**Generic ALB Technical Specification – Version 2025.1**

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Dette document fungerer som et samlet Terms of Reference og Technical Specification.   
  
Malen tar utgangspunkt i ALB Evalueringsprosjektet og er videreforedlet av NVE.

Tilbakemelding gis til via ‘issues’ i Gitlab eller ved direkte epost til [amb@nve.no](mailto:amb@nve.no) og/eller [christian.malmquist@kartverket.no](mailto:christian.malmquist@kartverket.no)

In connection with natural hazards mapping, safety measures and analyses of environmental conditions in and along watercourses, good terrain data is needed both above and below water, such as for river beds, lake beds, riverbanks and adjoining areas of land.

This Specification of Requirements covers the special requirements that have been set for technical equipment, type and scope of data collection, data processing and data deliveries. It also covers the documentation and reporting of the data collection, processing, project follow-up and results.

# Area Description

List areas to be mapped.

Include a clear unique ID that link to the attached polygon file.

# Requirements for collecting data and deliveries

## General information about requirements for methodology and proposed solutions

The lake and riverbed mapping must be carried out using an Airborne LiDAR Bathymetry (ALB) system that will provide the best basis for the best possible coverage of riverbeds, shallows, low water zones and riverbanks, as well as terrain formations on land. It is important to ensure some overlap between land and aquatic areas and topographic lidar acquisition will be required for land. The following chapters set out expectations regarding product standards, quality, point density, accuracy, data deliveries and documentation.

The tender must include a description of the proposed solutions with respect to the procedure from planning start-up to final delivery. The tender document must show that the contractor is able to deliver data that satisfies the described requirements for data collection, processing and collation of the data and data deliveries, and reporting. It is up to the contractor to assess the best ALB platform for the various stretches such that the requirements for delivery, quality and point density can be best met and that the maximum recommended flying altitude for the specified ALB system must not be exceeded.

These websites can be of help in analyzing which areas probably need the use of MBES:

* <https://norgeibilder.no>   
  Access to aerial images, which give indications about depth and visibility of the rivers
* <https://temakart.nve.no/tema/tverrprofil>  
  Access to bathymetric profiles of some of the rivers and for some stretches.
* <https://hoydedata.no/>   
  Terrain models and point clouds of neighboring terrain and possible existing bathymetric data.

## Requirements for mapping with ALB/ALS systems

### Product standards

Unless otherwise is described in this Specification of Requirements, the ALB/ALS survey must follow these product standards:

* The acquisition, processing and reporting, must be carried out according to the general requirements given in [*“Standard for geografisk informasjon: Produksjon av basis geodata 2.0”*](https://sosi.geonorge.no/Standarder/Produksjon_av_Basis_geodata/2.0/), chapter 7.
* The deliverables must meet the general requirements for ALB/ALS point clouds as stated in [“Produktspesifikasjon: Punktsky 1.0.2” *[Product Specification: Point cloud 1.0.2]* (current version)](https://sosi.geonorge.no/produktspesifikasjoner/Punktsky/) and the point cloud must meet the accuracy requirements and point density requirement for a category [Psky\_1\_ALB\_B](https://sosi.geonorge.no/produktspesifikasjoner/Punktsky/#trueluftb%C3%A5ren-batymetrisk-lidar) for ALB and category [Psky\_1\_ALS\_B](https://sosi.geonorge.no/produktspesifikasjoner/Punktsky/#trueluftb%C3%A5ren-topografisk-lidar) for ALS.

### Planning of the mapping campaign

The appropriate scanning campaign shall be planned in line with [*“Standard for geografisk informasjon: Produksjon av basis geodata 2.0”*](https://sosi.geonorge.no/Standarder/Produksjon_av_Basis_geodata/2.0/), unless otherwise is specified. The bidder shall prepare complete flight plans, including planned control surfaces and cross beds for the laser scanning. These must be appended to the tender as PDF files.

### Control surfaces, control profiles and cross lines

In order to remove a potential vertical datum shift, the contractor must test the point cloud using GCPs inside control surfaces, which must be surveyed and documented within each individual stretch that is mapped. This must comply with the requirements (“krav” in Norwegian) no. 34, 35, 36 in the standard: [*“Standard for geografisk informasjon: Produksjon av basis geodata 2.0”*](https://sosi.geonorge.no/Standarder/Produksjon_av_Basis_geodata/2.0/#krav-34-kontrollflate-ant-plassering).

For surveys utilizing alternative processing approaches, the contractor must describe how they will use the GCPs in processing in order to ensure a rigid and accurate pointcloud.

In order to identify a potential horizontal datum shift the contractor must test the pointcloud using GCPs inside control profiles, which must be surveyed and documented within each individual stretch that is mapped. This must comply with the requirements (“krav” in Norwegian) no. 37, 38, 39 in the standard: [*“Standard for geografisk informasjon: Produksjon av basis geodata 2.0”*](https://sosi.geonorge.no/Standarder/Produksjon_av_Basis_geodata/2.0/#krav-37-kontrollprofiler-ant-plassering).

For classical ‘lawnmower’ surveys crosslines are required to strengthen the strip adjustment. For ‘corridor surveys’, following a valley bottom or a river, the contractor must describe how they will ensure a rigid and accurate point cloud without the use of crosslines.

### Point cloud accuracy requirements

In addition to the accuracy requirements listed in [Produktspesifikasjon: Punktsky 1.0.2 (geonorge.no)](https://sosi.geonorge.no/produktspesifikasjoner/Punktsky/) for the categories [Psky\_1\_ALB\_B](https://sosi.geonorge.no/produktspesifikasjoner/Punktsky/#trueluftb%C3%A5ren-batymetrisk-lidar) for ALB and category [Psky\_1\_ALS\_B](https://sosi.geonorge.no/produktspesifikasjoner/Punktsky/#trueluftb%C3%A5ren-topografisk-lidar) for ALS, this has to be followed:

* To ensure no datum shift between the point cloud delivery and the surrounding Norwegian National Elevation Model, each area must be tested and adjusted to fit the current terrain model in each area. The reference point clouds are available for download at <https://hoydedata.no/>. The finale report (see chapter 2.8) must state the agreement between the point cloud and the national elevation model both pre and post adjustment. The National Elevation point clouds used in the adjustment must be listed in the report. This must comply with the requirements (“krav” in Norwegian) no. 43 and 44 in the [*“Standard for geografisk informasjon: Produksjon av basis geodata 2.0”*.](https://sosi.geonorge.no/Standarder/Produksjon_av_Basis_geodata/2.0/#krav-41-dokumentasjon-daglig-kalibrering)

### Point cloud processing

The contractor needs to document the approach to strip adjustment ensuring point cloud rigidity and accuracy, see requirements no. 41 and 42 in the [*“Standard for geografisk informasjon: Produksjon av basis geodata 2.0”*](https://sosi.geonorge.no/Standarder/Produksjon_av_Basis_geodata/2.0/)*.*

### Point cloud verification

In order to identify poor strip adjustment a dH plot (homogeneity plot) must be produced showing the strip-to-strip difference in height. Document the agreement between the point cloud and the existing terrain in the national elevation database (NDH). See requirement no. 45 in the [*“Standard for geografisk informasjon: Produksjon av basis geodata 2.0”.*](https://sosi.geonorge.no/Standarder/Produksjon_av_Basis_geodata/2.0/#krav-45-dokumentasjon-kontroll-punktsky)

## Point cloud density Requirements

The acquisition must be carried out in a way ensuring the following point density requirement:

* Minimum point density of 5 points/m2. This applies both for terrain data above water (class 2) and for classified seafloor / riverbed points (class 40).
* Minimum point density must be met for 80% of all 2m x 2m cells within a 10m x 10m area ([Produktspesifikasjon: Punktsky 1.0.2 (geonorge.no)](https://sosi.geonorge.no/produktspesifikasjoner/Punktsky/" \l "truekrav-til-punkttetthet), chapter 7.1). NB! Be aware that this deviates from what the [Produktspesifikasjon: Punktsky 1.0.2 (geonorge.no)](https://sosi.geonorge.no/produktspesifikasjoner/Punktsky/#truekrav-til-punkttetthet) requires for category Medium/B (Psky\_1\_ALS\_B, Psky\_1\_ALB\_B and Psky\_1\_MBES\_B). For ALB, the density requirement applies to 2m below the water surface at the time of data capture, and we are aware that the density will decrease with increased depth.

## Height and projected coordinate reference

The following applies to all data deliveries in this project:

Projected coordinate reference: XY: EUREF89 UTM32N

Height datum: NN2000 (based on the current HREF version at time of acquisition)

## Data deliveries

Data delivery shall include the following:

1. LAZ files that cover the entire mapping area (common for multibeam, ALB and ALS), delivery divided by map sheet (1:1000) and as described in [Produktspesifikasjon: Punktsky 1.0.2 (geonorge.no)](https://sosi.geonorge.no/produktspesifikasjoner/Punktsky/#trueleveranse-punktsky), chapter 11.1.   
     
   The classification must be done according to the following minimum classes:

(see also chapter 14 Appendix A in [Produktspesifikasjon: Punktsky 1.0.2](https://sosi.geonorge.no/produktspesifikasjoner/Punktsky/#trueappendix-a-punktsky-klasseinndeling).)

1 – Unclassified points on land

2 – Ground - Terrain points on land  
7 - Noise

17 – Bridge Deck  
21 - Snow

40 – Seafloor / riverbed Bathy

41 – Water surface Bathy (sea/river/lake surface elevation at time of data acquisition)

NB! Be aware that this deviates from what the [Produktspesifikasjon: Punktsky 1.0.2 (geonorge.no)](https://sosi.geonorge.no/produktspesifikasjoner/Punktsky/#trueluftb%C3%A5ren-batymetrisk-lidar) requires, as it also has classes 42 and 45 as compulsory classes.

1. Orthophoto – the contractor must strive to deliver orthophoto based on images collected at the same time as the laser scanning. If the date of data collection is during early winter, this requirement is not absolute and should be discussed with the client before planned data collection. The orthophotos shall comply with the requirements for temporary orthophoto stipulated in chap. 8.6.4 in [“Produktspesifikasjon for ortofoto” *[Product Specification for Orthophotos]*](https://register.geonorge.no/data/documents/Produktspesifikasjoner_digitale-ortofoto_v8_produktspesifikasjon-for-ortofoto-v5-0-geodata_.pdf), current version. Request for GSD of 0.1m, minimum requirement for GSD of 0.25m. The contractor must specify the resolution (GSD) it can deliver in its tender.   
     
   The ortophoto must be delivered as a GeoTIFF with JPG compression. The complete delivery must comply with the requirements set by the [“Norge i bilder”](https://norgeibilder.no/) (norgeibilder.no) upload management solution.
2. RGB colored point cloud for the entire mapping area, using the RGB values from the imagery.
3. The following rasters must be produced from the obtained point clouds and delivered as a lossless compressed GeoTiffs:

* Density Grid (Class 2 and 40) at 2x2m resolution
* 1m DTM grid generated from a TIN model (natural neighbors)   
  based on Class 2 and 40
* 25cm DTM grid generated from a TIN model (natural neighbors)   
  based on Class 2 and 40

1. Delivery of the ALB and ALS data must comply with the Norwegian national management solution [hoydedata.no](https://hoydedata.no/), as described in [Produktspesifikasjon: Punktsky 1.0.2 (geonorge.no)](https://sosi.geonorge.no/produktspesifikasjoner/Punktsky/#trueleveranse) chapter 11. This includes all necessary data and metadata about the project:
   * + Delivery of point cloud, see [chapter 11.1](https://sosi.geonorge.no/produktspesifikasjoner/Punktsky/#trueleveranse-punktsky).
     + Metadata, see [chapter 11.2.](https://sosi.geonorge.no/produktspesifikasjoner/Punktsky/#trueleveranse-metadata)
2. Metadata – coverage overviews and flightlines for each individual mapping area must be delivered in SOSI and shapefile format (ESRI).
3. Map overview of data holes larger than c. 50 m2 (polygon) for each individual mapping area that documents any missing data due to failures or other reasons for missing data with a unique reference to textual explanation in the report. The polygons must be delivered in SOSI, shapefile format or ESRI file geodatabase.

## Final report

A final report written in Norwegian (bokmål) or English in PDF format (without read-only protection). The LiDAR survey shall be documented in accordance with the requirements set out in [*“Standard for geografisk informasjon: Produksjon av basis geodata 2.0*](https://sosi.geonorge.no/Standarder/Produksjon_av_Basis_geodata/2.0/#tab-rapport-laserskanning)*”* chapter 7.5.

In addition, the report shall clearly document whether the results meet the specified point density and accuracy requirements. In any areas where these requirements are not met, the report shall provide a detailed explanation of the underlying causes - particularly in cases of reduced depth range or point density in the ALB point cloud. It is essential that the contractor explicitly states why such reductions occur. The comments must be linked to the polygon file showing holes larger than 50 m2.

# Project execution / project follow-up

## Deadline for deliveries

The deadline for data collection has been set to 15th of May 2024. Contractors will have a maximum of two weeks to fix problems after feedback on the delivery is provided from the client. See also chap. 3.2.

What the trial delivery shall include can be agreed in more detail when the contract is entered into.

|  |  |  |
| --- | --- | --- |
| **Delivery** | **Deadline Area 1** | **Deadline Area 2** |
| Absolute deadline for data collection | 15.05.2024 | 01.07.2024 |
| Trial delivery of sub-areas, processed ALB data, including status meetings with Contracting Authority | 10.06.2024 | 01.08.2024 |
| Feedback on trial delivery from Contracting Authority | Two weeks after trial delivery | Two weeks after trial delivery |
| Final delivery | Two weeks after feedback from Contracting Authority on trial delivery | Two weeks after feedback from Contracting Authority on trial delivery |

## Date and time of measurement work / data collection

The contractor is responsible for planning the data collection so that it takes place at the best possible time for measurements in relation to weather, water discharge, ice, vegetation conditions, etc. Importantly, data collection must be carried out when there is no flooding. Contractors should therefore exhibit some flexibility regarding the timing of data capture, and must plan the best time for data capture in close consultation with Contracting Authority. The Contracting Authority must be informed a reasonable time in advance of the planned time for data capture.

The degree of flexibility regarding the timing of data collection and mobilisation times will form part of the score assigned to execution capacity under the point regarding quality, see also chap. 4 in the Tender Documentation. This will thus have a positive effect for contractors who can point to a high degree of flexibility and short mobilisation times in their tenders. Mobilisation time here means how quickly a contractor can deploy its crew and equipment and thus have an opportunity to carry out data collection when an approved data collection window opens up.

Information about water flow and prognoses can be found on <https://sildre.nve.no/> and on <http://www.xgeo.no/?p=flomogjordskred>, and flood warnings on <https://varsom.no/>.

Data collection must be carried out when there is no risk of ice. If the contractor face difficulties to collect data before the deadline for data collection, the contractor must contact the client to discuss whether all or part of the project should be cancelled or continued.

## Contact person in Contracting Authority and information for municipalities

The contractor will receive the name, telephone number and email address of a contact person in Contracting Authority.

Contracting Authority will inform the municipalities about the start-up work.

Before data collection starts for each stretch of river or lake, Contracting Authority will send a defined text message to the municipalities concerning the survey works and concerning possible traffic on properties that the individual municipalities can publish on the municipality’s website.

## Project follow-up

During the entire project and up to delivery, the contractor shall keep the client continuously informed of its progress, as well as any factors of relevance for the execution, quality and delivery at the right time.

Start-up meetings via videoconferencing are planned (preferably Teams). Time must also be set aside for up to three videoconferencing meetings with the client during execution of the project.

The contractor must submit short status “reports” (email is sufficient) on a weekly basis, preferably every Friday. As a minimum, these must contain a short summary of the status of the measurement work, processing of data, and preparation of deliveries or the reasons for any lack of data collection, as well as an overview of mapped areas for each stretch (screenshot attached to the email is sufficient). The report/email must also provide information about activities planned for the current week.

The contractor shall, within a reasonable space of time, and a maximum of one week, inform the client of any challenges relating to the collection of data due to rapids, ponds, vegetation, shallow areas, weather, ice, etc.