Government of **Western Australia**
Department of **Transport**
and Major Infrastructure

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Generic Storm Monitoring 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	6/06/2025	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

Formatting Key

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

1. Required 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 aim of storm monitoring is to collect data to assess the effect a storm has on the LGA's coast. This can often entail observations of extreme erosion events. Multiple monitoring techniques can be implemented to complete the storm monitoring and can be used for different objectives, which may include the following.

- Capture the condition of the shoreline before the storm.
- Capture the conditions experienced during the storm.
- Observe and determine the short-term changes caused by the storm, including:
  - Vegetation line recession.
  - Sediment movement volume.
  - Change in beach profile.
  - Reduction in buffer distances.
- Provide visual evidence of changes.
- Identify risks and changes at strategic locations.
- Calibration of storm erosion modelling.

These monitoring tasks can be scaled depending on the individual capacity of the LGA. Collection of storm monitoring data is generally aimed at capturing short-term changes that a storm can have on the LGA's coast and is used to guide appropriate management decisions.]

Storm monitoring aims to obtain records of the effect a storm has on the LGA's coastline, especially at areas of concern. This is expected to be completed through some combination of photographic monitoring, survey transects, aerial imagery and/or metocean data collation. The objectives and purpose of storm monitoring generally include the following.

- To capture the condition of the shoreline before the storm.
- To capture the conditions experienced during the storm.
- To observe and determine the short-term changes caused by the storm.
- To provide visual evidence of changes.
- To identify risks and changes at strategic locations.

The tasks undertaken can be scaled to the requirements of the LGA.

To complete these monitoring objectives, multiple monitoring activities can be used. The following tasks can be completed as part of the storm monitoring. [Relate to the following tasks to those outlined below and that the LGA can complete.]

- Photographic monitoring.
- Beach survey transects.
- UAV/drone surveys.
- Orthorectified aerial images and vegetation line mapping.
- Metocean data analysis.
- Aerial imagery

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

Extent

[Provide a map of the area including the locations of the individual monitoring points and tasks. Provide a table of the required monitoring points and tasks. This can also reference other specifications such as photographic monitoring if they contain the required information and are already completed. Refer to DoT's website for these other specifications.

The location of storm monitoring points should be determined by an experienced coastal engineer and presented in a CMAP. If the LGA is selecting the monitoring points, previous points and the recommendations outlined in the specific monitoring activity specifications or scopes, available on DoT's website should be considered. The locations should be selected to be representative of the shoreline and allow monitoring of changes to the LGA's coast. This specification does not include the selection of monitoring points.]

The LGA manages approximately XX km of coast, stretching from XXX to XXX. Within this section of the coast, the LGA is specifically monitoring the following areas.

- Storm monitoring area 1. [Include the LGA's priority areas]
- Storm monitoring area 2.

At these key locations, storm monitoring is recommended. The required tasks and locations can be observed in the following figure and table. For the survey component, capture may include tasks detailed in the associated specifications on DoT's website (i.e. UAV/drones and/or beach transects).

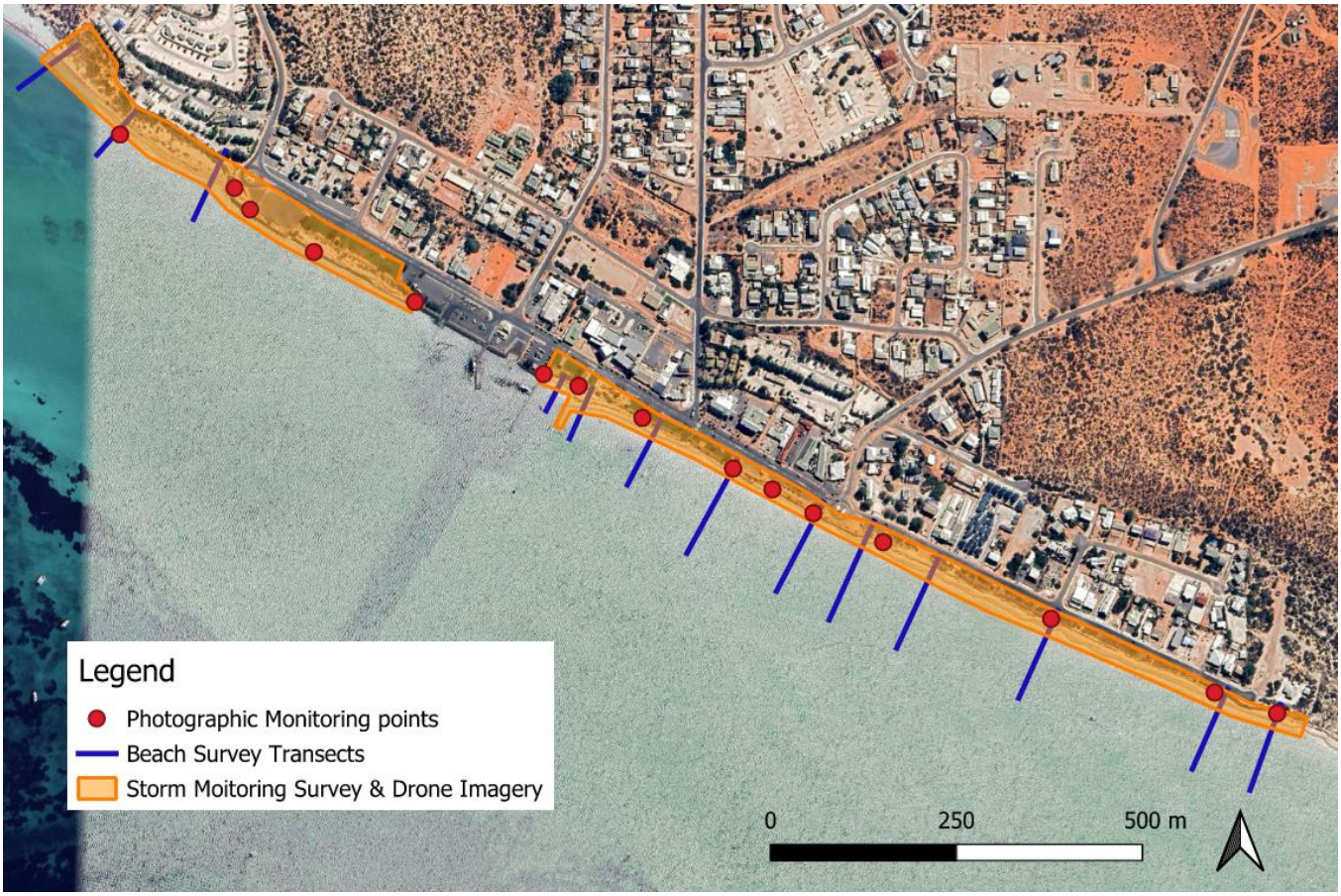

Figure 1 Area 1 Storm Monitoring Points. [Example at Denham from the Shire of Shark Bay CMAP.]

Table 1 Area 1 Photographic Monitoring Points. [Example at Denham from the Shire of Shark Bay CMAP.]

Photographic Monitoring Points					
Point	**Easting**	**Northing**	**Location Description**	**Direction**	**FOV**
1	754797	7129322	East end of Knight Terrace.	Southeast	LHS includes dune and beach.
				Northwest	RHS includes revetment and gazebo.
2	754713	7129350	Beach opposite 151 Knight Terrace.	Southeast	LHS includes revetment and gazebo.
				Northwest	RHS includes foreshore.
3	754493	7129449	Beach opposite Fry Cresent.	Southeast	LHS includes foreshore.
				Northwest	RHS includes foreshore.
4	754267	7129552	Southeast of Denham Road.	Southeast	LHS includes foreshore.
				Northwest	RHS includes revetment and foreshore.
5	754173	7129591	Northwest of Denham Road.	Southeast	LHS includes beach, revetment and foreshore.
				Northwest	RHS includes beach, revetment and foreshore.
6	754118	7129623	Beach opposite 89 Knight Terrace.	Southeast	LHS includes beach, revetment and foreshore.
				Northwest	RHS includes beach, revetment and foreshore.
7	754065	7129651	Beach at the Southeast end of Gordon Peters Park.	Southeast	LHS includes beach, revetment and foreshore.
				Northwest	RHS includes beach, revetment and foreshore.
8	753943	7129719	Beach opposite 67 Knight Terrace.	Southeast	LHS includes beach, revetment and foreshore.
				Northwest	RHS includes beach, revetment and foreshore.
9	753857	7129762	Beach at the sheet pile groyne.	Southeast	LHS includes beach and foreshore.
				Southwest	Captures the sheet pile groyne.
				Northwest	RHS captures beach and wall.
10	753810	7129778	Denham Recreation Jetty.	Southeast	LHS includes beach and foreshore.
				Northwest	RHS includes revetment and foreshore.
11	753637	7129875	Northern end of the granite revetment.	Southeast	LHS includes the revetment.
				Northwest	RHS includes revetment and foreshore.

Photographic Monitoring Points					
Point	**Easting**	**Northing**	**Location Description**	**Direction**	**FOV**
12	753501	7129942	Foreshore fronting George Wear Park.	Southeast	LHS includes beach, revetment and foreshore.
				Northwest	RHS includes beach, revetment and foreshore.
13	753415	7129999	Northern end of the boat ramp carpark.	Northwest	Includes beach, revetment end and foreshore.
14	753394	7130028	Northern end of the Revetment.	Northwest	Includes beach, revetment end and foreshore.
15	753240	7130100	Beach north of Denham.	Southeast	LHS includes beach and foreshore.
				Northwest	RHS includes beach and foreshore.

Table 2 Area 1 Photographic Monitoring Points. [Example at Denham from the Shire of Shark Bay CMAP.]

Transect Name	**Start Location**		**End Location**	
	Easting	**Northing**	**Easting**	**Northing**
SoSB BST 1	153808.94	7127237.41	153772.82	7127120.81
SoSB BST 2	153736.35	7127254.74	153693.74	7127145.71
SoSB BST 3	153503.32	7127349.73	153456.01	7127230.24
SoSB BST 4	153340.68	7127416.95	153288.68	7127289.87
SoSB BST 5	153250.31	7127459.24	153196.14	7127323.51
SoSB BST 6	153180.61	7127481.63	153123.55	7127358.89
SoSB BST 7	153062.72	7127531.19	153000.61	7127404.48
SoSB BST 8	152956.91	7127579.93	152916.46	7127492.56
SoSB BST 9	152862.90	7127620.44	152835.82	7127551.13
SoSB BST 10	152824.26	7127634.52	152802.59	7127587.23
SoSB BST 11	152355.05	7127916.25	152316.58	7127822.64
SoSB BST 12	152234.80	7127967.59	152182.61	7152182.61
SoSB BST 13	152073.28	7127988.19	152149.22	7128049.77

[include other storm monitoring priority locations]

Surveying and aerial image collection should capture the area to the landward side of the survey extent shown in the above image.

Tasks

[The storm monitoring can be scaled based on the individual requirements and capacity of an LGA. the following tasks should be scaled and adapted based on the individual requirements and capacity of the LGA]

The following tasks can be completed by the LGA to conduct storm monitoring of the LGAs coast.

- Task 1 – Conduct photographic monitoring.
- Task 2 – Conduct Beach survey transects (optional).
- Task 3 – Conduct UAV/drone surveys (optional).
- Task 4 – Capture aerial imagery (optional).
- Task 5 – Collate metocean conditions.
- Task 6 – Review and analysis.

The LGA will have to consider its internal capacity and scale the storm monitoring appropriately. The storm monitoring can be reduced considerably if capacity restricts additional data capture or review.

Task 1 – Conduct Photographic Monitoring

The photographic monitoring should be taken in-line with the specification and scope developed for the LGA, at the existing points along the LGA's coastline. The monitoring should aim to capture before, during and after the event for the best results.

Task 2 – Conduct Beach Survey Transects (Optional)

[It is recommended that either a UAV/drone survey or beach survey transects be undertaken to eliminate any overlapping of data. UAV/drone surveys will provide more data and allow for the extraction of profiles as well.]

The LGA should complete pre and post storm beach survey transects if possible. These can be completed in-house or by a consultant. The transects should be completed in the LGA's priority areas. These profiles shall follow the same line as any existing transects and be captured before and after the storm event. The surveys should aim to capture the full terrestrial extent and out to a depth of approximately 1 m or to where can be safely waded in the ocean. A generic specification for the capture of beach survey transects is available on DoT's website.

Task 3 – Conduct UAV/drone Surveys (Optional)

The LGA should complete pre and post storm UAV/drone surveys. These can be completed in-house or by a consultant. The surveys should be completed in the LGA's priority areas. The extent of surveys should extend from the back of the dune or foreshore reserve out to a depth of approximately 1 m or what can be safely waded. The UAV/drone survey component of storm monitoring should be completed in-line with the relevant specification available on DoT's website.

Task 4 – Capture Aerial Imagery (Optional)

The LGA should capture pre and post storm aerial imagery. These can be completed in-house or by a consultant. The aerial imagery should be orthorectified to allow for appropriate analysis. The capture of these aerial images aims to ascertain the position of the vegetation line before and after the storm event, as well as the general volume of terrestrial beach at the time of survey (if collected by drone). This will allow for any shoreline recession or change to be calculated from subsequent surveys, and trigger points examined. Aerial imagery capture should cover the LGA's priority areas. The capture of

this orthorectified aerial imagery should be completed in-line with the relevant specifications available through DoT's website.

If regular aerial images are captured by a provider such as Nearmap or similar, these can be used to ascertain changes via comparing images from before and after the storm if Nearmap's aerial run dates align accordingly. It is noted that Nearmap currently does not service all coastlines and requires a subscription cost to access.

This component could be completed via drone if the LGA has capacity.

Task 5 – Collate Metocean Conditions

Metocean data will be captured by BoM and DoT during the event if/where available. No additional data is typically required to be captured or analysed unless this is already underway as part of separate monitoring activities along the LGA's coast. The available data should be collated and recorded to be assessed by an appropriately experienced coastal engineer.

If there are no appropriate DoT and BoM metocean recording instruments or sites nearby, specialised equipment can be installed. This should be completed in-line with the scope available through DoT's website.

Task 6 – Review and Analysis

The data recorded and collected during the storm monitoring will need to be reviewed and analysed by an experienced coastal engineer. Review and analysis are expected to involve the following items.

- Determine and consider visual changes captured during the storm monitoring.
- Review surveys for changes including assessment of quantities.
- Determine vegetation line positions, assess change and consider trigger points.
- Review metocean conditions experienced and compare to resulting erosion or coastline change.

The LGA could undertake large portions of the storm monitoring in-house. However, it is recommended that the analysis be completed by an experienced coastal engineer. The analysis could be completed as part of the annual analysis and reporting.

Methodology

[The LGA will need to develop a methodology based on the included monitoring activities. The methodology should be taken from any existing specifications developed by the LGA based on the generic scopes and specifications available through DoT's website.]

Storm monitoring is to be completed in-line with the relevant specifications and scopes developed for this LGA, these are outlined below. Full details of the individual methodologies are available within the relevant specifications available on DoT's website.

[include individual methodologies for the monitoring tasks and update based on storm monitoring requirements]

Photographic Storm Monitoring Methodology

The photographic monitoring is to be completed in-line with the methods proposed below or in the photographic monitoring guidelines prepared by DoT (2012), available on DoTs website.

1. Review available information on monitoring locations including any previous monitoring images.
2. Confirm and comply with all WHS requirements.

3. Prepare equipment and observation recording sheet.
4. Visit each monitoring point and:
   - locate the required position for the photograph,
   - take the photographs ensuring the FOV is correct, and
   - review noticeable changes and record observations, notify any required party of significant changes.
5. Label and save all images for future use.
6. Repeat steps 2, 3, 4 and 5 before, during and after the storm [LGA to determine monitoring schedule. The safety of staff should be considered with any works completed during the storm].
7. Provide images to appropriate parties for review.

It is important to consider that each LGA has their own requirements for accessing sites and these may need to be completed as part of this work (e.g. SWMS, risk assessments and journey plans)

[Include other required monitoring tasks]

Beach Survey Transects Storm Monitoring Methodology

The beach survey transects are required to be completed in-line with the method proposed below, noting the individual requirements of specific survey equipment. The following methodology is expected to capture required aspects of transect surveying however the detailed requirements of individual survey equipment are not included [the LGA may wish to include this if known]. Further details are available in the associated specification available on DoT's website.

1. Review and confirm transect positions.
2. Review any previous survey data and confirm access and extent requirements.
3. Identify survey equipment and be familiar with its use.
4. Confirm and comply with all WHS requirements.
5. Undertake profile surveys along the required alignment.
   - Complete the surveys at a time of lower tide to allow for a larger extent to be captured.
   - Begin the survey at least 10 m behind the primary dune crest or at a fixed point such as a path.
   - Finish the surveys at a depth that can be safely waded, approximately 1 – 1.5 m.
6. Process survey information and prepare section plans for each profile.
7. Repeat surveys before and after the storm.
8. Review changes and assess buffer distances.

UAV/Drone Survey Storm Monitoring Methodology

The UAV/drone surveying (including orthorectified aerial image capture) should be completed following a methodology in-line with the one outlined below. Individual drone specifications, photogrammetry software and LGA requirements should be included if known, as these aspects are unique to each LGA and their equipment [the LGA may wish to include the individual drone and LGA requirements if known]. Further details are available in the associated specification available on DoT's website.

1. Review and confirm monitoring and survey locations.
2. Review and confirm required data.
3. Confirm and comply with all WHS requirements including CASA requirements.
4. Plan flight and ensure compliance with CASA and local regulations.
5. Deploy drone and undertake image and survey capture.
   - Capture aerial imagery with appropriate resolution (minimum 10 cm Ground Sample Distance (GSD)).
   - Maintain a consistent flight altitude for consistent data collection.

- Utilise Ground Control Points (GCPs) for enhanced accuracy.
- Ensure real-time positioning and metadata logging for GIS integration.

6. Process imagery using photogrammetry software (e.g. Pix4D, Agisoft, Metashape) to generate orthomosaics and extract any required data from the surveys.
7. Repeat survey and image capture before and after the storm.
8. Conduct analyses for the shoreline, dunes, vegetation and volumetric change.
9. Review changes and assess buffer distances.

Equipment

[The LGA will need to prepare the required equipment based on included monitoring activities. The equipment may be based on any existing specifications developed by / for the LGA from the generic scopes and specifications available through DoT's website.]

Storm monitoring is to be completed in-line with the relevant specifications and scopes developed by DoT and/or this LGA, with required equipment outlined below. Further details of the individual equipment required is available within those relevant specifications available on DoT's website.

[The LGA should include the required equipment based on monitoring tasks. The LGA should update the following list with the preferred equipment to conduct their photographic monitoring]

Example Photographic Storm Monitoring Equipment

An example of equipment required to complete photographic monitoring is outlined below, noting that some items are broad to allow for interchangeability based on specific requirements and capabilities.

- Device to capture images (e.g. camera, GPS camera or smartphone with GPS capability. A smartphone or GPS camera may allow for more information to be readily captured).
- Device to find the required and record the location of the images (e.g. handheld GPS, GPS camera or smartphone with GPS capability).
- Device to review previous images and confirm FOV is consistent (e.g. smartphone, tablet or printout).
- Device to record observations (e.g. smartphone, tablet or paper sheet).
- Storage location for the images (e.g. hard drive, online system, cloud or other storage system).

The equipment required to conduct the monitoring can largely be reduced by using an application such as Photomon that allows for previous images to be used as a guide and notes and observations to be recorded. This application also stores the images to a database that is accessible online.

It is noted that safety and transport of personnel/equipment has not been included and if the LGA requires this then it should be considered accordingly.

[Include equipment for other required monitoring tasks.]

Costs and Personnel

[Storm monitoring can be a relatively low-cost exercise completed by minimal staff members depending on scale and available resources. The exact costs and personnel can be difficult to determine without confirming the extent and requirements of monitoring. In general, it should take approximately one day to complete the majority of storm monitoring tasks depending on the locations, scale and available

monitoring. This assumes that monitoring activities are being conducted at the same time as other related monitoring activities, reducing the direct cost.

Personnel required to conduct the storm monitoring is dependent on the requirements of the LGA. It can be completed by one staff member, though safety requirements often require two or more staff members to conduct monitoring.

The LGA is to consider their requirements, capabilities and extent of their monitoring before determining the costs and personnel required to conduct the monitoring.

The following directs generic personnel requirements. The LGA should update this to match their own requirements.]

Storm monitoring should be completed by XX staff member(s) in XX hours both before and after the storm event.

(The actual timing and cost would be specific to the LGA and it is expected that these may need to be determined internally).