INSPIRE

Geopackage Hackathon

Einführung

ICA Commission on
Map Production and Geobusiness

BEV
Bundesamt für Eich- und Vermessungswesen

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Geopackage - Hackathon

- Zu der verwendeten Software im WS
  https://next.agrarforschung.at/index.php/s/CNk9PKDCnDYQpKB

- Der USB Stick (SW, Portables, Daten)

- http://www.geopackage.org/

Geopackage

http://ngageoint.github.io/geopackage-js/?gpkg=http://www.geopackage.org/data/empty.gpkg

Geopackage

- GeoPackage ist ein

  - offenes,
  - Standard-basiertes,
  - Plattform-unabhängiges,
  - portables,
  - selbstbeschreibendes,
  - kompaktes Format,

- um räumliche Informationen zu strukturieren (SQL) und zu sammeln.

Geopackage

- Der Geopackage Encoding Standard beschreibt für die Speicherung folgender Inhalte in einer Sqlite-DB ein Set von Konventionen:

  - vector features
  - tile matrix sets of imagery and raster maps at various scales
  - attributes (non-spatial data)
  - Extensions

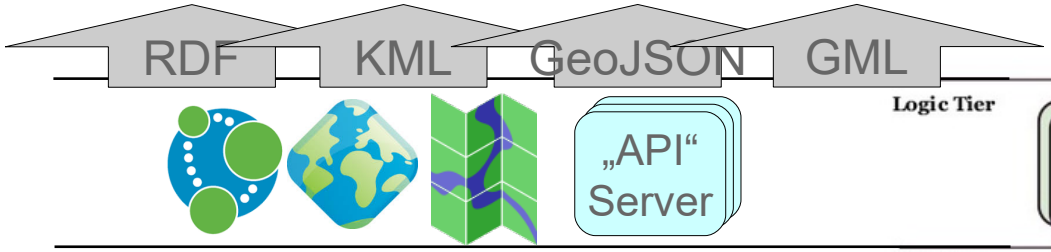
http://www.geopackage.org/spec120/?wb48617274=F5BA2B9E#_core

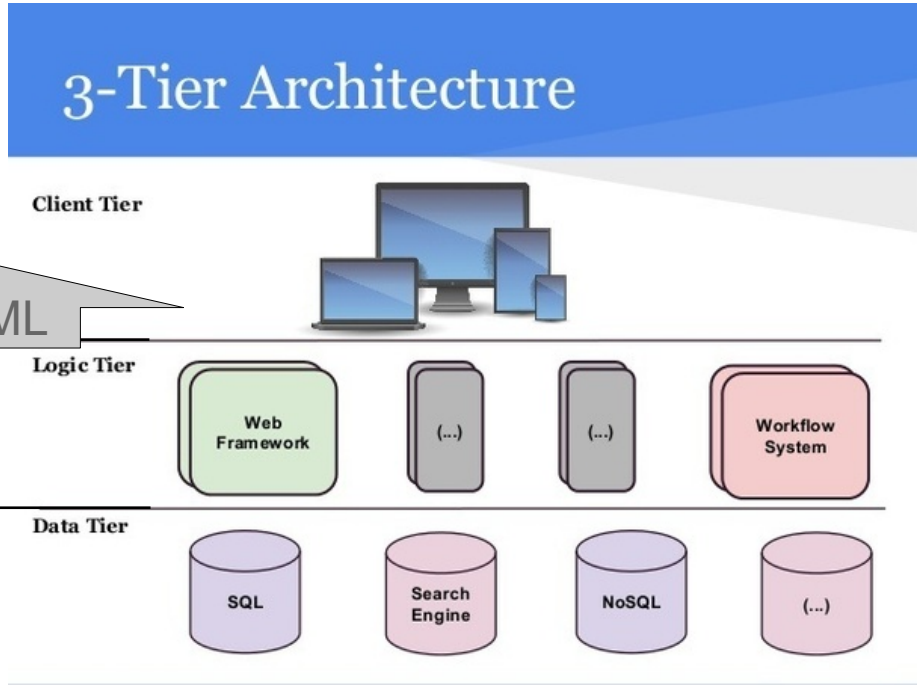
Geopackage

- Existieren unterschiedliche veröffentlichte Erweiterungen (extensions) für Geopackage, um weitere Bedürfnisse abzudecken.
- Mittlerweile (2019) unterstützt ein Großteil der bekannten GIS Software das Format GeoPackage.
- GeoPackage beinhaltet einen räumlichen Index (R-Tree).

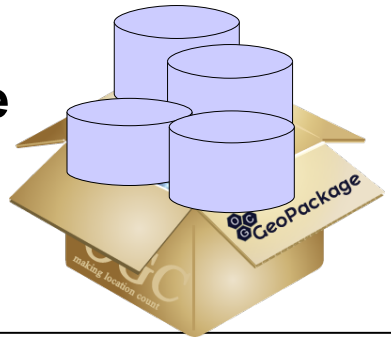
- **Nachteile** von Geopackage sind
  - Die zugrunde liegende SQLite DB ist ein **komplexes binäres Format**. (=Nachteil bei der Archivierung)
  - Daher ist das Format **nicht „streaming“** fähig: es muß auf ein lokales Dateisystem geschrieben oder mittels Datendienst zugänglich gemacht werden.

Geopackage - Architektur





Geopackage



Geopackage

- Ein GeoPackage beinhaltet, so wie andere relationale DB, eine Anzahl an Tabellen.
- Diese Tabellen werden in 2 Kategorien eingeteilt:
  - **Benutzer-definierte Datentabellen**
  - **Metadaten-Tabellen**
- Es existieren 2 verpflichtende Metadaten-Tabellen:
  - gpkg_contents and
  - gpkg_spatial_ref_sys.
- Andere Metadaten-Tabellen hängen vom verspeicherten Inhalt ab (siehe Content Types).
- Der Name der Benutzer-definierten Datentabelle ist der Primärschlüssel für die gpkg_contents.
- Generell ist es ein Fremdschlüsel für Inhalt-bezogene Metadaten-Tabellen (content-specific metadata tables).

http://www.geopackage.org/spec120/?wb48617274=F5BA2B9E#_core

Geopackage - Inhalte

Die gpkg_contents Tabelle ist das Inhaltsverzeichnis eines GeoPackage. Die **verpflichtenden Spalten** darin sind :

- *table_name*: der aktuelle Name der Benutzer-definierten Datentabelle (Schlüssel für diese Tabelle);
- *data_type*: der Datentyp, e.g., “tiles”, “features”, “attributes” oder ein anderer Typ, der mittels Erweiterung verfügbar gemacht wird;
- *identifier and description*: Menschen-lesbarer Text (“identifier” ist analog zum “title”);
- *last_change*: das Informationsdatm des letzten Änderung, in ISO 8601 Format (aus pragmatischen Gründen wird RFC3339 angewandt);
- *min_x, min_y, max_x, and max_y*: die räumliche Ausdehnung des Inhaltes. (Wird im Client zur Visualisierung der Bounding Box verwendet);
- *srs_id*: spatial reference system.

http://www.geopackage.org/spec120/?wb48617274=F5BA2B9E#_core

Geopackage: verpflichtende Tabellen

Tabellenname: gpkg_contents

Tabellenbeschreibung:

Tabellentyp: TABLE

Spalten

Eindeutige Schlüssel

Fremdschlüssel

Indizies

Referenzen

Auslöser

DDL

Spaltenname	#	Datentyp	Länge	Nicht N...	Automatische Schrit...	Defa...	Beschreib...
table_name	1	TEXT		☑	☐		
data_type	2	TEXT		☑	☐		
identifier	3	TEXT		☐	☐		
description	4	TEXT		☐	☐	''	
last_change	5	DATETIME		☑	☐	strfti...	
min_x	6	DOUBLE		☐	☐		
min_y	7	DOUBLE		☐	☐		
max_x	8	DOUBLE		☐	☐		
max_y	9	DOUBLE		☐	☐		
srs_id	10	INTEGER		☐	☐		

spatialite_gui [a GUI tool for S

Files

- E:\Data\metromap.gpkg
  - User Data
    - gpkg_contents
    - gpkg_spatial_ref_sys
    - gpkg_tile_matrix
    - gpkg_tile_matrix_set
    - metromap
    - st_spatial_ref_sys
  - ISO / INSPIRE Metadata
  - Styling (SLD/SE)
  - Topologies
  - Raster Coverages
  - Vector Coverages
  - Metadata
  - Internal Data
  - Spatial Index

	ROWID	table_name	data_type	identifier	description	last_change	min_x	min_y	max_x	max_y	srs_id
1	1	metromap	tiles	metromap	NULL	2016-03-18T12:50:16.845Z	2.109375	48.690960	2.636719	49.037868	4326
Insert row											

Geopackage – CRS

- Für Inhalte mit geografischer Referenz (einschließlich Features und Tiles), muss jede Zeile in contents einen Bezug zu einem Koordinatenreferenzsystem aufweisen.
- Das CRS wird in der gpkg_spatial_ref_sys Tabelle gespeichert.

- Verpflichtende Spalten in dieser Tabelle sind:
  - *srs_name, description*: a human readable name and description for the SRS;
  - *srs_id*: a unique identifier for the SRS; also the primary key for the table;
  - *organization*: Case-insensitive name of the defining organization e.g., EPSG or epsg;
  - *organization_coordsys_id*: Numeric ID of the SRS assigned by the organization;
  - *definition*: Well Known Text definition of the SRS.

Geopackage: verpflichtende Tabellen

gpkg_spatial_ref_sys

Eigenschaften | Daten | ER Diagramm — SQLite - empty.gpkg | Tabellen

gpkg_spatial_ref_sys — Geben Sie einen SQL-Ausdruck ein, um die Ergebnisse zu filtern (verwenden Sie Strg+ Leertaste).

Gitter | Text

	srs_name	srs_id	organization	organization_coordsys_id	definition	description
1	Undefined cartesian SRS	-1	NONE	-1	undefined	undefined cartesian coordinate reference sys
2	Undefined geographic SRS	0	NONE	0	undefined	undefined geographic coordinate reference
3	WGS 84 geodetic	4.326	EPSG	4.326	GEOGCS["WGS 84",DATUM["WGS_1984",SPH	longitude/latitude coordinates in decimal de

spatialite_gui [a GUI tool for SQLite/SpatiaLite]

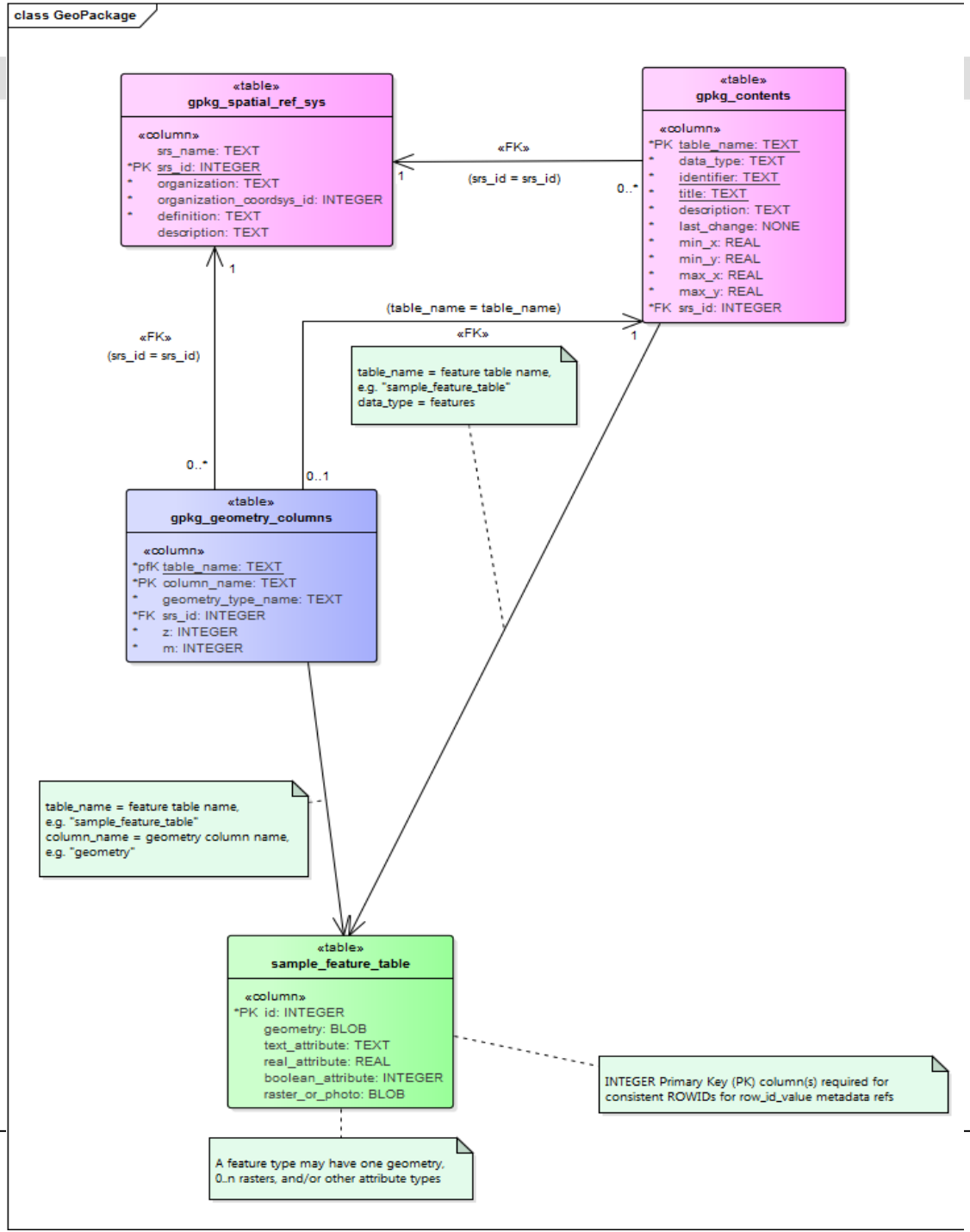
Files

- E:\Data\metromap.gpkg
  - User Data
    - gpkg_contents
    - gpkg_spatial_ref_sys
    - gpkg_tile_matrix
    - gpkg_tile_matrix_set
    - metromap
    - st_spatial_ref_sys
  - ISO / INSPIRE Metadata
  - Styling (SLD/SE)
  - Topologies
  - Raster Coverages
  - Vector Coverages
  - Metadata
  - Internal Data
  - Spatial Index

```
SELECT ROWID, "srs_name", "srs_id", "organization", "organization_coordsys_id", "definition", "description"
FROM "gpkg_spatial_ref_sys"
ORDER BY ROWID
```

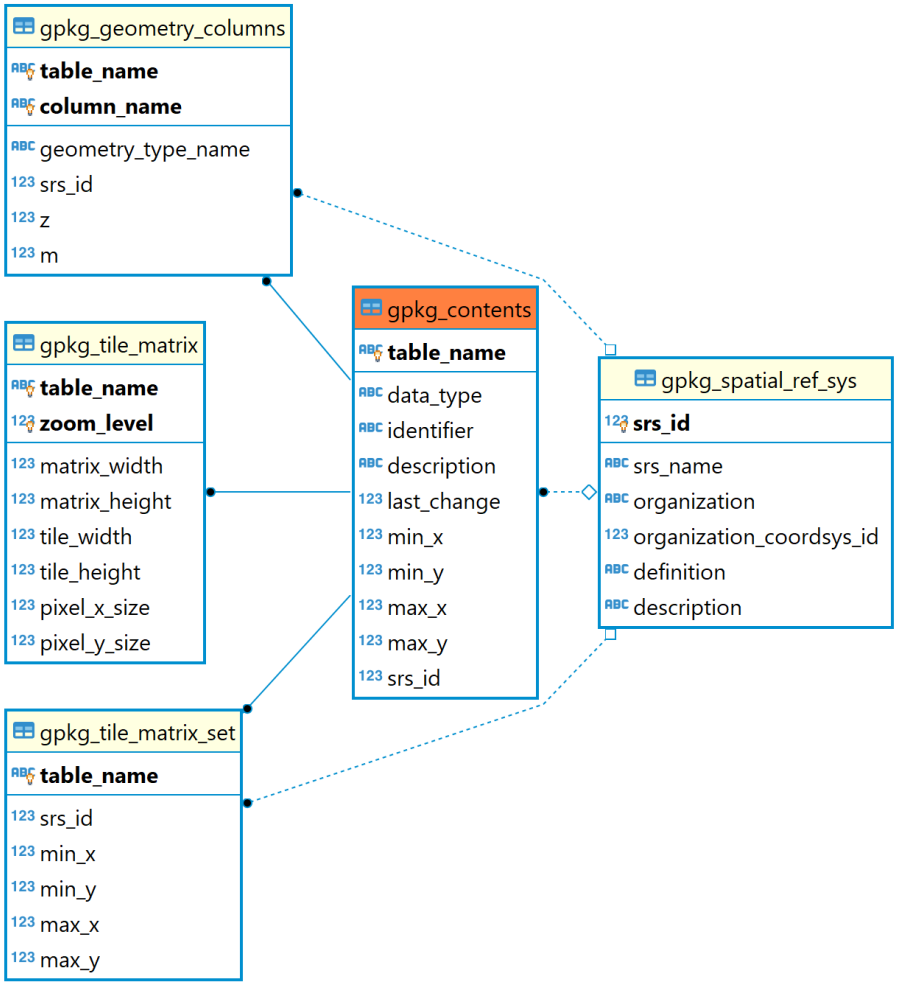
	ROWID	srs_name	srs_id	organization	organization_coordsys_id	
1	-1	Undefined cartesian SRS	-1	NONE	-1	undefined
2	0	Undefined geographic SRS	0	NONE	0	undefined
3	3857	WGS 84 / Pseudo-Mercator	3857	EPSG	3857	PROJCS["WGS 84 / Pseudo-Mercator",GEOGCS["Popular Visualisation CRS",DATUM["
4	4326	WGS 84 geodetic	4326	EPSG	4326	GEOGCS["WGS 84",DATUM["WGS_1984",SPHEROID["WGS 84",6378137,298.257223563,

Geopackage

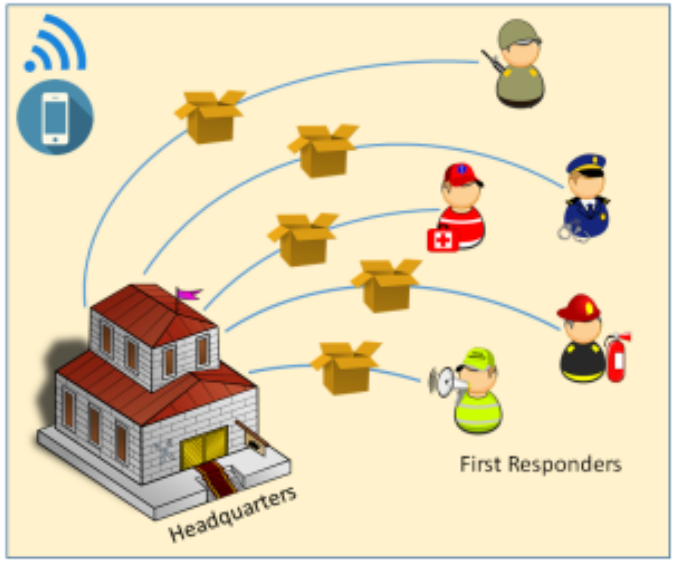

class GeoPackage
«table»
gpkg_spatial_ref_sys
«column»
srs_name: TEXT
*PK srs_id: INTEGER
* organization: TEXT
* organization_coordsys_id: INTEGER
* definition: TEXT
description: TEXT
«table»
gpkg_contents
«column»
*PK table_name: TEXT
* data_type: TEXT
* identifier: TEXT
* title: TEXT
* description: TEXT
* last_change: NONE
* min_x: REAL
* min_y: REAL
* max_x: REAL
* max_y: REAL
*FK srs_id: INTEGER
«FK»
(srs_id = srs_id)
1
0..*
(table_name = table_name)
«FK»
1
«FK»
(srs_id = srs_id)
1
0..*
0..1
table_name = feature table name,
e.g. "sample_feature_table"
data_type = features
«table»
gpkg_geometry_columns
«column»
*pfK table_name: TEXT
*PK column_name: TEXT
* geometry_type_name: TEXT
*FK srs_id: INTEGER
* z: INTEGER
* m: INTEGER
table_name = feature table name,
e.g. "sample_feature_table"
column_name = geometry column name,
e.g. "geometry"
«table»
sample_feature_table
«column»
*PK id: INTEGER
geometry: BLOB
text_attribute: TEXT
real_attribute: REAL
boolean_attribute: INTEGER
raster_or_photo: BLOB
INTEGER Primary Key (PK) column(s) required for
consistent ROWIDs for row_id_value metadata refs
A feature type may have one geometry,
0..n rasters, and/or other attribute types

Geopackage - Grundstruktur

- Download: http://www.geopackage.org/data/empty.gpkg
- Starten Sie DB-Beaver
- Erstellen Sie eine Verbindung mit empty.gpkg
- Evaluieren Sie die grundlegenden Tabellen des gpkg



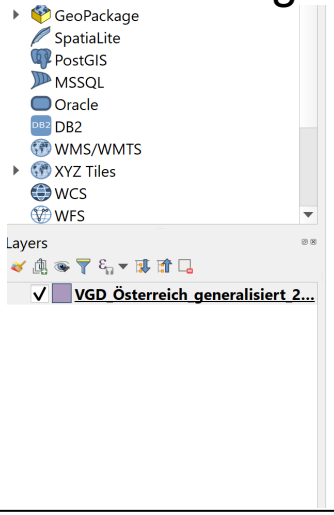
Geopackage

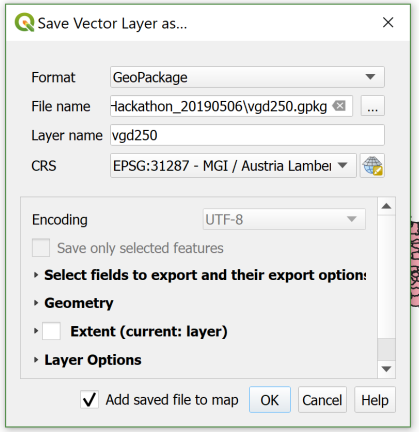

Headquarters
First Responders

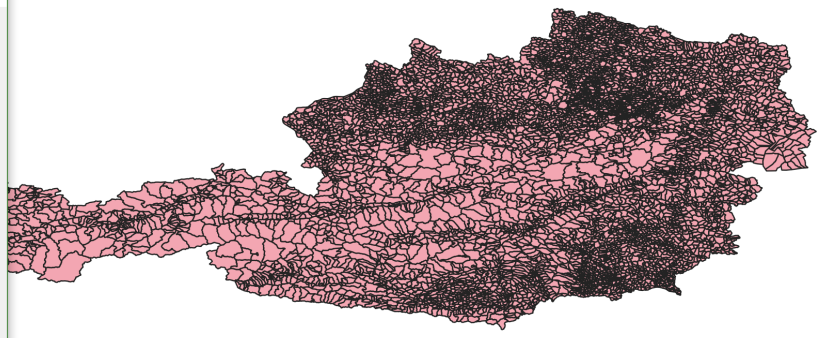

PARCELS
ZONING
TOPOGRAPHY
WETLANDS
DEMOGRAPHICS
LAND COVER
IMAGERY
BASEMAP
GeoPackage

Geopackage - Vektorimport

- Download der BEV VGD Daten (generalisiert):
  http://www.bev.gv.at/pls/portal/docs/PAGE/BEV_PORTAL_CONTENT_ALLGEMEIN/0200_PRODUKTE/UNENTGELTLICHE_PRODUKTE_DES_BEV/VGD-Oesterreich_gen_250.zip
- Starten Sie QGIS 3.6 und laden Sie den VGD Vektor
- Exportieren Sie die VDG Ebene als gpkg (vgd250.gpkg)
- Starten Sie DB-Beaver und erstellen Sie eine Verbindung mit vgd250.gpkg
- Evaluieren Sie die grundlegenden Tabellen des gpkg







Geopackage Applikationen

- GDAL
- Geoserver
- QGIS, ESRI ArcGIS for Desktop 10.2.2
- Hexagon LuciadMobile and LuciadFusion products
- SpatiaLite
- Safe Software FME Desktop
- GeoTools
- TerraGo
- OpenJump Plus
- Pitney Bowes Software MapInfo Pro, MapXtreme
- Manifold

http://www.geopackage.org/implementations.html

Geopackage - Requirements

- **Req1:** A GeoPackage SHALL be a SQLite database file using version 3 of the SQLite file format. The first 16 bytes of a GeoPackage SHALL be the null-terminated ASCII string „SQLite format 3“
- **Req2:** A GeoPackage SHALL contain a value of 0x47504B47 ("GPKG" in ASCII) in the "application_id" field of the SQLite database header
- **Req3:** A GeoPackage SHALL have the file extension name ".gpkg".
- **Req4:** A GeoPackage SHALL only contain the data elements (tables, columns, or values) and SQL constructs (views, constraints, or triggers)
- **Req5:** The columns of tables in a GeoPackage SHALL only be declared using one of the data types specified in table GeoPackage Data Types.
- **Req6:** The SQLite PRAGMA integrity_check SQL command SHALL return "ok" for a GeoPackage file.
- …
- **Req119:** A GeoPackage MAY contain tables or updatable views containing attribute sets. Every such Attribute table or view in a GeoPackage SHALL have a column with column type INTEGER and PRIMARY KEY AUTOINCREMENT column constraints per GeoPackage Attributes Example Table or View Definition

http://www.geopackage.org/spec120/?wb48617274=F5BA2B9E#_core

Geo

Data Type	Size and Description
BOOLEAN	A boolean value representing true or false. Stored as SQLite INTEGER with value 0 for false or 1 for true.
TINYINT	8-bit signed two's complement integer. Stored as SQLite INTEGER with values in the range [-128, 127].
SMALLINT	16-bit signed two's complement integer. Stored as SQLite INTEGER with values in the range [-32768, 32767].
MEDIUMINT	32-bit signed two's complement integer. Stored as SQLite INTEGER with values in the range [-2147483648, 2147483647].
INT, INTEGER	64-bit signed two's complement integer. Stored as SQLite INTEGER with values in the range [-9223372036854775808, 9223372036854775807].
FLOAT	32-bit IEEE floating point number. Stored as SQLite REAL limited to values that can be represented as a 4-byte IEEE floating point number.
DOUBLE, REAL	64-bit IEEE floating point number. Stored as SQLite REAL.
TEXT{(maxchar_count)}	Variable length string encoded in either UTF-8 or UTF-16, determined by PRAGMA encoding; see http://www.sqlite.org/pragma.html#pragma_encoding. The optional maxchar_count defines the maximum number of characters in the string. If not specified, the length is unbounded. The count is provided for informational purposes, and applications MAY choose to truncate longer strings if encountered. When present, it is best practice for applications to adhere to the character count. Stored as SQLite TEXT.
BLOB{(max_size)}	Variable length binary data. The optional max_size defines the maximum number of bytes in the blob. If not specified, the length is unbounded. The size is provided for informational purposes. When present, it is best practice for applications adhere to the maximum blob size. Stored as SQLite BLOB.
<geometry_type_name>	Geometry encoded as per clause Geometry Encoding. <geometry type_name> is one of the core geometry types listed in Geometry Types (Normative) encoded per clause 2.1.3 or a geometry type encoded per an extension such as GeoPackage Non-Linear Geometry Types. Geometry Types XY, XYZ, XYM and XYZM geometries use the same data type. Stored as SQLite BLOB.
DATE	ISO-8601 date string in the form YYYY-MM-DD encoded in either UTF-8 or UTF-16. See TEXT. Stored as SQLite TEXT.
DATETIME	ISO-8601 date/time string in the form YYYY-MM-DDTHH:MM:SS.SSSZ with T separator character and Z suffix for coordinated universal time (UTC) encoded in either UTF-8 or UTF-16. See TEXT. Stored as SQLite TEXT.

Geopackage - Extensions

- GeoPackage extensions that have been adopted by OGC
  - z.B. Tiled Gridded Coverage Data: ...defines how to encode and store tiled regular gridded data, such as a digital elevation model, in a GeoPackage.

- GeoPackage extensions that are not currently part of the GeoPackage Encoding Standard
  - z.B. 3D Tiles: ...represents 3D data in a GeoPackage using a relational data model in SQLite that mirrors the 3D Tiles spatial data structure.

http://www.geopackage.org/extensions.html

Geopackage - Extensions

To publish a new extension, fill out the extension template and let us know on the GeoPackage Mailing List.

Related Tables (see preface for template information)	This extension provides a mechanism for associating tables with existing feature or attribute tables in a GeoPackage. Among other things, it can be used to establish a many-to-many relationship between features and multimedia files. It was originally developed by Compusult and the plan is to test it during an upcoming OGC Interoperability Experiment.
3D Tiles	This extension represents 3D data in a GeoPackage using a relational data model in SQLite that mirrors the 3D Tiles spatial data structure.
QGIS Map Styling Information	This extension stores QGIS projects with their resources like images in print templates in a GeoPackage file.
Feature Tile Link	This extension creates a link between a feature and tile table. A tile table containing tiles that represent or were generated from features can be linked to the feature table. The link enables feature queries when dealing with tiles representing features.
Geometry Index	This extension defines a SQLite version agnostic way to index user feature table geometries by their bounding envelopes for fast ranged searches. Mobile implementations, including Android and iOS, use earlier versions of SQLite and can not rely on the R*Tree Module implementation. Each geometry in a feature table is indexed by it's geometry id and x, y, z, and m value ranges. The geometry index can be queried for fast retrieval of only geometries overlapping a desired envelope bounds.
OWS Context (GeoCat)	The main goal of the extension is to store context and styling of a mapping project as part of a GeoPackage file containing the data it refers to. The extension aims at similar use cases as presented in The USGS GeoPackage Styling Experiment in Testbed 12, however the approach is a bit different.
Aspatial Support (Legacy)	Support for aspatial data (ie. SQLite tables/views without a geometry column), potentially with associated metadata. This was used in GDAL 2.0 and GDAL 2.1, before the introduction of the 'attributes' data_type of GeoPackage v1.2. Starting with GDAL 2.2, 'attributes' will be used by default instead.
OWS Context (Image Matters) (Deprecated)	This extension, part of a joint effort between the GeoPackage SWG and OWS Context SWG, is an attempt to define an SQL-native encoding for OWS Context. It is incomplete, lacking a proper encoding for style information. It is in the process of being revised as part of the Vector Tiles Pilot.
Vector Tiles (Deprecated)	This extension allows vector tiles to be stored in a GeoPackage using the MapBox Vector Tiles approach but is in the process of being revised as part of the Vector Tiles Pilot.
User Defined Geometry Types (Deprecated)	Enables encoding of additional user-defined geometry types in ExtendedGeoPackageBinary format in an Extended GeoPackage. Removed from GeoPackage 1.2 due to interoperability reasons.
Geometry Type Triggers (Deprecated)	Geometry type triggers prevent the storage of geometries of types that are not assignable from the geometry types specified in the gpkg_geometry_columns table in the geometry columns of the specified tables. Removed from GeoPackage 1.2 due to interoperability reasons.
Geometry SRS ID Triggers (Deprecated)	Geometry SRS_ID triggers prevent the storage of geometries with spatial reference system identifiers that are not specified in the gpkg_geometry_columns table in the geometry columns of the specified tables. Removed from GeoPackage 1.2 due to interoperability reasons.

http://www.geopackage.org/spec/?wb48617274=BFC51E07#extension_template

Geopackage – Hackathon - Links

- Zu der verwendeten Software im WS
  https://next.agrarforschung.at/index.php/s/CNk9PKDCnDYQpKB

- http://www.geopackage.org/
- Geopackage Encoding Standard:
  http://www.geopackage.org/spec120/?wb48617274=F5BA2B9E#_core

- http://ngageoint.github.io/geopackage-js/?gpkg=http://www.geopackage.org/data/empty.gpkg