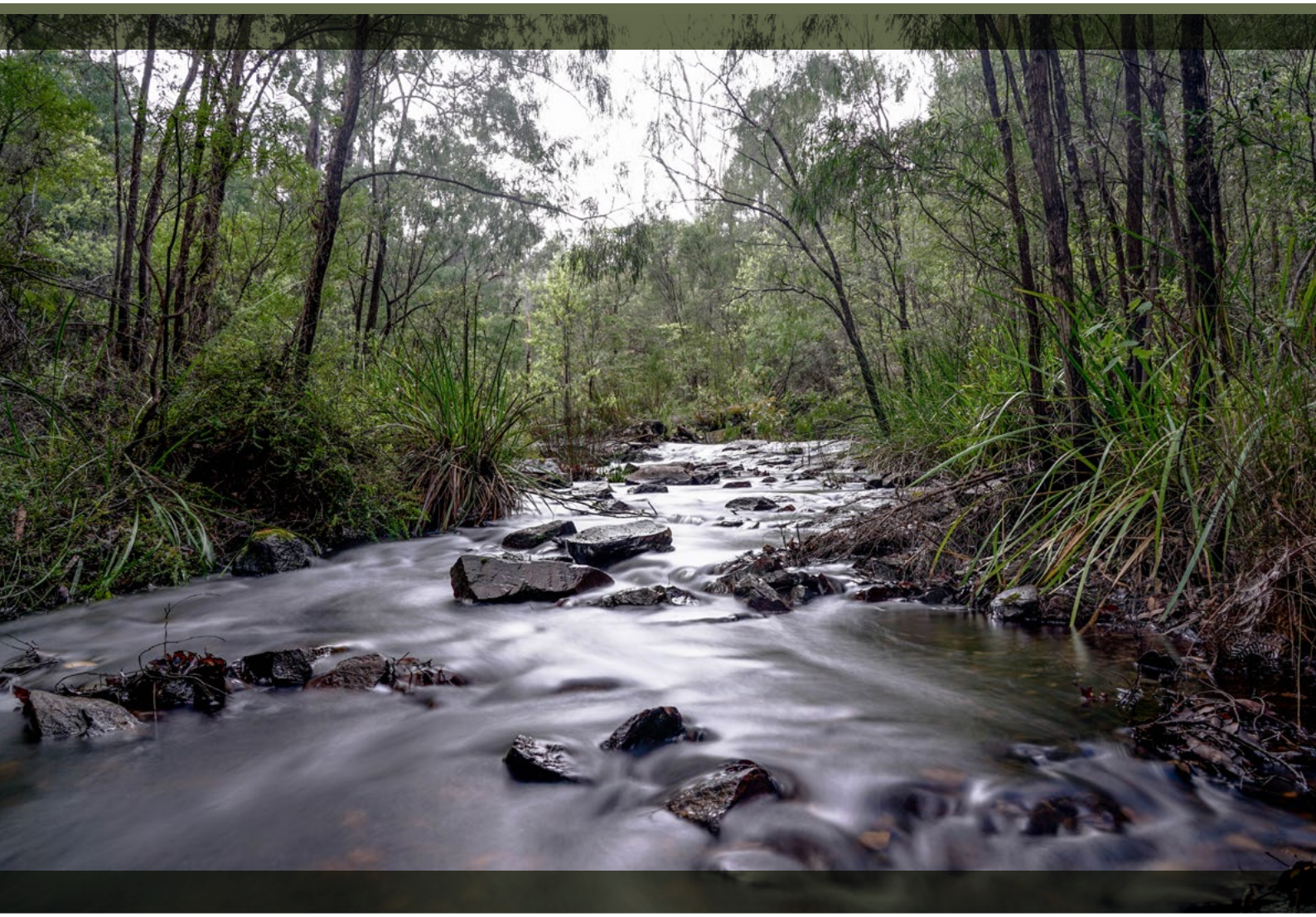
Government of **Western Australia**
Department of **Water and Environmental Regulation**

SOUTH-WEST
INDEX OF RIVER CONDITION

River Science

technical series



Photopoint monitoring

A guide to establishing sites and taking consistent photos

Report 9 | November 2021

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Cover image: Barlee Brook (Gina Marino)

Disclaimer

What are photopoints?

Photopoints are fixed positions in the environment where consistent photos of a particular area of interest can be collected over time.

Photopoint monitoring is used to assess changes in condition visually, particularly for evaluating environmental responses to on-ground management actions or documenting impacts due to natural events or human activities (e.g. installation of a weir or bridge).

Even small changes in the position, height, angle or direction of photos over time can have a significant effect on the ability to evaluate change.

This guide:

- provides standards for the set-up and use of photopoints
- focuses on how to use photopoints to capture qualitative[1] data to evaluate and communicate outcomes of river restoration actions over time
- is specifically designed for use in citizen science programs, where there can be a wide range in operator experience
- concentrates on the use of handheld cameras (including phones).

1 For obtaining quantitative data from photopoints, i.e. where accurate measurement of changes is needed, see Barraclough and Lucey (2001).

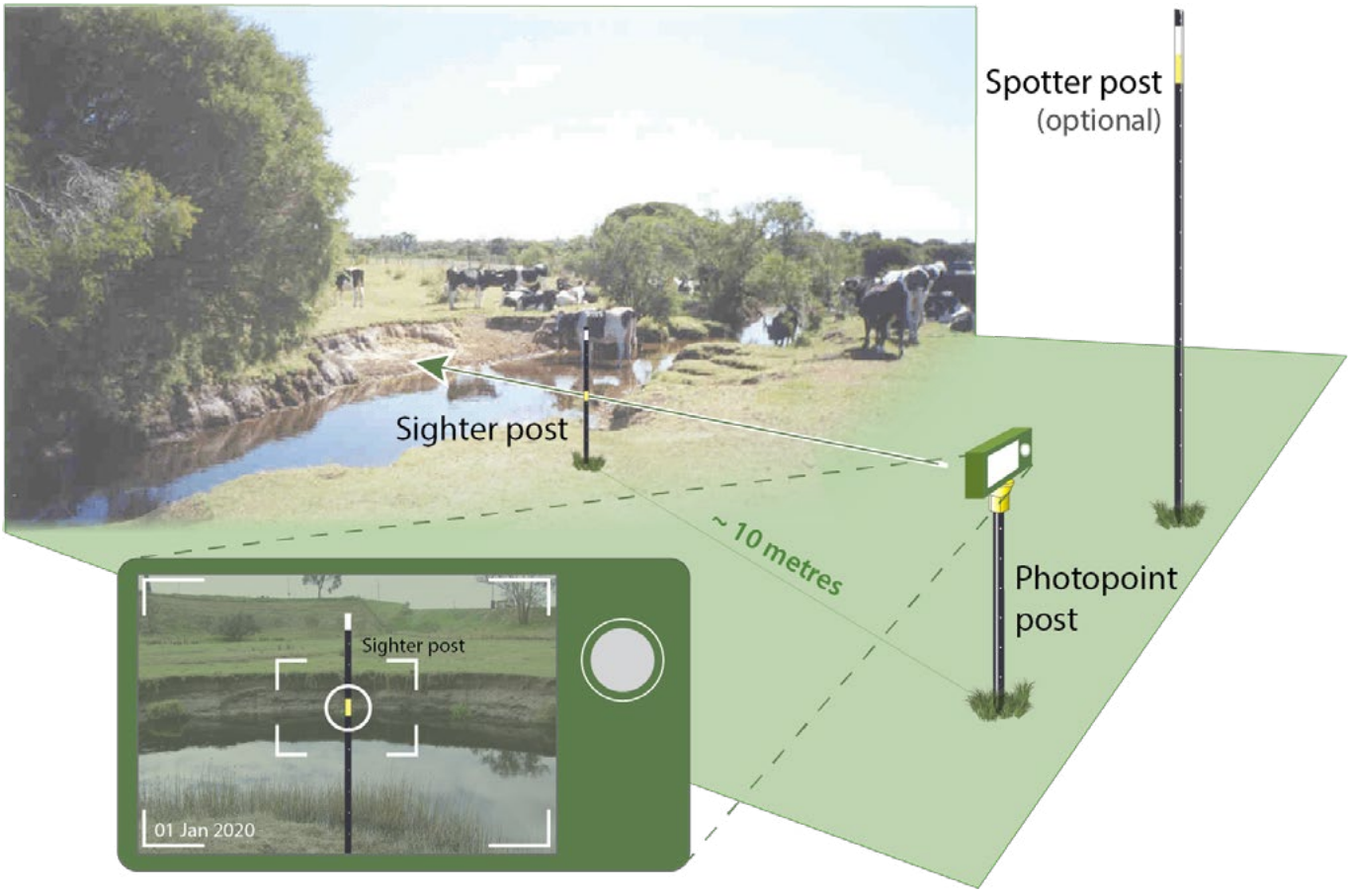


Figure 1 Photopoints are fixed locations where consistent photos of a particular feature(s) can be collected over time

Evaluating river restoration

Comparing visual changes across a time-series of replicated photos is an effective way of evaluating and communicating the response of ecosystems to a range of river restoration actions.

The use of photopoint monitoring is particularly effective when combined with other, more intensive monitoring efforts which are aimed at quantifying environmental changes.

Among its many benefits, photopoint monitoring:

- provides an unbiased visual record of site conditions and changes over time
- captures information that may not have been considered, or was missed, during more intensive assessments
- requires minimal training to set up and useful images can be collected easily
- allows different people to replicate images of the same area
- enables a high frequency of monitoring as photos are quick, simple and cheap to collect, which is ideal for assessing how ecosystems respond to river restoration over time or under different environmental conditions (such as high flows or drought), allowing managers to respond more quickly to issues as they arise
- causes minimal impact to the environment
- provides a simple visual tool for communicating the value of a management actions to a range of audiences, including to seek funding support.

Figure 2 Photopoint monitoring photos taken before, during and after restoration – demonstrating the benefits of visual records. Bickley Brook, Perth, Western Australia.

Permissions and approvals

In addition to permission to access a site, approvals may be required to install a photopoint when the site is located on crown land, council land or native title land, or where it interferes with the bed and banks of rivers. Consult with land holders, local government and the Department of Water and Environment Regulation to ascertain requirements.

Selecting a suitable location

The key requirements for an appropriate photopoint are:

1. the location is secure – low risk from natural or human-made disturbances
2. the location can be easily located, now and into the future
3. the photopoint is set up in a way that enables desired photos to be taken consistently over time.

The first step in selecting a suitable photopoint location is to define clear monitoring goals (short and long term), as this will highlight the information that needs to be captured, now and into the future.

This guide is aimed at using photopoints to demonstrate the effectiveness of one or more of the following restoration actions over a period of several years:

- livestock-exclusion fencing to prevent riparian vegetation from being impacted (grazing and trampling), and reduce related river bank erosion and nutrient and organic matter inputs to the stream
- weed control within the riparian zone
- planting of native, riparian vegetation
- installation of in-stream habitat, e.g. large wood
- channel restoration, including bank protection
- removal or alteration of artificial in-stream structures such as barriers to prevent flushing or the movement of aquatic species.

The goal of photopoint monitoring is to assess and communicate to others changes to:

- type, cover and/or health of native vegetation
- type and cover of exotic vegetation
- extent and severity of erosion
- channel form and flow pathways
- water depth and width
- fish passage conditions (e.g. inundation of structures, see Figure 3).

Figure 3 Monitoring potential fish barriers. Gingin Brook.

Field of view

Most photopoint images will focus on an area between 10 to a few hundred metres. This could be a specific structure such as a potential fish barrier (Figure 3), or a wide riparian zone following stock exclusion and revegetation with native seedlings (Figure 2).

The distance from the camera to the area of interest will depend on the level of detail needed in the photo. For example, photos may need to be taken closer to a subject to identify species of weeds, or further from the subject if a change in total vegetation cover over a wide area is required. Multiple photopoints may be needed to capture the required detail for all areas of interest at a site (discussed further in *Setting up the monitoring site*).

Duration and frequency of taking photos

The goals of the project will determine the frequency of monitoring. Most studies include photos taken before, during and immediately after implementing a management action – then periodically thereafter.

Taking photos at regular intervals following a management action provides a more accurate indication of rate of change when reviewing the series. Annual or biannual photos are common for evaluating response in vegetation following restoration (where change is relatively slow); however, more regular photos may be needed in situations such as tracking inundation of an in-stream structure to assess fish passage (e.g. Figure 14).

The frequency and duration of the monitoring program will impact both the photopoint position and the work involved in stabilising the equipment. For example, if monitoring is required through the wet season, the photopoint should be placed outside of the floodplain to ensure continual access (Figure 6). A photopoint located outside of the floodplain will also be more secure over multiple years.

If a photopoint needs to be placed in an area of potential or regular inundation, this will need to be factored into construction (discussed further in *Setting up the monitoring site*).

Test photos

Note: 'site' refers to the general area; 'position' relates to the specific location of the photopoint within the site.

Once potential photopoint positions are identified, test photos should be taken and reviewed based on the following considerations:

1. Does the field of view of the photo capture the extent of potential change within the area of interest (e.g. change in cover and height of vegetation)?
2. Does the photo capture the necessary detail within the area of interest? Photos may need to be taken closer to features to identify species or condition of vegetation.
3. Is there risk of a photo being obscured due to growth of vegetation in the foreground? (This will depend on duration of the monitoring period).

Figure 4 Growth of vegetation close to the photopoint can limit the ability to assess change over time. Note: this Figure includes a fallen tree, which is unfortunately largely unavoidable.

4. Can the position avoid unnecessary impacts from the sun? A position that avoids looking into the sun (i.e., facing south) allows for a larger window of opportunity to take an appropriate photo (see Figure 7 and tips in *Setting up the monitoring site*).
5. Can the position take advantage of fixed reference points within the FOV (such as large boulders or fence posts), which makes comparison of photos easier?
6. Is it possible to avoid risks associated with accidental damage or vandalism to photopoint equipment, such as not placing a photopoint on or in plain sight of a passing vehicle, or walking or livestock tracks?

Figure 5 Making use of fixed features in the FOV to indicate scale and aid in lining up successive photos.

7. Is there a risk that accessibility to the **site** may change over time? Factors that can affect access could include degradation of access tracks or change in permission from a landholder.
8. Is there a risk that accessibility to a photopoint **position** may change over time? Factors that can affect access could include flooding, which can prevent access by foot and may also wash away the photopoint. The risk of flooding is hard to predict; however, placing the photopoint above the average high-water level is sufficient for most monitoring projects (see Figure 6).
9. Is the photopoint position easily found at the site? (Discussed further in *Setting up the monitoring site*).

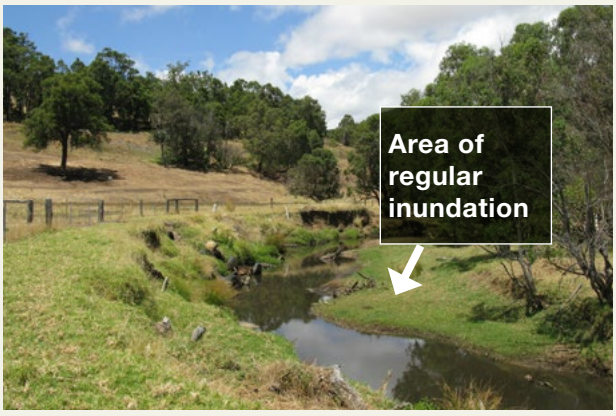


Figure 6 Avoid positioning a photopoint in areas of regular inundation unless necessary.

More examples of conditions that affect the success of photopoint images

Figure 7 Glare can reduce our ability to assess features within the area of interest.

Figure 8 Shadows can reduce ability to assess features within the area of interest.

The photo in Figure 8 was collected to assess flow over a weir which is directly below the bridge. However, the shade from the bridge limits the ability to assess inundation over the weir accurately. In some situations, it may be necessary to position a photopoint within a regularly inundated area to monitor a particular area of interest – this is covered in *Setting up the monitoring site*.

Figure 9 Livestock, high flows and bank erosion are all potential risks to photopoints placed in this area.

Setting up the monitoring site

This section covers the key construction elements for a successful photopoint setup, in particular the:

photopoint post	sets the position and height for the photo to be taken
sighter post	sets the direction and angle of the shot
spotter post	optional; to aid in finding the photopoint in the future

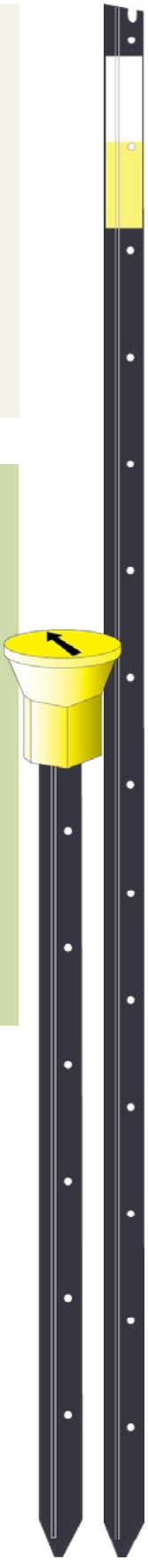
Remote cameras

Remote cameras, also known as fauna or trail cameras, are a viable option for some photopoint monitoring programs. They can be set up to take photos automatically at regular intervals (minutes, days or months), with batteries capable of lasting over a year. Remote cameras are not covered in this guide as costs associated with purchasing high-quality units plus the risk of theft (and loss of data) make them unviable for most citizen science programs. However, the same principles provided in this guide can be used for deploying remote cameras.

The photopoint and sighter posts

A simple, cost-effective photopoint can be constructed using one post as the photopoint and another positioned within the field of view (FOV) to establish direction and camera angle. This is called the sighter post (see site setup in Figure 1 and Figure 0).

In some situations, there may not be sufficient space to install the sighter post, and there is also a risk that the sighter post may move over time (due to natural causes or interference). It is, therefore, recommended that you include a direction marker on a cap placed over the top of the photopoint post (this can be engraved or written in permanent marker to suit the frequency and duration of monitoring) (see picture in the centre of this page).



Set the height of the photopoint post between 1 and 1.5 m above ground level. Ideally, the height should be around eye-level, but allow some flexibility to achieve the best angle to capture the area of interest.

Note: the length of the posts needed will depend on how far they can be driven into the ground (depending on soil type), the risk of erosion and the duration of the program. Longer stakes are recommended if the site is needed for an extended period.

The photo will be taken by lining up the centre of the camera frame with a fixed point marked on the sighter post (see Figure 1). The sighter post must be positioned at an appropriate distance away from the photopoint in the centre of the FOV, to allow for easy re-set if the sighter post moves over time. About 10 m is generally suitable to allow you to line up the photo without the sighter post obscuring the field of view. The distance set should be clearly documented on field sheets.

Once the two posts are set, confirm that the photopoint position allows both the area of interest and level of detail to be captured, and that risks associated with potential damage are low. Factors such as the sun's path should have already been considered when selecting the position.

All stakes will need to be clearly marked to help with relocating them. Markings need to be visible from a reasonable distance away to avoid injuries to people and animals, and unintentional damage to the posts (if passers-by discover the stakes, they are less likely to remove them if they understand they are there for a reason). Use bright marking tape or paint, avoiding any potential environmental toxicants (including plastics).

If vandalism is a risk, hidden markers can be used; however, consider whether hidden markers might be a risk to the public or wildlife.

Label all stakes with site and position information at the very least. This provides confidence of correct position if different people are taking photos, particularly where multiple reference points exist in a similar position. Aluminium tags are recommended.

Once both posts are in place, record accurate GPS coordinates, and a compass bearing from the photopoint to the sighter post (as a backup).

Spotter post

As the photopoint may be used by different people and/or used infrequently, its location must be easy to find.

If the photopoint post might be difficult to find (e.g. obscured by existing or future vegetation), then an additional spotter post is recommended. The spotter post should be set higher above the ground or in a slightly different, more visible area. Instructions need to be provided on field sheets regarding how to find the photopoint position from the spotter post.

Again, use bright marking tape or paint (avoiding any potential environmental toxicants, including plastics) to highlight the position of the spotter post (see Figure 1), and record GPS coordinates.

Information and equipment requirements

Always assume that future photos will be collected by someone who is unfamiliar with the site. The recording of accurate site information is critical both to finding the photopoint and taking consistent photos.

The following is a summary of important information and required equipment. A template field sheet is provided at the end of this guide to record information.

Information needed:

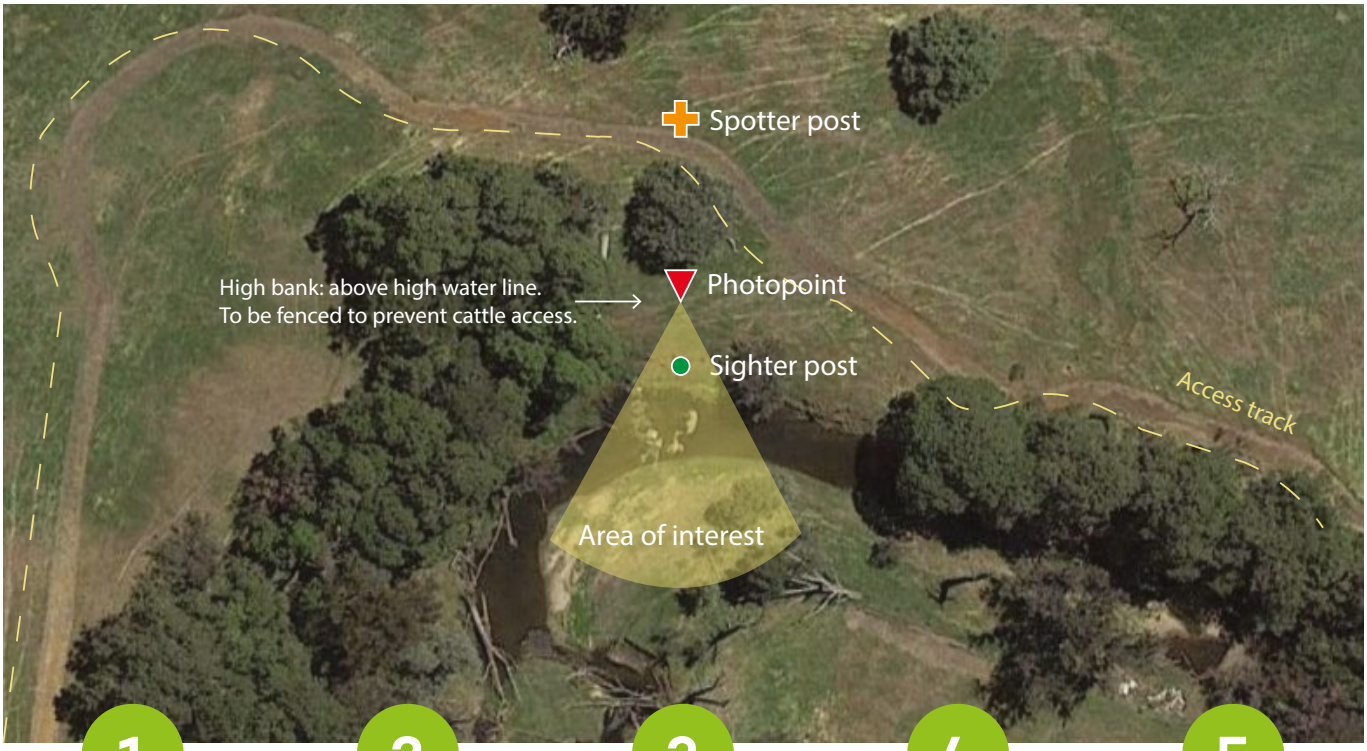
- What river restoration actions were implemented at the site and what the monitoring goals and features of interest are, plus the period of monitoring needed.
- Detailed access instructions to the site and the photopoint position. This includes GPS coordinates of the photopoint post and other features required to navigate to the location. Remember to note the coordinate reference system used.
- Name and contact details of person who established the site, and subsequent operators.
- Distance between and compass bearing from the photopoint to the sighter post.
- Height above ground that the photo should be collected, and height above ground that the camera should be focused on at the location of the sighter post (i.e. camera angle)
- Whether there is a spotter post and/or existing reference points and their GPS coordinates.

Equipment list

- waterproof field sheets – which should include maps and details for finding the site and taking the photo
- stakes of different sizes (star-pickets preferred for durability and ease of installation)
- caps for tops of star-pickets (ideally already engraved or with ability to do this in the field)
- hammer/post driver
- measuring tape (at least 10 m)
- pencils (pens can run in rain)
- marker pen, marking tape or paint (avoid potential contaminants such as plastics)
- aluminium tags to record site codes on posts
- GPS with compass (or separate compass)
- camera
- photos from previous sampling (for reference)
- back-up batteries for camera and GPS
- adequate camera memory cards.

Further considerations:

- Determine how photopoint images will be physically and/or digitally stored and how access will be controlled.
- Phone applications have been created to capture photopoint images with photo-databases managed by local natural resource management groups. Contact your local group to enquire.



1

The distance between the **photopoint** and the area of interest depends on the size of the area and the required level of detail.

2

The position of the **sighter post** sets the direction the photo is taken from the **photopoint**.

3

The distance between the **photopoint** and **sighter post** should be fixed, typically around 10 m.

4

A mark on the **sighter post** is used to set the angle from which the photo is taken from the **photopoint** by lining up the focal point on the camera with the mark.

5

The **spotter post** should be easy to find and there should be clear instructions on how to find the **photopoint** from that location.

Figure 10 Setting up photopoints, sighter posts and spotter posts.

Note: the distance between the photopoint position and the areas of interest will depend on the size of the area of interest (i.e. far enough back to capture the required field of view) and the level of detail needed (close enough to identify plant species or to assess vegetation health).

Taking the photos

Before you go to the site:

- Assemble appropriate field equipment (see information and equipment lists, above). This should include equipment to set up a replacement site in case posts have moved or need to be stabilised, or an additional site is needed to capture changes occurring outside the original area of interest.
- Check weather reports. Avoiding bright sunny days and rain – bright overcast conditions are preferred.
- Check site access permission is current.

Taking the photo:

- Choose an appropriate time of day (or manually alter camera settings) to minimise shadows and glare. For example, this may require waiting until the sun moves behind clouds or taking photos in the early morning or late afternoon.
- If the camera has the option, consider adding a date and time stamp to the photo. This information should also be recorded on field sheets.
- Ensure the camera is set to highest resolution and fully zoomed out.
- To ensure the area of interest is in focus and not overexposed, the following suggestions are provided: for smartphone cameras, set the correct camera position and then touch the screen in different locations to adjust the focal point and exposure. For other cameras, focus on the area of interest first and lock the setting by pressing the shutter halfway down, then move the camera into the correct position. This ensures the camera doesn't focus on the sighter post.
- Photos are recommended to be taken in landscape orientation, which provides the best depth of field for digital cameras. However, portrait orientation may be better suited in some situations. Do not use a wide angle or a telephoto lens, as this alters the perspective of the photo and makes it difficult to repeat – unless this is part of the photopoint monitoring protocol (see example photos on the next page).
- Take at least two photos to reduce the chance of any issues. Slight blurring may not be detectable when reviewing photos on the camera.
- Once a photo is taken, check that there is no change to the FOV compared with photos taken during previous visits. This ensures the photopoint or sighter post has not moved and that there are no inconsistencies associated with camera type or zoom.
- Check photos are of sufficient quality – consider glare, shadows, colour and level of detail.
- If possible, camera type and settings should be replicated – both to ensure a consistent FOV but also photo quality (Barraclough and Lucey 2001 recommend a 50 mm lens on a full-frame camera – or equivalent depending on camera sensor size – set to an f-stop of 16 to 22). However, as photopoint images will often be collected by multiple users over the course of a monitoring program, it is not always possible to standardise the camera type and settings.

Prior to leaving the site:

- Ensure all required information is recorded on field sheets (refer to the template field sheet at the end of this guide).
- Check stability of the photopoint and sighter posts. Rectify any issues and record the issues on the field sheet for future improvements to site set-up.
- Record any issues with site directions, access conditions etc.

Marker boards

Consider putting a marker board in the foreground of the FOV with key site information (site name, date, time and recorder's name) for easy processing later.

Barraclough and Lucey (2001) recommend the board is placed at a maximum distance of 6 m from the camera (without obscuring the features of interest).

Example photos

Additional photos or adjustments to the FOV may be useful – for example, a panorama.

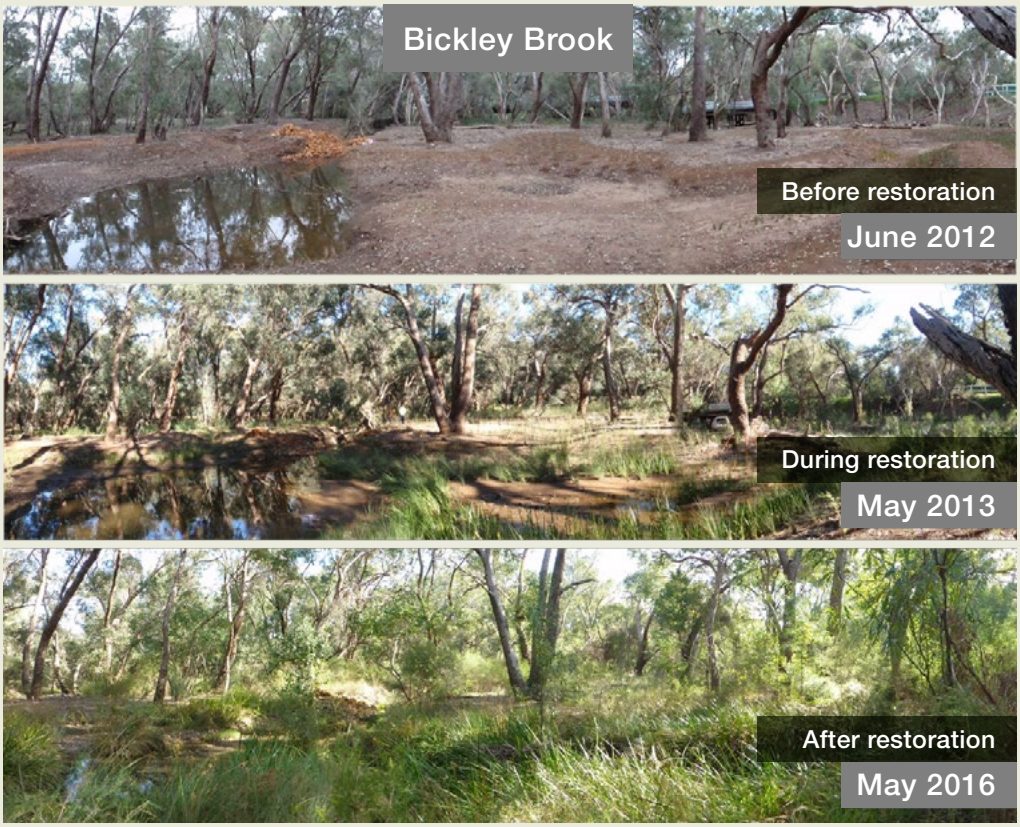


Figure 11 Evaluating environmental response to revegetation and remodelling of the river channel (Bickley Brook, Western Australia). Note: this is the same site as shown in Figure 2 but captured using a wider field of view via a panorama.

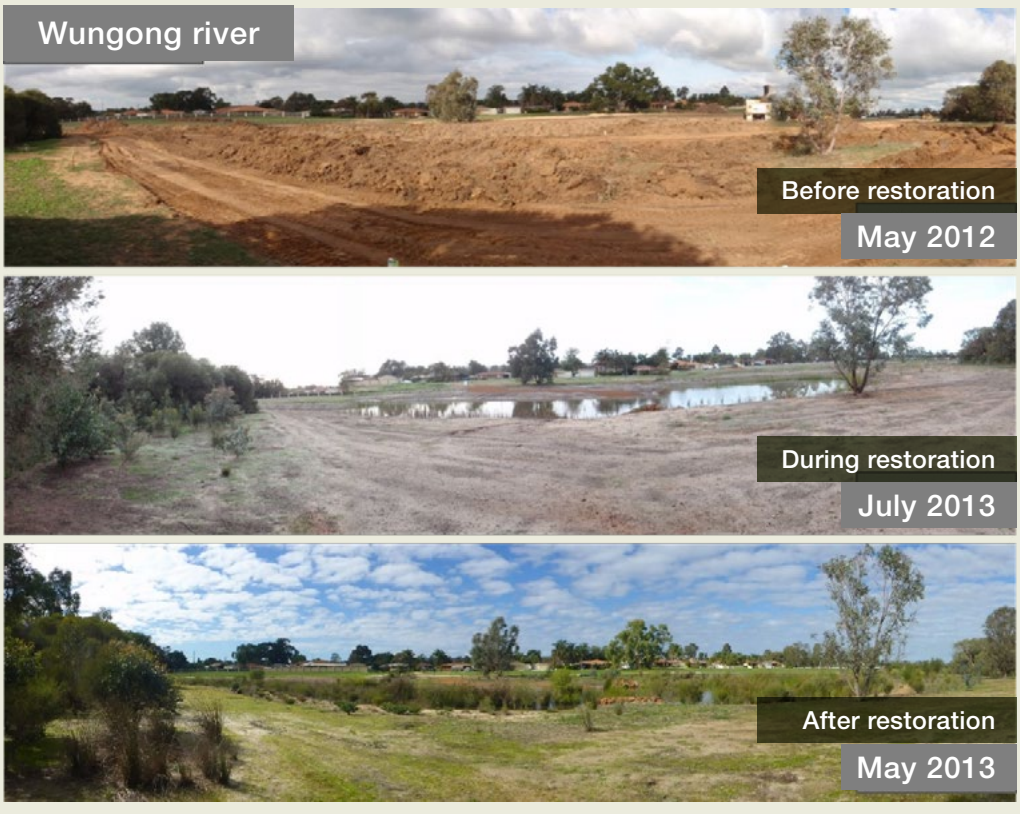


Figure 12 Evaluating environmental response to development of a treatment wetland for urban water runoff (Wungong Brook, Western Australia).

Figure 13 Assessment of habitat inundation, water levels or flow may require high-frequency image capture (Harvey River, Western Australia).

Figure 14 Detailed assessment of water levels and flow to determine requirements to support fish passage (Yanmah Brook, Western Australia).

References and recommended reading

Hussey BMJ 2001, 'Photographic monitoring of vegetation', *Wildlife notes* no. 9, Department of Conservation and Land Management, Perth, Western Australia.

Lucey WP, Barraclough CL 2001, *A user guide to photopoint monitoring techniques for riparian areas – Field test edition*, Aqua-Tex Scientific Consulting Ltd.

Northern Agricultural Catchments Council 2021, Photomon – Environmental photo-monitoring smartphone app.

Water and Rivers Commission 2002, 'Monitoring and evaluating river and restoration works', *Water notes for river management* no. 28, Perth, Western Australia.

Notes

SOUTH WEST INDEX OF RIVER CONDITION

Photopoint monitoring datasheet

COVER SHEET

Project name		Project code	
Organisation		Project manager(s)	

Site name		Site code	
Site manager(s)		Region	
Waterbody name		River catchment	

Purpose of monitoring program at this site		*Describe factors expected to influence site condition (e.g., type of restoration action)*	
Date at start of monitoring period		Period of monitoring (days, months, years)	
Frequency of monitoring			

Data storage: folder name and location

Site location & access details				*Existing site - refer to registered co-ordinates*	☐ Yes	☐ No
Latitude (°S) or Northing (m)				Longitude (°E) or Easting (m)		
GPS accuracy (m)			Coordinate system - *include Zone for Northing & Easting*		GDA94	
Street address and/or nearest crossroad						
Property owner				Phone / email		
Permission required	☐ Yes	☐ No	Details			
Notify before each visit	☐ Yes	☐ No	Details			
Key required	☐ Yes	☐ No	Details			

Access map and information	
Insert aerial image or include diagram	Description

Photopoint site layout

Photopoint post			
Photopoint name and/or code			
Photopoint type (e.g. metal post)		Photopoint markings	
Height photo to be taken (m AGL)		Compass bearing to sighter post (or to subject if a sighter post isn't used)	
Latitude (°S) or Northing (m)		Longitude (°E) or Easting (m)	
GPS accuracy (m)		Coordinate system - *include Zone for Northing & Easting (*GDA94/GDA20)	

Sighter post	☐ Yes	☐ No	Describe why a sighter post wasn't required		
Post type (e.g. metal post)			Post markings		
Height of reference point for photo (m AGL)		Compass bearing from photopoint		Distance to photopoint (m)	

Marker post		☐ Yes	☐ No
Latitude (°S) or Northing (m)		Longitude (°E) or Easting (m)	
GPS accuracy (m)		Coordinate system - *include Zone for Northing & Easting (*GDA94/GDA20)	
Describe how to navigate to photopoint from marker post			

Diagram of photopoint infrastructure layout

Insert annotated aerial image or diagram. Include distance and directions between posts, including location of other fixed features.

Reference photo

Photopoint monitoring (new sheet required for each photo taken)

Date (DD/MM/YYYY)		Name of field officer(s)	

Review of *Photopoint site layout*		
Have details from the *Photopoint site layout* description changed?	☐ No	☐ Yes, describe:
Note: if significant changes have occurred a new *Photopoint site layout* sheet may be required		

Information for new photo			
Time photo taken		Photo reference number (from camera)	

Site observations	
Describe any environmental conditions that have changed in comparison with reference photo(s) (e.g. growth of vegetation, erosion, fallen trees)	**Identify cause(s) of changes** (e.g. site works, high flows, fire). Provide date of any changes (if known)

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