Government of Western Australia
Department of Transport
and Major Infrastructure

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Generic UAV/Drone Survey and Images Specification

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Prepared for Department of Transport and Major Infrastructure (DTMI)

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Version control

Version No.	Date	Prepared by	Revision or issue descriptions	Issues to
Draft	10/04/2025	M P Rogers & Associates	Combined Draft for DoT review.	DoT
0	14/05/2025	M P Rogers & Associates	Updated with Client comments and issued for Client use.	DoT
1	23/06/2025	DoT	Additional updates from internal review	DTMI

Amendment record

This guidelines document is reviewed to ensure its continuing relevance to the systems and process that it describes. A record of contextual revisions is listed in the following table.

Page No.	Context	Revision	Date

Contents

Note

[This UAV/drone monitoring specification can be completed in-house if the LGA has capacity. Alternatively, this specification can be repurposed as a scope to assist procurement of a suitably qualified contractor(s). It is envisaged that this specification may be used in conjunction with the hydrographic survey scope. Combining this monitoring is likely to increase usable results and produce potential cost savings compared to completing them separately. This combination would require suitably merging both documents to include the hydrographic survey requirements. The hydrographic survey scope is available on DoT's website.

There is a possibility of cost sharing if surveys can be completed together with other costal managers. The LGA is encouraged to consult further with DoT to discuss their surveying capacity and/or history, as they regularly complete terrestrial surveying of coastal areas around the state.]

Formatting Key

[Throughout this template three text colours have been used to distinguish between the following items.]

1. Recommended content.
2. [Guidance notes for the user to be deleted prior to use.]
3. Example text to be edited by the user prior to use.

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Aim / Objectives

[The purpose of aerial UAV/drone surveying is to support coastal monitoring efforts by LGAs. UAVs/drones provide cost-effective, high-resolution imagery and surveys that enhance shoreline change assessments, vegetation mapping, and sediment transport analysis. This data supports informed decision-making regarding coastal management and adaptation strategies.

The use of aerial UAV/drone surveying or imagery collection can be utilised as part of other coastal monitoring tasks to allow for cost savings. The following components of monitoring tasks can be completed in-house by UAV/drone using this specification, if the LGA has capacity. Alternatively, this specification can be repurposed as a scope to assist procurement of a suitably qualified contractor(s).

- Coastal structure inspection and assessment:
  - Terrestrial survey of the structure.
  - Aerial images of the structure.
- Terrestrial Surveying:
  - Survey of above-water coastline and orthorectified aerial imagery capture.
- Profile Surveys:
  - Terrestrial survey components to allow for profile surveys to be extracted.
- Photographic Monitoring:
  - Oblique and vertical aerial imagery for visual monitoring of change.
- Volume Change Analysis:
  - Terrestrial survey components allow cut/fill analysis to be undertaken to determine beach volume changes between surveys.
- Benthic Habitat Surveys:
  - Orthorectified aerial images for use in assessing habitat areas or change.
- Shoreline Mapping:
  - Orthorectified aerial images for use in mapping the shoreline.
- Storm Monitoring:
  - Terrestrial survey.
  - Orthorectified aerial images for use in mapping the shoreline.
  - Oblique and vertical aerial imagery for visual monitoring of change.
  - Cut/fill analysis to determine beach volume change before/after storms.

The LGA should determine the requirements and intended use of UAV/drone surveying and adjust this specification accordingly. This specification could also be combined as part of the other specifications or scopes available on DoT's website, based on the LGAs requirements.

Any aerial UAV/drone survey program should be reviewed at least annually to assess data accuracy, refine methodologies, and adapt to changing coastal conditions. Adjustments should be made based on new technology and LGA priorities.]

Aerial UAV/drone surveys aim to capture accurate and repeatable coastal data, supporting coastal monitoring and management. These Surveys and images are to be used as part of [LGA to detail the intended use e.g. storm monitoring]. The objectives are as follows.

- Capturing baseline conditions of the coastline.

- Monitoring shoreline movement, dune erosion, volumetric change and sediment transport.
- Assessing vegetation line changes and foreshore stability.
- Identifying coastal hazards and risks and their effects.
- Providing georeferenced aerial imagery.
- Supporting strategic coastal planning and adaptation measures.
- Collecting LiDAR survey of the foreshore area*.
- [The intended use of the survey or orthorectified imagery should be detailed here]

The LGA will need to confirm what tasks are within its capacity and scale the required tasks appropriately.

*Note: LiDAR surveying is a useful, though expensive survey option that well exceeds the costs for collection and analysis of photogrammetric and topographic data. Most LGA surveying needs do not generally necessitate LiDAR data collection. However, if this is deemed important by the LGA, then pre-scoping advice from a suitably qualified contractor is recommended before proceeding further.

Legal and Safety

[LGAs must ensure compliance with all relevant regulations when conducting UAV/drone surveys. This includes Civil Aviation Safety Authority (CASA) regulations, privacy laws, and occupational health and safety requirements.]

Aerial UAV/drone operations must adhere to the following requirements.

- Civil Aviation Safety Authority (CASA) Regulations: Operators must hold a Remote Pilot Licence (RePL), be operating under a Remotely Piloted Aircraft Operator's Certificate (ReOC) or be accredited by CASA. All flights must comply with Part 101 of CASA's regulations.
- UAV/Drone registration: All UAV/drones must be registered through CASA.
- Flight Restrictions: Surveys must not be conducted in restricted airspace without appropriate approvals. Coastal areas near airports or controlled zones may require specific permissions.
- Public Safety and Privacy: All operations must consider public safety, ensuring flights are conducted away from populated areas where possible. Privacy laws must be adhered to as and when they become applicable now or into the future.
- Insurance and Liability: UAV/Drone operations must be covered by appropriate public liability insurance.
- Risk Assessments and Safe Work Procedures: LGAs must implement risk management plans, including job safety analyses (JSAs) or Safe Work Method Statements (SWMS).

Extent

[This section should define the specific coastline to be monitored and include a map of the survey area. LGAs should provide details on key monitoring locations and parameters. The selection of the survey extent should be based on required survey outcomes.]

The LGA manages approximately XX km of coastline, from XXX to XXX. Aerial UAV/drone surveys will focus on the following priority monitoring areas of foreshore.

- Survey Area 1. [Include the LGAs specific locations]
- Survey Area 2.

The location and extent of the survey is presented in the following figure.

Figure 1 Example UAV/drone survey extent. [Example location at Denham from Shire of Shark Bay CMAP.]

The surveys will need to consider the following components when confirming the extent.

- The survey area shall cover the foreshore area and extend 50 to 100m behind the primary dune.
- The survey area must contain suitable coverage of Ground Control Points (GCPs) to allow for accurate orthorectification of imagery.
- UAV/drone flight paths shall be planned to ensure safe, comprehensive and repeatable data collection.
- [The intended use (and repetition if required) of the survey or orthorectified imagery should be detailed here.]

Tasks

[Tasks can generally include the following components. However, the LGA should tailor tasks and requirements accordingly to match their needs and available resources.]

The following tasks must be undertaken as part of the aerial UAV/drone survey.

1. Task 1 – Pre-Flight Planning
2. Task 2 – UAV/Drone Deployment and Data Collection
3. Task 3 – Post-Processing and Data Analysis
4. Task 4 – Data Storage and Reporting

These tasks are expanded on below.

Task 1 – Pre-Flight Planning

Pre-flight planning is essential to ensure efficient and effective data collection. Before deploying the UAV/drone, monitoring locations must be identified based on historical data and areas of interest. Flight paths should be carefully designed to ensure sufficient image overlap, particularly if orthorectification or surveying is required. Risk assessments must be conducted to identify potential hazards, and all necessary approvals should be obtained. Additionally, compliance with CASA regulations and local restrictions must be confirmed before flights commence. Before proceeding, confirm wider LGA approval following flight plan completion, to ensure that everything needed is captured.

Task 2 – UAV/Drone Deployment and Data Collection

Once pre-flight planning is complete, the UAV/drone is to be deployed within the designated survey areas. GCPs should be placed immediately before take-off and recorded to improve spatial accuracy. High-resolution aerial imagery should be captured at a consistent flight altitude to maintain uniform data quality, with a minimum Ground Sample Distance (GSD) of 10 cm. The UAV/drone should have real-time positioning and metadata logging enabled to facilitate GIS integration and accurate post-processing. Imagery capture should coincide with low tide to ensure maximum morphology coverage.

Task 3 – Post-Processing and Data Analysis

Following data collection, aerial images are processed using photogrammetry software such as Pix4D or Agisoft Metashape to generate orthorectified images and DSMs or other required outcomes. If required, analyses of changes can be conducted to assess shoreline movement, dune morphology, volumetric change and vegetation shifts. Trend analysis can also be performed by comparing newly acquired data with historical datasets. The level of post-processing should be tailored to the LGA's specific monitoring requirements and capability. It is expected that most of the processing and analysis will be completed by experienced and suitably qualified personnel.

Task 4 – Data Storage and Reporting

All collected data must be securely stored in a centralised GIS database or other suitable storage solution. The results of surveys should be standardised to allow for consistent, detailed analysis by experienced coastal engineers. This will allow for regular monitoring reports to be prepared, including key findings, comparative imagery and analysis of coastal changes. Any reporting of results should be shared with relevant coastal management stakeholders to support decision making and long-term planning. The LGA should ensure all data remains accessible for future use and analysis.

Methodology

[LGAs should adapt this methodology based on their specific monitoring requirements and available resources.]

UAV/drone surveying and orthorectified aerial imagery capture should be completed following a methodology similar to the one outlined below. The individual UAV/drone and LGA requirements should be included if known, as these aspects are unique to the equipment and LGA. [LGA to include the individual UAV/drone and equipment requirements if known].

1. Review and confirm monitoring and survey locations.
2. Review and confirm the required data to be captured.
3. Confirm and comply with all WHS requirements including CASA requirements.
4. Plan flight and ensure compliance with CASA and local regulations.

5. Deploy UAV/drone and undertake image and survey capture.
   - Deploy GCPs to ensure appropriate accuracy.
   - Capture aerial imagery with appropriate resolution (minimum 10 cm GSD).
   - Maintain a set flight altitude for consistent data collection (refer manufacturer guidelines).
   - Ensure enabled real-time positioning and metadata logging for GIS integration.
6. Process imagery using photogrammetry software (e.g. Pix4D, Agisoft, Metashape) to generate orthomosaics and DSM, QA/QC and extract any required data from the surveys. If LiDAR data capture is required, this will necessitate additional specialised processing software.
7. Repeat survey and image capture as required.
8. Conduct an analysis of shoreline, dunes, volume, and vegetation shifts.
9. Review changes and assess buffer distances.

Equipment

[The LGA must define the required equipment based on their specific needs and capabilities.]

The following minimum specifications and/or capabilities are required for the collection of the orthorectified aerial images and surveys.

- Multirotor or fixed-wing UAV/drone with a high-resolution camera that meets the following minimum criteria (noting finer resolution and stricter tolerance is recommended for structural inspections):
  - Horizontal Resolution: 10cm or finer
  - Vertical Tolerance: +/- 10cm or lower
  - Horizontal Tolerance: +/- 10cm or lower
- GCPs applied to a suitable level of coverage and referenced onsite to known survey markers (refer here for survey marker locations: Landgate Map Viewer Plus).
- Flight endurance capability that allows for surveying large coastal areas (e.g. swap in/swap out of batteries mid-survey via return to home functionality).
- Automated flight planning software for consistent coverage.
- Data storage and processing software (e.g. Pix4D, Agisoft Metashape).

The following additional capabilities/equipment can be included that may improve survey outcomes in some circumstances.

- GPS-enabled UAV with RTK capability for accurate georeferencing e.g. where GCP placement/availability/use is difficult.
- [LGA to note any bespoke equipment if relevant e.g. LiDAR capability.]

Costs and Personnel

[Costs and personnel requirements will vary based on the scale of monitoring and available resources. The LGA will need to adjust the following aspects of the specification to relate the LGAs requirements.]

Aerial UAV/drone surveys require at least one trained personnel for deployment, data capture, and analysis. Further costs may include the following components.

- UAV/Drone equipment procurement or hire.
- Licensing and insurance costs.

- Data processing, QA/QC and storage expenses.
- Staff training or external contractor fees.
- Additional staff costs if spotter requirements are directed by the LGA/contractor.

Deliverables

[The LGA will need to adjust the following aspects of the specification to relate the LGAs requirements.]

The deliverables of the survey will include the following.

- Flight plan used for the survey and all metadata including QA/QC results and error flags.
- Georeferenced aerial imagery (orthomosaic format).
- Change detection analysis reports (if for a repeat survey).
- Previously available DSMs where applicable.
- [Include any analysis as required.]