

# OSM | Introduction

## Data Model and Elements



July 2018

# Basics of OSM Data

# The OSM Team

## Our Role as Editors



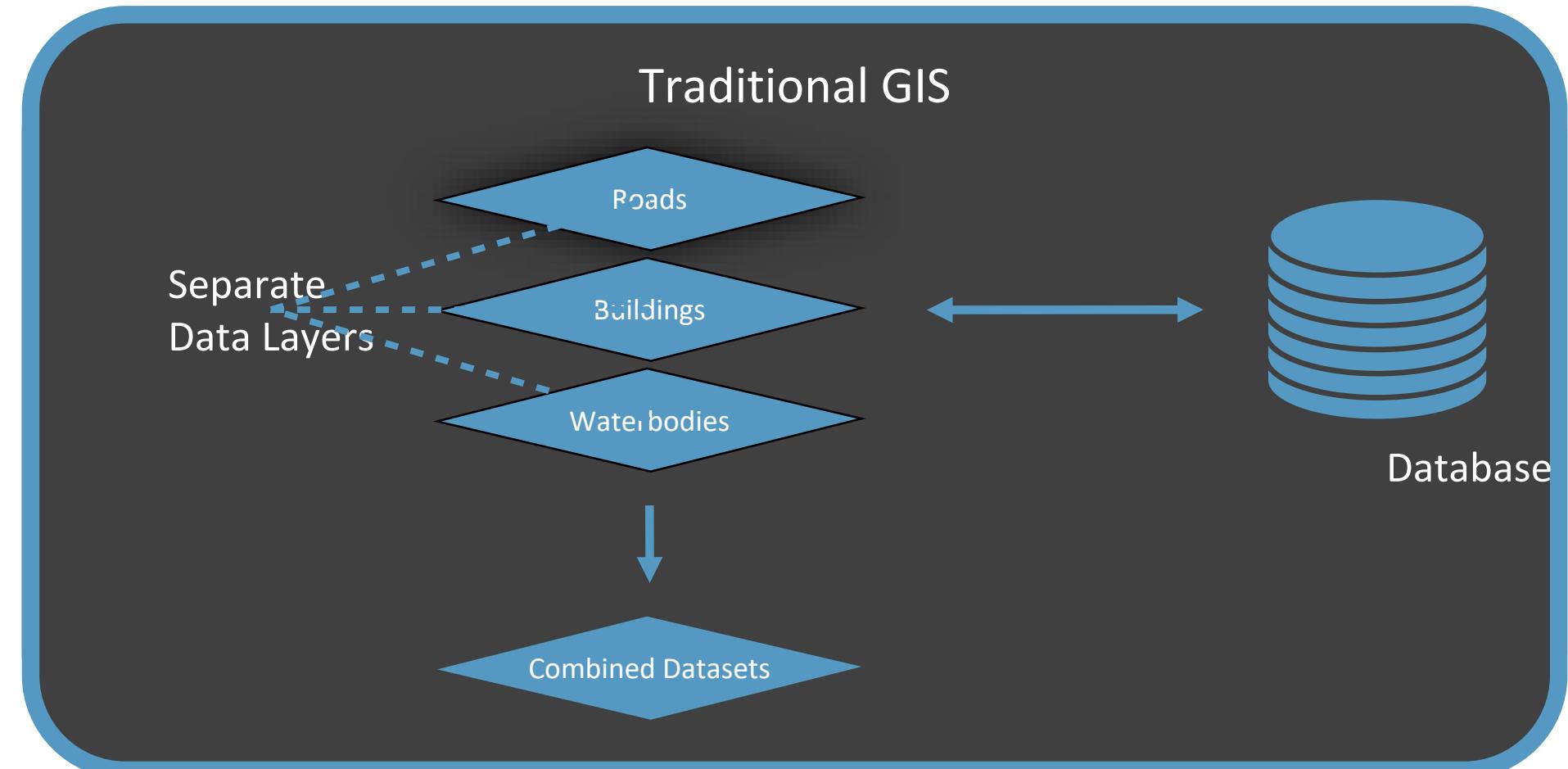
- We work cooperatively with the entire OSM community
- We rely on the OpenStreetMap community and guidelines to develop the map
- Editors must be respectful and careful with edits
- Everyone's shared goal is creating an accurate, useful, and open-source map

# Basics of OSM Data

## OSM Data

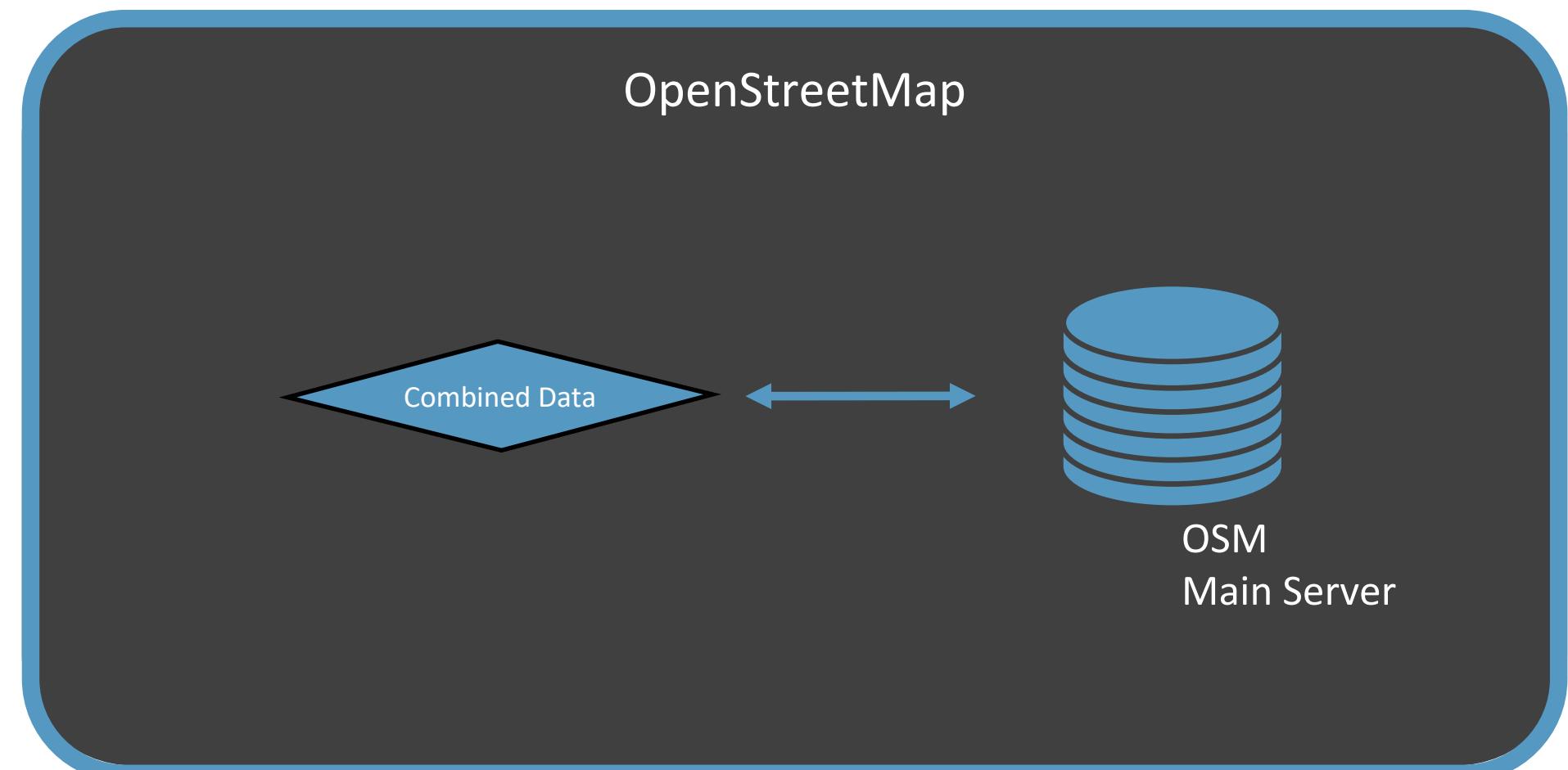
Traditional GIS uses a spatial database structure, where **each element type resides in a separate layer**

- Data layers are individual files (.shp, .geoJSON, .kml)
- Each layer contains unique elements and related attribute data



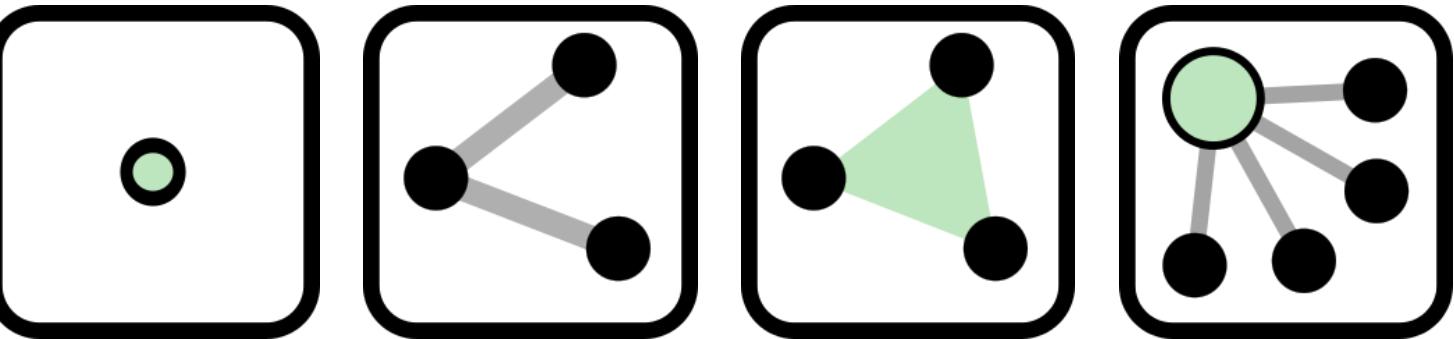
OSM does not follow a traditional structure

- OSM does not delineate elements into separate layers, rather, **all elements are contained in a single data layer**
- OSM data is always online



# Basics of OSM Data

## Core Data Structure



OSM data is modeled by [elements](#) in three element types

- [Element Types](#): Nodes, Ways, Closed Ways, and Relations

Every map element, at its most basic has:

1. 1) a unique osm\_id
2. 2) Latitude and Longitude

The osm\_id =

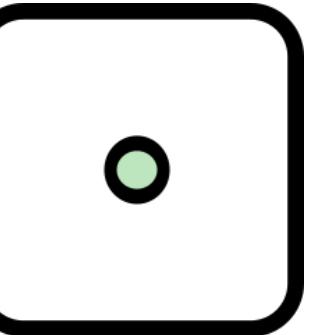
- 7+ digit numbers
- Identifies a unique element within its element type
- Ex. Way and node can both have osm\_id: 44885733

w44885733 ≠ n44885733

Ways (7)
MLA. Bandier (28931125, v8)
Padre Segura (403367820, v2)
175890310, v2
175890321, v2
Parque Local (180130399, v2)
Ramon Matias Mella (403367823, v3)
409578606, v1

Nodes (1-20 of 29)
318040012, v6
1864469325, v2
1864469307, v2
1864469320, v2
318039959, v4
318039958, v5
1864469293, v2
1864469277, v2
1864469270, v2
1864469269, v2
1864469264, v2
1905633709, v2
1905633727, v2
1905633735, v2
1905633712, v2
1864469249, v3
1864469246, v3
1864469239, v2
1864469242, v2
4114684450, v1



# Basics of OSM Data

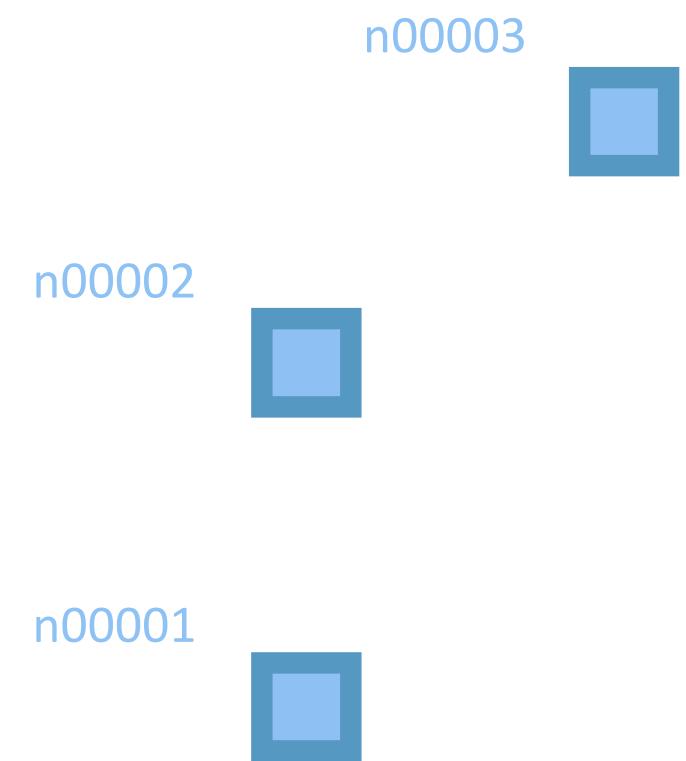
## OSM Elements

OSM data is created by **elements**

- Nodes, Ways, Closed Ways, and Relations
- Using these elements we can model data features

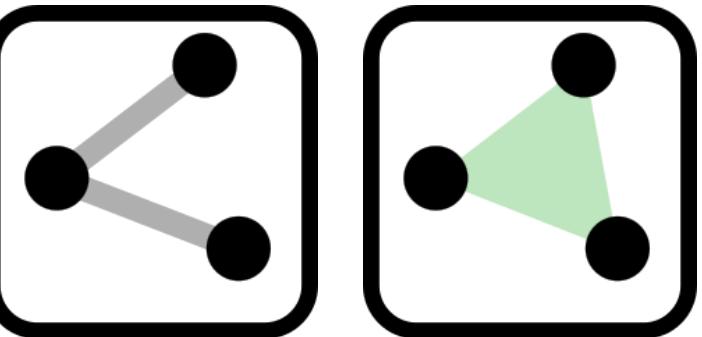
### Nodes (or “points”)

- A single discrete latitude and longitude
- Has a unique ID (starts with “n...”)



# Basics of OSM Data

## OSM Elements

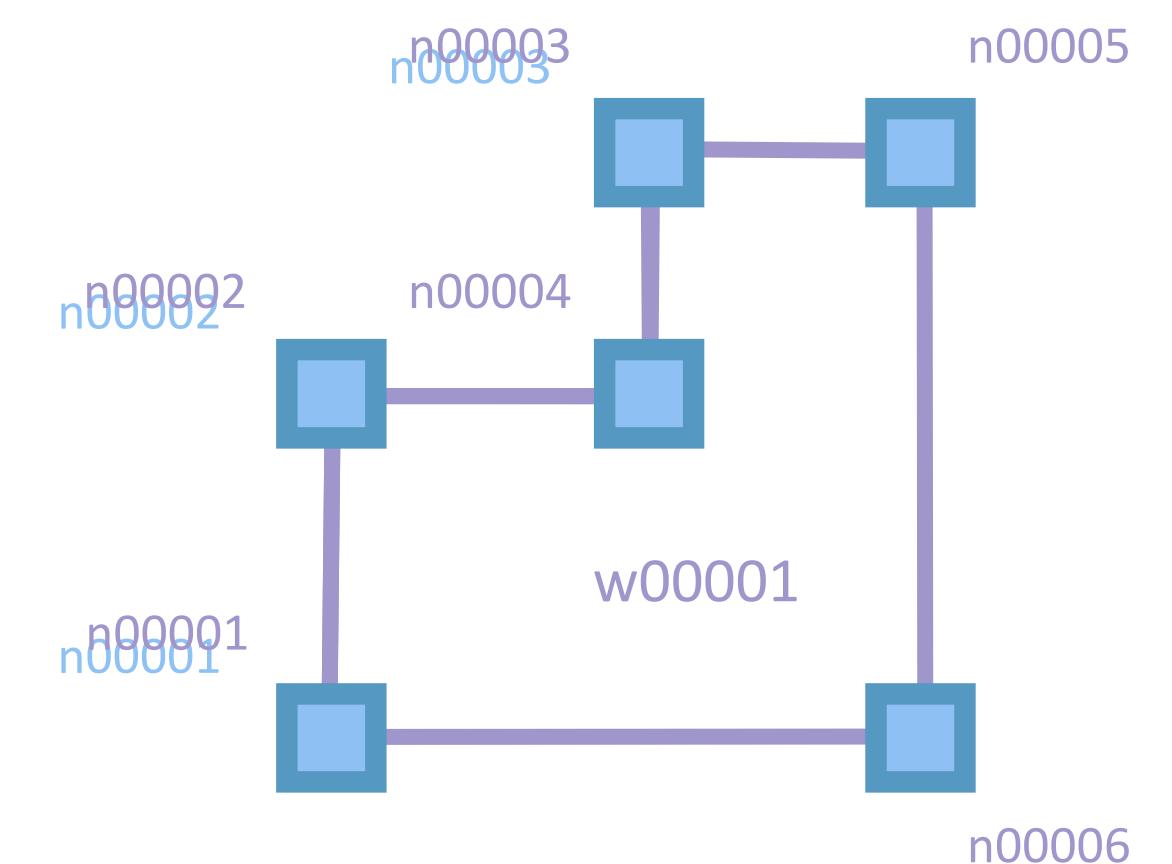


### Ways (or “lines”)

- Nodes connected via an ordered list
- Has a Unique ID (starts with “w...”)

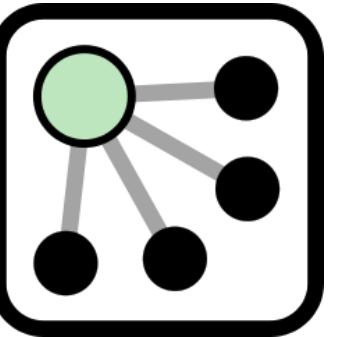
### Closed Ways (or “polygons”)

- Ways which enclose an areaSame ID as a standard way



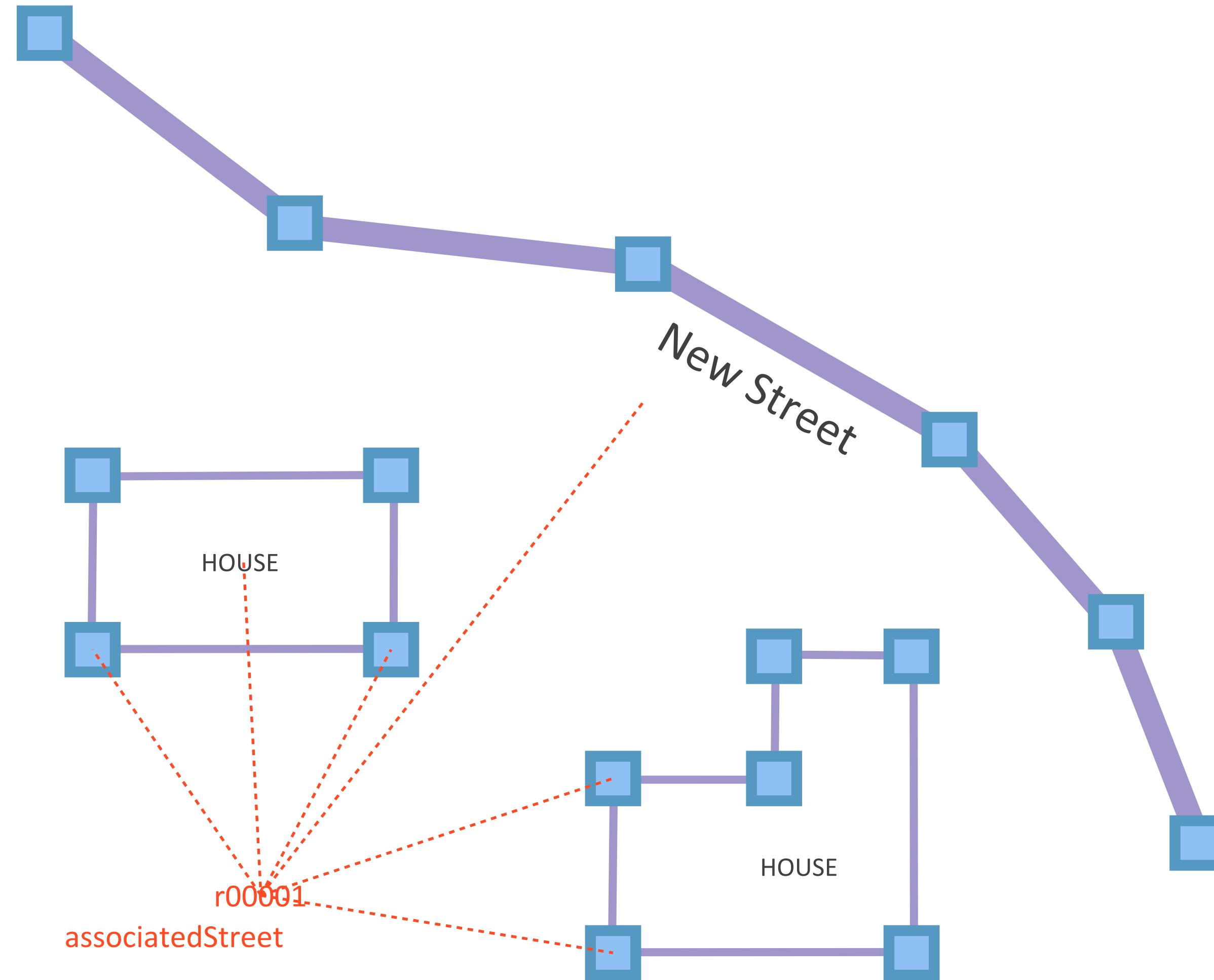
# Basics of OSM Data

## OSM Elements



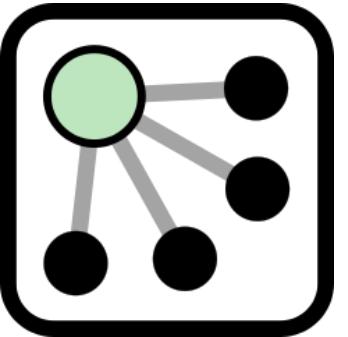
### Relations

- A data structure tying together distinct nodes and ways
- Does NOT merge elements together
- Unique ID (starting with “r...”)



# Basics of OSM Data

## Relations



Relations are a logical relationship between multiple elements

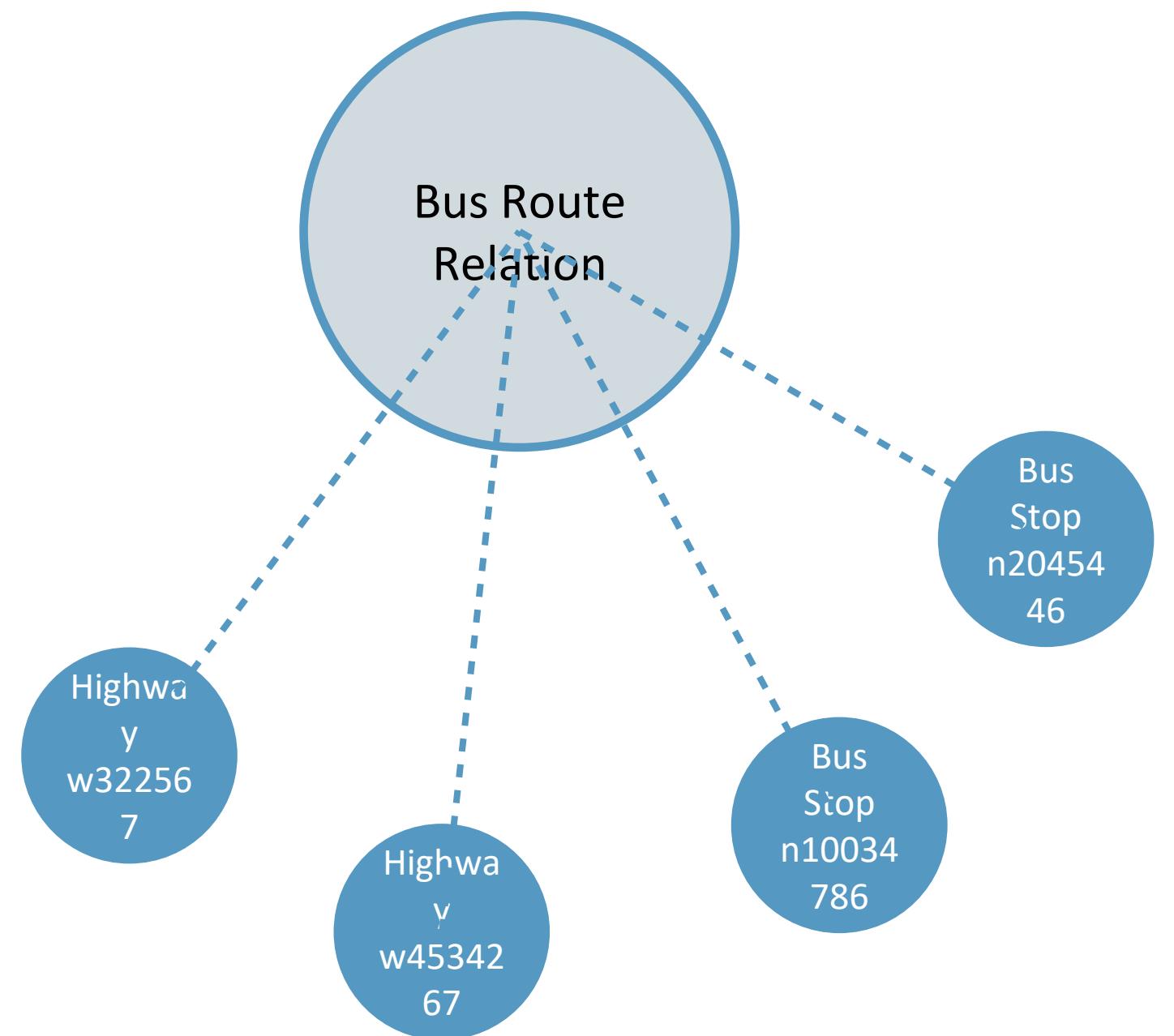
- To create a relation, elements need to share a common geographic or logical property

The elements are loosely held inside the relation and can be modified, removed, or added independently

- The relation itself can contain information (attributes) separately
- Up to 300 elements

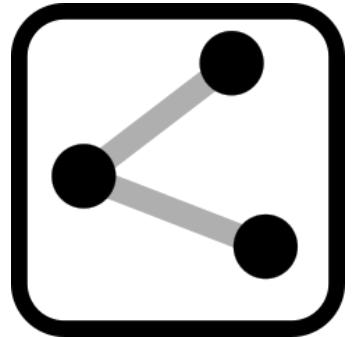
Example Relations:

- Bus Routes, Highway Routes, multipolygons, boundaries, waterways



# Basics of OSM Data

## Downloading Data

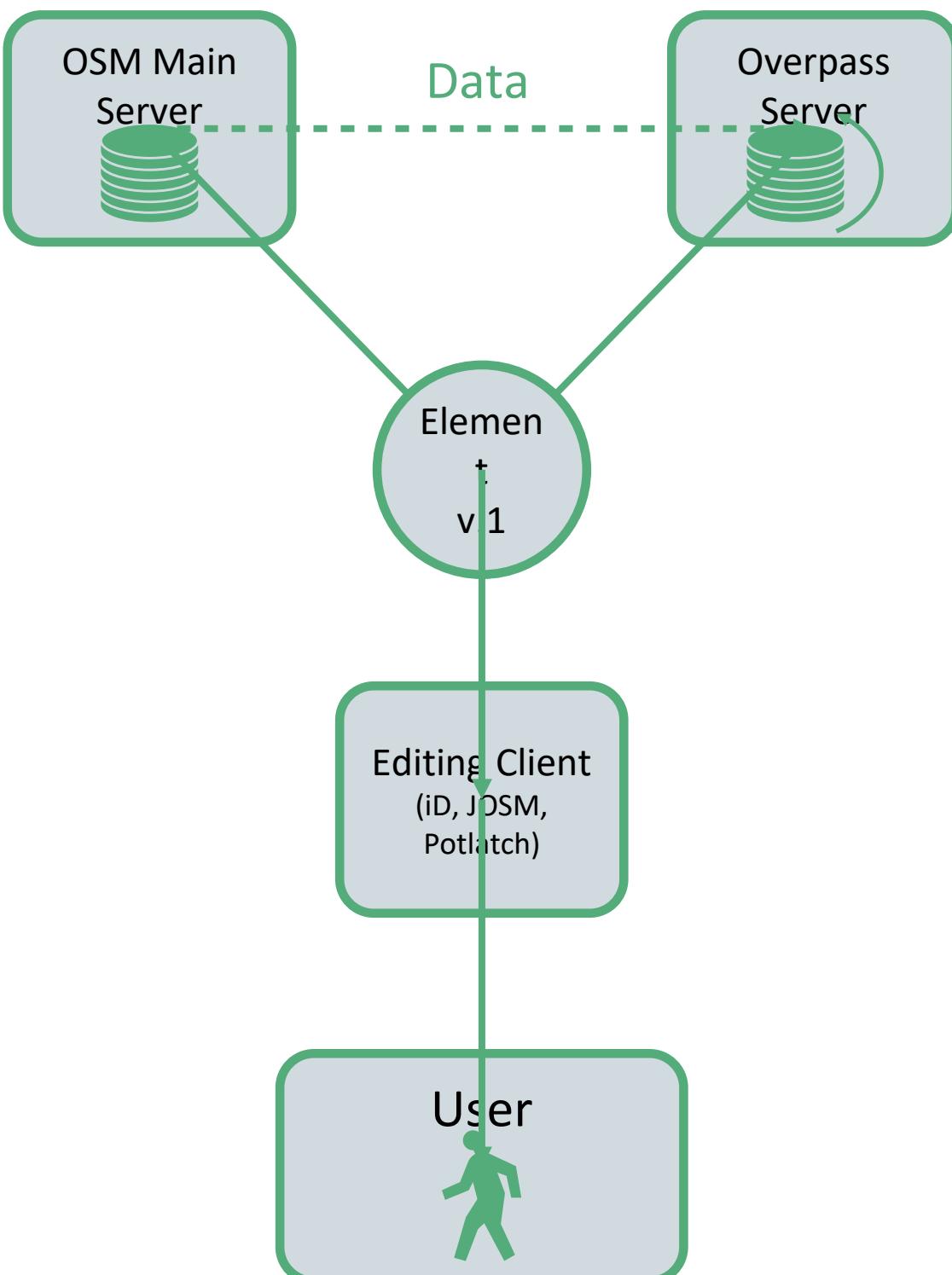


Data is downloaded from OpenStreetMap to access elements in a given geographic area

- Lets us:
  - View existing data
  - Modify data
  - Create new information

Two servers available to download from:

- **OSM Main Server**
  - ~2mb maximum, queries optional
- **Overpass Server**
  - Updated shortly after main server
  - 200+mb maximum?, queries necessary



# Basics of OSM Data

## Uploading

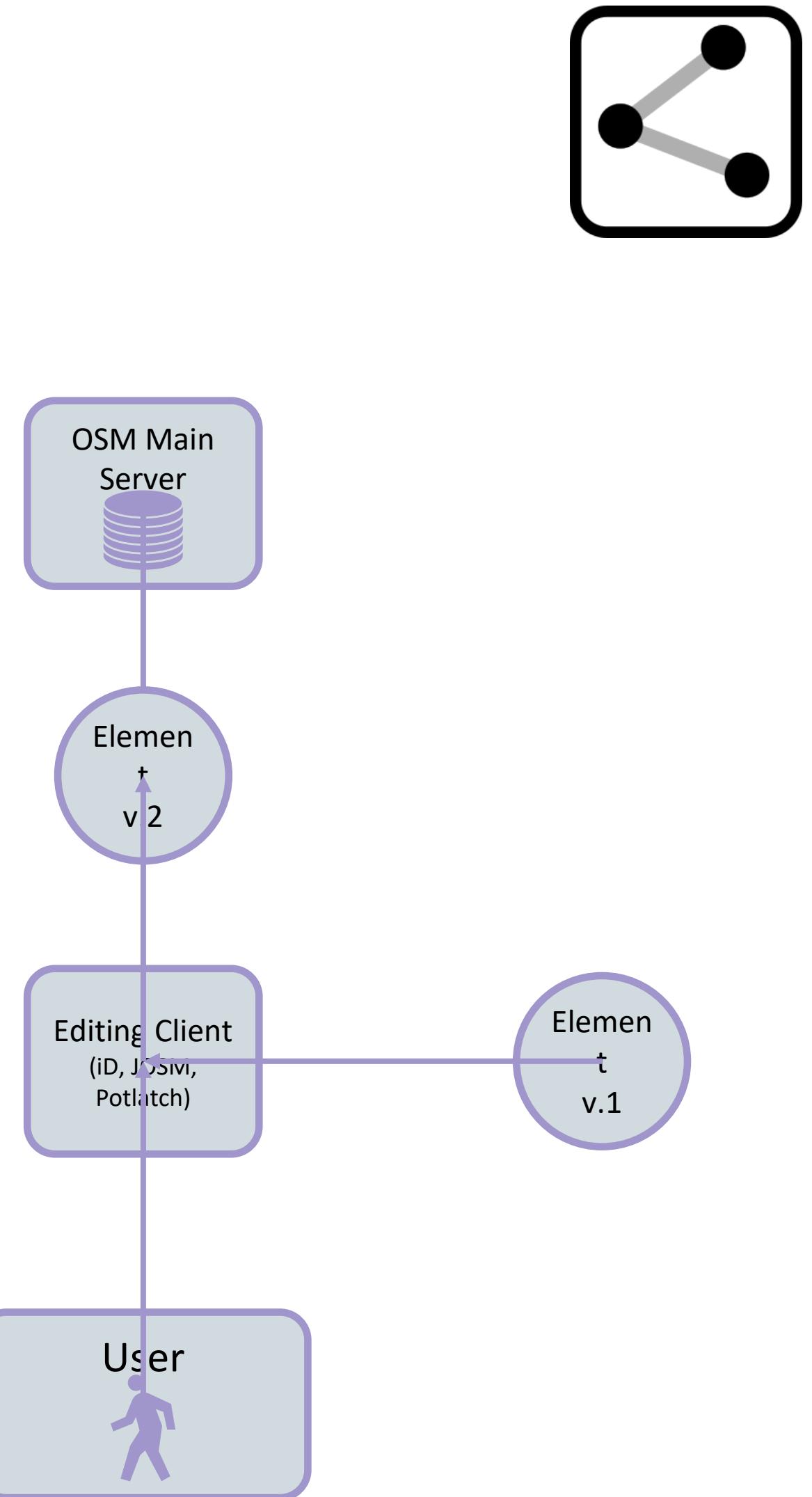
All Uploaded data returns to the OSM Main Server

Any edits are recorded as a new version of the data

- Ex. an element goes from version 1 -> version 2

All uploaded edits are recorded in a “[changeset](#)”

- A changeset is a “set of edits or changes”



# Basics of OSM Data

## Editing Cycle

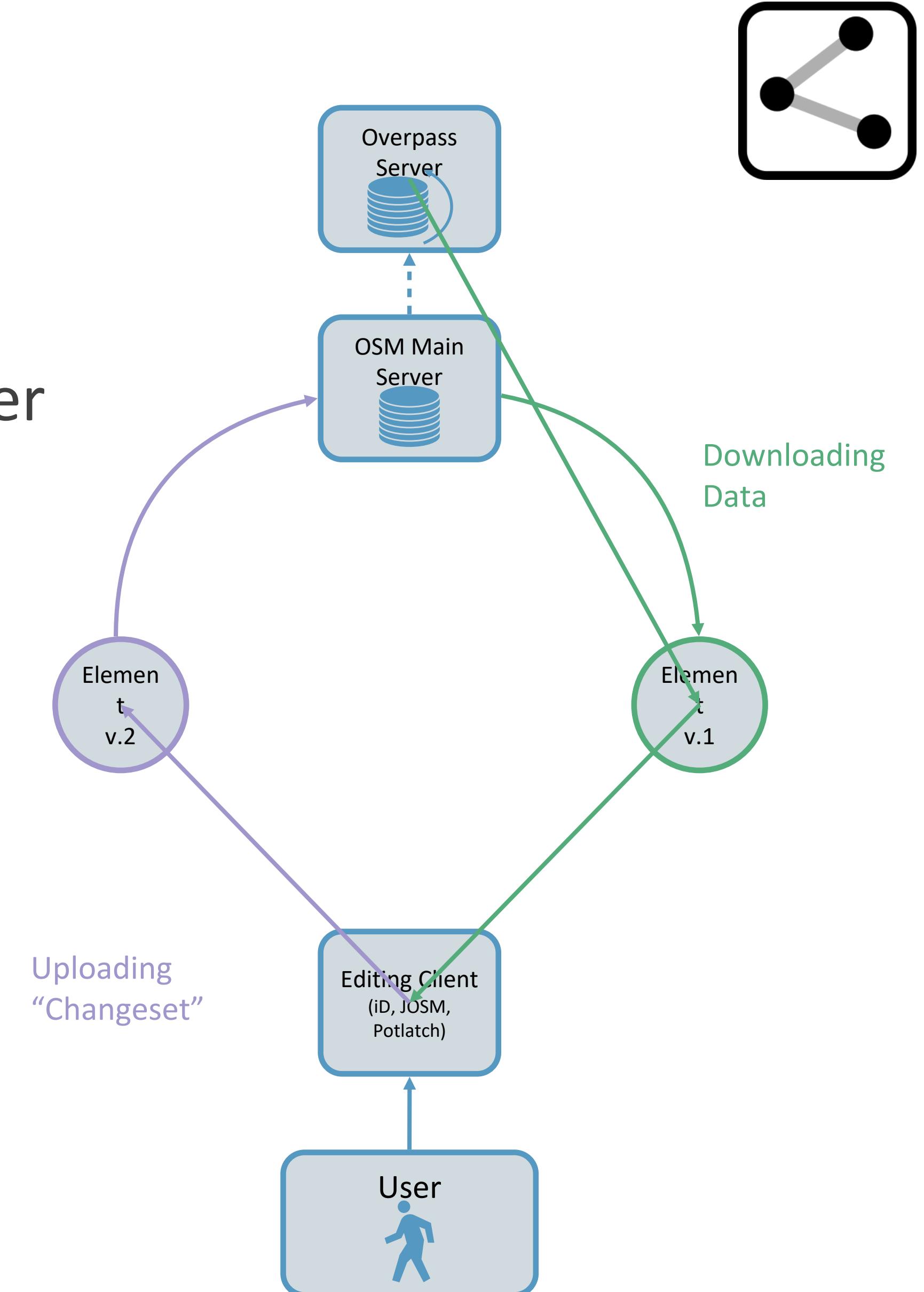
1) Un-edited OSM data is downloaded from the OSM server

2) Edits are made by an OSM user (like us)

3) All sets of edits are uploaded as a changeset

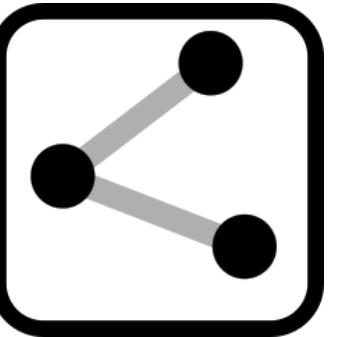
- Geometry changes (adjustments, removals, additions)
- Commentary
- Metadata

4) Data is ready for another user to download



# Basics of OSM Data

## Changesets as Public Record



- Edits are resubmitted to the server as a “[changeset](#)”
- Changesets record all changes made
- Each changeset has a unique ID like an element
- Allows OSM users to track edited areas and features
- Users are asked to submit a comment with changes
- Other users can see and discuss changes and comments

Changeset: 34659091

Road alignment to aerial imagery.

Closed 4 months ago by West Lake

Tags

created_by	JOSM/1.5 (8800 en)
source	Bing

Discussion [Subscribe](#)

Comment from Stalfur 4 months ago  
The Bing imagery I see is totally unusable. Do you have a better source?

Comment

Ways (1)  
Vestara Bryggja (375416108, v1)

Nodes (7)

- 564831707, v2
- 564831703, v2
- 3787857045, v1
- 3787857044, v1
- 3787857043, v1
- 3787857042, v1
- 3787857041, v1

Comment submitted with changes

Public user discussing the changeset

# Basics of OSM Data

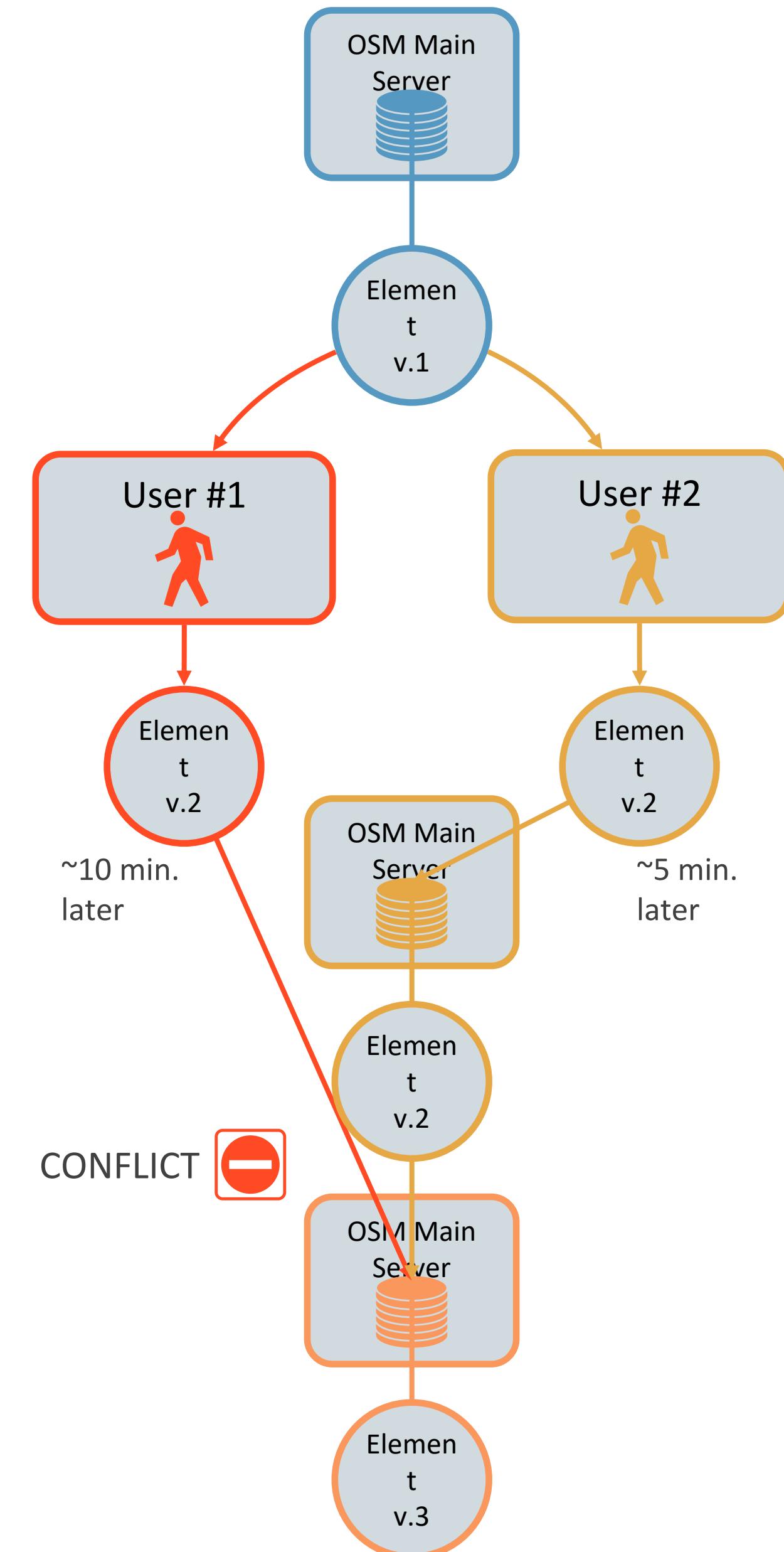
## Changesets as Version Control

Changesets are a form of “version control” or “versioning”

- OSM has millions of users
- More than one user may want to edit the same element at the same time

The server has the latest version of an element until you download an element and make edits

Two users uploading edits of the same element can create a conflict



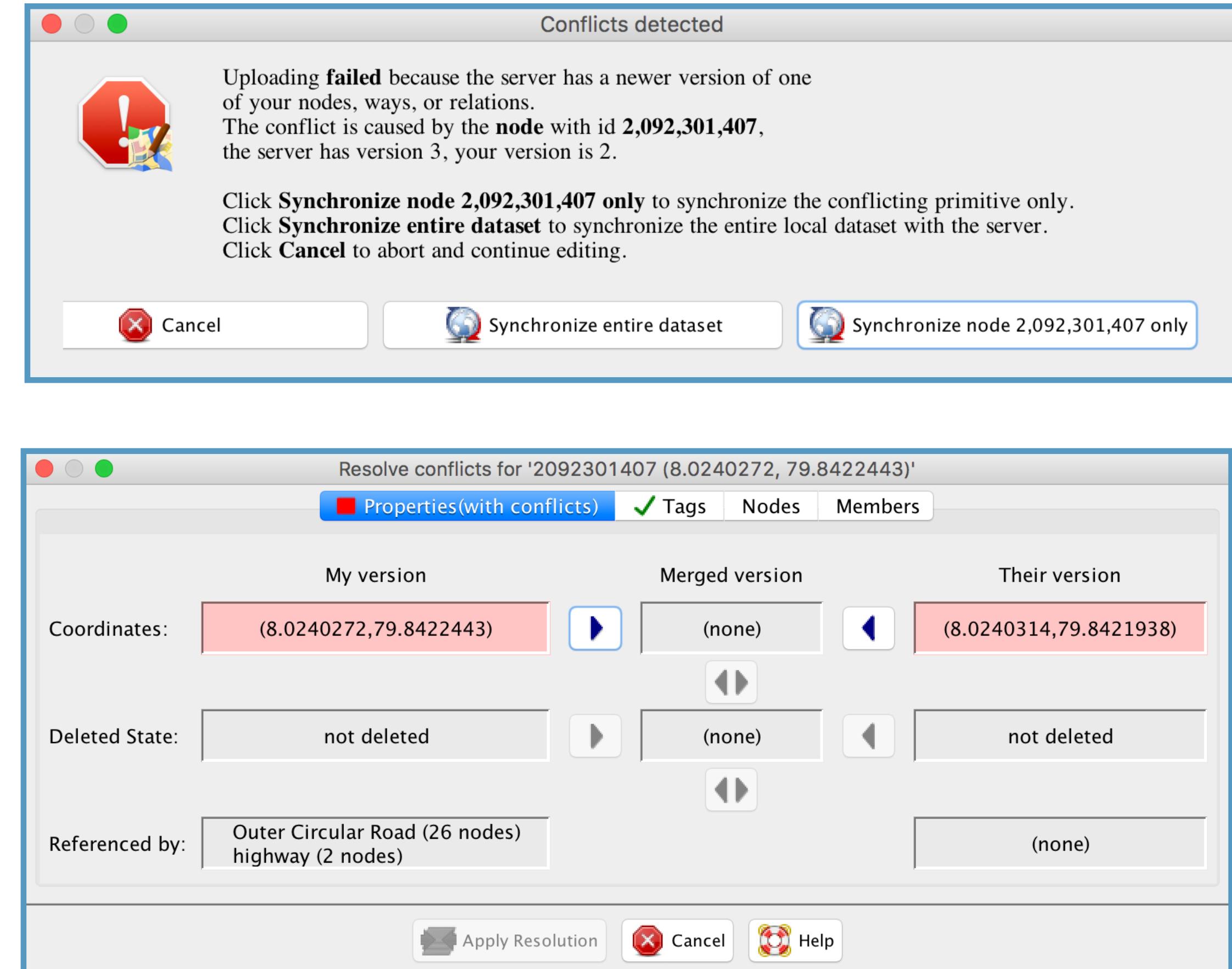
# Basics of OSM Data

## Conflicts

Conflicts are created when two or more OSM users edit the same feature at the same time

- Difference in your version vs. server version
- JOSM doesn't have the ability to auto-merge versions, so you must manually resolve conflicts

Resolving the conflict is important so you do not break the data



# Data Attributes

# Data Attributes

## OSM Tags

All elements (nodes, ways, & relations) are provided attribute data through a system of Feature Tags

- Attribute tables do not exist in OSM

Tags describe specific features of map elements

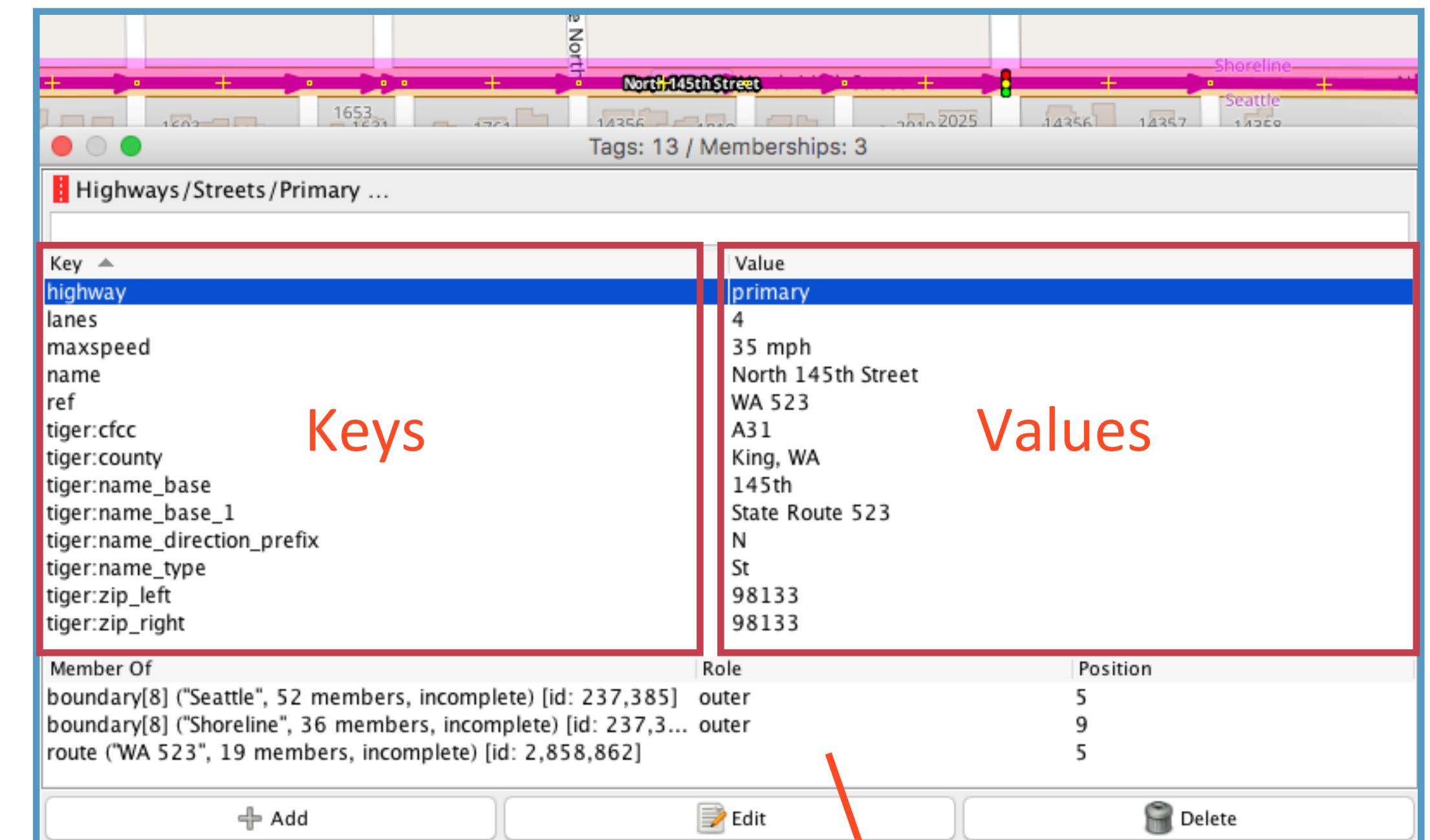
- Tag components: ([Key + Value = Tag](#))

- [Key](#) - Feature class

- [Value](#) - Feature information

Relations have tags which are independent from their members

JOSM



# Data Attributes

## OSM Tags

The **Key** is used to describe a topic, category or type of feature

- Some tags allow suffixes to further define data. These are subcategories:
  - E.g. `addr:housenumber=9810`

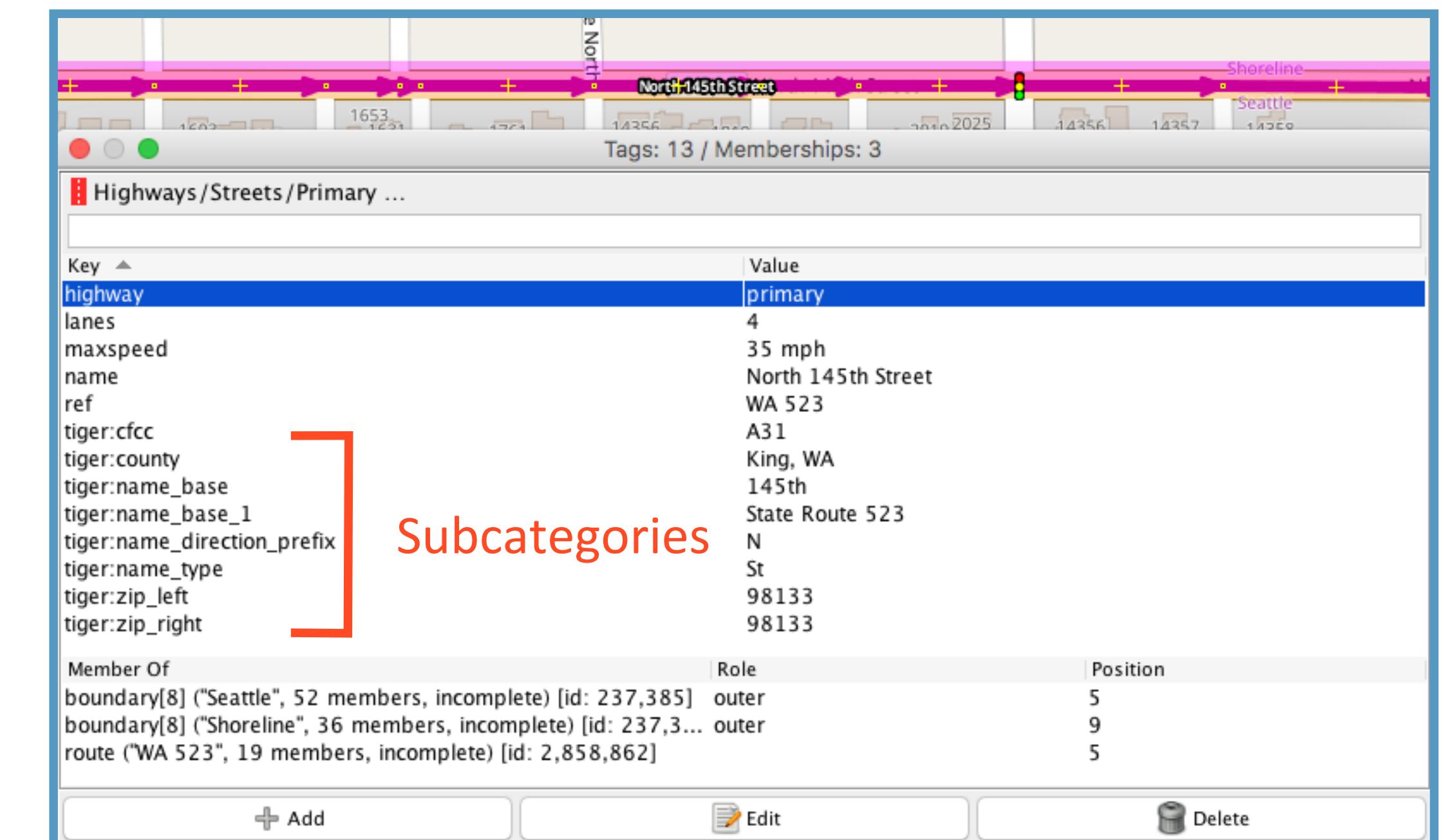
The **Value** details the specific form of the key-specified feature.

- Commonly, values fall into three formatting methods:
  - Defined values
  - Freeform text
  - Numbers

Tagging Resources:

- <http://wiki.openstreetmap.org/wiki/Tags>
- <http://wiki.openstreetmap.org/wiki/Namespace>

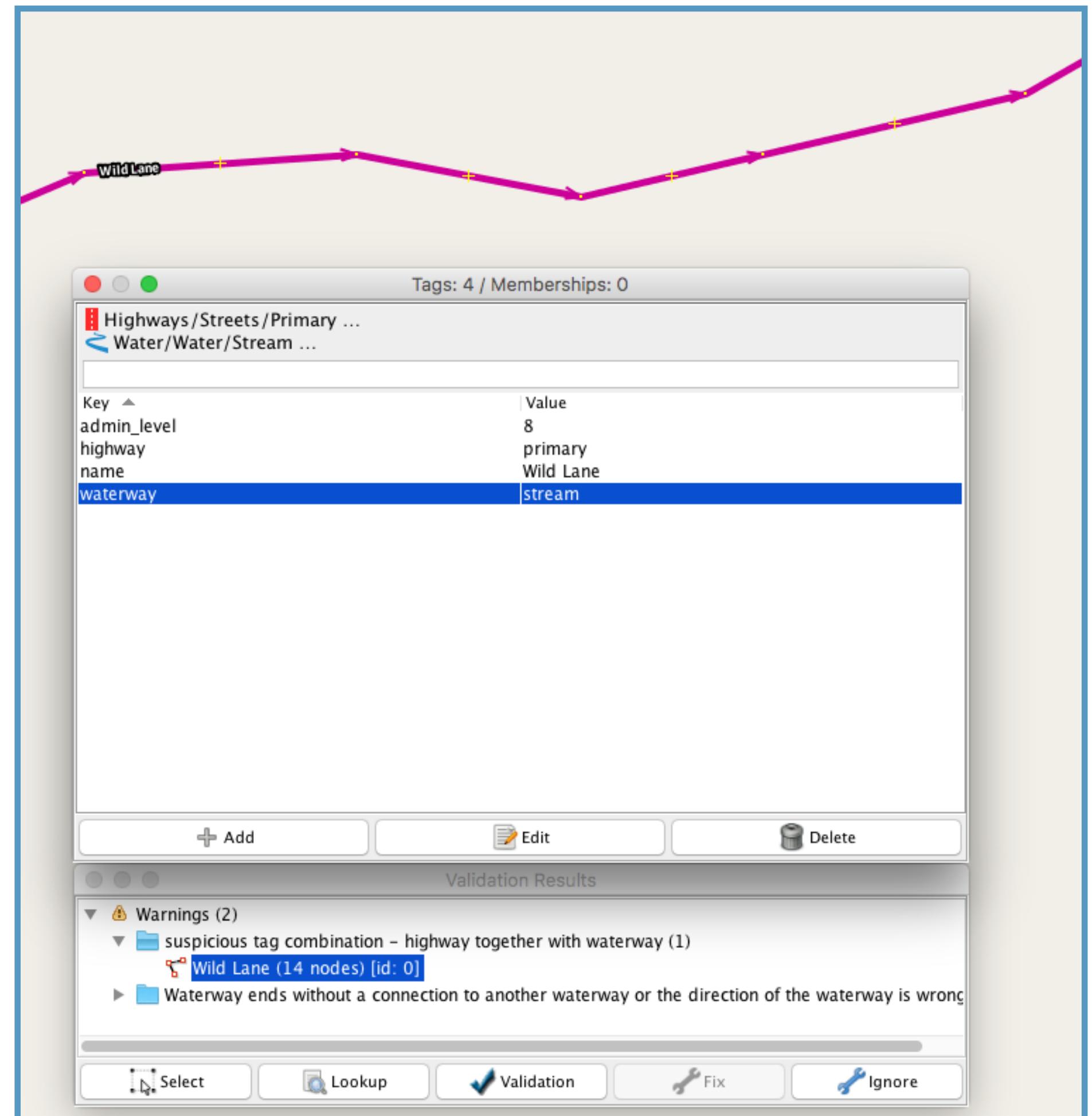
JOSM



# Data Attributes

## OSM Data Attributes con't...

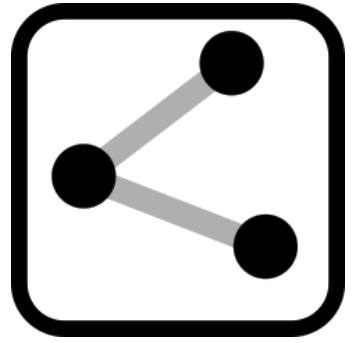
- Each [element](#) can hold an unlimited variety of tags
  - Typically, a feature will have a primary category (e.g. a roadway will be a “highway” or a forest will get a “landuse” Key)
- However, this is only a recommendation as OSM uses a “[Free Tagging System](#)” which allows nearly any combination of Tags
  - Community guidelines have developed to:
    - Recommend specific additional attributions
    - Warn against combining others



# OSM Features

# OSM Features

## Highways



A highway in OSM is any road or route which connects two locations.

- The most important tag, the class of highway, is a [hierarchy-based system](#).
- Community guidelines can be vague and highway conditions are different all around the world.
- Other important related features: roundabouts, highway ramps, and bus routes.

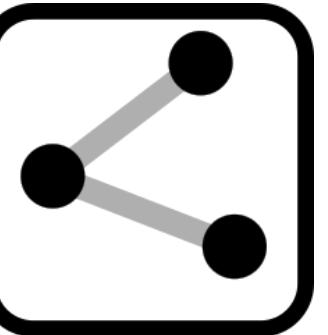


### Highway Resources:

- <http://wiki.openstreetmap.org/wiki/Key:highway>
- [http://wiki.openstreetmap.org/wiki/Australian\\_Tagging\\_Guidelines#Road\\_Tagging](http://wiki.openstreetmap.org/wiki/Australian_Tagging_Guidelines#Road_Tagging)

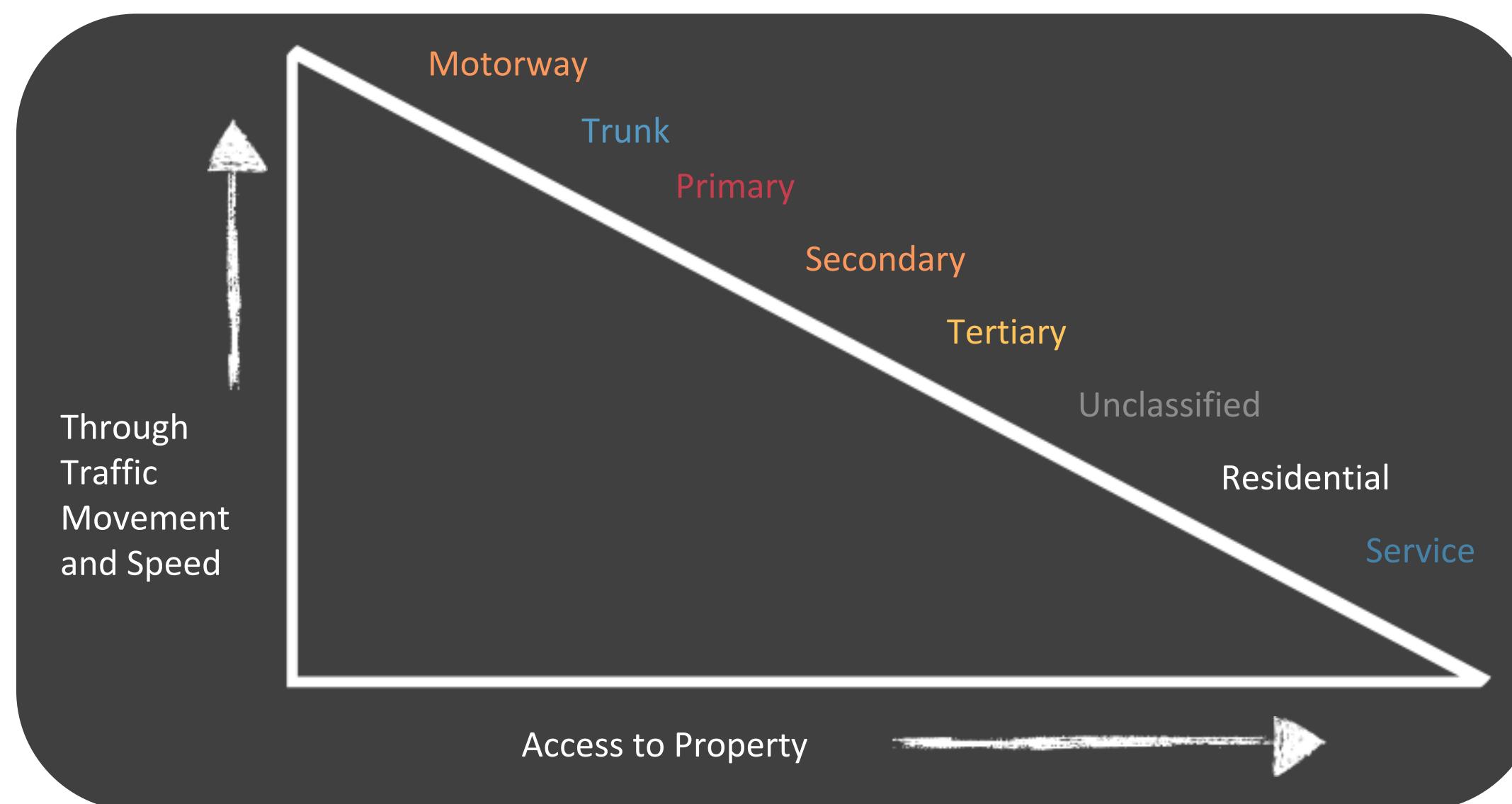
# OSM Features

## Highways

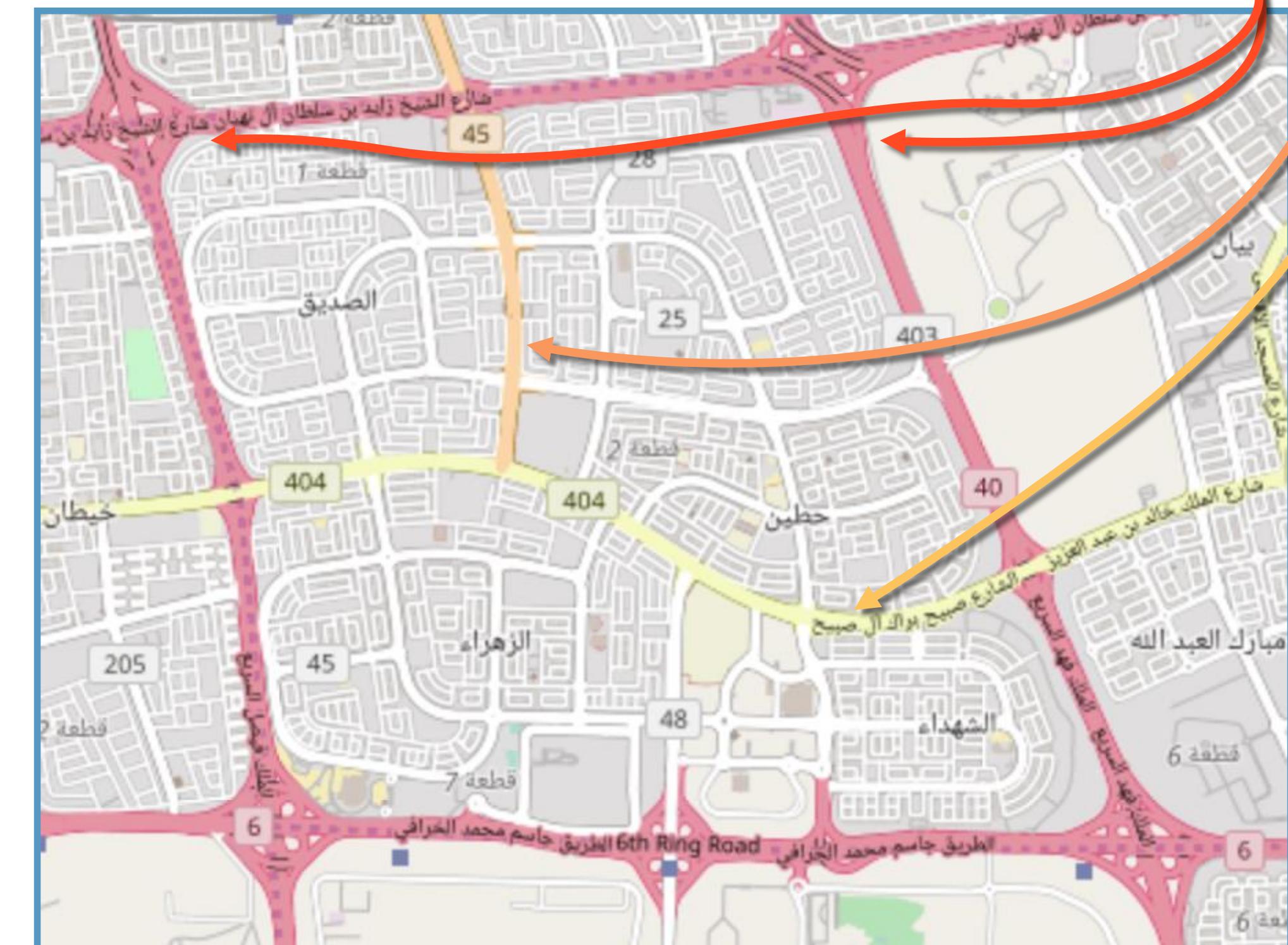


The most important tag classifies the category of highway

- Ranges from a large Motorway to a small Service alleyway
- Creates a hierarchy-based system
- Classify roads based on the density of vehicular traffic and the overall purpose of a highway



Density + Purpose	Value
Smaller arterial, connects neighborhoods	Tertiary
Lots of vehicles, large arterial, and connects two major destinations	Primary
Heavily traveled, long distance, and separated from other highways	Motorway



# OSM Features

## Highways

No highway is identical

Every highway requires investigating the bigger picture

Local and country-specific context matters

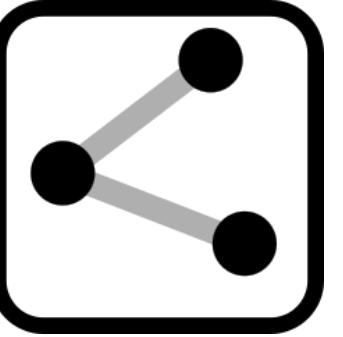
Same Highway Classification, Different Regions



Uganda, Africa

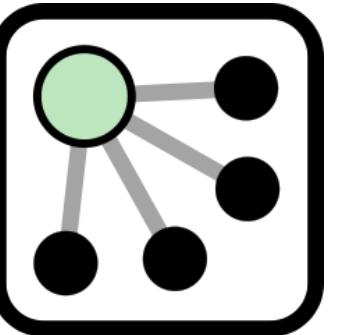


France, Europe



# OSM Features

## Relations



Reminder:

- A relation in OSM is a list of features which share a logical or geographic component.
- They are often used to apply **shared attributes** to similar features for a logical or geographical reason.

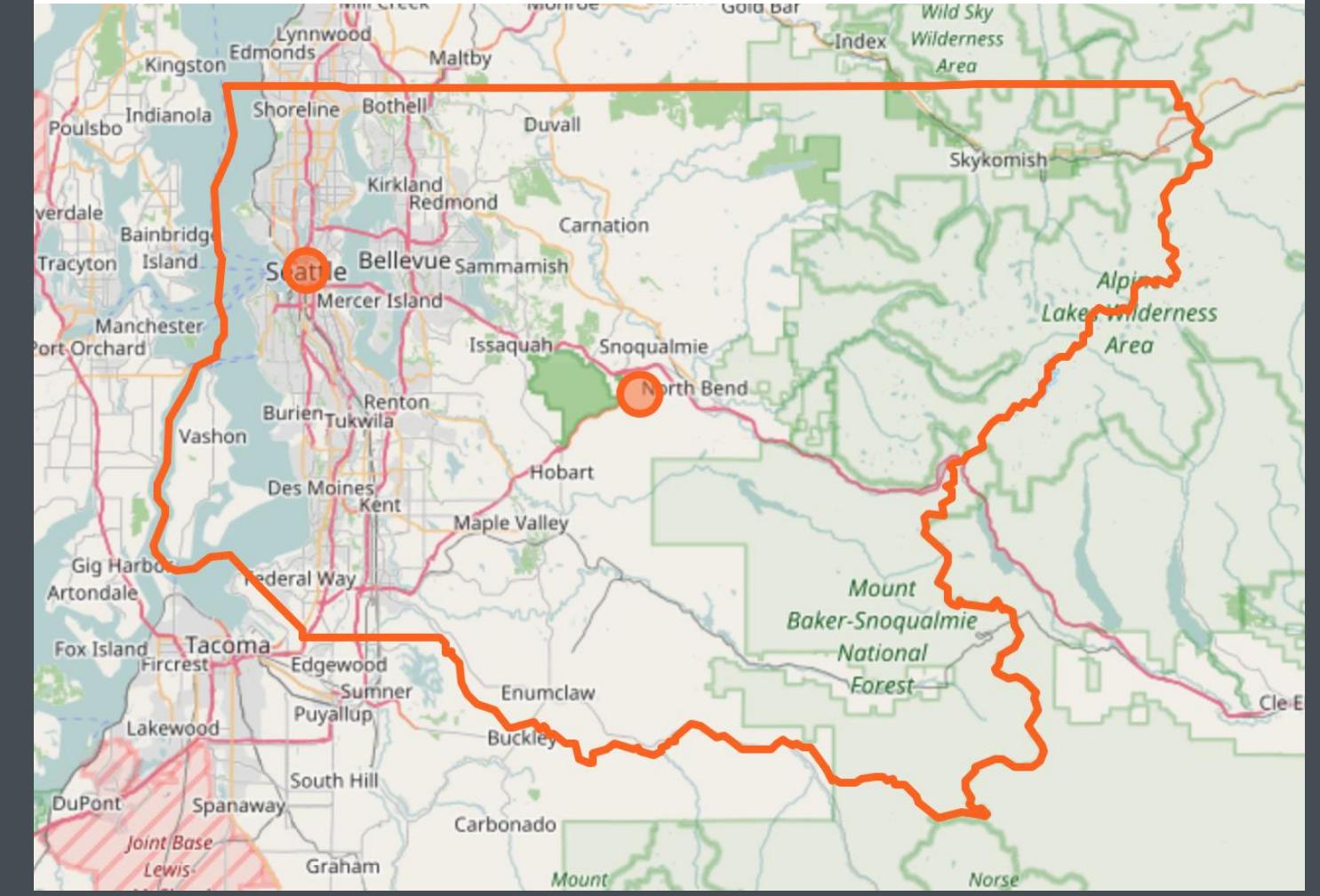
### Relations Resources:

- <http://learnosm.org/en/josm/josm-relations/>
- <http://wiki.openstreetmap.org/wiki/Relation>
- <http://wiki.openstreetmap.org/wiki/Relation:restriction>
- [http://wiki.openstreetmap.org/wiki/Tag:boundary%3Dadministrative#admin\\_level](http://wiki.openstreetmap.org/wiki/Tag:boundary%3Dadministrative#admin_level)
- <http://wiki.openstreetmap.org/wiki/Relation:multipolygon>
- [https://wiki.openstreetmap.org/wiki/JOSM/Advanced\\_editing#Relations](https://wiki.openstreetmap.org/wiki/JOSM/Advanced_editing#Relations)

**Relation: King County (1153346)** X

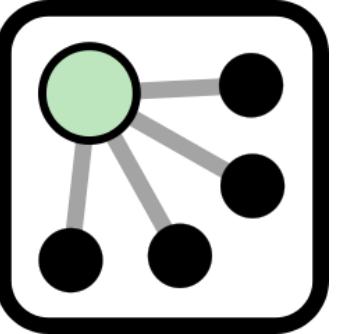
Set Wikidata ID for admin\_level=6 regions n america

Edited about 2 months ago by nyuriks  
Version #31 · Changeset #43866695

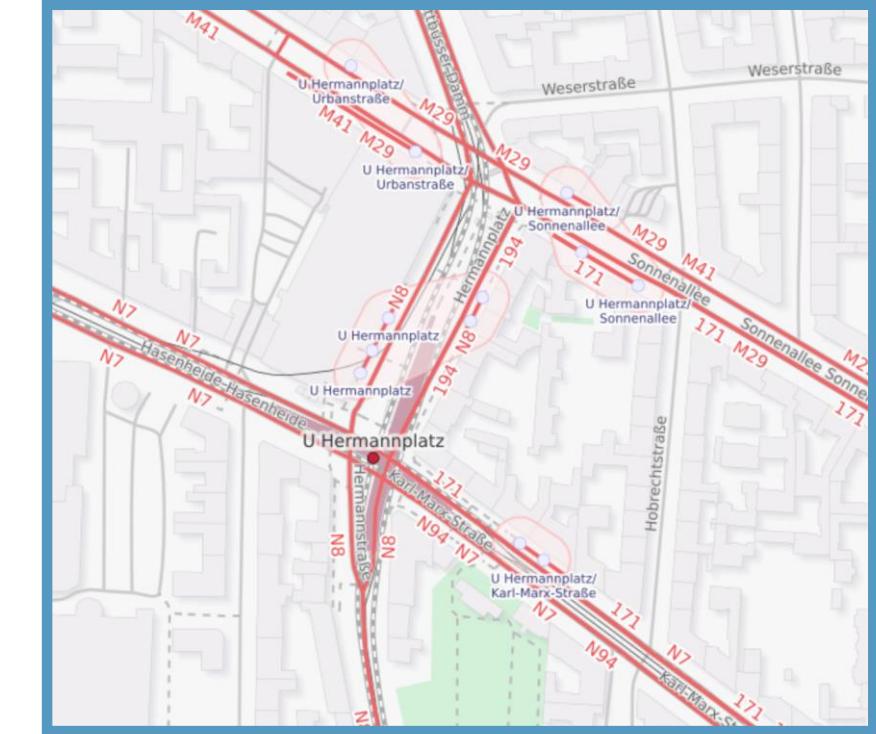


# OSM Features

## Relations



Turn Restrictions



Bus Routes

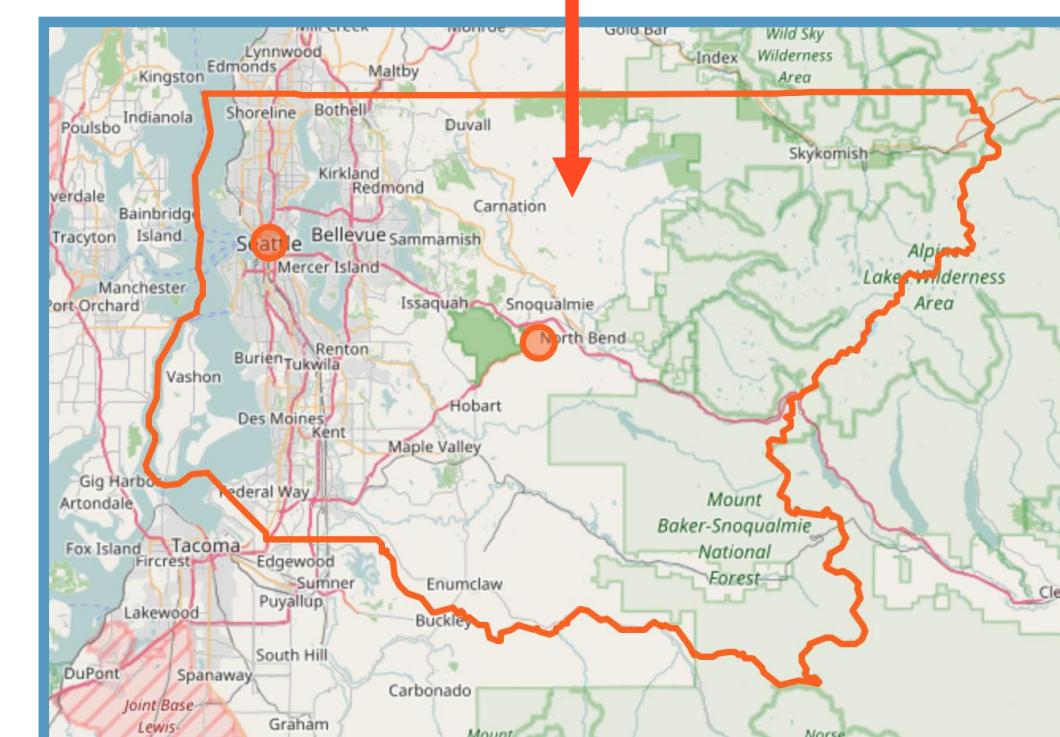


“Outer” Closed Way

“Inner” Closed Way

Multipolygons

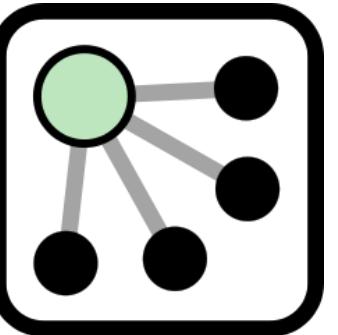
Constructed from  
63  
Individual Features



Administrative Boundaries

# OSM Features

## Relations



[OSM.org](#)

### Relation: King County (1153346)

Set Wikidata ID for admin\_level=6 regions n  
america

Edited about 2 months ago by nyuriks  
Version #31 · Changeset #43866695

Tags	
admin_level	6
boundary	administrative
name	King County
nist:fips_code	53033
nist:state_fips	53
type	boundary
wikidata	Q108861
wikipedia	en:King County, Washington

Members	
Way	408442924 as outer
Way	408442925 as outer
Way	408437150 as outer
Way	408437136 as outer
Way	408437139 as outer
Way	408437138 as outer
Way	408437134 as outer

[JOSM](#)

Edit relation #1,153,346 in layer 'Data Layer 1'

The screenshot shows the JOSM software interface with the 'Edit relation' dialog open. The 'Tags' tab is selected, displaying the following data:

Key	Value
nist:fips_code	53033
nist:state_fips	53
type	boundary
wikidata	Q108861
wikipedia	en:King County, Washington

The 'Members' tab is also visible, listing various ways and their roles (outer) that are part of this relation. A red arrow points from the 'Relation's Unique ID' label to the relation ID in the title bar of the dialog.

Relation's Unique ID

Relation-Specific Tags

Independent Elements  
with  
Unique IDs

# OSM Features

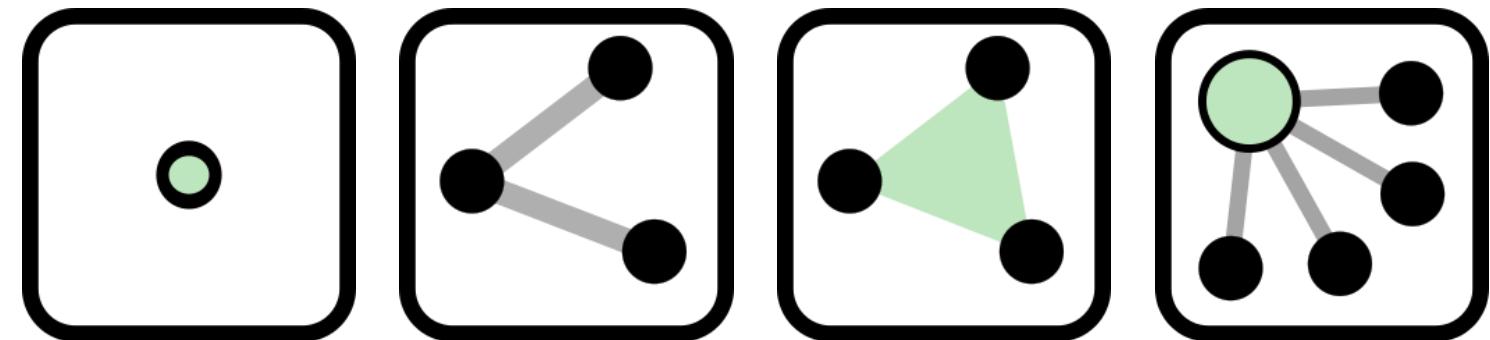
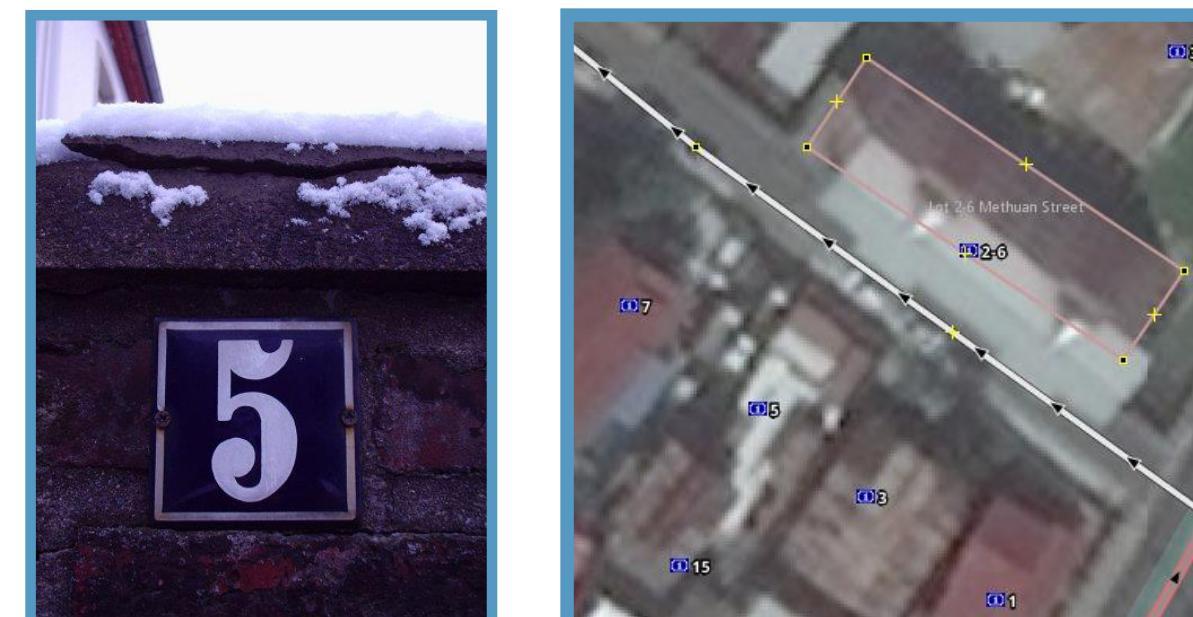
## Addresses

Addresses provide location information for a point, area, or facility

- Can be added via multiple methods:
  - An independent node
  - An independent way
  - Or [added to an existing node, way, or area](#)
- Sometimes addresses get duplicated due to all the various methods
- Every country has a different address format

### Address Resources:

- <http://wiki.openstreetmap.org/wiki/Addresses>
- <http://wiki.openstreetmap.org/wiki/Key:addr>



Example Address in Seattle, WA

Facilities/Accommodation/Hotel ...	
Man Made/Man Made/Building ...	
Man Made/Man Made/Residential Building ...	
Annotation/Address ...	
Annotation/Contact (Common Schema) ...	
Key	Value
addr:city	Seattle
addr:housenumber	2030
addr:postcode	98121
addr:street	4th Avenue
atm	no
building	yes
building:levels	19
internet_access	wlan
name	Warwick Seattle Hotel
phone	(206) 443-4300
source	King County GIS;data.seattle.gov
tourism	hotel
website	<a href="http://warwickhotels.com/seattle/">http://warwickhotels.com/seattle/</a>

+ Add      Edit      Delete

### Basic Address Component Explanation

Address Component	OSM Format	Example
Address Number	addr:housenumber= #	addr:housenumber= 2330
Postal Code	addr:postcode= #	addr:postcode= 15074
Street	addr:street= xxxx	addr:street= Jirón Azul
City	addr:city= xxxx	addr:city= Lima
Country	addr:country= (2-character ISO country code)	addr:country= PE

# OSM Features

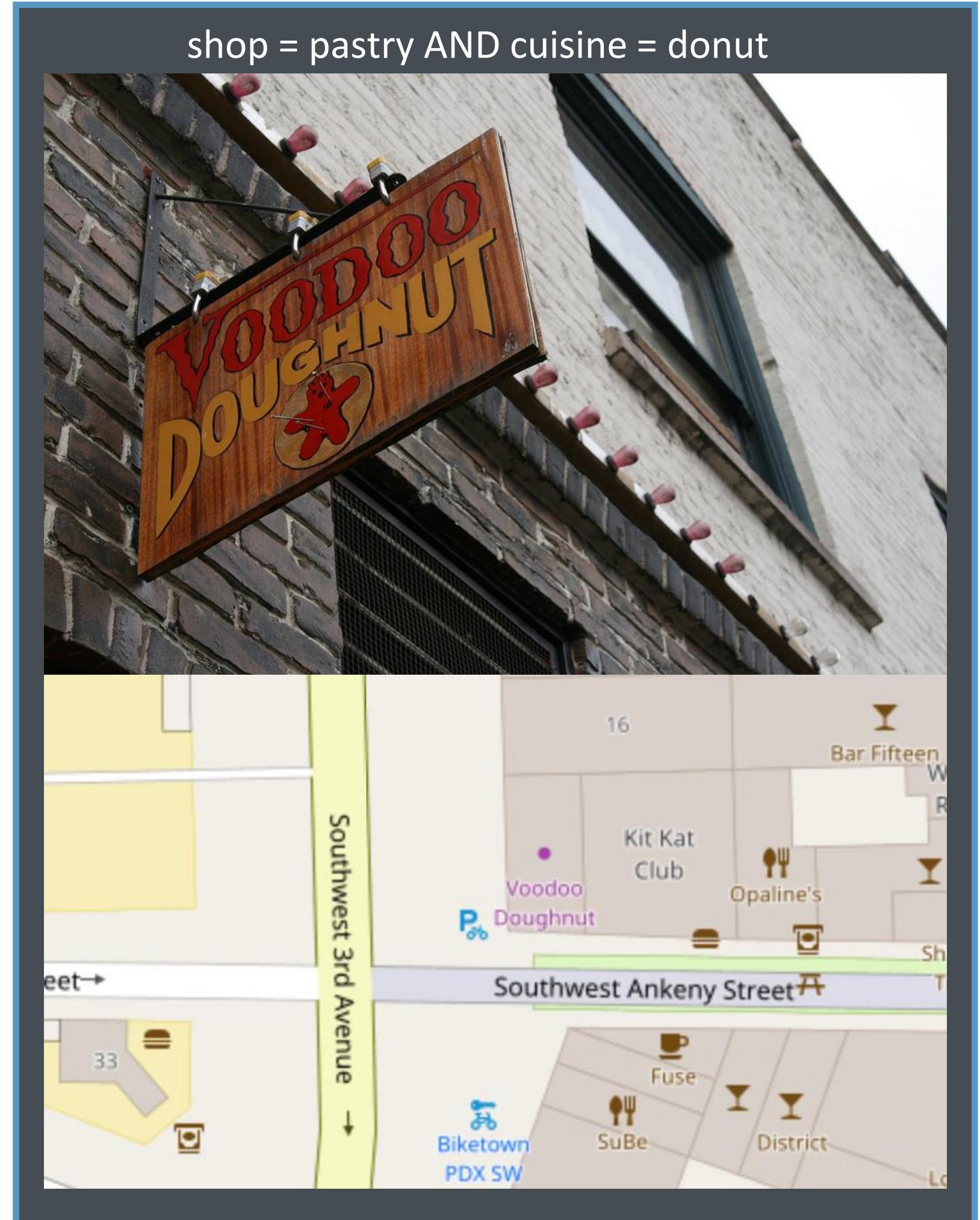
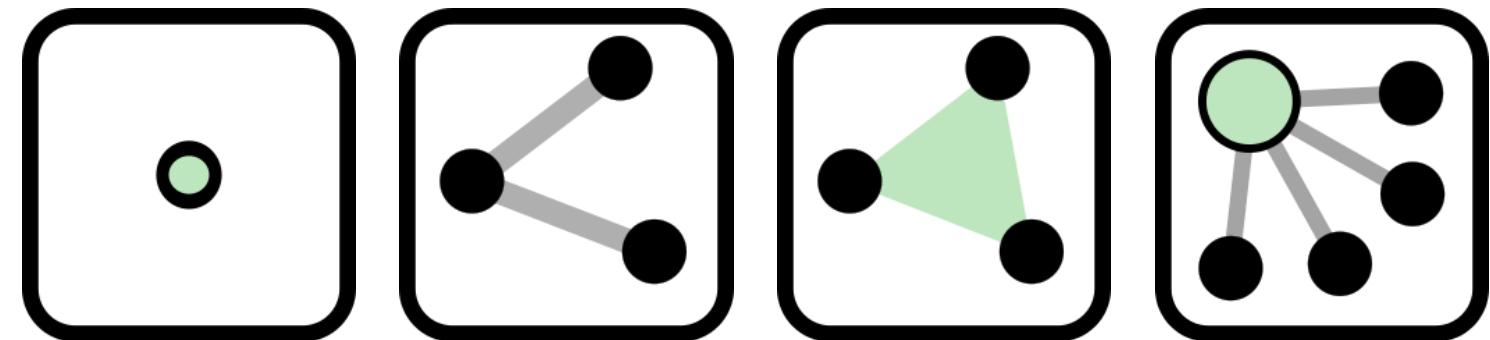
## Points of Interest

Elaborates on the feature type and is often a place of particular interest

- Features are often grouped with other important tags to further specify the POI. For example:
  - “amenity=place\_of\_worship” would be too generic
  - We need to add either a “religion” or “denomination”
- POI information can be found on any element type, including multipolygons
- Important POIs include:  
Craft, Shop, & Amenity

### POI Resources:

- <http://wiki.openstreetmap.org/wiki/Key:amenity>
- <http://wiki.openstreetmap.org/wiki/Key:shop>
- <http://wiki.openstreetmap.org/wiki/Key:craft>



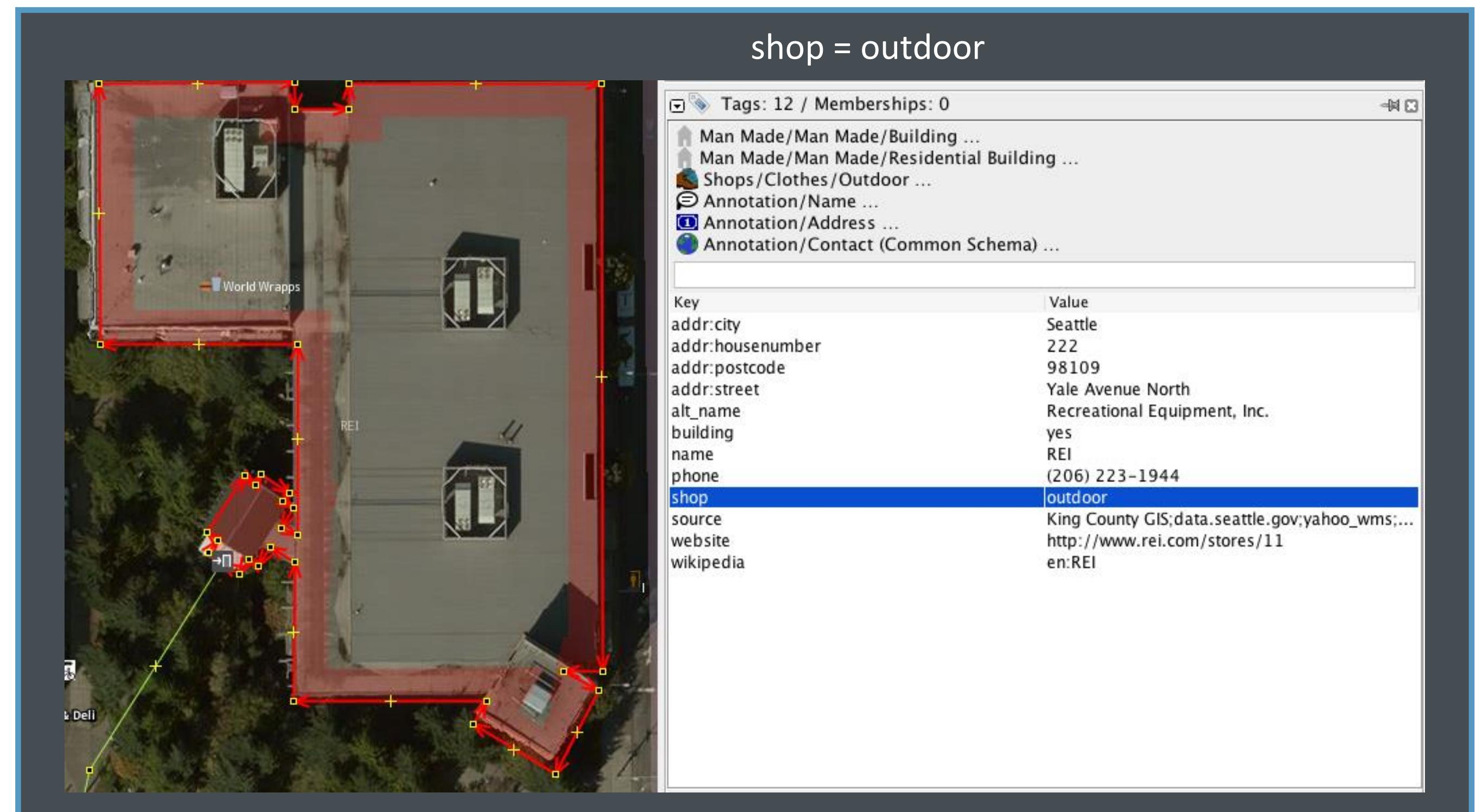
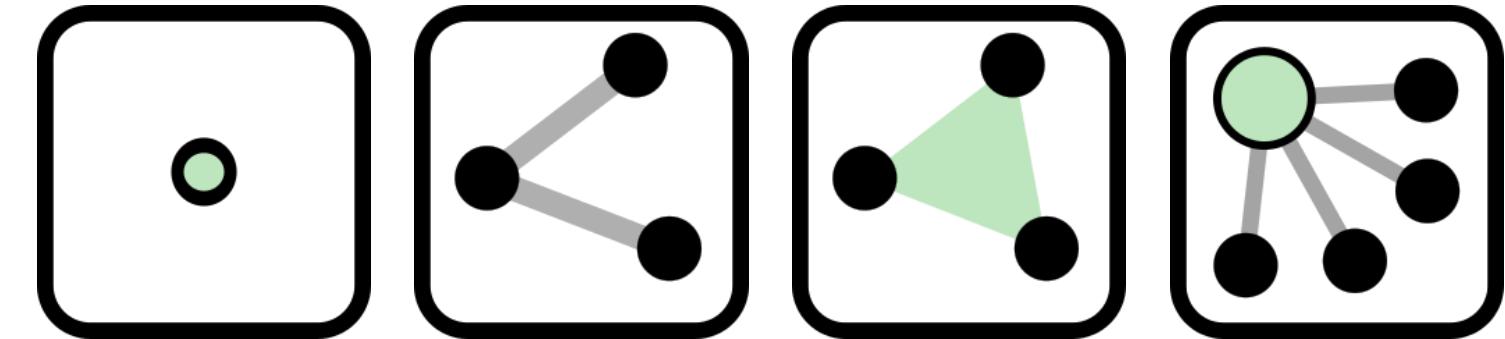
# OSM Features

## Points of Interest - Shop

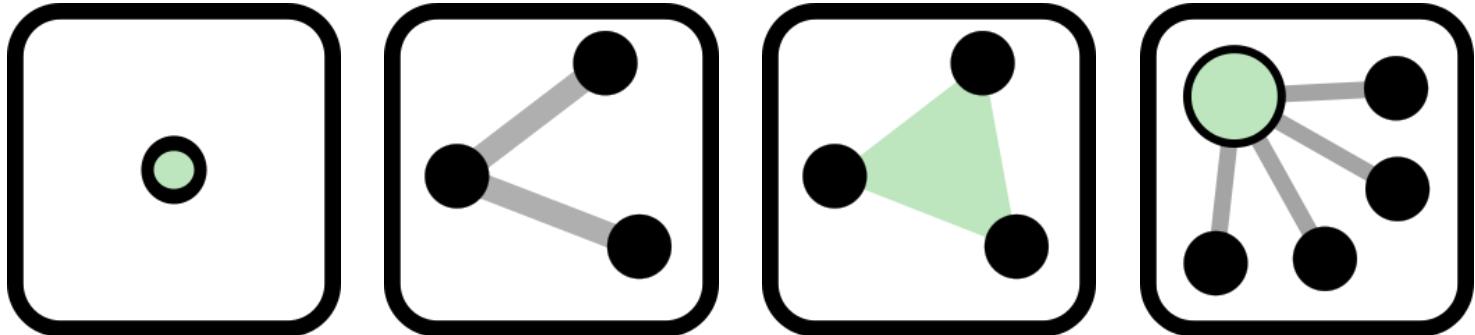
Typically, shops are businesses where a specific good is bought and taken home

- Examples of Shops include:

- Supermarket
- Bakery
- Hardware
- Mobile\_Phone



# OSM Features

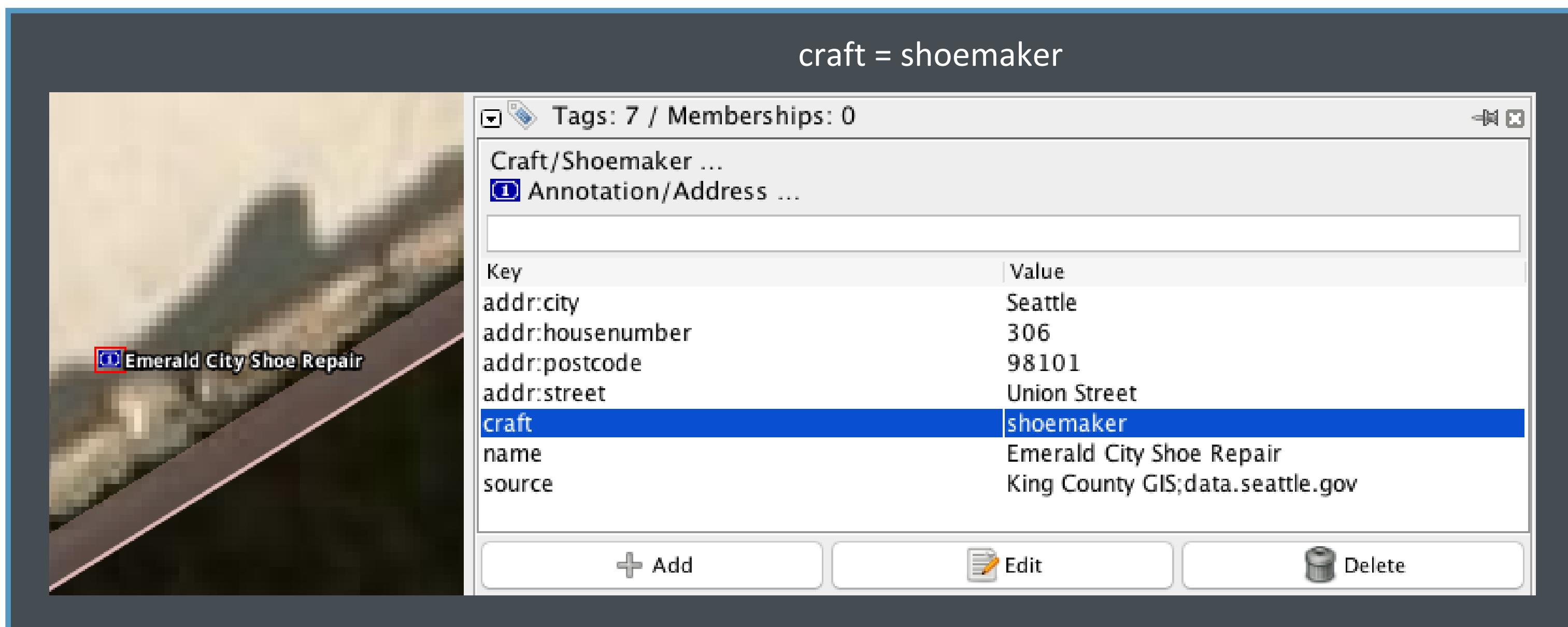


## Points of Interest - Craft

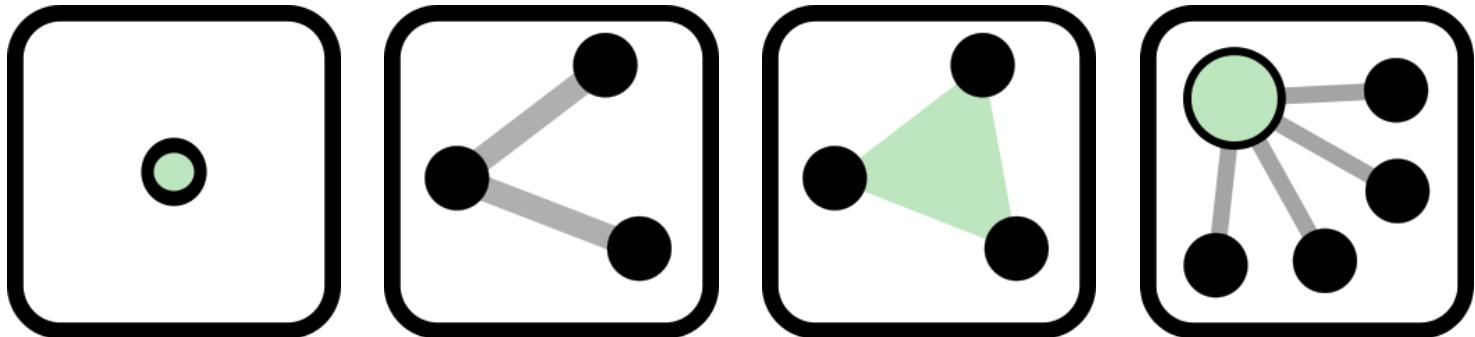
Craft tags are used for businesses that provide a physical service or labor

- Examples of Crafts include:

- Brewery
- Electrician
- Plumber
- Shoemaker



# OSM Features

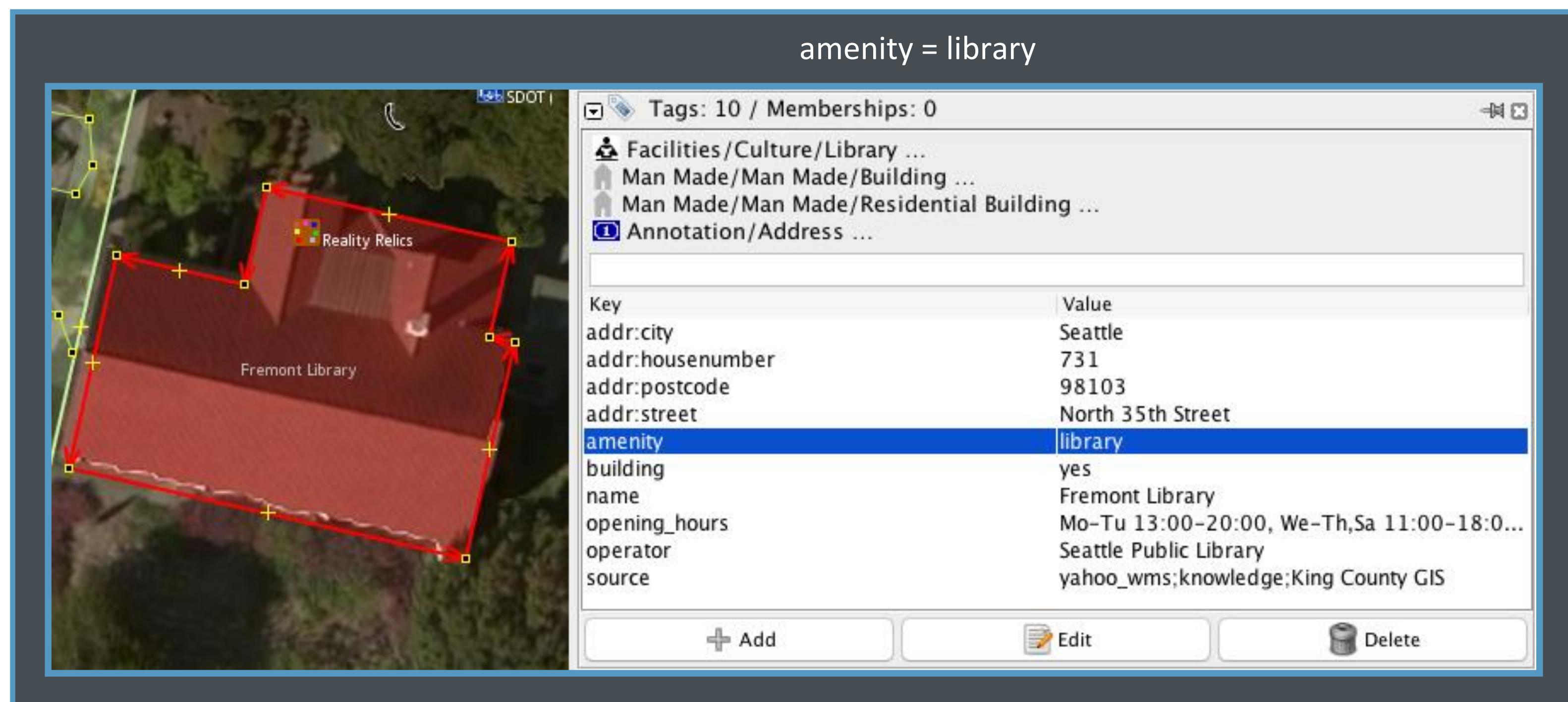


## Points of Interest - Amenity

Amenities are businesses that provide a service which is free or can be bought

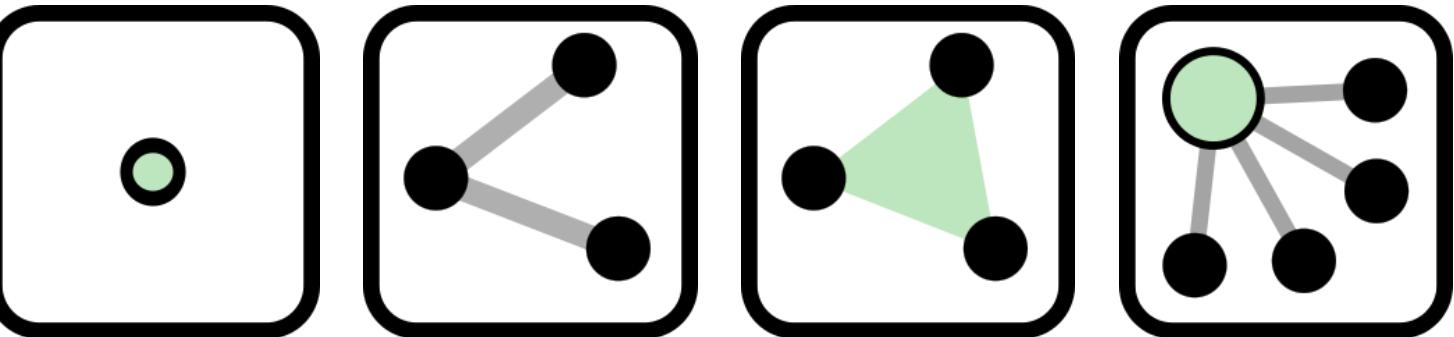
- Examples of Amenities include:

- Restaurant
- Dentist
- Bicycle\_parking
- Place\_of\_worship



# OSM Features

## Points of Interest



### Free Tagging System

- OpenStreetMap's Free Tagging System allows features on the map to include an **unlimited number of tagged attributes**
- The community agrees on some key and value combinations
- The more common the feature, the more likely to have a consensus on tagging guidelines
- However, users can add any new tag they want if they believe it'll further enhance the data



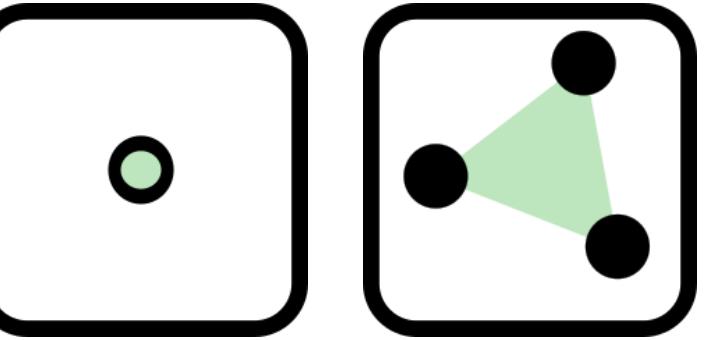
Free Tagging System Resources:

- <http://wiki.openstreetmap.org/wiki/Tags>
- [http://wiki.openstreetmap.org/wiki/Map\\_Features](http://wiki.openstreetmap.org/wiki/Map_Features)

# OSM Features

## Buildings

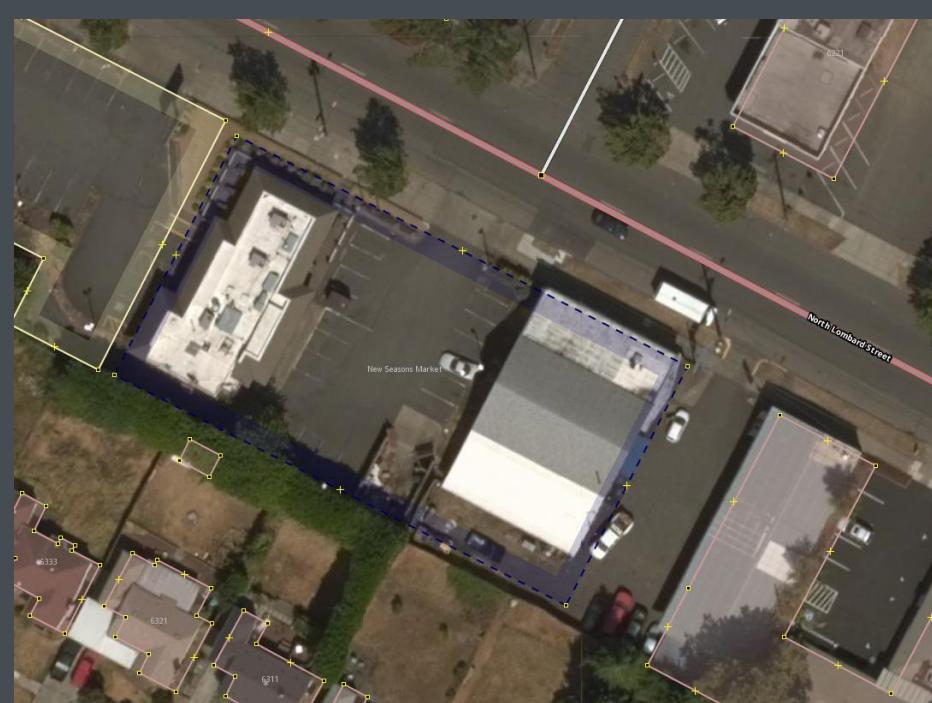
- Buildings are a structure with walls and a roof. In OSM, these range from simple cottages to large factories or landmarks.
- Every individual structure is recommended to get its own polygon. Building nodes are rare.
- Most buildings are created from aerial imagery so it is common to see a building tagged as “building” = “yes”
- It is also recommended to square buildings using automated tools (found in JOSM)



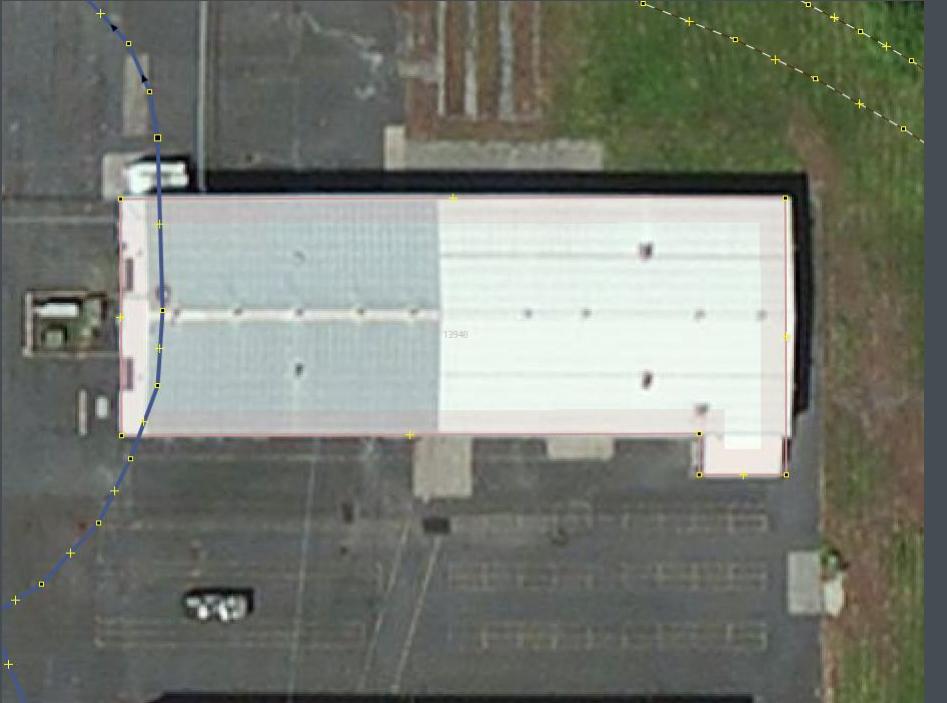
Building = yes



Building = construction

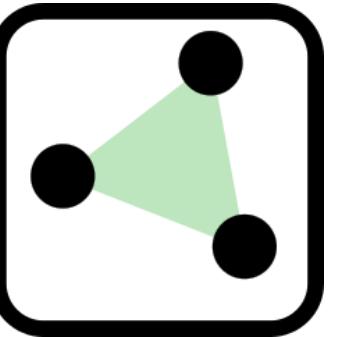


Building = industrial



# OSM Features

## Areas



An [area](#) is any feature best described by a filled-in polygon.

- Some features are automatically assumed to be areas due to their tag needing to be a filled-in polygon.
  - Example: A “landuse” = “commercial” feature will be filled-in
- The most common area feature we see are landuse polygons used to describe numerous managed features near highways.
- Multipolygons and buildings are included as area features

### Area Resources:

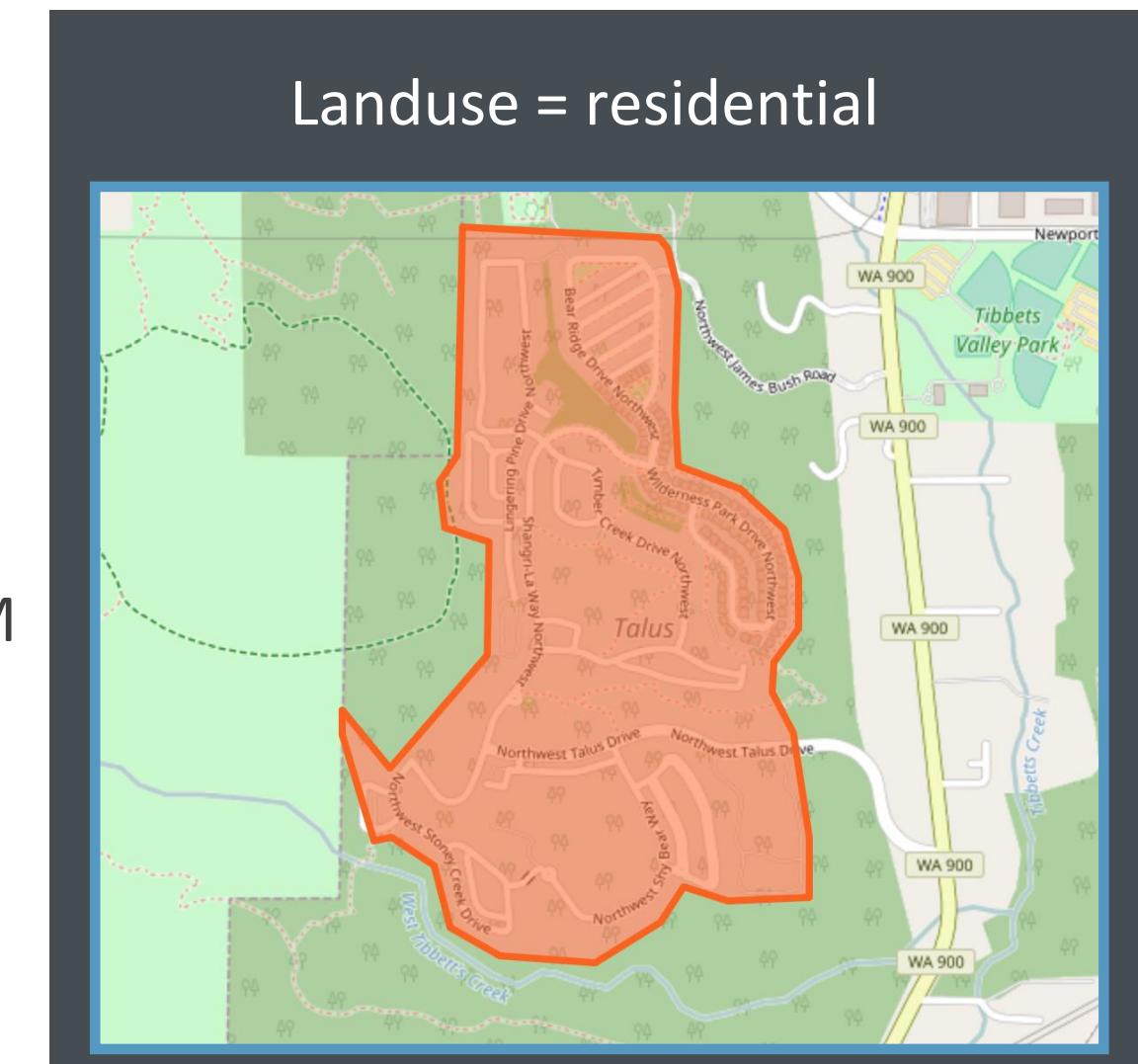
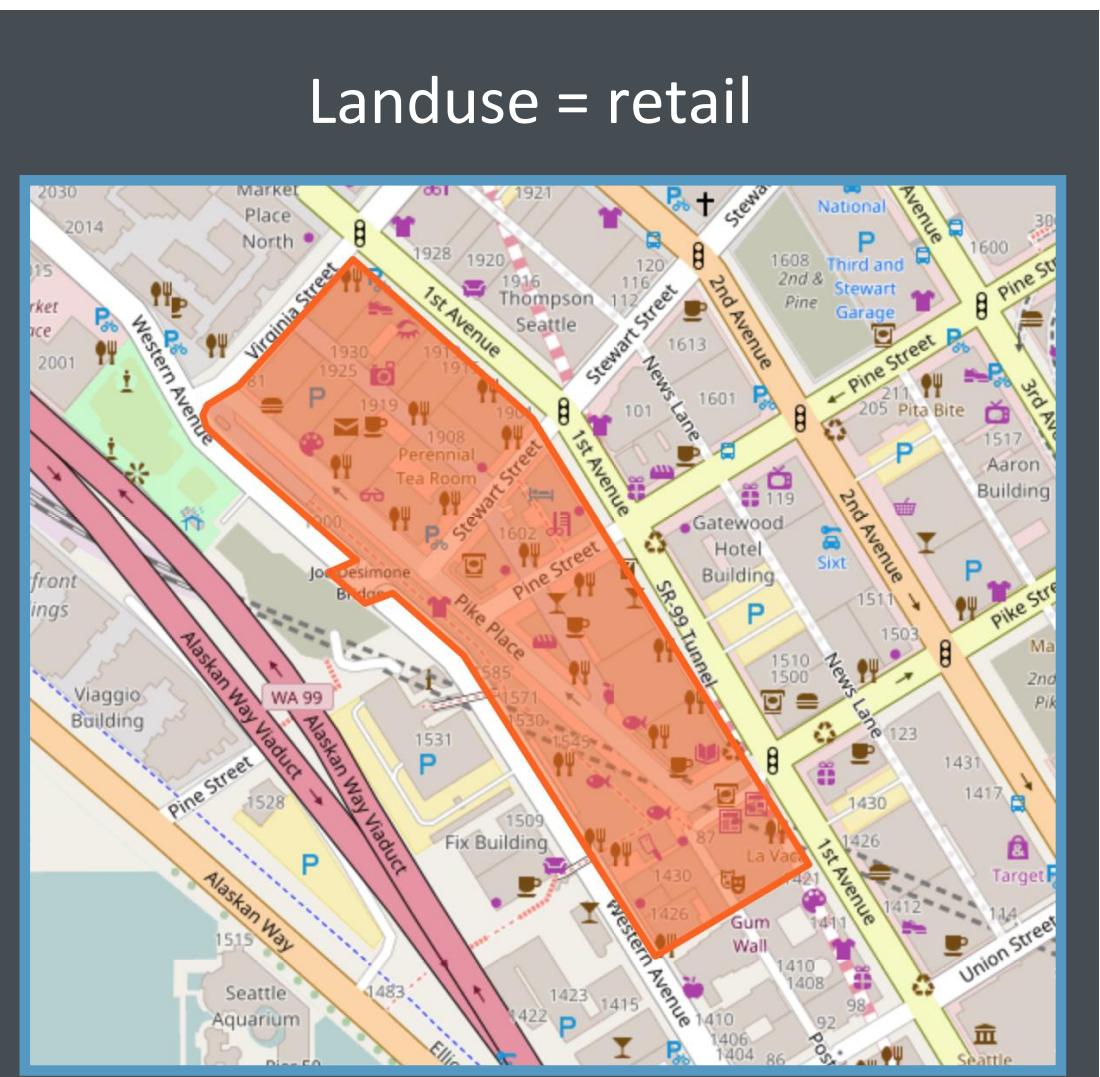
- <http://wiki.openstreetmap.org/wiki/Area>
- <http://wiki.openstreetmap.org/wiki/Key:landuse>
- <http://wiki.openstreetmap.org/wiki/Key:natural>
- <http://wiki.openstreetmap.org/wiki/Key:building>
- <http://wiki.openstreetmap.org/wiki/Key:leisure>

# OSM Features

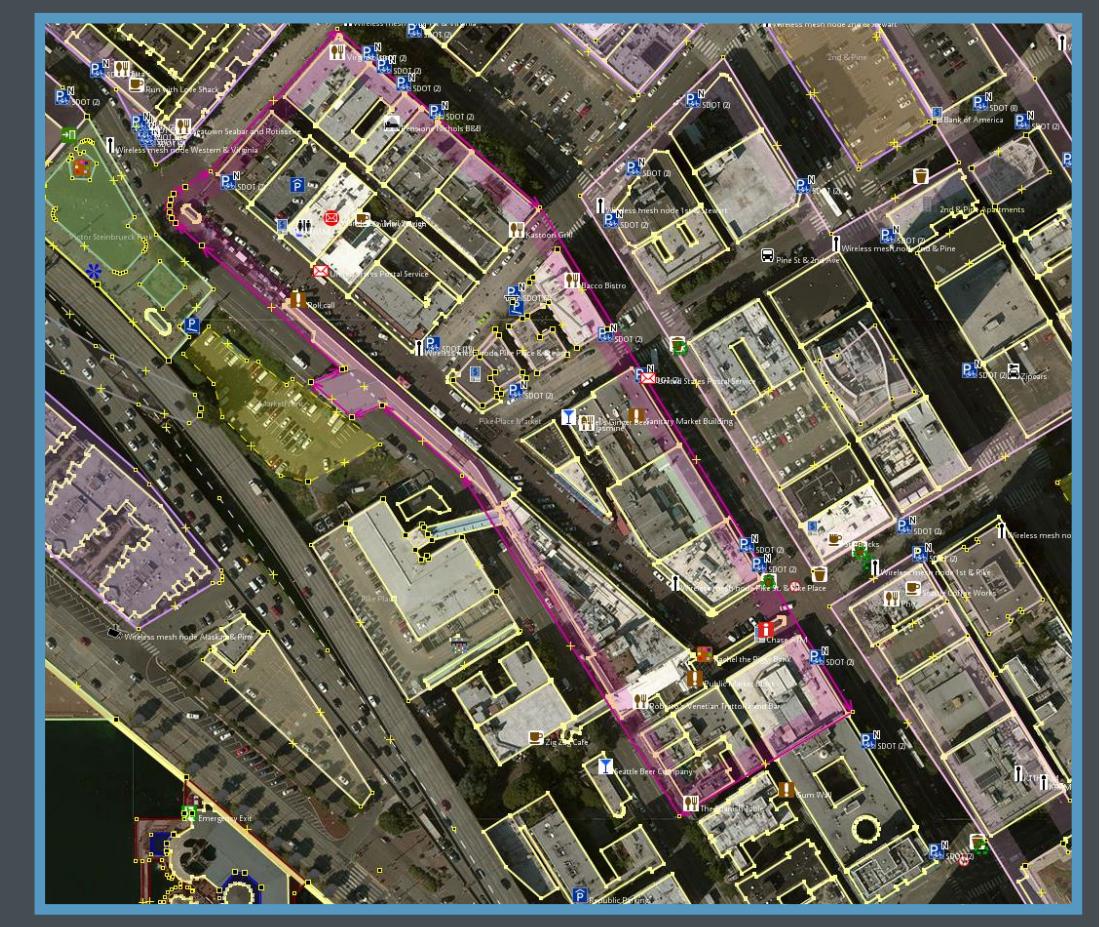
## Landuse Areas

“Landuse” is a tag which describes the human utilization of a specific zone.

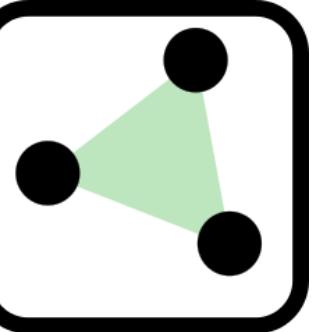
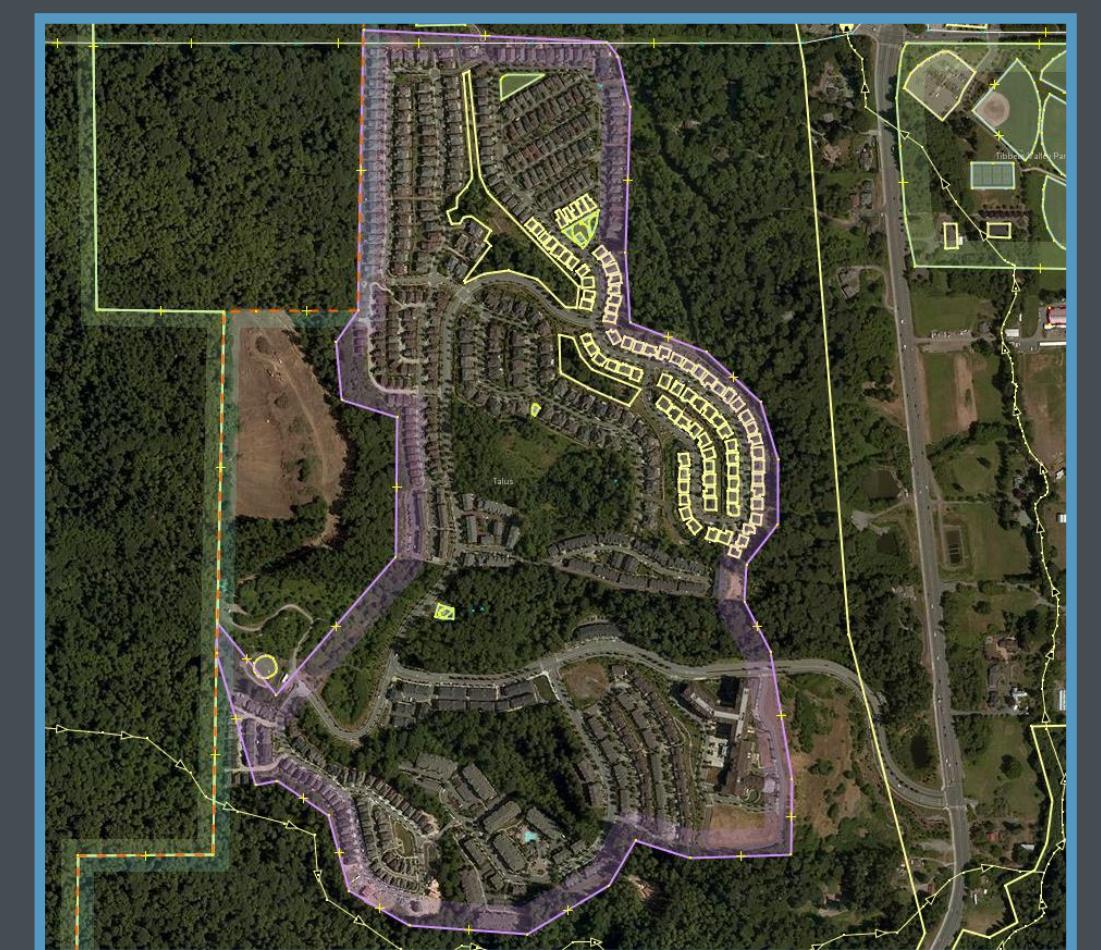
- These areas are often bordering or features we are interested in
- The most important tag defines the primary use of the landuse polygon
- Examples of Landuse tags:
  - Residential
  - Commercial
  - Forest
  - Military
  - Farmland



OSM



JOSM



# OSM Features

## Leisure Areas

The “Leisure” tag is an area which functions as a place where people go in their spare time.

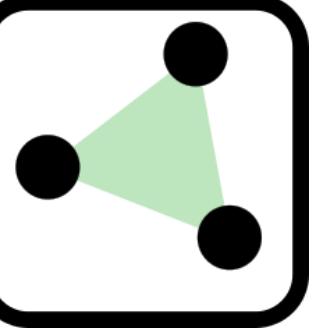
- Leisure is not as common as the “landuse” tag but we’ll regularly see Parks or Stadiums
- You may find some Leisure tags combined with other area tags like Landuse
- Examples of Leisure tags:
  - Golf Course
  - Park
  - Playground
  - Stadium



OSM



JOSM

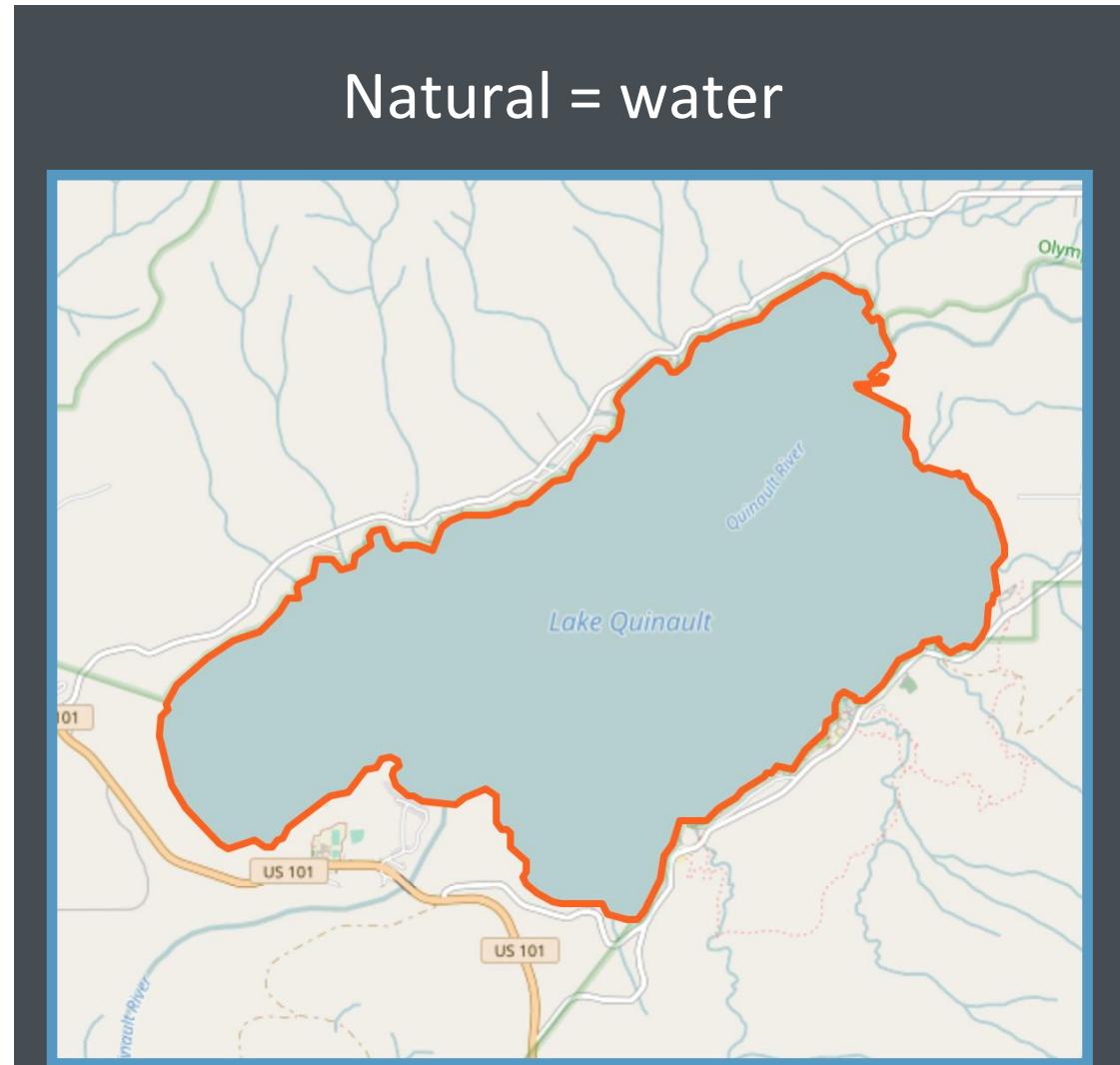
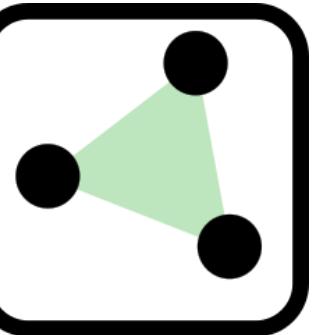


# OSM Features

## Natural Areas

The “Natural” tag is often used on area features to describe a variety of physical features.

- Our team usually sees Natural areas bordering or connected to features we are working on.
- It’s better to have human-managed features in the “landuse” tag
- Examples of Natural tags:
  - Wood
  - Water



OSM



JOSM

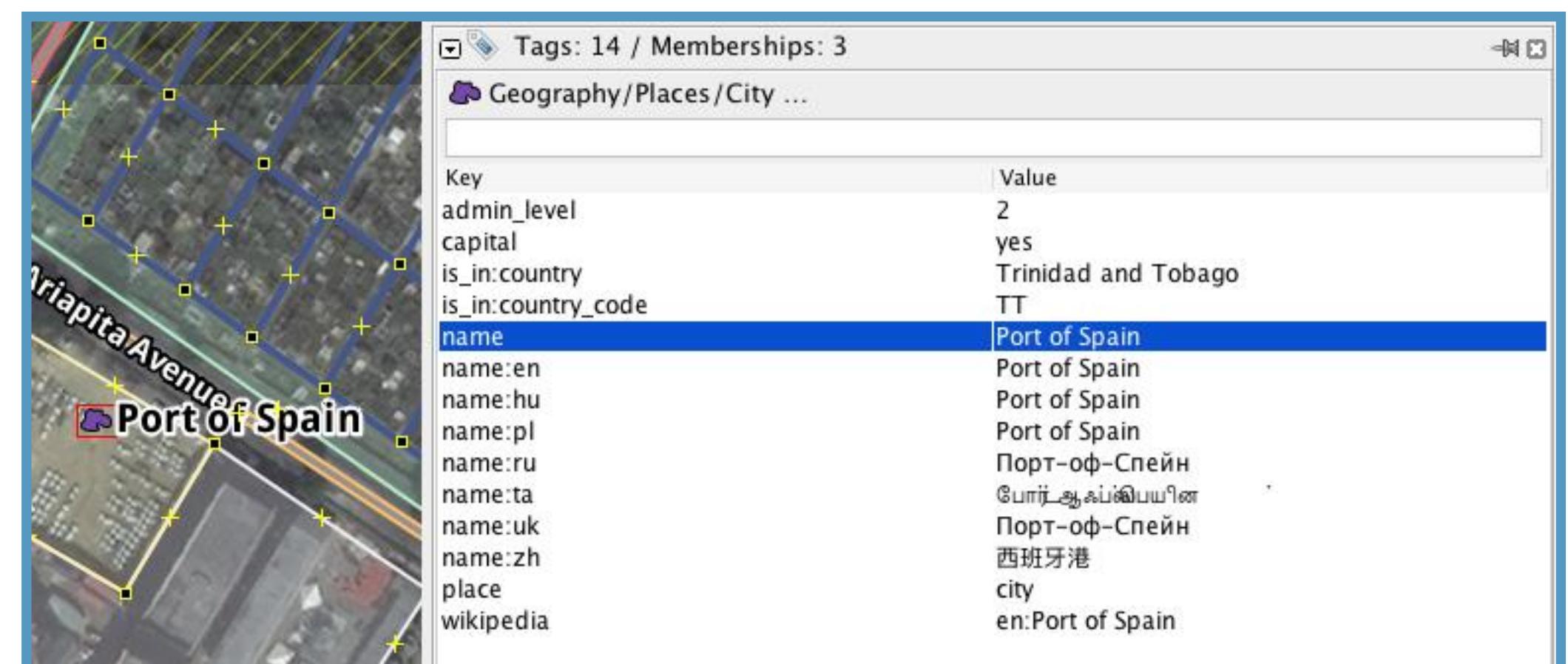
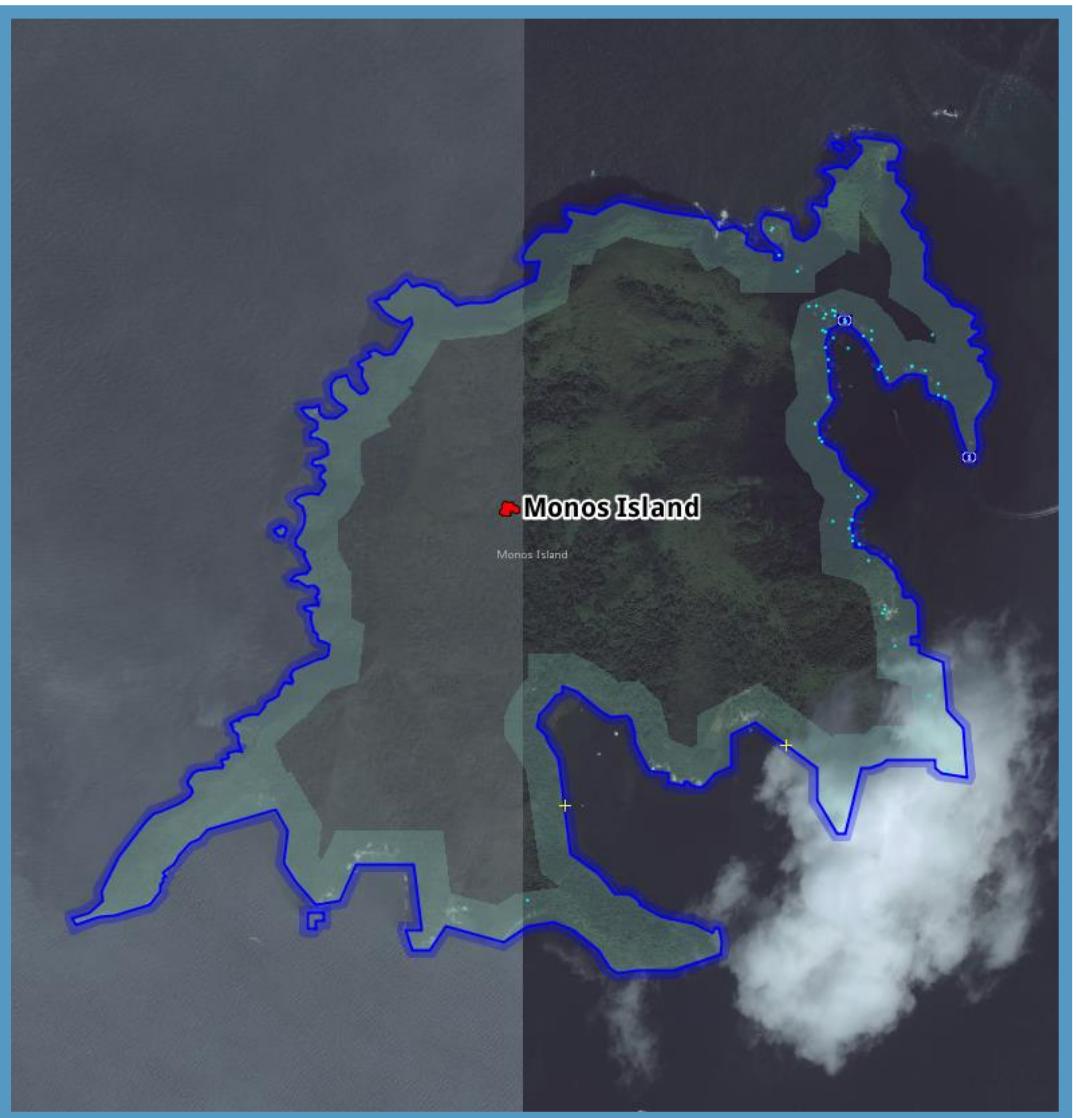
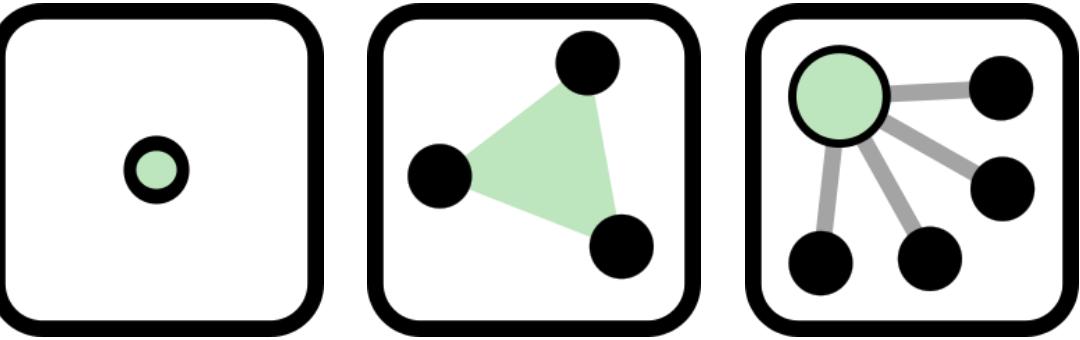
# OSM Features

## Places

- “Place” tags:
  - Indicate what kind of location it is.
  - Should exist for every significant human settlement.
  - Types of settlements: city, town, village, suburb, neighborhoods, hamlets, etc.
  - Should exist for notable locations (continents & oceans)
- Islets and other small named physical features
  - Should be found on a central “node” for a feature *AND* the area which encompasses a specific feature.
- At minimum, a node feature should exist

Place Resources:

- <http://wiki.openstreetmap.org/wiki/Places>
- <http://wiki.openstreetmap.org/wiki/Key:place>



# OSM Features

## Administrative Boundaries

An Administrative Boundary is a political subdivision of an area/territory/jurisdiction recognized internally by a government or by the international community.

- Administrative boundaries are defined by the “admin\_level” tag
  - The admin\_level tag is a hierarchy of increasing importance starting at the lowest numerical value
  - The most important admin\_level = “2” (National Boundaries)
  - The scale currently delineates levels down to “11”

Boundary Resources:

- <http://wiki.openstreetmap.org/wiki/Tag:boundary%3Dadministrative>

admin_level	Mapnik	admin_level	Mapnik	admin_level	Mapnik
1	(not rendered)	5	dotted	9	dotted
2	solid	6	dotted	10	dotted
3	dotted	7	dotted	11	light gray
4	dotted	8	dotted	12	(not rendered)



# Editing Basics

## “Tagging for the Renderer”

- Don't deliberately enter incorrect data so it renders a certain way
- Some OSM editors have been caught by the community editing the data to *look* a certain way
  - Ex.: Drawing a rose field as landuse=industrial just because it gets rendered as a pink polygon
- Our goal should be to map according to OSM guidelines while still creating a truthful map that is aesthetically pleasing and easy to comprehend

