Georeferencing Concepts
+
Point-Radius Method + Locality Types

Based on iDigBio Georeferencing Train-the-Trainer Workshops

Definitions from GBIF Georeferencing Best Practices

Map images from Logainm/OSI/Google/Geolocate

Georeference: The process (verb) or product (noun) of interpreting a locality description into a spatially mappable representation using a georeferencing method.

Georeferencing Best Practices

Arthur D. Chapman · John R. Wieczorek – Version 8928428, 2023-07-12 09:02:13 UTC

GBIF Global Biodiversity Information Facility

Chapman AD & Wieczorek JR (2020) Georeferencing Best Practices. Copenhagen: GBIF Secretariat. https://doi.org/10.15468/doc-gg7h-s853

- data have the potential to be used in ways unforeseen when collected.
- the value of the data is directly related to the fitness for a variety of uses.
- “as data become more accessible many more uses become apparent.” – Chapman 2005
- GBIF Best Practices promote data quality and fitness for use.

Mammal Networked Information System MaNIS

ORNIS

HerpNET

Current best practices
Based on work by Chapman and Wieczorek
+ pioneering collaborative digitization projects MaNIS (mammals), Ornis (birds) and Herpnet (herpetology)

BioGeomancer

Guide to Best Practices for Georeferencing

Georeferencing Best Practices

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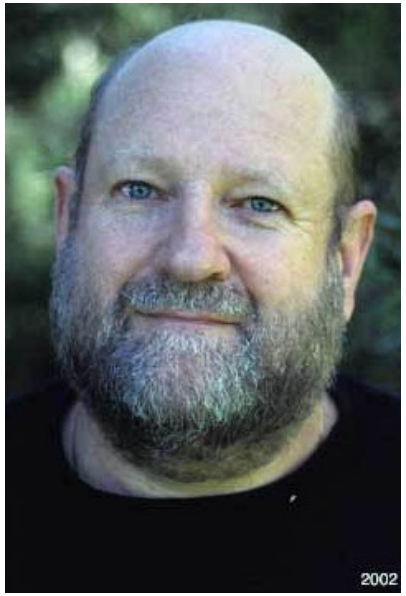
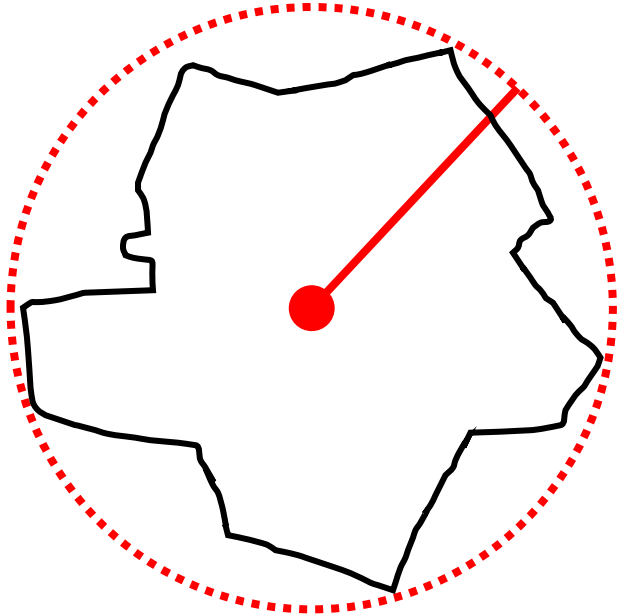


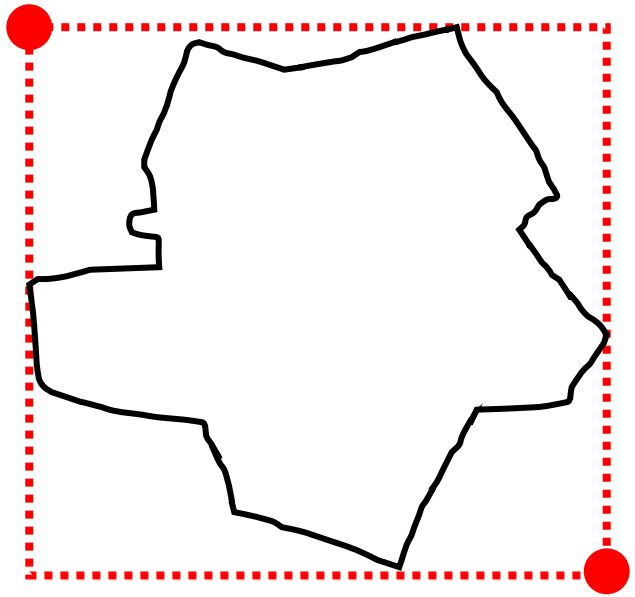
Arthur Chapman

John Wieczorek

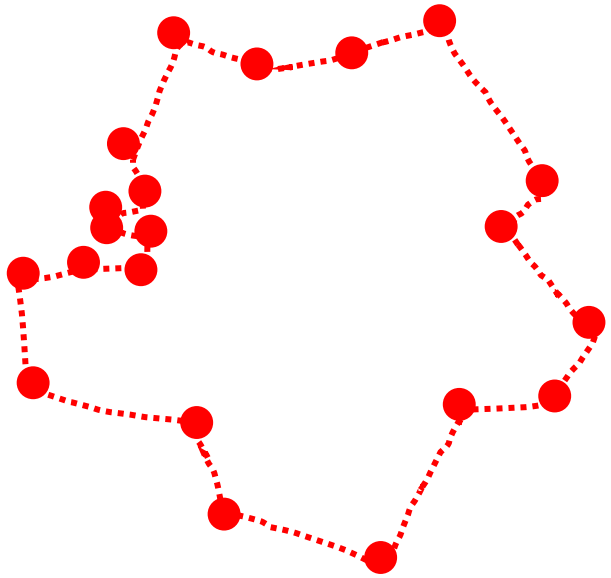
iDigBio Integrated Digitized Biocollections



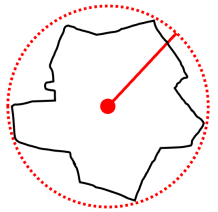
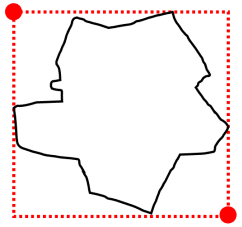
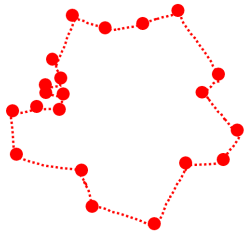
Point-radius



Bounding Box

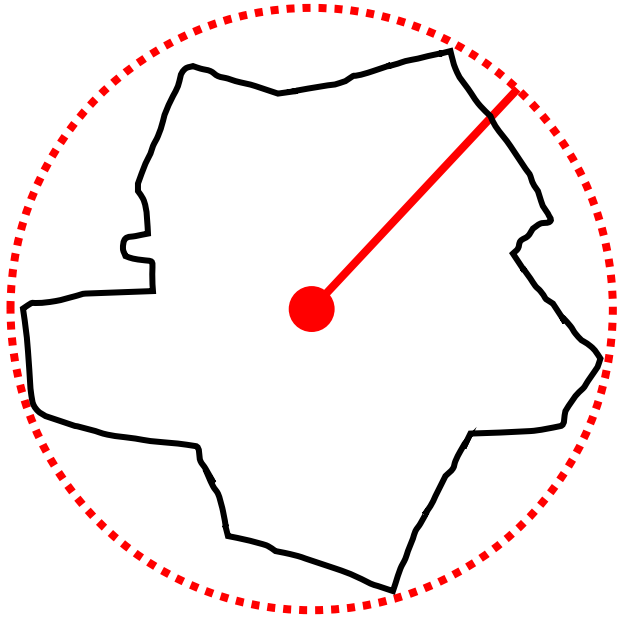


Shape/Polygon

point-radius	easy quality assessment difficult spatial queries	
bounding-box	simple spatial queries difficult quality assessment	
shape	accurate representation complex, uniform	

point-radius

- Circle encompasses all sources of uncertainty about the location
- Formalizes assumptions, algorithms, and documentation standards that promote reproducible results
- Methods are universally applicable
- Common in Natural History collection digitization projects – relatively quick, easy to store data, fulfills requirements of central data aggregators



geographic coordinate (the "corrected center")
+ geodetic datum
+ maximum uncertainty distance as a radius

DARWIN CORE

dwc:decimalLatitude, dwc:decimalLongitude
dwc:geodeticDatum
dwc:locality
dwc:verbatimLocality
dwc:coordinateUncertaintyInMeters
dwc:georeferenceSources
dwc:georeferencedBy, dwc:georeferencedDate
dwc:georeferenceRemarks
dwc:georeferenceProtocol
dwc:coordinatePrecision
dwc:verbatimCoordinates
dwc:verbatimLatitude, dwc:verbatimLongitude
dwc:verbatimCoordinateSystem
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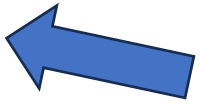
dwc:georeferenceRemarks
dwc:footprintWKT….



Darwin Core is a vocabulary standard which facilitates data sharing in the biodiversity community (it also includes some geological terms).

https://www.tdwg.org/standards/dwc/

These are some of the Darwin Core terms which relate to georeferencing.

For full details and definitions see https://dwc.tdwg.org/terms/#location

Collections management software used by Natural History Collections usually accommodates most of these terms, albeit with some differences in how the information is structured and presented. Data export to GBIF requires mapping to the Darwin Core standard.

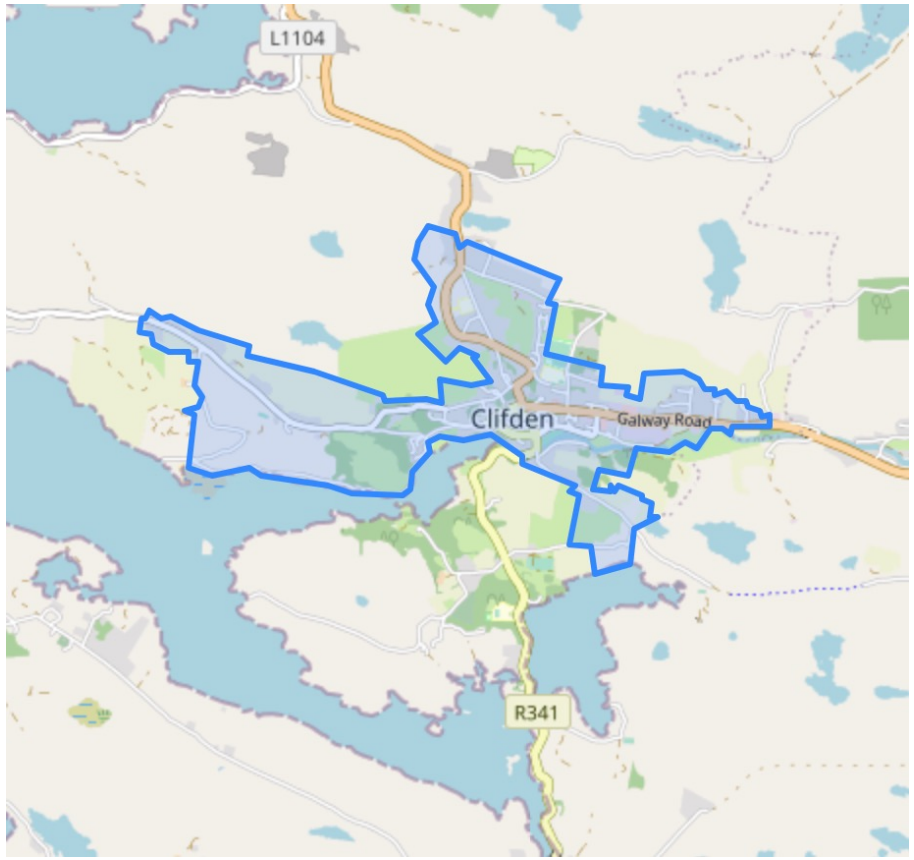
FEATURE

Definition: An object of observation, measurement, or reference that can be represented spatially.

Often categorized into "feature types" (e.g., mountain, road, populated place, etc.) and given names for specific instances (e.g., "Mount Everest", "Ruta 40", "Istanbul"), which are also sometimes referred to as "named places", "place names" or "toponyms".

Example: “Clifden” – a town in County Galway, Ireland

Could also be the basis of a longer locality description e.g., “5km N of Clifden”

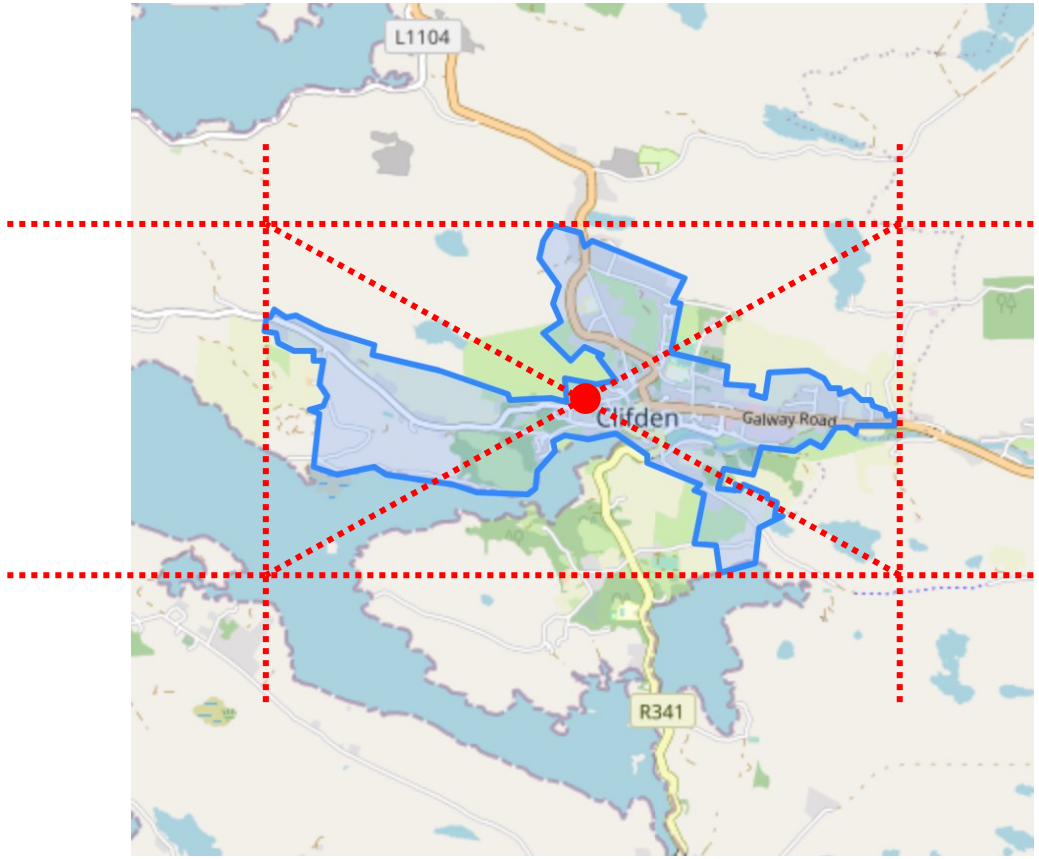


Clifden

GEOGRAPHIC CENTER

Definition: The midpoint of the extremes of latitude and longitude of a feature.

Geographic centres are relatively easy to determine, but they generally do not correspond to the centre obtained by a least circumscribing circle*. For that reason it is **not recommended** to use a geographic centre for any application in georeferencing.
Compare corrected center.

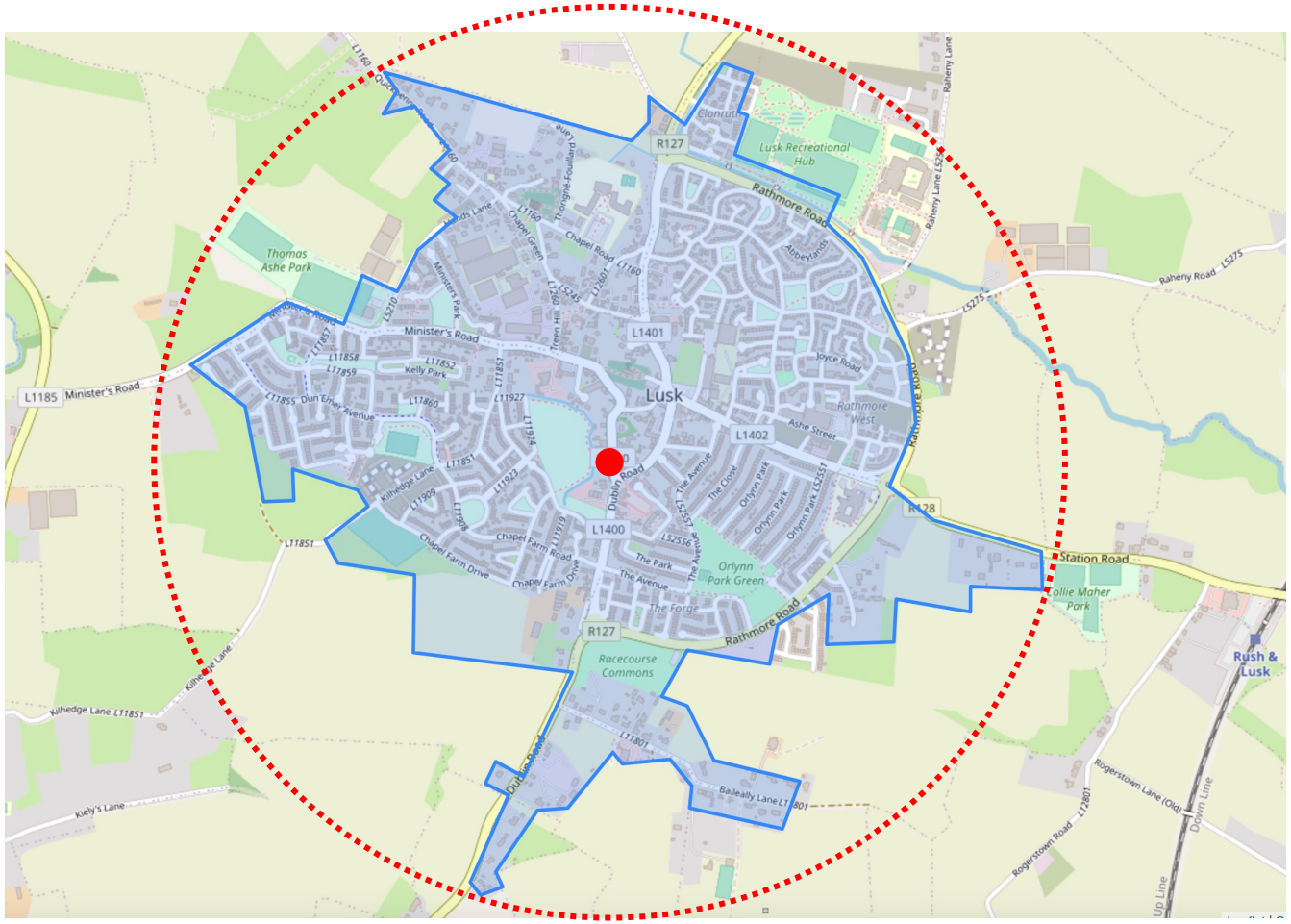


*while putting together these examples, I couldn't find any where the geographic center wasn't *extremely close* to the center of the smallest circumscribing circle, but see GBIF for examples

CORRECTED CENTER

Definition: The point within a location, or on its boundary, that minimizes the geographic radial of the location.

This point is obtained by making the smallest enclosing circle that contains the entire feature, and then taking the centre of that circle.



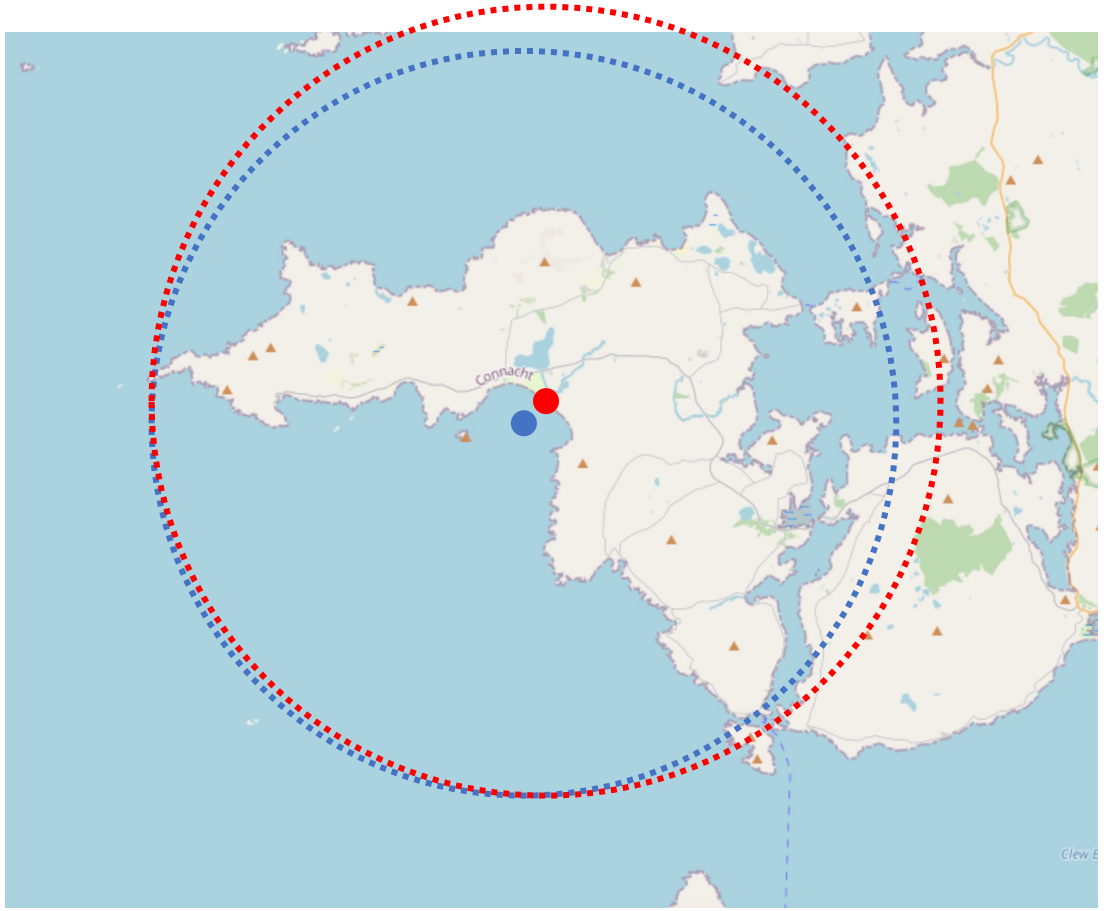
Lusk, a town in County Dublin

CORRECTED CENTER

Definition: The point within a location, or on its boundary, that minimizes the geographic radial of the location.

This point is obtained by making the smallest enclosing circle that contains the entire feature, and then taking the centre of that circle.

If that centre does not fall inside the boundaries of the feature, make the smallest enclosing circle that has its centre on the boundary of the feature. Note that in the second case, the new circle, and hence the radial, will always be larger than the uncorrected one.



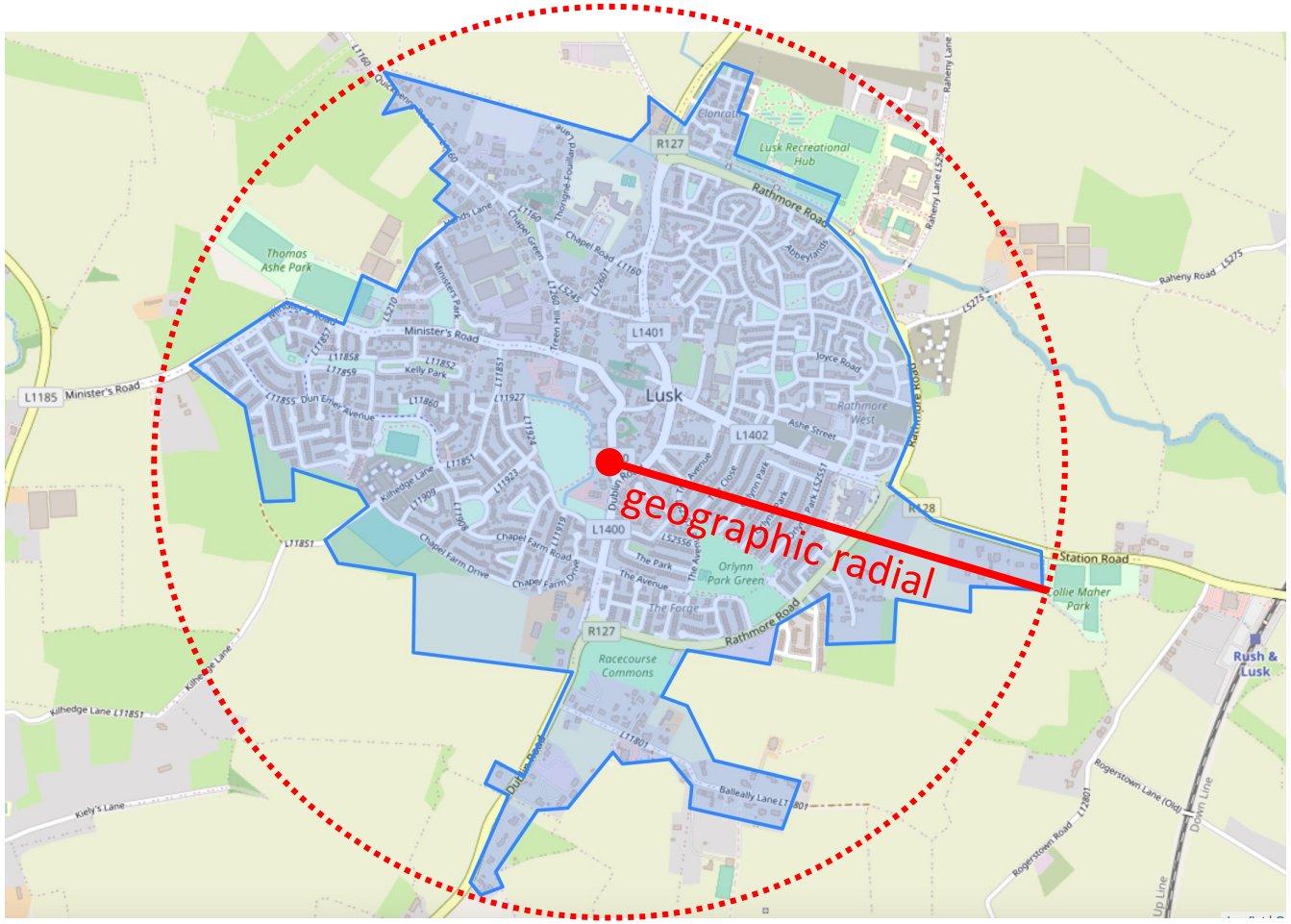
A case where the initial corrected centre (blue) falls outside the the feature (Achill Island) – instead we use the smallest enclosing circle which has its center on the boundary (red)

GEOGRAPHIC RADIAL

Definition: The distance from the corrected center of a location to the furthest point on the geographic boundary of that location.

The geographic radial* is what contributes to calculations of the maximum uncertainty distance using the point-radius georeferencing method.

= “Radial of Feature” in the georeferencing calculator.



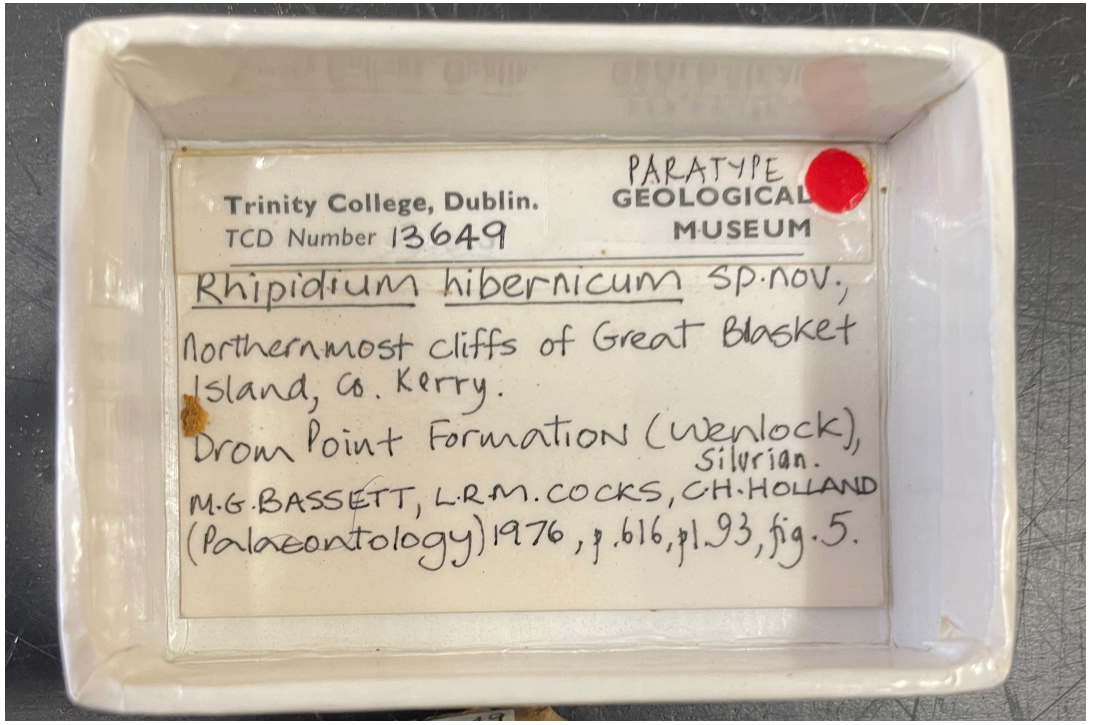
Lusk, a town in County Dublin

*The term geographic radial, as defined here, replaces its equivalent "extent" used in the early versions of this *Quick Reference Guide* and related documents.

LOCALITY TYPES

The following slides give examples of some (not all) types of localities that are common in natural history collections, using Irish examples

The Georeferencing Quick Reference Guide* gives more examples and a step-by-step approach: https://docs.gbif.org/georeferencing-quick-reference-guide/1.0/en/.



*Zermoglio PF, Chapman AD, Wieczorek JR, Luna MC & Bloom DA (2020) Georeferencing Quick Reference Guide. Copenhagen: GBIF Secretariat. https://doi.org/10.35035/e09p-h128

Feature - with obvious spatial extent

e.g. cities, towns, villages, mountains, junctions, townlands, islands, quarries…

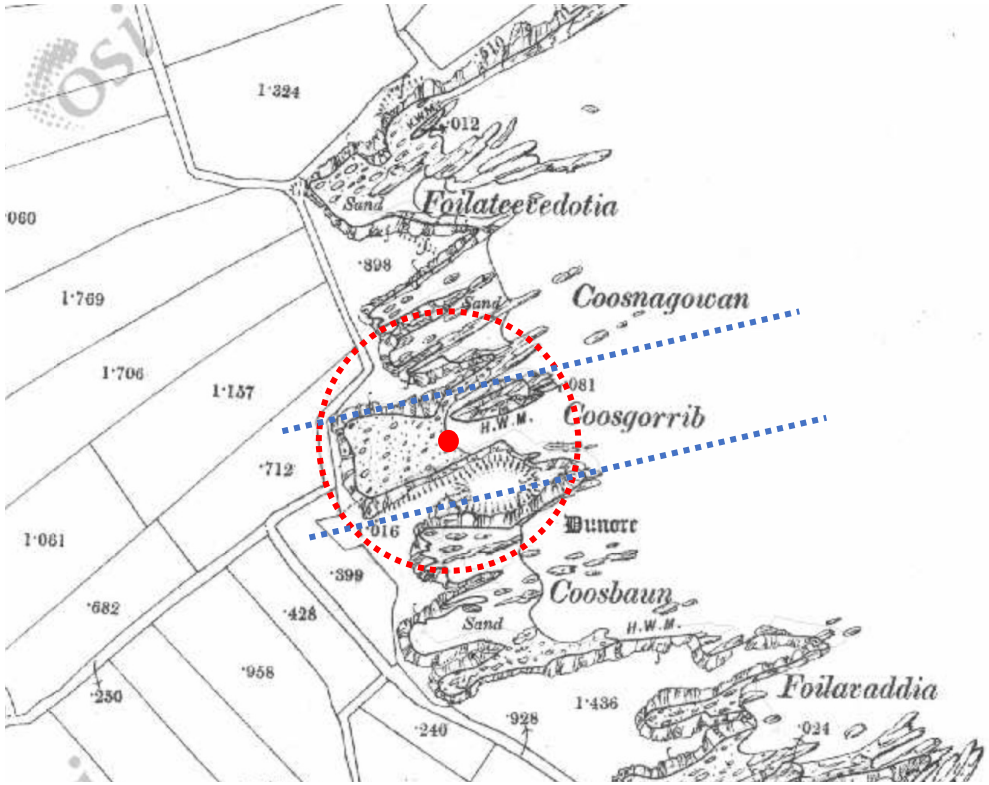
- Find the corrected centre and geographic radial
- Use georeferencing calculator to get uncertainty (also accounting for Coordinate Source, Coordinate Format, Datum, Coordinate Precision, GPS Accuracy/Measurement Error, and Distance Units)

Great Blasket Island, Co. Kerry

Feature - without obvious spatial extent

- Estimate the boundary based on features that could reasonably be included, e.g., closely associated buildings in the case of a small village. If necessary use the midpoint between the feature in question and the nearest similar feature. Be explicit about the assumptions you make in the georeferencing remarks.

- Use georeferencing calculator to get uncertainty (accounting for Coordinate Source, Coordinate Format, Datum, Coordinate Precision, GPS Accuracy/Measurement Error, and Distance Units)

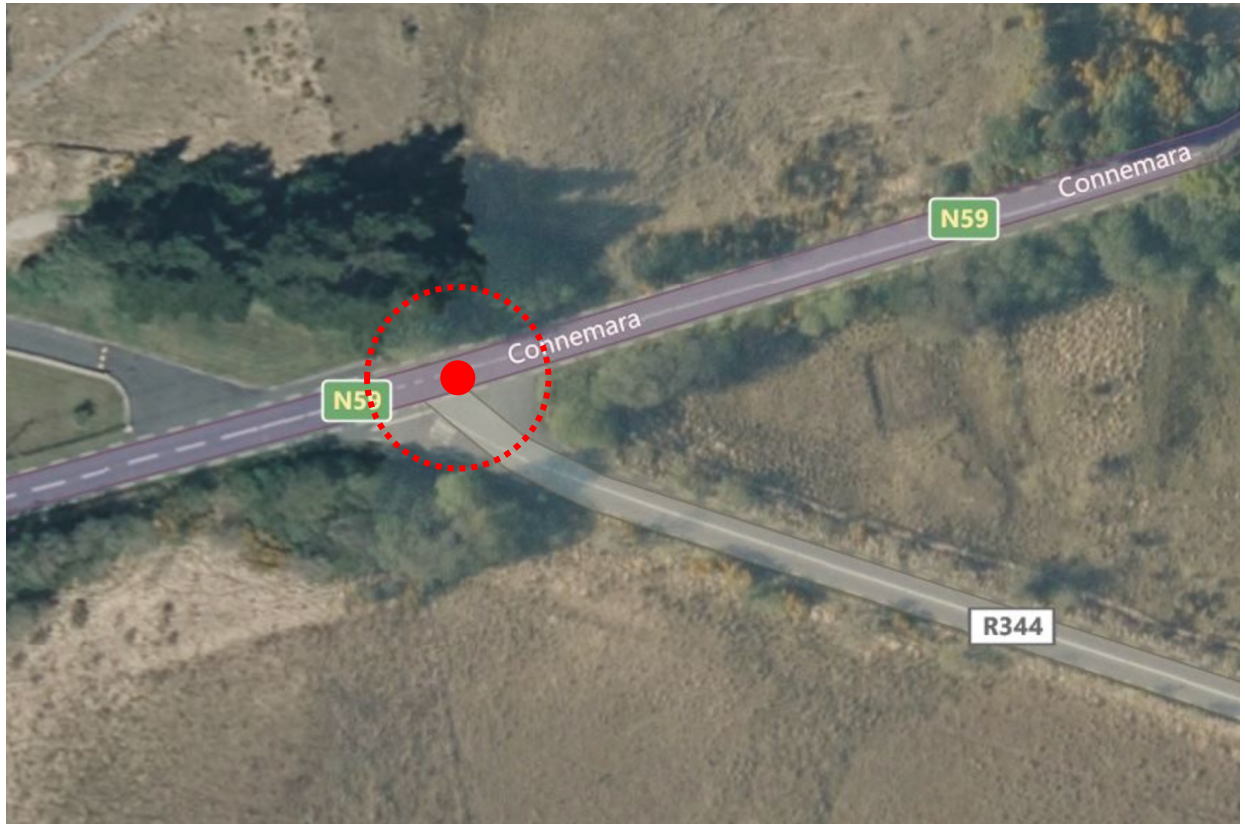


Example “Coosgorrib”

The names on this map correspond to small inlets, but it is not always clear where one ends and the next begins. Estimated boundary half-way between neighbouring inlets

Feature – Junction, Intersection, Crossing, Confluence

- Determine the boundary of the junction, find the corrected centre and geographic radial as before
- Use georeferencing calculator to get uncertainty (accounting for Coordinate Source, Coordinate Format, Datum, Coordinate Precision, GPS Accuracy/Measurement Error, and Distance Units)

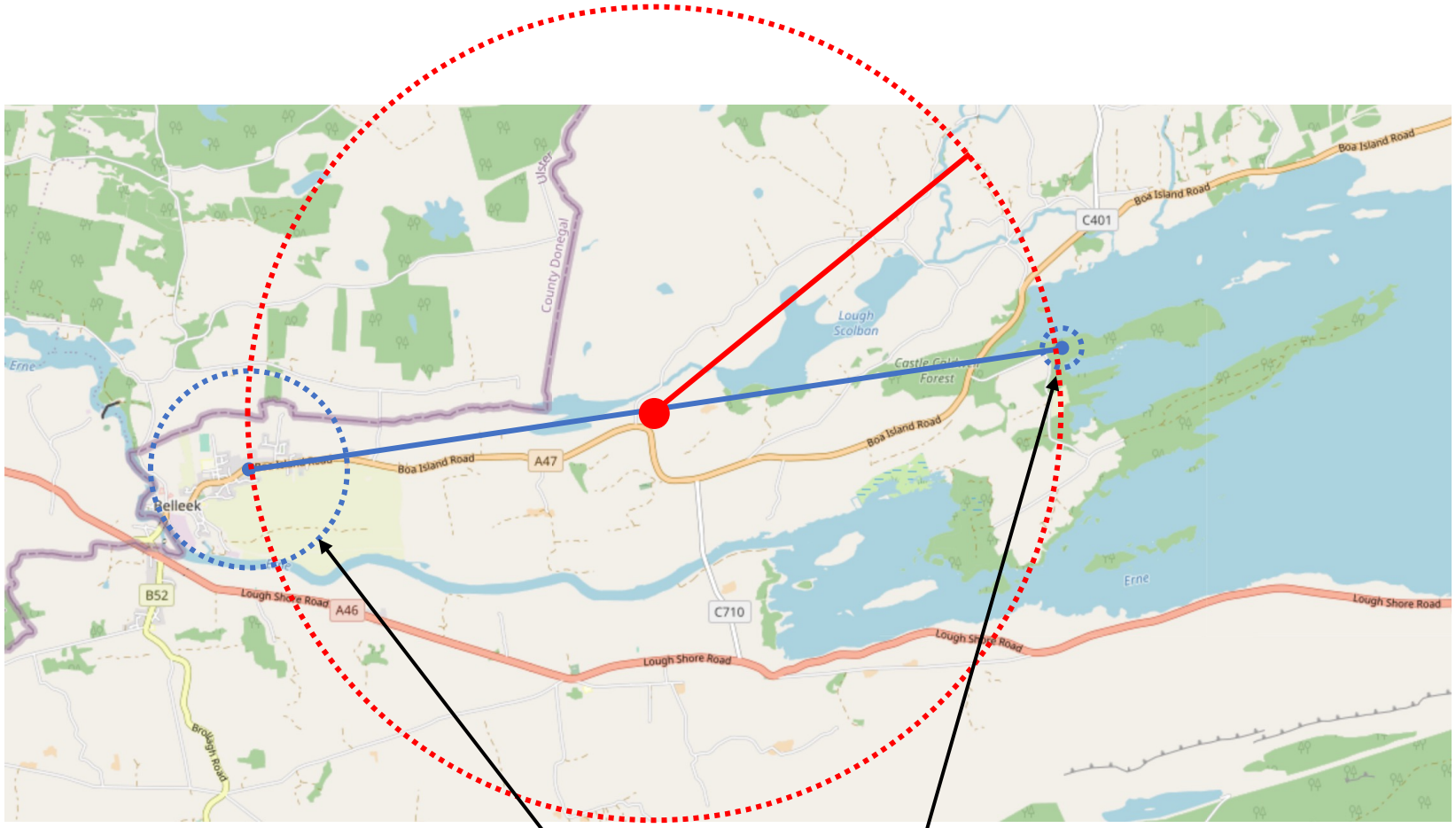


Example: Junction of N59 and R344, north of Lough Inagh*

*A tricksy example…the N59 loops around and meets the R344 again at its southernmost point. Illustrates the importance of a good locality description. Additional detail e.g., relative to Lough Inagh is needed to distinguish the two intersections in this case.

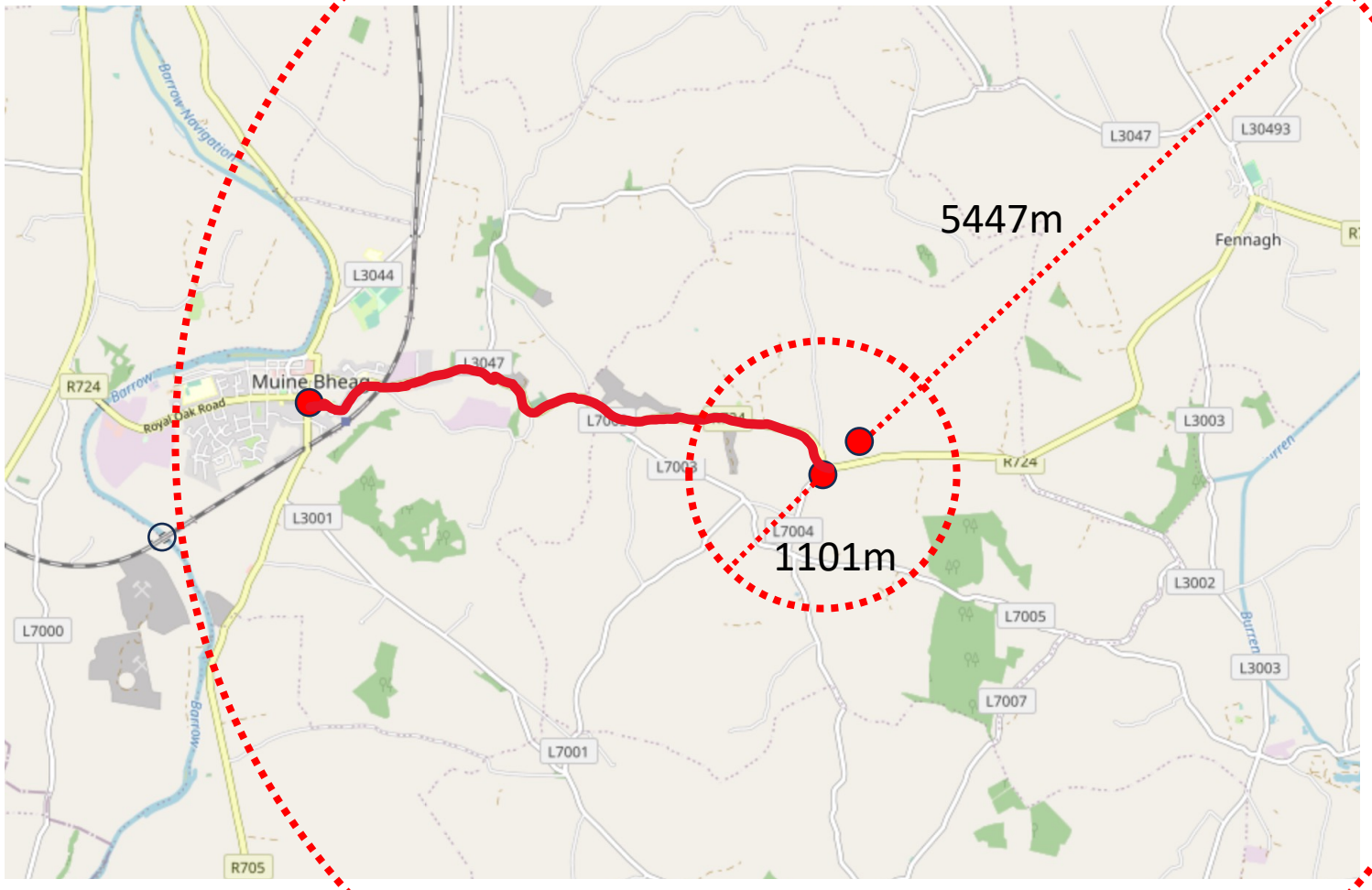
Feature - between two features

- Find the corrected centre for each feature (blue points)
- Find the midpoint between the corrected centres (red point)
- Geographic radial is half the distance between the two features (red line)
- Use georeferencing calculator to get uncertainty (accounting for Coordinate Source, Coordinate Format, Datum, Coordinate Precision, GPS Accuracy/Measurement Error, and Distance Units)



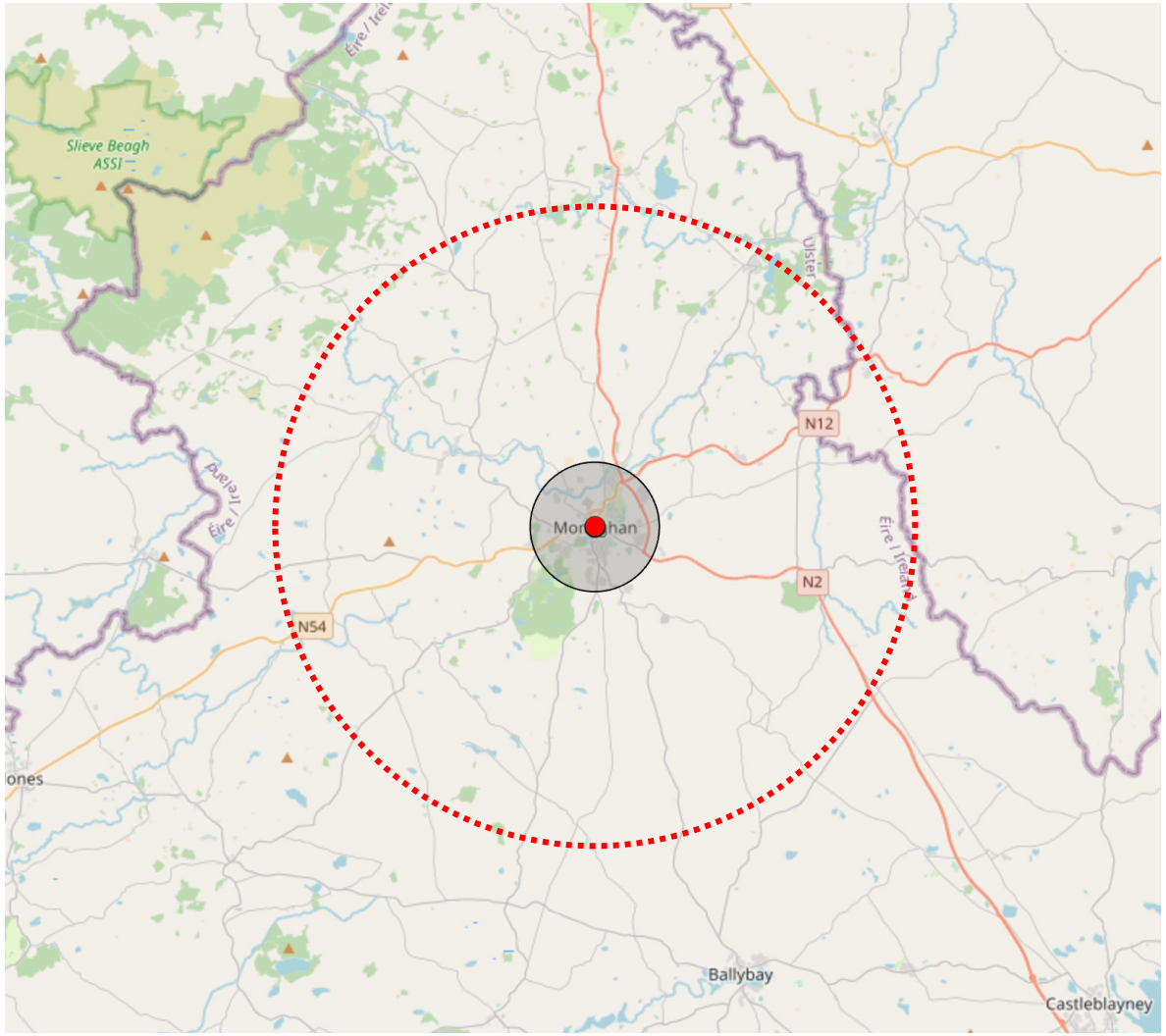
Example: between **Belleek and Castle Caldwell**

Offset - distance along a path and distance at a heading compared
(crudely drawn! - see quick reference guide and georeferencing calculator for detailed examples)



“5km E of Bagenalstown along the road to Fennagh” vs “5km E of Bagenalstown”

Offset – distance only



Monaghan town (grey)
“4.5 miles from Monaghan town”(red)

Parsing a Locality

"Small roadside quarry at Head of Burren Bridge, east of the Nine Stones, 1.5km north of Mount Leinster."

Long, complex localities can be parsed into 'clauses'.

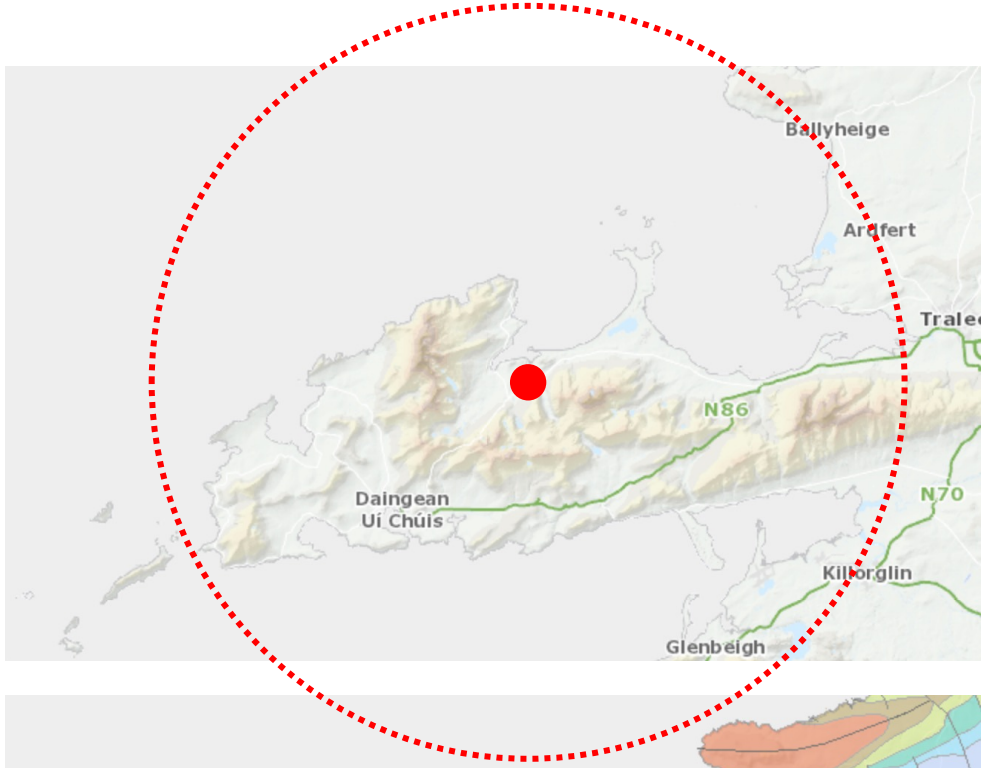
In this example the quarry is the most specific part of the description.

The rest of the locality description can be used to find the quarry, which is marked on this 6" OSI map.

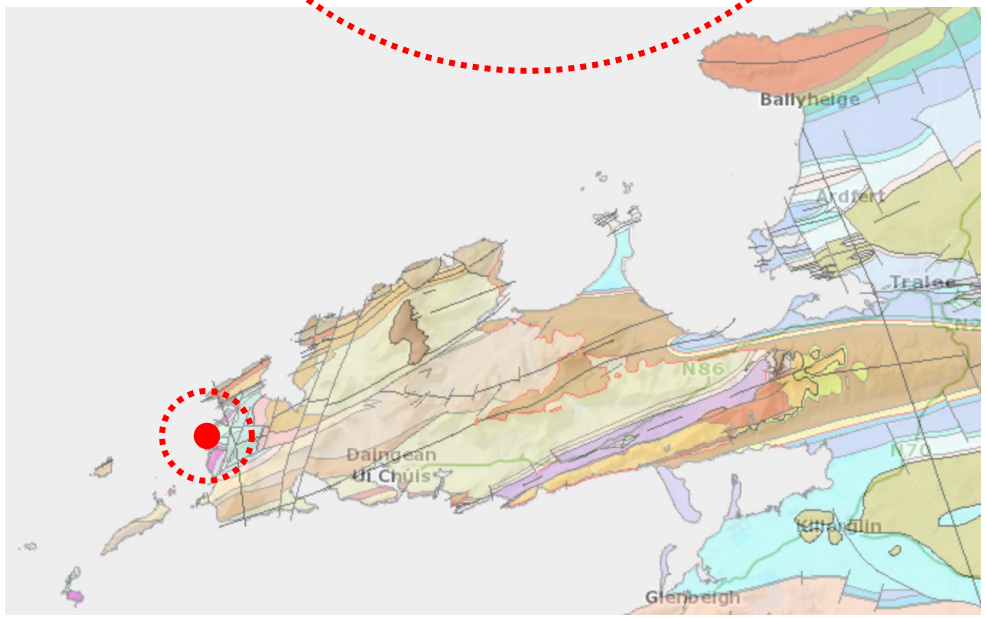
The quarry can then be georeferenced as a 'feature with (reasonably) obvious extent'.

Additional information – Geology

Dingle Peninsula

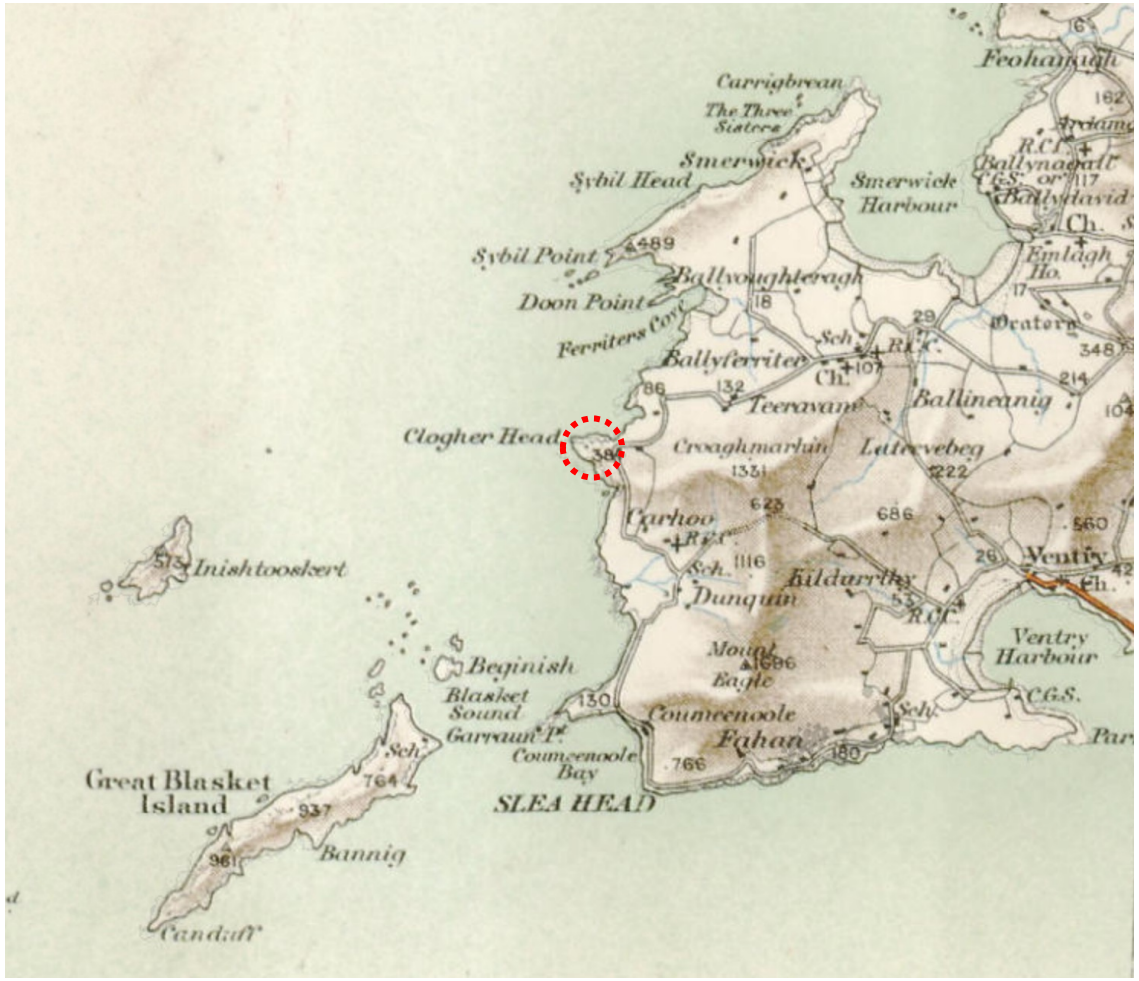


Clogher Head Formation
Dingle Peninsula

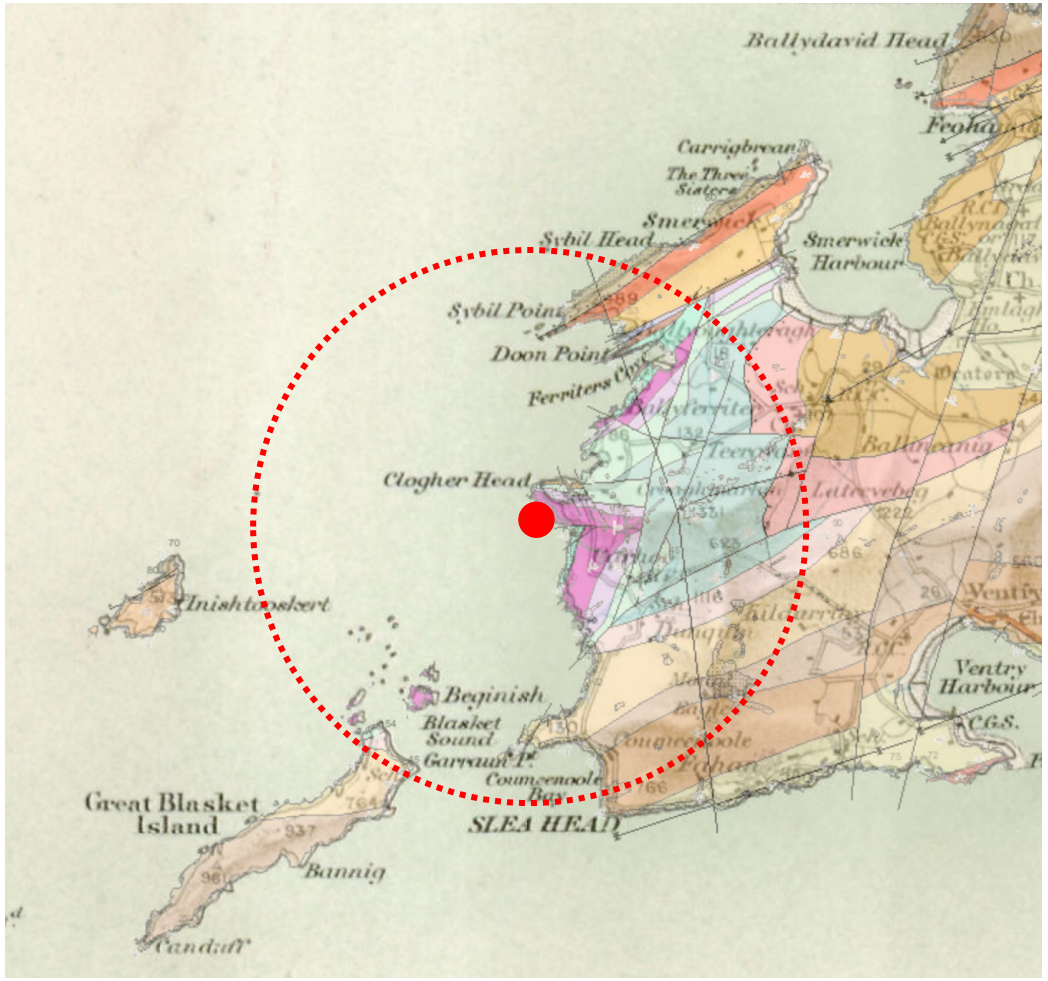


Maps: MapGenie + GSI bedrock geology 1:100,000

The importance of distinguishing between Geography and Geology



Clogher Head



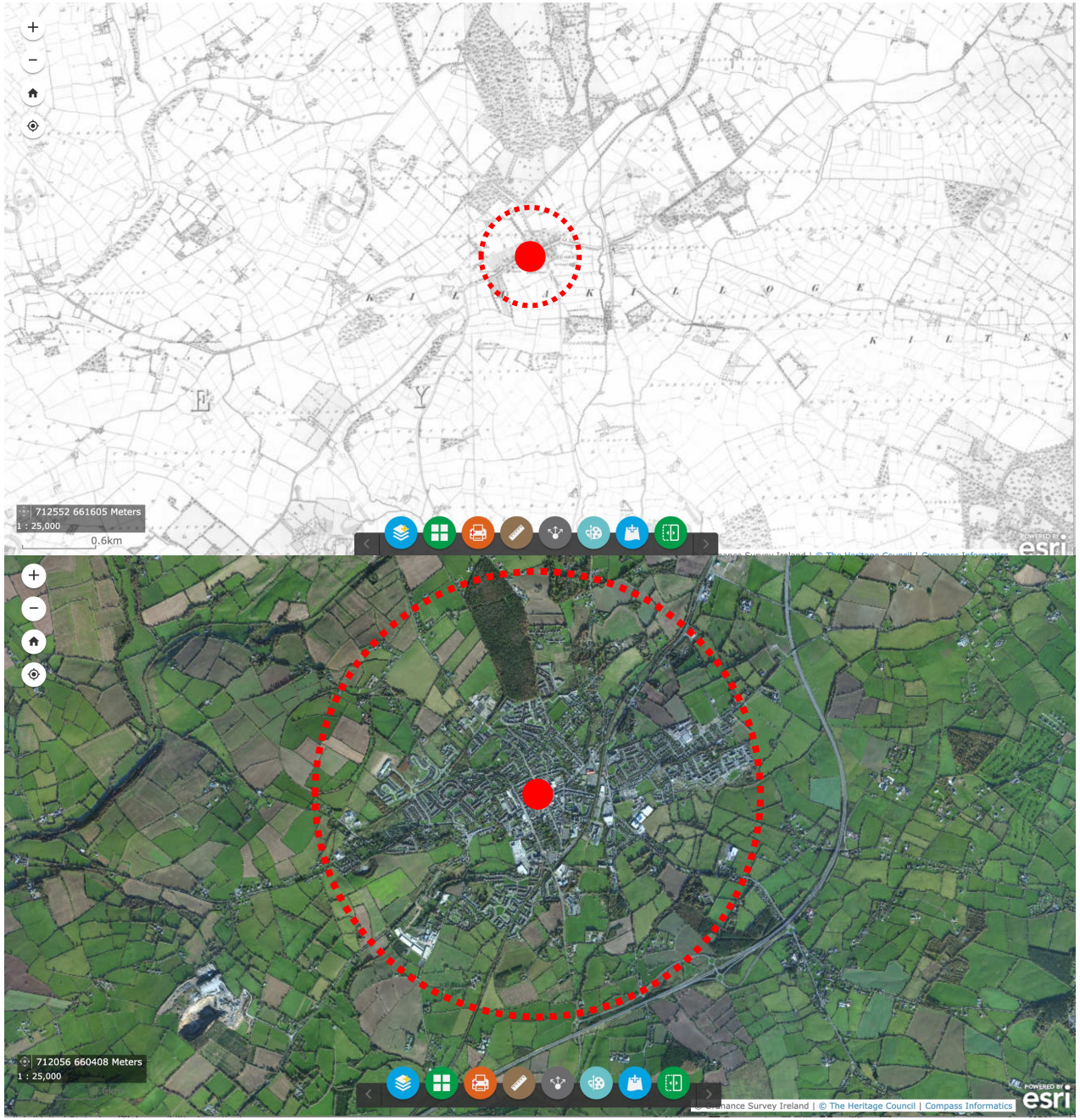
Clogher Head Formation

Maps: Geohive/OSI + GSI bedrock geology 1:100,000

The importance of history – features may change through time, and the date of collection can be significant.

Historic OSI 6” map (1830s-1840s)

MapGenie 2013 imagery



Gorey, Co. Wexford extent through time