

# Running in Circles

Spatial Optimisation with OSRM and R

Megan Beckett  
Exegetic Analytics  
satRday 2020

3 (relevant) things:

3 (relevant) things:  
I like green spaces

3 (relevant) things:

I like green spaces

I like R

3 (relevant) things:

I like green spaces

I like R

I like running





**cycle.travel**

ROUTE GUIDES . CITY GUIDES . MAP . MY

Key · Help · Data © Ordnance Survey/  
OpenStreetMap contributors

Search and directions

From:

To: town/blank for suggestions

On: Paths & roads  Paved only

[Get route](#) [Round-trip](#) [Suggest a ride](#)

**Using the journey-planner**

To plan a bike route, click the start and end points, or type placenames above.

To alter the route, just drag anywhere on the route - a new marker will appear.

To see photos (UK/Ireland), click on the route, and choose 'Find photos'.

To remove a point, click the point, and choose 'Remove via point'.

To find places to stay, click 'Find hotels', then look for the bed icons.

To view your route in an app, download an app that opens GPX files (we like Viewranger, MapOut, and OsmAnd), then click 'GPS' to open the track in the app.

To share your route with friends, click 'Save'. You'll need to log in first.

For more help, read our detailed help pages.

[Log in to save routes »](#)

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# Maps and location for developers

Precise location data and powerful developer tools to change the way  
we navigate the world.

[Start mapping for free](#)

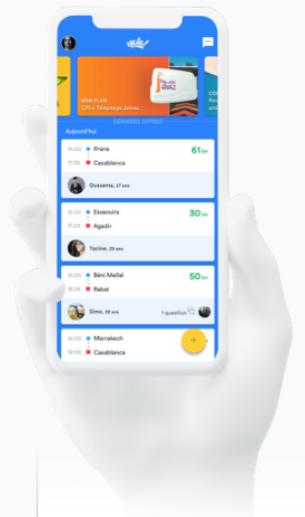
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# Partagez plus qu'un voyage

Covoiturage Fiable & Moderne au Maroc

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## Pourquoi voyager avec Yala ?

Help



Discover a location near you



Search for a dispensary:



Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapbox | Dispensary Data © Ganja405

Ganja405 Selections:

A & R Med Shop, LLC

Alchemy Gold Healing

Alice's Restaurant Dispensary

BC Medi Chronic

Blue Collar Criminals

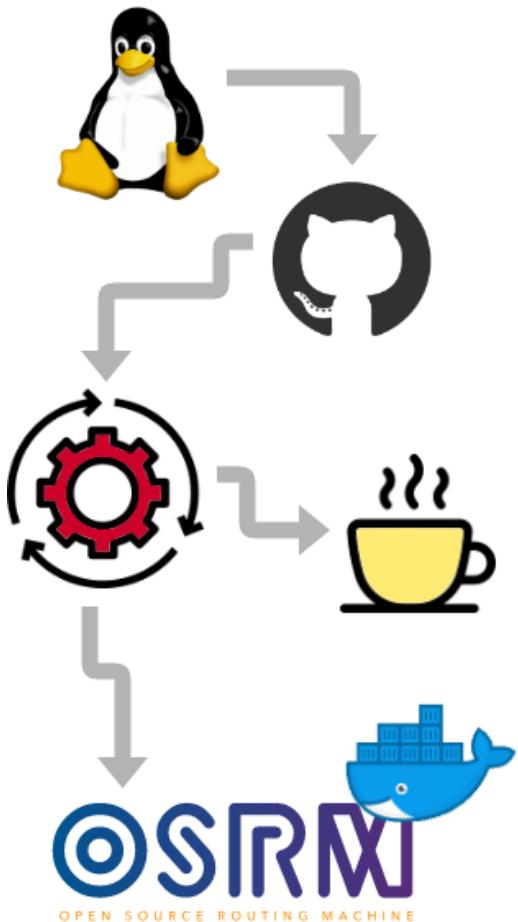
Cannabis Aid

Cannabis Care of Oklahoma

Cannabis Therapeutics

Cannabless

# Building OSRM



```
# Necessary infrastructure.  
sudo apt update  
sudo apt install -y git cmake build-essential jq htop \  
    liblua5.2-dev libboost-all-dev \  
    libprotobuf-dev libtbb-dev \  
    libstxxl-dev libbz2-dev  
  
# Grab the source on GitHub.  
git clone https://github.com/Project-OSRM/osrm-backend.git  
  
# Create a build folder and then run cmake.  
cd osrm-backend/  
mkdir build  
cd build/  
cmake ..  
  
# Next initiate the build.  
# This will take some time - grab a cup of coffee!  
make  
  
# When the build completes,  
# make the install target for OSRM.  
sudo make install
```

# Getting the data - [www.openstreetmap.org](http://www.openstreetmap.org)

 OpenStreetMap [Edit](#) [History](#) [Export](#)

Search [Where is this?](#) [Go](#) 

### Export

-26.0273  
27.8210  
28.2818  
-26.2852

[Manually select a different area](#)

#### License

OpenStreetMap data is licensed under the [Open Data Commons Open Database License \(ODbL\)](#).

[Export](#)

If the above export fails, please consider using one of the sources listed below:

#### [Overpass API](#)

Download this bounding box from a mirror of the OpenStreetMap database

#### [Planet OSM](#)

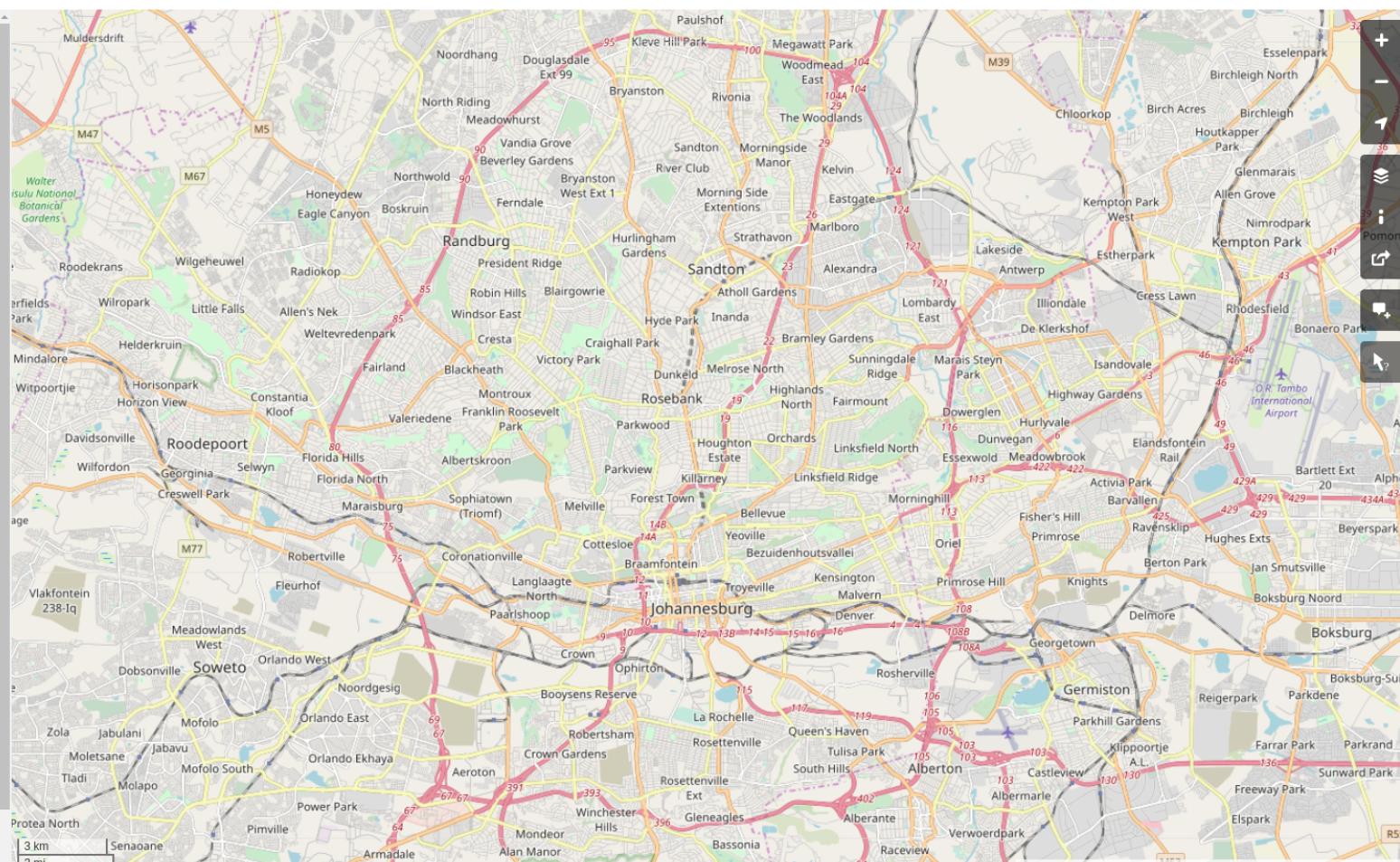
Regularly-updated copies of the complete OpenStreetMap database

#### [Geofabrik Downloads](#)

Regularly-updated extracts of continents, countries, and selected cities

#### [Other Sources](#)

Additional sources listed on the [OpenStreetMap wiki](#)



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# Getting the data - [www.openstreetmap.org](http://www.openstreetmap.org)

You requested too many nodes (limit is 50000). Either request a smaller area, or use planet.osm

# Getting the data - [www.openstreetmap.org](http://www.openstreetmap.org)

Download OpenStreetMap data for this region:

## South Africa

[\[one level up\]](#)

The OpenStreetMap data files provided on this server do **not** contain the user names, user IDs and changeset IDs of the OSM objects because these fields are assumed to contain personal information about the OpenStreetMap contributors and are therefore subject to data protection regulations in the European Union.

[Extracts with full metadata](#) are available to OpenStreetMap contributors only.

### Commonly Used Formats

- [south-africa-latest.osm.pbf](#), suitable for Osmium, Osmosis, imposm, osm2pgsql, mkgmap, and others. This file was last modified 8 hours ago and contains all OSM data up to 2020-03-02T21:59:01Z. File size: 174 MB; MD5 sum: [43eee1de3dd6a0418ef5f80fc78a8e](#).
- [south-africa-latest-free.shp.zip](#), yields a number of ESRI compatible shape files when unzipped. ([Format description PDF](#)) This file was last modified 4 hours ago. File size: 334 MB; MD5 sum: [85221d4f5dea5d09c272ca8e85839db2](#).

### Other Formats and Auxiliary Files

- [south-africa-latest.osm.bz2](#), yields OSM XML when decompressed; use for programs that cannot process the .pbf format. This file was last modified 28 days ago. File size: 526 MB; MD5 sum: [d36e6dbe7db01a0a8b94f384cfa86e9f](#).
- [south-africa/internal.osm.pbf](#) The history file contains personal data and is available on the [internal server](#) only. See notice above for further information.
- [.poly\\_file](#) that describes the extent of this region.
- [.osc.gz\\_files](#) that contain all changes in this region, suitable e.g. for Osmosis updates
- [raw directory index](#) allowing you to see and download older files

### Sub Regions

No sub regions are defined for this region.

GEOFABRIK  [downloads](#)



 Not what you were looking for? Geofabrik is a consulting and software development firm based in Karlsruhe, Germany specializing in OpenStreetMap services. We're happy to help you with data preparation, processing, server setup and the like. [Check out our web site](#) and contact us if we can be of service.

 Nicht das Richtige dabei? Die Geofabrik ist ein auf OpenStreetMap spezialisiertes Beratungs- und Softwareentwicklungsunternehmen in Karlsruhe. Gern helfen wir Ihnen bei der Datenaufbereitung, Datenkonvertierung, Serverinstallation und ähnlichen Aufgaben. [Besuchen Sie unsere Webseite](#) und sprechen Sie mit uns, wenn wir Ihnen helfen können.

# Preparing the data

## Extract the map

- car
- bike
- foot

```
osrm-extract map.xml -p profiles/foot.lua
```



# Preparing the data

## Extract the map

- car
- bike
- foot

```
osrm-extract map.xml -p profiles/foot.lua
```

## Create the hierarchy

```
osrm-contract map.xml.osrm
```



# Preparing the data

## Extract the map

- car
- bike
- foot

```
osrm-extract map.xml -p profiles/foot.lua
```

## Create the hierarchy

```
osrm-contract map.xml.osrm
```

## Launch the service

```
osrm-routed map.xml.osrm
```



# How long and far to walk from here to the nearest park?



# How long and far to walk from here to the nearest park?



# How long and far to walk from here to the nearest park?

```
curl "http://127.0.0.1:5000/route/v1/walking/28.053241,-26.113230;28.073497,-26.105388" | jq
```

```
{  
  "code": "Ok",  
  "waypoints": [  
    {  
      "hint": "9lAqgBf7LYArAAAAlQAAALwBAABWAQAAPxLCQHeHpEGs9nZCSEgAfw88ZX0",  
      "distance": 2.634498,  
      "location": [  
        28.053251,  
        -26.113252  
      ],  
      "name": "Discovery Place"  
    },  
    {  
      "hint": "eNMGgITTBoBfBQAAZAEAAAAAAABIDAA99A-Q8MARUIAAAAWBPaQ1",  
      "distance": 0.447755,  
      "location": [  
        28.0735,  
        -26.105385  
      ],  
      "name": "Grayston Drive"  
    }  
  ],  
}
```

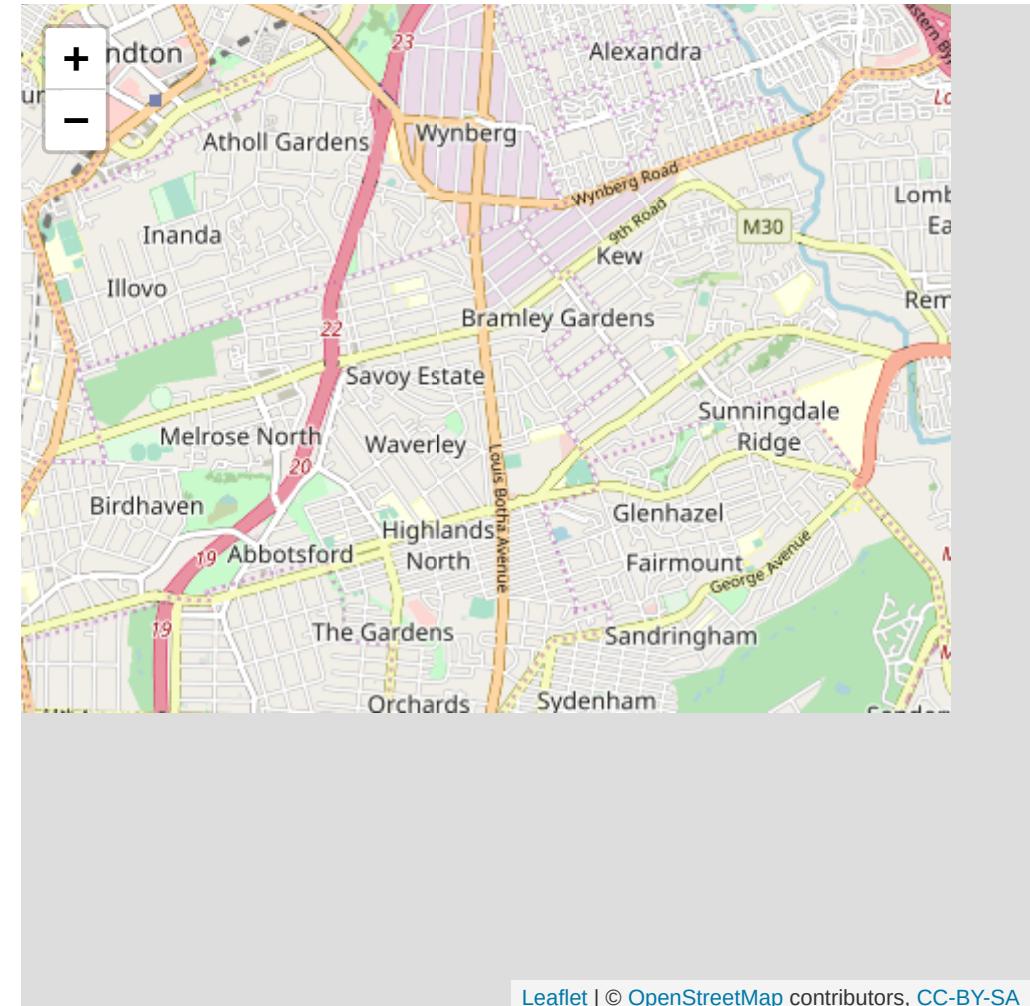
# How long and far to walk from here to the nearest park?

```
"routes": [
  {
    "legs": [
      {
        "steps": [],
        "weight": 1997.1,
        "distance": 2756.8,
        "summary": "",
        "duration": 1997.1
      }
    ],
    "weight_name": "duration",
    "geometry": "xfk~CycfjD_EeNu0}0cCoEoNme@] }@WJ_JiXgAOWiBOMqCVw@UcAbCj@{Bv@_BtMuN",
    "weight": 1997.1,
    "distance": 2756.8,
    "duration": 1997.1
  }
]
```

- The duration is in seconds.
- The distance is in metres.

# The osrm R package

```
install.packages('osrm')
```

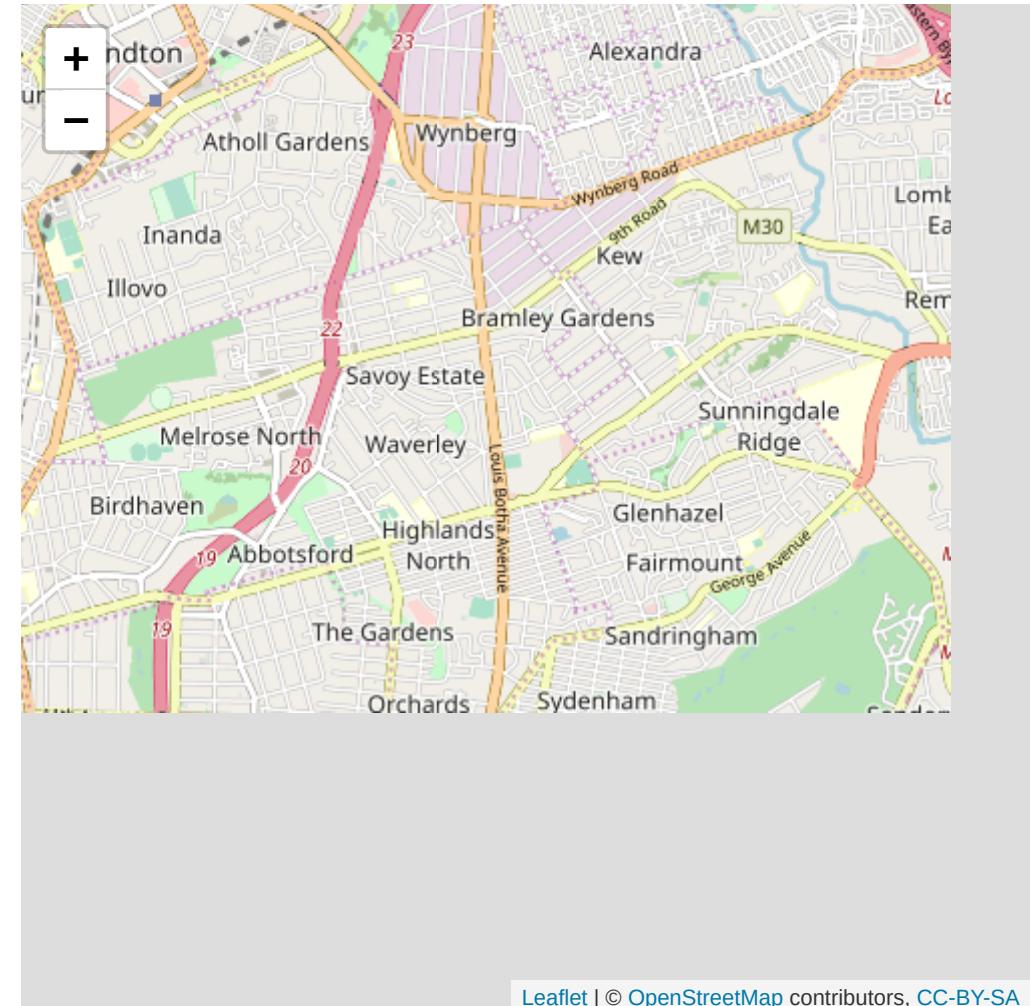


# The osrm R package

```
install.packages('osrm')
```

Two important questions:

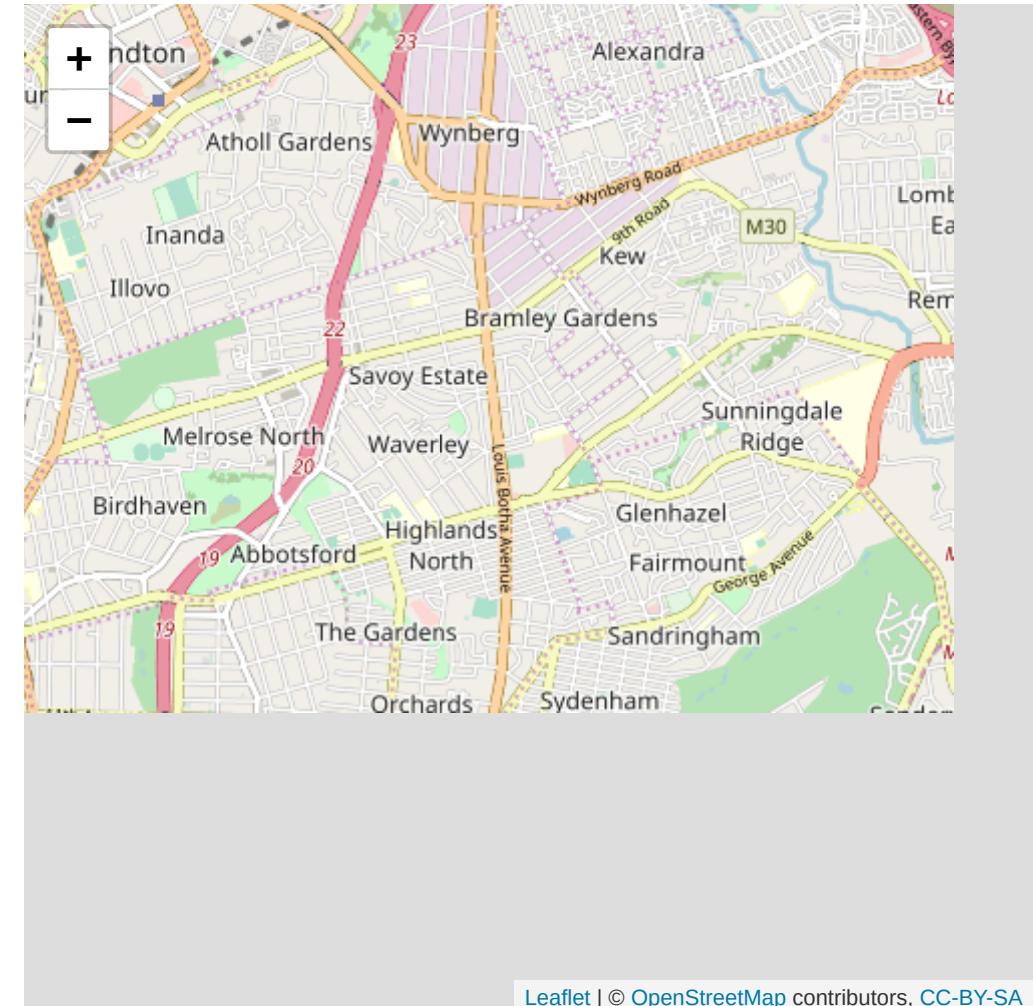
1. What's the *optimal route* to visit the parks in the surrounding area?
2. What can I possibly see within certain *time intervals*?



# The osrm R package

```
install.packages('osrm')
```

With my running shoes on!



# 1. What's the optimal route?



```
# Libraries
library(osrm)
library(leaflet)
library(dplyr)

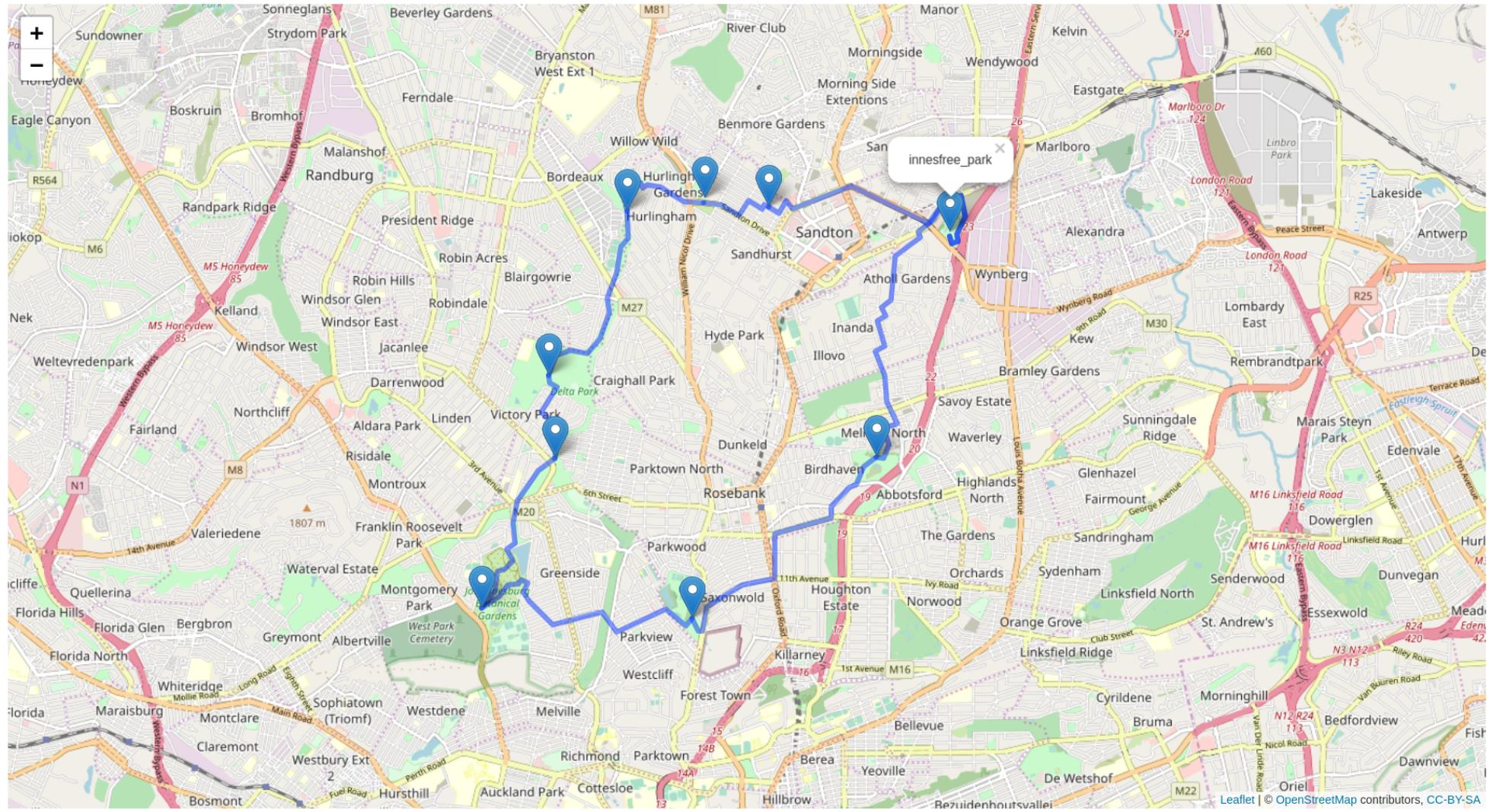
# Point to osrm server
options(osrm.server = "http://127.0.0.1:5000/")

# Create dataframe of (unordered points)
locs <- data.frame(id = c("bnb", "jhb_botanical_gardens", ...),
                     lon = c(28.045374, 28.062958, 27.998316, ...),
                     lat = c(-26.100931, -26.137748, -26.159879, ...))

# Calculate the shortest round trip
trip <- osrmTrip(locs)

# Plot with Leaflet
leaflet(data = trip[[1]]$trip) %>%
  addTiles() %>%
  addMarker() %>%
  addPolylines()
```

Notebook - [bit.ly/satrdy-osrm](http://bit.ly/satrdy-osrm)



## 2. What can I see within certain time intervals?



```
# Libraries
library(osrm)
library(leaflet)
library(dplyr)

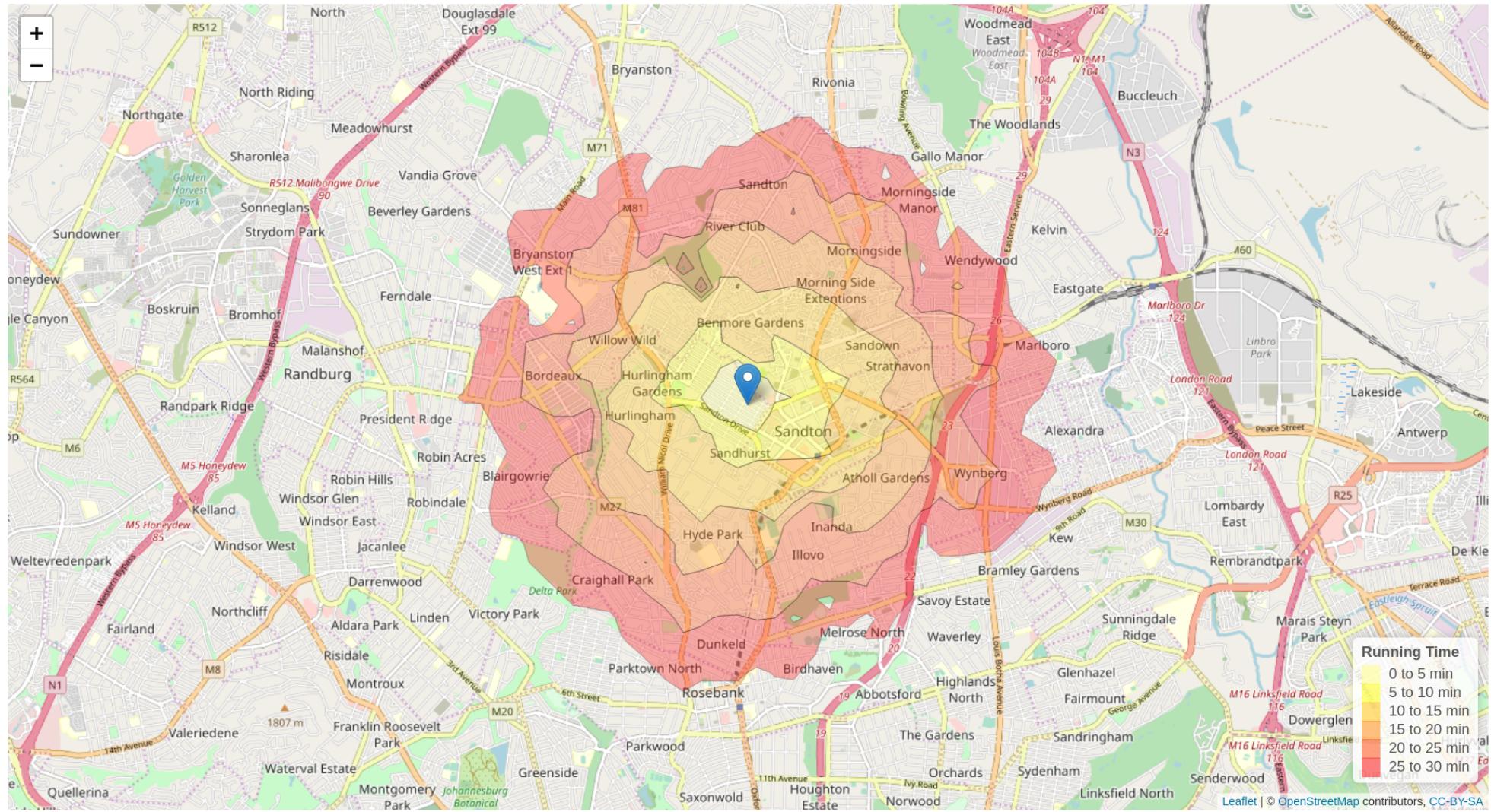
# Point to osrm server
options(osrm.server = "http://127.0.0.1:5000/")

# Set location
loc <- c(28.045374, -26.100931)

# Generate isochrones at time intervals
iso <- osrmIsochrone(loc,
                      breaks = seq(from = 0, to = 30, by = 5),
                      res = 300)

# Plot with Leaflet
leaflet(data = iso) %>%
  addTiles() %>%
  addMarkers() %>%
  addPolygons()
```

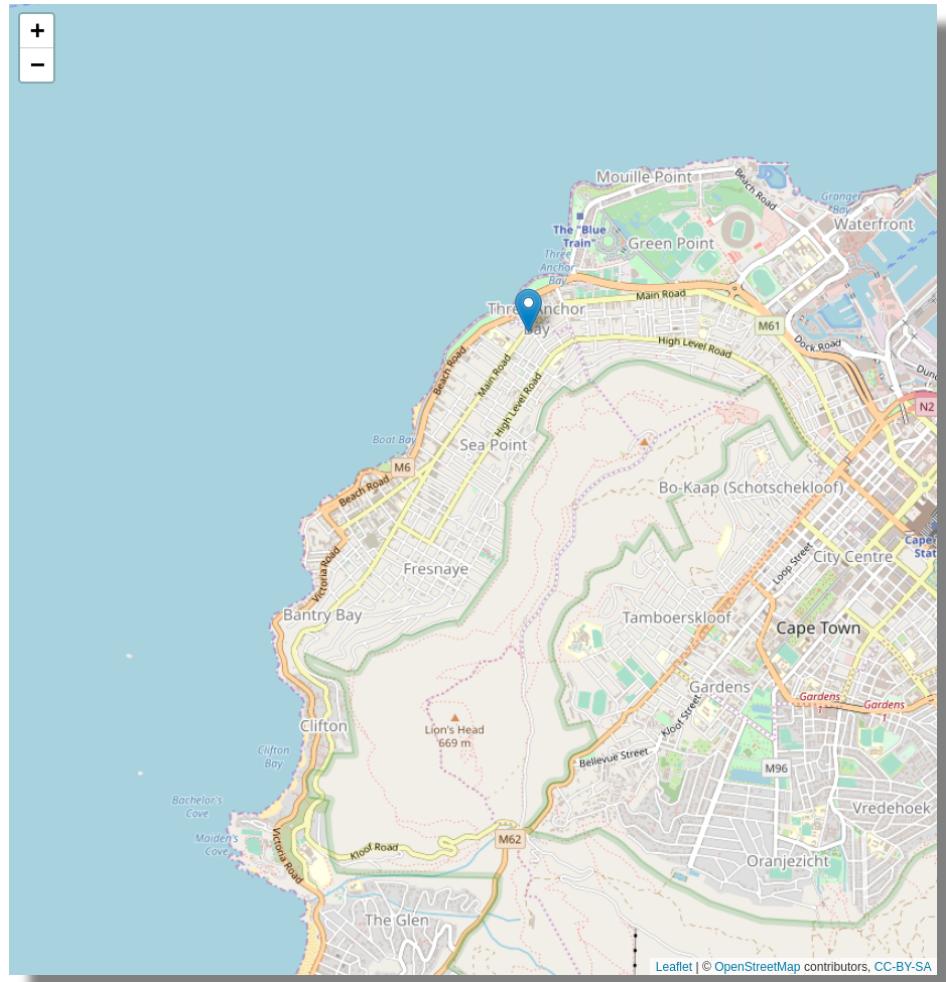
[Notebook - bit.ly/satrday-osrm](https://bit.ly/satrday-osrm)





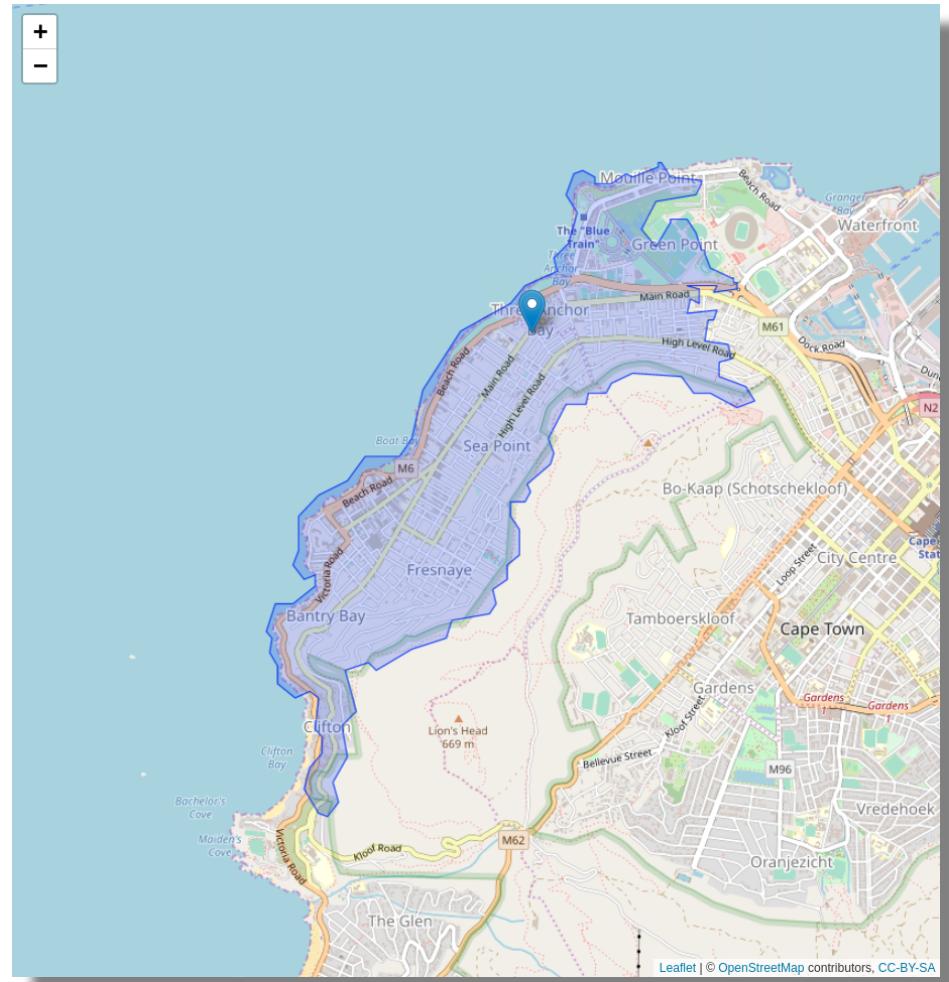
# Application: Delivery area compromise

- A store **location**



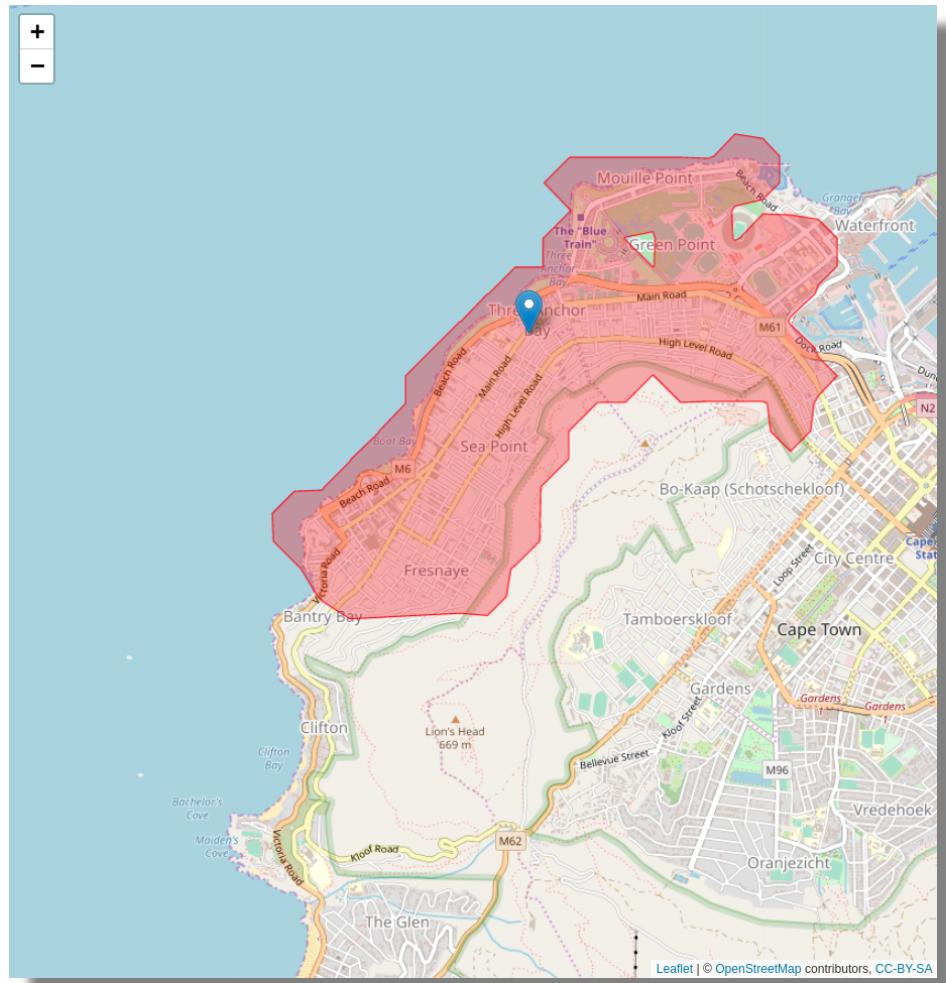
# Application: Delivery area compromise

- A store location
- A delivery area of max **8 min** - *isochrone*



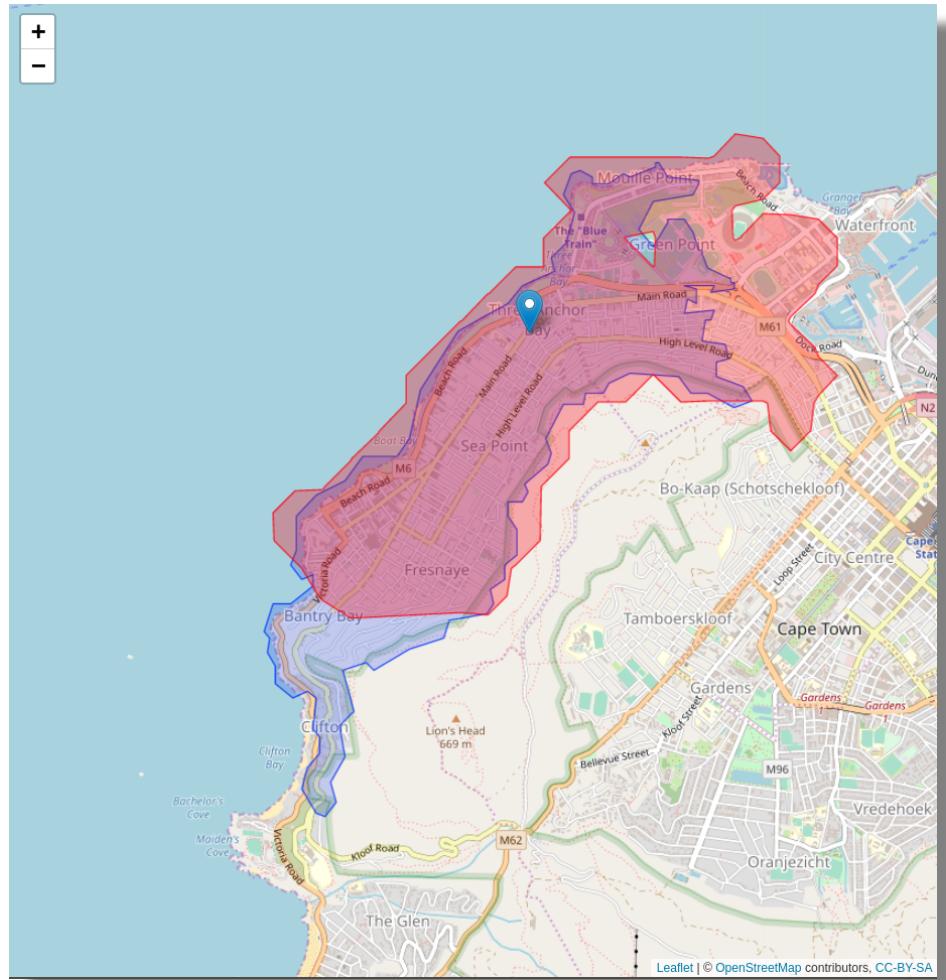
# Application: Delivery area compromise

- A store location
- A delivery area of max 8 min - *isochrone*
- A delivery area of max **2.5 km** - *isodistance*



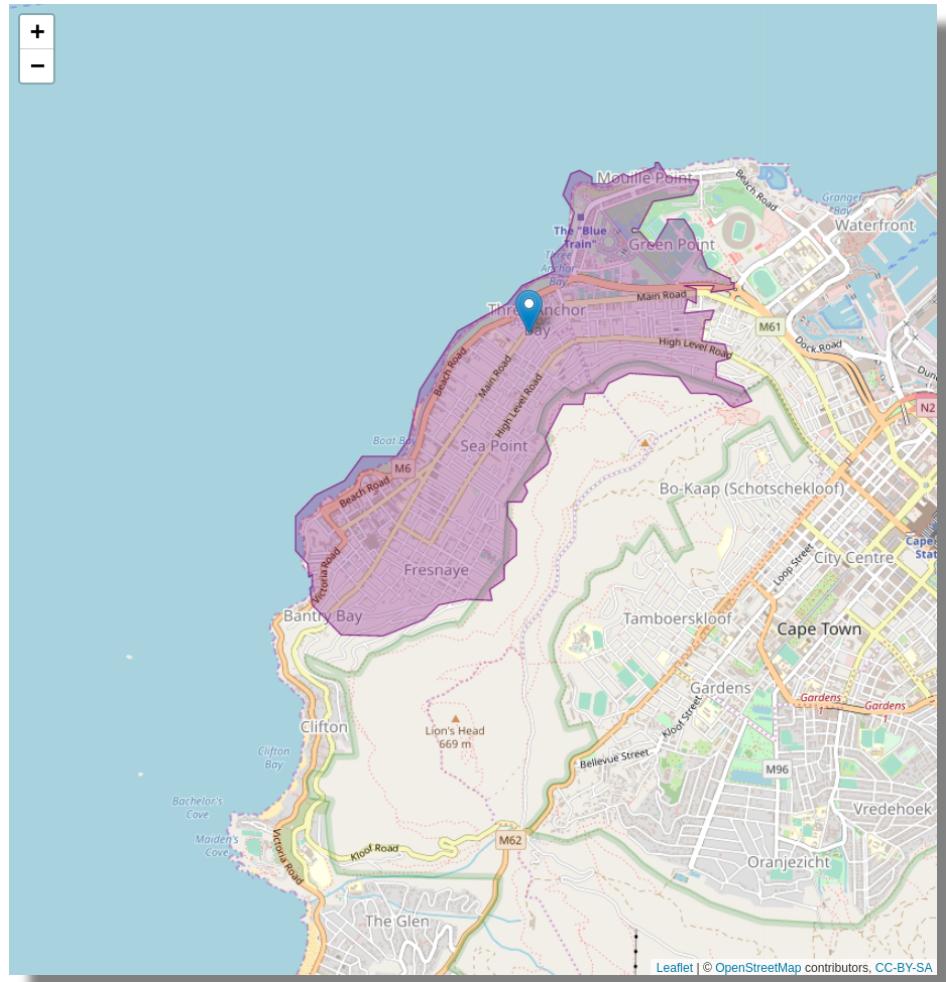
# Application: Delivery area compromise

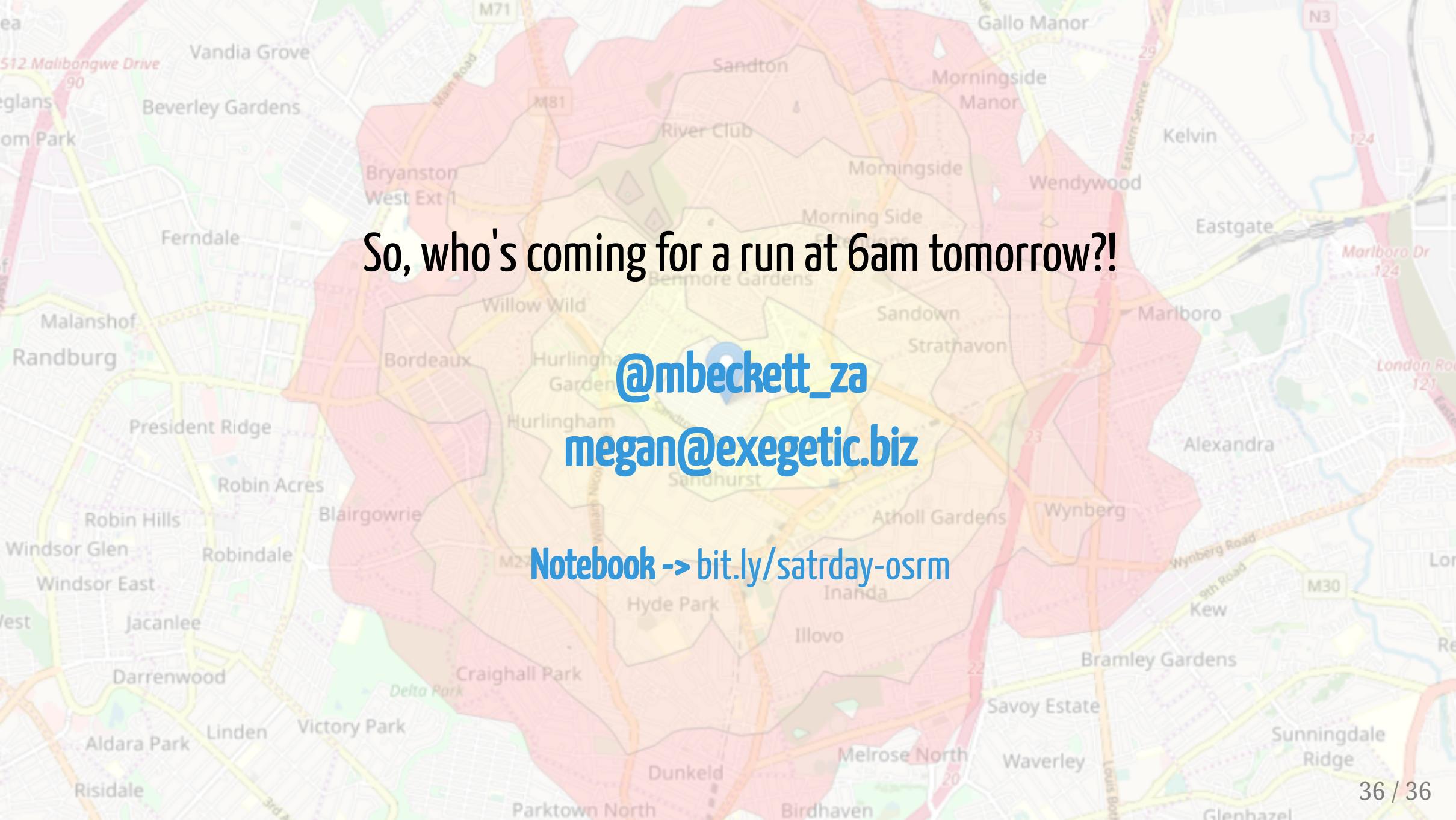
- A store location
- A delivery area of max 8 min - *isochrone*
- A delivery area of max 2.5 km - *isodistance*
- An **intersection**



# Application: Delivery area compromise

- A store location
- A delivery area of max 8 min - *isochrone*
- A delivery area of max 2.5 km - *isodistance*
- An intersection
- Everyone is **happy!**





So, who's coming for a run at 6am tomorrow?!

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megan@exegetic.biz

Notebook -> [bit.ly/satrday-osrm](http://bit.ly/satrday-osrm)