



# TrashTag

*If you can't take it, TAG IT!*



# Design Presentation

CS 410 Fall 2025 Team Iron

# Table of Contents

1

## Part 1: The Vision

- Team Bio: Get to Know Us
- Background



2

## Part 2: The Societal Problem

- Problem Statement: Reporting Disconnect
- Who is Affected?
- Problem Characteristics
- Current Process Analysis: The Reporting Breakdown



3

## Part 3: Our Solution

- Solution Statement: Introducing TrashTag
- Solution: What does it do and What does it not do?
- Solution Flow
- Competition Matrix: Where do we fit in?



4

.....

## Part 4: Project Roadmap

- Tools and Technologies: Solution Architecture
- Risk Assessment and Mitigation: Our Strategy for Success
- Appendix: References and Definitions



# Team Bio



J. Scott Zumwalt  
Team Lead



Sara Perez  
Front End Developer &  
Document Specialist



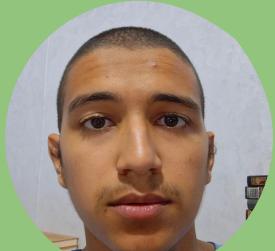
Emily Rick  
Full Stack  
Developer



Teddy Kovacs  
Back End Developer &  
Database Design



Luca Brooks  
Back End Developer &  
Test Analyst



Adam Daif  
Full Stack Developer  
& GIS Specialist



Ryan Fee  
Full Stack Developer

# Background

- Over the past 36 years, volunteers in the state of Virginia have removed approximately 7.1 million pounds of litter (Chesapeake Bay Foundation, 2025).
- It can take hundreds of people to search an area for all the trash and dumping (KUT News 2023)
- Oversized items, such as mattresses, tires, and appliances, create challenges for individuals lacking equipment to haul and dispose of them safely.



# Background (cont.)



- The accumulation of waste has led to approximately 100,000 marine animal deaths annually (Environmental Volunteers, 2023).
- Illegal dumping has causes an estimated drop of property values by 7% - 10% (City of Hampton, n.d.).
- Approximately 21% of beach goers report they have been injured from beach litter. (Science Direct 2016)
- When people see litter or dumping they are more likely to litter or dump more in that area. (Allegheny Front 2016)

# Background (cont.)

- Litter makes tourist destinations less attractive and causes an estimated drop in revenue by 38% in areas with litter. (Keep Texas Beautiful)
- Texas has spent \$50 million in litter clean up. Costs paid for by local governments. (Keep Texas Beautiful)

.....



# Problem Statement

The communication gap that keeps trash on the map!

Independent organizations and local governments struggle to efficiently locate and remove litter in outdoor recreational areas such as parks, rivers, lakes, and beaches. Without knowing locations and characteristics of waste items, volunteer efforts can be left unprepared and ineffective. Communities lack a live reporting system to connect citizens with organizations capable of safe and efficient waste removal efforts.



# Problem Characteristics

## Identifying the Critical Gaps

01

### Resources

- Organizations struggle to track illegal dumping.
- Items too much for individuals.
- Users and Litterers alike may or may not have adequate knowledge of proper disposal options.

02

### Communication

- Users don't know who to contact regarding trash.
- Users lack tools focused on organizing cleanup efforts.
- User reports come in one at a time and require coordination within cleanup organizations to increase efficiency.

03

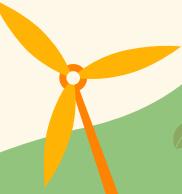
### Convenience

- Users can't communicate in the moment when they see the trash.
- They've forgotten by the time they return home.
- Litterers often dump out of convenience on private or public property

04

### Complexity

- Users reach out to orgs via email/social media which may get lost or go unnoticed.
- Thus, users contact multiple orgs at a time to ensure attention



# Who is Affected?

## Focusing on Those Impacted the Most

---

01

### The Environment

- Open dumping landfills negatively impact the environment by contributing to pollution via toxic chemicals.
- These landfills account for at least 40% of all global waste.

02

### Local Governments

- Local governments spend millions of taxpayer dollars annually on litter clean up.
- In Virginia alone, 3.5 million dollars is spent to clean the state's roadways.

03

### Environmental Organizations

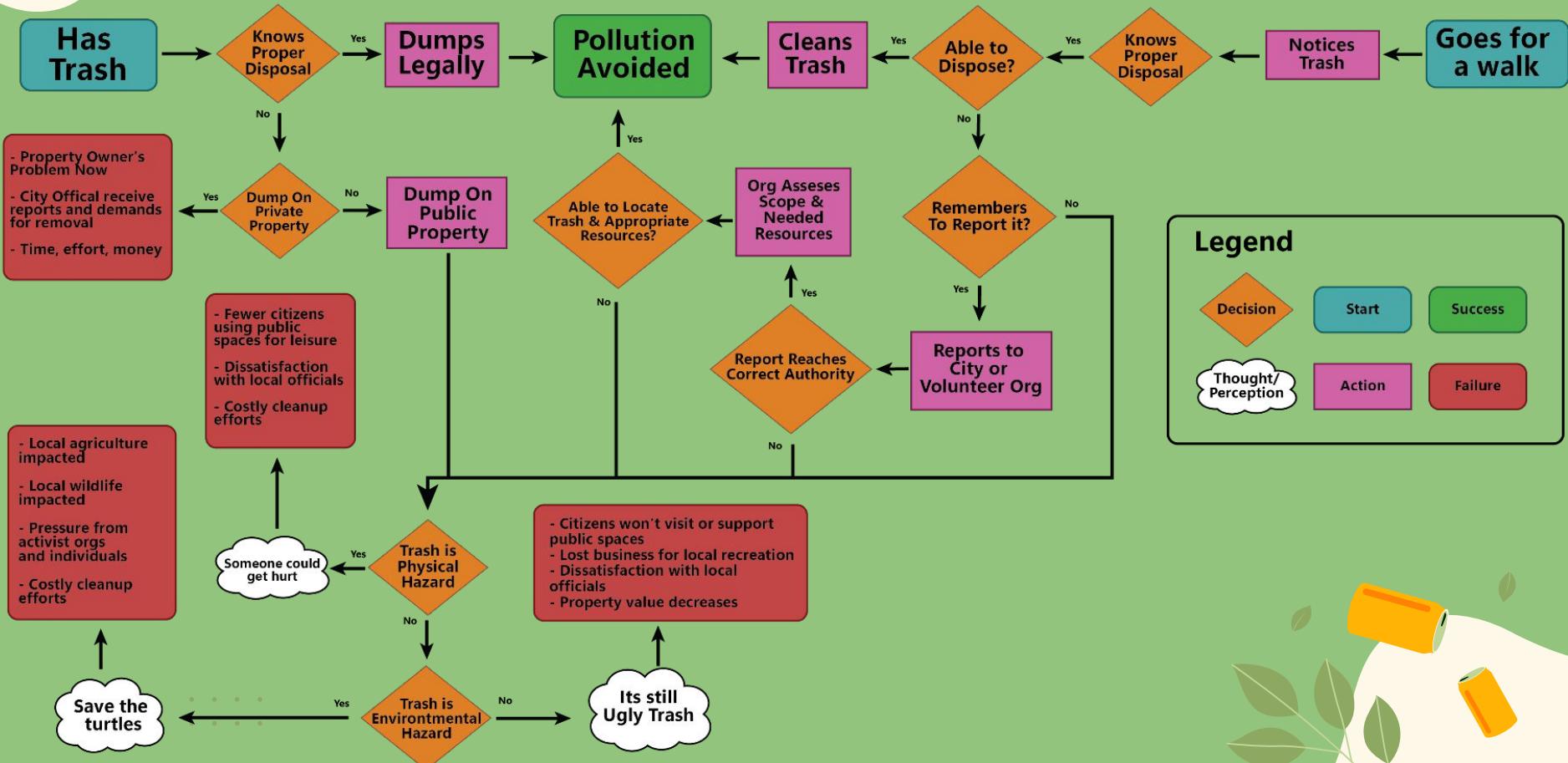
- Safety risks often put volunteer efforts at a significant disadvantage.
- Rising annual costs are another factor in turning away volunteers and organizations from cleaning up litter.

04

### The General Public

- Excess litter creates various health hazards and diseases.
- Litter also negatively impacts waterways, communities' aesthetic value, and the cleanliness of natural areas.

# Current Process Flow





# Solution Statement

TrashTag aims to improve the litter and waste cleanup process by developing a mobile application where users can photograph and report piles of waste, give their exact locations, and connect with cleanup groups that are well-equipped to handle the cleanup process in order to improve environmental wellbeing and preserve nature's beauty for the public eye.

We are committed to helping the environment and the public by providing a resource that clearly highlights the location, extent, type and weight of the waste as well as provides updates regarding existing cleanup efforts, dangers and geographic littering patterns to help cleanup crews allocate their time and resources more effectively.



# Solution Characteristics

## Live Reporting and Mapping:

- Users snap a picture of the litter and geotag it in the app for it to be uploaded to an interactive map.
- This allows organizations to properly allocate time, resources, staff, and funding.

## Litter Report System

- The images provide users with a visual understanding of the problem.
- This allows them to prepare resources for proper clean up.

## “Litter Hero!”

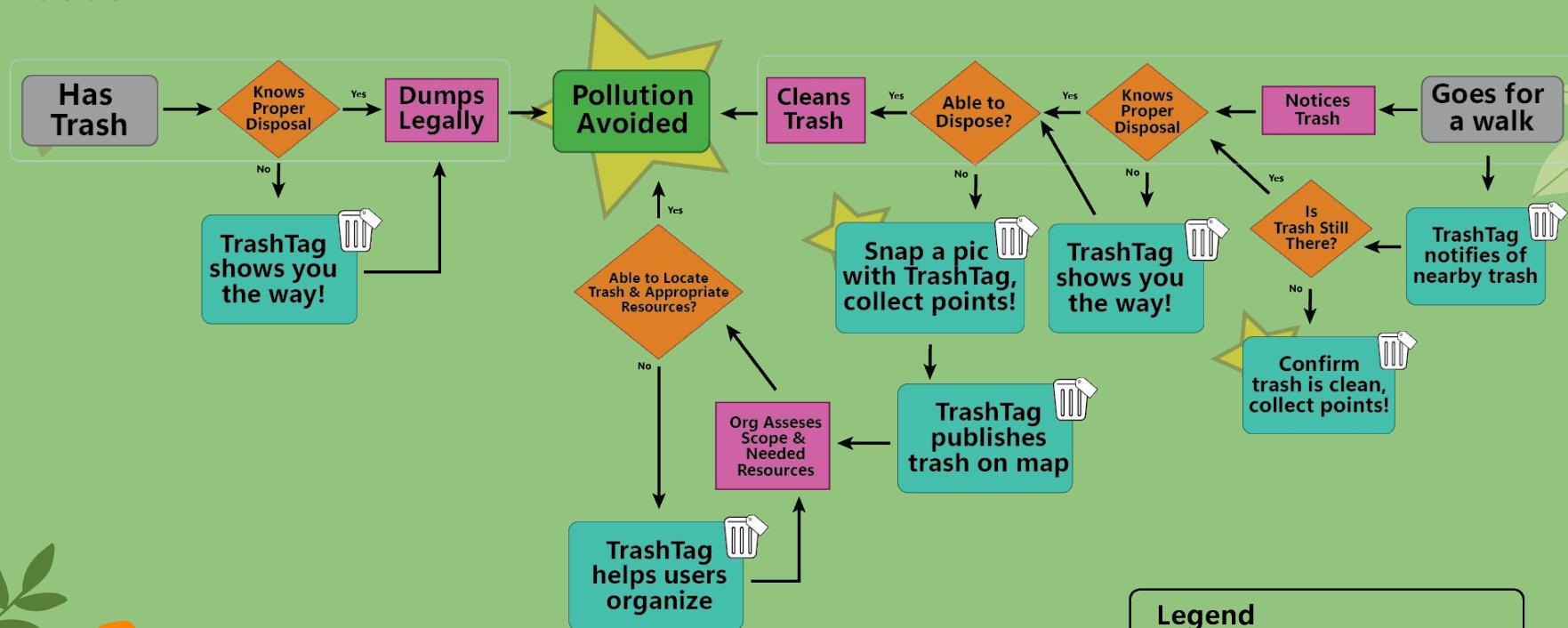
- A reward system for users who successfully clear litter locations from the map.
- This allows users track their progress and notice measurable impact.

## Close the loop

- When users are near reported trash they receive a request to verify the trash is still there or if its been previously cleared.



# Solution Process Flow



## Legend

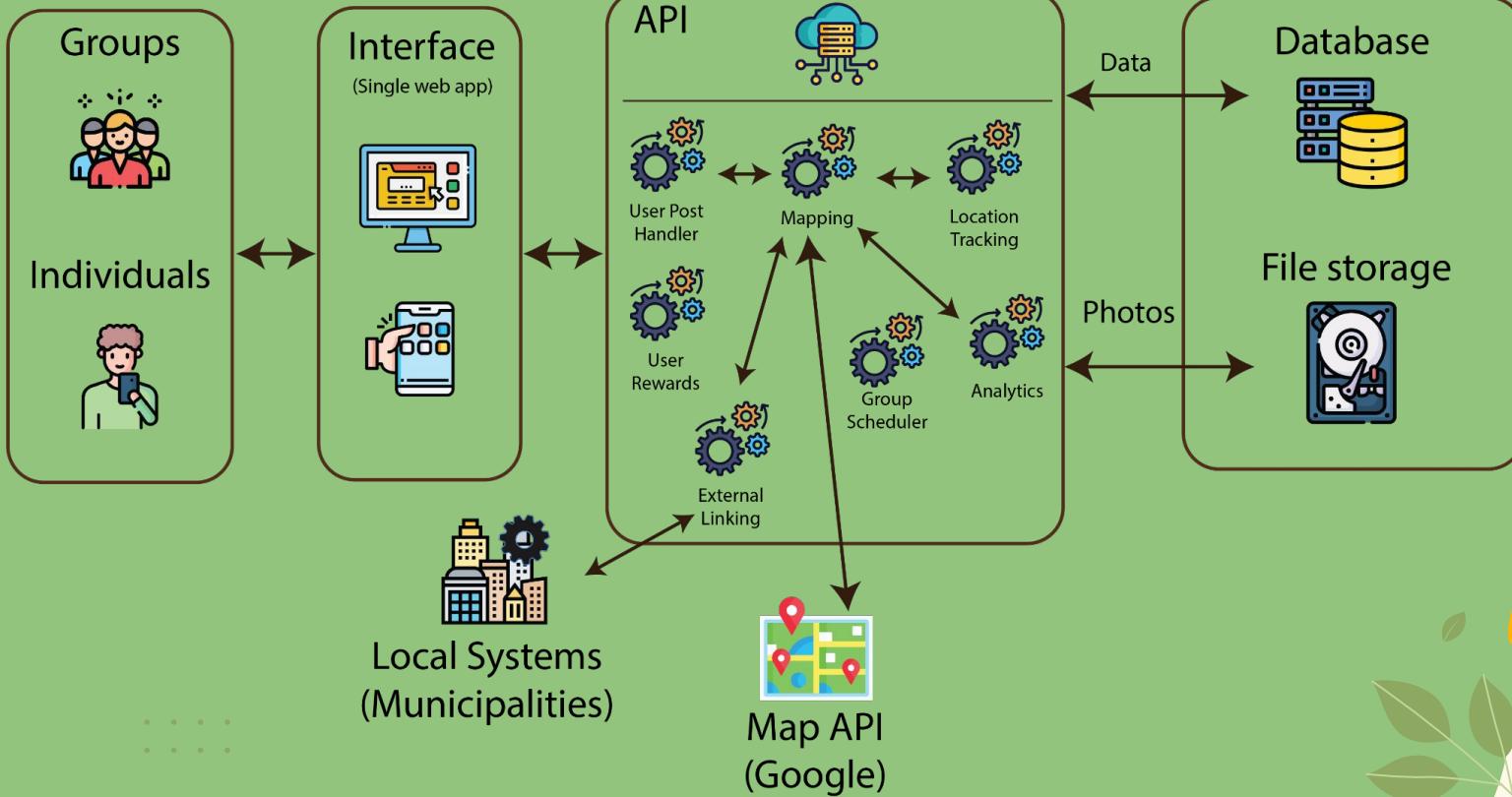


# Major Functional Component Diagram

Presentation

Application

Data



# Solution Characteristics: What Will It Do?

- Live Litter Reporting and Mapping
- Ranking System for Active Report and Cleanup Users
- Updates Regarding Cleanup Efforts For Each Report
- Images of Litter for Cleanup Crews to Accurately Gauge Its Scope
- Collaboration Space for Other Users to Provide Information and Updates
- Direct Connection Between Reporters and Cleanup Crews
- Mapping Tools to Scope All Reports in a Geographic Area
- Users Receive Alerts When Near Reported Litter to Verify If It's Gone or Still There
- Scheduled Clean ups

.....



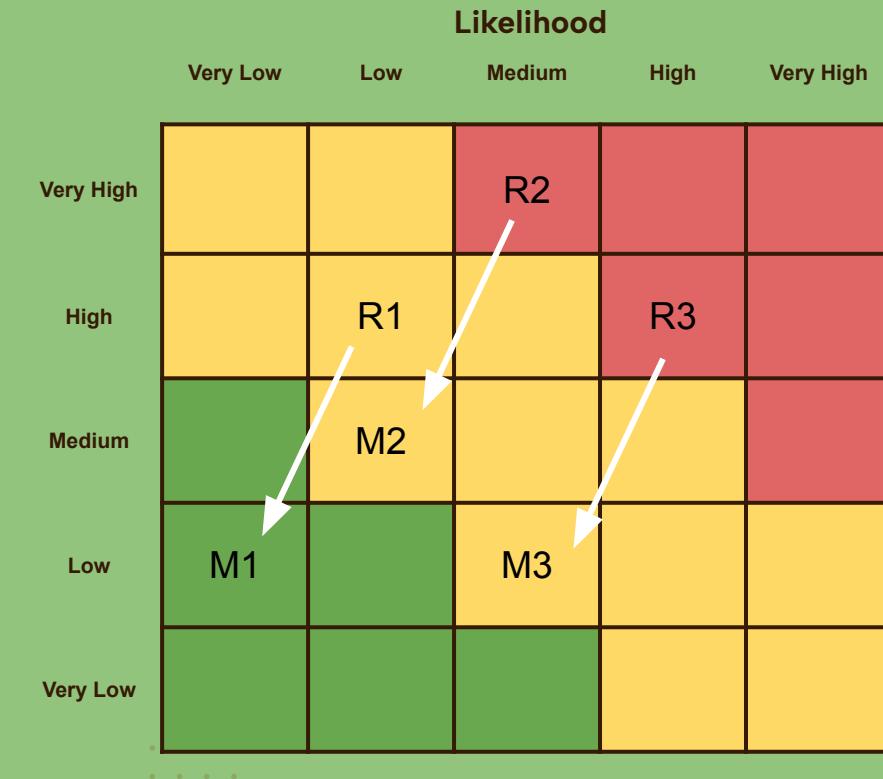
# Solution Characteristics: What Will It Not Do?

- Provide Tangible or Monetary Rewards for Active Users
- Guarantee a Cleanup Response
- Law Enforcement and Penalizing Illegal Littering
- Replace Emergency Service Reporting (e.g., chemical waste)



.....

# User Risks & Mitigation



**R1:** False entries entered that are not trash.

**R2:** Minimal/no clean-up organizations in the area to handle tagged trash.

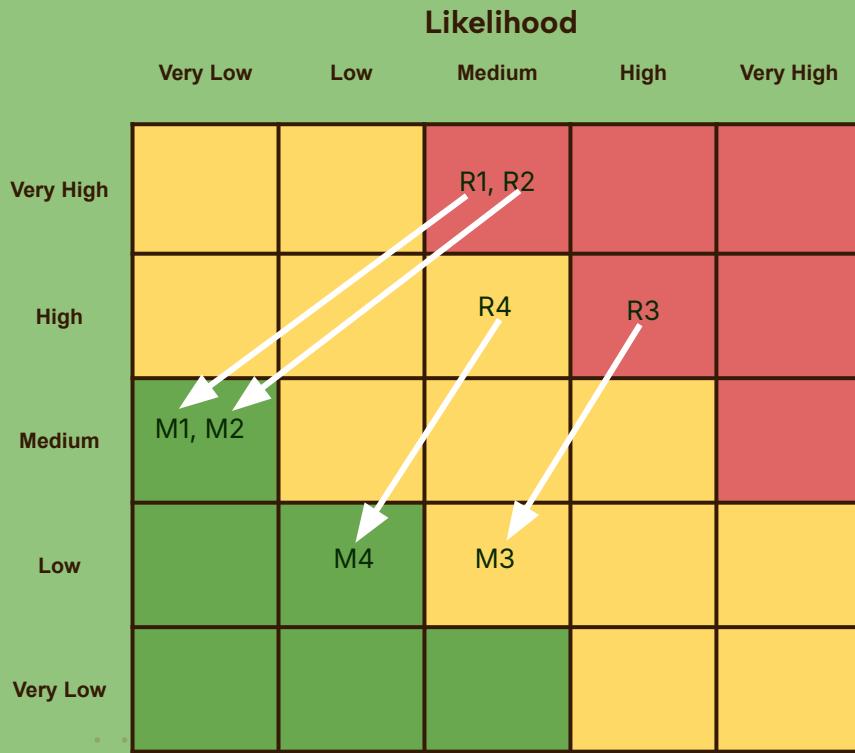
**R3:** Minimal/no users installing or using the app.

**M1:** Entries are verified by other users with location based notifications.

**M2:** Users can organize themselves. Users near tagged items receive requests to join ad hoc groups.

**M3:** Organization outreach/advertising

# Customer Risks & Mitigation



**R1:** Does not integrate well with existing city/org workflows causing limited adoption

**R2:** Misallocation of crews due to bad/duplicate pins hurting budgets and staff morale

**R3:** Difficulties proving impact to local officials and donors.

**R4:** Budget surprises due to usage spikes and/or excessive storage needs

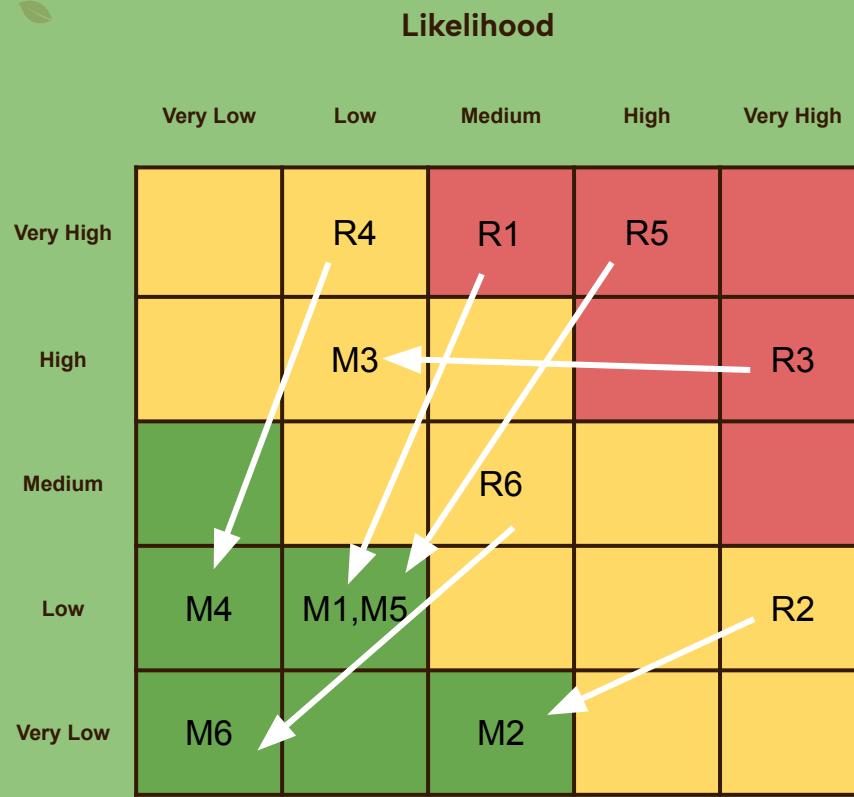
**M1:** Pilot by locale; API bridges for tailored implementation; Limit categories to not exceed capabilities

**M2:** Validate before dispatch recommendation; Confidence scoring; User cooldowns for inaccurate reporting

**M3:** Before/After photos; Outcome dashboard, Service Level Agreement (SLA) tracking

**M4:** Spending dashboard; Annual Total Cost of Ownership (TCO) quotes; Spending lock on non-critical features; Usage caps

# Technical Risks & Mitigation



**R1:** Servers are down

**R2:** User refuses to share location

**R3:** Wifi connection is lost

**R4:** App deletes trash that still exists

**R5:** App presents trash that no longer exists

**R6:** Individual accounts are hacked

**M1:** Utilize reliable hosting, a backup DNS, uptime monitoring and data backups.

**M2:** Clarify their location is private data that will not be shared & allow choosing location on map.

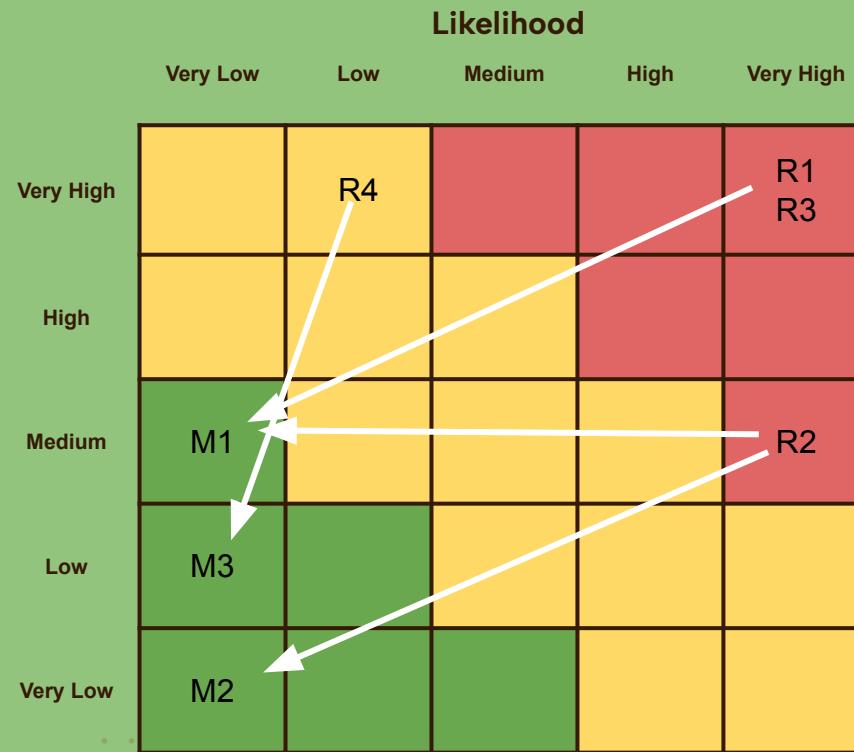
**M3:** Add offline data persistence & auto-sync: save posts locally & publish when connection returns.

**M4:** Trash report not deleted until cleaner confirms.

**M5:** Nearby users are asked to update trash's status. Once enough users report it's removed, it is no longer displayed in the app.

**M6:** Use best practices for cybersecurity & reporting

# Legal & Security Risks & Mitigation



**R1:** Users may trespass onto private property during cleanups

**R2:** Users may use the platform to organize crime

**R3:** Users may get hurt during the cleanup

**R4:** A data leak would likely reveal a user's location

**M1:** Users will have to agree to an End-User License Agreement (EULA) to use the platform that makes clear that the platform does not assume any responsibility for any injuries or arrests obtained through use of the platform

**M2:** Users who violates the EULA will be banned from the platform permanently

**M3:** User data will be encrypted to avoid data leaks revealing the location of users

# Competition Matrix

Features	TrashTag	Clean Something For Nothing	Pirika	Litterati	City 311 app
Report trash	✓	✓	✓		✓
Upload Geotagged photos of trash	✓	✓	✓	✓	
Interactive map	✓	✓	✓	✓	✓
Scope Indicator	✓	✓			
Reward System	✓	✓			
Organize Groups	✓	✓		✓	
Verify Cleanup	✓				
Scheduled Cleanups	✓				
Resources on Proper Dumping	✓				✓



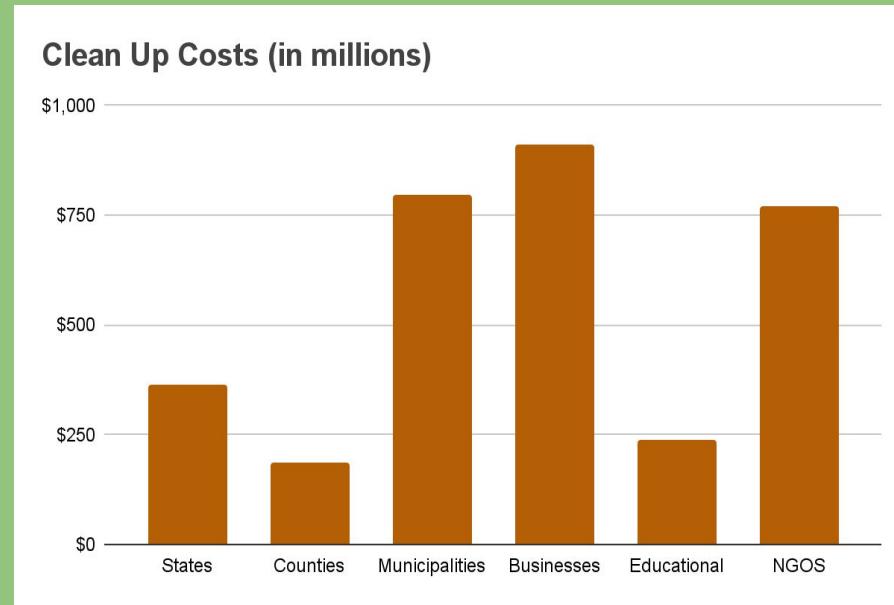
# Development Tools



<b>Development Environment</b>	VS Code
<b>Version Control</b>	Git, GitHub
<b>Continuous Integration and Deployment</b>	GitHub
<b>Frontend Languages</b>	JavaScript (React Native)
<b>Backend Languages</b>	C# and .NET
<b>Cloud</b>	Azure

# Benefits to Customers

- **Local Governments, Businesses, and Environmental Organizations**
  - Cut back on the amount of money spent on annual litter clean up.
  - Quickly track affected areas and efficiently organize volunteers groups to help clean these areas.



Source: Litter in America Results from the Nation's Largest Litter Study<sup>[15]</sup>



# Benefits to Customers

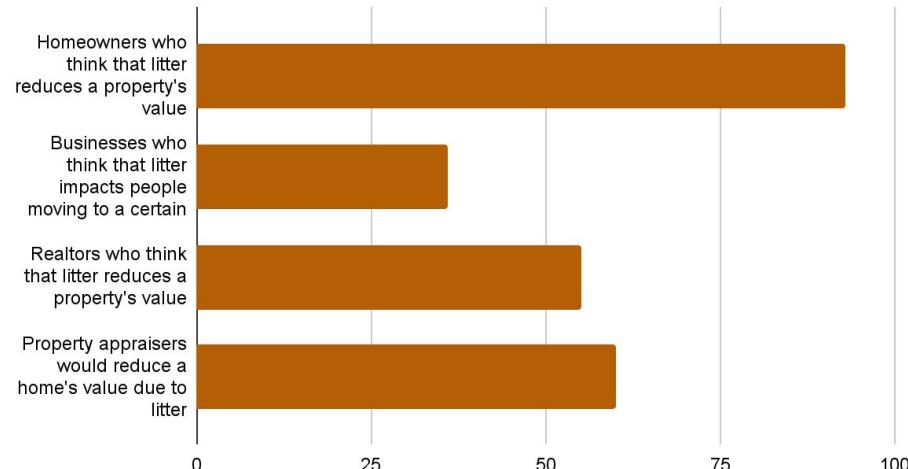
- Local Recreational Organizations
  - Can coordinate via the app with users about local volunteer efforts.
  - Can use the app to locate trash within parks and recreational areas, keeping them clean and in turn helping local businesses and other parks thrive.<sup>[16]</sup>



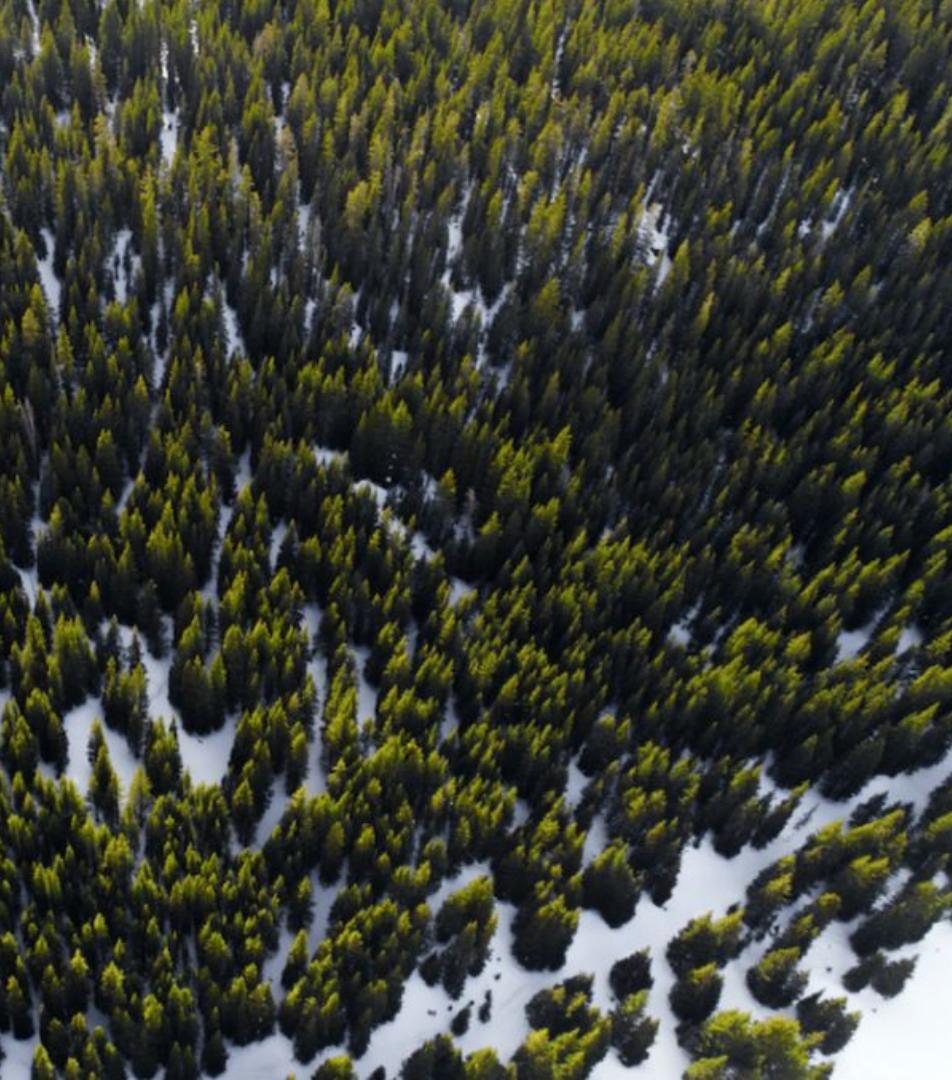
# Benefits to Customers

- Nature Enthusiasts and Local Communities
  - Able to connect users with likeminded people to make their communities better and raise the value of it.
  - Lets users track down trash and connect with the proper authorities if heavy equipment is required to remove it.

Litter's Impact on Housing



Source: Litter in America Results from the  
Nation's Largest Litter Study<sup>[15]</sup>



# Benefits to Customers

- **Nature and the Ecosystem**
  - Makes previously littered areas more habitable for animals and plant life.
  - Benefits human health by reducing waste and landfill emissions.



# User Roles

- **Citizens:** Community Members who report litter by uploading photos, marking severity levels, collaborate in cleaning events, and earn rankings as rewards for their initiative efforts.
- **Organizations:** Non-profit environmental organizations that organize and allocate their resources to successfully remove litter from litter dense areas.
- **Local Government:** Government staff who benefit from the platform by reducing cleanup costs and optimizing waste management. They can view litter trends and density heavy areas, as well as gather statistics for appropriate budget planning and future policy decisions. User information is protected and remains anonymous to government users.
- **Administrator/Moderator:** Platform managers who ensure system integrity and quality remain intact. The administrators will be responsible for user account management, removing inappropriate and/or duplicate reports, and responding to community flagged submissions. This ensures the platform provides accurate data analytics for all its users.

# User Stories

## As a Citizen,

- I want to report the location of where trash is located so that other users can see where the issue is at and potentially clean it up.
- I want to upload photos of litter I find so that others can see the issue, clean it, and mark it as cleaned.
- I want to be able to report the litter type so that others are able to know if it can be safely disposed of or if assistance is required.
- I want to mark the severity level of reported trash so that others can know how much litter is in the reported area.
- I want to request cleanup verification status of the affected area so that it can be verified if it still exists or not.
- I want to be able to interact with a map that locates litter-affected areas so that I can see where the litter is at.
- I want to view the map with a “litter density” filter so that I can know which areas are heavily affected.
- I want to be able to filter the map by “cleanup status”, “litter type”, and “location” so that the map can be easily accessible to users.

# User Stories

## As a Citizen,

- I want to coordinate, join, and view local cleanup events so that I can help with cleaning up litter.
- I want to claim cleanup areas during cleanup events so that I can help with cleaning up litter.
- I want to delegate cleanup tasks to other users when coordinating events so that cleanup events will run smoothly.
- I want to be able to RSVP and check-in to local cleanup events so that my participation in the event(s) can be logged in the app.
- I want to be able to see and click on app notifications about new litter-affected areas that get reported by other users so that I can be alerted to verify it.
- I want to be able to receive proximity cleanup alerts and notifications so that I can be alerted to such events and plan accordingly.
- I want to be able to update cleanup status so that cleanup tracking can be manually updated by users.
- I want to upload proof of the cleanup, such as images, so that it can be accurately verified by other users.

# User Stories

## As a Citizen,

- I want to be able to monitor cleanup status so that I can know what needs to be cleaned up and where.
- I want to verify accurate cleanup status so that repeated reports do not occur in report listings.
- I want to flag suspicious content so that only litter-affected areas are getting properly reported.
- I want to view impact statistics so that I can be motivated to help clean my community.
- I want the app to have a reward system so that I can stay motivated to participate in clean up events.
- I want to see a ranked list of “Top Contributors” so that I can easily track my reward progress against other users.
- I want to be able to access the Community Guidelines so that there is clear communication between users.
- I want my personal information to remain private so that I can safely report issues without fear of exposure.
- I want to be able to mark certain reports as spam so that I can know if I need to flag a moderator to review it.

# User Stories

## As an Organization (Non-Profit Environmental Group),

- I want to report the location of where trash is located so that other users can see where the issue is at and potentially clean it up.
- I want to upload photos of litter I find so that others can see the issue, clean it, and mark it as cleaned.
- I want to be able to report the litter type so that others are able to know if it can be safely disposed of or if assistance is required.
- I want to mark the severity level of reported trash so that others can know how much litter is in the reported area.
- I want to request cleanup verification status of the affected area so that it can be verified if it still exists or not.
- I want to be able to interact with a map that locates litter-affected areas so that I can see where the litter is at.
- I want to view the map with a "litter density" filter so that I can know which areas are heavily affected.
- I want to be able to filter the map by "cleanup status", "litter type", and "location" so that the map can be easily accessible to users.

# User Stories

## As an Organization (Non-Profit Environmental Group),

- I want to coordinate, join, and view local cleanup events so that I can help with cleaning up litter.
- I want to claim cleanup areas during cleanup events so that I can help with cleaning up litter.
- I want to delegate cleanup tasks to other users when coordinating events so that cleanup events will run smoothly.
- I want to be able to RSVP and check-in to local cleanup events so that my participation in the event(s) can be logged in the app.
- I want to be able to see and click on app notifications about new litter-affected areas that get reported by other users so that I can be alerted to verify it.
- I want to be able to receive proximity cleanup alerts and notifications so that I can be alerted to such events and plan accordingly.
- I want to be able to update cleanup status so that cleanup tracking can be manually updated by users.
- I want to upload proof of the cleanup, such as images, so that it can be accurately verified by other users.
- I want to be able to monitor cleanup status so that I can know what needs to be cleaned up and where.

# User Stories

## As an Organization (Non-Profit Environmental Group),

- I want to verify accurate cleanup status so that repeated reports do not occur in report listings.
- I want to flag suspicious content so that only litter-affected areas are getting properly reported.
- I want to view impact statistics so that I can be motivated to help clean my community.
- I want the app to have a reward system so that I can stay motivated to participate in clean up events.
- I want to see a ranked list of “Top Contributors” so that I can easily track my reward progress against other users.
- I want to be able to access the Community Guidelines so that there is clear communication between users.
- I want to embed the TrashTag map on the organization’s website so that citizens can access the data easily.
- I want to view reported litter areas for trends so that I can easily identify where help is needed most.
- I want to download user reports of affected areas so that I can easily know which areas are most affected.

# User Stories

## As an Organization (Non-Profit Environmental Group),

- I want to view density (heavy litter)-related analytics so that I know which areas need help the most.
- I want to track event impact and the number of events completed so that I can visibly measure our environmental impact on the community.
- I want to view cleanup statistics so that our impact is measurable and trackable.
- I want to be able to mark certain reports as spam so that I can know if I need to flag a moderator to review it.
- I want to assign volunteers to a particular task via scheduled cleanups so that cleanup communication is effective.
- I want to communicate with citizens and local government directly through the platform so that we can act together.
- I want to be able to mark areas as in-progress so that other users know we are cleaning that area.
- I want to be able to mark an area as litter free so that other users know the area is clean now.

# User Stories

## As a Local Government,

- I want to view aggregated litter trends and density maps so that I can identify problem areas.
- I want to access statistics about litter reports and cleanups so that I can plan budgets and policies.
- I want citizen data to remain anonymous so that privacy laws and ethics are upheld.
- I want to receive periodic reports about cleanup progress so that I can track the impact on municipal costs.
- I want to embed the TrashTag map on city websites so that citizens can access the data easily.
- I want to be able to easily put the TrashTag map on city websites so that more people be informed about cleanups.
- I want to be able to coordinate city wide clean up events so that they can use direct government resources
- I want to be able to claim cleanup areas so that hired volunteers can clean them directly

# User Stories

## As a Local Government,

- I want to be able to delegate hired volunteers to a cleanup area so that we can communicate on the cleanup site without needing to be face to face
- I want to view upcoming cleanups so that we can advertise them on our website
- I want to RSVP to local events so that other volunteers know our volunteers will be there
- I want to check into events so that other volunteers know our volunteers are there

# User Stories

## As a Moderator,

- I want to be able to monitor and review user-submitted reports so that I can automatically remove inappropriate or duplicate data.
- I want to respond to post reports from users so that the platform remains trustworthy.
- I want tools to correct or delete false or spam submissions so that data analytics remain accurate.
- I want to be able to create and enforce clear community guidelines so that the app can foster a healthy, engaging, and collaborative online community for users.
- I want to be able to delegate tasks so that a misassigned task can be corrected
- I want to be able to view cleanup events so that I can monitor that event

# Feature Table(1 of 6)

Category	Features	Citizens	Organizations	Government	Moderator
Litter Reporting	Report Litter Location	✓	✓	✓	
	Upload Photos	✓	✓	✓	
	Report Litter Type	✓	✓	✓	
	Mark Severity Level	✓	✓	✓	
	Request Cleanup Verification status	✓	✓		
Mapping	View Litter Map	✓	✓	✓	✓
	Litter Density Map	✓	✓	✓	✓
	Filter by Status	✓	✓	✓	
	Filter by Type	✓	✓	✓	
.....	Filter by Location	✓	✓	✓	

# Feature Table(2 of 6)

Category	Features	Citizens	Organizations	Government	Moderator
Event Coordination	Coordinate Cleanup Events	✓	✓	✓	
	Claim Cleanup Area	✓	✓	✓	
	Delegate Cleanup Tasks	✓	✓	✓	✓
Event Participation	View Cleanup Events	✓	✓	✓	✓
	RSVP to Events	✓	✓	✓	
	Check-In to Events	✓	✓	✓	
	Proximity Cleanup Alerts	✓	✓	✓	

# Feature Table(3 of 6)

Category	Features	Citizens	Organizations	Government	Moderator
Cleanup Tracking	Update Cleanup Status	✓	✓	✓	✓
	Upload Cleanup Proof	✓	✓		
	Monitor Cleanup Status	✓	✓	✓	✓
Verification	Verify Accurate Cleanup Status	✓	✓	✓	✓
	Verify Cleanup Completion			✓	✓
...	Flag Suspicious Content	✓	✓	✓	

# Feature Table(4 of 6)

Category	Features	Citizens	Organizations	Government	Moderator
Community Impact	View Impact Statistics	✓	✓	✓	✓
	Gamifications/Rewards	✓	✓		
	Top Contributors	✓	✓	✓	✓
Accessible Resources	Community Guidelines	✓	✓	✓	✓
Map Embedding	Embed Map Widget		✓	✓	

# Feature Table(5 of 6)

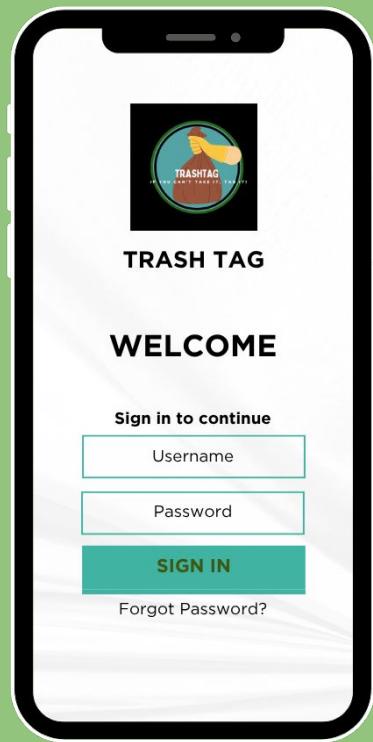
Category	Features	Citizens	Organizations	Government	Moderator
Analytics	View Litter Trends		✓	✓	✓
	Download Reports		✓	✓	✓
	View Density - Heavy Litter Analytics		✓	✓	✓
	Track Event Impact		✓	✓	✓
	View Cleanup Statistics		✓	✓	

# Feature Table(6 of 6)

Category	Features	Citizens	Organizations	Government	Moderator
Platform Moderation	Review Flagged Reports				✓
	Respond to Flagged Reports				✓
	Edit/Correct Flagged Report Data				✓
	Remove Duplicate and/or Suspicious Reports				✓
	Mark Reports as Spam	✓	✓	✓	✓
	Issue Violation Warnings				

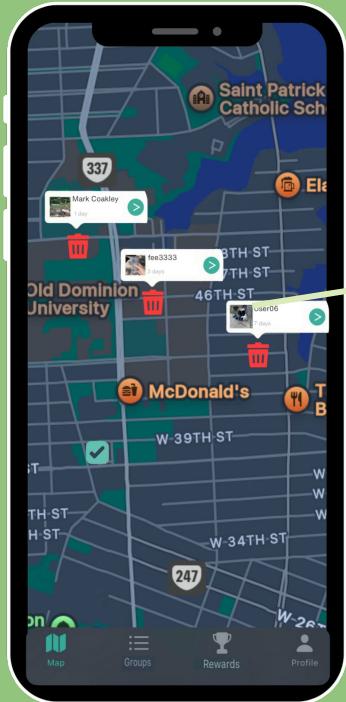
# UI Mockups

## Login Screen

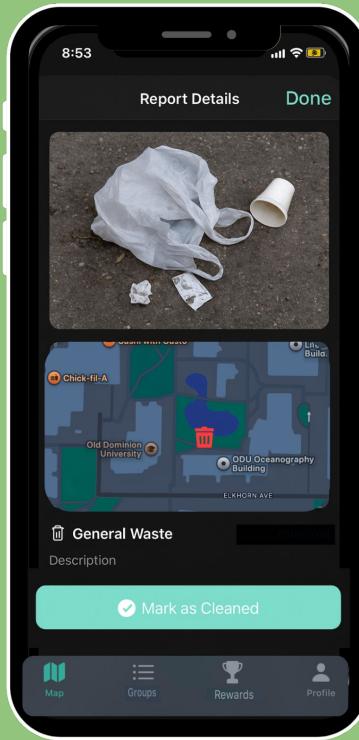


# UI Mockups

Trash Map Screen

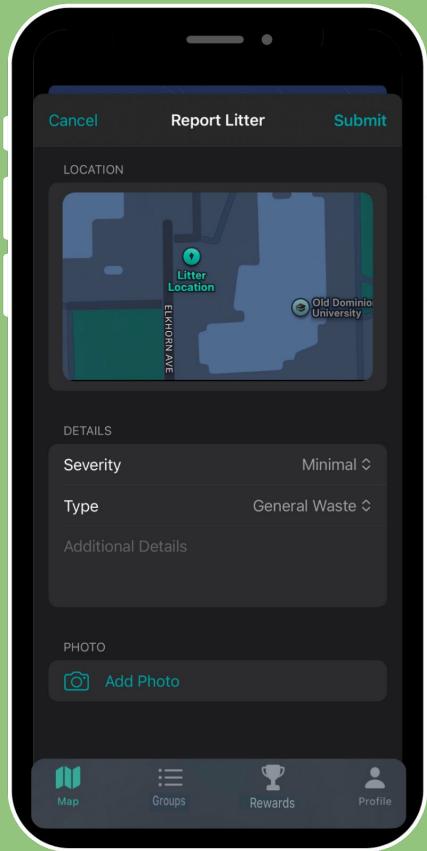


Trash Detail Screen



# UI Mockups

## Trash Report Screen



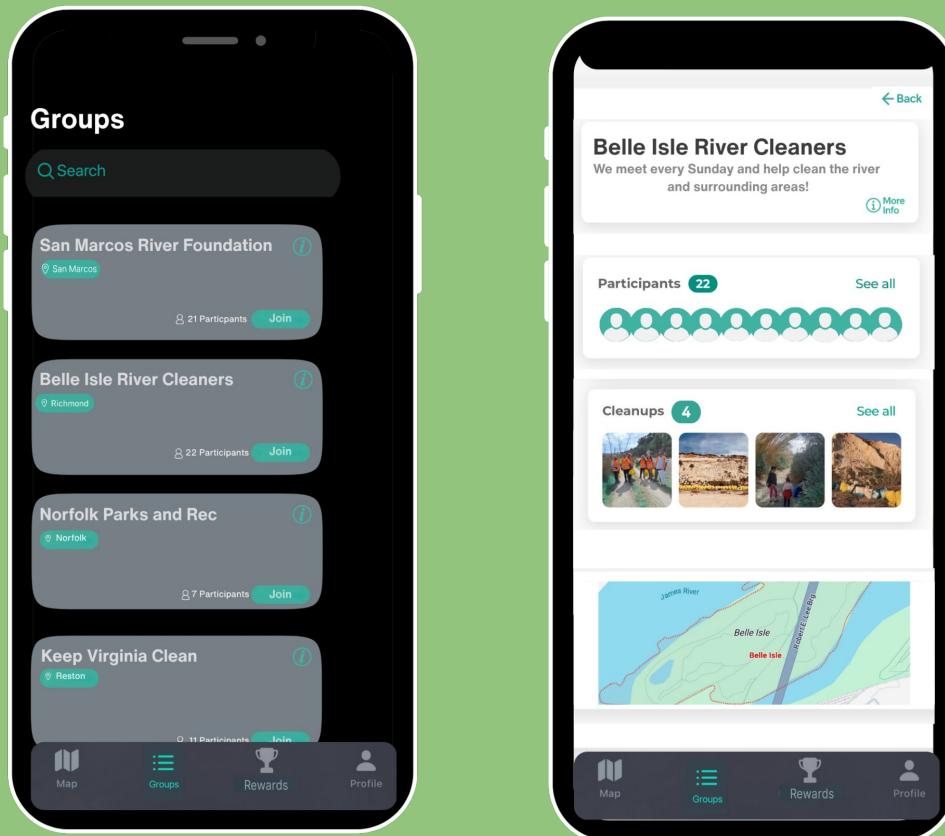
# UI Mockups

## Trash Verify Screen



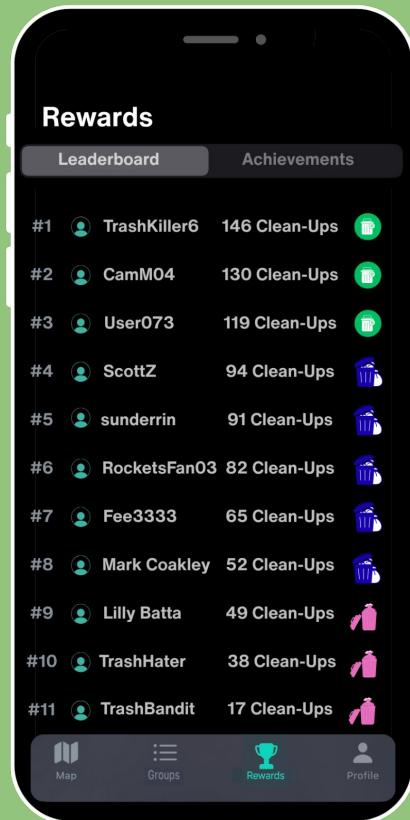
# UI Mockups

## Groups Screen



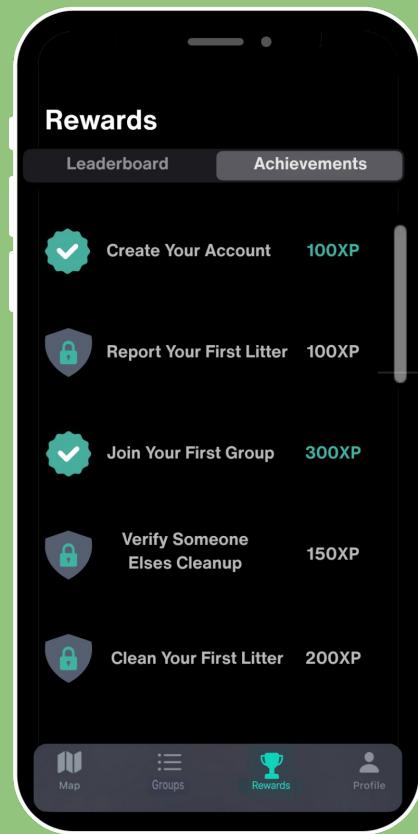
# UI Mockups

## Rewards Screen



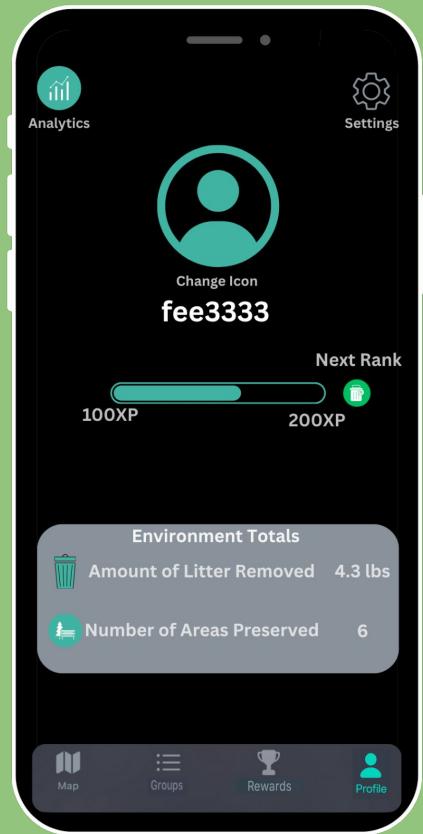
# UI Mockups

## Rewards Screen #2



# UI Mockups

## Profile Screen

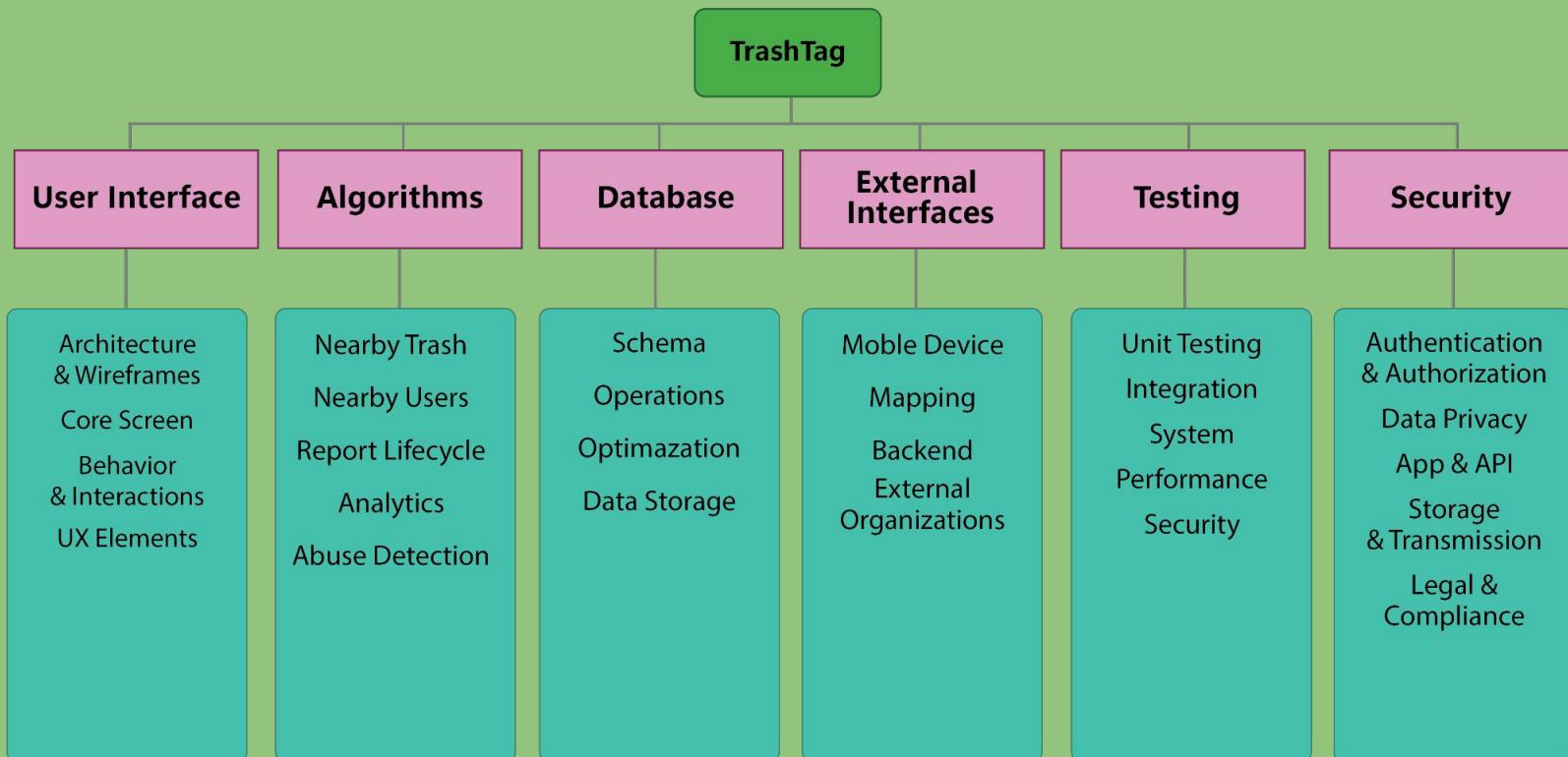


# UI Mockups

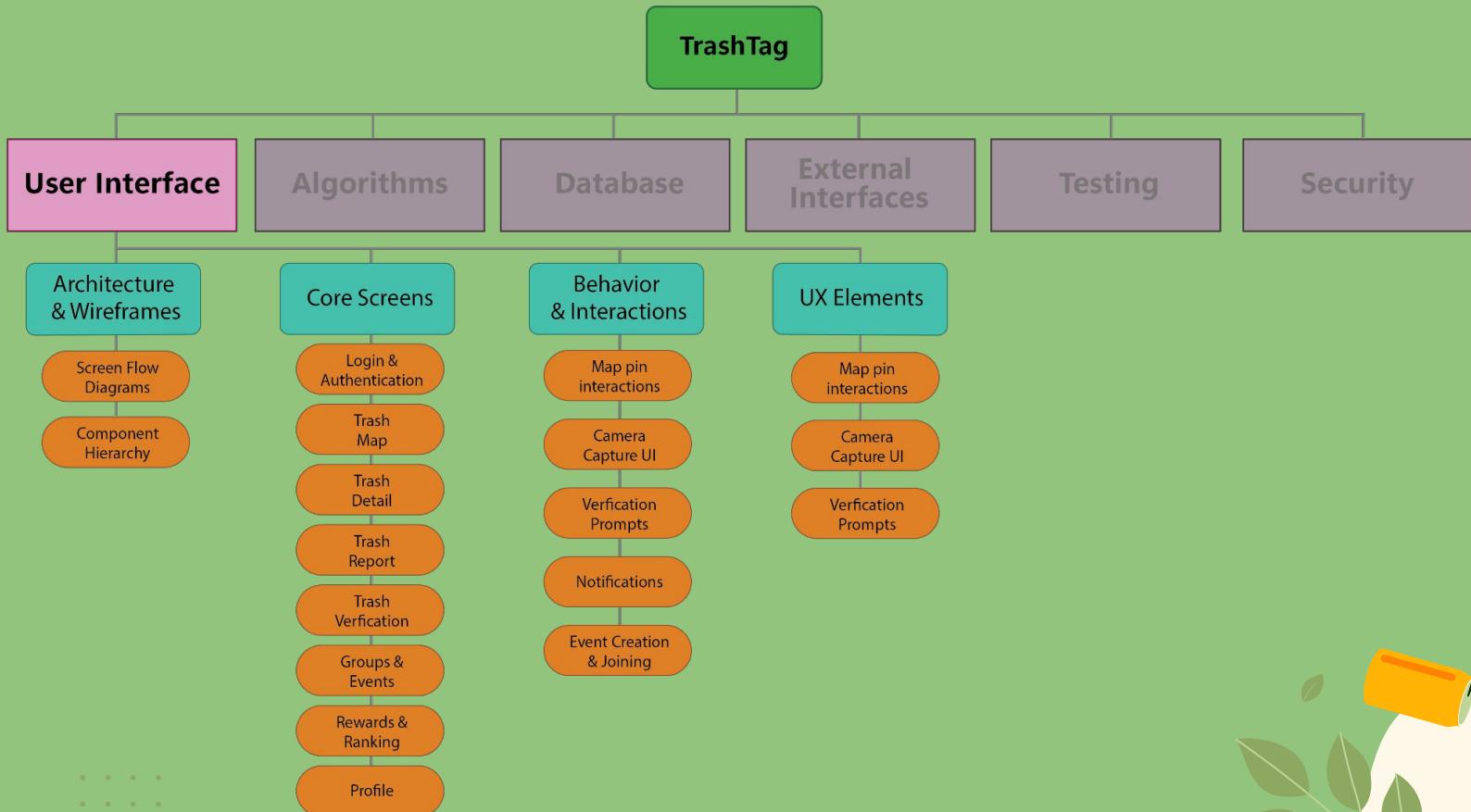
## Analytics Screen



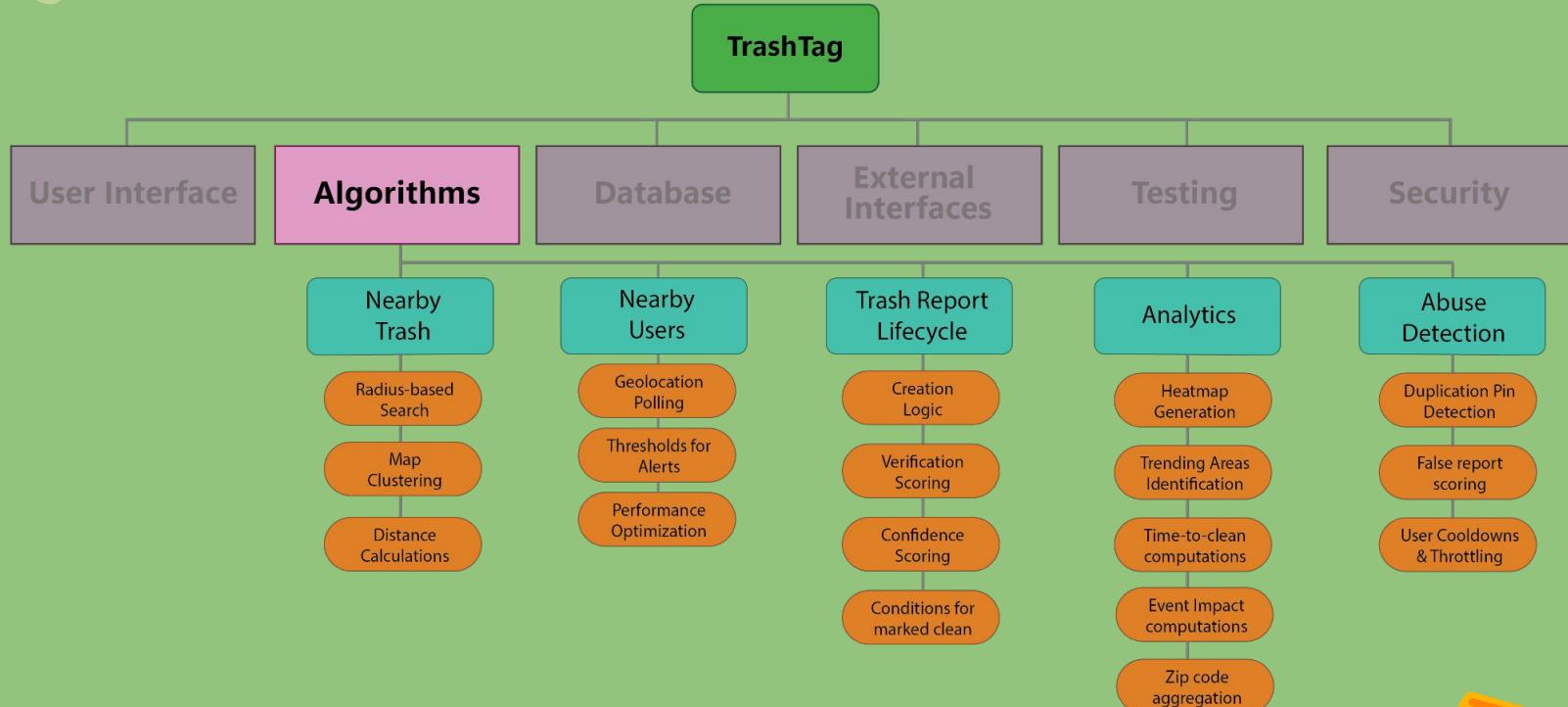
# Work Breakdown Structure



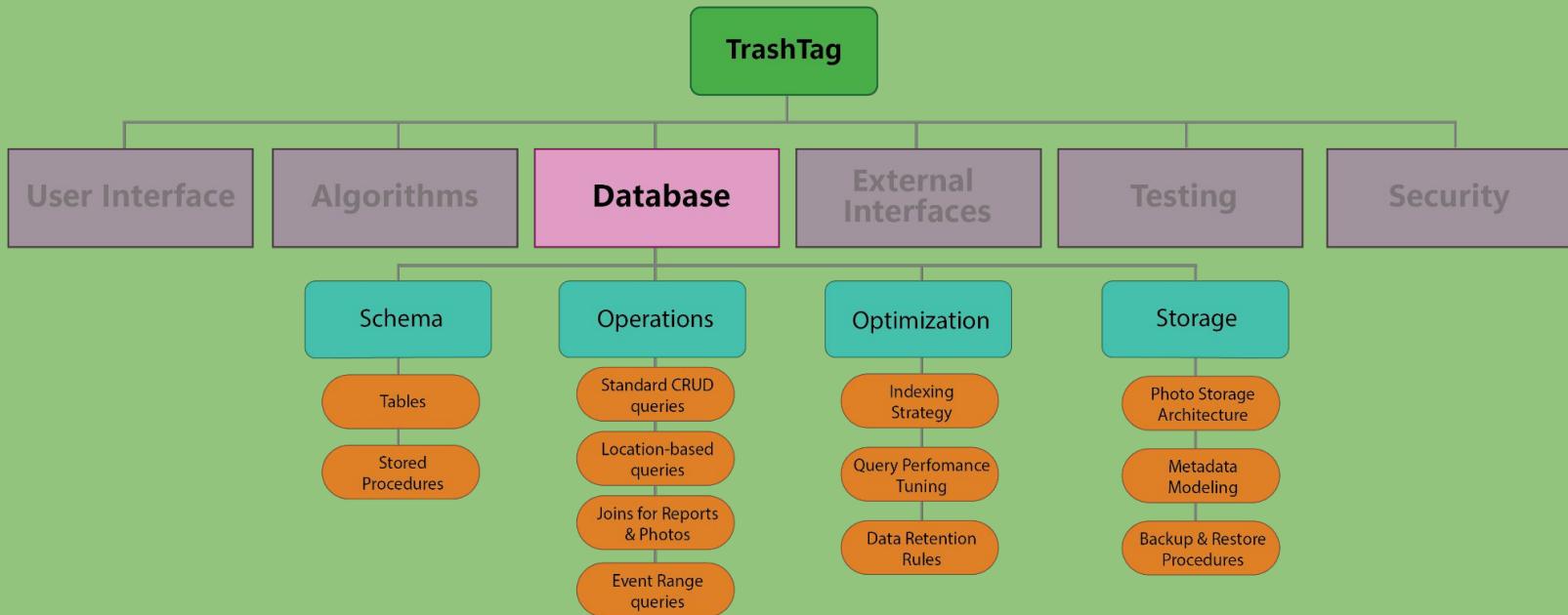
# Work Breakdown Structure



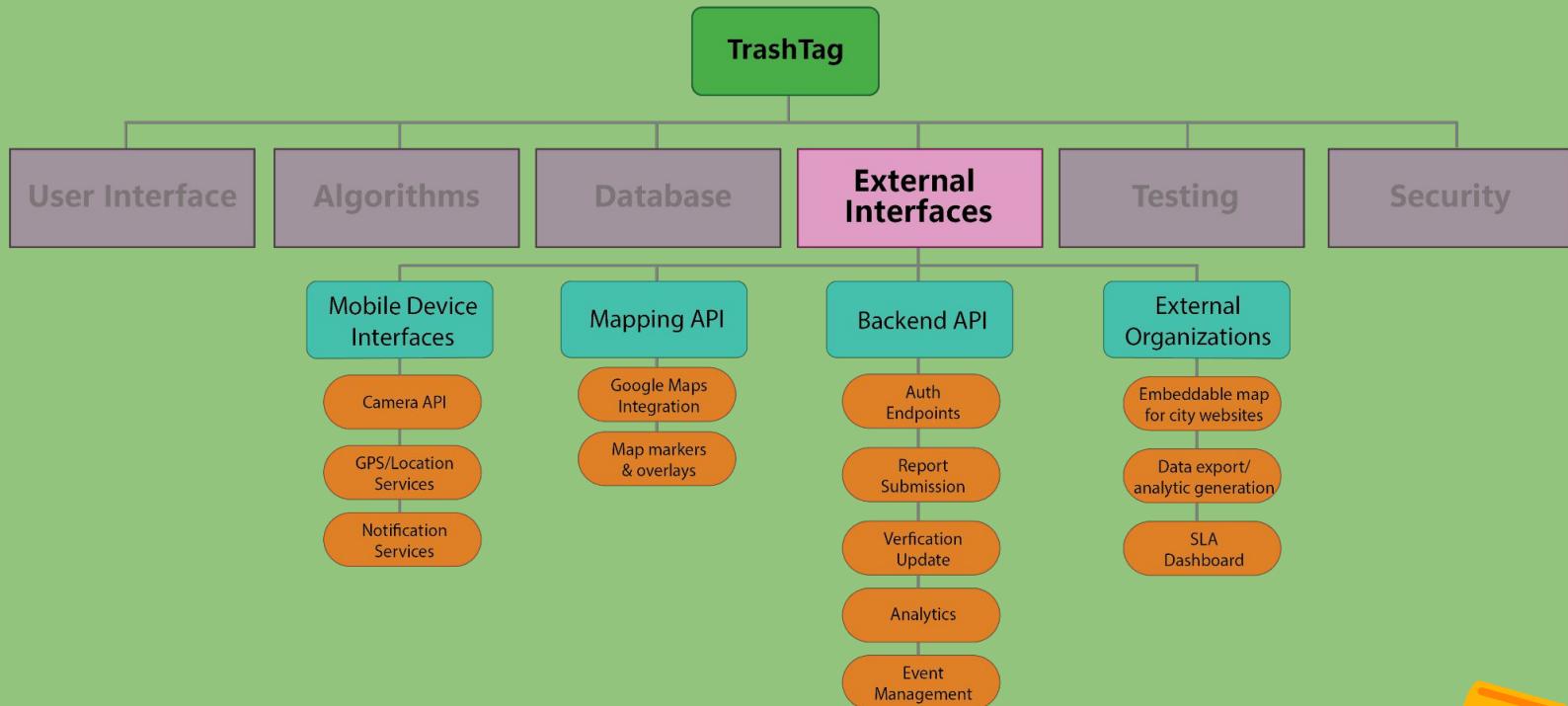
# Work Breakdown Structure



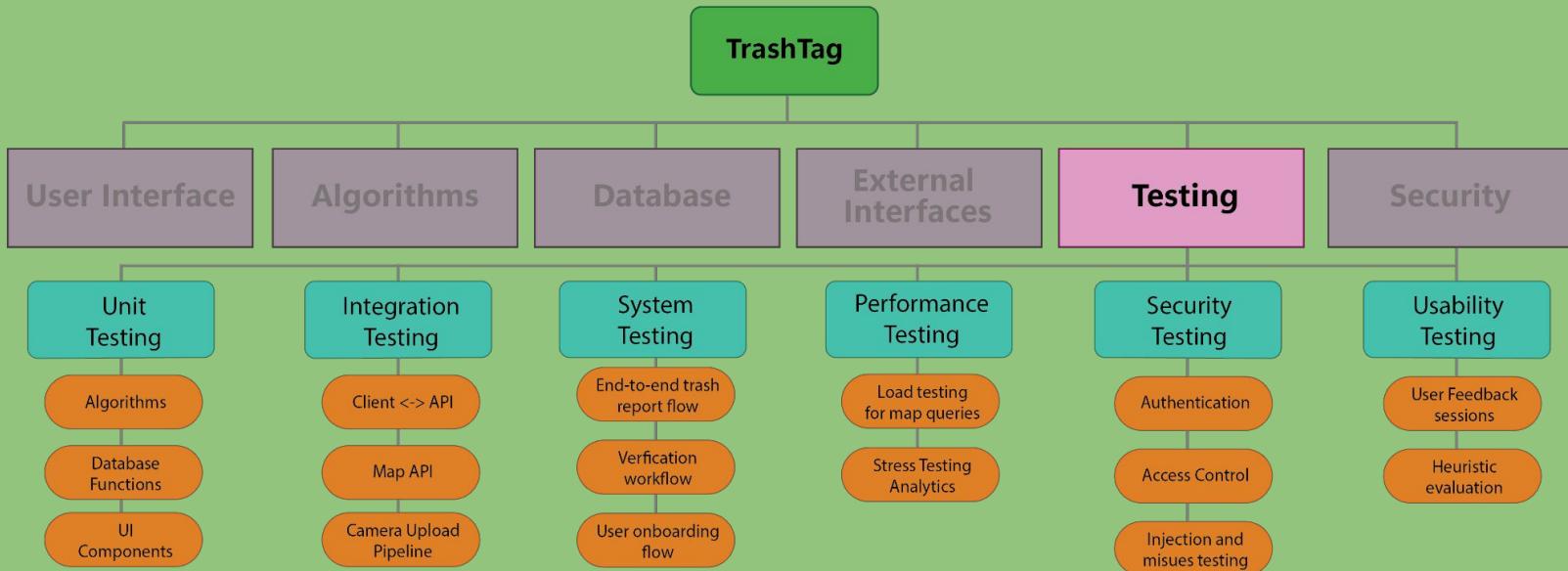
# Work Breakdown Structure



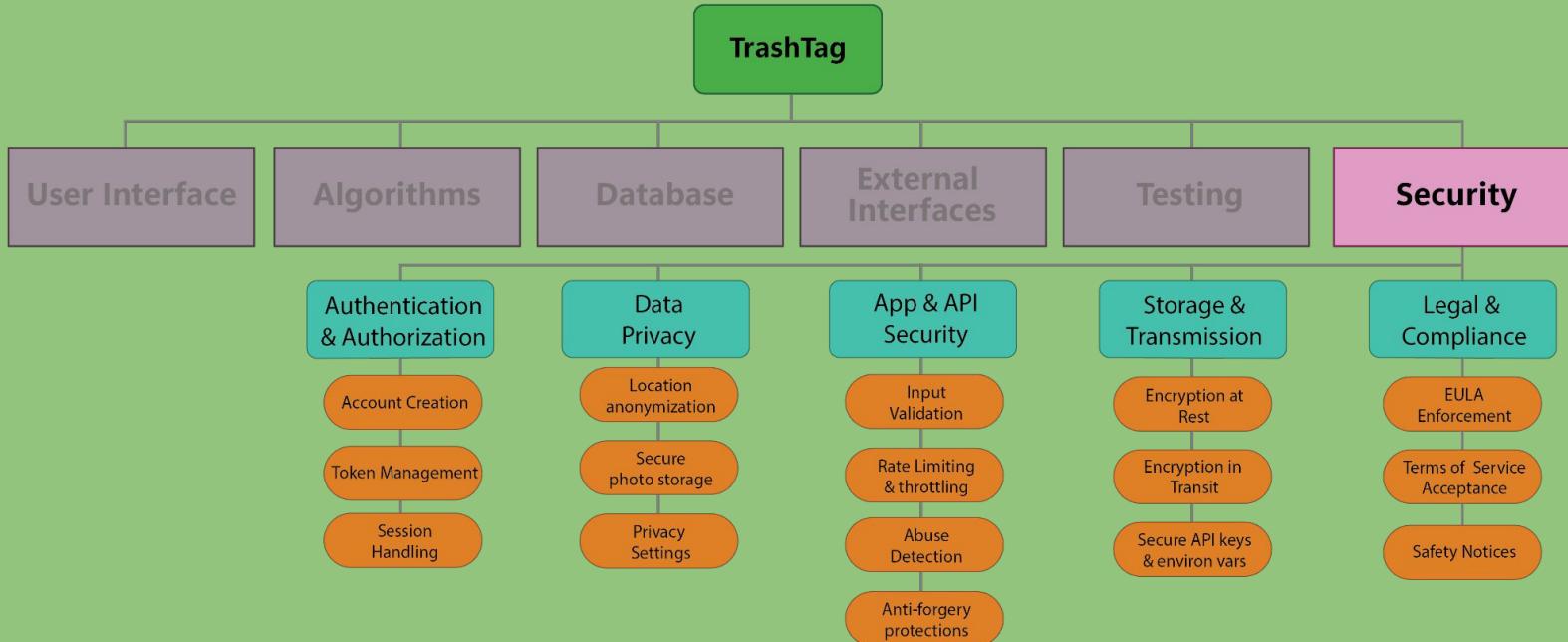
# Work Breakdown Structure



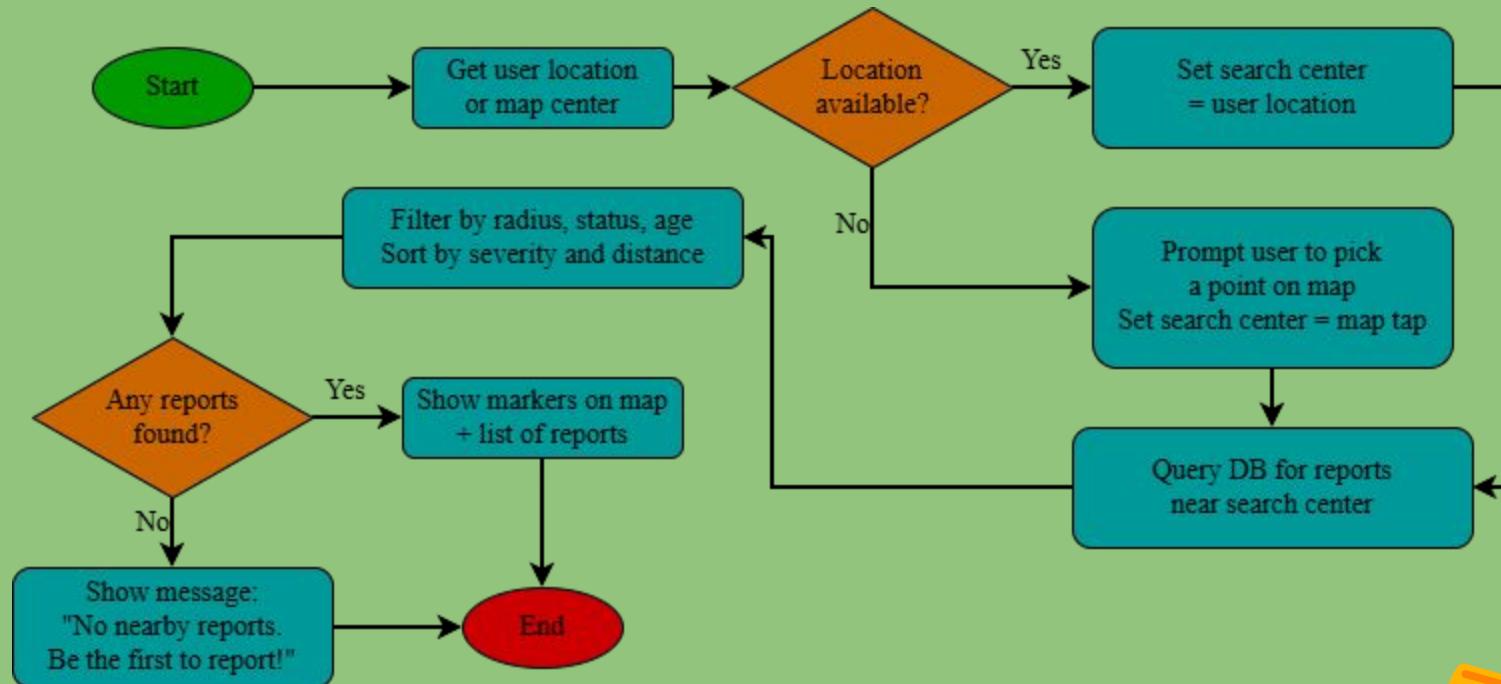
# Work Breakdown Structure



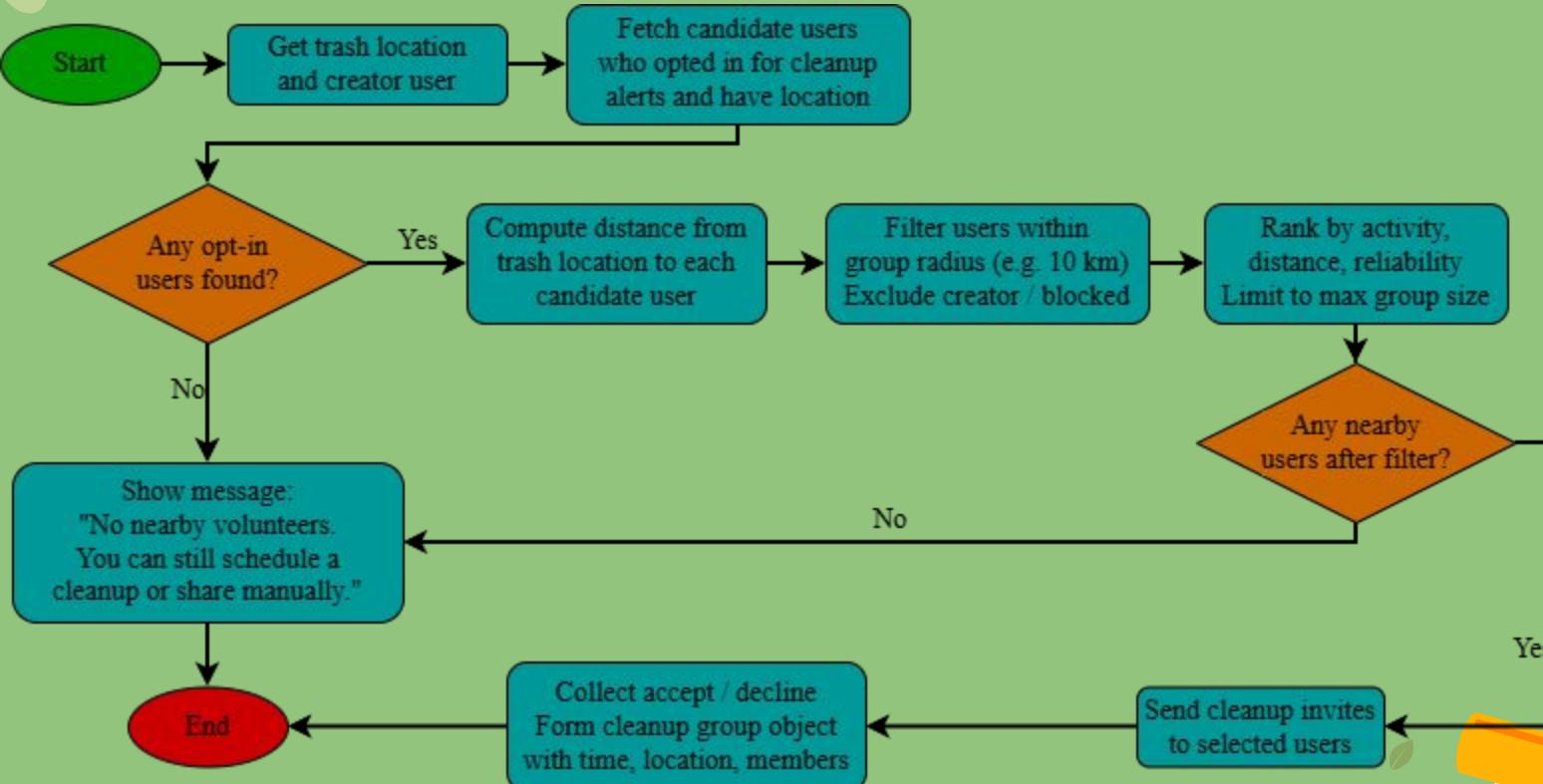
# Work Breakdown Structure



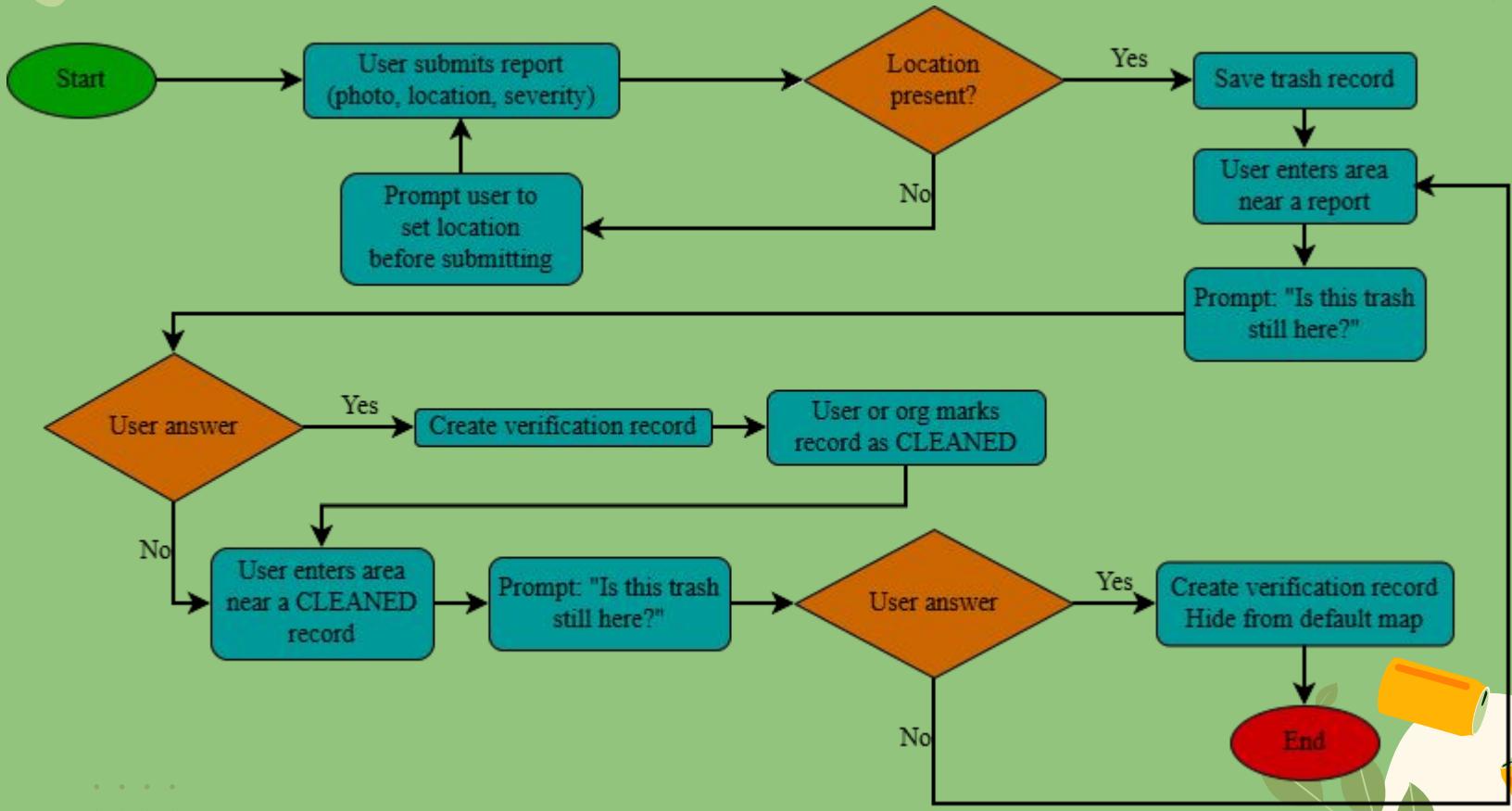
# Algorithms - Nearby Trash Reports



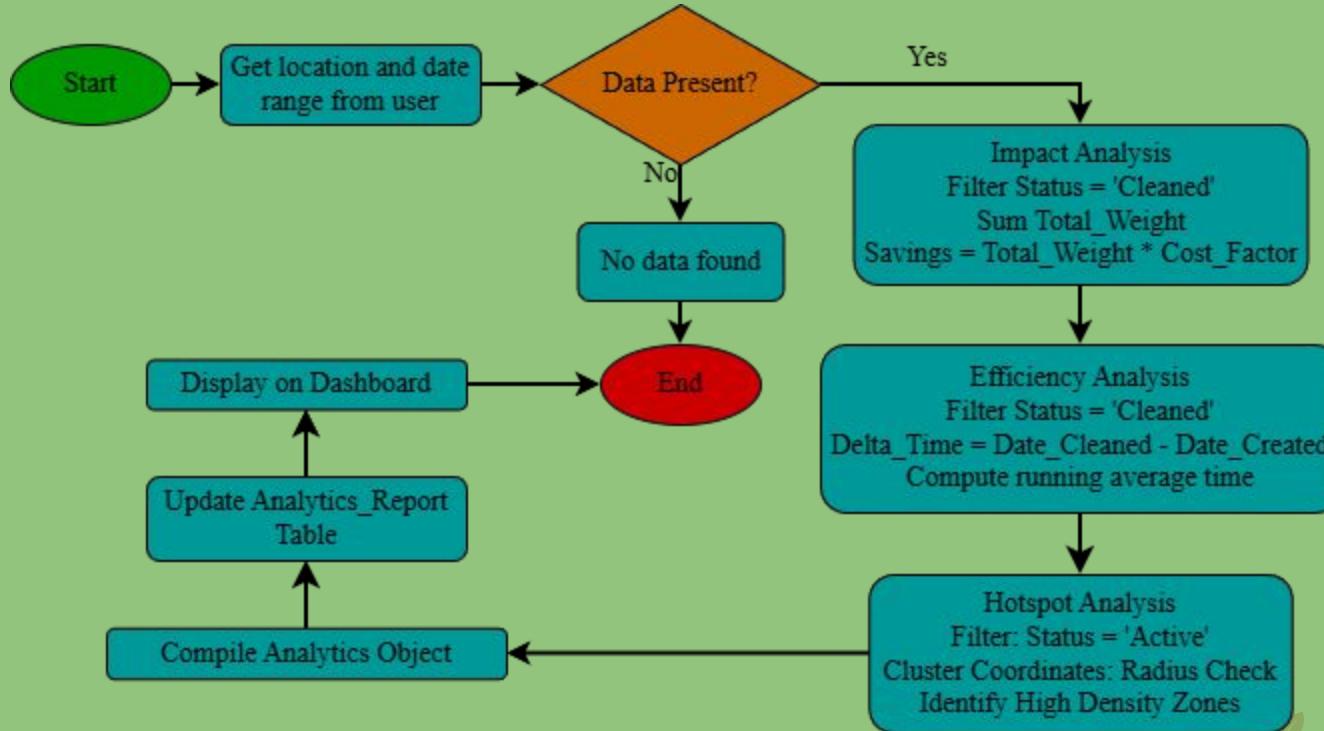
# Algorithms - Find Nearby Users



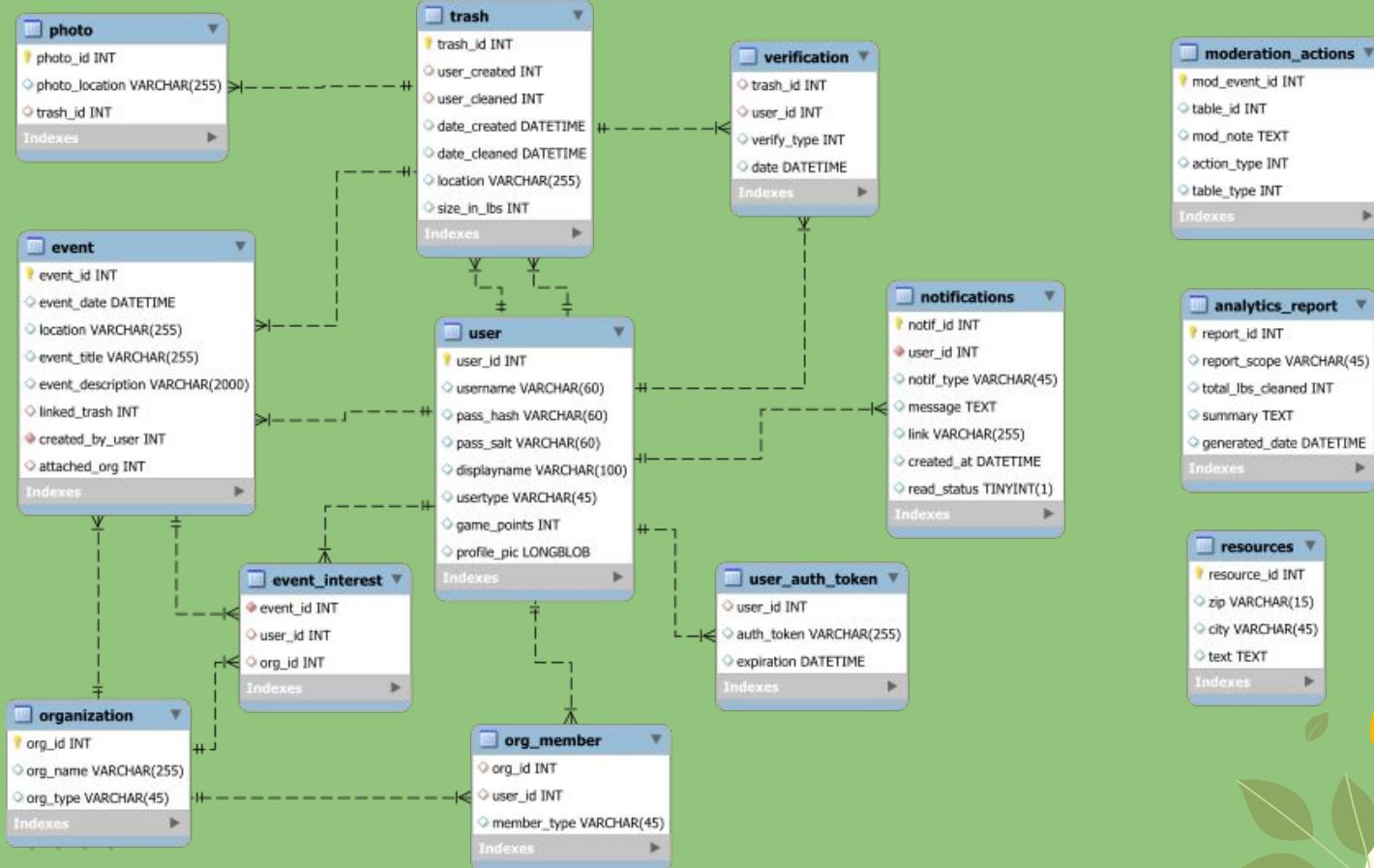
# Algorithms - Trash Report Lifecycle



# Algorithms - Analytics



# Database Schema



# Data Management

## Data Input

- REST API + Mobile App
- Users upload geotagged photos of trash
  - Reports include location, description, size estimate, and timestamp
  - Cleanup org submits claims and update statuses
  - All inputs validated before entering the database

## Data Backups

- SurrealDB Backup System
- Automated daily and weekly backups of all tables
  - Incremental backups reduce storage overhead
  - Supports restoration of individual tables
  - Ensures no data is lost if a server fails

## Data Storage

- SurrealDB (Multi-Model DB)
- Stores structured relational data
  - Stores file references for photos and map coordinates
  - Scalable for large datasets and high user engagement
  - Cloud-deployable for high availability across regions

## Data Protection

- SurrealDB + Platform Security
- RBAC (Role-Based Access Control)
  - Token-based auth
  - Data encryption



# Sprint Breakdown

## Sprint 1

### Setup Environments

- Github
- Finalize DB schema
- Setup cloud hosting

## Sprint 2

### Basic Client

- Show Google Map
- Capture from camera
- Verify location data

### Basic API

- Image upload endpoint
- Verify location data
- Test Google API

## Sprint 3

### Client-API interaction

- API save data to DB
- Client upload to API
- API map data endpoint
- Client gets map data points from API

## Sprint 4

### Client Auth

- Create account
- Setup profile

### API Auth

- New account endpoint
- Save profile endpoint

## Sprint 5

### Client Auth

- Edit Profile
- Login

### API Auth

- Handle login
- All endpoints enforce auth

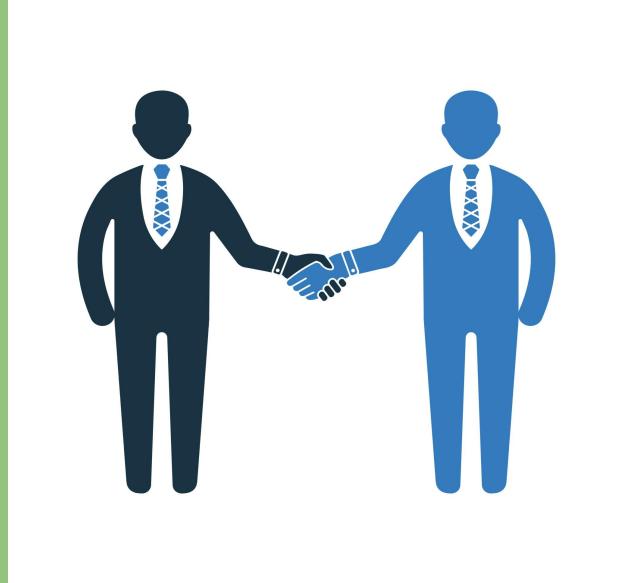
## Sprint 6

- Location-based searching in background
- Notifications
- Show trash details
- Verify trash report/clean



# Conclusion

- Littering is a continuous issue prevalent in our society that affects our environment, governments, and communities.
- **The problem:** Due to the immense communication gap between citizens who see litter and cleanup organizations equipped to remove it, these organizations waste more time searching for litter rather than investing that time removing it.
- **Our solution:** A live reporting platform that closes that gap and facilitates communication through a live mapping system.
- **Engagement:** Motivating communities to “see it, report it, and clean it” through positive engagement strategies and healthy competition
- **Our vision:** By empowering communities to report litter locations, we can successfully close that gap, allowing cleanup organizations to spend more time actively removing litter rather than wasting time searching for it. This platform will transform civic duty into an engaging community movement with our powerful platform components.

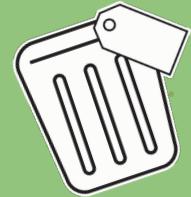


# References

1. "Volunteers Gather Over 16,000 Pounds of Trash from the San Marcos River." *Corridor News*, 13 Apr. 2020, <https://smcorridornews.com/volunteers-gather-over-16000-pounds-of-trash-from-the-san-marcos-river/>
2. Fawaz, Maya. "Hundreds of Volunteers will fan out on San Marcos waterways Saturday to clean up trash." *Kut News*, 3 Mar. 2023, <https://www.kut.org/energy-environment/2023-03-03/hundreds-of-volunteers-will-fan-out-on-san-marcos-waterways-saturday-to-clean-up-trash>
3. "54th San Marcos River Rendezvous Clean Up." *Texas Rivers Protection Association*, <https://txrivers.org/texas-river-blog/54th-san-marcos-river-rendezvous-clean-up/>. Accessed 23 Sept. 2025.
4. Mendoza, Madalyn. "San Marcos River litter 2018." *My San Antonio*, 31 May 2018, <https://www.mysanantonio.com/news/local/slideshow/San-Marcos-River-litter-2018-181939.php>
5. Earth Day. "How Our Trash Impacts the Environment." *EarthDay.org*, updated 22 Sept. 2025, [www.earthday.org/how-our-trash-impacts-the-environment/](https://www.earthday.org/how-our-trash-impacts-the-environment/). Accessed 30 Sept. 2025.
6. thomas. "How Does Littering Affect the Environment?" Texas Disposal Systems, 1 Feb. 2024, <https://www.texasdisposal.com/blog/the-real-cost-of-littering/>.
7. "On This 52nd Annual Earth Day, What Is the State of Litter in Virginia?" VPM, 22 Apr. 2022, <https://www.vpm.org/news/2022-04-21/on-this-52nd-annual-earth-day-what-is-the-state-of-litter-in-virginia>.
8. "Cleaning Litter along Arkansas Roads Costs Millions in Taxpayer Money." Thv11.Com, 28 Oct. 2021, <https://www.thv11.com/article/news/education/arkansas/litter-costs-arkansas-taxpayers-millions/91-38fe040f-82c7-4698-a34a-d8cf7d77de34>

# References (cont.)

9. Garza, Ariana. "More than \$40 Million Taxpayer Dollars Spent Annually on Texas Litter Cleanup." KTXS, 25 Mar. 2014,  
[https://ktxs.com/news/abilene/more-than-40-million-taxpayer-dollars-spent-annually-on-texas-litter-cleanup\\_20160517100457192](https://ktxs.com/news/abilene/more-than-40-million-taxpayer-dollars-spent-annually-on-texas-litter-cleanup_20160517100457192).
10. Picking up Litter: Pointless Exercise or Powerful Tool in the Battle to Beat Plastic Pollution?, 2018,  
[www.unep.org/news-and-stories/story/picking-litter-pointless-exercise-or-powerful-tool-battle-beat-plastic](http://www.unep.org/news-and-stories/story/picking-litter-pointless-exercise-or-powerful-tool-battle-beat-plastic).
11. Lara. "The Economics of Litter." Keep Texas Beautiful, 10 Oct. 2024,  
[ktb.org/ktb-blog/the-economics-of-litter/#:~:text=Infrastructure%20Impacts,million%20deficit%20in%20infrastructure%20investments](http://ktb.org/ktb-blog/the-economics-of-litter/#:~:text=Infrastructure%20Impacts,million%20deficit%20in%20infrastructure%20investments).
12. "How Litter Harms Humans, Animals, and the Environment." Fire & Ice,  
<https://indoortemp.com/resources/how-litter-harms-humans-animals-environment>. Accessed 12 Oct. 2025.
13. Campbell, Marnie L., et al. "Human Health Impacts from Litter on Beaches and Associated Perceptions: A Case Study of 'Clean' Tasmanian Beaches." Ocean & Coastal Management, vol. 126, Jun. 2016, pp. 22–30.  
ScienceDirect, <https://doi.org/10.1016/j.ocecoaman.2016.04.002>
14. Blouin, Lou. "The Psychology of Littering." The Allegheny Front, 8 Jan. 2016,  
<https://www.alleghenyfront.org/the-psychology-of-littering/>.
15. Litter in America Results from the Nation's Largest Litter Study,  
[www.hampton.gov/DocumentCenter/View/308/litter-factsheet-costs?bidId=](http://www.hampton.gov/DocumentCenter/View/308/litter-factsheet-costs?bidId=). Accessed 12 Oct. 2025.
16. How to Reduce Litter In Your Parks, <https://www.miracle-recreation.com/blog/reduce-litter-in-parks/>
17. The Economics of Litter, [https://ktb.org/ktb-blog/the-economics-of-litter/](http://ktb.org/ktb-blog/the-economics-of-litter/)
18. 48,000 Pounds of Litter Removed Across Virginia on Clean the Bay Day,  
<https://web.archive.org/web/20250622092145/https://www.cbf.org/news-media/newsroom/2025/virginia/more-than-43000-pounds-of-litter-removed-across-virginia-on-clean-the-bay-day.html>



# Appendix

**Application Programming Interface (API):** A set of rules that allows different software programs to communicate with each other and share data or functionality.

**RDBMS (Relational Database Management System):** A database system that stores data in tables and organizes relationships between them.

**Metadata:** Data that describes other data, such as when a file was created, who created it, or what type it is.

**Geotagging:** The process of attaching location information to digital content, so it can be linked to a specific place on a map.

**Analytics:** The reports we send to local government authorities and/or organizations providing them our collected data regarding littering.

**Report/Reporting:** The reports that users individually enter into the app to indicate illegally dumped trash they have found in the public.

