

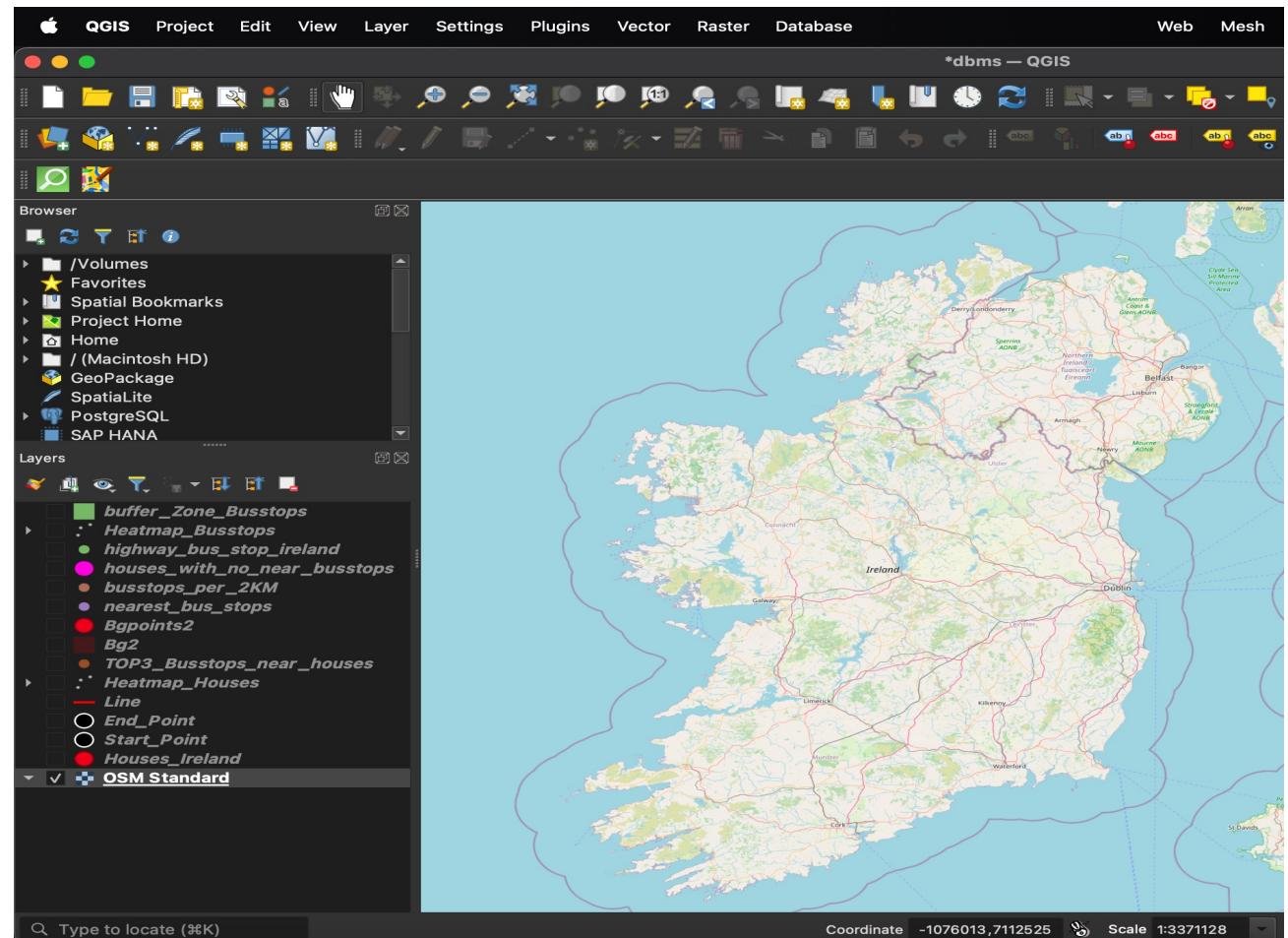
Spatial Databases

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Module : CS621B[A] Spatial Databases

Spatial analysis of Housing & Transportation in Ireland

- I am exploring the distribution of accommodations and bus stops across Ireland using PostgreSQL, PostGIS, and QGIS. My goal is to analyze the spatial distribution of accommodations and their proximity to public transportation, particularly bus stops. This project is useful for students, travelers, and residents who want to find easily accessible accommodations near bus stops, improving convenience and travel planning.



Analysis

Visualizing the polygon map of Ireland

- **Map Representation:** Polygons can be used to represent and visualize geographical regions on a map

- **Thematic Maps:** Polygons allow us to create thematic maps, where different colors or patterns represent different attributes or characteristics of the regions.

- **Pathfinding:** Polygons can be used to model obstacles or restricted areas in routing and navigation systems.

- **Zoning Analysis:** Polygons can represent different zoning areas, helping in land-use planning and management.



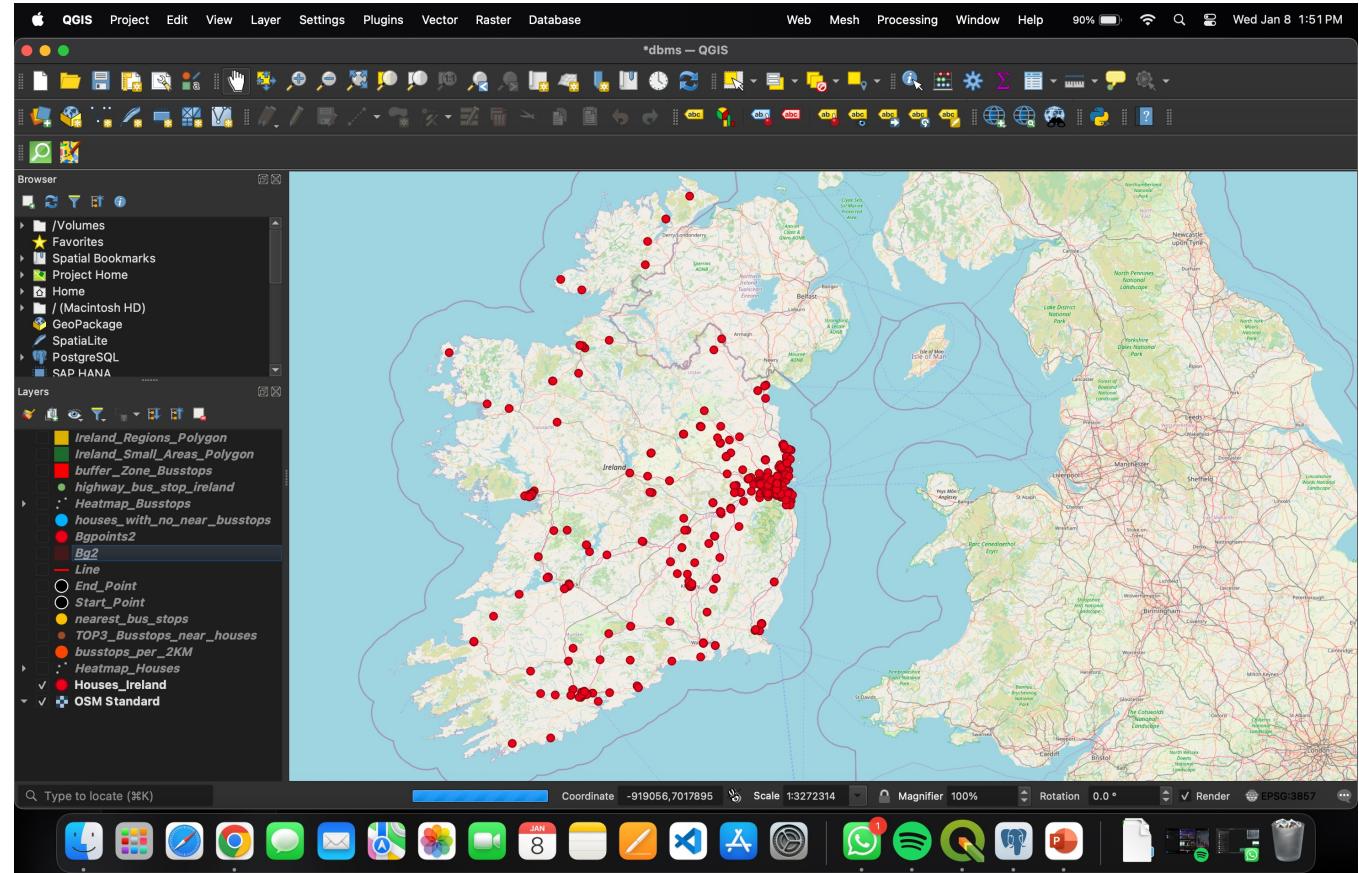
Analysis

Visualizing the Houses on Map

Mapping the houses in Ireland provides valuable insights into residential distribution and accessibility.

By visualizing these houses alongside public transport infrastructure, we can analyze commuting patterns and accessibility. The spatial data helps identify areas with strong public transport coverage and regions that may require better connectivity.

This analysis is crucial for urban planning, real estate development, and sustainable living solutions in Ireland.



Analysis

Retrieving All Houses within 10km of Maynooth University

This query retrieves all houses that are **within a 10km radius of Maynooth University**. It uses the **ST_DWithin** function to filter houses based on their spatial proximity to the university's geographic coordinates. The result includes **all columns** from the map table but only contains houses that fall within the specified distance.

The screenshot shows the SSMS interface with the following details:

- Object Explorer:** Shows the database structure with tables, views, and other objects.
- Query Editor:** Contains the following SQL query:

```
1 v SELECT * FROM map
2 WHERE ST_DWithin
3   (wkb_geometry::geography,
4    ST_SetSRID(ST_MakePoint(-6.601037, 53.384782), 4326)::geography,
5    10000);
```
- Data Output:** Displays the results of the query in a grid format. The columns are:

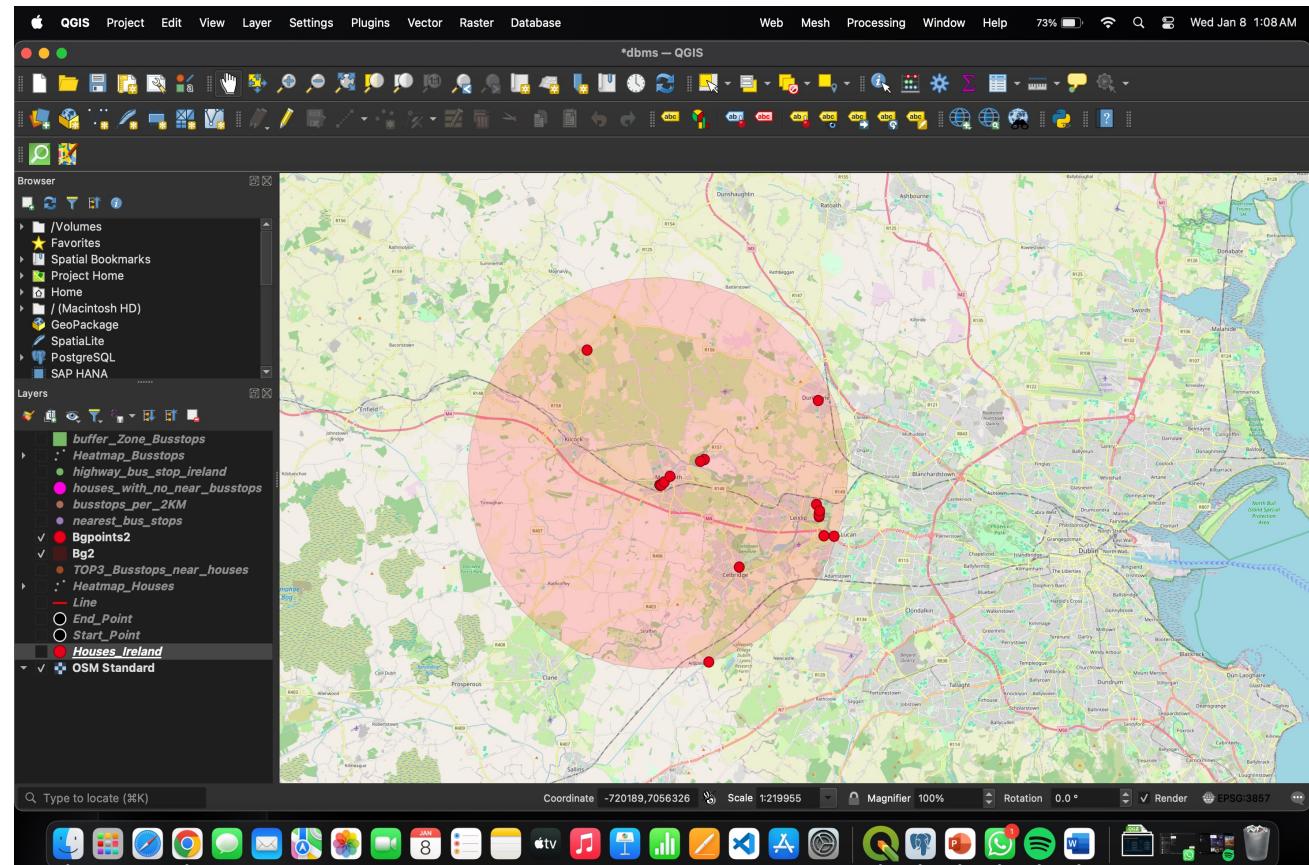
ogc_fid	wkb_geometry	full_id	osm_id	osm_type	leisure	utility
1	59	n327117470	327117470	node	[null]	[null]
2	60	n327226520	327226520	node	[null]	[null]
3	61	n327368422	327368422	node	[null]	[null]
4	62	n327368427	327368427	node	[null]	[null]
5	63	n327368440	327368440	node	[null]	[null]
6	65	n338762868	338762868	node	[null]	[null]
7	75	n392394437	392394437	node	[null]	[null]
8	76	n392394590	392394590	node	[null]	[null]
9	91	n449811021	449811021	node	[null]	[null]
10	92	n449960116	449960116	node	[null]	[null]
11	93	n450695119	450695119	node	[null]	[null]

Analysis

Visualizing All Houses within 10km of Maynooth University

Maynooth University is one of Ireland's leading academic institutions, attracting students and faculty from across the country. A crucial factor for incoming students and staff is the availability of housing within a reasonable distance from the university. This query extracts all houses within a 10km radius, allowing for better insights into accommodation options.

By mapping these results in QGIS, we can identify clusters of housing density and evaluate their accessibility to the university. The findings can be further used to analyze rental trends and property values in the vicinity.

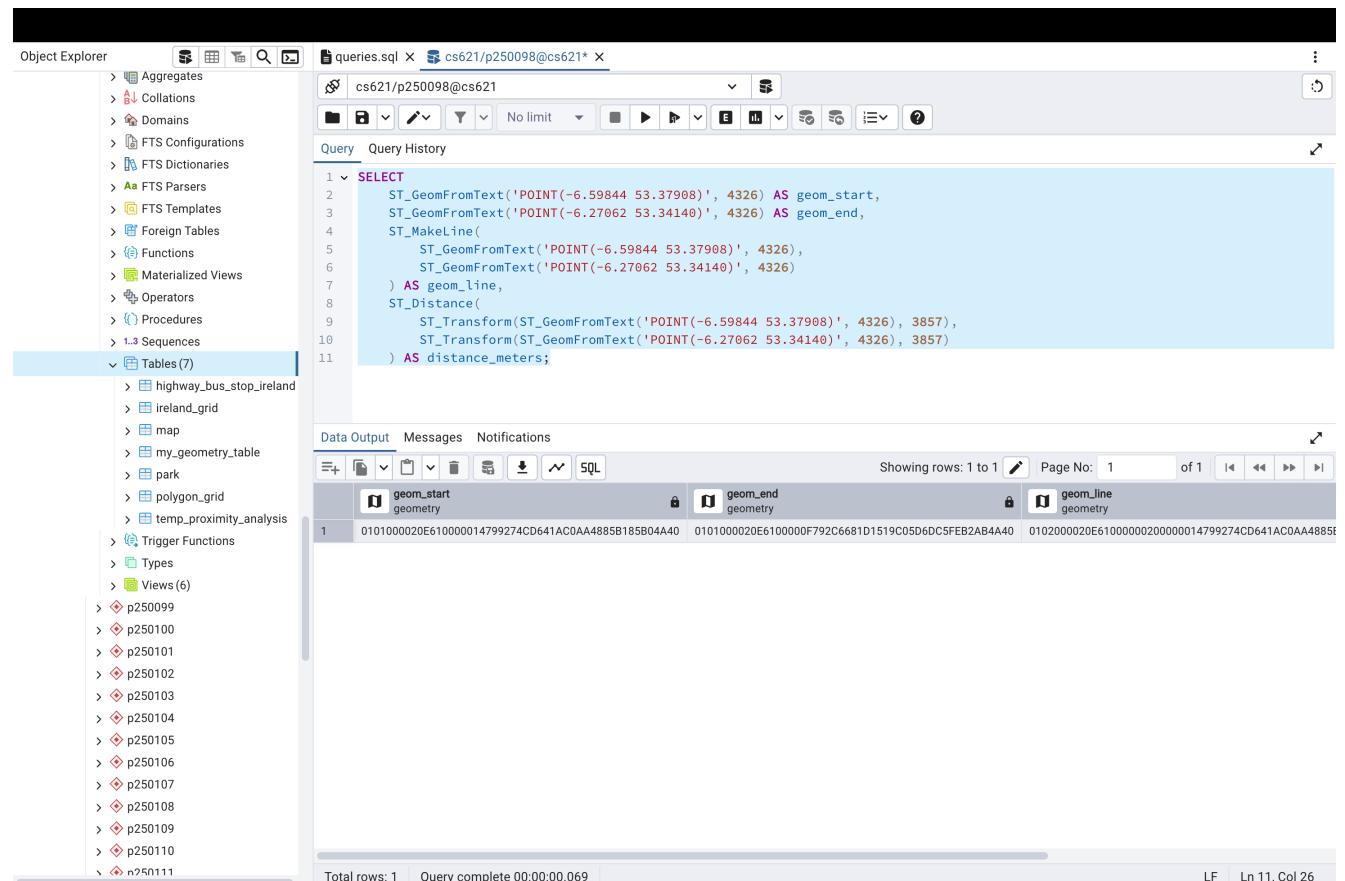


Analysis

Distance from Maynooth to Dublin City Center

This query calculates the **straight-line (Euclidean) distance** between Maynooth and Dublin City Center. It first defines the **start and end points** as geometry objects and then uses **ST_Distance** to compute the direct distance between them. The result includes:

- The **starting location (Maynooth)**
- The **destination (Dublin City Center)**
- The **line geometry** connecting both points
- The **calculated distance in meters**



The screenshot shows the SSMS interface with the Object Explorer on the left and a query results grid on the right. The query results grid displays three columns: geom_start, geom_end, and geom_line. The geom_start and geom_end columns show geometry values corresponding to the coordinates of Maynooth and Dublin City Center respectively. The geom_line column shows a line geometry connecting the two points.

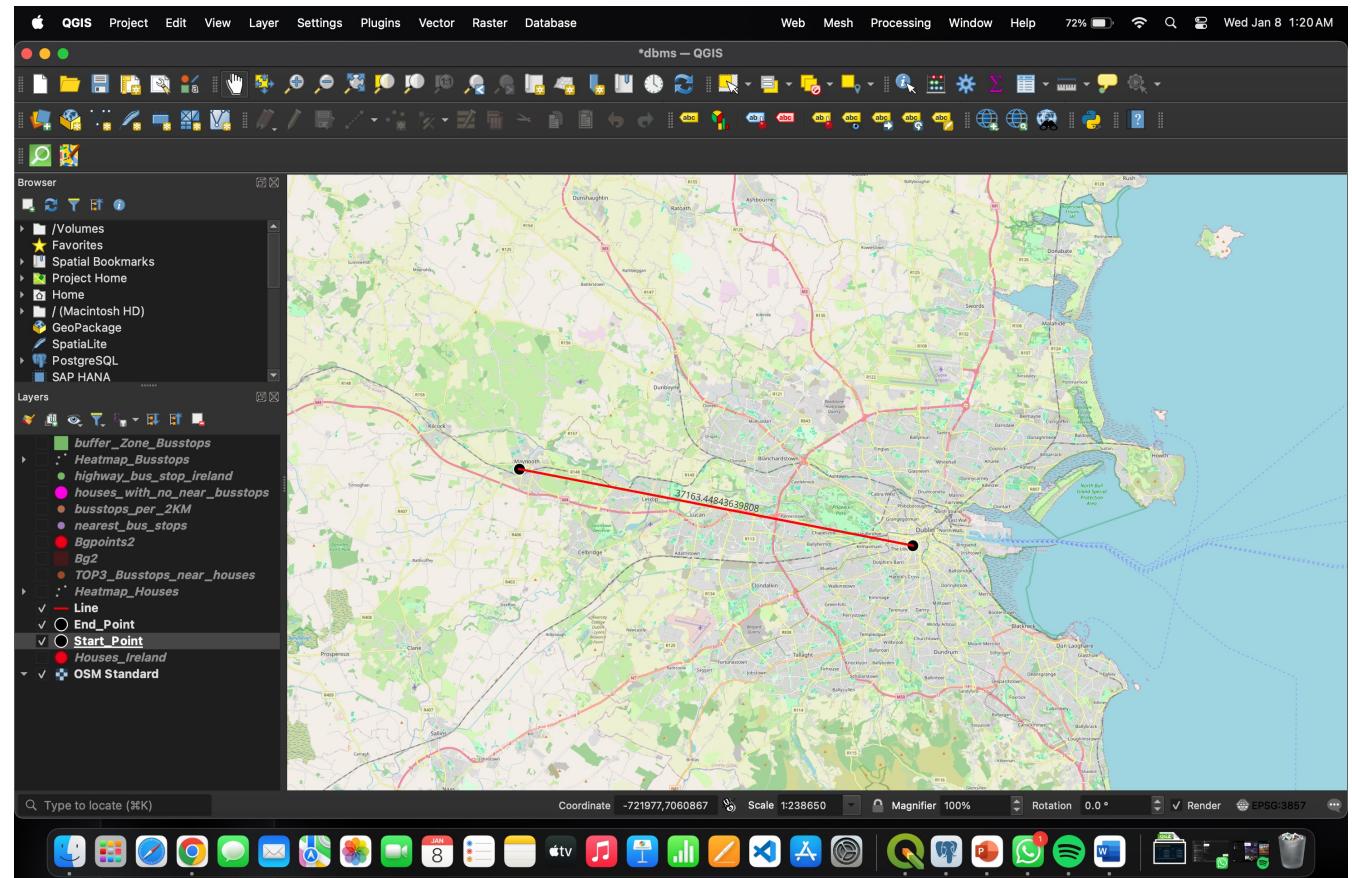
	geom_start	geom_end	geom_line
1	0101000020E610000014799274CD641AC0AA4885B185B04A40	0101000020E6100000F792C6681D1519C05D6DC5FB2AB4A40	0102000020E6100000200000014799274CD641AC0AA4885E

Analysis

Visualizing Distance from Maynooth to Dublin City Center

Maynooth is a suburban town with strong connections to Dublin City Center. Many residents commute daily, making the distance between the two locations a critical factor for urban planning and transportation analysis.

This query calculates the straight-line (Euclidean) distance from Maynooth University to Dublin City Center. The actual travel distance via roads and public transport may vary, but this base calculation provides a fundamental reference for travel time estimation and accessibility planning.



Analysis

Generating a Heatmap of Houses

This query selects all bus stop locations from the highway_bus_stop_irland table.

These coordinates can be used to generate a heatmap in QGIS, helping visualize **bus stop density** across the study area.

The screenshot shows the pgAdmin interface with the following details:

- Object Explorer:** Shows a tree view of database objects. The "Tables" node is expanded, and the "map" table is selected, highlighted with a blue border.
- queries.sql***: The current query editor tab contains the following SQL code:

```
SELECT ogc_fid, wkb_geometry FROM map;
```
- Data Output:** The results of the query are displayed in a table. The columns are "ogc_fid" (PK integer) and "wkb_geometry" (geometry). The table shows 819 rows of data, each containing a unique identifier and a geometry value representing a bus stop location.
- Messages:** No messages are present.
- Notifications:** No notifications are present.

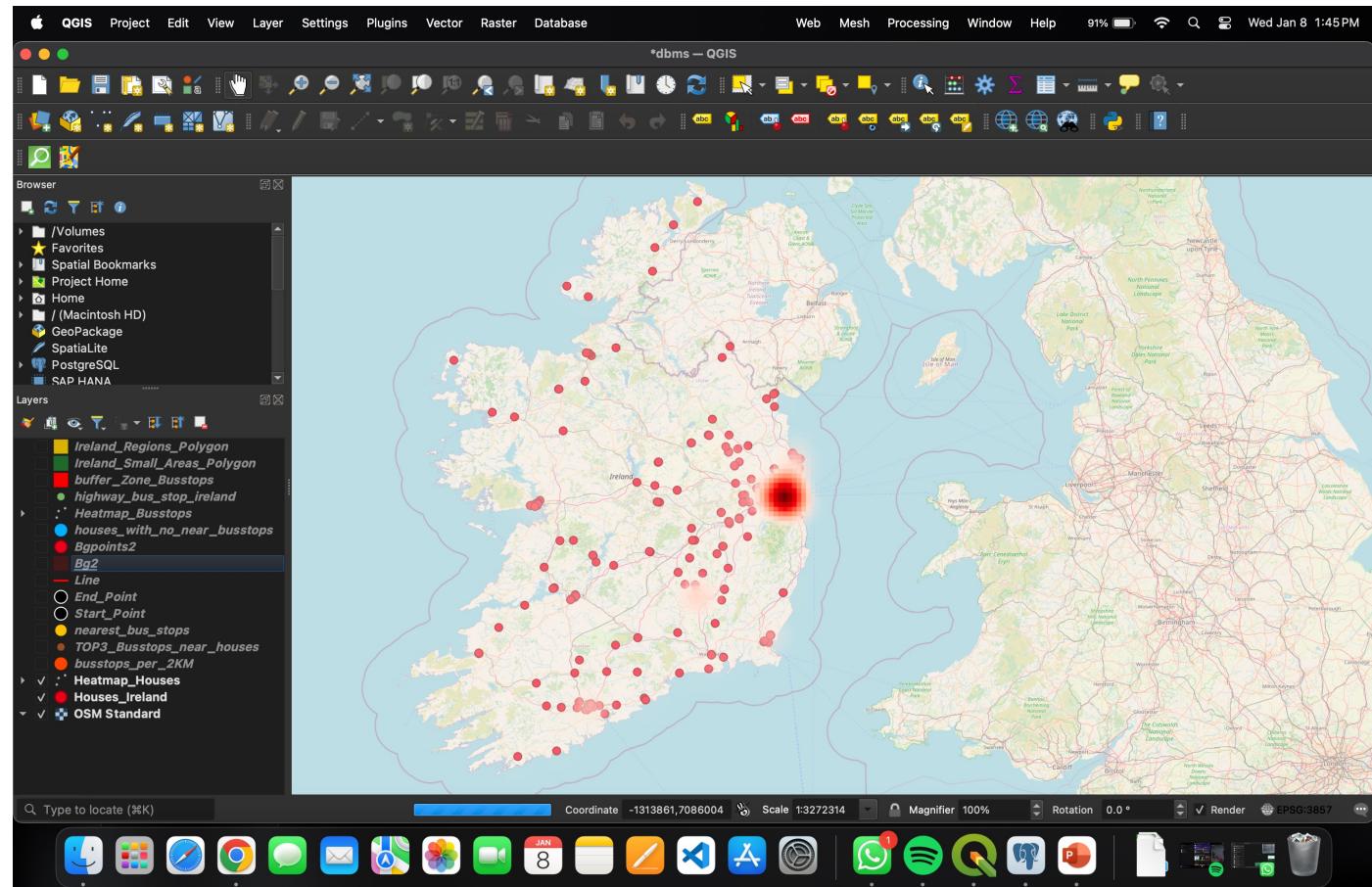
ogc_fid	wkb_geometry
1	0101000020E6100000BF7E880D162E19C0F2A7D7778FAC4A40
2	0101000020E61000006D74CE4F710C19C01308E00B38AB4A40
3	0101000020E6100000ED2DE57CB10719C0685FD44911AB4A...
4	0101000020E6100000B9E3A837FE6719C06EBCE078E3AE4A40
5	0101000020E610000085268925E5F618C060AE4508D0BA4A40
6	0101000020E610000045DF933DF85F19C0B4D4B4E9253A74A40
7	0101000020E6100000A78D8FBAD6520C01DC4735BC76E4A...
8	0101000020E6100000BE6C9626008219C060EF593222B2A4A0
9	0101000020E610000075D7C864270A19C0882EEBB424AB4A...
10	0101000020E6100000BC7A70D28F0919C09B4E571C73AB4...
11	0101000020E61000006144EC5DCD0B19C0CEF2864556AB4A...
12	0101000020E61000008BA94FC400819C04847832568AB4A40
13	0101000020E610000067D311C00DD0A19C03E096CCEC1AA4A...
14	0101000020E610000013B0C2D2650619C0F9C55B9D52AB4A...

Analysis

Visualizing a Heatmap of Houses

To understand how well-connected different areas are in terms of public transport, a heatmap of Houses is generated. High-density areas may indicate well-serviced locations, while sparse areas may highlight potential zones for adding new houses in future.

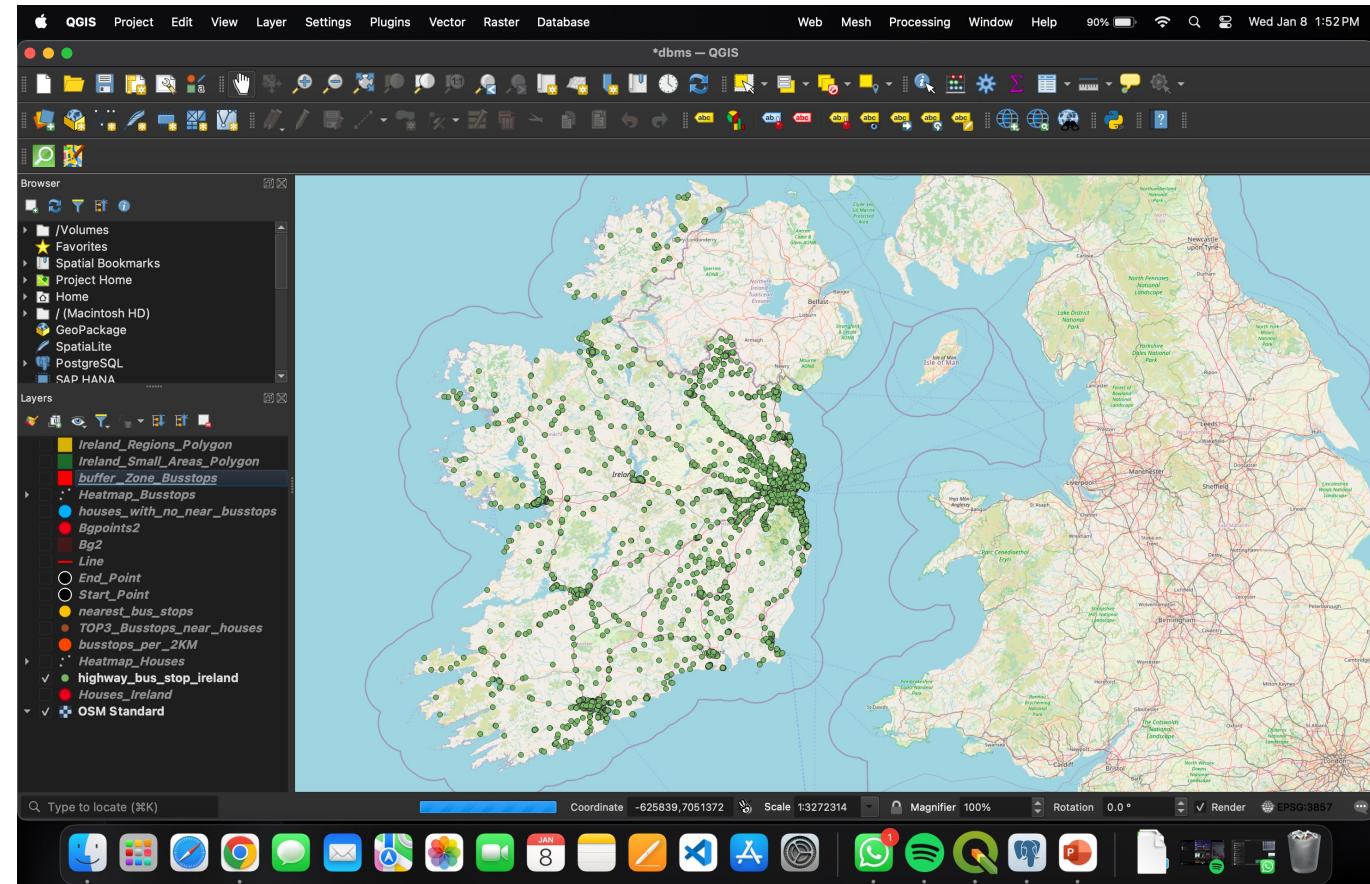
The visualization of this data in QGIS allows for easy identification of transit deserts—areas with limited houses.



Analysis

Visualizing the Bus Stops on Map

Mapping the bus stops in Ireland provides key insights into public transport accessibility and efficiency. The distribution of bus stops shows how well different areas are connected to the transport network, making it easier to assess commuting convenience for residents and students. By analyzing the spatial patterns of bus stops, we can identify well-served areas and transportation gaps where additional stops may be needed. This visualization plays a crucial role in urban planning, optimizing bus routes, and improving overall mobility in Ireland.



Analysis

Finding the Nearest Bus Stops to Houses

This query creates a **view** (`nearest_bus_stops`) that finds the **nearest bus stop** for each house in the map table. It uses **ST_Distance** to calculate distances between houses and bus stops and selects the closest one for each house. The result includes:

- The **house ID** (`map_id`)
- The **nearest bus stop ID** (`bus_stop_id`)
- The **distance in meters** between the house and the bus stop
- The **geometries of both the house and bus stop**

The screenshot shows a SQL query editor interface with the following details:

- Object Explorer:** On the left, it lists database objects: Aggregates, Collations, Domains, FTS Configurations, FTS Dictionaries, FTS Parsers, FTS Templates, Foreign Tables, Functions, Materialized Views, Operators, Procedures, Sequences, and Tables (7). The 'Tables' node is expanded, showing: highway_bus_stop_ireland, ireland_grid, map, my_geometry_table, park, polygon_grid, temp_proximity_analysis, Trigger Functions, Types, and Views (6). The 'Views' node is also expanded, listing p250099, p250100, p250101, p250102, p250103, p250104, p250105, p250106, p250107, p250108, p250109, p250110, and p250111.
- Query Editor:** The main area contains the following SQL code:

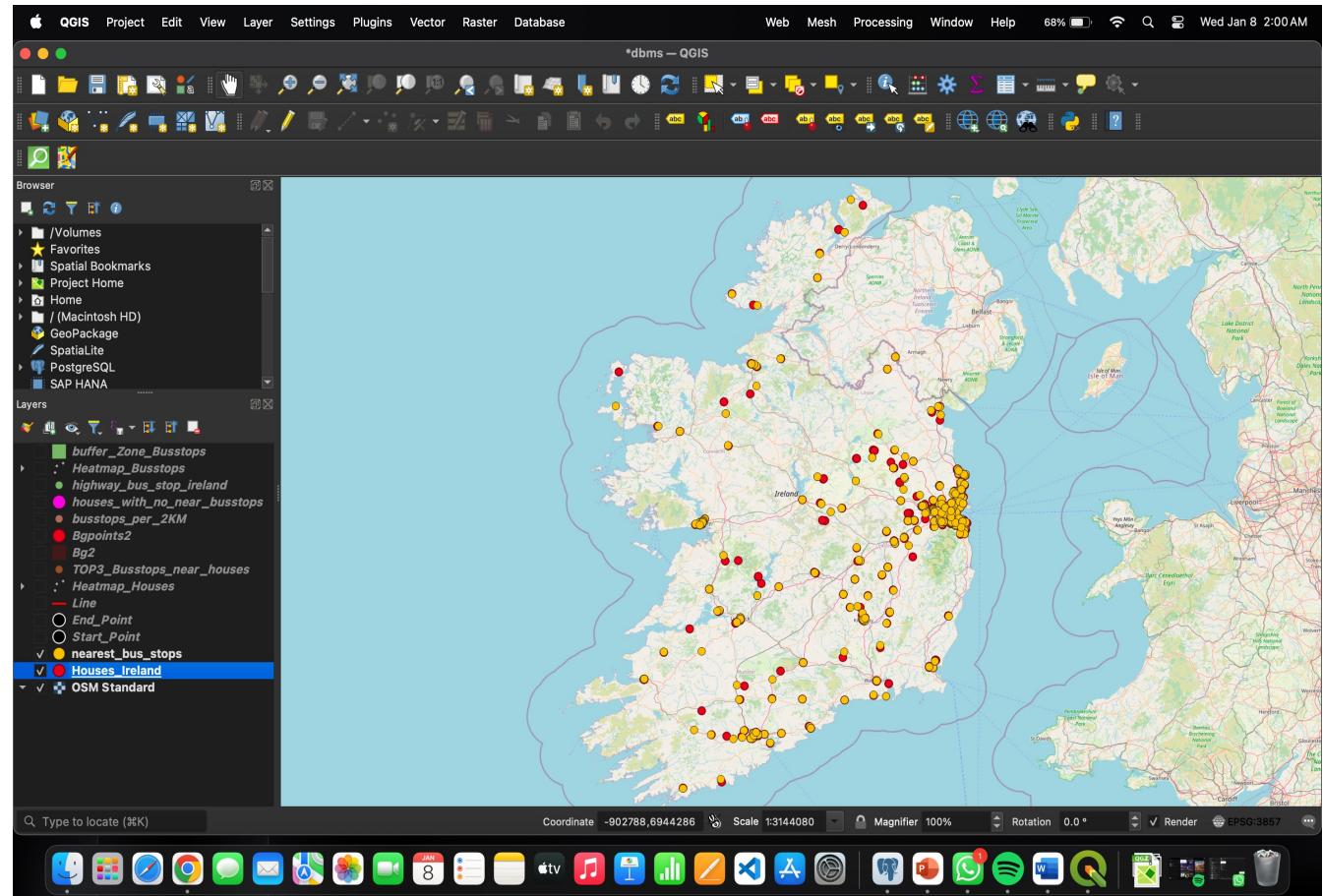
```
1 DROP VIEW IF EXISTS nearest_bus_stops;
2 CREATE VIEW nearest_bus_stops AS
3 SELECT
4     m.ogc_fid AS map_id,
5     bs.ogc_fid AS bus_stop_id,
6     ST_Distance(
7         ST_Transform(m.wkb_geometry, 3857),
8         ST_Transform(bs.wkb_geometry, 3857)
9     ) AS distance_meters,
10    ST_Transform(m.wkb_geometry, 3857)::geometry(Point, 3857) AS map_geom,
11    ST_Transform(bs.wkb_geometry, 3857)::geometry(Point, 3857) AS bus_stop_geom
12 FROM map m
13 CROSS JOIN LATERAL (
14     SELECT ogc_fid, wkb_geometry
15     FROM highway_bus_stop_ireland
16     ORDER BY m.wkb_geometry <-> wkb_geometry
17     LIMIT 1
18 ) bs;
```
- Data Output:** Below the code, it says "CREATE VIEW" and "Query returned successfully in 37 secs 706 msec."
- Bottom Status:** It shows "Total rows: 0" and "Query complete 00:00:37.706".
- Bottom Right:** It includes "LF" and "Ln 12, Col 11".

Analysis

Visualizing the Nearest Bus Stops to Houses

Public transportation plays a vital role in everyday commuting. This query identifies the nearest bus stop to each house, providing insights into public transport accessibility.

By visualizing the results in QGIS, we can observe gaps in public transportation coverage and propose solutions for better urban mobility. This data could be particularly useful for city planners and policymakers.

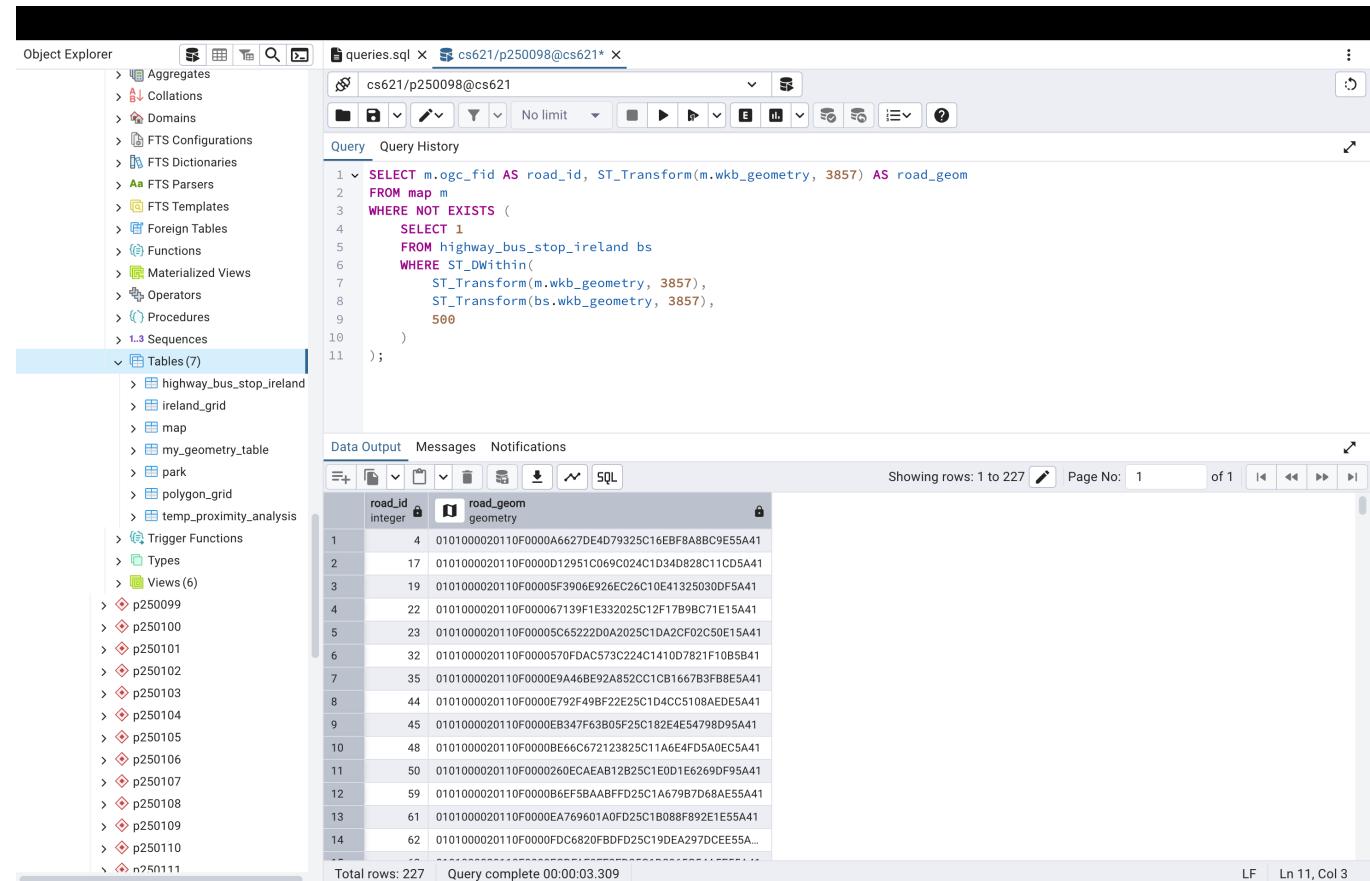


Analysis

Identifying Houses with No Bus Stops Within 500m

This query identifies **houses that do not have a bus stop within a 500m radius**. It does so by using **ST_DWithin** to check if any bus stop is within the specified distance and excludes houses that meet this condition. The result includes:

- The **house ID (road_id)**
- The **geometry of the house**



The screenshot shows the Object Explorer on the left, displaying a list of database objects including Aggregates, Collations, Domains, FTS Configurations, FTS Dictionaries, FTS Parsers, FTS Templates, Foreign Tables, Functions, Materialized Views, Operators, Procedures, Sequences, and Tables (7). The 'Tables' node is expanded, showing tables such as highway_bus_stop_ireland, ireland_grid, map, my_geometry_table, park, polygon_grid, temp_proximity_analysis, Trigger Functions, Types, and Views (6). The 'queries.sql' window is open in the center, containing the following SQL code:

```
1 v SELECT m.ogc_fid AS road_id, ST_Transform(m.wkb_geometry, 3857) AS road_geom
2 FROM map m
3 WHERE NOT EXISTS (
4     SELECT 1
5     FROM highway_bus_stop_ireland bs
6     WHERE ST_DWithin(
7         ST_Transform(m.wkb_geometry, 3857),
8         ST_Transform(bs.wkb_geometry, 3857),
9         500
10    )
11 );
```

The Data Output tab shows the results of the query, which consists of two columns: 'road_id' and 'road_geom'. The 'road_id' column contains integer values ranging from 4 to 62, and the 'road_geom' column contains geometry data represented as binary strings. The total number of rows is 227.

road_id	road_geom
1	010100020110F0000A6627DE4D79325C16EBF8A8BC9E55A41
2	010100020110F0000D12951C069C024C1D34D828C11CD5A41
3	010100020110F00005F3906E926C26C10E4132503DF5A41
4	010100020110F000067139F1E332025C12F17B9BC71E15A41
5	010100020110F00005C6522D0A2025C1DA2CF02C50E15A41
6	010100020110F0000570FDAC573C224C1410D7821F10B5B41
7	010100020110F0000E9A46BE92A852CC1CB1667B3FB8E5A41
8	010100020110F0000E792F49BF22E25C1D4CC5108AED5A41
9	010100020110F0000EB347F63B05F25C182EAE5479BD95A41
10	010100020110F0000BE66C672123825C11A6E4FD5A0EC5A41
11	010100020110F0000260ECAEB12B25C1E001E6269DF95A41
12	010100020110F0000B6EF5BAABFD25C1A679B7D68AE55A41
13	010100020110F0000EA769601A0FD25C1B088F892E1E55A41
14	010100020110F0000FDC6820FBFD25C19DEA297DCEE55A..

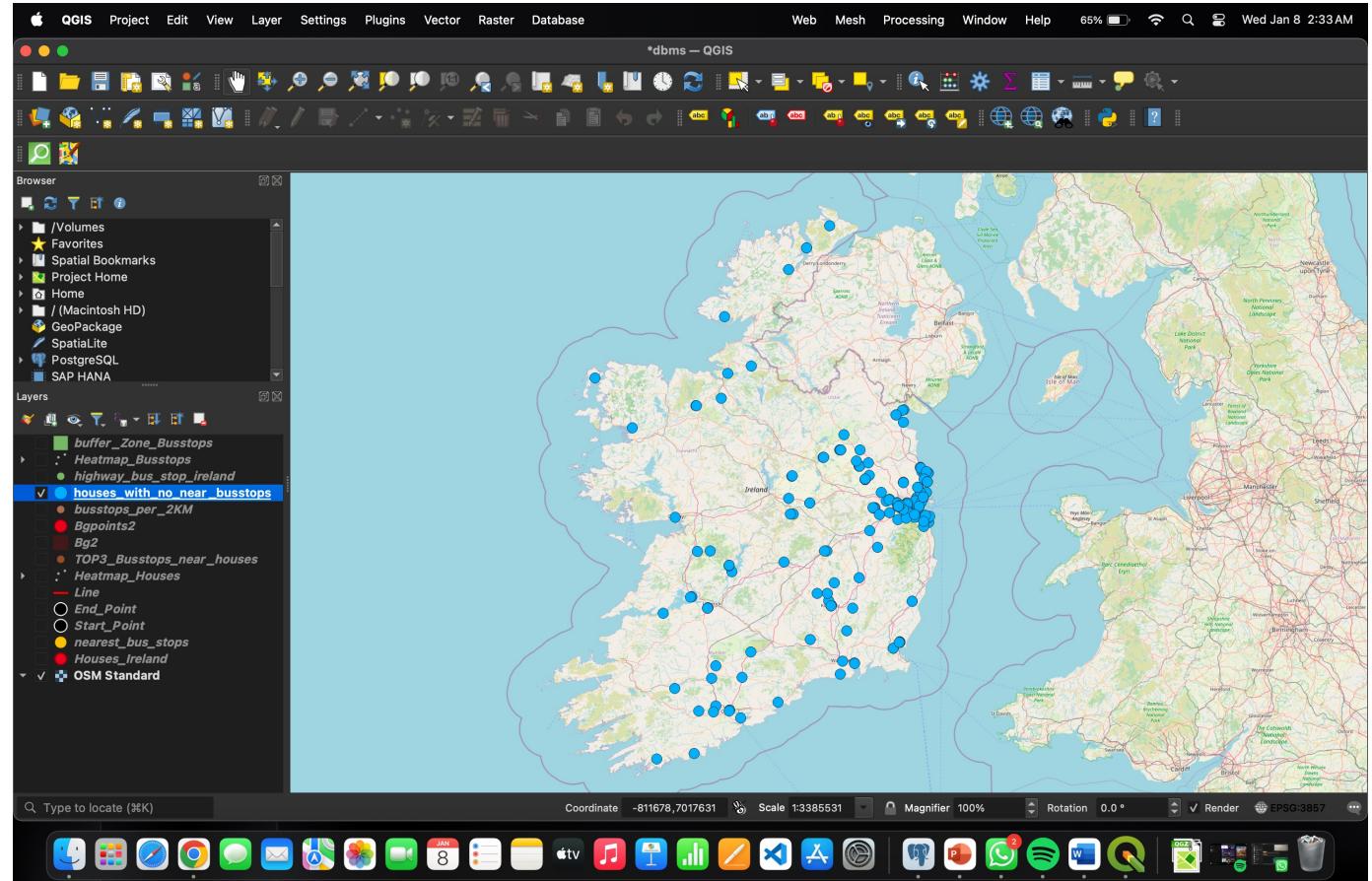
Total rows: 227 Query complete 00:00:03.309

Analysis

Visualizing Houses with No Bus Stops Within 500m

Efficient public transportation is a necessity for urban and suburban communities. This query identifies houses that lack bus stops within a 500m radius, highlighting areas that may require additional transit services.

By analyzing these results, city planners can make data-driven decisions about future bus stop placements, ultimately improving urban mobility.



Analysis

Finding the Nearest Three Bus Stops for Each House

This query finds the **three closest bus stops** for each house by using **ST_Distance** and ordering the results based on proximity. The result includes:

- The **house ID (road_id)**
- The **bus stop IDs** of the three nearest stops
- The **distance in meters**
- The **geometries of the house and bus stops**

The screenshot shows the SQL Server Management Studio interface. The Object Explorer on the left lists various database objects like Aggregates, Collations, Domains, FTS Configurations, etc., with the 'Tables' node expanded to show tables such as 'highway_bus_stop_irland', 'ireland_grid', 'map', 'my_geometry_table', 'park', 'polygon_grid', 'temp_proximity_analysis', and several user-defined tables starting with 'p250'. The main window displays a query named 'queries.sql' in the 'cs621/p250098@cs621*' connection. The query uses a LATERAL JOIN to find the three nearest bus stops for each house. The results are shown in the 'Data Output' tab, which includes columns for road_id, bus_stop_id, distance_meters, road_geom, and bus_stop_geom. The results table has 12 rows, with the last row being a total. The status bar at the bottom right indicates 'Query complete 00:00:00.138'.

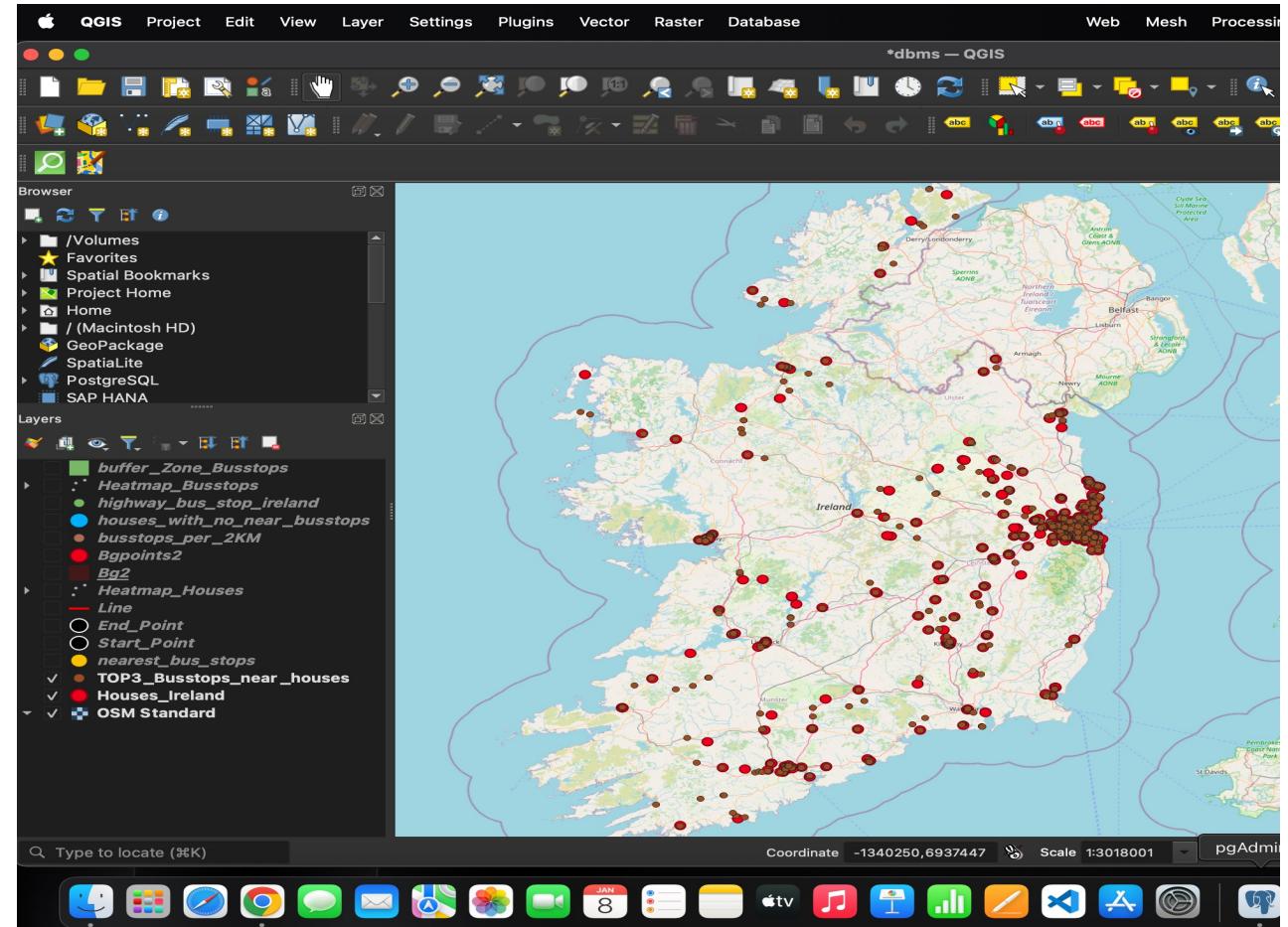
road_id	bus_stop_id	distance_meters	road_geom	bus_stop_geom
1	1	287.7522005157245	0101000020110F00009F6F94B9A96225C1074A666979E25A41	0101000020110F0000B47B1E951B6325C12DC843E532E25A41
2	1	5966	356.9589373671	0101000020110F00009F6F94B9A96225C1074A666979E25A41
3	1	40	240.74268826920937	0101000020110F00009F6F94B9A96225C1074A666979E25A41
4	2	620	468.1087752241139	0101000020110F00009987D2EB164625C10BF225E090E05A41
5	2	1353	417.197590182925	0101000020110F00009987D2EB164625C10BF225E090E05A41
6	2	8374	677.8050612823545	0101000020110F00009987D2EB164625C10BF225E090E05A41
7	3	6917	92.19387705769837	0101000020110F0000F35D53520E4225C16A9E6DBF59E05A41
8	3	3219	138.4124994724588	0101000020110F0000F35D53520E4225C16A9E6DBF59E05A41
9	3	1726	184.3977309611147	0101000020110F0000F35D53520E4225C16A9E6DBF59E05A41
10	4	1386	743.3249725297381	0101000020110F0000A6627DE4D79325C16EBF8A8BC9E55A...
11	4	4769	800.006128665756	0101000020110F0000A6627DE4D79325C16EBF8A8BC9E55A...
12	4	3755	790.8888828861718	0101000020110F0000A6627DE4D79325C16EBF8A8BC9E55A...
12	5	1646	105.54700021151045	0101000020110F000079675800CA3329C1E20K359A7E66A11

Analysis

Visualizing the Nearest Three Bus Stops for Each House

Accessibility to multiple bus stops gives commuters more flexibility in planning their routes. This query finds the three nearest bus stops to each house, offering a more comprehensive view of available public transport options.

This data can be used for optimizing public transport schedules and routes to serve residential areas more effectively.



Analysis

Finding Isolated Bus Stops (More than 2km Away from Any Other Stop)

This query finds **bus stops that are isolated** (more than 2km from any other stop). It does this by checking for stops that do not have another stop within 2000 meters using

ST_Distance. The result includes:

- The **bus stop ID** (isolated_stop_id)
- The **geometry of the isolated bus stop**

The screenshot shows the Microsoft SQL Server Management Studio (SSMS) interface. The Object Explorer on the left lists various database objects, with the 'Tables' node expanded to show seven tables: highway_bus_stop_irland, ireland_grid, map, my_geometry_table, park, polygon_grid, and temp_proximity_analysis. The 'Tables (7)' node is selected. The central pane contains a query window titled 'queries.sql' with the following T-SQL code:

```
1 v SELECT a.ogc_fid AS isolated_stop_id,
2      ST_Transform(a.wkb_geometry, 3857) AS geom
3  FROM highway_bus_stop_irland a
4 WHERE NOT EXISTS (
5   SELECT 1
6   FROM highway_bus_stop_irland b
7   WHERE a.ogc_fid <> b.ogc_fid
8   AND ST_Distance(
9     ST_Transform(a.wkb_geometry, 3857),
10    ST_Transform(b.wkb_geometry, 3857)
11   ) < 2000
12 );
```

The bottom pane displays the results of the query in a table format. The table has two columns: 'isolated_stop_id' (integer) and 'geom' (geometry). There are 217 rows returned. The first few rows of the results table are:

isolated_stop_id	geom
1	4463 010100020110F000036FF7AD08C7228C1A4385DAF0D2D5C...
2	48 010100020110F0000C302C4B255812AC1B1ABD0AFCF635B...
3	94 010100020110F0000AC07370B967D2FC1AC075C7C99A159...
4	98 010100020110F0000D59FB860E38B2AC1F5AA6C2C95695A...
5	131 010100020110F0000B38C09ABF49326C1286838FA2EA5A...
6	144 010100020110F0000B366D3571A062DC137B4AF00CCA25B...
7	161 010100020110F00001A6CC0CB639328C1F98EBB600E195A...
8	162 010100020110F00008D5B2D3B1DEA2BC1C5BFE949448A5A...
9	335 010100020110F00001CF7A0489E7B25C1BCB7318136A55A...
10	311 010100020110F0000FF802F875A4630C1A80B784573DB5941
11	396 010100020110F0000ABF6BC30A0AF2E17B84E5CF80A659...
12	397 010100020110F00008E82066B14982EC196FFA36295A55941
13	6176 010100020110F0000D2588F23D3F630C1850667513B105A41
14	958 010100020110F0000BE19E262B71C30C135F35450A93F5A41
15	959 010100020110F00002BB9E1A2E5D2EC16AF3E32A76BC5A...
16	6248 010100020110F00007C38F70A1C72BC1893F0D62A6925B...

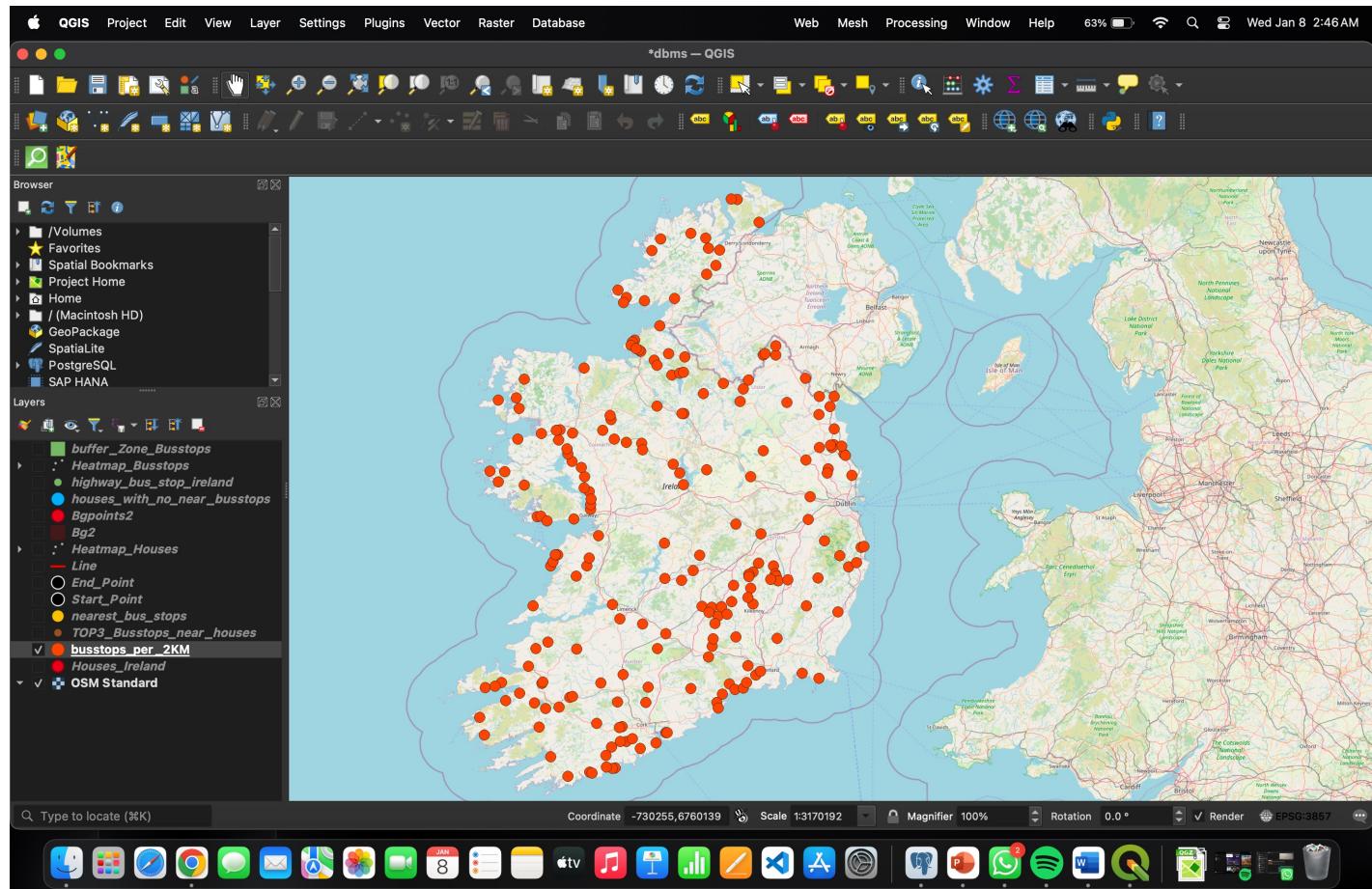
Total rows: 217 Query complete 00:00:13.664

Analysis

Visualizing Isolated Bus Stops (More than 2km Away from Any Other Stop)

A well-connected transit network ensures easy accessibility to public transport for all residents. However, some bus stops might be isolated, making them inconvenient for most commuters.

This query identifies bus stops that are more than 2km away from any other stop, helping transport authorities optimize their routes and coverage.

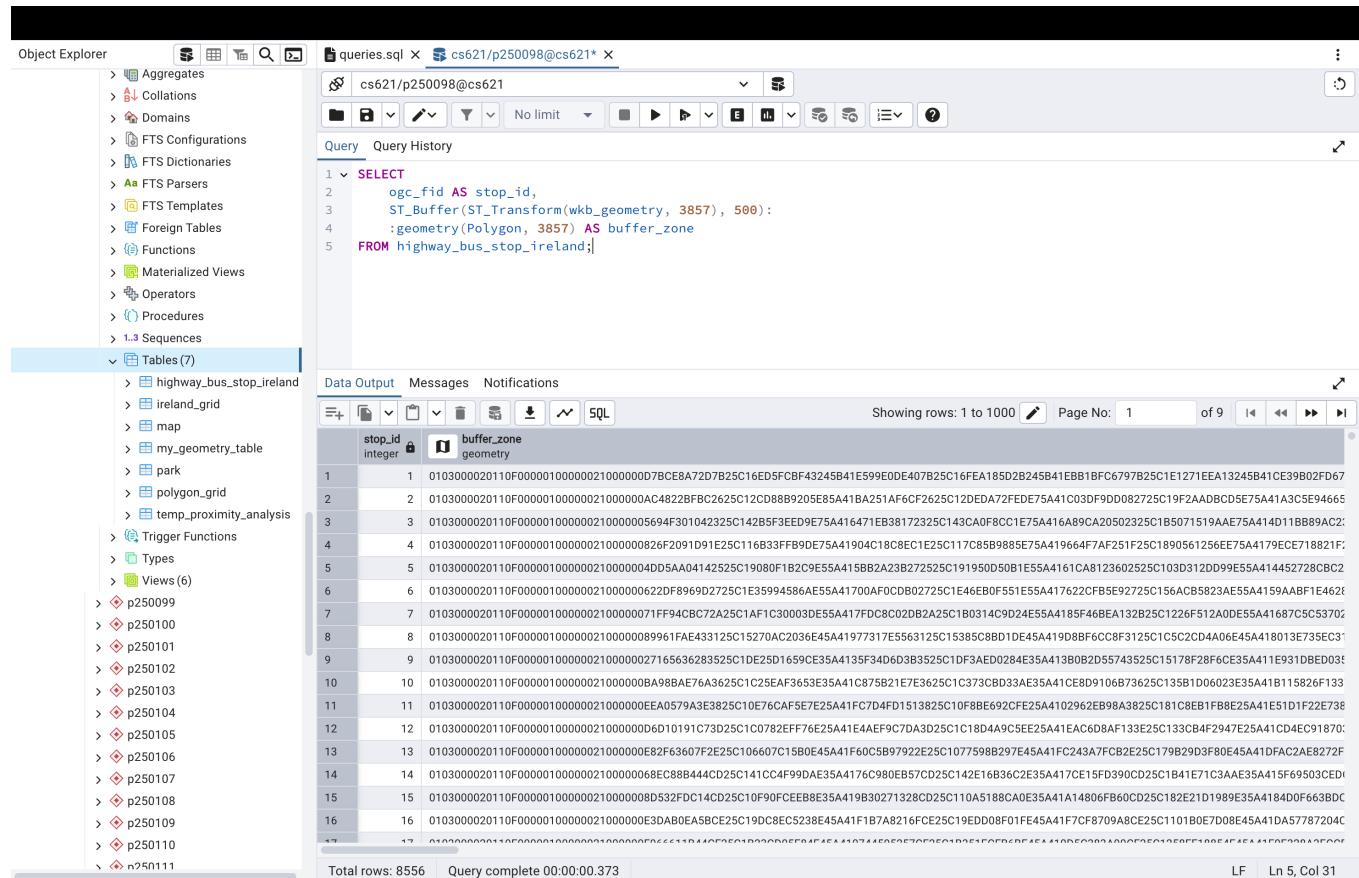


Analysis

Creating a 500m Service Area Around Bus Stops

This query generates a **500m buffer zone** around each bus stop to **visualize service areas**. It uses **ST_Buffer** to create a polygon surrounding each bus stop, representing the area **within walking distance** of public transport. The result includes:

- The **bus stop ID**
- The **buffer polygon geometry**



The screenshot shows the SSMS interface with the following details:

- Object Explorer:** Shows the database structure with a selected table named "highway_bus_stop_irland".
- Query Editor:** Displays the T-SQL query used to generate the service areas:

```
1 v SELECT
2   ogc_fid AS stop_id,
3   ST_Buffer(ST_Transform(wkb_geometry, 3857), 500) 
4   :geometry(Polygon, 3857) AS buffer_zone
5  FROM highway_bus_stop_irland;
```
- Data Output:** A grid showing the results of the query. The columns are "stop_id" (integer) and "buffer_zone" (geometry). The data consists of 8556 rows, each representing a bus stop with its corresponding 500m buffer zone.

stop_id	buffer_zone
1	0103000020110F00000100000210000007BCE8A72D7B25C16ED5FCBF43245B41E5990E0DE407B25C16FEA185D2B245B41EBB1BFC6797B25C1E1271EEA13245B41CE39B02FD67
2	0103000020110F0000010000021000000AC4822BFB2625C12CD88B9205E85A41BA251AF6CF2625C12DEDA72FDE75A41C03DF9D082725C19F2AA0BCDE575A41A3C5E94665
3	0103000020110F00000100000210000005694F301042325C142B5F3EED9E75A416471EB38172325C143CDA0F8CC1E75A416A89CA020D02325C1B5071519AAE75A414D1B89AC2:
4	0103000020110F0000010000021000000826F2091D91E25C116B33FB9D75A41904C18C8EC1E25C117C85B9885E75A419664F7AF251F25C1890561256EE75A4179ECE718821F:
5	0103000020110F00000100000210000004DD5AA04142525C19080F1B2C9E55A415BB2A23B272525C191950D5081E55A41700AF0CB02725C156ACB5823AE55A41452728C62
6	0103000020110F0000010000021000000622DF8969D2725C1E35994586AE55A417622CFB5E92725C156ACB5823AE55A4159AABF1E462:
7	0103000020110F000001000002100000071FF94CBC72A25C1AF1C30003DE55A417DC8C02DB2A25C1B0314C9D24E55A4185F46BEA132B25C1226F512A0DE55A41687C53702
8	0103000020110F000001000002100000089961FAE433125C15270AC2036E45A41977317E5563125C15385C8B1DE45A41908BF6CC8F3125C1C5C2CD406E45A418013E735EC3:
9	0103000020110F000001000002100000027165636283525C1DE25D1659CE35A4135F34D6D3B3525C1D3AE0284E35A413B0B2D55743525C15178F28F6CE35A411E931DBED03:
10	0103000020110F00000100000210000008A98BAE76A3625C1C25EAF3653E35A41C875B21E7E3625C1C373CB3D3AE35A41CE8D9106B73625C135B1D06023E35A41B115826F133
11	0103000020110F0000010000021000000EEA0579A3E3825C10E76CAF5E7E25A41FC7D4FD1513825C10F8BE692CFE25A4102962EB98A3825C181C8EB1FB8E25A41E5101F22E738
12	0103000020110F0000010000021000000D6D10191C73D25C1C0782EF76E25A41EAEF9C7DA3D25C1C18D4A9C5E25A41EAC6D8AF133E25C133CB4F2947E25A41CD4E91870:
13	0103000020110F000001000002100000082F63607F2E25C106607C15B0E45A41F60C5B97922E25C1077598B297E45A41FC243A7FCB8E25C179B29D3F80E45A41DFAC2A8E272F
14	0103000020110F000001000002100000068EC88B444C25C141CC4F99DAE35A4176C980EB57CD25C142E16B36C2E35A4171C3AAE35A415F69503CED:
15	0103000020110F0000010000021000000E3DA80E5ABC25C19DC8E5C5238E45A41F1B7A8216FCE25C19ED008F01F45A41F7CF8709A8CE25C1101B0E7D08E45A41DA57787204C
16	0103000020110F0000010000021000000E3DA80E5ABC25C19DC8E5C5238E45A41F1B7A8216FCE25C19ED008F01F45A41F7CF8709A8CE25C1101B0E7D08E45A41DA57787204C
17	0103000020110F0000010000021000000E3DA80E5ABC25C19DC8E5C5238E45A41F1B7A8216FCE25C19ED008F01F45A41F7CF8709A8CE25C1101B0E7D08E45A41DA57787204C

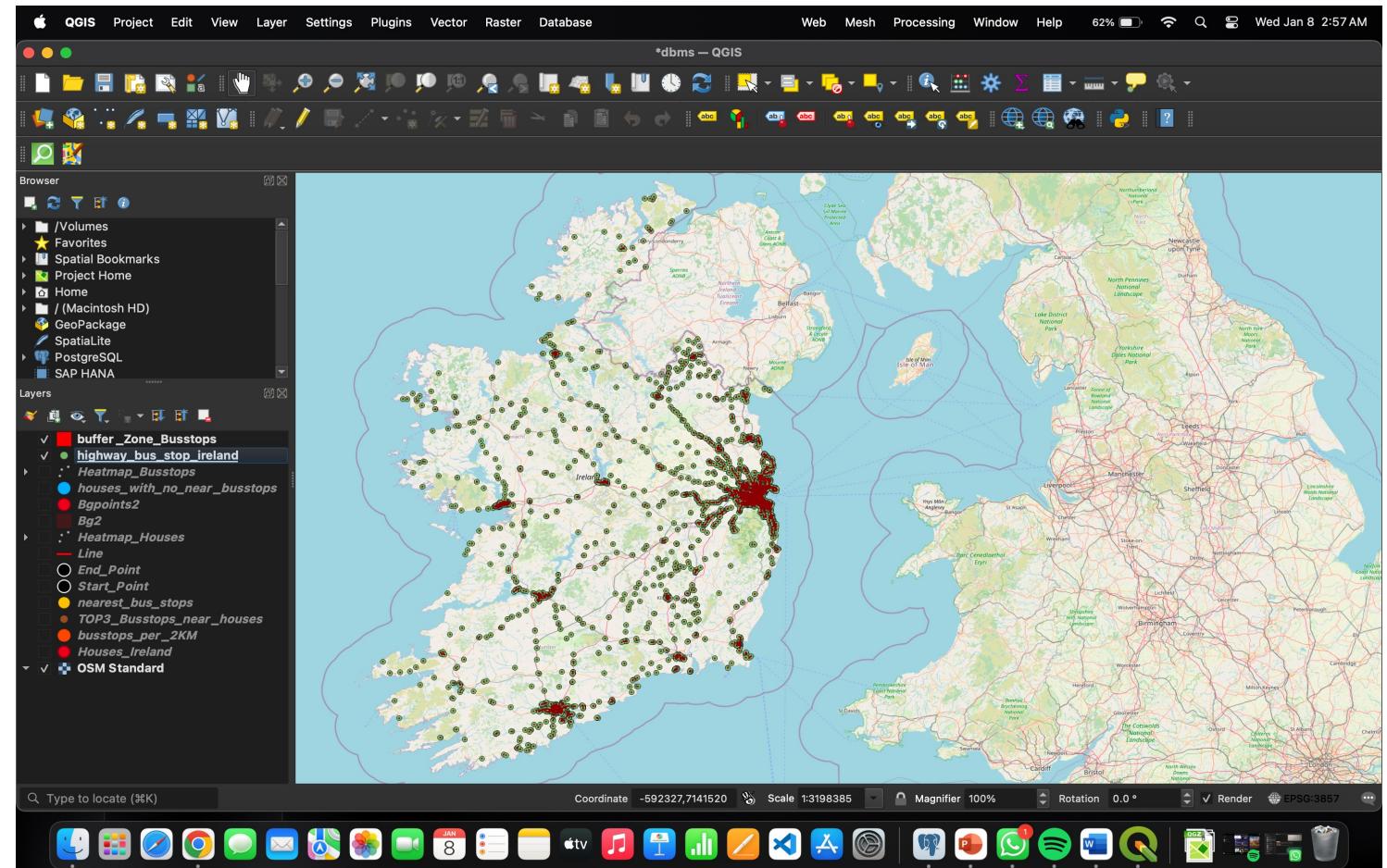
Total rows: 8556 Query complete 00:00:00.373

Analysis

Visualizing a 500m Service Area Around Bus Stops

Bus stops should ideally cover a substantial portion of the community. This query generates a 500m service area around each bus stop, creating buffer zones to visualize the areas well-served by public transportation.

By mapping these zones in QGIS, we can identify underserved areas and propose better bus stop placements.



Analysis

Generating a Heatmap of Bus Stops

This query selects all bus stop locations from the highway_bus_stop_irland table.

These coordinates can be used to generate a heatmap in QGIS, helping visualize bus stop density across the study area.

The screenshot shows the pgAdmin 4 interface. The left pane is the Object Explorer, displaying various database objects like Aggregates, Collations, Domains, FTS Configurations, FTS Dictionaries, FTS Parsers, FTS Templates, Foreign Tables, Functions, Materialized Views, Operators, Procedures, Sequences, and Tables. The 'Tables' node is selected. The main pane shows a query editor with the following SQL code:

```
SELECT ogc_fid, wkb_geometry FROM highway_bus_stop_irland;
```

The results pane displays the output of the query, showing 8556 rows. The columns are 'ogc_fid' and 'wkb_geometry'. The 'ogc_fid' column contains integer values from 1 to 14, and the 'wkb_geometry' column contains geometry data represented as binary strings. The bottom status bar indicates 'Total rows: 8556' and 'Query complete 00:00:00.143'.

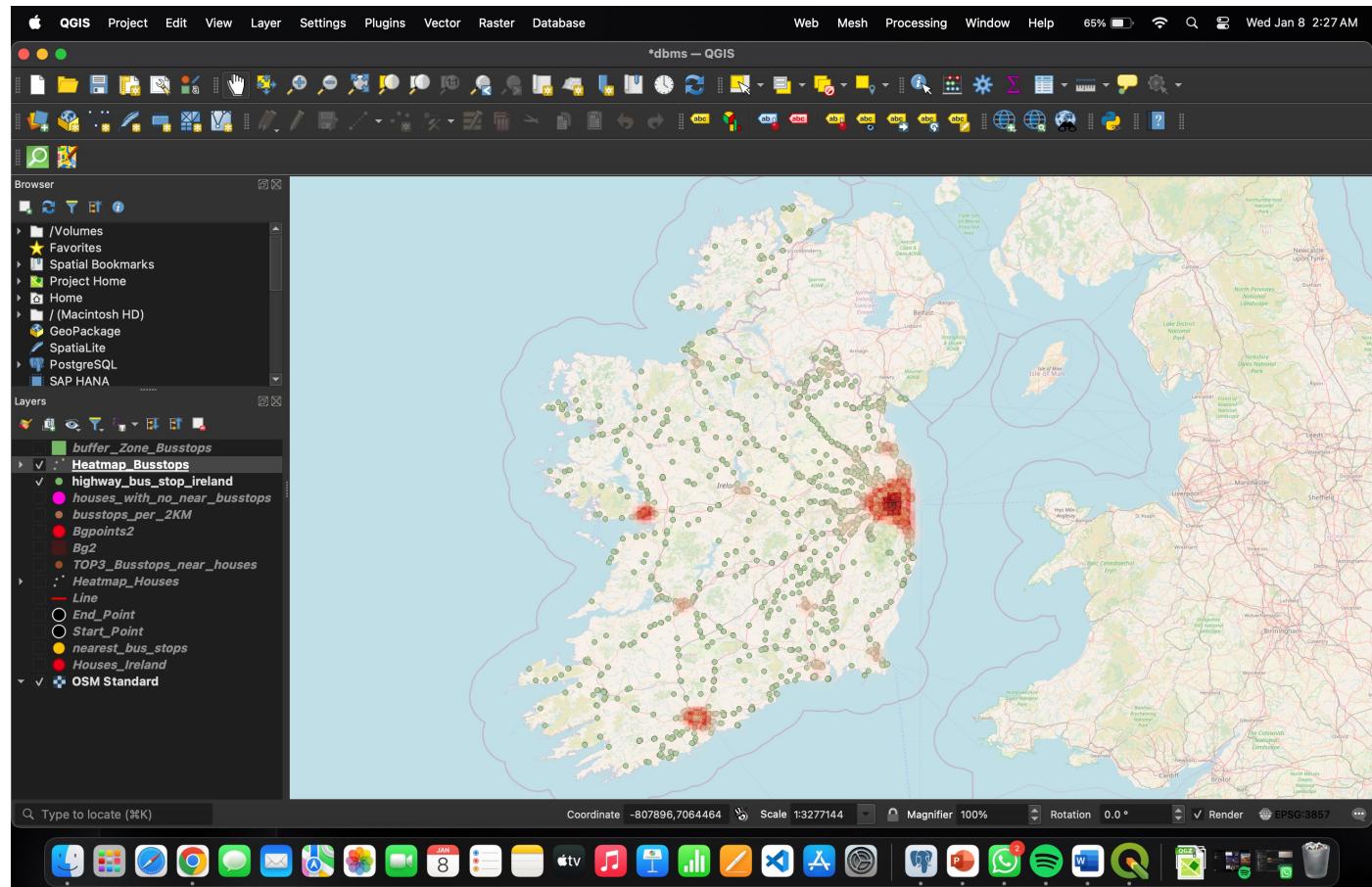
ogc_fid	wkb_geometry
1	0101000020E61000003B6000D068D4F19C0DA80016C9BDA4...
2	0101000020E610000019D3026A20EC18C023B6604E75B04A...
3	0101000020E610000021A00C9FBE718C0D0481ACA756B04A...
4	0101000020E6100000F13B97F3D6E218C0645798B2CB04A...
5	0101000020E6100000DD616E522CEA18C09D6EBF94E3AE4A...
6	0101000020E6100000A9B6402729ED18C01F1DD96A0AE4A...
7	0101000020E610000038A91E1FE3F018C047C3CEB980AE4A...
8	0101000020E6100000C25C418985F818C064703903C8AD4A...
9	0101000020E610000075D487E41AFD18C0959D2F5B8D4A...
10	0101000020E6100000A7391ED896FE18C01B44108C28AD4A...
11	0101000020E6100000876BB587BD0019C006E1E82ADD4C4...
12	0101000020E6100000CC5CEB410719C0C90050C58DAC4...
13	0101000020E6100000558A1D8D43F518C0746CF3B51DAE4A...
14	0101000020E6100000E59FB3FA34B019C04FC9398187AD4A...

Analysis

Visualizing a Heatmap of Bus Stops

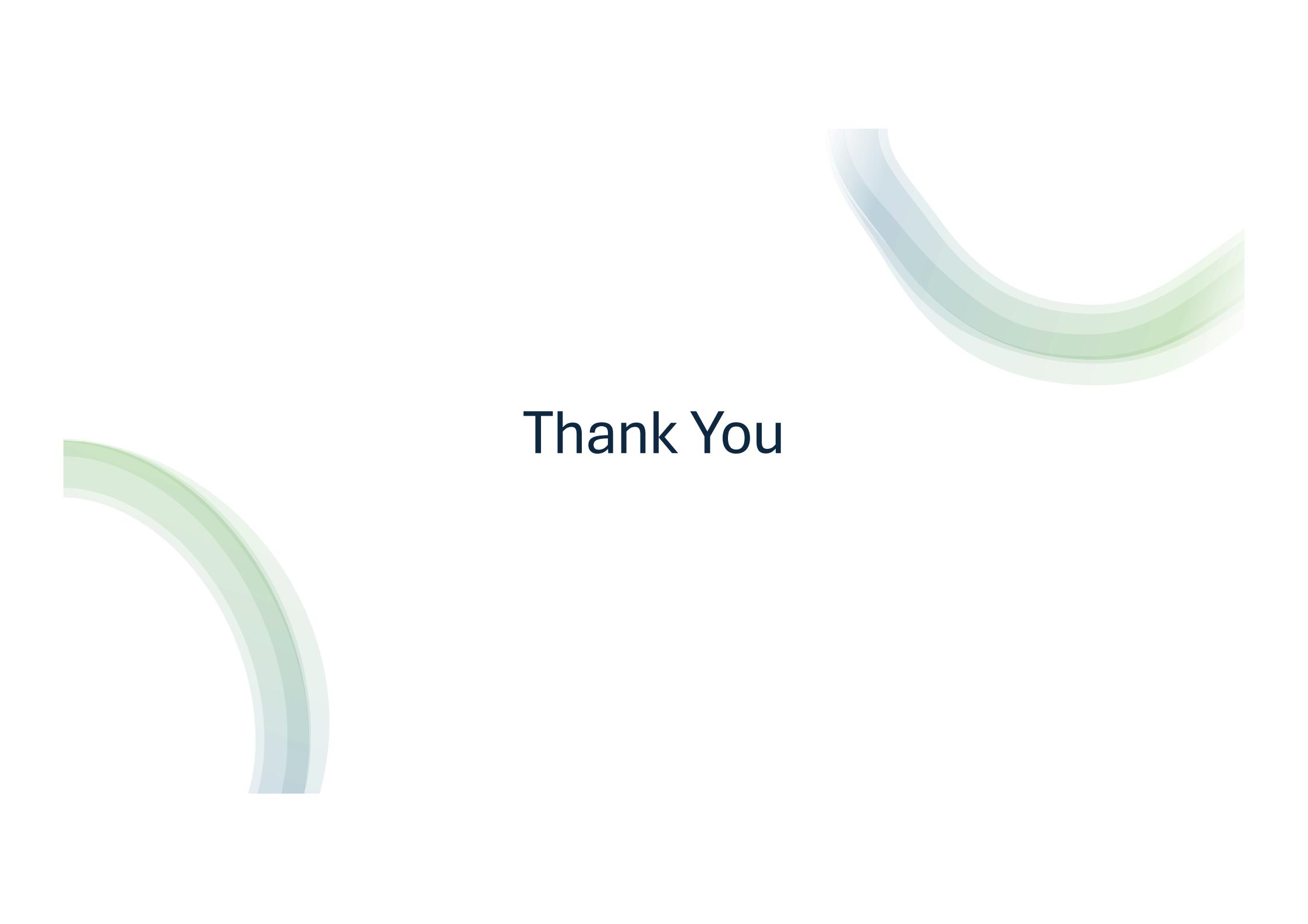
To understand how well-connected different areas are in terms of public transport, a heatmap of bus stops is generated. High-density areas may indicate well-serviced locations, while sparse areas may highlight potential zones for adding new bus routes.

The visualization of this data in QGIS allows for easy identification of transit deserts—areas with limited or no public transportation access.



Conclusion

- Our study on housing and public transport accessibility in Ireland revealed interesting patterns. We found that houses are clustered around Maynooth University, making it a key residential area for students and staff. Many homes are well-connected to public transport, while others lack nearby bus stops, indicating gaps in accessibility.
- We found that houses with nearby bus stops provide better commuting options for students and residents, ensuring easy access to essential locations such as the university, shopping centers, and workplaces.
- We also found that some bus stops are isolated and more than 2km away from any other stop, making them less effective for commuters. Additionally, the 500m service area analysis showed areas where public transport coverage is insufficient, suggesting opportunities for new bus stops to improve connectivity.
- By optimizing bus stop placements and improving transport coverage, Ireland can offer better living conditions and more efficient commuting options for students and residents.

The background features two sets of curved bands. On the left, there are three bands that curve upwards from bottom-left to top-right. On the right, there are four bands that curve downwards from top-left to bottom-right. The bands are composed of multiple thin, semi-transparent curves in shades of light green, medium green, and light blue.

Thank You