

Web Mapping and Geospatial Web Services

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Assignment 4

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Introduction

GeoPackage (GPKG)

A .gpkg file is a geographical information system that is implemented as an SQLite database container and contains data and metadata tables with standard definitions, format limitations, integrity assertions, and content constraints. It was defined by the OGC (Open Geospatial Consortium) on behalf of the US military and published in 2014. The GeoPackage has widespread support from a variety of government, commercial, and open-source organizations [1].

GPKG File Format

A standard defines a set of rules (required conventions) for [1]:

- Keeping imagery in tile matrix sets
- Characteristics of vector
- At various scales, raster maps
- Schema and metadata

The extension rules described in clause 2.3 of the standard can be used to extend a GeoPackage. The goal of creating a GeoPackage was to create a database that was as light as possible and include it in a single file that was ready to use. This makes it ideal for off-line mobile apps and quick sharing via cloud storage or USB storage devices, among other things [1].

Canada Geospatial Data Extraction Tool

Natural Resources Canada's Canadian Geospatial Data Extraction tool is a useful tool that all geospatial users in Canada should be familiar with. It enables users to extract continuous geospatial open data based on a user-defined geographic area and data options. While downloading authoritative topographic and elevation data for use in their projects, this gives the user complete control [2].

Users can extract topographic data from the CanVec series, which includes over 60 topographic features organized into eight main themes, using the Canadian Geospatial Data Extraction tool (transportation features, administrative features, hydrographic features, land features, man-made features, elevation features, resources management features, and toponymic features). It is based on the most up-to-date data sources and provides high-quality topographic data in vector format that meets international geomatics standards. CanVec data can be used for extensive spatial analysis as well as cartographic design because of its many attributes [2].

QGIS

QGIS (until 2013 known as Quantum GIS) is a free and open-source cross-platform desktop geographic information system (GIS) application that supports viewing, editing, and analysis of geospatial data [3].

QGIS functions as geographic information system (GIS) software, allowing users to analyze and edit spatial information, in addition to composing and exporting graphical maps. QGIS supports both raster and vector layers; vector data is stored as either point, line, or polygon features. Multiple formats of raster images are supported, and the software can georeference images [3].

QGIS supports shapefiles, coverages, personal geodatabases, dxf, MapInfo, PostGIS, and other formats. Web services, including Web Map Service and Web Feature Service, are also supported to allow use of data from external sources [3].

Metadata

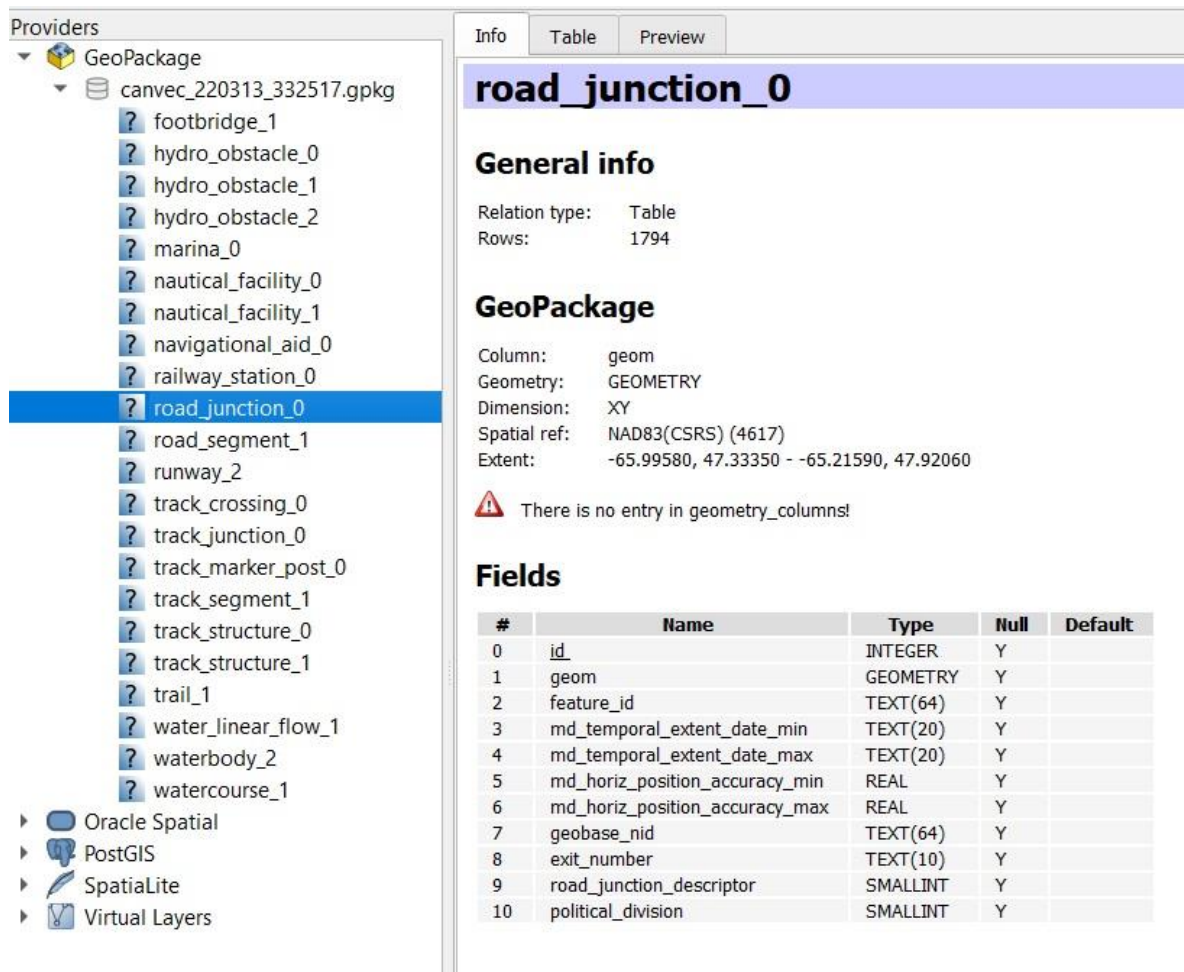
The following is the metadata of the extracted CanVec hydrographic and transportation features of the GeoPackage file for the Gloucester, NB geographic area:



Figure 1: Metadata

Road Junction Layer

The following is a visualization of the road junction layer of the Gloucester, NB geographic area GeoPackage file, as well as an excerpt from the attribute tables:



Providers

- GeoPackage
 - canvec_220313_332517.gpkg
 - footbridge_1
 - hydro_obstacle_0
 - hydro_obstacle_1
 - hydro_obstacle_2
 - marina_0
 - nautical_facility_0
 - nautical_facility_1
 - navigational_aid_0
 - railway_station_0
 - road_junction_0**
 - road_segment_1
 - runway_2
 - track_crossing_0
 - track_junction_0
 - track_marker_post_0
 - track_segment_1
 - track_structure_0
 - track_structure_1
 - trail_1
 - water_linear_flow_1
 - waterbody_2
 - watercourse_1
- Oracle Spatial
- PostGIS
- Spatialite
- Virtual Layers

Info | Table | Preview

road_junction_0

General info

Relation type: Table
Rows: 1794

GeoPackage

Column: geom
Geometry: GEOMETRY
Dimension: XY
Spatial ref: NAD83(CSR5) (4617)
Extent: -65.99580, 47.33350 - -65.21590, 47.92060

⚠ There is no entry in geometry_columns!

Fields

#	Name	Type	Null	Default
0	id	INTEGER	Y	
1	geom	GEOMETRY	Y	
2	feature_id	TEXT(64)	Y	
3	md_temporal_extent_date_min	TEXT(20)	Y	
4	md_temporal_extent_date_max	TEXT(20)	Y	
5	md_horiz_position_accuracy_min	REAL	Y	
6	md_horiz_position_accuracy_max	REAL	Y	
7	geobase_nid	TEXT(64)	Y	
8	exit_number	TEXT(10)	Y	
9	road_junction_descriptor	SMALLINT	Y	
10	political_division	SMALLINT	Y	

Figure 2: Road junction layer information

Providers		Info	Table	Preview
GeoPackage				
canvec_220313_332517.gpkg				
<ul style="list-style-type: none"> footbridge_1 hydro_obstacle_0 hydro_obstacle_1 hydro_obstacle_2 marina_0 nautical_facility_0 nautical_facility_1 navigational_aid_0 railway_station_0 road_junction_0 road_segment_1 runway_2 track_crossing_0 track_junction_0 track_marker_post_0 track_segment_1 track_structure_0 track_structure_1 trail_1 water_linear_flow_1 waterbody_2 watercourse_1 				
Oracle Spatial				
PostGIS				
Spatialite				
Virtual Layers				

	id	geom	feature_id	mporal_exten_dat	mporal_exten_dat	iz_position_accura	iz_position_accura	geobase_nid	exit_number	d_junction_descrip	political_division
1	1	POINT ...	f81b5f9cdd504...	20170331	20170331	10.0	10.0	4d06a2bc38a24...	311	361	95
2	2	POINT ...	c8bb6a1093d04...	20170331	20170331	10.0	10.0	faecf6678d4047...	308	361	95
3	3	POINT ...	23e1fcfa0f0847...	20170331	20170331	10.0	10.0	da9c4fe9aba74...	308	361	95
4	4	POINT ...	8957c0ed0e234...	20170331	20170331	10.0	10.0	9c26413ecd5f54...	301	361	95
5	5	POINT ...	edct209710064...	20170331	20170331	10.0	10.0	8272983e66884...	344	361	95
6	6	POINT ...	7bbc8636aa5d4...	20170331	20170331	10.0	10.0	66560b1ed0854...	300A	361	95
7	7	POINT ...	b4c66c86e21e4...	20170331	20170331	10.0	10.0	59bc9ac24e764...	310	361	95
8	8	POINT ...	ebec4fb9564d4...	20170331	20170331	10.0	10.0	39d9e26304164...	304	361	95
9	9	POINT ...	830d1893d99c4...	20170331	20170331	10.0	10.0	b0a7ac3a06794...	231	361	95
10	10	POINT ...	6716eacdcde84...	20170331	20170331	10.0	10.0	e8eaf6c0943694...	310	361	95
11	11	POINT ...	a7b65600901d...	20170331	20170331	10.0	10.0	2f73240b12e84...	231	361	95
12	12	POINT ...	b8bbeed60e86...	20170331	20170331	10.0	10.0	e832c19abef64...	231	361	95
13	13	POINT ...	b23eee138c374...	20170331	20170331	10.0	10.0	4471f973bec34...	308	361	95
14	14	POINT ...	4397ac969da44...	20170331	20170331	10.0	10.0	dd8daf7be64c4...	344	361	95
15	15	POINT ...	585c0560b4a94...	20170331	20170331	10.0	10.0	6ba51662b66d4...	304	361	95
16	16	POINT ...	f60b7ad300f44...	20170331	20170331	10.0	10.0	98e95e41aff64f...	344	361	95
17	17	POINT (-65.701...	8a5db295a9b6...	20170331	20170331	10.0	10.0	5ef7078b2d0f4...	310	361	95
18	18	POINT ...	73871bb595744...	20170331	20170331	10.0	10.0	f4e9fbcc5f674e...	308	361	95
19	19	POINT ...	c9da916114884...	20170331	20170331	10.0	10.0	af15e7cbdd94...	326	361	95
20	20	POINT ...	4d2fe7759e524...	20170331	20170331	10.0	10.0	1d94df58b9994...		361	95
21	21	POINT ...	8d6a03b32a3e4...	20170331	20170331	10.0	10.0	c36deadacd6b4...		359	95
22	22	POINT ...	cb08091310c84...	20170331	20170331	10.0	10.0	6482069a22094...		361	95
23	23	POINT ...	b8a9648a86aa4...	20170331	20170331	10.0	10.0	7c6c280612864...		361	95

Figure 3: Road junction layer table



Figure 4: Road junction layer preview

Road Segments Layer

The following is a visualization of the road segments layer of the Gloucester, NB geographic area GeoPackage file, as well as an excerpt from the attribute tables:

The screenshot shows the QGIS interface. On the left, the 'Providers' panel lists various layers from a GeoPackage file named 'canvec_220313_332517.gpkg'. The 'road_segment_1' layer is selected and highlighted in blue. On the right, the 'Info' panel is active, showing details for the 'road_segment_1' layer.

General info

Relation type: Table
Rows: 2829

GeoPackage

Column: geom
Geometry: GEOMETRY
Dimension: XY
Spatial ref: NAD83(CSRS) (4617)
Extent: -65.99630, 47.33000 - -65.21500, 47.92060

⚠ There is no entry in geometry_columnsl

Fields

#	Name	Type	Null	Default
0	id	INTEGER	Y	
1	geom	GEOMETRY	Y	
2	feature_id	TEXT(64)	Y	
3	md_temporal_extent_date_min	TEXT(20)	Y	
4	md_temporal_extent_date_max	TEXT(20)	Y	
5	md_horiz_position_accuracy_min	REAL	Y	
6	md_horiz_position_accuracy_max	REAL	Y	
7	closing_period	SMALLINT	Y	
8	exit_number	TEXT(10)	Y	
9	political_division	SMALLINT	Y	
10	road_jurisdiction_en	TEXT(100)	Y	
11	road_jurisdiction_fr	TEXT(100)	Y	
12	is_national_highway_system	SMALLINT	Y	
13	is_trans_canada_highway	SMALLINT	Y	
14	number_of_lanes	SMALLINT	Y	
15	road_class	SMALLINT	Y	
16	geobase_nid	TEXT(64)	Y	
17	route_name_1_en	TEXT(100)	Y	
18	route_name_2_en	TEXT(100)	Y	
19	route_name_3_en	TEXT(100)	Y	
20	route_name_4_en	TEXT(100)	Y	
21	route_name_1_fr	TEXT(100)	Y	
22	route_name_2_fr	TEXT(100)	Y	
23	route_name_3_fr	TEXT(100)	Y	
24	route_name_4_fr	TEXT(100)	Y	
25	road_segment_name_en	TEXT(100)	Y	
26	road_segment_name_fr	TEXT(100)	Y	

Figure 5: Road segments layer information

Providers

GeoPackage

canvec_220313_332517.gpkg

footbridge_1

hydro_obstacle_0

hydro_obstacle_1

hydro_obstacle_2

marina_0

nautical_facility_0

nautical_facility_1

navigational_aid_0

railway_station_0

road_junction_0

road_segment_1

runway_2

track_crossing_0

track_junction_0

track_marker_post_0

track_segment_1

track_structure_0

track_structure_1

trail_1

water_linear_flow_1

waterbody_2

watercourse_1

Oracle Spatial

PostGIS

Spatialite

Virtual Layers

Info	Table	Preview															
	id	geom	feature_id	mporal_extnt_daf	mporal_extnt_dat	iz_position_accura	iz_position_accura	closing_period	exit_number	political_division	oad_jurisdiction_e	oad_jurisdiction_f	tional				
1	1	LINESTRING ...	1a8cd349d8734...	20170331	20170331	10.0	10.0	20		95			13				
2	2	LINESTRING ...	a88100085fb4...	20170331	20170331	10.0	10.0	20		95			13				
3	3	LINESTRING ...	baffde2877b48...	20170331	20170331	10.0	10.0	20		95			13				
4	4	LINESTRING ...	a3e779f6dba84...	20170331	20170331	10.0	10.0	20		95			13				
5	5	LINESTRING ...	54e82cf458294...	20170331	20170331	10.0	10.0	20		95			13				
6	6	LINESTRING ...	c878cc1aeb944...	20170331	20170331	10.0	10.0	20		95			13				
7	7	LINESTRING ...	3610831002c4...	20170331	20170331	10.0	10.0	20		95			13				
8	8	LINESTRING ...	d337a8e051c4...	20170331	20170331	10.0	10.0	20		95			13				
9	9	LINESTRING ...	e12cb4ba142d4...	20170331	20170331	10.0	10.0	20		95			13				
10	10	LINESTRING ...	c8a11049966c4...	20170331	20170331	10.0	10.0	20		95			13				
11	11	LINESTRING ...	94c59fa696e4...	20170331	20170331	10.0	10.0	20		95			13				
12	12	LINESTRING ...	82e28426f87b4...	20170331	20170331	10.0	10.0	20		95			13				
13	13	LINESTRING ...	573f82c770d4...	20170331	20170331	10.0	10.0	20		95			13				
14	14	LINESTRING ...	009ba8ac00704...	20170331	20170331	10.0	10.0	20		95			13				
15	15	LINESTRING ...	1e5cf4ca1c44a...	20170331	20170331	10.0	10.0	20		95			13				
16	16	LINESTRING ...	947cf31319184...	20170331	20170331	10.0	10.0	20		95			13				
17	17	LINESTRING ...	5b1fee5953a84...	20170331	20170331	10.0	10.0	20		95			13				
18	18	LINESTRING ...	dc52883e8694...	20170331	20170331	10.0	10.0	20		95			13				
19	19	LINESTRING ...	c5a09b7d6a04...	20170331	20170331	10.0	10.0	20		95			13				
20	20	LINESTRING ...	b7e930f5501c4...	20170331	20170331	10.0	10.0	20		95			13				
21	21	LINESTRING ...	234caa0ba5e4...	20170331	20170331	10.0	10.0	20	231	95			13				
22	22	LINESTRING ...	5caf50ea135c4...	20170331	20170331	10.0	10.0	20		95			13				
23	23	LINESTRING ...	731f4117c7b4...	20170331	20170331	10.0	10.0	20		95			13				

Figure 6: Road segments layer table

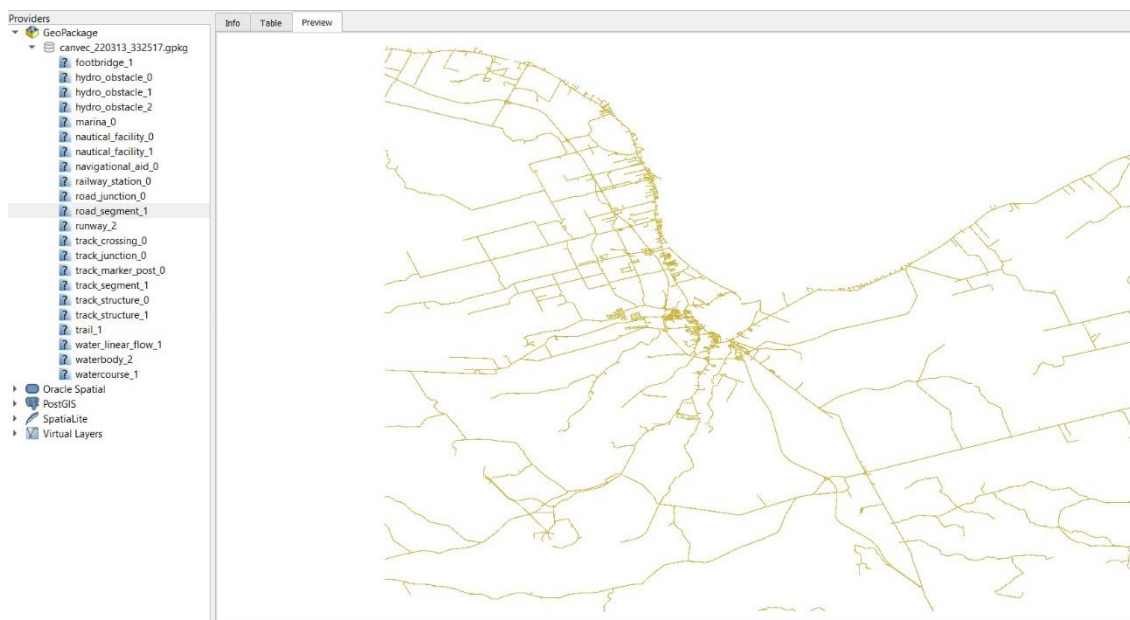


Figure 7: Road segments layer preview

Water Body Layer

The following is a visualization of the water body layer of the Gloucester, NB geographic area GeoPackage file, as well as an excerpt from the attribute tables:

The screenshot shows the QGIS interface with the 'Providers' panel on the left and the 'Info' panel on the right. The 'waterbody_2' layer is selected in the Providers panel. The 'Info' panel shows the following details:

waterbody_2

General info

Relation type: Table
Rows: 679

GeoPackage

Column: geom
Geometry: GEOMETRY
Dimension: XY
Spatial ref: NAD83(CSR) (4617)
Extent: -65.99630, 47.33000 - -65.21500, 47.95450

There is no entry in geometry_columnst

Fields

#	Name	Type	Null	Default
0	id	INTEGER	Y	
1	geom	GEOMETRY	Y	
2	feature_id	TEXT(64)	Y	
3	md_temporal_extent_date_min	TEXT(20)	Y	
4	md_temporal_extent_date_max	TEXT(20)	Y	
5	md_horiz_position_accuracy_min	REAL	Y	
6	md_horiz_position_accuracy_max	REAL	Y	
7	permanency	SMALLINT	Y	
8	shoreline_water_level	SMALLINT	Y	
9	water_definition	SMALLINT	Y	
10	is_isolated	SMALLINT	Y	
11	name_db	TEXT(100)	Y	
12	name_id	TEXT(64)	Y	
13	name_en	TEXT(100)	Y	
14	name_fr	TEXT(100)	Y	
15	name_other	TEXT(100)	Y	
16	language_other	TEXT(3)	Y	
17	name_ik1_id	TEXT(64)	Y	
18	name_ik1_en	TEXT(100)	Y	
19	name_ik1_fr	TEXT(100)	Y	
20	name_ik2_id	TEXT(64)	Y	
21	name_ik2_en	TEXT(100)	Y	
22	name_ik2_fr	TEXT(100)	Y	
23	name_rv1_id	TEXT(64)	Y	
24	name_rv1_en	TEXT(100)	Y	
25	name_rv1_fr	TEXT(100)	Y	
26	name_rv2_id	TEXT(64)	Y	

Figure 8: Water body layer information

Providers		Info	Table	Preview
GeoPackage				
canvec_220313_332517.gpkg				
<ul style="list-style-type: none"> footbridge_1 hydro_obstacle_0 hydro_obstacle_1 hydro_obstacle_2 marina_0 naucal_facility_0 naucal_facility_1 navigational_aid_0 railway_station_0 road_junction_0 road_segment_1 runway_2 track_crossing_0 track_junction_0 track_marker_post_0 track_segment_1 track_structure_0 track_structure_1 trail_1 water_linear_flow_1 waterbody_0 watercourse_1 				
<ul style="list-style-type: none"> Oracle Spatial PostGIS Spatialite Virtual Layers 				

	id	geom	feature_id	mporal_extent_dai	mporal_extent_dat	iz_position_accur	iz_position_accura	permanency	shoreline_water_low	water_definition	is_isolated	name_db	name
1	1	POLYGON ...	a769bbee48914...	1966	1966	10.0	10.0	59	76	83	12		
2	2	POLYGON ...	7efa1ae6060c4...	1966	1966	10.0	10.0	59	76	83	11		
3	3	POLYGON ...	dba9ebc9a2d2...	1966	1966	10.0	10.0	59	76	83	11		
4	4	POLYGON ...	74e487ad7b984...	1966	1966	10.0	10.0	59	76	83	12		
5	5	POLYGON ...	e56b67b489134...	1966	1966	10.0	10.0	59	76	83	11		
6	6	POLYGON ...	ddd9d7e346a34...	1966	1966	10.0	10.0	59	76	83	12	CGNDB	0c8044a
7	7	POLYGON ...	3e15aabad2924...	1966	1966	10.0	10.0	59	76	91	12		
8	8	POLYGON ...	611d9d48cdad...	1966	1966	10.0	10.0	60	76	85	12		
9	9	POLYGON ...	8ea8a9f436de4...	1966	1966	10.0	10.0	59	76	83	11		
10	10	POLYGON ...	07b340db34b4...	1966	1966	10.0	10.0	59	76	83	11		
11	11	POLYGON ...	2229b2ac18e94...	1966	1966	10.0	10.0	60	76	85	12		
12	12	POLYGON ...	2b47a4ee080d4...	1966	1966	10.0	10.0	60	76	85	12		
13	13	POLYGON ...	1209f3512d2a4...	1966	1966	10.0	10.0	59	76	83	12		
14	14	POLYGON ...	4bbbc157b9f34...	1966	1966	10.0	10.0	59	76	83	11		
15	15	POLYGON ...	187d3365c25d4...	1966	1966	10.0	10.0	59	76	83	11		
16	16	POLYGON ...	6902775008514...	1966	1966	10.0	10.0	59	76	83	11		
17	17	POLYGON ...	fe4fb0e120a14f...	1966	1966	10.0	10.0	59	76	83	12		
18	18	POLYGON ...	de77ba4d6936...	1966	1966	10.0	10.0	59	76	83	11		
19	19	POLYGON ...	cbe2787f363e4...	1966	1966	10.0	10.0	59	76	83	12		
20	20	POLYGON ...	9fbb3b3fb1484...	1966	1966	10.0	10.0	59	76	83	11		
21	21	POLYGON ...	e996ca8f14494...	1966	1966	10.0	10.0	59	76	83	11		
22	22	POLYGON ...	a86eaf12734...	1966	1966	10.0	10.0	59	76	83	11		
23	23	POLYGON ...	41b985c6b6904...	1966	1966	10.0	10.0	59	76	83	11		

Figure 9: Water body layer table

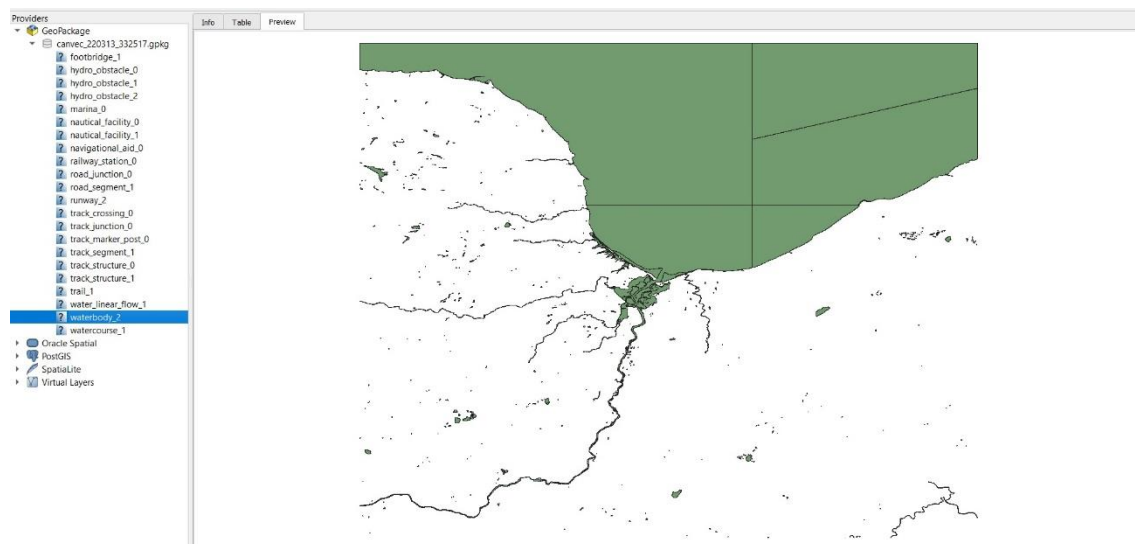


Figure 10: Water Body layer preview

REFERENCES

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- [3] Wikipedia, "QGIS," Wikipedia. Jan. 2022, Accessed: Mar. 13, 2022. [Online]. Available: <https://en.wikipedia.org/w/index.php?title=QGIS&oldid=1064006339>.