Arbeitsgemeinschaft der Vermessungsverwaltungen
der Länder der Bundesrepublik Deutschland

KLA Konferenz der Leiterinnen und Leiter der Archivverwaltungen des Bundes und der Länder

Guidelines

for the nationwide uniform archiving of geographic reference data

Final report
of the joint
AdV-KLA working group
“Archiving geographic reference data”

2014 – 2015, reviewed in 2021

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The guidelines are permanently available as a PDF document on the websites of the following organisations.

Geschäftsstelle der Arbeitsgemeinschaft der Vermessungsverwaltungen der Länder, presently:
https://www.adv-online.de/Veroeffentlichungen/Broschueren-und-Faltblaetter/Allgemeines/

Bundesarchiv, KLA sub-site, presently:
https://www.bundesarchiv.de/das-bundesarchiv/kooperationen-und-partner/kla/

Contents

1 Introduction

1.1 The development of these guidelines

At the level of the Laender, there has been a proven and effective cooperation for many years between the surveying and mapping authorities and the archive authorities with regard to the disposition of analogue products, particularly maps. In the context of this cooperation, some of the results of work in the field of surveying and geospatial information become archive material of lasting value. However, hardly any analogue products are being created at the surveying and mapping authorities. In 2015, the surveying and mapping authorities and the archive authorities therefore adopted joint guidelines for the archiving of digital geographic reference data.

This version of the guidelines represents the 2021 revision and expansion of the version published in 2015[1].

For this reason, the Working Committee of the Surveying and Mapping Authorities of the Laender of the Federal Republic of Germany (AdV) and the Conference of Directors of the Archive Authorities of the Federal Government and the Laender (KLA) appointed the original working group in 2013 to develop a document on a harmonised approach to archiving digital geographic reference data.

In accordance with the requirements of the document at the time, this working group was reconstituted five years later, on 29 June 2020, with a slightly modified staff under the leadership of the Landesvermessung und Geobasisinformation Brandenburg (LGB), in order to take stock of the results meanwhile achieved in the Laender and to incorporate the required changes and additions to the guidelines.

In fulfilling this task, the working group noticed a number of parallel developments in the areas of research data infrastructure, infrastructure for geospatial information (GDI-DE) and legislation on open data, which are addressed in various places of the text and presented in more detail in the outlook on the future.

1.2 Relationship to international standards

In 2014 – 2017, the International Standard ISO 19165-1:2018 “Preservation of digital data and metadata – Part 1: Fundamentals” was developed in ISO Technical Committee 211 at the instigation of the national surveying and mapping authorities and the Open Geospatial Consortium. Preliminary work had been carried out by a working group of EuroSDR (European Spatial Data Research). The present guidelines can be understood as a national version of this standard.

Where the guidelines deviate from the requirements of the ISO standard, the guidelines take precedence. In particular, ISO 29500-2 (Open Packaging Conventions) is not applicable.

[1] Guidelines for the nationwide uniform archiving of geographic reference data (2015): https://www.bundesarchiv.de/assets/bundesarchiv/de/Downloads/Erklaerungen/guidelines-geoarchiving-kla.pdf

It stipulates the ZIP standard for the packaging of data. The ZIP standard has a maximum package size of 4 gigabytes and does not fulfil the requirements of geographic reference data, the volume of which often amounts to 4 gigabytes. It is, therefore, not applicable.

The standards prescribed by the INSPIRE Directive and its transposition into German legislation are taken into account in these guidelines, in particular ISO 19115-1 and ISO 19115-2 (see section 3.1), GML (see section 2.4.2).

Although not yet established as a standard, the E-ARK Content Information Type Specification for digital geospatial data records archiving (CITS Geospatial)[2] of the DILCIS Board, a European association of archiving experts, can be regarded as a preliminary study for future standardisation. It is available in version 3.0.0 (August 2021) at the time of the revision of the guidelines and points the way towards a standardised definition of delivery packages. The German state archives did not participate in the development of this concept. The need for strict implementation is not currently perceived. However, the concept makes a useful contribution to the concretisation of the specifications in section 3 of these guidelines on metadata and in section 4.2.5 on packaging.

1.3 Purpose and contents of this document

Until the establishment of the Archiving Geographic Reference Data working group, there was no coordination between the individual federal Laender regarding the archiving of digital geographic reference data. The working group therefore identified products that are standardised in the surveying and mapping authorities throughout Germany. The only products not taken into account were the ones that are created by the federal government. Furthermore, one of the objectives of the working group was to define the formats and time cycles as well as the associated metadata for submission to the archives and to make them available to all surveying and mapping authorities and archives as a basis for a standardised nationwide procedure.

This document summarises all the issues that were developed by the working group members in 2014 and 2015 and also in 2020 and 2021 and which are a prerequisite for defining and applying a common strategy for archiving geographic reference data.

For the first time, this new edition considers the question of “significant properties”. This refers to those features and properties of the archived digital geographic reference data that must be preserved unaltered in the long term, i.e. across all migration cycles, in order to maintain authenticity and integrity (see chapter 5). The working group also endeavoured to discuss the problems of duplicate data keeping that occur in practice and to describe the scenarios identified (see chapter 7).

[2] https://dilcis.eu/content-types/cs-geospatial-data

The document thus serves as a guideline in the sense of a recommended course of action for a coordinated approach so that the digital archive material can be stored and utilised on a permanent basis in a way that is as homogeneous as possible across the Laender.

This document can therefore also be used as a recommendation for geographic reference data that is produced by the federal government and for which coordination is necessary between the Federal Agency for Cartography and Geodesy and the German Federal Archives.

The document was again submitted to the two delegating bodies (AdV and KLA) for approval.

The final report is divided into eight chapters and it consists of:

- an introduction;
- basic considerations regarding the archiving of geographic reference data;
- metadata on the processes involved;
- practical advice on offering and transferring geographic reference data;
- digital preservation of/for geographic reference data;
- notes on legal aspects of access to the archives of the federal government and the Laender;
- ways of cooperatively implementing the guidelines; and
- a closing outlook on the future.

The report additionally includes:

- a bibliography and a list of abbreviations;
- an appendix with the selection policy scheme agreed on, including a table with examples of metadata and data volumes and a list of the working group members.

In the chapters that follow, the recommendations for action in each section are presented in a box.

2 Basic considerations for the archiving of geographic reference data

2.1 Taking stock of the surveying and mapping authorities' geographic reference data

AdV defines the term "geographic reference data" as follows:

"Geographic reference data is data from official surveying and mapping that documents and describes the landscape, the real estate and the standardised geodetic spatial reference in a way that is not application-specific. It forms the basis for technical applications with a spatial reference." (Resolution 117/11 on agenda item 5.1 of the 117th meeting of the Plenum in Magdeburg on 28 and 29 September 2005.)

Geographic reference data can therefore exist in analogue or digital form. With regard to the working group's assignment, however, only digital geographic reference data will be considered in the following, without special reference being made to that fact in each case. This data comes in various technical formats and is generally designed for use in a geographic information system (GIS). A list of the selected products can be found in the Appendix. There were minor changes as part of the revision after 5 years.

2.1.1 AdV products

AdV products refer to such geographic reference data that is produced and updated nationwide for the whole area of Germany by the surveying and mapping authorities of the Laender – and by the federal government in individual cases – according to uniform standards and rules. These products are generally described in detail in product sheets. These also include information about the standards and rules behind the production of the products.

All the product sheets on the AdV products covered below can be found at www.adv-online.de, which takes you to the AdV homepage.

AdV can only make regulations for the products it is responsible for. All further considerations therefore concentrate solely on AdV products that have been deemed of archival value both by the surveying and mapping representatives and by the archive representatives following a vote at the workshops.

2.1.2 Discontinued products

Although the discontinued products are AdV products that are still available in individual surveying and mapping authorities, they are to be regarded as discontinued and are not being updated any longer because of the changeover to the AAA data model (AFIS®, ATKIS®, ALKIS®: details about this are also to be found on AdV's web pages). In the real estate cadastre field, these products ("precursor products") comprise ALK and ALB data (superseded by ALKIS®). In the field of geotopography, the products Basis-DLM (in the "old" data model) and the preliminary edition of the Digital Topographic Maps (DTK-V) belong to this group.

AFIS® has replaced the control point products in the spatial reference category.

Since the migration or AAA implementation took place at a different time in each of the Laender, the working group recommends taking into account also discontinued products as well as products which will be discontinued in the future or no longer continued after a certain cut-off date.

It is recommended, as far as possible, to transfer at least the most recent updated version of the discontinued products. Furthermore, additional earlier time slices of the discontinued products can be transferred to the archives if they are available, if this is feasible in technical terms and if the archives are interested in acquiring this data.

These data submissions are to be arranged bilaterally.

As a general rule, the working group is in favour of precursor products being transferred as far as possible.

Apart from this, the working group does not regard discontinued products as part of its assignment.

2.1.3 Land-specific peculiarities

Beyond the minimal solution of joint products of archival value, in the individual Laender there are large quantities of additional geographic reference data or geospatial data that is provided via file-based interfaces or web-based services and that is likely to be of archival value from a regional point of view (e.g. Digital Topographic Map 1: 10,000 [DTK10], which is not produced in all Laender). Regarding its archiving, bilateral arrangements are necessary between the surveying and mapping authority and the archive of the Land in question.

If additional geospatial and geographic reference data is maintained on individual Laender level or at the federal level, the working group recommends making a decision about its archiving on the basis of this document.

To this end, a separate list of products can be compiled. In keeping with its assignment, the working group has not addressed the possible contents of such a list.

2.2 Appraisal principles for the products

A prerequisite for the organised acquisition and archiving of digital data in the archives concerned is the decision as to which data is to be classed as having archival value. For this purpose, the working group developed a recommendation as to which kind of geographic reference data should be preserved permanently at the archives and which kind can be destroyed, i.e. deleted, once the retention period has expired (see selection policy in the appendix). In drawing up this recommendation and weighing up the selection choices, the working group considered criteria related to both contents and form.

2.2.1 Overarching criteria

Using appraisal criteria, the working group selected the geographic reference data files of lasting value from a historical perspective. Criteria that played a role here were the greatest possible scope for analysis and the widest possible coverage of space and time. In this way, the working group took into consideration in its appraisal the probably very broad range of interests of future archive users.

The working group here identified two main groups of potential users: firstly, there is the group of users with local interests (e.g. local history researchers), who primarily wish to examine a particular small area of land regarding its condition at some point in the past. These currently comprise the majority of users of the archives.

Secondly, there are scientific and academic users with regional or cross-regional interests. This group pursues the aim of selecting geographic reference or geospatial data over a wide area, or of analysing segments of it but with great attention to detail. Examples include archaeologists, civil engineers, demographers, monument conservators, geologists, historians, urban planners, economists, social scientists, etc.

Being able to serve these different key interests in the future in a way that is as suitable as possible to the applications was one of the main intentions in formulating the selection choices related to contents.

In addition, there was the criterion of avoiding redundancies. For example, the working group generally classified those products that are merely derived from other products (e.g. as in the case of the Digital Landscape Model 1:50,000 [DGM50], which is derived from the Basis-DLM) as being less important.

2.2.2 Individual criteria for the lasting value of geographic reference data

Taking these overarching aspects as a starting point, individual criteria were named, on the final weighting of which the individual appraisal was then based.

The following qualities have been defined as criteria for archival value:

- high relevance of contents;
- greatest level of detail within one product group (largest scale, greatest ground resolution);
- usefulness in exploring other geospatial data (digital cadastral map, digital topographic maps [DTK], orthophotos [DOP]);
- milestones in the history of technology (e.g. first flight for ATKIS®-DOP40).

Criterion that limits the value for permanent preservation:

- geographic reference data that constitutes derivations or generalisations of other data (e.g. digital terrain models with derived raster sizes such as DGM25, DLM50).

In making the selection choices, the working group kept in mind the costs and expenditure that arise particularly in the case of large data quantities being acquired, processed and made available.

2.3 Temporal and spatial object definition for geographic reference data

This chapter describes the criteria according to which the working group examined the AdV products with regard to their temporal and spatial extent.

2.3.1 Submission in time slices

For the kind of geographic reference data that is kept in technical applications (databases) the working group decided to archive the contents of the storage systems at regular intervals on a specific date. Acquiring so-called time slices is the most suitable solution for very large information systems that are subject to constant change.

Generating time slices can also be useful for databases that are periodically updated. An example of this is orthophotos, which generally constitute the results of several years of flight cycles. In this context, it makes sense to acquire the complete data upon completion of the flight cycle even though the individual orthophotos document completely different points in time.

The intervals at which geographic reference data is to be archived were determined taking into consideration the rates of change and the storage requirements of each of the products. They are intervals of five, ten or twenty years.

Details of the practical implementation can be found in chapter 4.2.

2.3.2 Information on the up-to-dateness of AdV products

For the question as to the intervals and points in time at which geographic reference data is to be offered to and acquired by the archives, the criterion of “up-to-date” is of central importance:

“Up-to-date is a quality feature of geospatial data and covers the temporal validity of data regarding: the point in time at which it was created, how up to date the data is and the time period in which the data is valid.”[3]

A product being up-to-date depends on how promptly existing changes on the earth’s surface are incorporated into the product and are available to the users. The product “Digital Orthophoto” for example, can be assigned definite up-to-dateness. Its being up-to-date corresponds to the date on which the underlying aerial image was taken. The up-to-dateness of the image is assigned to the individual DOP tile using metadata.

[3] https://www.geodaten.niedersachsen.de/startseite/allgemeine_informationen/glossar/glossar-137718.html#A

This statement generally also applies to digital terrain models (DGM); their being up-to-date corresponds to the time of the flight if data is created in this way on a large scale through laser scanning and if that data is then used to generate the DGM. The statement needs to be qualified, however, in cases where a DGM is updated on a small scale by means of local topographic measurements or the stereoscopic analysis of aerial images.

Things are more complicated when it comes to identifying the up-to-dateness of a segment of land from the ALKIS® data. Although the structure of the data model is designed to allow each object to be assigned a lifetime span (with the beginning and end of the lifetime), many objects bear the migration date (date of data transfer to ALKIS®) as the beginning of the lifetime, meaning that the "beginning" does not allow any conclusions to be drawn as to when the data was actually created. The ALKIS® database is updated on an ad hoc basis, i.e. not necessarily at the exact point in time at which a spatial change occurs.

While the update for a segmentation of plots of land (e.g. for construction purposes) is carried out promptly, the update resulting from a change in the building inventory on a particular site will, in many cases, depend on whether and when the owner of the building meets their obligation to arrange for the newly erected building, which is to be documented in the real estate cadastre, to be surveyed. The time at which very large areas (e.g. changes to the coastline) are updated depends not least on the extent to which staff is available to handle this matter.

It is therefore impossible to make a general statement on a segment of land being current. Instead, the term "updated daily" is resorted to. This merely expresses that this product is updated day by day.

A similar situation applies to the ATKIS®-Basis-DLM database. At AdV. a differentiation is made here between basic up-to-date and top up-to-date.

For top up-to-dateness, the most important object, attribute and value types of the ATKIS®-Basis-DLM are checked in graduated update periods of 3, 6 or 12 months, and updated in the event of changes. Top up-to-date covers the period from the emergence of the change in the landscape to the discovery, procurement, preparation and incorporation of the information into the existing database to the release of the updated database. For top up-to-date, there is a list for the objects and attributes in the Basis-DLM in connection with the current GeoInfoDok 6.0 dated 10 May 2021.[4]

All objects not listed there should be updated at intervals of no more than five years (basic up-to-date).

Determining whether the DTK is up-to-date is also difficult. The metadata item "up-to-date" here relates to a processing unit (a tile, for example, based on the analogue map sheets).

[4] http://www.adv-online.de/GeoInfoDok/GeoInfoDok-6.0/broker.jsp?uMen=d3b70780-c5f2-bc61-f27f-31c403b36c4c

The objects depicted in the DTK come from the vectorial ATKIS®-DLM database. In general, the metadata item of a DTK tile merely states when this segment of land was generated as a DTK. It is therefore only indirectly possible to make a statement about the contents being up-to-date.

2.3.3 Spatial delimitation of the product deliveries (portioning and packaging)

One challenge in the long-term archiving of geographic reference data results from the discrepancy between the demand for the completeness of a geospatial database and the necessity to divide the volume of data into individual packages (AIPs) for the purpose of archiving it. For active use, a complete, seamless mapping may guarantee better manageability and simpler combination options.

When it comes to archiving, however, this completeness is a disadvantage, because it requires keeping very large data quantities in active storage or in individual processing packages. For long-term storage, it is more sensible and sometimes even essential to create portions that are delimited according to administrative borders or arbitrary rasters and that only return to the active storage when required. Portioning may also be necessary to facilitate the billing of fees and to make it easier to process operations for preserving the data.

Since, as a rule, all products are available by now for the whole country and in seamless form, the surveying and mapping authorities have determined the type of portioning (the length of one side of the land segments) with which the data is supplied. In this case, the recommendations are based on the amount of data resulting from each product and the technical capabilities that the receiving system can be assumed to have. The total amounts of data of the individual products are recorded in the selection policy (see appendix) in an exemplary form, but they can also be calculated for particular sizes of tile.

It is recommended that the same standardised tiling used by AdV for supplying the products also be used when archiving them. For example, for reasons of capacity, arranging the DOP in 2 x 2 km tiles has proven to be a good option. Added to this is the fact that the metadata has also been recorded on the basis of the same tile size.

In accordance with ISO 14721, when transmitted to the Land archive, the packages are called Submission Information Packages (SIP) when they are acquired, Archival Information Packages (AIP) when they are stored, and Dissemination Information Packages (DIP) when they are in use.

2.4 Selecting formats for transfer

This chapter describes which technical formats have been determined for products being archived. The details can be found in the selection policy in the appendix.

2.4.1 General requirements regarding archival formats

For the permanent preservation of digital data, it is necessary to archive the historical data in a format that can be stored on a long-term basis and used with standard hardware and software in order to enable the most comprehensive and reliable preservation possible. The basic principles for this are explained in section 5 “Digital Preservation of the Database for Geographic Reference Data”.

The decision on a preservation format must always be made individually for each database to be transferred. As a result, however, the working group's considerations on format requirements could often be applied to entire product groups.

The preservation perspective of formats also includes the secure availability of the specifications in the future. All stakeholders should therefore emphasise the importance of keeping not only the geospatial data but also the data specifications permanently available.[5]

2.4.2 Vector data

The Esri Shapefile, the Geographic Markup Language (GML) profile “Norm-Based Exchange Interface (NAS)” and generic GML were debated as formats for vector geometry data.

The working group decided against recommending Esri Shapefile as the standard preservation format. Compared to more highly developed formats, Esri Shapefile has the following deficiencies:

- the lack of an option to display point-to-point connections (topologies);
- the lack of an option to display arcs;
- the multiplication of individual files when it comes to geographic themes with many feature types (an Esri Shapefile level consists of up to seven individual files);
- no national or international standard, but rather a company standard.

By contrast, all the participants consider the GML format to present great opportunities. This language can be specified and adapted in so-called “profiles”, the simplest of which is the so-called “Simple Features” profile. For Germany, this standard has been implemented in the form of the GML profile NAS for the AAA schema and thus as the standard interface for AdV products.

After careful consideration, the working group is in favour of weighing, as a rule, for the NAS format when it comes to AdV products in a vector data format. If this format is not available for submission, Esri Shapefile or GML Simple Features should be submitted

[5] The Landesarchiv Baden-Württemberg provides corresponding specifications to supplement its acquisitions, which can be accessed via permalinks: http://www.landesarchiv-bw.de/plink/?f=2-5957299. The scope of the specifications was agreed with the AAA office at the Landesamt für Digitalisierung, Breitband und Vermessung in Munich as far as they concern the AdV. The specifications can be passed on to other organisations.

(e.g. for Official Building Polygons). If only point geometries are submitted, supplying CSV tables is sufficient.

The open, standards-based and platform-independent GeoPackage format has increasingly established itself as an exchange format for mobile applications in recent years. Both vector and raster data can be transmitted. In the event that GeoPackage becomes widespread in Germany as a new storage form of GML, in which the data is NAS-compliant but is no longer stored in XML code but in SQLite tables, the archiving capability must be checked again. Presumably, however, archiving vector data in GeoPackage format is not critical, as the SQLite[6] container format has been in use for almost two decades.

When dealing with NAS, it is important to note that the format is not easy to use. NAS is a standard exchange format established by the AdV, which can also be recommended as a preservation format for digital archiving. According to its original purpose, however, it is not a format directly suitable for use in a GIS. Smaller amounts of data can be read directly into a GIS, but extensive datasets (e.g. an extract from the data stored in the ATKIS®-Basis-DLM and covering all of Germany) cannot be interpreted with sufficient performance in this way. Rather, in these cases it is necessary to first re-import the NAS data into a geospatial database without loss of information or to migrate it to a “flat” application format (e.g. Shapefile) with loss of information.

The adequate usability of NAS data will depend on whether it can be successfully transferred back to a target system. To do this, the data must be mapped to the data schema of the target system (mapping). If no schema is available, one must be modelled first. The working group therefore recommends archiving the AAA data model or a suitable derivation thereof in machine-readable form so that it can be reused in computer-aided automatic procedures for schema modelling and data mapping.

One example[7] of the complete transfer of data back to a target system is the free software "PostNAS Suite". It was developed by NAS users and offers a solution for importing NAS data (ALKIS®, ATKIS®) into a PostgreSQL database. For the automated creation of the database schema, the PostNAS suite uses a data structure created from the NAS implementation schema. The NAS implementation schema is a derivation of the AAA data model that has been “optimised” for implementation in GML. However, as the case of application shows, it is sufficient for creating a database schema that contains all object types, attributes and characteristics of the AAA data model.

[6] https://sqlite.org/about.html.

[7] Kindly pointed out by Mr Oliver Schmidt, Landesamt für Vermessung und Geobasisinformation Rheinland-Pfalz.

The NAS implementation schema is currently described in the Unified Modelling Language (UML) and provided by the AdV.

How the utilisation process of NAS data will be clearly organised in the archive is left to the individual archives. Scenarios are conceivable here in which the archive generates or stores usable data formats as required, as well as scenarios in which the data preparation of the NAS databased is left to the users themselves.

2.4.3 Raster images

There are currently two main format variants available to archives for raster data from imaging processes.

The Tag Image File Format (TIFF) is widely used. Although not an ISO standard, the format, which has been stable since 1992, has proven to be robust, easily accessible and comparatively simple to use in archiving practice. Nevertheless, TIFF also has some disadvantages that could be an argument in favour of choosing a different format:

- With uncompressed storage (1 pixel = a fixed number of bits), uneconomical data volumes are quickly reached.
- The compression standards permitted in TIFF for the contained image data (with loss of information like JPEG or lossless like LZW) are not very up-to-date and unnecessarily increase complexity.
- As a standard, TIFF recognises so many variants that validation software can be overstrained.

As an alternative to TIFF, archives currently favour the JPEG2000 format in its lossless compression version. JPEG2000 is openly accessible as ISO standard 15444 and offers significantly better compression options than TIFF, particularly for archiving photo data. However, JPEG2000 is nowhere near as widespread outside the archiving world as TIFF, which makes technical processing (slightly) more complicated.

The working group considers both variants to be equally suitable for archiving raster data:

- TIFF without compression or with lossless compression
- JPEG2000 with lossless compression[8]

A significant property of digital geographic raster data is spatial referencing (see 5.4 “Significant properties for geographic reference data”). It therefore goes without saying that frame coordinates (bounding boxes) are provided with every geospatial data package.

These can be supplied either by entries in the file header (for the so-called GeoTIFF) or by files of the same name with the extension “XXw” (XX for two letters of the respective format abbreviation, e.g. tfw or j2w).

Both JPEG2000 and TIFF as well as JPEG (ISO 10918-1) can be georeferenced using the latter method, known as World File, which is why this georeferencing method is recommended.

Irrespective of the question of the data format, the question of how to deal with the considerably growing data volumes from remote sensing in the future (e.g. infrared channel, more colour values per channel, higher ground resolution) remained open in the workshops of the working group. With regard to both the raster data format and the compression algorithms, all Laender should closely follow technical discussions in the surveying and mapping as well as archiving sectors and, if necessary, initiate format migrations or changes to the delivery specifications.

2.4.4 Data tables, point geometries, non-pictorial raster data

For data tables, point geometries (e.g. fixed points) and non-image raster data (e.g. DGM), the working group decided in favour of the established standards CSV and ASCII (fixed-width format). The fields and tables should be described in an XML document; text documents are permitted as an alternative.

The reference for valid CSV is the IETF RFC 4180[9] standard recommendation. If fixed-width formats are available, these should be supplemented by unique field separators (e.g. comma or semicolon).

[8] For reasons of economy, the use of formats that utilise compression which is prone to loss of information should also be discussed. TIFF and JPEG2000 with corresponding compression or JPEG in its highest quality level could be considered for this. However, the working group has not yet developed a uniform position on this

[9] https://tools.ietf.org/html/rfc4180.

2.4.5 Accompanying text documents

For text documents, e.g. metadata that describes the data transfer, the options are the PDF/A-1 (1a and 1b) and PDF/A-2 (2a, 2b and 2u) formats. The choice of the specific version is to be clarified bilaterally. PDF/A-3 and -4 are not permitted.[10]

2.4.6 Transmission containers

In some cases, large quantities of data will require the use of container formats. Such container formats additionally make it possible to check the integrity of the files contained using checksums. ZIP and TAR/GZIP are suitable for this.

2.4.7 Coordinates for spatial referencing

In any of the individual Laender and with discontinued products, it may still happen that coordinates are submitted to the archives using Gauss-Krüger mapping (GK). In connection with the migration of the data from the old data models to the AAA data model, the AdV decided in 2004 to make a position reference to ETRS89/UTM. As early as in 1991, the AdV decided to introduce the European Terrestrial Reference System (ETRS 89) for all surveying and mapping as well as cadastral tasks. The Universal Transverse Mercator Projection (UTM) was set to be the mapping system. Therefore, UTM is now the prevalent mapping system for spatial referencing in Germany.

From the user's point of view, the geodetic datum (ETRS89/Bessel) as well as its EPSC code[11] should be specified in the metadata.

The archives acquiring the data seek to configure their catalogue systems in such a way that the coordinate systems used can be seen as early as during the research.

[10] See KLA-Ausschuss Digitale Archive, Empfehlungen zur Anwendung von PDF/A bei der Aufbewahrung elektronischer Unterlagen in Behörden und Gerichten. Version 1.1 (Juli 2017), https://www.bundesarchiv.de/assets/bundesarchiv/de/Downloads/Beitraege/pdfa-aufbewahrung-elektronischer-unterlagen.pdf

[11] The EPSG codes, invented by the European Petroleum Survey Group Geodesy, are maintained by the International Association of Oil&Gas Producers. https://epsg.org/home.html.

2.4.8 Summary

Type of information	Format
Vector data	▪ Norm-based exchange interface NAS, in the form of NBA (if available), e.g. ALKIS® and ATKIS® ▪ CSV (if there are point geometries only) ▪ Esri Shapefile or GML Simple Features (if no NAS format is available)
Raster images	▪ TIFF (either uncompressed or with lossless LZW or CCITT Fax 4 compression), e.g. DTK and DTK-V ▪ JPEG2000, losslessly compressed, e.g. DOP ▪ All raster images should always be supplied with coordinate frames using the World File method
Data tables, point geometries, non-pictorial raster data	▪ CSV (comma-separated values) in accordance with IETF RFC 4180[12] ▪ XML-based description of the table and its fields, alternatively text document
Accompanying text documents	▪ PDF/A-1 or PDF/A-2 in coordinated form
Transmission containers	▪ ZIP ▪ TAR/GZIP
Coordinates	▪ Universal Transverse Mercator Projection (UTM) ▪ Gauß-Krüger (GK)

Table 1: Overview of the formats to be used

[12] https://tools.ietf.org/html/rfc4180

3 Metadata in the processes involved

3.1 Use of the metadata standards ISO 19115-x

Geographic reference data, like most other digital objects, cannot be interpreted in a completely authentic or correct manner without additional data. Geographic reference data that is to be archived should therefore be provided with metadata, which is a prerequisite for understanding, preserving and searching it and for recombining it with other data.

In this case, metadata is understood to mean data that serves the purpose of describing, preserving or managing geospatial data and that is compiled by the surveying and mapping authorities in a standardised, machine-readable form.

The metadata standard for geospatial data, ISO 19115-x, distinguishes between two parts: Part 1 from 2014 (ISO 19114-1:2014) basically describes geographic information and associated services. Part 2 from 2019 (ISO 19915-2:2019) deals with extensions for the collection and processing of geospatial information.

When archiving geospatial data, the first part of the standard, i.e. ISO 19115-1[13], is decisive. The working group recommends that the surveying and mapping authorities always supply the complete dataset in accordance with the AdV metadata profile for the sake of consistency. It is the role of the archives to decide how this metadata is handled and how it can be used for further archiving (see the selection scheme in the appendix, here: “Metadata” spreadsheet).

Besides metadata, accompanying information material should also be supplied, e.g. text documents (such as product sheets and format specifications) or videos (as training assistance).

3.2 Proposal of selected metadata for acquiring and making geospatial data available

The following list contains a small selection of the metadata that either comes from ISO standard 19115-1 (“ISO Metadata”) or that is needed for the acquisition process.

For readers from the archival field, it serves above all to familiarise them with the most important metadata from the surveying and mapping authorities. This metadata is marked with ISO/INSPIRE, which refers to the ISO standard and the European Geospatial Data Access Directive.

[13] German translation at https://www.gdi-de.org/download/2020-03/Deutsche_Uebersetzung_der_ISO-Felder.pdf

For surveying and mapping experts, on the other hand, the data of primary interest is the remaining metadata that serves the purpose of preserving and managing the archived data. This data is always given at the beginning of the list.

The explanations are selected in such a way that both the surveying and mapping authorities and the archival services can develop an understanding of the metadata.

3.2.1 The metadata most important for cataloguing and use

- Number of files contained
- Title (ISO/INSPIRE): designation by which the resource is known
- Alternative title (ISO/INSPIRE)
- Author (ISO/INSPIRE): the submitting authority (surveying and mapping authority)
- Dates (ISO/INSPIRE) of creation, publication or revision of the resource
- Date of issue (ISO/INSPIRE): for publication
- Bounding box of the resource (ISO/INSPIRE): Extent (frame of the package defined by two pairs of coordinates) or (if frame not definable) coordinates of central point and extent
    - Note: For archival cataloguing systems, it may not always be the case that coordinates can be processed conveniently during a transition period. If location information is available (e.g. place names for DTK25) it is a good idea to add it to the packages to facilitate a large-scale search even without the use of GIS. These tools are unnecessary if the coordinates are processed in the catalogue system and a gazetteer is connected that allows spatial queries.
- Spatial representation (ISO/INSPIRE): term for vector, raster or grid data type
- Spatial resolution (ISO/INSPIRE): level of detail, specified by a scale number or ground resolution

3.2.2 The metadata most important for transmission

- File sizes for validity checks
- Biunique filename with restricted length
- Checksums: for the data transmitted; possibly covered by container formats
- Estimated size of a delivery unit
- Contact for the resource (ISO/INSPIRE): submitting authority

3.2.3 The metadata most important regarding data structure and significance

- Descriptions of the individual fields of the technical feature attributes
- Purpose and revision (ISO/INSPIRE)
- Theme (ISO/INSPIRE)
- Temporal extent (ISO/INSPIRE)
- Details of use (ISO/INSPIRE)
- Quality report (ISO/INSPIRE): information on the positional accuracy and completeness of the product
- Updating (ISO/INSPIRE): when the next update will be conducted

3.2.4 The metadata most important for digital preservation

- Decompression method (ISO/INSPIRE): compression algorithm for geographic reference data[14]
- Presentation form (ISO/INSPIRE)
- Production environment (ISO/INSPIRE): e.g. software, operating system
- Designation of data format (ISO/INSPIRE): description of the format used by the distribution point

[14] This specification refers to data streams of geospatial data objects, not to the delivery as a whole.

4 Practical advice on offering and transferring geographic reference data

4.1 Model procedure for the disposition of digital records

The disposition of electronic records from official bodies is typically performed in four steps (called the four-stage process):

Stage 1:

Offering: The submitting authority sends a disposition list to the competent archive, indicating which electronic records (digital data) are to be disposed of.

Stage 2:

Appraisal: The competent archive decides which parts of the data offered are of archival value and which can be destroyed.

Stage 3:

Preparing for submission: The digital data marked as being of archival value is processed by the submitting authority, ready for transfer to the archive. To this end, the data, the metadata necessary for its interpretation, and the available documentation material on it are exported from the storage system of the submitting authority in a form and structure agreed on in advance and formed into a submission package (SIP). The contents of the submission package are described by the submitting authority in an electronically recorded submission index.

Transfer: The submitting authority transfers the digital data of archival value to the competent archive. The archive is notified of the transfer by means of a submission index listing the data to be actually transferred. Once the transmission path and, if applicable, the data storage device to be used (hard drive, DVD, USB flash drive, magnetic tape, etc.) have been agreed on, the submission package is forwarded to the archive. The archive confirms receipt of the package and confirms the completeness and integrity of the digital data it contains.

Stage 4:

If the digital data transferred is intended for deletion at the authority, the authority must not delete the data disposed of from its own system until the archive's confirmation of receipt has come in.

For geographic reference data, the working group has already defined the archival value for individual products by means of a selection policy. Time slices and data formats were also taken into consideration here (see selection policy scheme in appendix). This means that process steps 1) and 2) can be omitted as a rule. The result is a shortened transfer process in which the geographic reference data can immediately be processed by the surveying and mapping authority ready for transfer delivery to the archive.

Specifically, this means that any metadata the working group has agreed on in advance (see chapter 3) can be prepared and additional accompanying documents added to the data package (SIP). The actual datasets are exported from the storage system and combined with the metadata and relevant documentation material to form a submission package. In a final step, the archive receives the data from the surveying and mapping authority by means of a data storage device. Following a thorough inspection of the data by the archives, a confirmation of receipt is issued.

Once the confirmation of receipt has come in, the responsibility for deleting the data supplied or for using it for further in-house purposes lies with the authority having submitted the data. In this context, both legal aspects (data protection, obligations for secrecy and/or deletion) and economic aspects are to be taken into consideration.

In each case, the disposition process should be fully clarified in advance in a bilateral agreement between the surveying and mapping authority and the archive, so that only the details are left to be clarified for each disposition.

4.2 Questions to be clarified when an AdV product is submitted for the first time

When an AdV product is submitted for the first time, the two parties should agree on the time at which the digital objects the product is based on are to be transferred to the archive in the form of digital data. This time is generally set according to the dispensability of an object. For AdV products that consist of a great many individual objects and are maintained in databases, it is generally not possible to precisely define the moment of dispensability (see chapter 2.3.1 for details on this).

Instead, so-called time slices are formed, containing both very up-to-date and very old objects.

Regarding the time of transfer, the following variants are possible:

1. Export and transfer of the data immediately in the year fixed according to the regular schedule for the origination or formation of a time slice (see selection policy scheme).
2. Export of the data in the year fixed according to the regular schedule, but: further storage on data storage devices of the submitting authority. Transfer of the objects to the archive after a period of time to be agreed on with the archive. This is particularly useful if the archive still has initial difficulties in accepting data.
3. Export and transfer of the data only after a period of time to be agreed on with the competent archive. This requires that the object selection or time slice for the year fixed according to the regular schedule can be authentically restored retrospectively!

The below example dates are given for the different variants.

Variant	**Date of time slice** specified by the selection policy	**Date of export** variable, very technology-dependent	Date of transfer variable
Variant 1	2010, 1 January	2010, 3 January	2010, 18 January
Variant 2	2010, 1 January	2010, 3 January	2019
Variant 3	2010, 1 January	2019	2019

Table 2: Comparison of export variants

Here the working group recommends variant 1, i.e. the immediate transfer of the data from the surveying and mapping authorities to the archives in the year fixed in accordance with the selection policy.

The commitment to one variant goes hand in hand with when the digital data submitted can be used and passed on in accordance with the regulations of the relevant archive law. See information on this in chapter 6.

4.2.1 Setting the exact time of the time slice

The working group has decided to stipulate the same time slices for data submission to the archives in all of the Laender so as to maintain the homogeneity of nationwide map series.

Submission is made on the basis of the current GeoInfoDok reference version decided on by AdV (in 2022 that still is GeoInfoDok version 6.0 – resolution 120/2 of the AdV Plenum from the year 2008).

The year of the first data delivery is left up to the Laender, but it should be made as early as possible.

The following time slice dates should always be adhered to:

always on 1 January

- for a 5-year cycle: 2010, 2015, 2020 …
- for a 10-year cycle: 2010, 2020, 2030 …
- for a 20-year cycle: 2020, 2040, 2060 …

Any more extensive agreements should be made at the bilateral level.

For basic considerations on this, see chapter 2.3.1.

4.2.2 Deciding on the creation of filenames

In order to make further processing of the acquired data in the archives easier or even possible in the first place, it is necessary to establish conventions for creating the filenames that are to be used. In particular, biunique filenames should be used whose length and encoding do not exceed the file systems' specifications (e.g. no §%*.? characters, etc., no umlauts, file names max. 80 characters long).

If possible, the original AdV file names should be retained.

4.2.3 Portioning the submission

Since it can be assumed that the geographic reference data to be supplied will need to be divided into numerous sub-portions/tiles – for practical reasons in many cases, but also for the sake of better usability – a decision should be made as to the way in which this is done. The following options are possible:

- acquiring the data in the traditionally used map sheets (e.g. for DTK);
- acquiring the data in a specific tile size (e.g. vector data such as ALKIS® or ATKIS®-Basis-DLM);
- transferring the data at the level of administrative districts (e.g. export exactly up to the administrative border or using a rectangle that encloses the administrative district).

The choice of the appropriate divisions should be guided not least by the resulting file sizes.

The standard procedures of the surveying and mapping authorities[15] lend themselves to replication. The choice of procedure should be documented.

For basic considerations on this, see chapter 2.3.3.

4.2.4 Packaging the submission

An individual submission package (SIP) usually consists of the following components:

- primary data (= geographic reference data in the stricter sense);
- metadata to describe the data submitted (metadata in accordance with ISO standard 19115-1:2014 – see chapter 4 and appendix);
- accompanying documentation material (process documentation/description, training material, set-up instructions, guidelines/directions for use, etc.).

It should be agreed with the archive acquiring the data as to how exactly the entire submission package or the individual packages contained is to be configured.

[15] As an example, please refer to the technical guidelines for the data exchange of the ATKIS®-Basis-DLM: https://www.adv-online.de/icc/extdeu/nav/f80/binarywriterservlet?imgUid=25419114-249e-4711-1fea- f5203b36c4c2&uBasVariant=11111111-1111-1111-1111-111111111111

4.2.5 Deciding on the relationship between metadata and file objects

Metadata can be directly attached to each individual file object as an XML file; alternatively, it can be supplied in a list for the entire submission package referring to each of the objects contained. In the latter case, an agreement should be reached as to which biunique identifier can be used to match the metadata with the file objects.

The working group recommends a bilateral advance agreement with the archive acquiring the data so as to clarify the metadata transfer.

4.2.6 Deciding on the compression method

Owing to the sometimes quite substantial extent of the data volumes to be transmitted, ZIP or TAR/GZIP is recommended as the packing/compression method to be used.

4.2.7 Deciding on security features for unaltered and secure transmission

In order to guarantee the data security and integrity of the data to be transferred, and to be able to check this once the archive has acquired it, security features need to be agreed on, such as:

- checksum / hash value creation;
- encryption methods;
- digital signature (only when requested by both parties).

The working group agrees that the data to be transferred do not need to be digitally signed. Rather, it is sufficient if several security measures are implemented when the data is transferred and received, such as the checking of checksums / hash values, in order to rule out manipulation and prevent any falsification. The data can be transferred to the archives in encrypted or unencrypted form.

A transparent approach to the process of ensuring authenticity and integrity, including its long-term documentation, increases the level of trust in the data producer and the archive.

4.2.8 Agreeing on the future submission procedure

A written agreement between the surveying and mapping authority and the archive in question should be used to establish which of the arrangements made in this way are also to apply to future dispositions and therefore do not need to be agreed on again each time.

4.3 Points to be agreed on for each submission of an AdV product

Even if all the major features and process steps have been agreed on for the long term in the way described above, it is advisable for the submitting authority to contact the archive in good time for all further dispositions.

4.3.1 Deciding on the time of transfer

Because of the sometimes considerable amounts of data, the precise time of transfer, in particular, needs to be agreed on between the submitting authority and the archive each time.

Especially in the case of extensive data deliveries, the archive must have the time to make the necessary resources available for storing the data.

4.3.2 Deciding on the transmission path

For data security reasons and also owing to the quantities of data, it is not possible to simply transmit the data to be delivered in the typical way (e-mail). For this reason, the transmission path should be agreed on between the submitting authority and the archive. Since the basic conditions for this are constantly changing, this question should be considered anew for each submission.

Possible options include:

- secure connection;
- external hard drive;
- optical data storage device;
- FTP service.

5 Digital preservation of geographic reference data

5.1 Digital preservation

In abstract terms, the aim of electronic (long-term) archiving is to preserve digital information objects for long-term use[16]. An information object can be defined as a statement ("content") that is transported by a medium (the data object, i.e. usually one or more files including the metadata required to interpret them) and that can be interpreted using hardware and software. The usability of an information object depends on the precisely harmonised interaction of the file objects and the technical interpretation environment. This is jeopardised by technical progress, e.g. by the fact that a certain file format loses importance due to a better, new development, and that suitable display programmes are gradually no longer available.

A simple, practical example that has nothing to do with geographic reference data: An archived silent film (the information object) is made accessible by playing the film reel (the data object) with a film projector (the hardware). The usability of the information object is jeopardised by the decay of the data object at some point (film rolls do not last forever) or the dwindling availability of suitable film projectors. The archive in charge must intervene to prevent the complete loss of information.

The method currently favoured in the archiving world to counter this danger is the so-called migration strategy[17]. It is based on the approach of continuously converting information objects in the form of data objects that are becoming obsolete and therefore outdated into new, more modern data objects that are as long-lived as possible.

For the example of silent film, this could mean that the film reel, which is still just readable, has to be transmitted into a digital data format with the help of special technology. A new "video file" data object is created from the old "film reel" data object. This video file is the first digital representation of the silent film and can (or must) also be played in a completely different technical interpretation environment. As soon as the video format of this first digital representation becomes obsolete at a later point in time, the information object must be migrated again so that another representation is created.

[16] An information object is information in a delimited form. See nestor-AG Digital Preservation: Guidelines on digital data preservation. Version 2.0. 2012, p. 22 and 70 https://d-nb.info/1047612364/34

[17] The diametrical opposite of format migration (adaptation of old data to new environments) is emulation (adaptation of the new software environment to old data), which appears to be less applicable for geospatial data.

The aim of this form of preservation is to keep the “content” of the information object as unchanged as possible. The biggest problem here is the fact that every conversion of a data object also has more or less serious effects on the information object itself and on its utilisation options.

Here a simple example: A file format from an old word processing programme that is becoming obsolete is converted to PDF. The new PDF document contains the same text, but can, for example, no longer be edited without further effort. A potentially important functional property of the information object has thus changed.

Digital preservation attempts to counter this dilemma by defining significant properties of information objects. These are the properties of the information object that must be preserved throughout the entire archiving process.[18] In other words: When creating any new representation, it must be ensured that all essential features and properties of the information object are actually preserved and can be retrieved.

For the above example of the obsolete word processing file, this would mean that conversion to PDF would only be possible if the responsible archive had determined that the “editable” property of the information object is not a significant property.

It is not possible to objectify which properties of information objects are significant and which are not. Rather, significance is measured according to the objectives of the archive, the expected utilisation scenarios, and the original purpose of the information objects or other criteria inherent in the nature of the information object. The decision on significance is made by the responsible archive (if necessary in consultation with the submitting authority).

The following considerations on the significance of geographic reference data are of an exemplary nature and show in detail what a definition and description of properties of a homogeneous group of information objects, worthy of long-term preservation, might look like. Individual archives will undoubtedly arrive at different definitions.

In order to make preservation measures based on the assumption of significant properties technically feasible, it is also necessary to summarise largely similar information objects into so-called “information types” and to translate the significant properties into values that can be checked and processed by machines. For all information objects within one

[18] Nestor working group Preservation Planning: Guideline for Preservation Planning. Version 2.0. 2014, p. 20 and 67. https://d-nb.info/1060129876/34

information type, the same (possibly) relevant properties are assumed.[19]

5.2 Preservation objectives for geographic reference data

Geographic reference data are basically application-neutral, i.e. they form the "basis" for many different information objects. The concretely perceptible information object is only created when geographic reference data is displayed in a GIS[20] or in another application and thus interpreted in a certain way. The interpretation is highly dependent on the form of question or presentation lodged - the user therefore only ever gets to “see” a section of the actual, multi-perspective overall object.

> *Example: The same data from the Digital Terrain Model of Hesse can be used both to visualise a map view of the deciduous forest throughout Hesse and to determine the total area of all swimming pools in the Hesse city of Wiesbaden-Biebrich.*

The type and number of existing query options for geographic reference data are hardly limited, their information content is only ever made available selectively in an application context and, finally, the data can be further processed into new information products as required.

This “multi-perspectivity”, which is undoubtedly a core characteristic of the “geographic reference data” information type, can be handled in two ways to preserve the information:

1. The “multi-perspectivity” (or linkability, analysability, ability for further processing) of geographic reference data is regarded as fundamentally significant and must be maintained. Instead of preserving individual forms of geographic reference data content (e.g. property maps from ALKIS), the aim is to preserve the geographic reference data on which these forms of processing are based so that they are fully available for future multi-perspective interpretation. In this context, the geographic reference data themselves can be understood as information objects that are not intended for direct sensory perception or interaction, but are intended for a mediated application in a GIS.[21]
2. The “multi-perspectivity” of geographic reference data is not considered to be fundamentally significant. Instead, archiving is limited to creating and preserving

[19] Nestor working group Preservation Planning: Guideline for Preservation Planning. Version 2.0. 2014, p. 8, 15 - 21 and appendix A, p. 28 - 67. https://d-nb.info/1060129876/34

[20] A GIS consists of a set of hardware and software components that enable the creation, storage, retrieval, visualisation, transformation and analysis of geospatial information.

[21] Nestor working group Preservation Planning: Guideline for Preservation Planning. Version 2.0. 2014, p. 50 and 54. https://d-nb.info/1060129876/34

individual forms of processing these information objects. (e.g. a real estate map from ALKIS, a digital topographic map as a product derived from the DGM). These are then regarded as “independent” information objects.

While in the one case, “the big picture” is regarded as the actual information object, in the other case it is the derived individual view. Both approaches have specific advantages and disadvantages, and both approaches can also be combined - as long as you are prepared to accept redundant data keeping (as is also the case in the present appraisal recommendations).

5.3 Geographic reference data as subjects of preservation

In the light of the above, “geographic reference data” should be handled differently depending on their appearance and purpose.

The most important scenarios are explained below by way of example, differentiated according to the technical structure of the data objects concerned:

1. Geographic reference data containing line and area data (vector data, multi-perspective);
2. Geographic reference data containing point information (raster data, multi-perspective); and
3. Clearly defined processing forms (map or image views), which in turn can appear as raster or vector data.

The same preservation objective can be pursued for each of these information types, and comparable significant properties can be used as a benchmark for preservation (see 5.4 “Significant properties for geographic reference data”). The specific archive records of the geographic reference information can be assigned to one or more of these information types.

5.3.1 Line and area data (vector data, multi-perspective)

The majority of AdV products are geographic reference data that are held as vector data and are not graphic in nature, i.e. no specific map view has been defined for them as an output form. The vector data on which they are based realises its informational value (the geographic reference information) when it is interpreted in a GIS on a case-by-case basis. The information objects for archiving should therefore ideally be the vector data so that they remain available for future interpretation in a GIS. These AdV products can be summarised under the information type “vector data”:

- ATKIS® digital landscape models;
- AFIS® position, height and gravity fixed points;
- Building Polygons DE;
- House Coordinates DE;
- 3D Building Models (LoD1-DE, LoD2-DE).

5.3.2 Point data (raster data, multi-perspective)

The AdV products of the type of raster data which can be interpreted in a multi-perspective way should also be archived in such a way that they can be explored and interpreted “in a multi-perspective way” in a GIS in the future. The following products can be summarised under this type of information:

- ATKIS® Digital Terrain Model (DGM);
- ATKIS® Digital Orthophoto (DOP).

5.3.3 Vector or raster data as defined forms of preparation

The AdV products of the Digital Topographic Map (DTK) type are defined forms of processing for geotopographic data. They are provided by the Laender surveying and mapping authorities as raster data. Therefore, the following applies: The raster data must be preserved so that the map view stored in it can be permanently retained. For the DTK, the meaning of the map symbols must also be kept evident. This simply means archiving a map legend as part of the documentation.

For the archiving of the DOP, known types of use should be taken into account, which require a special form of data preparation. Depending on whether the archive wishes to support the type of use in question in the future, it may be necessary to archive the form of processing for this purpose. These are two examples of well-known types of utilisation in environmental research that may also be relevant for historical environmental research in the future:

- Colour infrared DOP (RGBI) enables the evaluation of forest damage (in 3D, stereoscopic, with aerial images).
- Greyscale DOP enables the evaluation of landslide areas or other geological and geomorphological anomalies (in 3D, stereoscopic, with aerial images).

As a public register, the official real estate cadastre identifies, depicts and describes properties (parcels of land and buildings) in a standardised way throughout Germany. The data basis is formed by object-structured vector data, which is held in the Official Real Estate Cadastre Information System (ALKIS®). The data can be interpreted from multiple perspectives and can at the same time be viewed in a defined format, the official real estate map.

The working group recommends retaining both the multi-perspective interpretability and the defined form of processing (real estate map) for ALKIS®. There are two implementation options for this:

1. The real estate map can be generated in the GIS by applying the ALKIS® signature catalogue to the vector data. For this purpose, it makes sense to archive the ALKIS® signature catalogue in machine-readable form as part of the documentation so that it will be possible to reconstruct the signatures from it (automatically) in the future.

   The free software "PostNAS Suite" currently offers the option of visualising ALKIS® vector data as a real estate map corresponding to the ALKIS® signature catalogue in the free geospatial information system software "QGIS". Such functionality should also be kept available in the future as part of open source software.

2. ALKIS® is archived as a vector dataset and, complementary to this, the real estate map is archived as a raster dataset, so that a combined interpretation of vector and raster data will be possible in future.

In addition, a map legend should be archived as part of the documentation for the real estate map (regardless of whether it is based on raster data or vector data) so that the meaning of the map symbols can be preserved.

The working group advises against archiving only the real estate map in the form of a raster dataset for ALKIS®. This is because not all information from ALKIS® is visualised in the raster dataset (e.g. owner data). In addition, the ability to search and manipulate the raster dataset in the same way as the vector data will be lost.

5.4 Significant properties for geographic reference data

For each new representation of the archived, official geographic reference data that was created as part of a format migration, it must be possible the in future to check whether the information stored in it has been preserved. The significant properties are designed to help assess this. These are the properties of the information object that must be preserved throughout the entire archiving process.[22]

The following table contains significant properties for the information objects of the raster data and vector data types. Selections can be made according to the modular principle.

In addition to the raster and vector data information types, other information types with comparable properties may need to be preserved. This refers to information objects whose content is also not intended for direct sensory perception or interaction,

[22] See nestor working group Preservation Planning: Guideline for Preservation Planning. Version 2.0. 2014, p. 20 and 67. https://d-nb.info/1060129876/34

but is provided for mediated use in an application. This includes the geographic metadata provided by the Laender surveying and mapping authorities as datasets in the XML format (see Chapter 3 "Metadata in the processes involved"). Some of the significant properties listed below can therefore also be transmitted to these information types (labelled "Geographic meta data" and "Other data" in the table).

Finally, depending on the respective archiving case, further information types must be considered, for example for accompanying documentation material. The working group recommends the procedure model of the Nestor Guidelines for Digital Preservation.[23]

Information types	**Significant property**	**Description**
Vector data, raster data	Meaning of the map symbols	The meaning of the map symbols can be understood from the map legend.
Vector data, raster data	AdV compliant presentation	Geographic reference data are visualised in a GIS in accordance with the AdV presentation rules. A check is possible using the signature catalogue or the map legend.
Vector data, raster data	Scale	Information on the relationship between the distances on the digital map / in the digital model and their equivalent in nature is preserved. The information is contained in the accompanying metadata.
Raster data	Ground resolution	The information about the ground resolution (one pixel corresponds to ... cm of ground) is preserved (e.g. in the product metadata).
Raster data	Colour channels	The information about the colour channels is preserved. (e.g. in the product metadata)
Raster data	Tile size	The information about the section of the earth's surface

[23] Nestor working group Preservation Planning: Guideline for Preservation Planning. Version 2.0. 2014. https://d-nb.info/1060129876/34

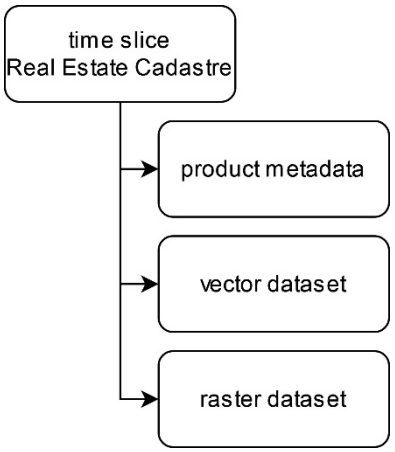
Information types	Significant property	Description
		(in kilometres) depicted in an image tile is preserved (e.g. in the product metadata).
Vector data, raster data	Coordinate reference system and projection	The information on the coordinate reference system and the projection must be completely preserved. The information can a) be supplied in supplementary files: Esri Shapefile, PRJ File b) The coordinate reference system is contained in the product metadata and must be reconstructed for the database: NAS, TIFF
Vector data, raster data	Geospatial reference	The geospatial reference information must be fully preserved. The information can a) itself be part of the database: NAS, Esri Shapefile b) can be supplied in supplementary files: TIFF, World-File (TFW)
Raster data	Image size and resolution	The image size intended or specified by the author (e.g. in cm) and the resolution (DPI number or pixels per cm match) are relevant.
Raster data	Alignment/orientation of the image	For raster image data, orientation is possible by specifying the coordinates of the bottom left corner (in a TFW file).
Raster data	Chromaticity	Is the image in colour or black and white? Changing the colour space (e.g. RGB, RGBI) or reducing the bit depth of the channel will result in a loss of information.

Information types	Significant property	Description
Raster data	Preservation of the accompanying metadata	File name and save date are preserved, preservation of the accompanying TFW file
Raster data	Completeness of the raster data tiles	The number of raster data tiles is fully preserved.
Vector data, geographic metadata, other data	Semantics of the data (schema / structure)	The schema or data structure on which the data is based is validly preserved. (Examples: layers, relationships between the layers, attributes of the layer, data types of the attributes, value ranges of the attributes, optional and mandatory attributes, etc.)
Vector data, geographic metadata, other data	Number of entities[24]	The number of entities is fully preserved. (Example: the number of layers is complete)
Vector data, geographic metadata, other data	Number of datasets	The number of datasets is fully preserved (Examples: number of simple features per layer)
Vector data, geographic metadata, other data	Values of the individual datasets	The values of the individual datasets are fully preserved. (Examples: the attribute values of a simple feature such as ID, geometry type, coordinate geometry, etc. are fully preserved)

[24] In an object-relational data model, the entities are clearly distinguishable objects to which the attributes are assigned as properties. In a relational database, entities are usually transformed into tables and the attributes into fields of the table. In the case of geographic reference data, the entities are referred to as object types. Example: the object type “AX_Gebaeude (AX-Building)” has the attribute “Gebaeudefunktion (Building function)”.

5.5 Examples for a procedure model

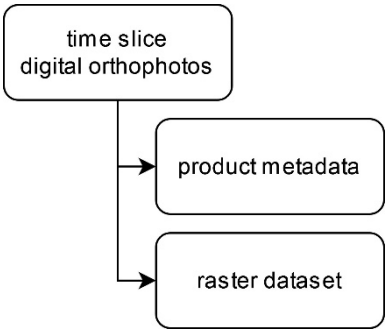
5.5.1 Real estate cadastre (ALKIS)

Preservation objective
The archive would like to archive a time slice of the Official Real Estate Cadastre. In future, the vector data will be visualised using a software application based on the NAS data. At the same time, however, a view of the real estate map is to be archived as a raster dataset in TIFF format. The following data is to be archived: • product metadata • a vector dataset in NAS format • a raster dataset in TIFF + TFW file format (as an option of the selection policy, see section 12.1)
Information objects

Significant properties

Information types	Significant property
Vector data	Meaning of the map symbols
	AdV compliant presentation
	Scale
	Coordinate reference system and projection

	Geospatial reference
	Semantics of the data (schema / structure)
	Number of entities
	Number of datasets
	Values of the individual datasets
Raster data	Scale
	Meaning of the map symbols
	Coordinate reference system and projection
	Geospatial reference
	Tile size
	Colour scheme, light, contrast
	Image size and resolution
	Integrity of content
	Alignment/orientation of the image
	Chromaticity
	Preservation of the accompanying metadata
	Completeness of the raster tiles
	Values of the individual datasets
Geographic metadata, AAA data model	Semantics of the data (schema / structure)
	Number of entities
	Number of datasets
	Values of the individual datasets

5.5.2 Digital orthophotos 20cm (ATKIS-DOP20)

Preservation objective
The archive intends to archive a nationwide dataset of digital orthophotos with a ground resolution of 20cm (ATKIS-DOP20). In addition to the widely usable red, green and blue (RGB) colour channels, an additional infrared colour channel will enable historical environmental research to evaluate the vitality of landscape vegetation. The following data are to be archived: • product metadata • one raster dataset, colour infrared (RGBI) in TIFF + TFW file format
Information objects

Significant properties

Information types	Significant property
Raster data	Scale
	Coordinate reference system and projection
	Chromaticity
	Image size and resolution
	Ground resolution
	Colour channels
	Alignment/orientation of the image
	Tile size
	Completeness of the raster data tiles
	Geospatial reference
	Preservation of the accompanying metadata
Geographic metadata	Semantics of the data (schema / structure)
	Number of entities
	Number of datasets
	Values of the individual datasets

6 Legal aspects of access to geographic reference data in the archives of the federal government and the Laender

This chapter describes when and how, from a legal point of view, it will be possible to access geographic reference data in the archives in the future.

6.1 Terms

First, the general terminology will be explained for better understanding.

6.1.1 Retention

The retention of finalised geographic reference data until the end of the retention period, in other words, until the moment of dispensability for performance of the tasks is the responsibility of the competent surveying and mapping authorities. Defining the retention period is also one of their tasks, provided there are no applicable legal regulations on the subject. The right of disposal of the geographic reference data also lies with the surveying and mapping authorities during the time of retention.

6.1.2 Archiving

Archiving of geographic reference data is the responsibility of the competent archives. This task includes selecting the geographic reference data as to its archival value, acquiring as archive material those parts determined as being of archival value, and indefinitely safekeeping and preserving them and making them accessible and available.

6.1.3 Archive material

The geographic reference data only becomes archive material – through repurposing – when the competent archive has made a positive appraisal decision, when the time for the time slice has come and/or the retention period has expired and when the data has definitively been transferred to the archive. With the repurposing, the right of disposal of the geographic reference data passes from the surveying and mapping authority to the archive.

6.1.4 Pre-archival material

Documents that were permanently acquired by the archive due to their archival value even before the retention period expired (pre-archival material) are a special case with regard to accessibility and the charging of storage costs. The extent to which pre-archival material are legally treated as official documents or as archive material varies from Land to Land.

6.2 Archive legislation and INSPIRE conformity

With reference to the comments in section 6.9 on the limited online availability of archived data, it would appear at first glance to be a step backwards for geospatial data if they are dedicated to being archive material and are therefore no longer naturally available online in accordance with the provisions of the INSPIRE Directive.

At second glance, however, this implementation, as it stands in German law (with the exception of Bavaria), has its advantages. Even if the geospatial data access laws are not mandatory, it is legally permissible and desirable to make large parts of the archived geospatial data or preview images of this geospatial data available in conformity with INSPIRE. Archives are required to do this by the Data Utilisation Act[25], and any access infrastructures, including those of the cadastral surveying offices, can be used for this purpose.

Keeping large amounts of data from the past constantly available online sometimes incurs costs that are not commensurate with the benefits. Archives, like libraries and museums, have therefore been deliberately exempted from certain aspects[26] of the obligation to make all information available digitally under EU freedom of information framework legislation:

- Section 4 subsection 1 in conjunction with section 10 of the German Data Utilisation Act obliges all public authorities to authorise the use of their data for any commercial or non-commercial purpose, largely free of charge. Section 4 subsection 2 of the German Data Utilisation Act excludes archive documents from the general re-use authorisation if they or the submitting authorities are entitled to copyright or related protection rights and that leaves it up to the archive to decide which information it makes accessible online.
- Section 10 subsection 2 No. 2 of the German Data Utilisation Act in conjunction with Section 11 subsection 2 sentence 2 expressly stipulates that archives may use fees a) to refinance more than the costs required for the provision and b) to refinance the costs incurred for the preservation of the information. This even applies explicitly to so-called “high value datasets” (HVD, section 3 No. 9 of the German Data Utilisation Act), which all other public bodies must provide free of charge from mid-2022 at the latest.

This shows that the legislature has deliberately provided the archives with flexible legal options, rather than an obligation, to make historical geospatial data available as part of a national geospatial data infrastructure. The reclassification as archive material does not legally prevent the INSPIRE-compliant provision of archived geospatial data; it only has a cost-reducing effect insofar as it enables more targeted provision that is better geared to the needs of society.

[25] https://www.gesetze-im-internet.de/dng/. The predecessor regulation of the German Data Utilisation Act was the Information Reuse Act (IWG), which expired with the implementation of the German Data Utilisation Act in summer 2021.

[26] See most recently Recital 38 of Directive 2019/1024/EU amending Directive 2003/98/EC on the re-use of public sector information, https://eur-lex.europa.eu/legal- content/DE/TXT/?uri=CELEX%3A32019L1024.

6.3 Application of the archive legislation currently in force

Since archive legislation falls under the regulatory power of the agencies that maintain the archives, every Land and the federal government each have their own archive law.[27] These archive laws of the federal government and the Laender differ from one another, particularly regarding individual details of access. For this reason, the following outline only reflects the general tendencies of the archive laws and cannot replace the specific examination of the appropriate individual regulation for individual cases. Nonetheless, all the archive laws of the federal government and the Laender essentially contain similar access regulations, which makes it possible to provide an overview and a rough outline of the shared contents. This does not preclude the need for bilateral arrangements to be made between the surveying and mapping authorities and the archives.

6.4 Aim and differentiation of the access regulations in the archive laws

All the access regulations of the archive laws of the federal government and the Laender are aimed at meeting the requirements of data protection and, equally, complying with citizens' need for information, the freedom of science and teaching, and any interest on the part of the delivering authorities to continue accessing the material.

Here the archive laws fundamentally differentiate between archive material and records that have been acquired before the expiry of the retention periods (transitional records, pre-archival records).[28]

A second differentiation of access possibilities according to archive law is made according to user groups. Here a distinction is essentially made between the delivering authorities, affected parties and third parties. Furthermore, there are sometimes different conditions of use, depending on whether it is a matter of legal or academic research.

Moreover, the archive laws differentiate between access options according to formal criteria. Here a distinction is made between records that have already been published or were intended for publication, "normal" official records without any personal details, and records that contain personal information and are therefore subject to particular protection periods.[29]

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[27] A compilation of the archive laws of the federal and Laender governments can be found at http://www.archivschule.de, the website of the Archivschule Marburg.

[28] The status "transitional records" and "pre-archival records" can be disregarded in this context.

[29] The fourth category taken into account in the archive laws, namely that of confidential, protected records, can be disregarded in this context.

From the point of view of the surveying and mapping authorities, published geographic reference data can be regarded as data that is accessible to everyone, freely available and without legal obstacles.

6.5 Status of geographic reference data in access law

In all archive laws of the federal government and the Laender, archive material is subject to the complete access regulations of archive law. For geographic reference data, which is to be understood as archive material in this context, the access principles of archive law described in more detail in chapter 6.9 apply at the archive. This is the case irrespective of whether the delivering authority has decided to delete the geographic reference data submitted or to continue to keep it available at the authority after archiving.[30] Legal rights standardised beyond archive law and granting access to specific records may also be significant in some circumstances.

6.6 User groups

This section describes the different user groups.

6.6.1 Delivering authorities

The delivering authorities and their functional and legal successors enjoy privileged access rights in the archive laws of the federal government and the Laender. They are entitled to use, at any time, the data that originated with them and has been acquired by the archive. This right, however, is restricted in some archive laws for data that is subject to data deletion or data access regulations and that should therefore be withdrawn from the scope of the delivering authority by law. For the field of geographic reference data, however, these regulations are largely irrelevant. Far more significant, when it comes to allowing delivering authorities to draw on geographic reference data, is the question as to how the privileged access right mentioned above can be realised in practice. On this subject, please refer to the information in chapter 6.9.

6.6.2 Affected parties

A second privileged user group according to archive law is that of the “affected parties”. In the archive laws of the federal government and the Laender, these enjoy an extensive right to information or inspection for archive material if it refers to them personally. In the area of archived geographic reference data, this regulation is significant above all for the area of real estate data. It means that affected parties can and must be granted access to this data irrespective of other legal rights and without having to observe any relevant protection periods.

[30] In this case, the responsibility to verify the legal conformity of a redundant data keeping of this kind and the legal conformity of making the data available in any way at the authority lies with the delivering authority.

6.6.3 Third parties

According to the archive laws of the federal government and the Laender, everyone is basically entitled to the right to use archive material within the scope of the appropriate regulations of archive law. Although some archive laws make access to the material dependent on substantiating a legitimate interest, this is a vague legal concept that almost never leads to denial of access in everyday archive business. More relevant in practical terms, by contrast, are the detailed regulations in archive law that reconcile this general right to access with the requirements of data protection law. For this, all the archive laws of the federal government and the Laender provide for the governing of third-party access by means of protection periods (see chapter 6.7 and following). Once the protection periods have expired, everyone is granted access to the archive material without restriction – unless there exists one of the special reasons for a restriction of use that are described in the archive laws of the federal government and the Laender (see chapter 6.8). These provisions function not least as a kind of safety net for those cases in which the protection periods were not long enough or could not be applied.

6.7 Protection periods

This chapter outlines the various protection periods.

6.7.1 Handling of published data

Fundamentally excluded from the possibility of access being governed by protection periods is any data that has already been published or that was intended for publication when it was created. These archive records can basically be used at the archive by any authorised persons without any further constraints and without any adherence to protection periods. This regulation, which otherwise generally constitutes an exceptional case in an archival context, is of central importance when it comes to archived geographic reference data. Since a crucial feature of the AdV products is the principle of the database being public, a large proportion of archived geographic reference data can be classed as “published”. If this is the case, after it has been acquired by the archive, the data is to be provided to the relevant users without applying protection periods. The concept of usability is not to be equated here with exemption from charges.

All the AdV products were considered by the working group to be published, with the exception of the ALKIS® data that is subject to data protection. Within the applicable protection periods containing personal information, such data is only available to a limited group of users upon proof of a legitimate interest. Furthermore, “Underground Monuments” and historical point information in the AFIS® product are subject to special protection (see selection policy in appendix).

6.7.2 General protection period

According to the archive laws of the federal government and the Laender, data that was not intended for publication is subject to a general protection period of 30 years during which access for everyone is not provided for. As a rule, this protection period can,

however, be shortened by filing an application, although the Laender have different ways of regulating the procedure for filing and justifying applications and for approving them.

6.7.3 Protection periods for archive material containing personal information

There are stricter regulations for the protection of archive material containing personal information, i.e. data that, due to its purpose or essential content, relates to one or more natural persons. Such archive material is excluded from use (for slightly differing periods of time) under the federal government and in the Laender even beyond the death of the affected persons. Here, too, it is possible to shorten the protection periods upon special application, but this is usually only done after a significantly more critical and complex verification procedure and after a careful weighing of interests. For access to archived geographic reference data, the protection periods for personal data are relevant, above all, in the area of the real estate cadastre, to the extent that the data is enriched with or linked to details about natural persons. During the protection period, it will only be possible for everyone to access this data if the protection period is shortened. This must be justified separately in each case.

6.7.4 Restricting access to archive material in special cases

Irrespective of the protection periods mentioned, access to archive material can also be denied, limited or made subject to conditions if there are important reasons to do so that do not fall under the criteria specified. The list of these reasons varies from one archive law to another but generally contains matters of fact such as a threat to the welfare of the Federal Republic of Germany or of a Land, a violation of legitimate or protectable interests of third parties, unreasonable expenditure for provision, or possible damage to the archive material in question. For access to archived geographic reference data, restrictions on this basis are possible.

In the view of the working group, this could apply to “Underground Monuments” in AFIS®.

6.8 Access to archive material on the basis of statutory provisions beyond archive legislation

Before being repurposed as archive material, access to geographic reference data follows

a) the surveying, mapping and cadastral laws of the Laender;

b) the geospatial data access laws or geospatial data infrastructure laws of the Laender;

c) any other rules that justify access to the records of public bodies.

After being repurposed as archive material, access to geographic reference data essentially follows the archive laws of the Laender. In practice, however, conflicts can arise between a right to access resulting from the rules described in a) and c) (for example: “the owners are to be provided with ... upon application”) and the right to access based on the archive laws of the Laender. A conflict between a right to access resulting from the rules mentioned in b) and the right to access based on the archive laws of the Laender is not possible.

After being repurposed as archive material, geographic reference data is “no longer in use” and is thus excluded from the scope of the rules mentioned in b).[31]

A conflict of rules should always be resolved on the basis of the conflict-of-law rule “lex specialis derogat legi generali” (the more specific law has precedence over the more general law).

Therefore, if the statutory provisions regarding access to geographic reference data merely grant the right to a decision without abuse of discretion (for example: “... can be provided to anyone unless this conflicts with public interests”), the rules of the archive access law will take precedence.

6.9 Possible types of access

In the archive laws of the federal government and the Laender, the concept of access (use, utilisation, exploitation) is used as a vague legal concept that is generally only defined more precisely in the appropriate implementation regulations, schedules of fees and reading room regulations. Here a “normal” case of use defined by all the archives is the situation in which the user personally inspects the material in the archive’s reading room or, if this is not possible, in which the user is given an answer to a specific enquiry in writing or by telephone. As an additional form of use, the provision of reproductions is possible.

So far none of the state archives in Germany have implemented a “protected digital reading room” that can be used via the Internet.[32] The growing volume of electronic data that is being submitted by the authorities and courts will, however, make it necessary in the foreseeable future to create such infrastructures – also in the context of the National Research Data Infrastructure NFDI[33] – everywhere for users to be able to inspect the electronic documents in a suitable form in the reading room and – where legally possible and applicable – for duplicates of the archived data to be made available.

For access to freely accessible geographic reference data, the working group believes that co-operative solutions covering all Laender would be very useful.

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[31] See Neumann, Conrad: Zugang zu Geodaten. Neue Impulse für das Informationsverwaltungsrecht durch die INSPIRE-Richtlinie (Beiträge zum Informationsrecht Band 35), Berlin 2014, p. 554 (Neumann refers to the geospatial data access law of the federal government). See also Article 7, para. 3, sentence 1 of Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 on establishing an Infrastructure for Spatial Information in the European Community (INSPIRE).

[32] As an example for orthophotos see http://www.landesarchiv-bw.de/plink/?f=2-5934126-1.

[33] https://www.nfdi.de/.

7 Ways of cooperative implementation of the guidelines

Since 2015, the ways in which this guideline has been implemented have proved to be more varied than originally expected. In particular, the question of which (historicised) official geographic reference data are held at which institution at which point in time and where they can best be made accessible to external users can be answered in very different ways.

The following sub-chapters present the most common (realistic) implementation scenarios and role allocations between the surveying and mapping authority and archives. It should be noted that not every scenario can be realised in every Land. How the guidelines are actually realised depends rather on the specific legal framework conditions of the partners involved and their bilateral implementation agreements. This chapter shows the variety of possibilities.

7.1 Conventional retention period

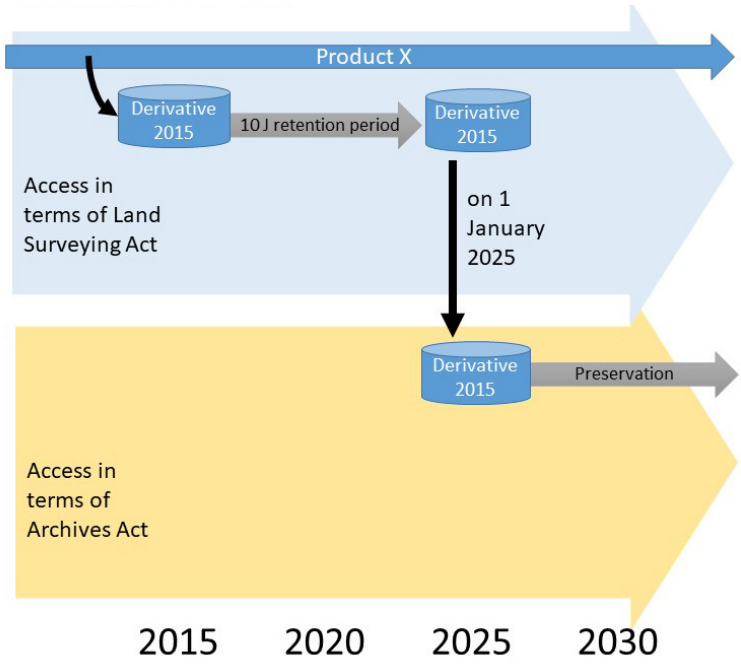

Figure 1: Conventional retention

The AdV product X is continuously being updated. At a given point in time, time slices (here “derivatives” for short) are generated for archiving. In this scenario, these are initially retained by the surveying and mapping authority and made available to users for as long as the internal retention period runs.

Once the retention period has expired, the derivative is transferred to the archives. If the archive and the surveying and mapping authority are located in the same computer centre, there may only be legal and organisational changes – but as a rule there are also considerable technical changes involved.

Example: In 2020, interested parties can obtain product X with the 2020 version and the 2015 derivative from the surveying and mapping authority.

In 2026, interested parties can obtain product X with the 2026 version from the surveying and mapping authority. The 2015 derivative, on the other hand, must be requested from the archive. From this moment on, the requesting person must therefore turn to two places.

If the acquisition of the derivative were delayed until the end of the agreed period, the archive and the surveying and mapping authority would have to agree on an interim solution. This could be, for example, an extension of the retention period or distribution in accordance with the German Archives Act with user fees by the surveying and mapping authorities.

7.2 Safekeeping in the archive immediately after generation ("pre-archiving")

If it makes technical and economic sense, the derivative can also be transferred to the archive immediately after its creation. However, the archive laws do not offer this option in every Land. The use of these derivatives in the archive therefore generally requires a bilateral agreement.

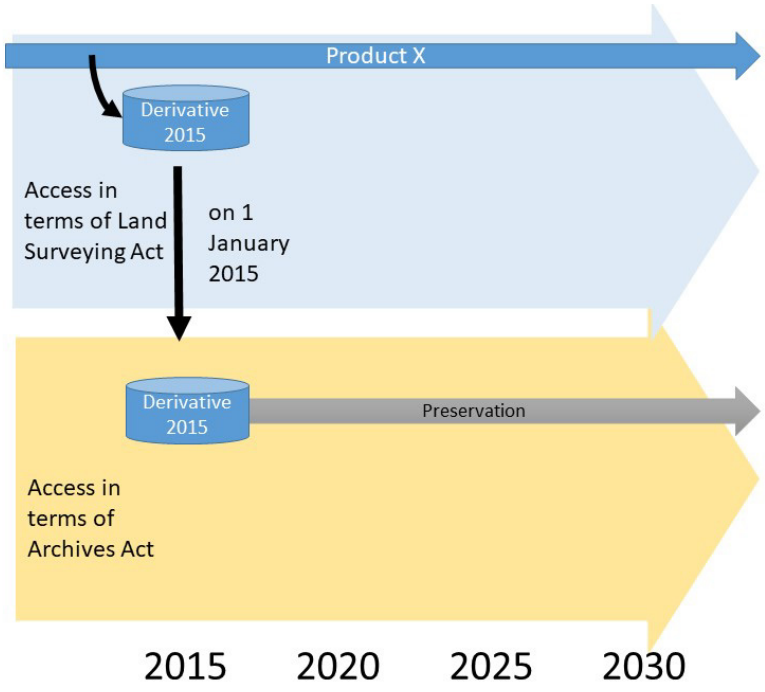

Figure 2: Submission of the derivative immediately after creation

7.3 Duplicate data keeping

In the previous implementation of the guidelines, situations arose in which the geospatial data were held both in the surveying and mapping authority and in the Land archives. This situation causes double costs, but is currently the only solution in some Laender to satisfy the needs of both institutions. In the long term, it certainly makes sense to resolve this duplication of data keeping, but it involves great effort. When changing this situation, care must be taken to ensure that access is not made more difficult for the users.

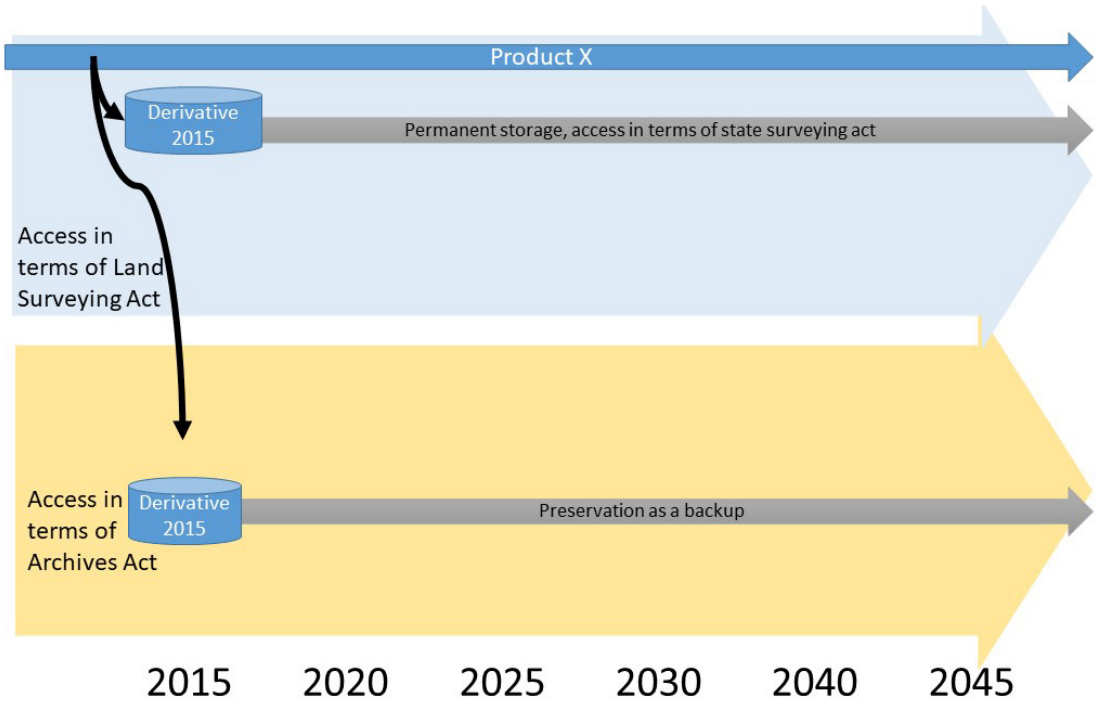

Figure 3: Duplicate data keeping

7.4 Overarching use with central contact point

In the previous scenarios, there was no central point of contact for geographic reference data. One is given in this scenario, which allows the integration of different solutions. Here there are two derivatives with different content, which are made searchable and provided by the archive and the surveying and mapping authority using the same architecture.[34]

[34] One example is the results of a complete aerial survey of Baden-Württemberg, which are available as an orthophoto in the WMS (integrated here in the portal LEO-BW https://www.leo-bw.de/web/guest/karte-vollbild/-/gisviewer-expert/voll?_gisviewerexpertportlet_WAR_gisviewerportlet_map=DOP_1968) by LGL BW on the one hand, and as individual aerial photos made available by LABW, on the other (http://www.landesarchiv-bw.de/plink/?f=2-5684305&a=fb).

The derivatives can, for example, be researched via a WMS and made available via a download service, or provided directly via WFS. Close co-operation between the archives and surveying and mapping authorities is a prerequisite for this to work.

The Distributed Unified Architecture, which in the example is created around the year 2023, consists mainly of definitions of how the objects on both sides are provided in a common catalogue and in an environment that is as WMS-compatible as possible. The actual implementation is carried out by the partners (e.g. GDI-DE, GDI-HE, German Digital Library, Bayern-Atlas, LEO-BW).

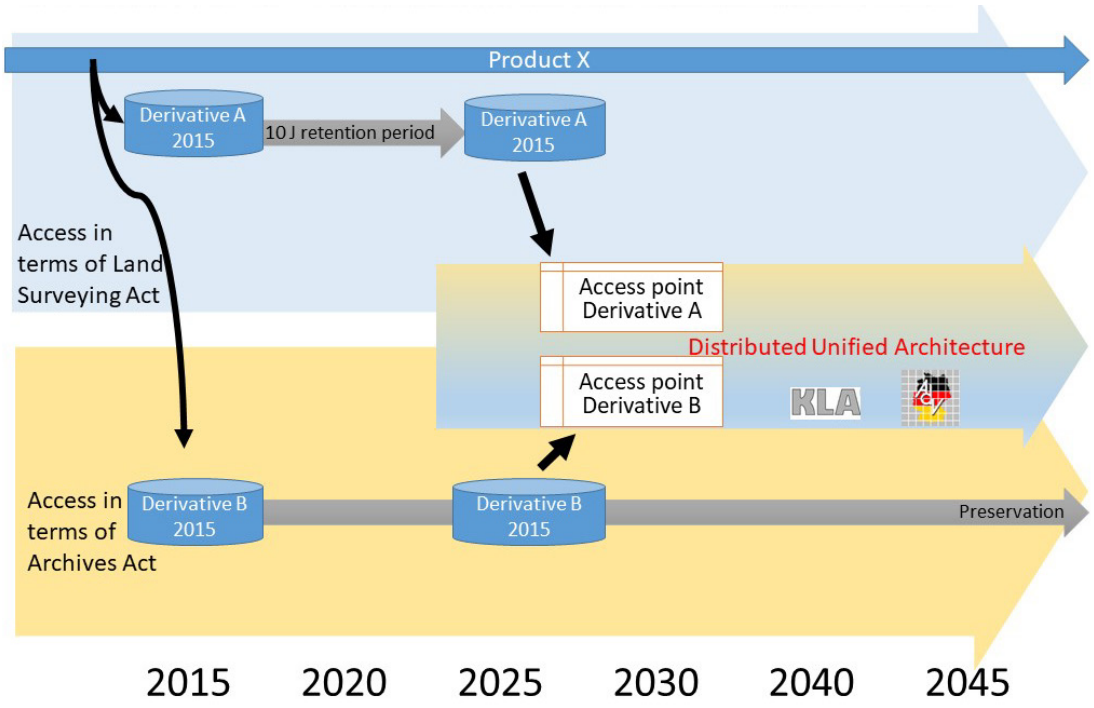

Figure 4: Different derivatives (derivative A differs significantly from B), different storage locations, common display option (Distributed Unified Architecture)

8 Outlook on the future

The guidelines presented in 2015 and the associated recommendations for action have now been successfully implemented in most of the Laender, while the others are in the preparatory stage.[35] In some Laender, geographic reference data is already being continuously disposed of and submitted to the archives. The archive administrations have made further progress in dealing with digital administrative data, especially in making archived data available to users. There is still a need for action to further standardise the archiving process for digital geographic reference data - also to ensure that homogeneous digital datasets can be made available to archive users across the Laender.

The guidelines should continue to be discussed in the working group every five years for revision in order to implement any need for adjustments resulting from practical experience and to include any new products or adjust time cycles.

In addition to its own activities and this document, the working group encourages an in-depth bilateral exchange between the surveying and mapping authorities and the archive administrations, as well as with other public administration and scientific infrastructure organisations, in order to benefit from each other and increase understanding of the other side.

The Federal Republic of Germany and many other countries are currently investing in digital infrastructures for public administration and science, which are manifested in the following developments relevant to our mission:

- Since the creation of the INSPIRE Directive, Germany's spatial data infrastructure (Geodateninfrastruktur, GDI) has become an important building block for economic and scientific development. It comprises significantly more potentially valuable historical data than the AdV geodata discussed in this document, for example environmental data, traffic data or economic data. In this respect, the guidelines on the long-term preservation of geospatial data, which were prepared and published by the Federal Agency for Cartography and Geodesy in parallel with the revision of these guidelines, are an important contribution.[36]

[35] For examples of implementation, see Frank Lehmann, Kooperation zahlt sich aus: Die Archivierung von digitalen Orthophotos vom Staatsbetrieb Geoinformation und Vermessung durch das Sächsische Staatsarchiv, in: I.C. Becker et al. (editors): E-Government und digitale Archivierung (Veröffentlichungen der Archivschule Marburg 67), Marburg 2021, p. 129 - 144. The guidelines are also observed at municipal level: Beatrix Pusch, Fachliches aus den DiPS.kommunal Arbeitskreisen: Beispiel Geobasisdaten, in: Archivpflege in Westfalen-Lippe Band 91 (2019), p. 23 - 27.

[36] AK Architektur der GDI-DE (2021): Leitlinien für die Fortführung und die Langzeitspeicherung von Geoinformationen, https://www.gdi-de.org/download/Architektur_GDI-DE_Leitlinien_Langzeitspeicherung_von_Geoinformationen.pdf.

- Large parts of science make use of overarching digital infrastructures, which are becoming more extensive with each passing year and the content of which will pose the preservation problems described in chapter 5 of these guidelines at a certain age. The Nationale Forschungsdateninfrastruktur (National Research Data Infrastructure, NFDI), which has been under development since 2018, in particular the NFDI4Earth[37] consortium, can benefit from the guideline papers accordingly.
- The specialised information services of the public university and research libraries for geosciences, geography and cartography aim to improve access to current and past geological and geographic information.

The working group hopes that this exchange will in particular create synergy effects for the tasks of technology monitoring and the joint provision of geographic reference data and specialised geospatial data.

[37] https://www.nfdi4earth.de/.

9 Thanks

The working group would like to thank Sandra Rein and Christian Killiches from Landesvermessung und Geoinformation Brandenburg, who led the working group in 2014/15 and 2020/21, for their tireless and friendly support during the discussion and editing process.

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Nationale Forschungsdaten Infrastruktur:
https://www.nfdi.de/

Landeskundliche Informationssystem für Baden-Württemberg (Leo-BW):
https://www.leo-bw.de/web/guest/home

Landesarchiv Baden-Württemberg:
https://landesarchiv-bw.de

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https://www.gdi-de.org/download/Architektur_GDI-DE_Leitlinien_Langzeitspeicherung_von_Geoinformationen.pdf

11 List of abbreviations

AdV	-	The Working Committee of the Surveying Authorities of the Laender of the Federal Republic of Germany
AAA data model	-	Application scheme for the geographic information systems **A**LKIS®, **A**TKIS®, **A**FIS®
ALKIS®	-	The Authoritative Real Estate Cadastre Information System
ATKIS®	-	The Authoritative Topographic-Cartographic Information System
AFIS®	-	The Authoritative Control Point Information System
AKS	-	Automated data on purchasing prices
ALK	-	Automated real estate map
ALB	-	Automated real estate book
AG AGL	-	The KLA working group “Archiving LGL Geographic Reference Data”
AG ESys	-	The KLA working group “Electronic Systems in Justice and Administration”
(Geo)-**AIP**	-	archival information package (information packages in long-term storage)
BRW	-	Standard land value
(Geo)-**DIP**	-	Dissemination information package (user package)
(Geo)-**SIP**	-	Submission information package (information package for the delivery of digital Archive material)
DGM	-	Digital terrain model
DLM	-	Digital landscape model
DNG	-	The German Data Usage Act (Data Utilization Act)
DTK	-	Digital topographic map
DTK-V	-	Digital topographic map, preliminary edition
DOP	-	Digital orthophoto
EDBS	-	Uniform database interface

EuroSDR	-	Pan-European organisation for spatial data research
ETRS	-	The European Terrestrial Reference System
GeoInfoDok	-	Documentation on the modelling of geoinformation of official surveying and mapping
GIS	-	Geographic information system
GML	-	The Geography Markup Language
HVD	-	High-value datasets
IETF	-	The Internet Engineering Task Force
ISO	-	The International Organization for Standardization
INSPIRE	-	The Infrastructure for Spatial Information in Europe
KLA	-	The Conference of Directors of the Archive Authorities of the Federal Government and the Laender
LZW	-	Data compression technique after Lempel, Ziv and Welch
LGB	-	Surveying, mapping and geographic reference information authority of Brandenburg
LGL	-	Baden-Württemberg agency for geoinformation and rural development
LoD	-	Level of detail
NAS	-	Norm-based exchange interface
NBA	-	User-oriented inventory data updating
OAIS	-	The Open Archival Information System, common abbreviation for ISO standard 14721
RGB	-	Red, green, blue
RGBI	-	Red, green, blue, infrared
RFC	-	Request for comment
UML	-	The Unified Modelling Language
UTM	-	The Universal Transverse Mercator projection
XMI	-	The XML Metadata Interchange
XML	-	The eXtensible Markup Language
ZIP	-	Format for compressed data

12 Appendix

12.1 Selection policy scheme including examples of metadata and data volumes

Ser. No.	Designation	Origin, contents, function	Appraisal	Comments	Launch year	Frequency	Acquisition form	Scale / raster size	Published
1	**Real Estate Cadastre**								
1.1	ALKIS	Documentation of the real estate cadastre	A		Depends on Land	5 years (more frequent submission on Land-specific basis)	XML format portioned (at archive's request) in the form of complete NBA basic configuration; optionally in addition: TIFF+TFW or PDF/A1b		No, owing to owner data (and land parcel numbers)
1.2	Real Estate Map (ALK)	Documentation of the real estate cadastre	A	Depends on Land, if technically feasible			TIFF, EDBS		Yes
1.3	Real Estate Book (ALB)	Documentation of the real estate cadastre	A	Depends on Land, if technically feasible				None.	No
1.4	Official House Coordinates (HK-DE)	Based on 1.1 and 1.2	A			5 years (more frequent delivery on Land-specific basis)	ASCII		Yes
1.5	Official Building Polygons (HU-DE)	Based on 1.1 and 1.2 2D building polygons	A			5 years (more frequent delivery on Land-specific basis)	Shapefile		Yes
1.6	3D Building Models (LoD1- DE)		V / A	A if 1.7 not yet available			CityGML; shp		Yes
1.7	3D Building Models (LoD2- DE)		A	Replaces no. 1.6 if available for whole area		5 years (more frequent delivery on Land-specific basis)	CityGML; in BB: Version 1.0		Yes
1.8	Real estate valuation (BRW, AKS)		B	Land-based solution since not an AdV product					Yes for BRW, no for AK

Ser. No.	Designation	Origin, contents, function	Appraisal	Comments	Launch year	Frequency	Acquisition form	Scale / raster size	Published
2	**Digital Landscape Models**								
2.1	Basis-DLM	Object-structured vector database before migration	B				EDBS	1: 10.000	Yes
2.2	ATKIS - Basis-DLM	Object-structured vector database after migration	A		2015	5 years	XML format portioned (at archive's request) in the form of complete NBA basic configuration		Yes
2.3	ATKIS - DLM50	Model generalisation from Basis-DLM	V	Discontinued				01: 50,000	Yes
2.4	DLM250 (BKG)			Responsibility: German Federal Archives				1:250,000	Yes
2.5	DLM1000 (BKG)			Responsibility: German Federal Archives				1:1,000,000	Yes

Ser. No.	Designation	Origin, contents, function	Appraisal	Comments	Launch year	Frequency	Acquisition form	Scale / raster size	Published
3	**Digital Terrain Models**								
3.1	DGM1	Digital, numerical model of the terrain heights and shapes of the earth's surface reduced to a regular grid	A	The highest resolution version per Land	2010	10 years	ASCII	1m	Yes
3.2	DGM2	Digital, numerical model of the terrain heights and shapes of the earth's surface reduced to a regular grid	A / V	The highest resolution version per Land	2010	10 years	ASCII	2m	Yes
3.3	DGM5	Digital, numerical model of the terrain heights and shapes of the earth's surface reduced to a regular grid	A / V	The highest resolution version per Land	2010	10 years	ASCII	5m	Yes
3.4	DGM10	Digital, numerical model of the terrain heights and shapes of the earth's surface reduced to a regular grid	A / V	The highest resolution version per Land	2010	10 years	ASCII	10m	Yes
3.5	DGM25							25	Yes
3.6	DGM50							50m	Yes
3.7	DGM200 (BKG)			Responsibility: German Federal Archives				200m	Yes
3.8	DGM1000 (BKG)			Responsibility: German Federal Archives				1000m	Yes

Ser. No.	Designation	Origin, contents, function	Appraisal	Comments	Launch year	Frequency	Acquisition form	Scale / raster size	Published
4	**Digital surface model**								
4.1	DOM	Model of the earth's surface with vegetation, buildings, vehicles	A	New product Details yet to be checked	Yes				

Ser. No.	Designation	Origin, contents, function	Appraisal	Comments	Launch year	Frequency	Acquisition form	Scale / raster size	Published
5	**Digital Topographic Maps**								
5.1	DTK10 – colour edition		A	If available	2015	every 5 years	TIFF LZW + World File	1: 10.000	Yes
5.2	DTK25 – colour edition		A		2015	every 5 years	TIFF LZW + World File	1:25,000	Yes
5.3	DTK50 – colour edition		A		2015	every 5 years	TIFF LZW + World File	01: 50,000	Yes
5.4	DTK100 – colour edition		A		2015	every 5 years	TIFF LZW + World File	1:100,000	Yes
5.5	DTK250 – colour edition (BKG)			Responsibility: German Federal Archives					Yes
5.6	DTK1000 – colour edition (BKG)			Responsibility: German Federal Archives					Yes
5.7	DTK10-V – colour edition		A	If available		Discontinued; last update and further acquisitions on Land-specific basis	TIFF LZW + World File		Yes
5.8	DTK25-V – colour edition		A			Discontinued; last update and further acquisitions on Land-specific basis	TIFF LZW + World File		Yes
5.9	DTK50-V – colour edition		A			Discontinued; last update and further acquisitions on Land-specific basis	TIFF LZW + World File		Yes
05:10:00 hours	DTK100-V – colour edition		A			Discontinued; last update and further acquisitions on Land-specific basis	TIFF LZW + World File		Yes

Ser. No.	Designation	Origin, contents, function	Appraisal	Comments	Launch year	Frequency	Acquisition form	Scale / raster size	Published
6	**Aerial image products**								
6.1	ATKIS-DOP20		A	Submission in RGBI, since available, otherwise RGB (covering whole area)		10 years	TIFF+LZW/ JPEG2000 (lossless compression)		Yes
6.2	ATKIS-DOP40		A	The first flight (covering whole area), only as long as no higher resolution available		10 years	TIFF+LZW/ JPEG2000 (lossless compression)		Yes

Ser. No.	Designation	Origin, contents, function	Appraisal	Comments	Launch year	Frequency	Acquisition form	Scale / raster size	Published
7	**Nationally Standardised Control Point Field**	**Geodetic Reference Network Points (GGP), 1st order elevation control points, 1st order gravity control points, SAPOS reference station points**							
7.1	AFIS	Control point information system in AAA model	A		2020	20 years	XML format portioned (at archive's request) in the form of complete NBA basic configuration		Yes, except for "Underground Monuments" and historical point information (BB example: regulated in NivP decree)
7.2	Position Control Points (LFP)	Before AAA model; coordinates	B	Land-specific solution	One-time				
7.3	Documentation of Position Control Points	Before AAA model; file for point with sketch	B	Land-specific solution	One-time				
7.4	Elevation Control Points (HFP)	Before AAA model; coordinates	B	Land-specific solution	One-time				
7.5	Documentation of Elevation Control Points	Before AAA model; file for point with sketch	B	Land-specific solution	One-time				
7.6	Gravity Control Points (SFP)	Before AAA model; coordinates	B	Land-specific solution	One-time				
7.7	Documentation of Gravity Control Points	Before AAA model; file for point with sketch	B	Land-specific solution	One-time				

Legend

Selection:

A – Archive

B – Select

V – Destroy

Present product

Precursor product

Example metadata records from Brandenburg

Authoritative Real Estate Cadastre Information System (ALKIS data):
https://geoportal.brandenburg.de/detailansichtdienst/render?view=gdibb&url=https%3A%2F%2Fgeoportal.brandenburg.de%2Fgs-json%2Fxml%3Ffileid%3D6de36219-3e68-489e-8ebc-632e5ffb6dc9

Digital Topographic Map 1: 10 000 - 2740-SW Blesendorf:
https://geoportal.brandenburg.de/detailansichtdienst/render?view=gdibb&url=https%3A%2F%2Fgeoportal.brandenburg.de%2Fgs-json%2Fxml%3Ffileid%3Dd550ae2e-0c29-4387-b5c6-8f7a34caa598

12.2 Information on data volumes in different federal Laender (Laender coverage)

Ser. No.	Designation	Data pack SH (not compressed)	Data pack TH (not compressed)	Data pack BW (not compressed)	Data pack BB	Data pack RLP
1	Real Estate Cadastre					
1.1	ALKIS	94.5 GB	350 GB (storage by plots of land)	11,75 GB (2020; compressed)	4 - 5 GB	compressed approx. 9 GB
1.2	Real Estate Map (ALK)		14.3 GB			max. approx. 25 GB
1.3	Real Estate Book (ALB)		0.85 GB			compressed 600 MB
1.4	Official House Coordinates (HK-DE)	100 MB	0.07 GB	0.06 GB (2020)		
1.5	Official Building Polygons (HU-DE)	1.2 GB	0.5 GB	0.57 GB (2020; format: Shapefile)	400 MB (Shp)	
1.6	3D Building Models (LoD1- DE)	25 GB	14 GB	1,61 GB (2015; compressed)		
1.7	3D Building Models (LoD2- DE)	being set up	being set up	6,87 GB (2020; compressed)	5 GB as City-GML zipped	
2	Digital Landscape Models					
2.1	Basis-DLM		1.7 GB			
2.2	ATKIS - Basis-DLM	5.8 GB	8.1 GB	24.2 GB (2020; NAS) 8.7 (2020; SHP)	compressed 500 MB	
2.3	ATKIS - DLM50		3.3 GB			

3	**Digital Terrain Models**					
3.1	DGM1	670 GB (ASCII)	-	1.11 TB (2020)	150 GB compressed ASCII format XYZ	approx. 1 TB
3.2	DGM2	Derivation from DGM1	490 GB (1m-raster size)	Derivation from DGM1		
3.3	DGM5		Derivation from DGM2		13 GB (ASCII)	approx. 50 GB
3.4	DGM10					
3.5	DGM25					
3.6	DGM50					
4	**Digital Topographic Maps**					
	DTK5	35 GB	-	-		
4.1	DTK10 – colour edition		4.5 GB (8.1 GB with individual layers)	9.25 GB (2020)	LZW compressed: 4.4 GB	
4.2	DTK25 – colour edition	1.6 GB	1.6 GB (2.8 GB with individual layers)	2.44 GB (2020)	LZW compressed: 1.2 GB	approx. 1.5 GB
4.3	DTK50 – colour edition	640 MB	0.61 GB (0.91 GB with individual layers)	0.75 GB (2020)	LZW compressed: 455 MB	approx. 0.9 - 1.0 GB
4.4	DTK100 – colour edition	100 MB	0.26 GB (0.366 GB with individual layers)	0.18 GB (2020)	LZW compressed: 165 MB	approx. 250 MB
5	**Aerial image products**					
5.1	ATKIS-DOP20	1.5 TB	1.7 TB	4 TB (2015)	uncompressed 3.2 TB	uncompressed 1.5 - 2.0 TB
5.2	ATKIS-DOP40	400 GB	430 GB		uncompressed: 220 GB	
6	**Nationally Standardised Control Point Field**					
6.1	AFIS			0.33 GB (2020; compressed; NAS, CSV) 5.78 GB (2020, geoTIFF)		
	Other products					
	ATKIS-DOP20 historical	7.5 TB	-	approx. 9.5 TB (resolution 25 cm)		
	ATKIS-DOP40 historical	2.5 TB	-		uncompressed: 220 GB	
	ATKIS-DOP10			16 TB		

12.3 Members of the working group

Mr Killiches – BB
Landesvermessung und Geobasisinformation Brandenburg
as representative of the Geographic Reference Steering Committee (LA)

Surveying and mapping	Archive
Mr Eckhoff – HH Freie und Hansestadt Hamburg Landesbetrieb Geoinformation und Vermessung	**Ms Kress – HH** Freie und Hansestadt Hamburg - Behörde für Kultur und Medien, Staatsarchiv
Mr Klenner – SN Staatsbetrieb Geobasisinformation und Vermessung Sachsen - Abt. 3 Liegenschaftskataster	**Dr. Grau – BY** Bayerisches Hauptstaatsarchiv
Mr Grams – BW Ministerium für Landesentwicklung und Wohnen Baden-Württemberg Referat 15 **Mr Ellsäßer – BW** Landesamt für Geoinformation und Landentwicklung Baden-Württemberg (LGL) Referat 23 Vertrieb, Marketing, Reproduktion	**Dr. Naumann – BW** Landesarchiv Baden-Württemberg – Abt. Archivischer Grundsatz **Mr Weber – BW** Landesarchiv Baden-Württemberg – Abt. Staatsarchiv Ludwigsburg
Mr Magg – SH Landesamt für Vermessung und Geoinformation Schleswig-Holstein - Abt. 6 als Vertreter AK Liegenschaftskataster (AK LK)	**Ms Stahlberg, Mr Süß – BB** Brandenburgisches Landeshauptarchiv
	Dr. Schmidt – HE Hessisches Landesarchiv, Digitales Archiv
	Mr Haydar Aldemir Landesarchivverwaltung Rheinland-Pfalz - Stabsstelle Digitale Infrastruktur
Head of the office **Ms Rein – BB**	

Contact addresses of the surveying and mapping authorities and archives in the Laender

Baden-Württemberg
Landesamt für Geoinformation und Landentwicklung Baden-Württemberg
www.lgl-bw.de

Landesarchiv Baden-Württemberg
www.landesarchiv-bw.de

Bavaria
Landesamt für Digitalisierung, Breitband und Vermessung
www.geodaten.bayern.de

Bayerisches Hauptstaatsarchiv
www.gda.bayern.de

Berlin
Senatsverwaltung für Stadtentwicklung und Umwelt
www.stadtentwicklung.berlin.de/geoinformation

Landesarchiv Berlin
www.landesarchiv-berlin.de

Brandenburg
Landesvermessung und Geobasisinformation Brandenburg
www.geobasis-bb.de

Brandenburgisches Landeshauptarchiv
www.landeshauptarchiv-brandenburg.de

Bremen
GeoInformation Bremen
www.geo.bremen.de

Staatsarchiv Bremen
www.staatsarchiv.bremen.de

Hamburg
Landesbetrieb Geoinformation und Vermessung
www.geoinfo.hamburg.de

Staatsarchiv der Freien und Hansestadt Hamburg
www.hamburg.de/staatsarchiv

Hesse
Hessisches Landesamt für Bodenmanagement und Geoinformation
www.hvbg.hessen.de

Hessisches Landesarchiv
www.archive.hessen.de

Mecklenburg-Vorpommern
Amt für Geoinformation, Vermessungs- und Katasterwesen
www.lverma-mv.de

Landesarchiv Mecklenburg-Vorpommern www.kulturwerte-mv.de

Lower Saxony
Landesvermessung und Geobasisinformation
www.lgln.niedersachsen.de

Niedersächsisches Landesarchiv
www.nla.niedersachsen.de

North Rhine-Westphalia
Bezirksregierung Köln
Abteilung Geobasis NRW
www.geodatenzentrum.nrw.de

Landesarchiv Nordrhein-Westfalen
www.lav.nrw.de

Rhineland-Palatinate
Landesamt für Vermessung und Geobasisinformation Rheinland-Pfalz
www.lvermgeo.rlp.de

Landeshauptarchiv Rheinland-Pfalz
www.landeshauptarchiv.de

Saarland
Landesamt für Vermessung, Geoinformation und Landentwicklung
www.lvgl.saarland.de

Archiv des Saarlandes
www.saarland.de/landesarchiv

Saxony
Staatsbetrieb Geobasisinformation und Vermessung Sachsen
www.geosn.sachsen.de

Sächsisches Staatsarchiv
www.staatsarchiv.sachsen.de

Saxony-Anhalt
Landesamt für Vermessung und Geoinformation Sachsen-Anhalt
www.lvermgeo.sachsen-anhalt.de

Landeshauptarchiv Sachsen-Anhalt
www.lha.sachsen-anhalt.de

Schleswig-Holstein
Landesamt für Vermessung und Geoinformation Schleswig-Holstein
www.lvermgeosh.schleswig-holstein.de

Landesarchiv Schleswig-Holstein
www.lash.schleswig-holstein.de

Thuringia
Landesamt für Vermessung und Geoinformation
www.thueringen.de/vermessung

Thüringische Staatsarchive
www.thueringen.de/staatsarchive