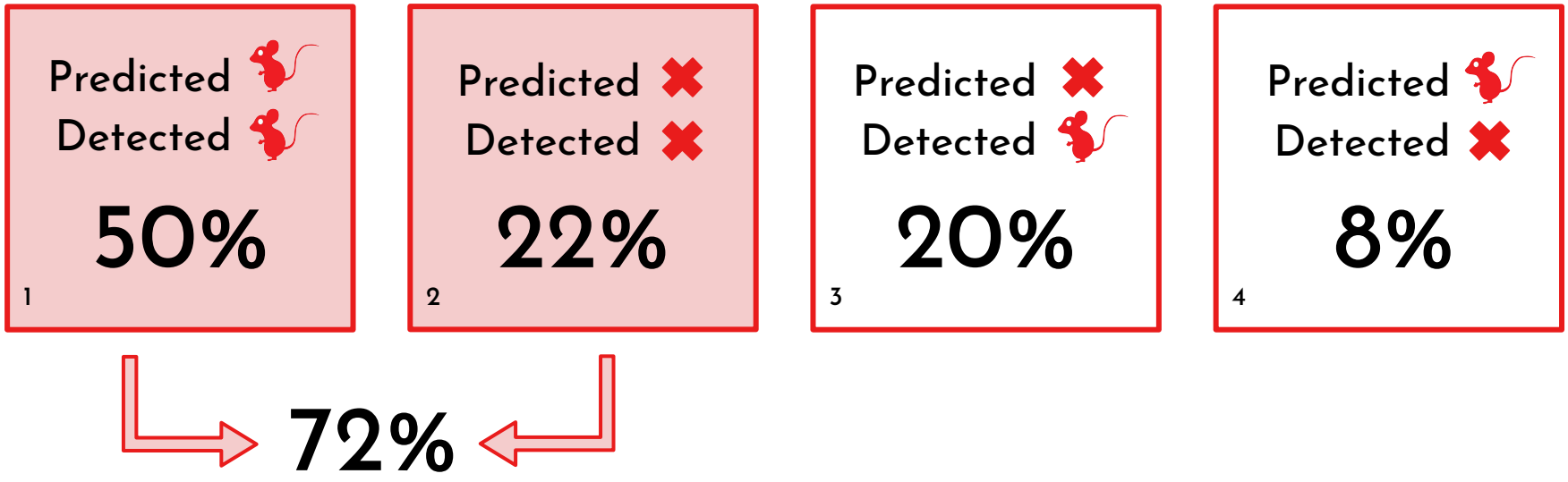


Model Evaluation



RATScreener Models

Model Accuracy



RATScreener Models

Model Accuracy

86%

Percent of blocks with positive rat detection that RATScreener correctly predicted

71%

Percent of positive rat detection predictions that RATScreener correctly predicted

RATScreener Models

Model Generalizability

Across 100 Folds

87%

Percent of blocks with positive rat detection that RATScreener correctly predicted

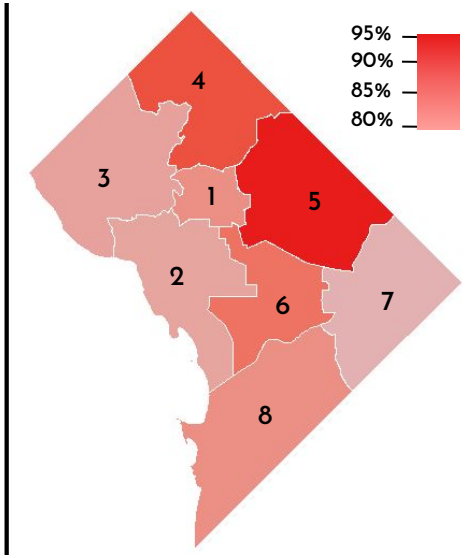
75%

Percent of negative rat detection predictions that RATScreener correctly predicted

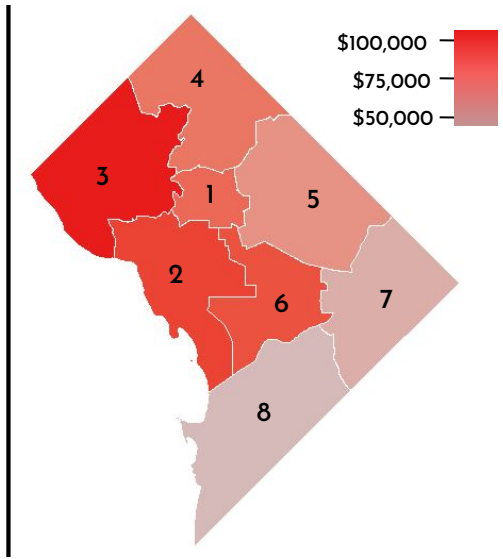
RATScreener Models

Model Generalizability

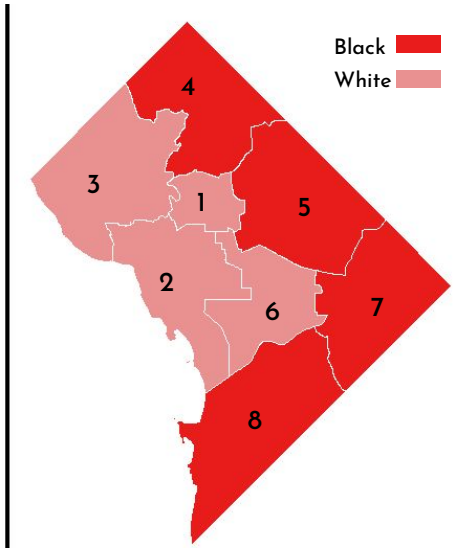
Prediction Accuracy by Ward



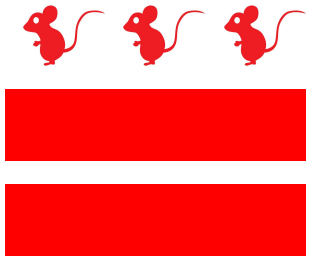
Median Household Income by Ward



Most Common Race by Ward



RATScreener App



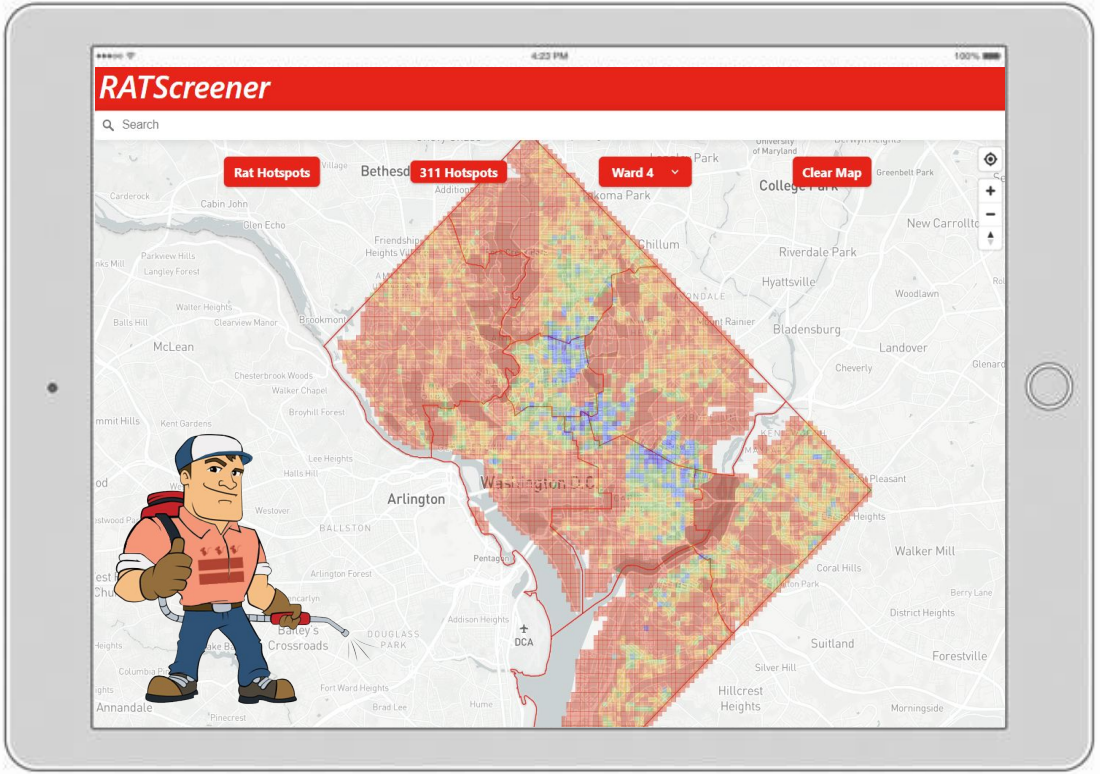
RATScreener App

Designed for DC vermin inspectors to use while in the field and on inspection visits

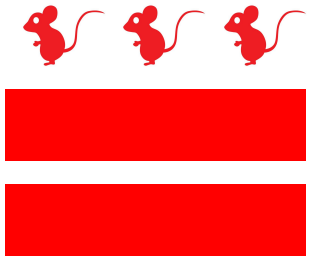
Uses:

- View prioritized inspection requests and locations
- Review notes from prior inspections
- Visualize rat detection and 311 request hotspots

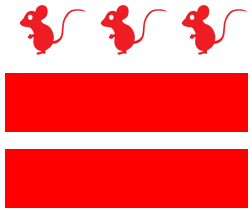
https://henryfeinstein.github.io/musa-rats/site/



Conclusion

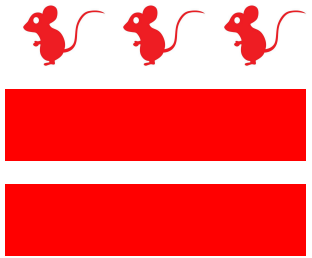


RATScreener

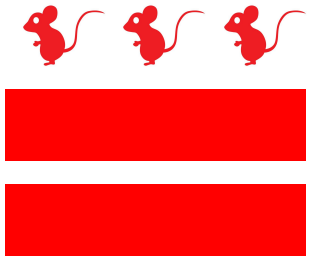


- Rodent infestations and rodent management programs are huge costs to cities
- Inspectors are knowledgeable assets to any local government
- Incorporate spatial data to improve model performance and increase efficiencies within inspection system

Thank you!

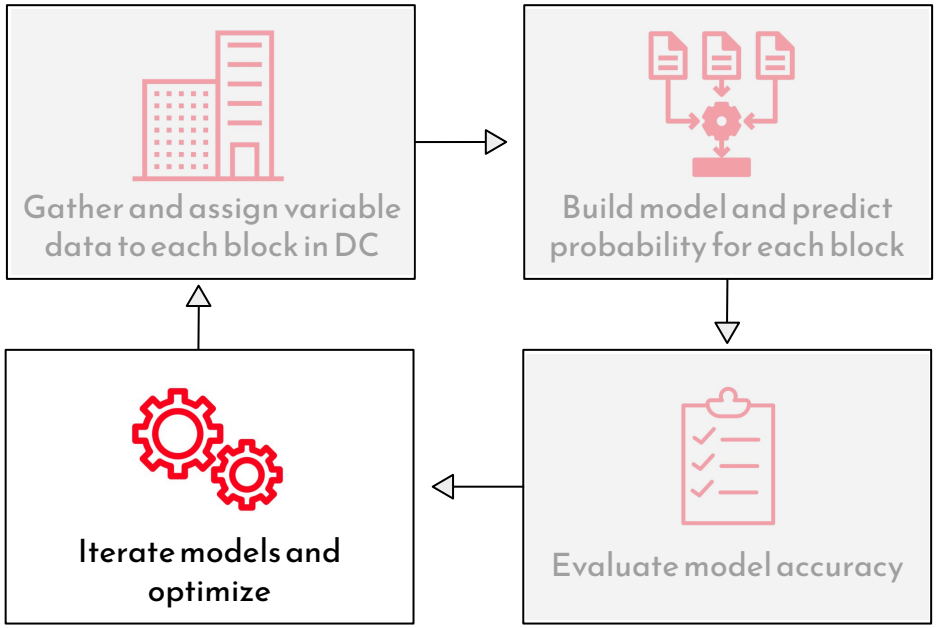


Additional Slides

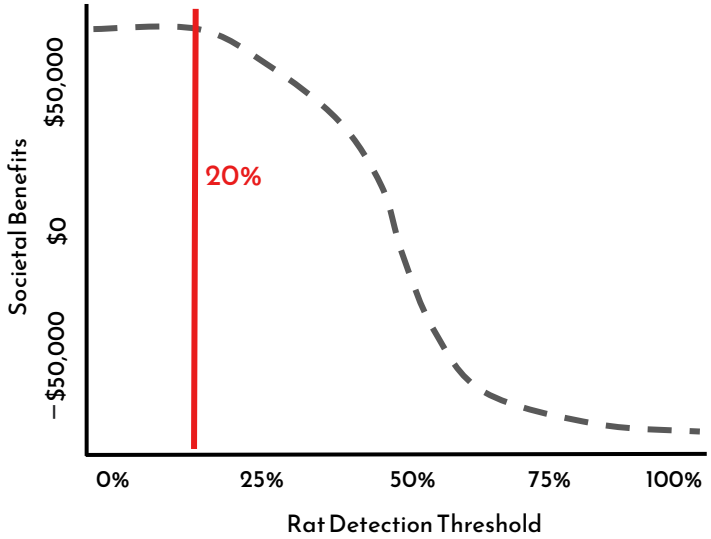


RATScreener Models

Modeling Process

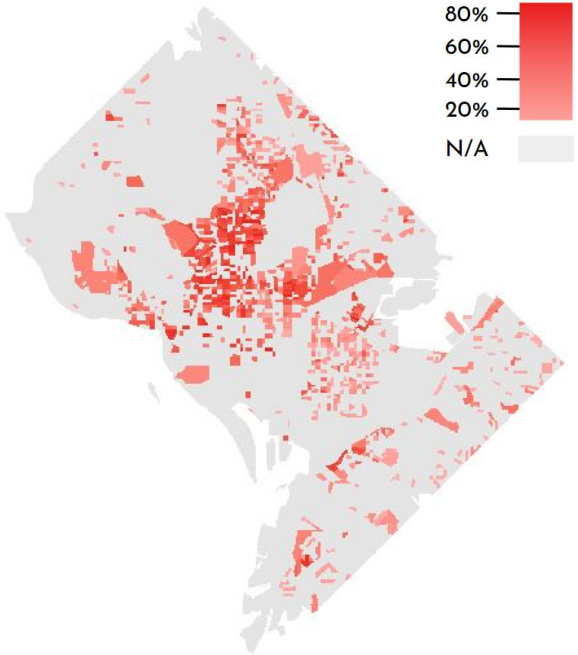


Optimal Threshold:



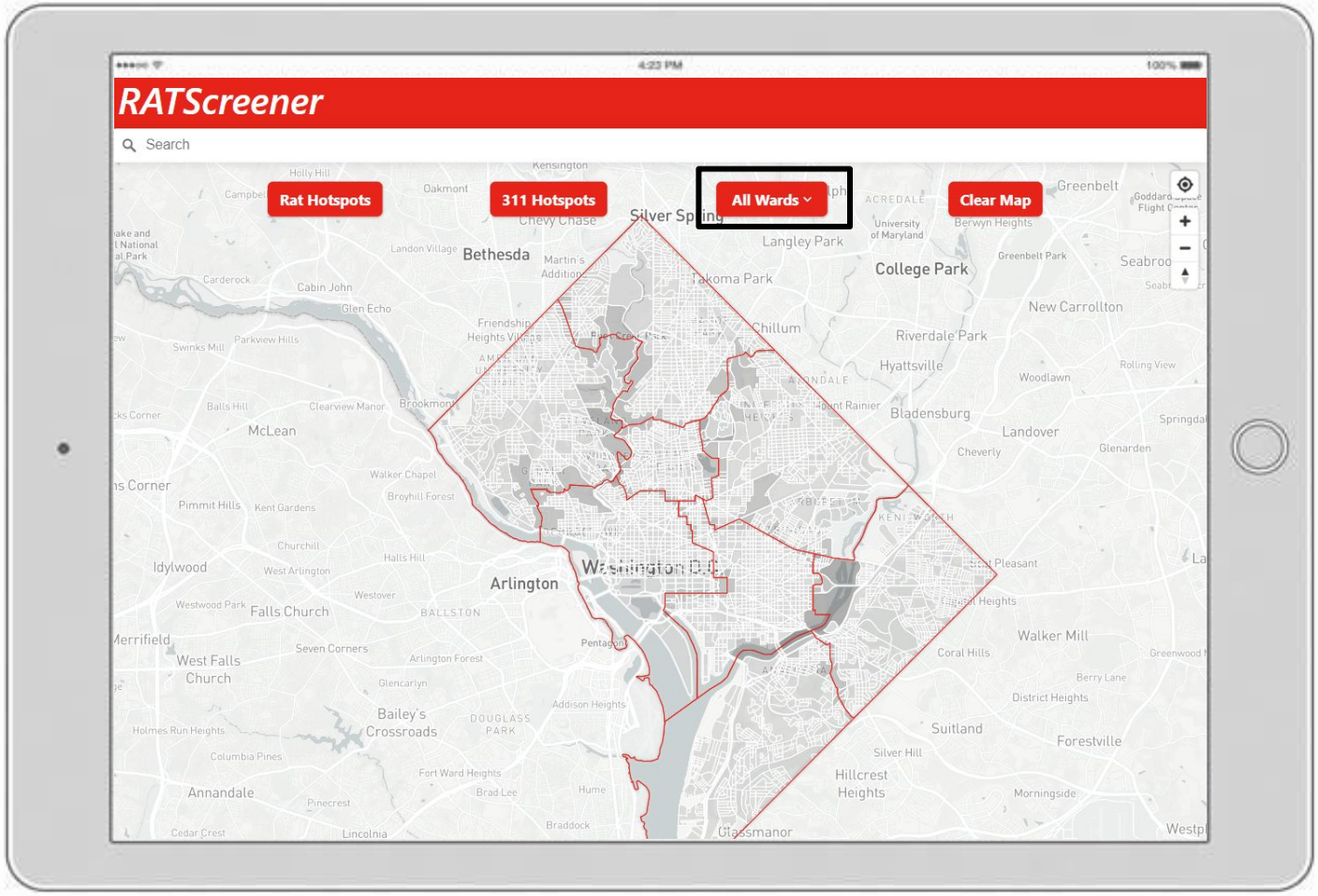
RATScreener Models

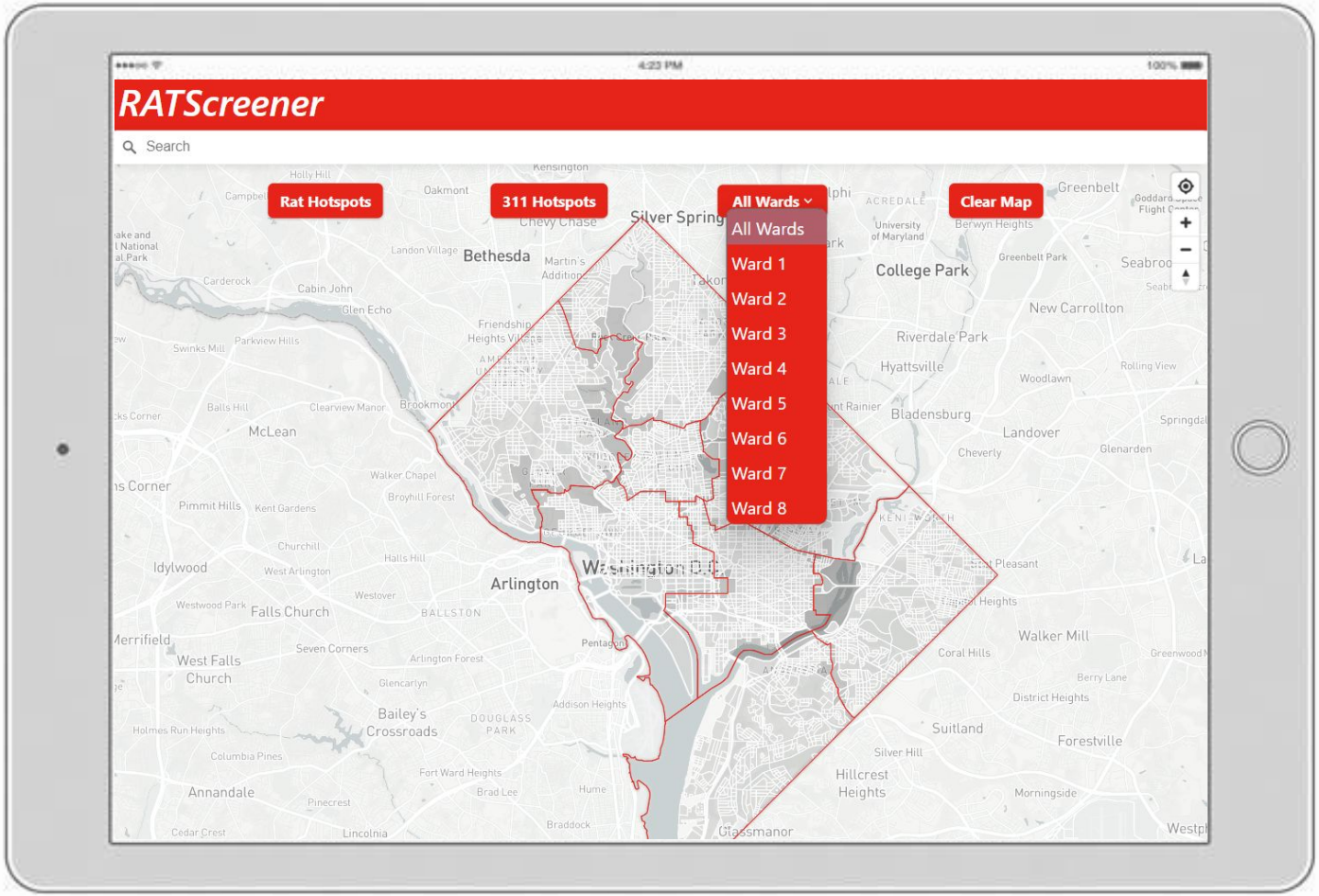
Predicted Probability of Rat Detection

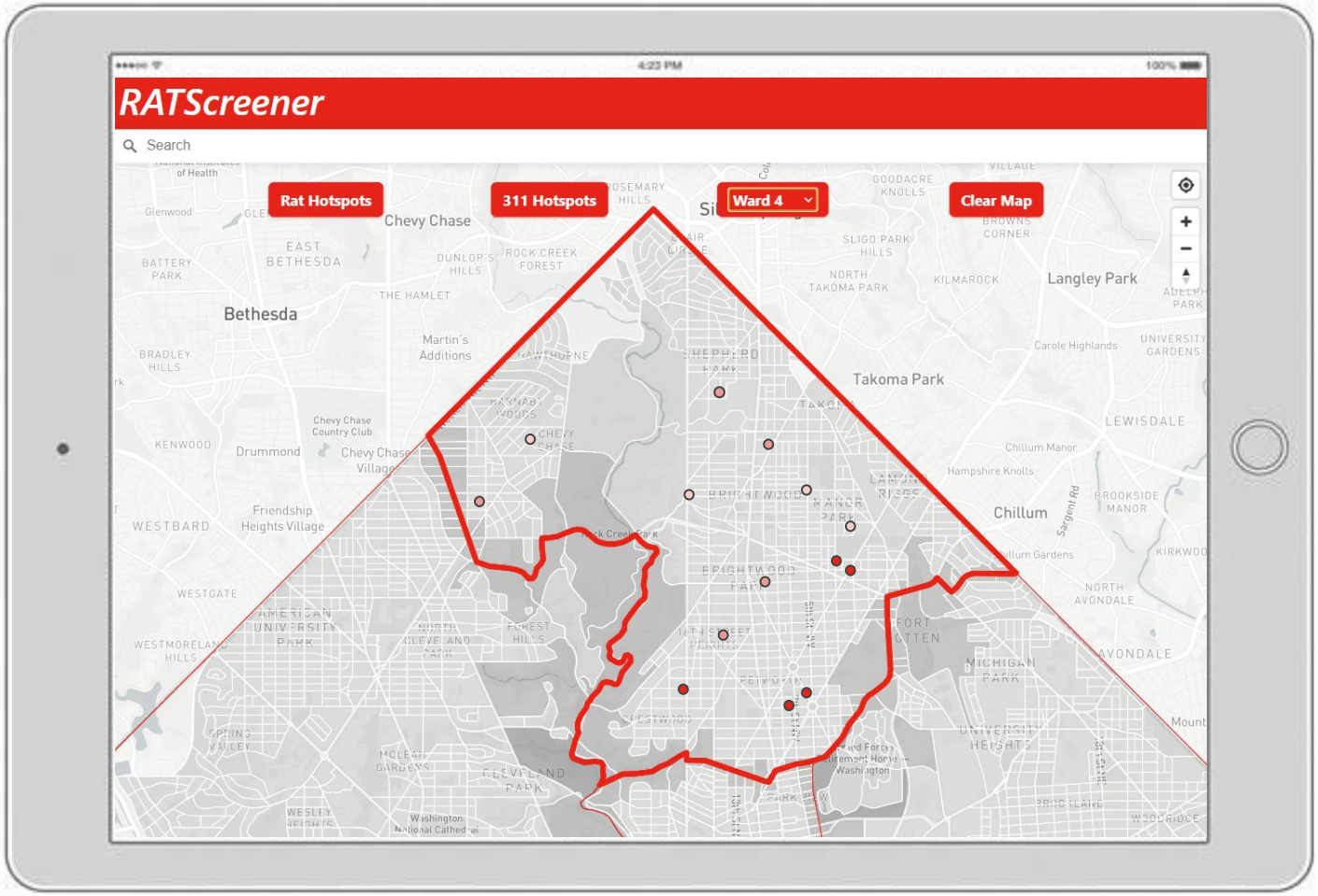


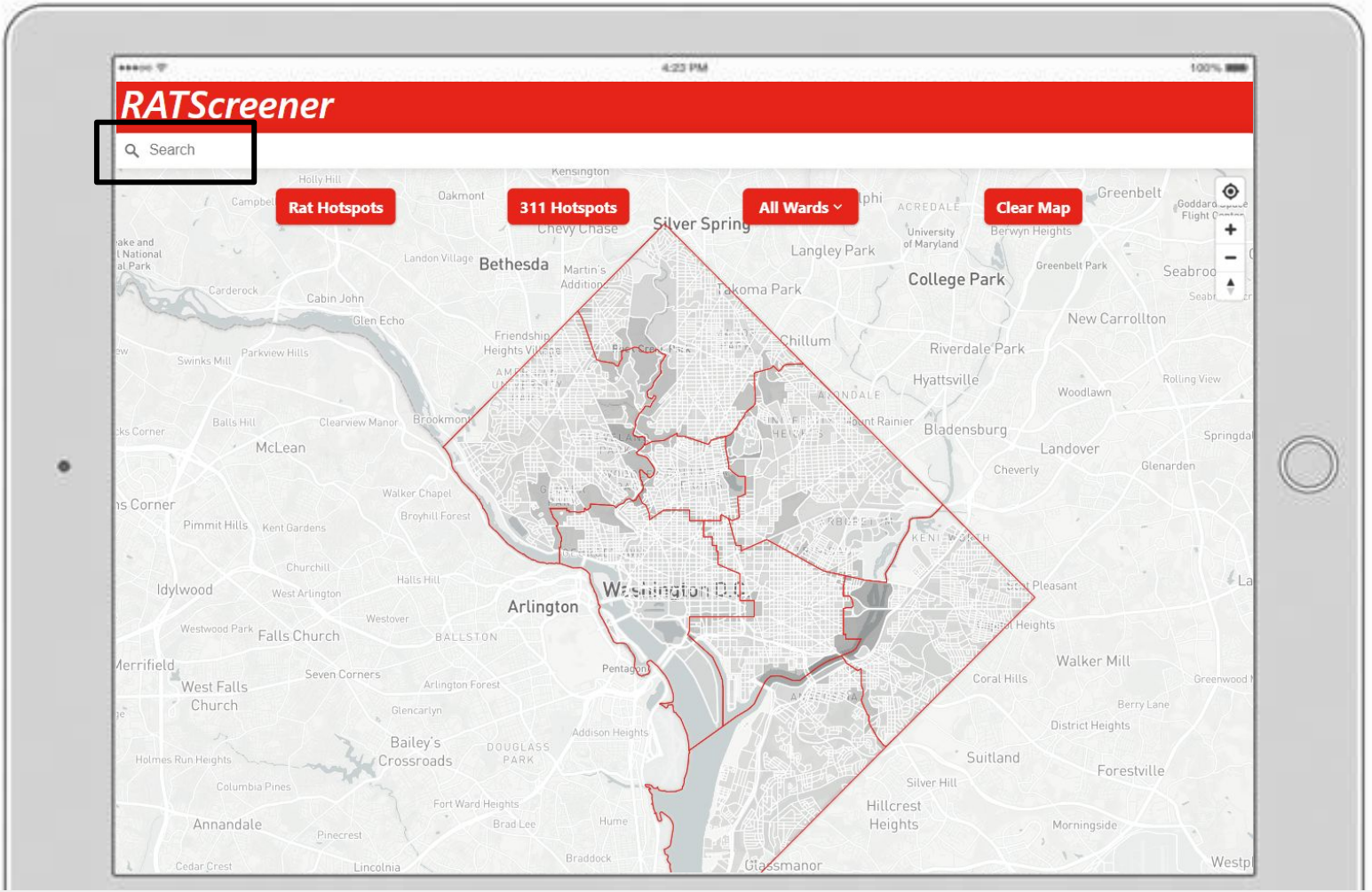
Priority	Probability of rat detection	Count of blocks	%
Low	0 - 20%	251	25
Medium	20 - 60%	482	47
High	60 - 100%	294	28

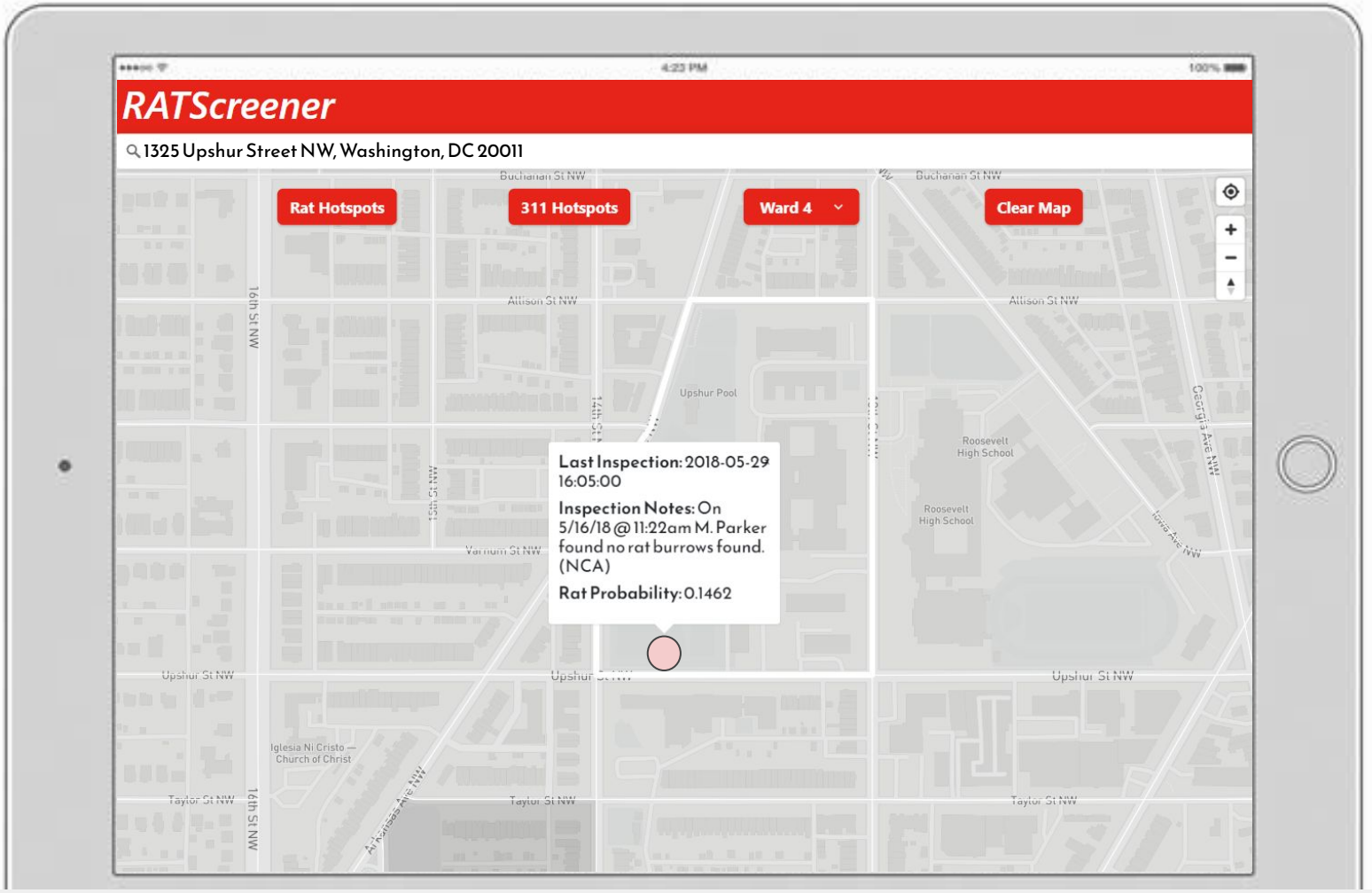
5,423 blocks total
1,027 blocks with inspection history
4,216 blocks without inspection history

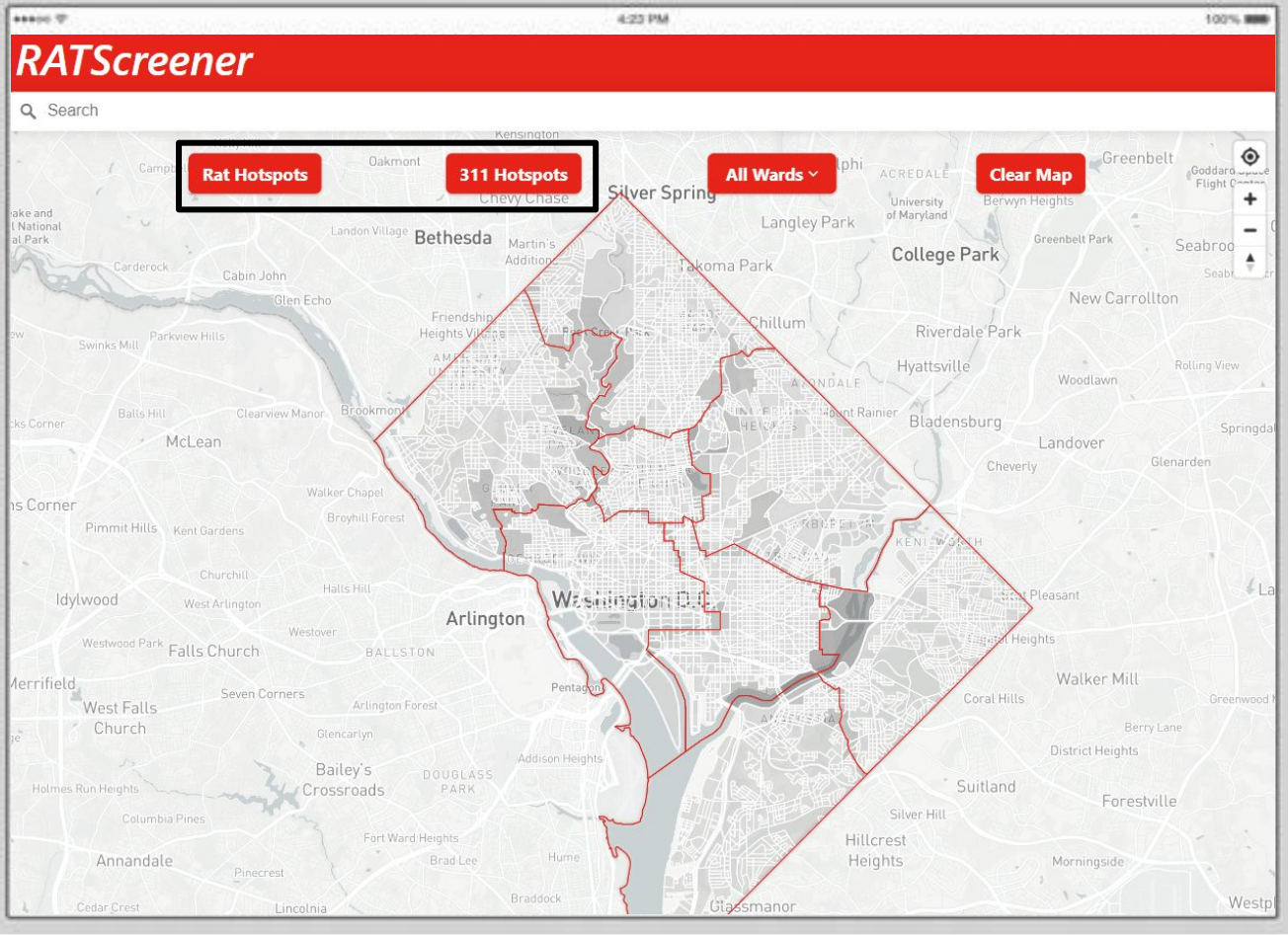

RATScreener
Search
Rat Hotspots
311 Hotspots
All Wards
Clear Map
Bethesda
Silver Spring
Chevy Chase
Takoma Park
College Park
Langley Park
Greenbelt
New Carrollton
Riverdale Park
Hyattsville
Bladensburg
Landover
Chillum
McLean
Arlington
Falls Church
Annandale
Bailey's Crossroads
West Falls Church
Seven Corners
Idylwood
Merrifield
Walker Mill
Suitland
Forestville
Hillcrest Heights
Glassmanor
Oxon Hill
Pentagon
Cabin John
Glen Echo
Carderock
Kensington
Wheaton
Rockville
Gaithersburg
Germantown
Clarksburg
Damascus
Olney
Laurel
Beltsville
Greenbelt
Bowie
Upper Marlboro
Clinton
Fort Washington
Alexandria
Fairfax
Centreville
Manassas
Woodbridge
Dumfries
Quantico
Stafford
Fredericksburg
Leesburg
Sterling
Herndon
Reston
Chantilly
Dulles
Aldie
Middleburg
Warrenton
Culpeper
Front Royal
Winchester
Martinsburg
Charles Town
Shepherdstown
Hagerstown
Frederick
Brunswick
Harpers Ferry
Point of Rocks
Poolesville
Dickerson
Barnesville
Boyds
Hyattstown
Clarksburg
Urbana
Mount Airy
Ijamsville
Monrovia
Libertytown
Woodsboro
Walkersville
Thurmont
Emmitsburg
Taneytown
Westminster
New Windsor
Union Bridge
Manchester
Hampstead
Sykesville
Eldersburg
Mount Airy
Lisbon
Woodbine
Glenwood
Highland
Fulton
Columbia
Ellicott City
Elkridge
Jessup
Savage
Laurel
Gambrills
Odenton
Crofton
Bowie
Mitchellville
Upper Marlboro
Brandywine
Waldorf
La Plata
Indian Head
Port Tobacco
Charles Town
Leonardtown
Lexington Park
California
Hollywood
Great Mills
Piney Point
Chaptico
Mechanicsville
Hughesville
Prince Frederick
Solomons
Lusby
Chesapeake Beach
North Beach
Owings
Huntingtown
Dunkirk
Port Republic
Deale
Shady Side
Edgewater
Annapolis
Arnold
Pasadena
Glen Burnie
Linthicum
Severna Park
Millersville
Crownsville
Gambrills
Odenton
Crofton
Bowie
Mitchellville
Upper Marlboro
Brandywine
Waldorf
La Plata
Indian Head
Port Tobacco
Charles Town
Leonardtown
Lexington Park
California
Hollywood
Great Mills
Piney Point
Chaptico
Mechanicsville
Hughesville
Prince Frederick
Solomons
Lusby
Chesapeake Beach
North Beach
Owings
Huntingtown
Dunkirk
Port Republic
Deale
Shady Side
Edgewater
Annapolis
Arnold
Pasadena
Glen Burnie
Linthicum
Severna Park
Millersville
Crownsville

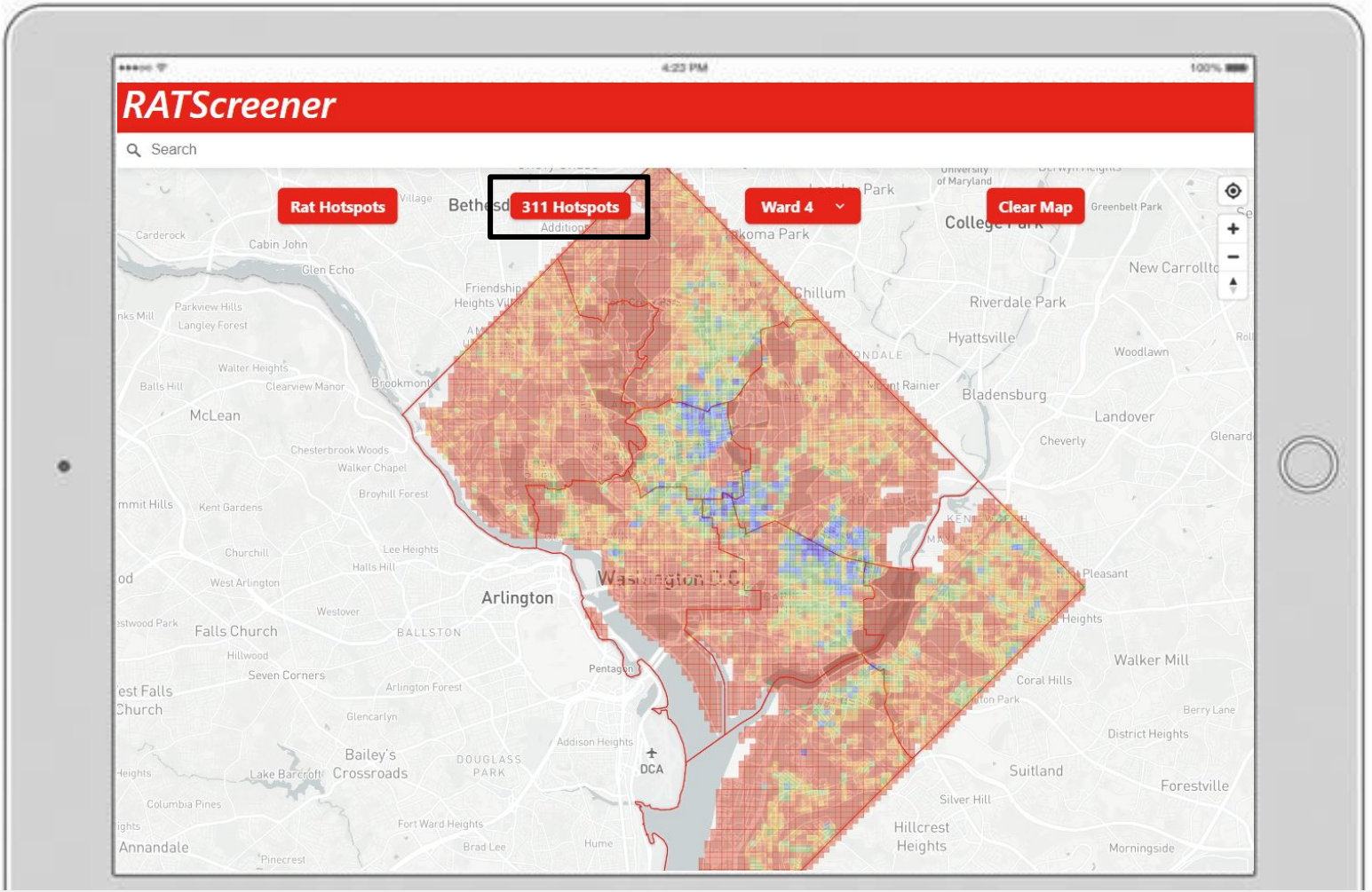

RATScreener
Search
Rat Hotspots
311 Hotspots
All Wards
Clear Map
All Wards
Ward 1
Ward 2
Ward 3
Ward 4
Ward 5
Ward 6
Ward 7
Ward 8
Bethesda
Silver Spring
College Park
Greenbelt
New Carrollton
Riverdale Park
Hyattsville
Bladensburg
Landover
McLean
Arlington
Washington D.C.
Falls Church
Idylwood
West Falls Church
Bailey's Crossroads
Annandale
Suitland
Forestville
Hillcrest Heights
Walker Mill
Glassmanor


RATScreener
Search
Rat Hotspots
311 Hotspots
Ward 4
Clear Map
Chevy Chase
Bethesda
Takoma Park
Langley Park
Chillum
Drummond
Friendship Heights Village
Martin's Additions
Chevy Chase Country Club
Chevy Chase Village
Chillum Manor
Hampshire Knolls
Carole Highlands
Washington National Cathedral


RATScreener
Search
Rat Hotspots
311 Hotspots
All Wards
Clear Map
Silver Spring
Bethesda
Takoma Park
College Park
Chevy Chase
Langley Park
Chillum
Riverdale Park
Hyattsville
Bladensburg
Landover
New Carrollton
McLean
Arlington
Washington D.C.
Falls Church
Annandale
Hillcrest Heights
Suitland
Forestville
Glassmanor
Bailey's Crossroads
West Falls Church
Walker Mill


RATScreener
1325 Upshur Street NW, Washington, DC 20011
Rat Hotspots
311 Hotspots
Ward 4
Clear Map
Last Inspection: 2018-05-29 16:05:00
Inspection Notes: On 5/16/18 @ 11:22am M. Parker found no rat burrows found. (NCA)
Rat Probability: 0.1462
Upshur Pool
Roosevelt High School
Iglesia Ni Cristo — Church of Christ


RATScreener
Search
Rat Hotspots
311 Hotspots
All Wards
Clear Map
Silver Spring
Bethesda
Chevy Chase
Takoma Park
College Park
Langley Park
Greenbelt
New Carrollton
Riverdale Park
Hyattsville
Bladensburg
Landover
Chillum
Arlington
Washington D.C.
Falls Church
McLean
Annandale
Bailey's Crossroads
Hillcrest Heights
Suitland
Forestville
Walker Mill
Glassmanor


RATScreener
Search
Rat Hotspots
311 Hotspots
Ward 4
Clear Map
Washington D.C.
Arlington
Bethesda
Chillum
Riverdale Park
Hyattsville
Bladensburg
Landover
Cheverly
Falls Church
Bailey's Crossroads
Suitland
Forestville
Walker Mill
Hillcrest Heights
Annandale
McLean
Brookmont
Pentagon
DCA