SGD LAB EXP – 4

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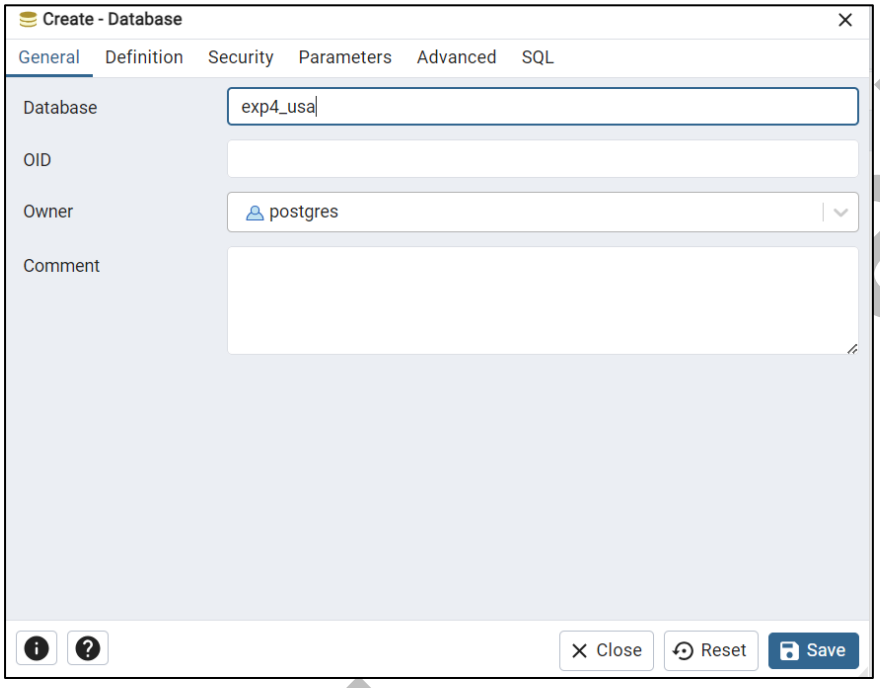
Aim:

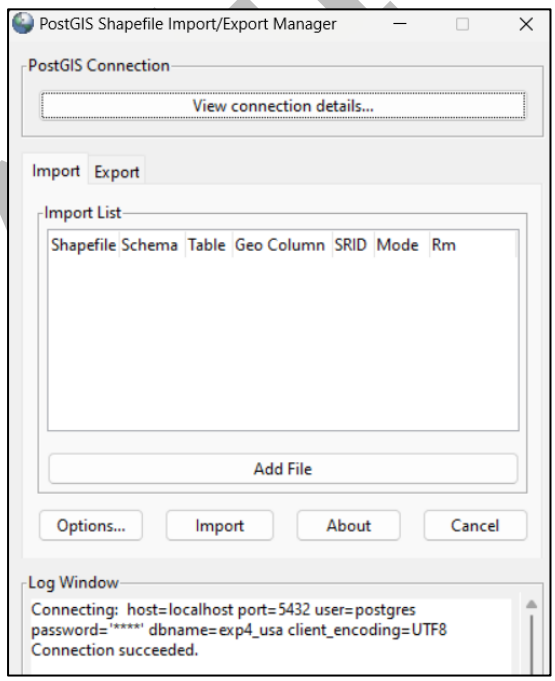
Spatial select queries.

Implementation:

1. *Creating a database first.*



2. *Establish connection and see the successful connection message.*



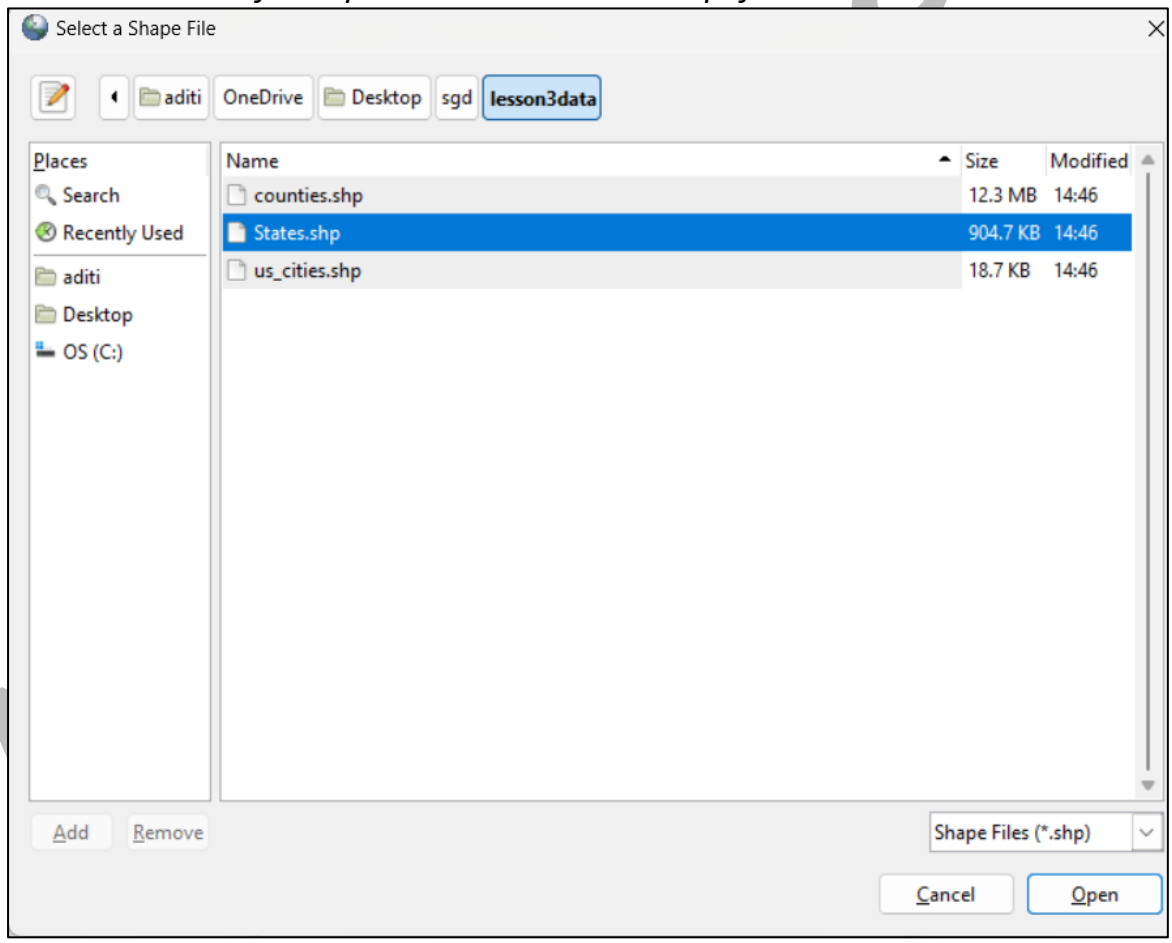
3. *Import Shapefiles*

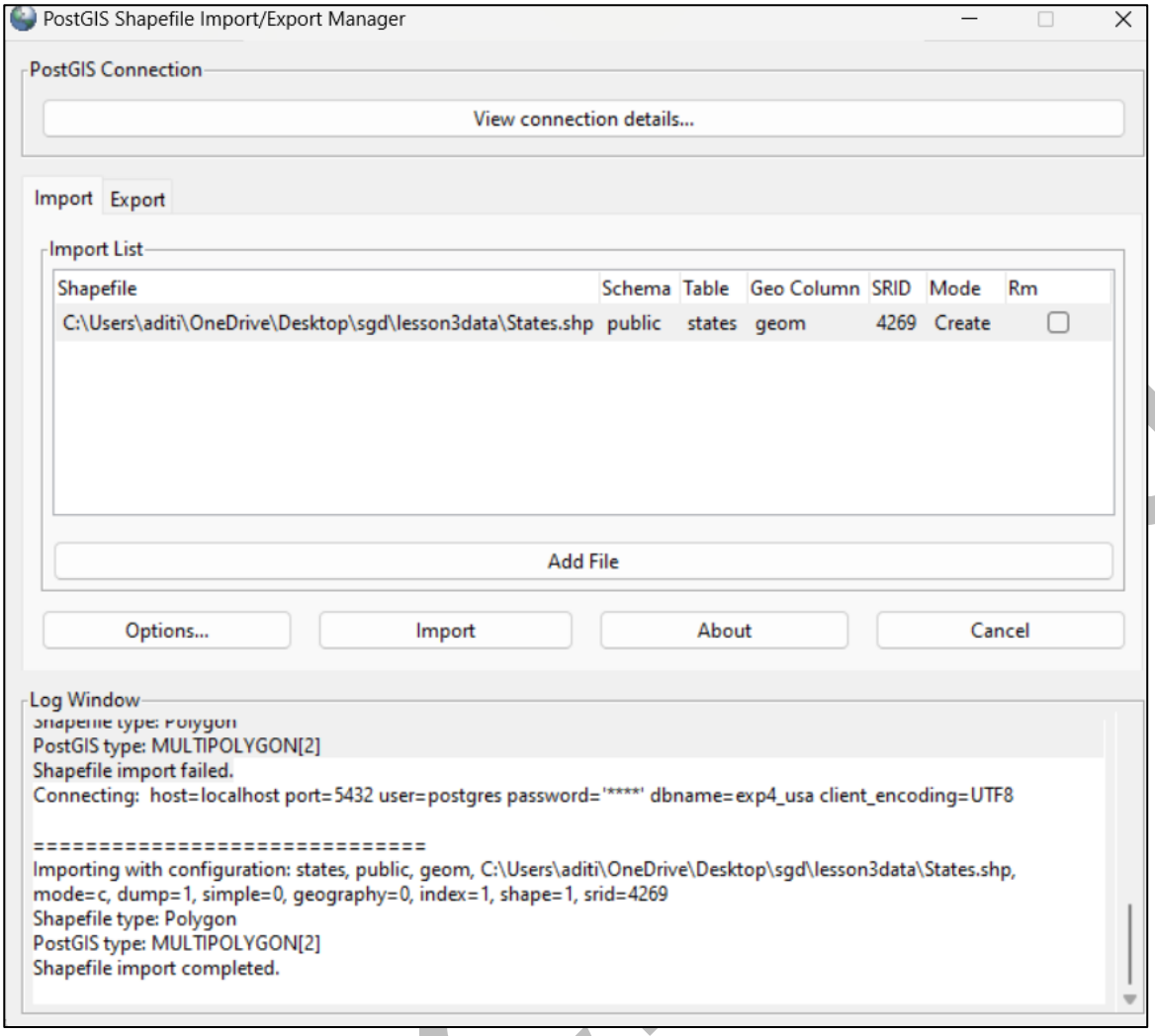
```
Query  Query History
1  CREATE EXTENSION IF NOT EXISTS postgis;
2
```

(first create a connection)

Navigate to c:\Program Files\PostgreSQL\15\bin\postgis gui and run executable file shp2pgsql-gui.exe

- *Click on view connection details*
- *Enter username as postgres, password, server host as localhost and port as 5432 and database name is the same as that was created above in step 1. After clicking on OK, it should give a message connection succeeded.*
- *Select the add files option and select the shapefile.*





Checking the loaded sql file.

```
select * from public.states;
```

Data Output | Messages | Notifications

	gid [PK] integer	name character varying (110)	state character varying (254)	pop2008 double precision	rank double precision	sub_region character varying (50)	geom geometry
1	1	Alabama	Alabama	4661900	23	Coke	0106000020AD10000002000000010300000001000000130000014B9
2	2	Alaska	Alaska	686293	47	Pop	0106000020AD100000CE000000010300000001000001B0000006A06
3	3	Arizona	Arizona	6500180	14	Soda	0106000020AD10000001000000010300000001000000102000003321
4	4	Arkansas	Arkansas	2855390	32	Coke	0106000020AD10000001000000010300000001000000C02000022FA
5	5	California	California	36756666	1	Soda	0106000020AD10000007000000010300000001000001600000823C
6	6	Colorado	Colorado	4939456	22	Pop	0106000020AD10000001000000010300000001000000250100009ED1
7	7	Connecticut	Connecticut	3501252	29	Soda	0106000020AD10000001000000010300000001000000850000001038
8	8	Delaware	Delaware	873092	45	Soda	0106000020AD10000001000000010300000001000000910000000152
9	9	District of Columbia	District of Columbia	591833	50	Soda	0106000020AD10000001000000010300000001000000190000007539
10	10	Florida	Florida	18328340	4	Coke	0106000020AD1000002D000000010300000001000000210000000FF0C
11	11	Georgia	Georgia	9685744	9	Coke	0106000020AD10000004000000010300000001000000240000078F3
12	12	Hawaii	Hawaii	1288198	42	Soda	0106000020AD10000008000000010300000001000000770000005C0C
13	13	Idaho	Idaho	1523816	39	Pop	0106000020AD10000001000000010300000001000000D60400001BFF
14	14	Illinois	Illinois	12901563	5	Pop	0106000020AD10000001000000010300000001000000920500000075C
15	15	Indiana	Indiana	6376792	16	Pop	0106000020AD10000001000000010300000001000000320400000F9C7
16	16	Iowa	Iowa	3002555	30	Pop	0106000020AD10000001000000010300000001000000C0300000D42
17	17	Kansas	Kansas	2802134	33	Soda	0106000020AD10000001000000010300000001000000BB010000FA44

Theory:

1. ST_Centroid(geom):

- Computes the geometric center (centroid) of a given geometry, typically a polygon.

- The output is in the coordinate system of the input geometry, often in hexadecimal format, which is hard to read.

2. ST_AsText(ST_Centroid(geom)):

- Converts the centroid's coordinates to a readable format (longitude, latitude).

- This is useful for human-friendly display of geometric points.

3. ST_Area(geom):

- Calculates the area of a geometry. The units of the result are based on the geometry's spatial reference system.

- If the geometry uses latitude/longitude (degrees), the area will be in square degrees, which is unreliable for area calculation due to varying degree sizes across the globe.

4. ST_Transform(geom, SRID):

- Re-projects a geometry from its original spatial reference system to another, specified by the `SRID` (Spatial Reference Identifier).

- Example: Transforming to SRID `2163` (an equal-area projection in meters for the U.S.) enables more accurate area calculations in square meters.

- Note: `ST_Transform` changes the geometry only in the query, not in the table itself.

5. Using ST_Transform with ST_Area:

- By re-projecting geometries to an equal-area projection before calling `ST_Area`, we get accurate area calculations in square meters, which is essential for meaningful area measurement.

These functions and transformations provide essential tools for spatial analysis, enabling accurate area measurements, centroids, and readable output across varied coordinate systems.

Execution (Introduction to Spatial Select Queries):

1. *First Query*

```
4  SELECT name, ST_Centroid(geom) AS centroid
5  FROM states
6  WHERE sub_region = 'Soda';
```

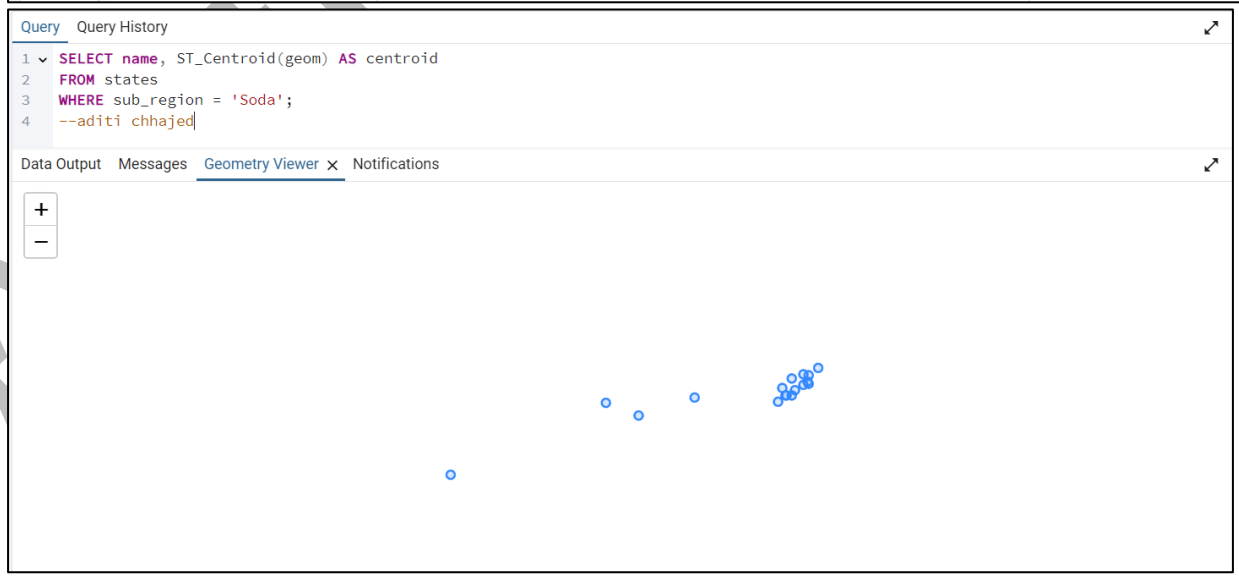
Data Output | Messages | Notifications

	name character varying (110)	centroid geometry
1	Arizona	0101000020AD100000834046ED60EA5BC0B0B7A559452641...
2	California	0101000020AD100000CB597749D8E65DC00D4D94E94F9F42...
3	Connecticut	0101000020AD10000054611D386E2E52C07C8B7269ABCF44...
4	Delaware	0101000020AD10000025DBB15341E052C086987A44E57E4340
5	District of Columbia	0101000020AD10000025C94D64EE4053C0F6922EDBEF734340
6	Hawaii	0101000020AD10000097D59EC3368B63C0D648EF8E7C403440
7	Kansas	0101000020AD1000003C09F787599858C0379155BC1D3E4340
8	Maine	0101000020AD1000003AEA9064A94E51C050D32DE926B146...
9	Maryland	0101000020AD100000AD99A9B0F33253C0540018A6BE8643...
10	Massachusetts	0101000020AD100000B0DB9789F3F351C0BA2024A923214540
11	New Hampshire	0101000020AD100000D9CD12EE0BE551C01E1AFC5BECD745...
12	New Jersey	0101000020AD1000009A74FACAC4AA52C0835AECA4F11844...
13	New York	0101000020AD1000006DBBCEBC07E152C0DA33636C927945...
14	Pennsylvania	0101000020AD100000D57473CF2D7353C0F090AEFEDF6F4440
15	Rhode Island	0101000020AD1000004BD2CD4E9CE351C072CC2D0336D644...
16	Vermont	0101000020AD1000007AF436EE722A52C089DF317D7A094640
17	Virginia	0101000020AD10000096384FF673B553C0AC3E25C357C24240

Query | Query History

```
1  SELECT name, ST_Centroid(geom) AS centroid
2  FROM states
3  WHERE sub_region = 'Soda';
4  --aditi chhajed
```

Data Output | Messages | Geometry Viewer | Notifications



2. *Second Query.*

```
8  SELECT name, ST_AsText(ST_Centroid(geom)) AS centroid
9  FROM states
10 WHERE sub_region = 'Soda';
```

Data Output | Messages | Notifications

	name character varying (110)	centroid text
1	Arizona	POINT(-111.66216594563052 34.29899139968563)
2	California	POINT(-119.60695110946033 37.244626233494365)
3	Connecticut	POINT(-72.72547724599036 41.622418576173885)
4	Delaware	POINT(-75.50398723953965 38.99137168871043)
5	District of Columbia	POINT(-77.01455028148901 38.905757329694026)
6	Hawaii	POINT(-156.35043507597285 20.251900609416076)
7	Kansas	POINT(-98.3804645454847 38.485282460957414)
8	Maine	POINT(-69.22908891822672 45.38399996507235)
9	Maryland	POINT(-76.79612366259126 39.05269313976228)
10	Massachusetts	POINT(-71.81173934774301 42.258900778427645)
11	New Hampshire	POINT(-71.57885314785325 43.686900613877)
12	New Jersey	POINT(-74.66826128443282 40.194874396712315)
13	New York	POINT(-75.51609726132092 42.949780987204306)
14	Pennsylvania	POINT(-77.79967104220425 40.874023280370125)
15	Rhode Island	POINT(-71.55641527271034 41.67352332817326)
16	Vermont	POINT(-72.66326480261515 44.074050568916455)
17	Virginia	POINT(-78.83520276771955 37.518303292451805)

3. *Third Query*

```
8  SELECT name, ST_AsText(ST_Centroid(geom)) AS centroid, ST_Area(geom) AS area
9  FROM states
10 WHERE sub_region = 'Soda';
```

Data Output | Messages | Notifications

	name character varying (110)	centroid text	area double precision
1	Arizona	POINT(-111.66216594563052 34.29899139968563)	28.858317404117383
2	California	POINT(-119.60695110946033 37.244626233494365)	41.67198912418638
3	Connecticut	POINT(-72.72547724599036 41.622418576173885)	1.3935803455822695
4	Delaware	POINT(-75.50398723953965 38.99137168871043)	0.5379483168098962
5	District of Columbia	POINT(-77.01455028148901 38.905757329694026)	0.017387475052014694
6	Hawaii	POINT(-156.35043507597285 20.251900609416076)	1.442532949830415
7	Kansas	POINT(-98.3804645454847 38.485282460957414)	22.007905409640504
8	Maine	POINT(-69.22908891822672 45.38399996507235)	9.65744574641041
9	Maryland	POINT(-76.79612366259126 39.05269313976228)	2.6858090224747926
10	Massachusetts	POINT(-71.81173934774301 42.258900778427645)	2.2947865291017835
11	New Hampshire	POINT(-71.57885314785325 43.686900613877)	2.6715583482962106
12	New Jersey	POINT(-74.66826128443282 40.194874396712315)	2.0875578270290127
13	New York	POINT(-75.51609726132092 42.949780987204306)	13.90869344711657
14	Pennsylvania	POINT(-77.79967104220425 40.874023280370125)	12.530949787966678
15	Rhode Island	POINT(-71.55641527271034 41.67352332817326)	0.30415205123645106
16	Vermont	POINT(-72.66326480261515 44.074050568916455)	2.8062482480922015
17	Virginia	POINT(-78.83520276771955 37.518303292451805)	10.603562181530581

4. *Fourth Query*

```
8  SELECT name, ST_AsText(ST_Centroid(geom)) AS centroid, ST_Area(ST_Transform(geom,2163)) AS area
9  FROM states
10 WHERE sub_region = 'Soda';
```

Data Output | Messages | Notifications

	name character varying (110)	centroid text	area double precision
1	Arizona	POINT(-111.66216594563052 34.29899139968563)	294658802723.2793
2	California	POINT(-119.60695110946033 37.244626233494365)	409751779504.5893
3	Connecticut	POINT(-72.72547724599036 41.622418576173885)	12880466314.670607
4	Delaware	POINT(-75.50398723953965 38.99137168871043)	5169554276.580522
5	District of Columbia	POINT(-77.01455028148901 38.905757329694026)	167301325.88484004
6	Hawaii	POINT(-156.35043507597285 20.251900609416076)	16731122197.307226
7	Kansas	POINT(-98.3804645454847 38.485282460957414)	212976665761.00836
8	Maine	POINT(-69.22908891822672 45.38399996507235)	83854250459.44655
9	Maryland	POINT(-76.79612366259126 39.05269313976228)	25787640587.02203
10	Massachusetts	POINT(-71.81173934774301 42.258900778427645)	20999237294.469162
11	New Hampshire	POINT(-71.57885314785325 43.686900613877)	23884602535.76386
12	New Jersey	POINT(-74.66826128443282 40.194874396712315)	19714822224.492924
13	New York	POINT(-75.51609726132092 42.949780987204306)	125856065524.10994
14	Pennsylvania	POINT(-77.79967104220425 40.874023280370125)	117147550650.04947
15	Rhode Island	POINT(-71.55641527271034 41.67352332817326)	2808986304.2507906
16	Vermont	POINT(-72.66326480261515 44.074050568916455)	24926379297.00165
17	Virginia	POINT(-78.83520276771955 37.518303292451805)	103979385256.27252

Conclusion:

This experiment highlights the importance of accurate spatial reference systems (SRIDs) and geometry handling when performing spatial analyses in PostgreSQL/PostGIS:

1. Accuracy Over Shortcuts: Properly transforming data isn't optional if we want reliable results. So, I took the time to project my data accurately; it matters, especially with real-world distances.

2. Geometry Types Matter: Choosing the right geometry (e.g., full boundary vs. centroid) based on the experiment analysis goal significantly changed the results .

3. Check Data Integrity: Always verify SRID and projection details first to avoid analysis errors. Data integrity sets the foundation for meaningful results.

These points underscore the importance of precision, clarity, and foundational checks in spatial analysis which helped in the experiment.