On Ground Training Workshop –

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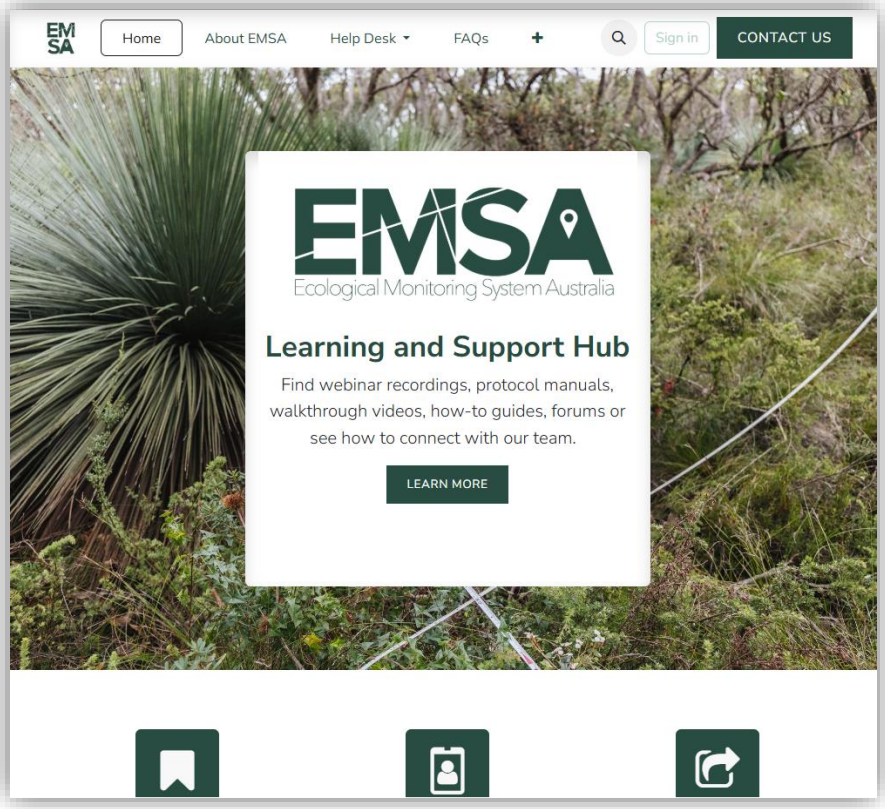
Terrestrial Ecosystem Research Network

Australian Government
Department of Climate Change, Energy, the Environment and Water

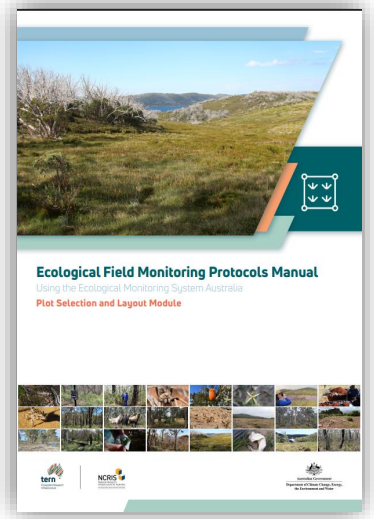
NCRIS National Research Infrastructure for Australia
An Australian Government Initiative

tern Ecosystem Research Infrastructure

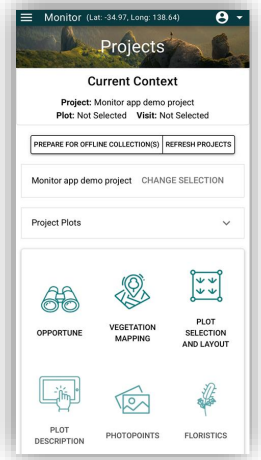
EMSA Support



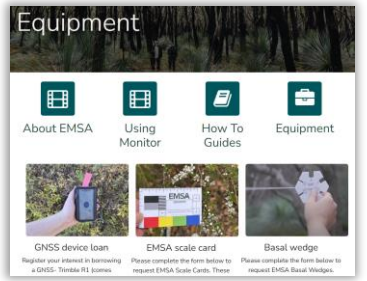
emsa.tern.org.au



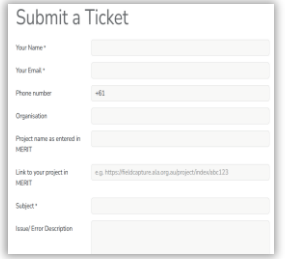
Protocol manuals



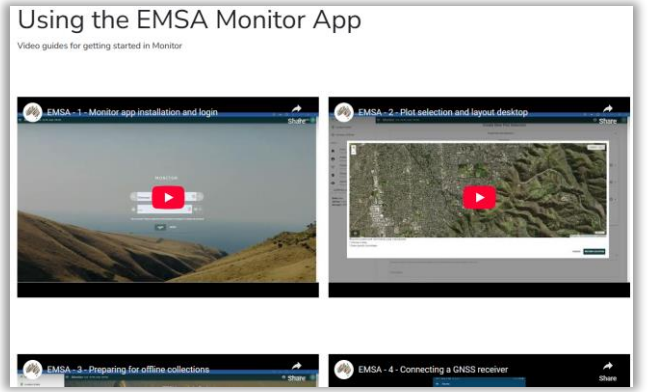
Field data collection app



Equipment hire



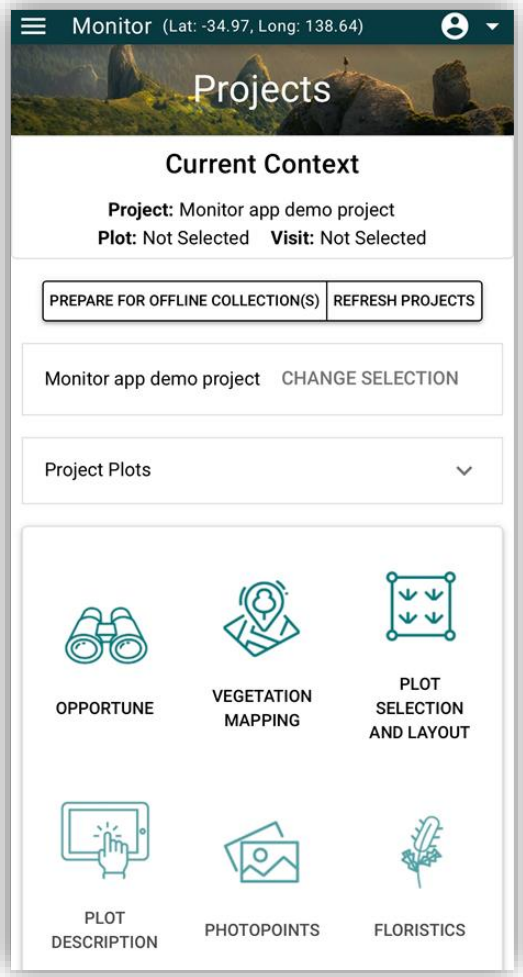
Help desk



Videos guides

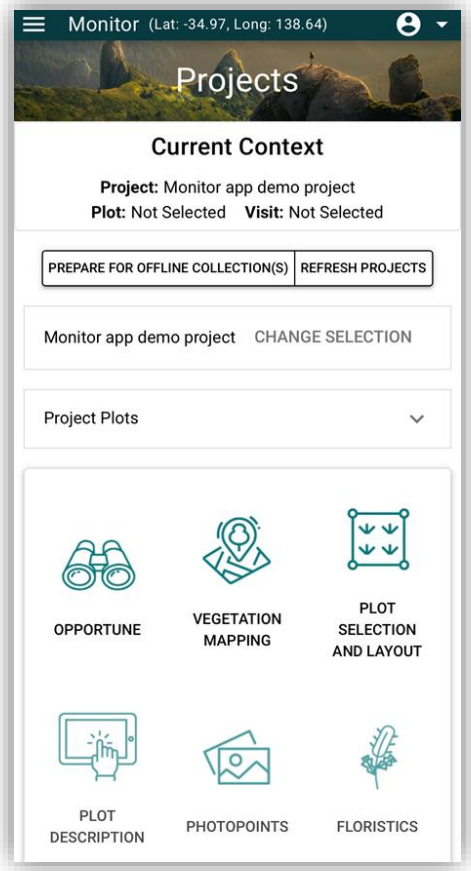
Monitor

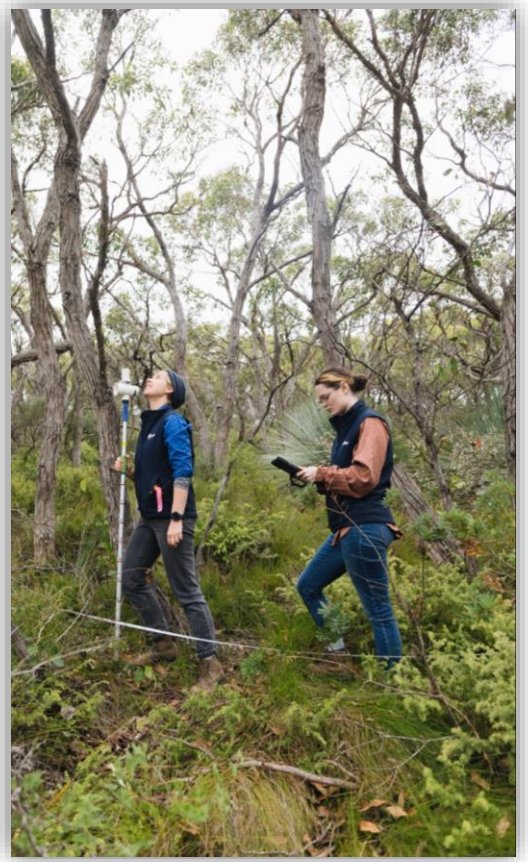
- Field Data Collection App
  - The EMSA Modules and Protocols outline standardised methodologies for surveying
  - Monitor captures in-field data entry for those surveys.
- Saves time on data entry
- Restricts data to ‘picklists’ or ‘data type’ with certain restrictions
- Standardises terminology
- Staging and Production platforms



Using the Monitor App

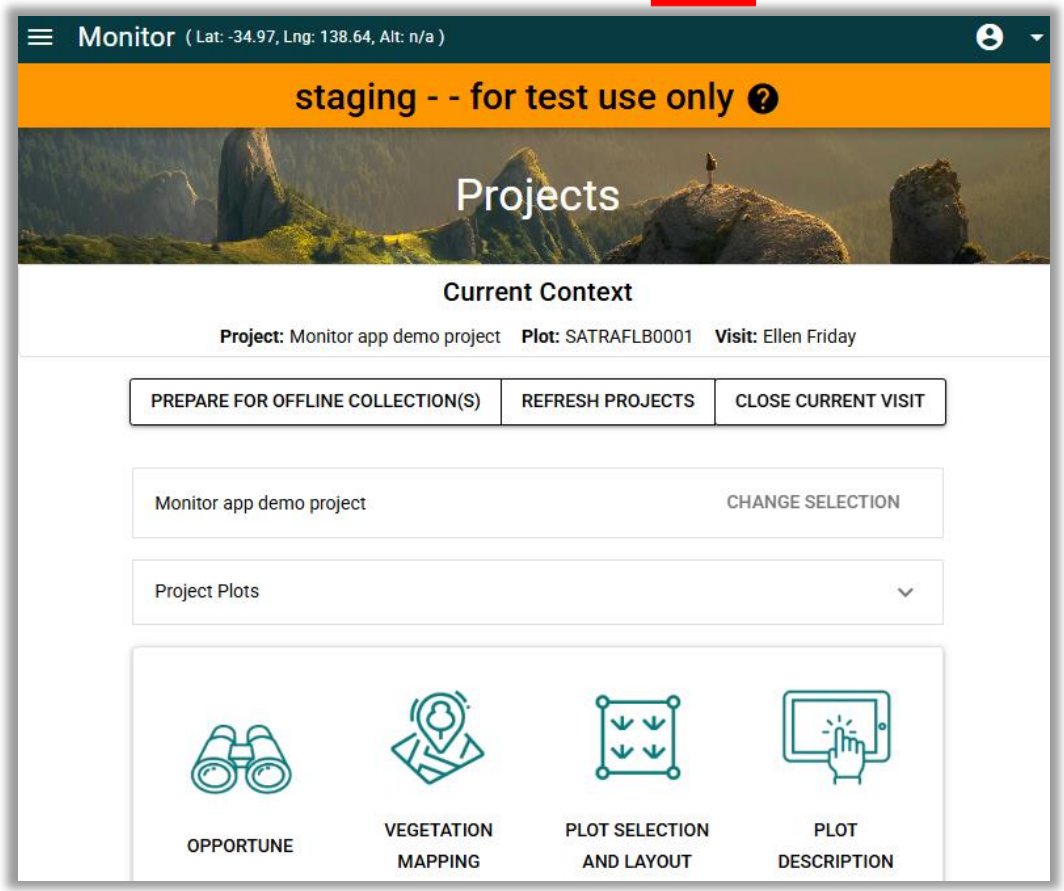
- Progressive Web App (PWA)
- Developed for use on **Android devices**
- Optimised to be used with Chrome (please don't use Samsung Internet! Microsoft Edge)
- Login using Atlas of Living Australia credentials
- Admin and Field Data Collectors.
- Staging platform vs Production platform



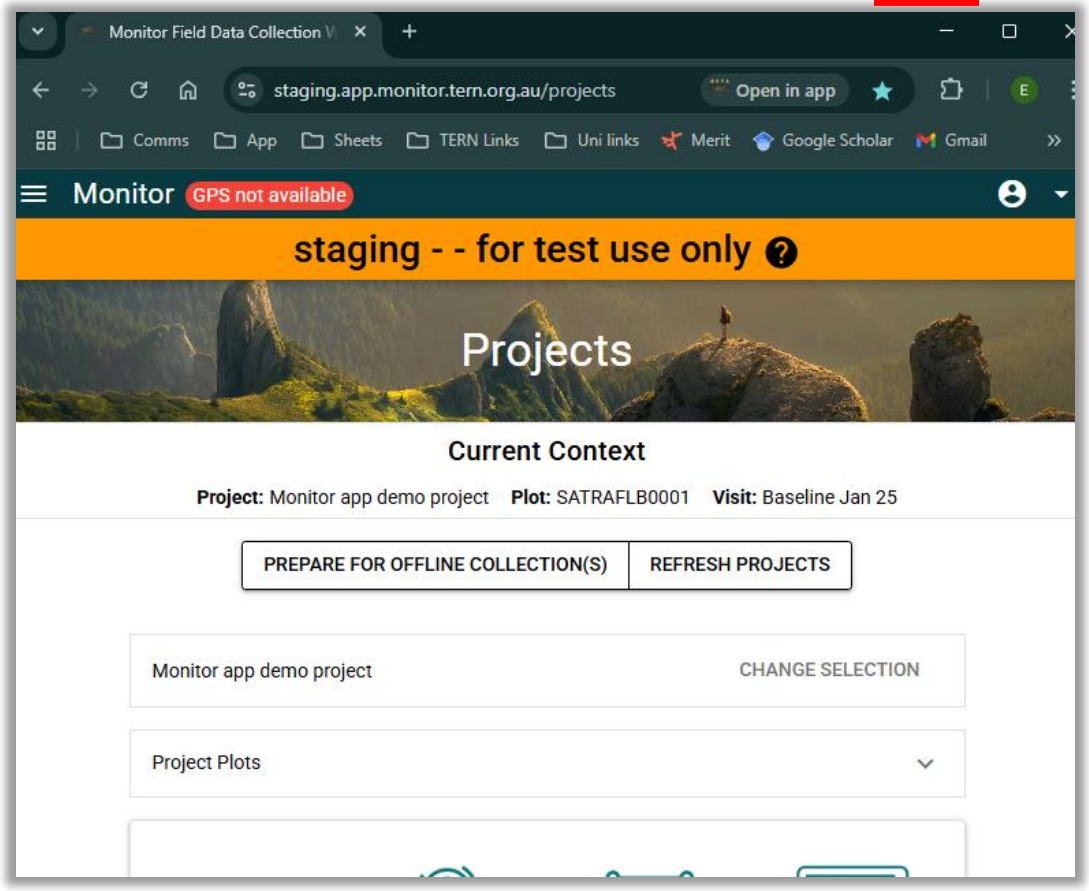


Installing the Progressive Web App

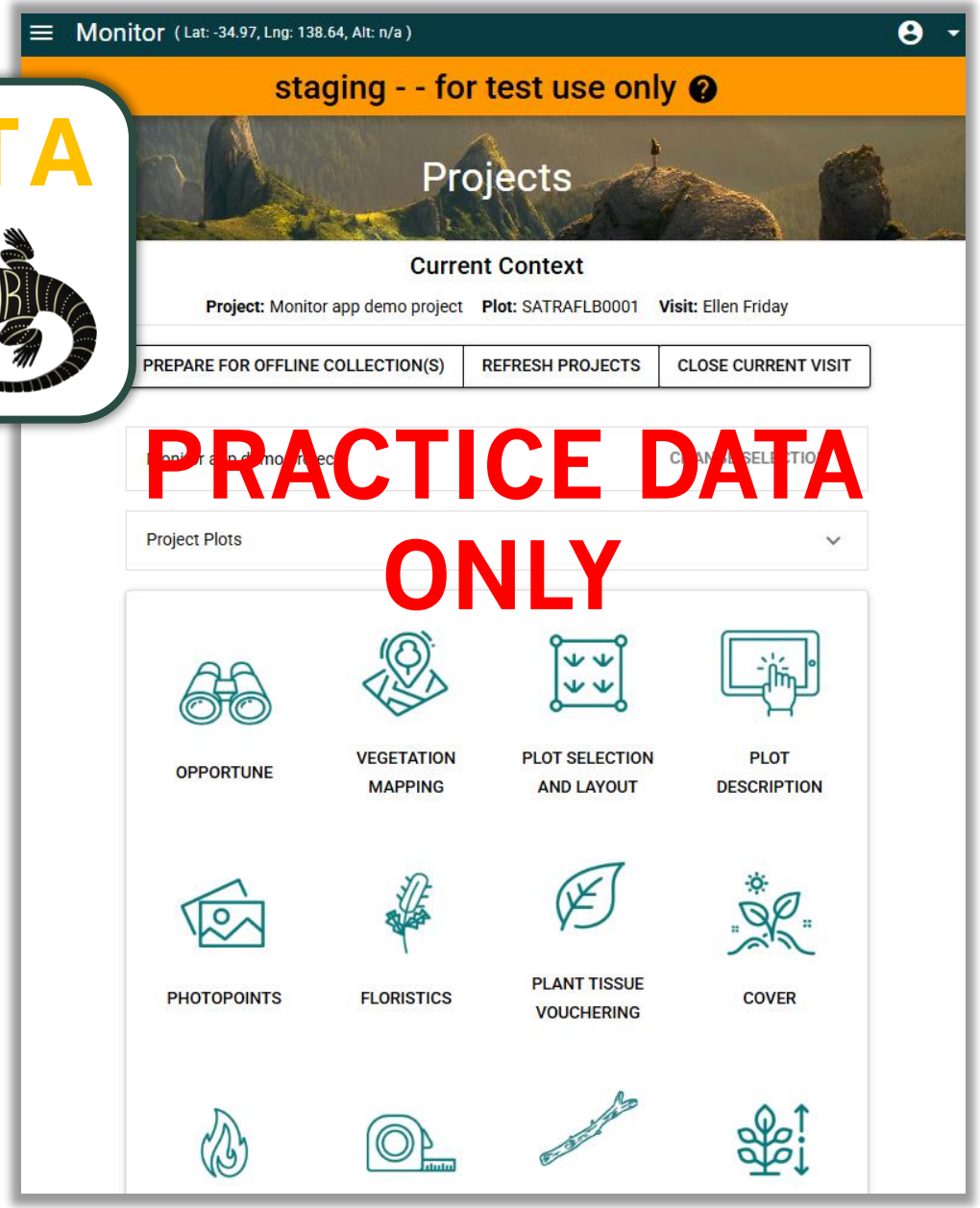
PWA ☑



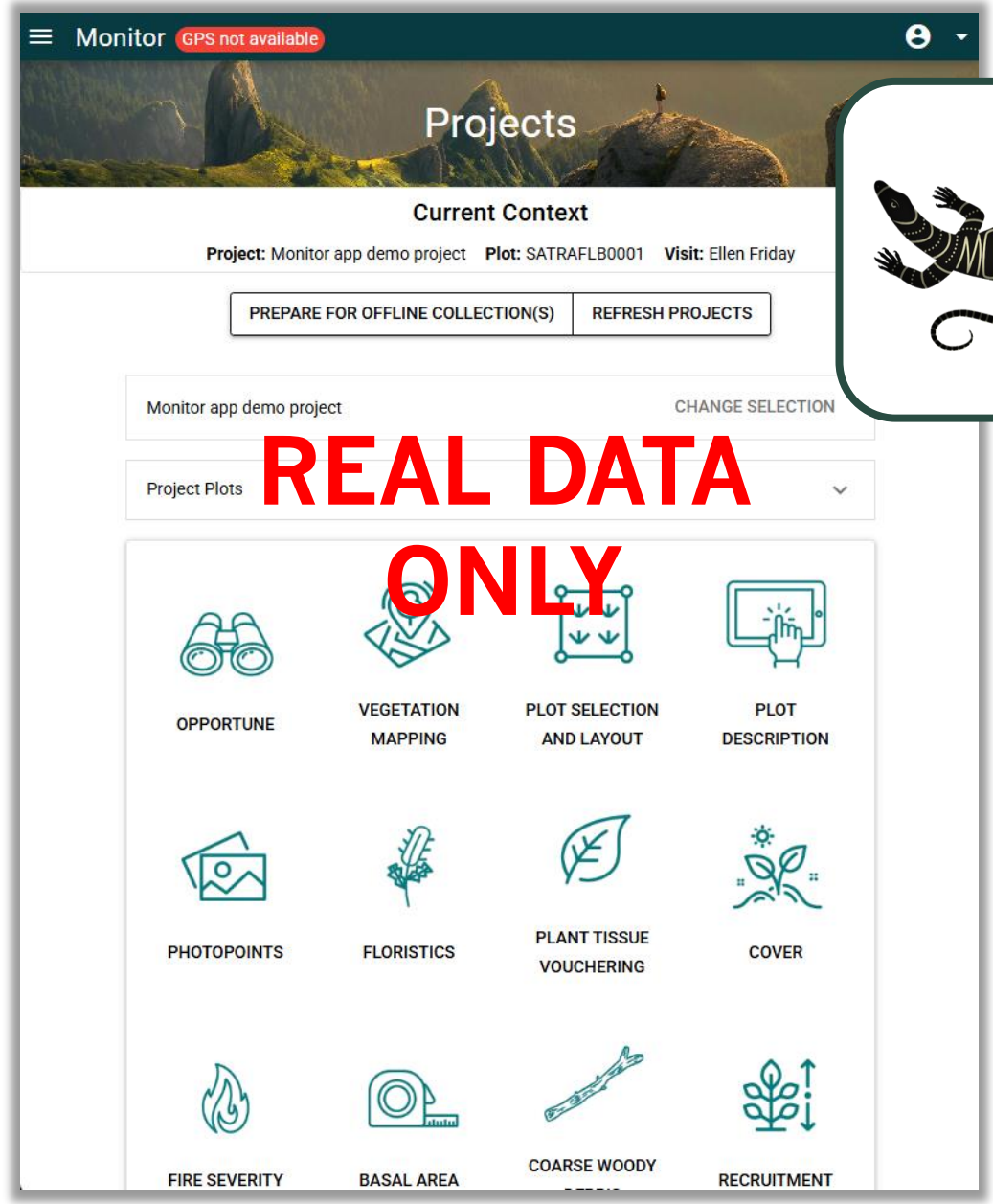
Internet Browser ☒



BETA



PRACTICE DATA ONLY



REAL DATA ONLY

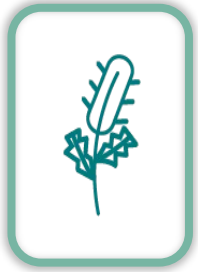
staging.app.monitor.tern.org.au

Steps for installing the Monitor Staging PWA

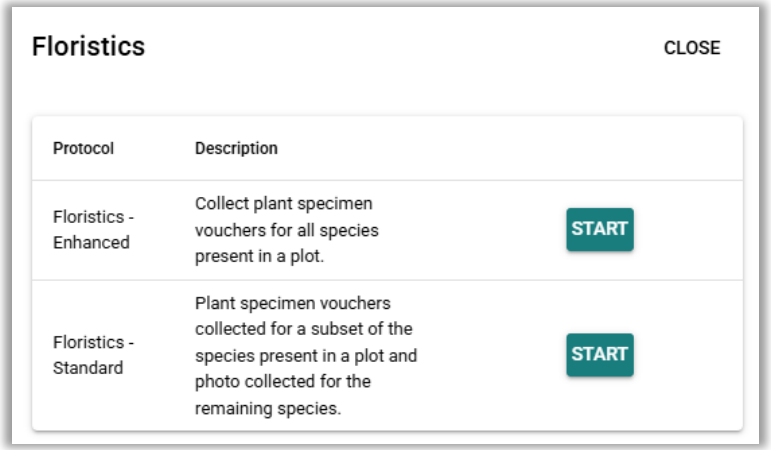
- Open **staging.app.monitor.tern.org.au** in the Chrome brow
  - If prompted by a pop up to 'install' follow the link
  - Don't use the 'Open PWA' in the middle of the screen, it won't work.
- Select the icon in the top right of the browser
- Select a **to home screen** or **install**
- If prom d, select "**install**" again
- Close the chrome browser
- Open the Monitor app via the icon
- Log in using your ALA account deta

EMSA modules and protocols

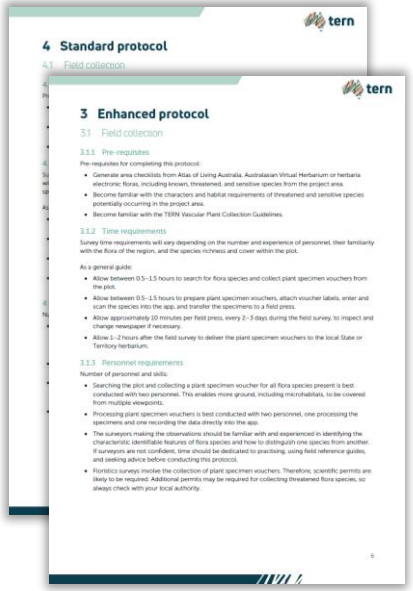
- Modular so they can be tailored to specific project needs
- Modules may have one or more protocol variations
  - Standard vs Enhanced
  - Multiple methodologies
  - Plot vs off-plot modules
- Module dependencies



Module icon



Protocol



Manual sections

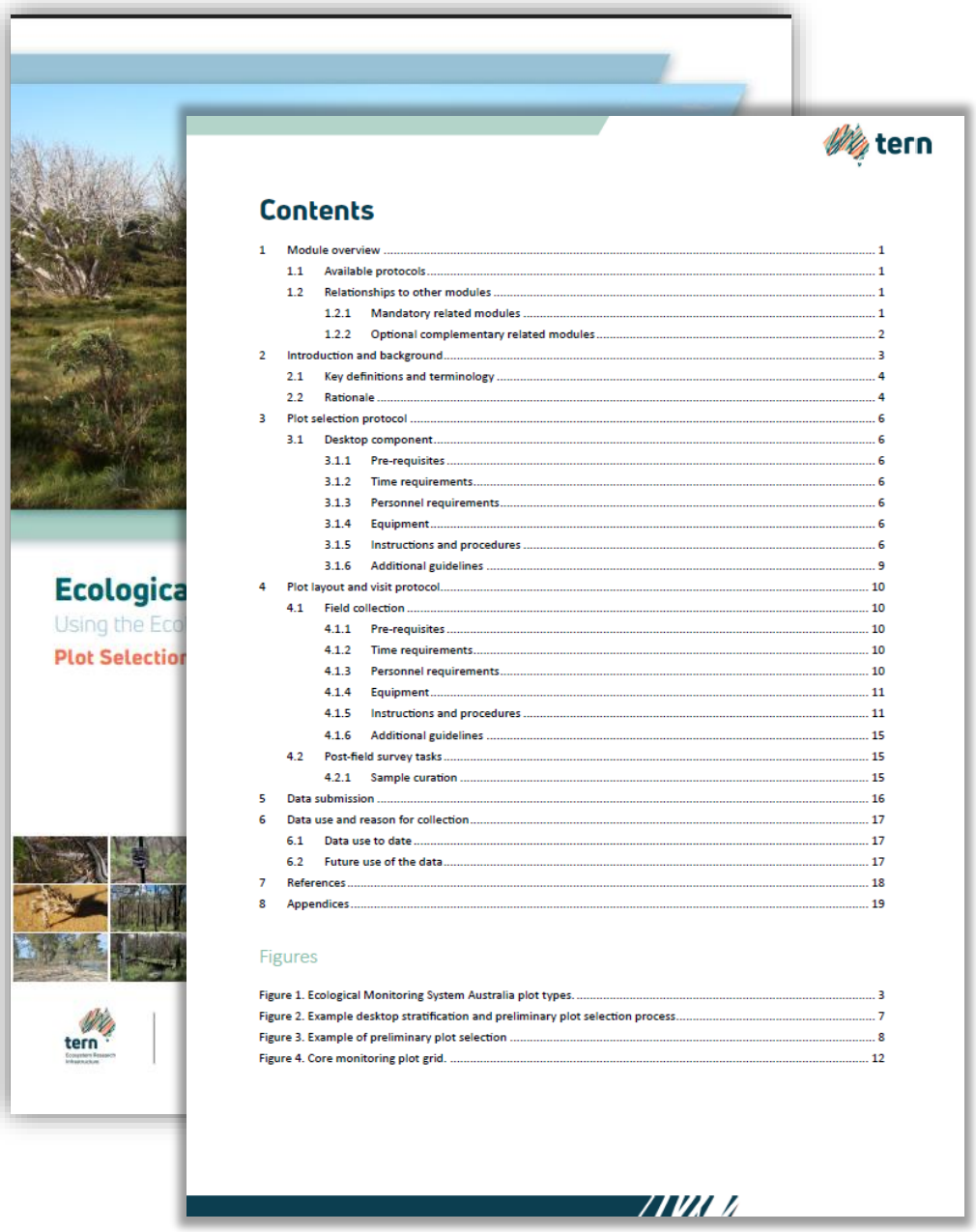
Method of data collection

EMSA

Module manuals

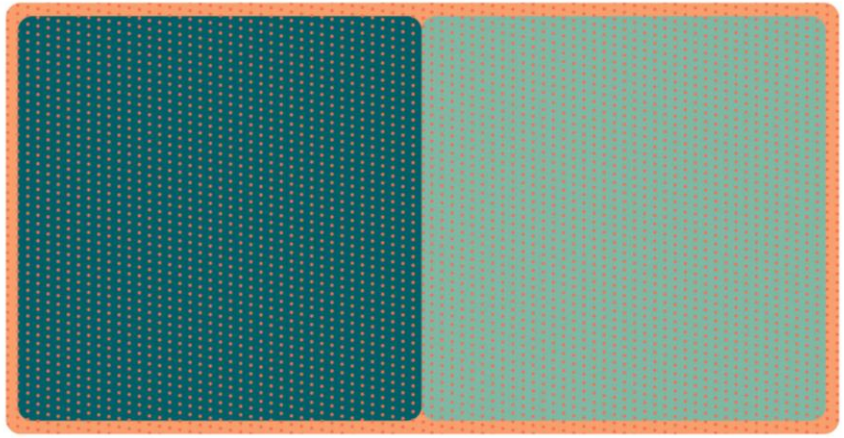
- Step by step instructions and procedures
- Additional guidelines
- Figures and diagrams
- Detailed rational for methodologies
- Multiple protocols
- Equipment list
- Time requirements
- Outlines relationships with other EMSA modules (dependencies)
- Data use and reason for collection

- emsa.tern.org.au

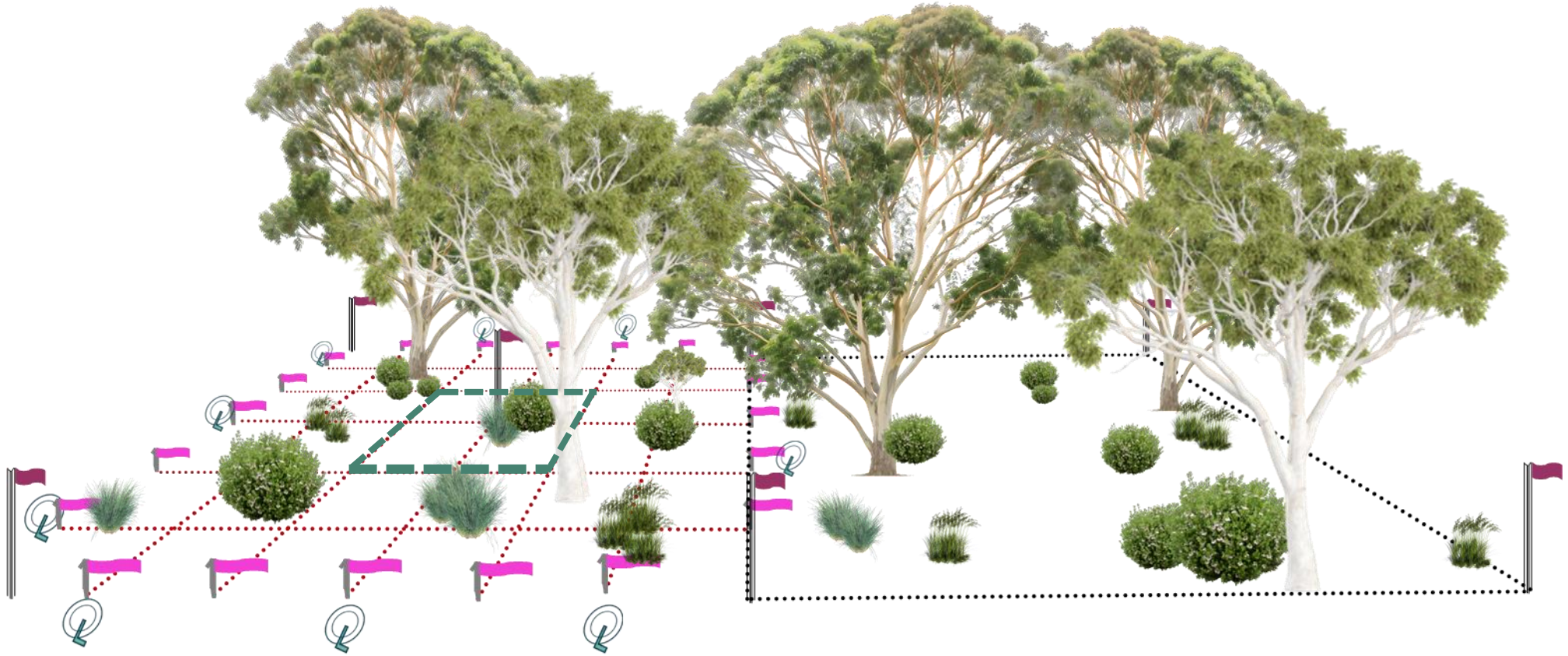


OPPORTUNE
VEGETATION MAPPING
PLOT SELECTION AND LAYOUT
PLOT DESCRIPTION
PHOTOPOINTS
FLORISTICS
PLANT TISSUE VOUCHERING
COVER
FIRE SEVERITY
BASAL AREA
COARSE WOODY DEBRIS
RECRUITMENT
HERBIVORY AND PHYSICAL DAMAGE
VERTEBRATE FAUNA
INVERTEBRATE FAUNA
CONDITION
TARGETED SURVEYS
CAMERA TRAPPING
FAUNA AERIAL SURVEYS
SIGN-BASED FAUNA SURVEYS
FAUNA GROUND COUNTS
Pre-requisite module
Dependent module
Module with some dependent protocols

Plots



Core Plot
Fauna Plot
Biodiversity Plot (2ha)
Bird Survey area (2ha)



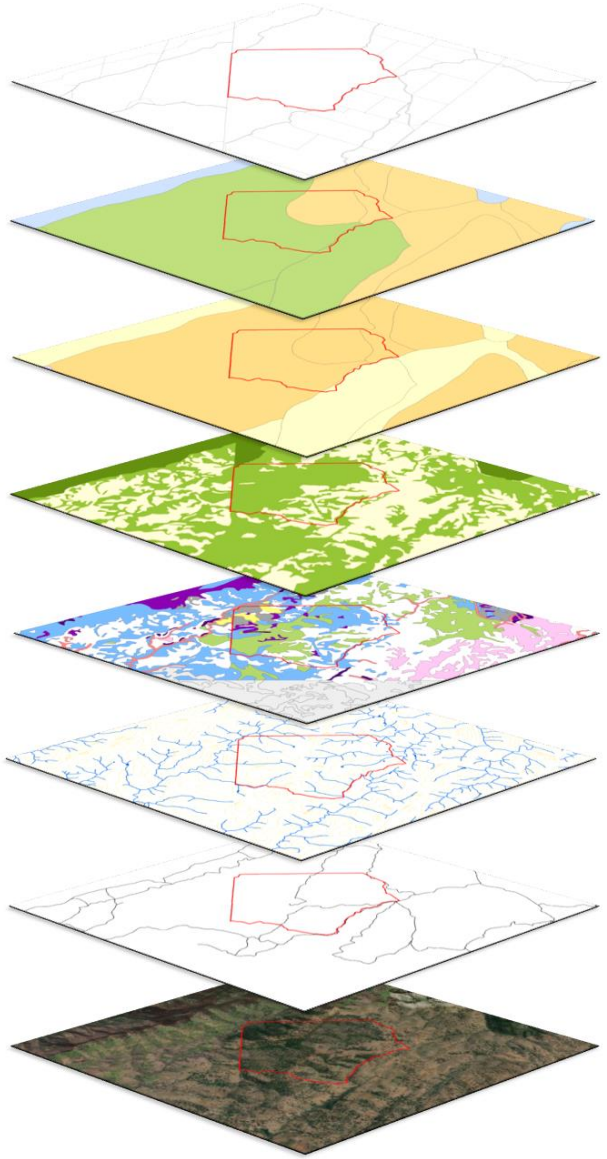
Project design –plot locations

- **Plot Type**: Impact, Control
- **Replicate** plot #
- Before-After, Control-Impact (BACI) designs
  - **Control plots**: where no environmental interventions are taking place within a plot/ immediate surrounds. Control sites are also commonly referred to as reference sites.
  - **Impact plots**: plots where environmental intervention activities are occurring, and impacts could be expected.
  - e.g. either side of a fenced area where pest control activities are occurring
- EMSA website FAQs

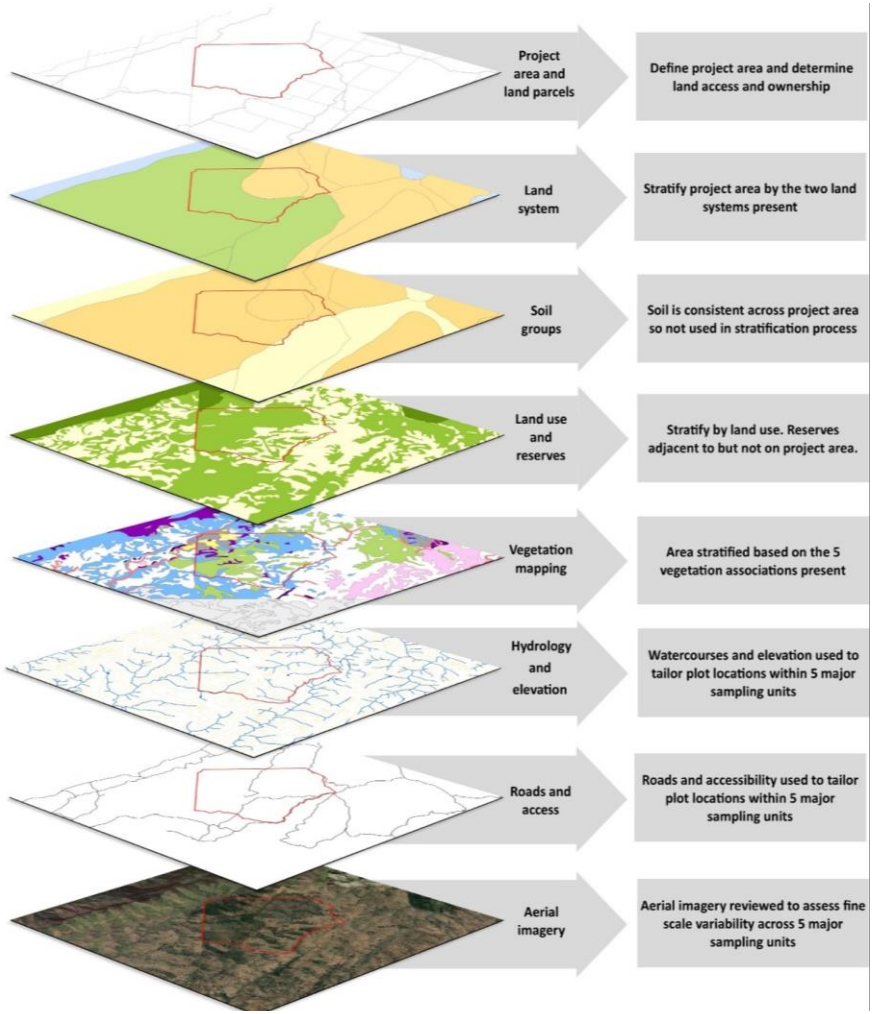
Plot Selection and Layout Module

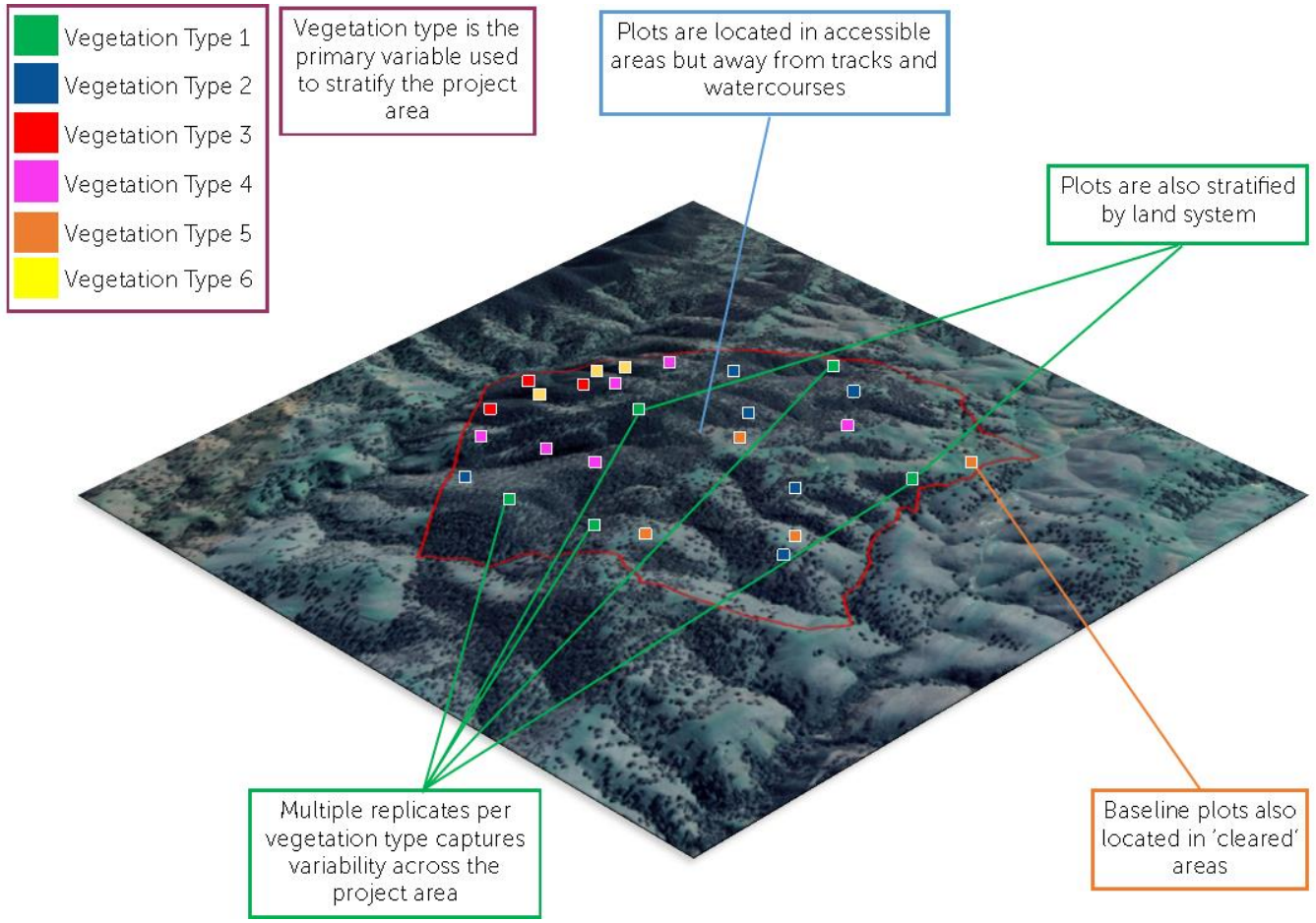
Plot Selection Protocol

- Desktop component
- Undertaken by project managers
  - Define project area boundaries
  - Stratify the project area into sampling units
  - Select proposed plot locations
- All of the other modules require the Plot Selection module to be completed prior to fieldwork
  - Non-plot based modules will only require the Project Area to be defined
  - Plot-based modules will require recommended plot locations to be selected.



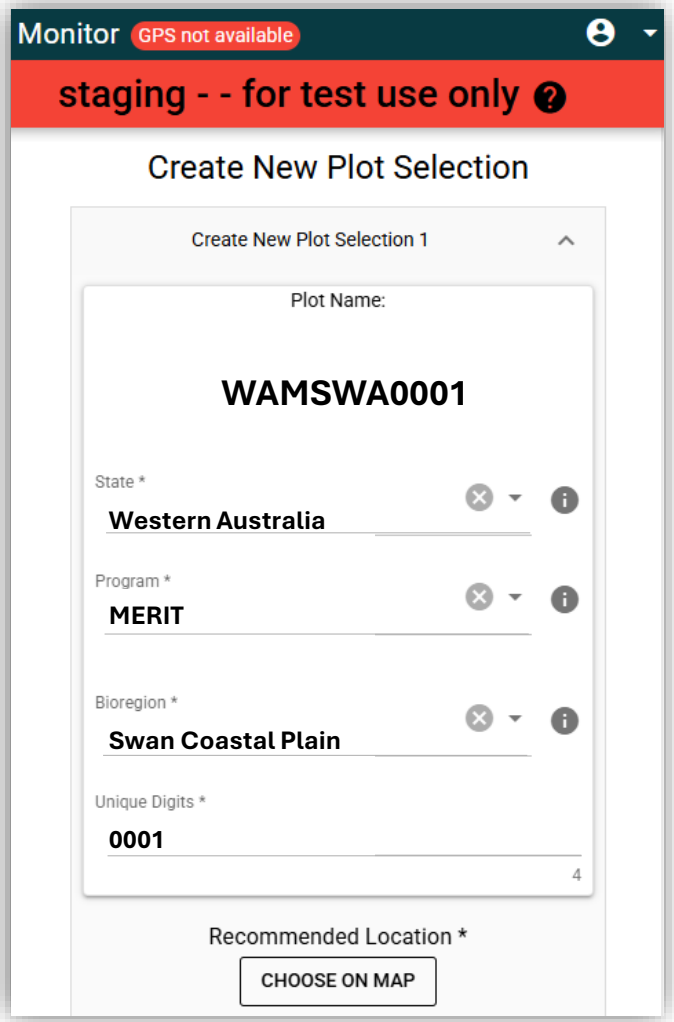
Plot Selection and Layout Module





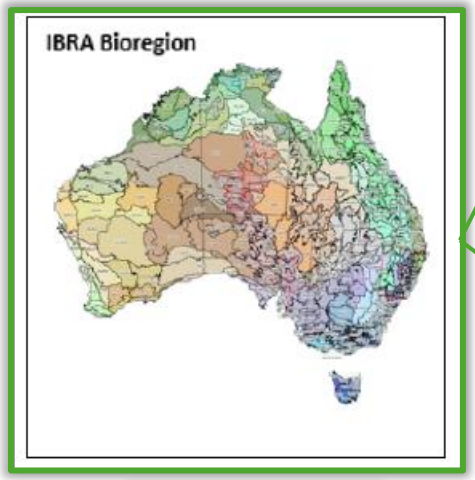
Example desktop stratification and preliminary plot selection process

Plot Name: WAMSWA0001



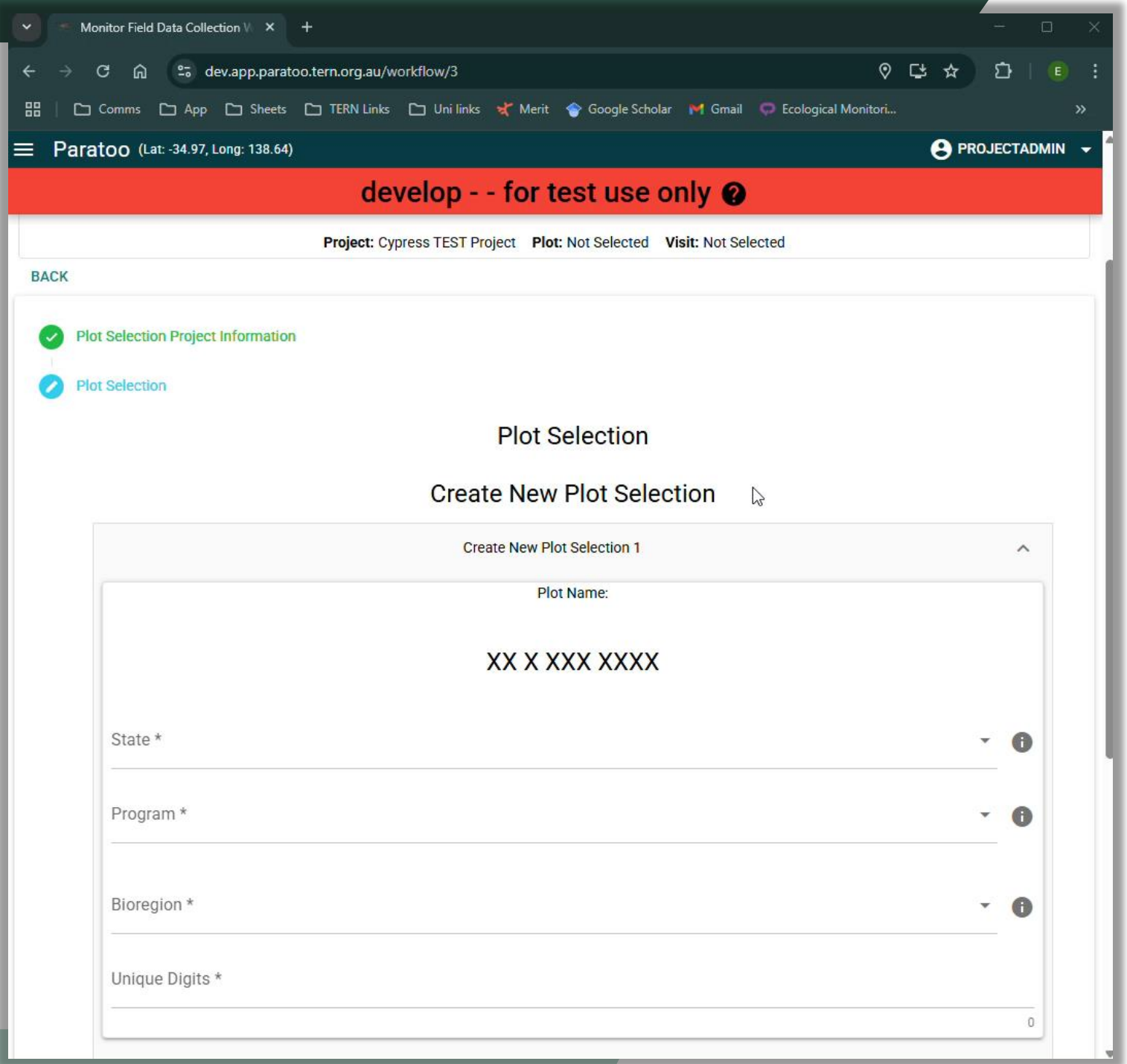
State/Territory
Northern Territory NT
South Australia SA
New South Wales NS
Queensland QD
Western Australia WA
Australian Capital Territory CT
Tasmania TC
Victoria VC

Program
MERIT M



Unique Digits
0001

IBRA Bioregion
Arnhem Coast ARC
Arnhem Plateau ARP
Australian Alps AUA
Avon Wheatbelt AVW
Brigalow Belt North BBN
Brigalow Belt South BBS
Ben Lomond BEL
Broken Hill Complex BHC
Burt Plain BRT
Carnarvon CAR
Central Arnhem CEA
Central Kimberley CEK
Central Ranges CER
Channel Country CHC
Central Mackay Coast CMC
Coolgardie COO
Cobar Peneplain COP
Coral Sea COS
Cape York Peninsula CYP
Daly Basin DAB
Darwin Coastal DAC
Dampierland DAL
Desert Uplands DEU
Davenport Murchison Ranges DMR
Darling Riverine Plains DRP
Einasleigh Uplands EIU
Esperance Plains ESP
Eyre Yorke Block EYB
Finke FIN
Flinders Lofty Block FLB
Furneaux FUR
Gascoyne GAS
Gawler GAW
Geraldton Sandplains GES
Gulf Fall and Uplands GFU
Gibson Desert GID
Great Sandy Desert GSD
Gulf Coastal GUC
Gulf Plains GUP
Great Victoria Desert GVD
Hampton HAM
Indian Tropical Islands ITI
Jarrah Forest JAF
Kanmantoo KAN
King KIN
Little Sandy Desert LSD
MacDonnell Ranges MAC
Mallee MAL
Murray Darling Depression MDD
Mitchell Grass Downs MGD
Mount Isa Inlier MII
Mulga Lands MUL
Murchison MUR
Nandewar NAN
Naracoorte Coastal Plain NCP
New England Tablelands NET
NSW North Coast NNC
Northern Kimberley NOK
NSW South Western Slopes NSS
Nullarbor NUL
Ord Victoria Plain OVP
Pine Creek PCK
Pilbara PIL
Pacific Subtropical Islands PSI
Riverina RIV
Subantarctic Islands SAI
South East Coastal Plain SCP
South East Corner SEC
South Eastern Highlands SEH
South Eastern Queensland SEQ
Simpson Strzelecki Dunefields SSD
Stony Plains STP
Sturt Plateau STU
Southern Volcanic Plain SVP
Swan Coastal Plain SWA
Sydney Basin SYB
Tanami TAN
Tasmanian Central Highlands TCH
Tiwi Cobourg TIW
Tasmanian Northern Midlands TNM
Tasmanian Northern Slopes TNS
ast TSE
n Ranges TSR
WE
VIB
VIM



Link to video

Plot Selection and Layout Module

Plot Layout and visit protocol

- Ground truthing plot
- Determining on ground suitability of plot locations
  - Representative of the project area
  - Homogenous vegetation community
  - Accessible
- Requires extremely precise location data (GNSS receiver)
  - Ensure measurements monitor change

Photopoints Module

- 360° panoramas captured using one of three protocols
  - DSLR Panorama
  - Compact Camera Panorama
  - Device Panorama
- Visual reference recording environmental change over time
- Data from DSLR Panoramas can be used to
  - Create 3D point clouds
  - Provide estimates of basal area and biomass

Plot Description Module

- Uses standardised terminology to describe physical characteristics of the plot including
  - Landform
  - Land surface
  - Land use
  - Lithology
  - Fire history
  - Site disturbance
  - Structural formation
  - Growth stage

- Terminology aligns with Australian standards
  - The National Vegetation Information System (NVIS)
  - Australian Soil and Land Field Survey Handbook (the Yellow Book).
- Revisits capture change in vegetation
  - Physical disturbance like fire, flood, grazing etc.
  - Ecological change such as flowering, fruiting, die back, recruitment etc.

EMSA Modules

Vegetation Monitoring

Condition Module

Floristics

Vegetation Mapping

Basal Area

Recruitment

Plant Tissue Vouching

Opportune

Coarse Woody Debris

Cover

Fire Severity

Floristics Module

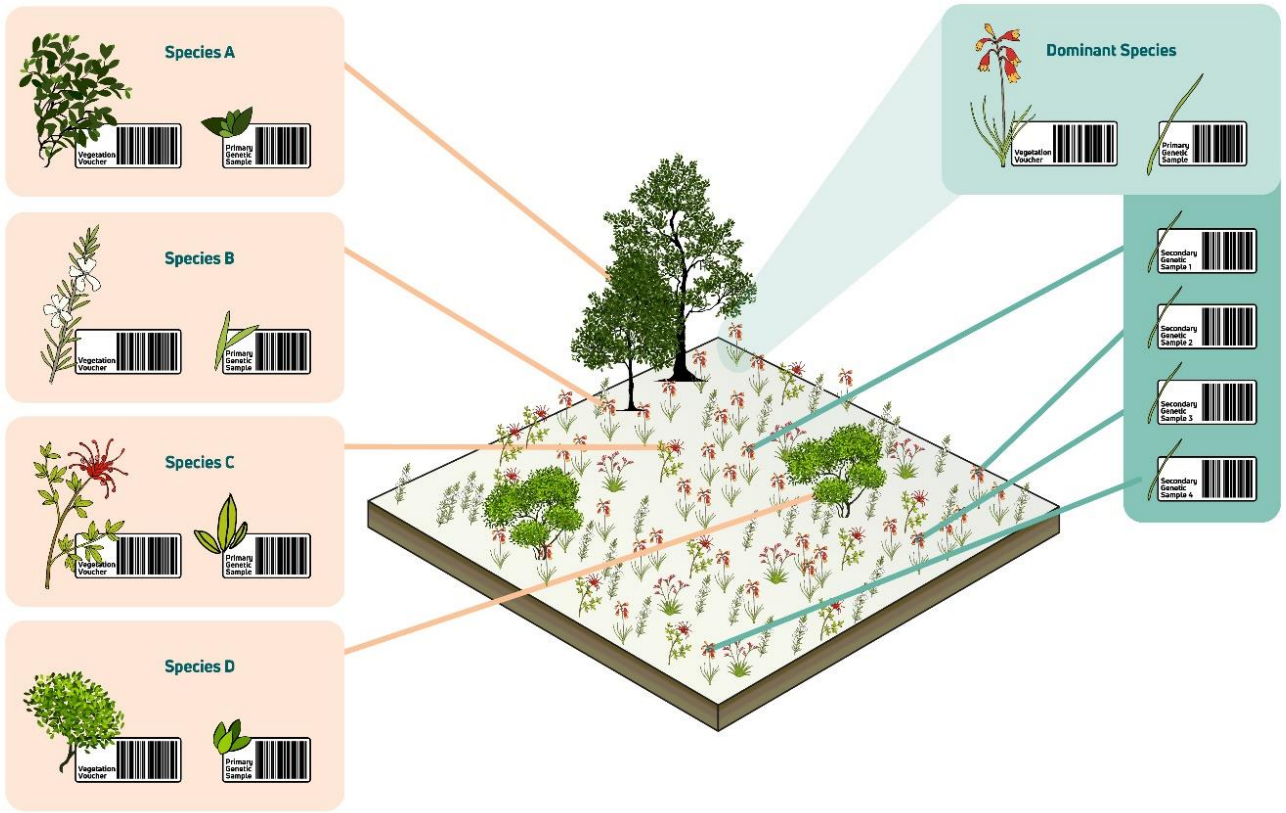
- Collect voucher specimens for of all the species appearing on a plot
- Collect specimens that:
  - Representative of the population at the site,
  - Include distinguishing ID features (flowers and seeds etc.)
  - Are fertile (if possible)
  - Have above and below ground structures (where possible)
- Collect into a day press on the plot and then transfer into a field press when barcoding and naming.
- Voucher specimens are pressed and dried.
  - Photographs may be taken to accompany the pressed specimen (e.g. of bark, habit etc.)
- On revisits only collect voucher specimens for new species
  - Photograph species that have already been inventoried
- Use field names to identify unknown species
  - Field names carry over to other protocols such as Cover and Recruitment
- Herbarium or approved botanist will verify the species for voucher specimens

EMSA-approved Botanist

- EMSA-approved botanists may make vouchered species ‘determinations’ in the place of herbarium-based botanist.
  - *Requirements to make flora species determinations in the Floristics Module (factsheet)*
    - Outlines who can ‘*determine*’ species identifications in the Floristics module
    - How to apply
  - *Application form to be recognised as an EMSA-approved Botanist*
    - Self assessment
    - References
- Applications sent to ltmp@dcceew.gov.au

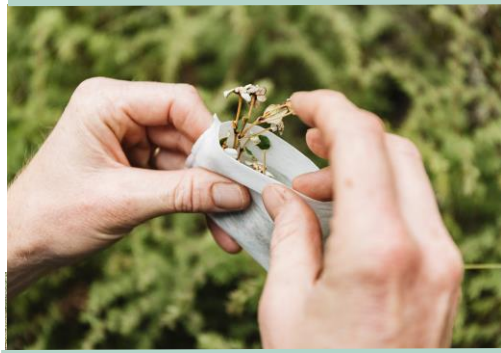
Plant Tissue Vouchering Module

- Collect, dry and store plant tissue vouchers from within the plot
- Replicate collections for dominant species from each stratum

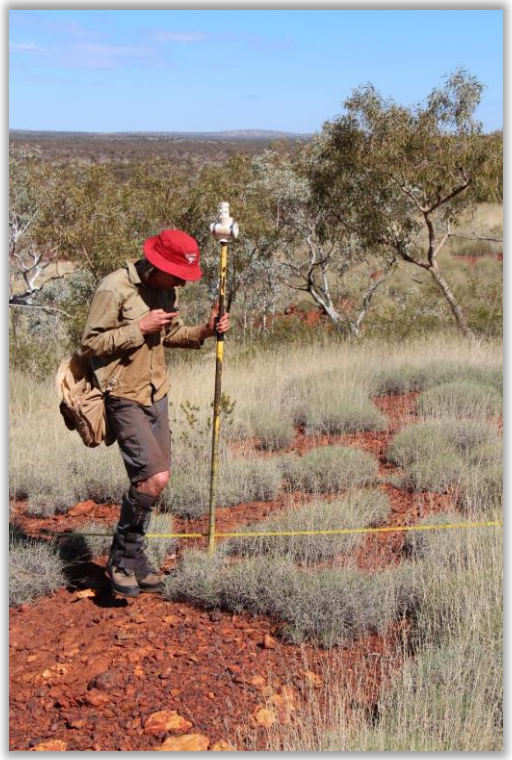


Plant tissue voucher uses:

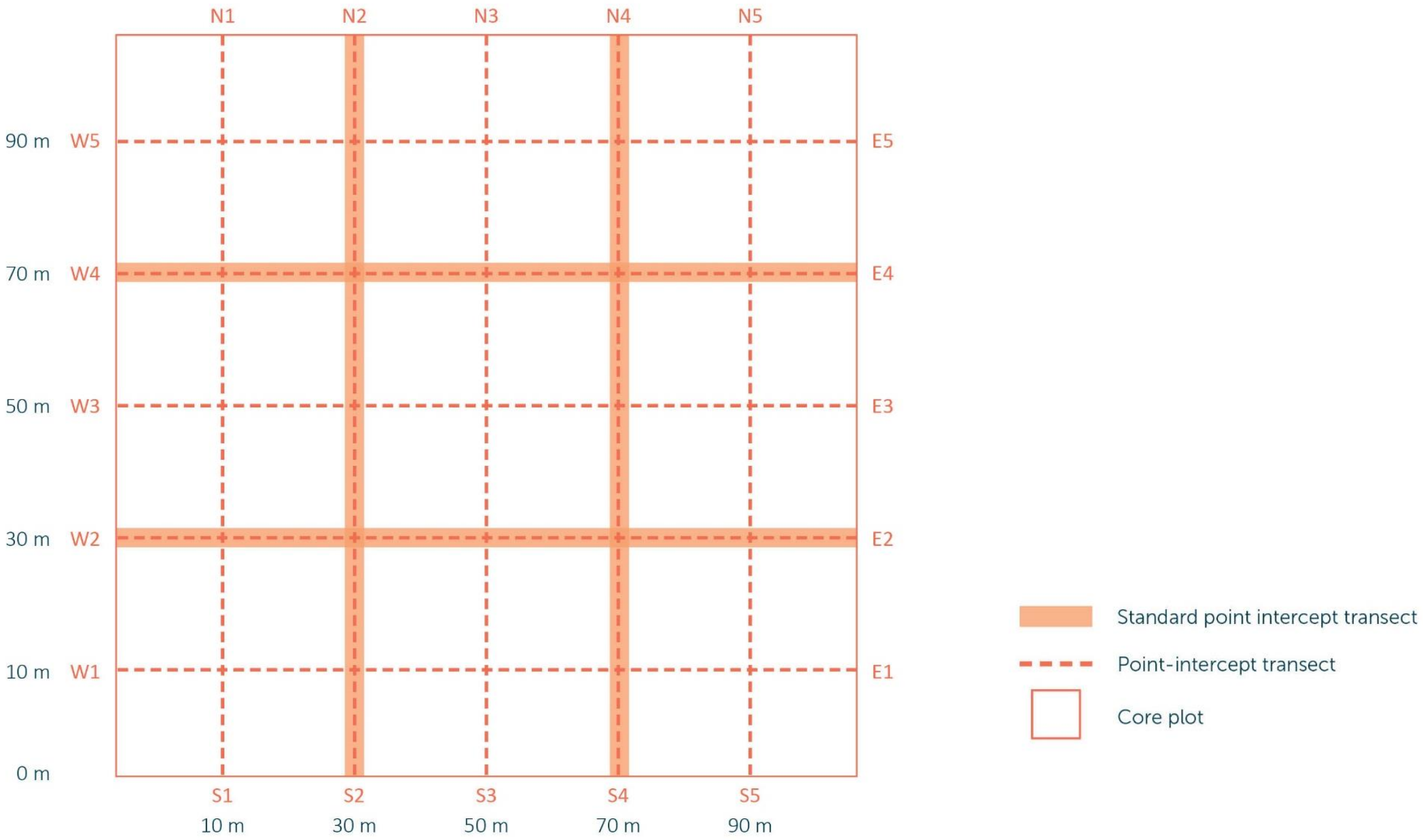
- Molecular analysis including:
  - DNA Barcoding
  - Population genetics
  - Stable isotope
  - Leaf trait analyses
- Accurate plant species ID
- Identify genetically important populations.



Cover Module



- Requires Floristics vouchers
- Record substrate and vegetation cover
- Uses the point intercept method
  - **Enhanced protocol**
    - Records the substrate, vegetation and vegetation height at 1010 points across a plot
    - Estimates cover and species richness
    - Data used to classify the vegetation association to NVIS Level 5
  - **Standard protocol**
    - Has a smaller samples size (404 points)
    - Standard protocol collects fractional cover
    - Classifies vegetation as photosynthetic or non photosynthetic


N1
N2
N3
N4
N5
90 m
W5
E5
70 m
W4
E4
50 m
W3
E3
30 m
W2
E2
10 m
W1
E1
0 m
S1
10 m
S2
30 m
S3
50 m
S4
70 m
S5
90 m
Standard point intercept transect
Point-intercept transect
Core plot

Fire Severity Module

- Additional attributes measured during Cover - point intercept surveys
- Cover survey plus fire severity attributes measured at a total of 404 points along 4 x transects
- Maximum trunk char height measured at 4 x locations
- Requires Floristics vouchers

Basal Area Module

- Requires Floristics vouchers
- Use one of two protocols to measure the average area within the plot occupied by trees and provide information on stand density.
  - **DBH Protocol**
    - Plot sampling
    - Measure diameter at breast height (DBH) for all trees within 40 x 40 m or 100 x 100 m area
  - **Basal Wedge Protocol**
    - Point sampling, rapid assessment
    - Using handheld gauge (basal wedge)
    - Basal area can be estimated in m^2/ha by multiplying the count of 'in' trees across a 360° sweep with the selected BAF.
- Data may be used to:
  - Monitor tree growth
  - Calculate tree biomass and carbon sequestration (using allometric equations)

in (+1) borderline (+0.5) out (0)

Recruitment Module

- Recruitment is an indicator of ecosystem health and condition
- Requires Floristics vouchers

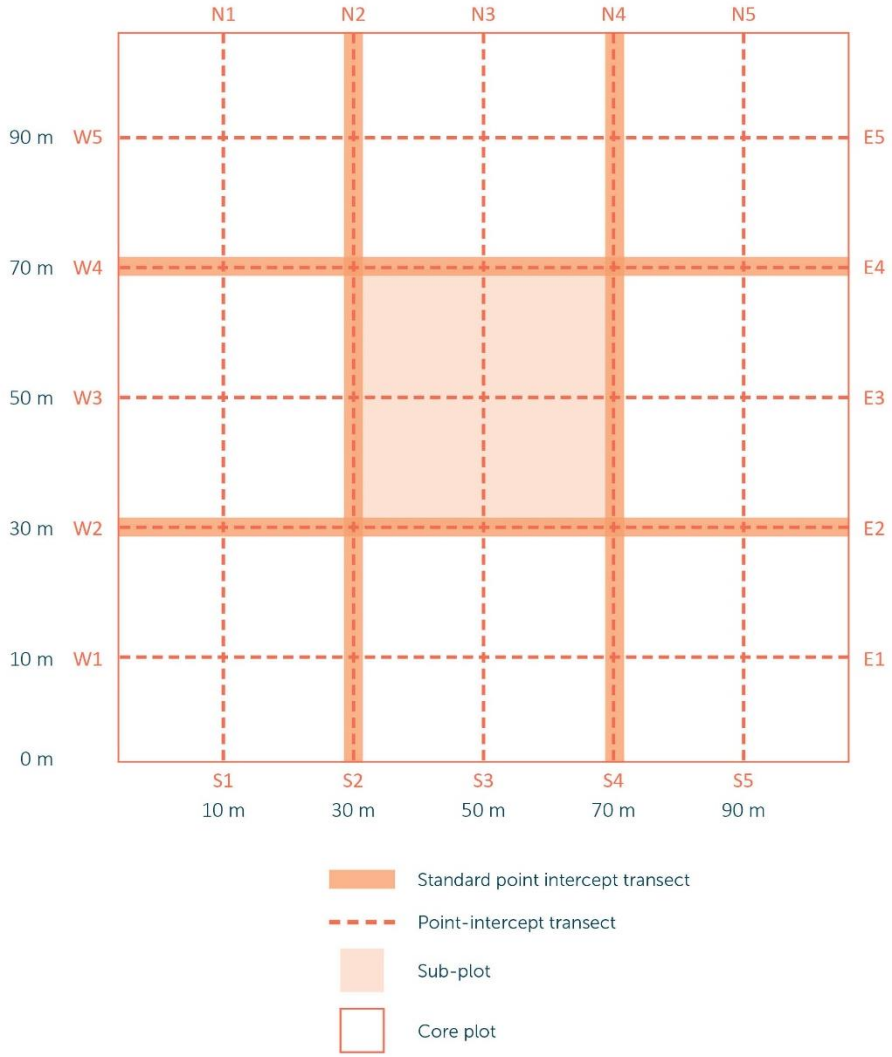
- **Age structure protocol**
  - Records the growth and life stages of each perennial species to assess level of recruitment and potential to recruit (100 x 100 m)
  - Seedling, sapling, juvenile counts for woody species to assess age class structure (40 x 40 m)

- **Survivorship protocol**
  - Tagging and tracking growth and health of individual plants over time
  - Monitoring restoration, translocations, post fire recovery

Vegetation Mapping Module

- Provides a standardised approach to vegetation classification in line with NVIS information hierarchy
- For dominant species of each strata record:
  - Dominant growth form
  - Foliage projective cover
  - Average height
- Additional measures help identify variability within vegetation associations and assist stratification and assessment. These measures include:
  - Homogeneity measure
  - Land use history
  - Vegetation growth stage
  - Fire history
  - Disturbance
- Classifying and mapping vegetation helps simplify complex systems into discreet units and understand the distribution of vegetation communities.
- Vegetation mapping may be used to inform monitoring plot and management action locations.

Coarse Woody Debris Module



- Record the size and decay class of coarse woody debris (CWD) and tree stumps on the ground.
- Condition measure
- CWD contributes to a range of ecosystem processes
- Data provides insight into structure, habitat, fuel load

Decay class 1:	Decay class 2:	Decay class 3:	Decay class 4:	Decay class 5:
Recently fallen. Structurally intact or almost so; bark or small branches still attached; few signs of wood decay; wood mostly retains original colour.	Structurally less intact but still hard when kicked; small branches absent; little or no bark present; early signs of wood decay, bark loss or discolouration.	Clearly decaying but still supports own weight; may be slightly soft when kicked; may be hollow in places; no bark; moss and fungi may be prominent.	Cannot support its own weight; soft to kick (but may still be hard in places; in which case may be extensively hollow); moss, fungi and invading roots likely.	No longer retains original shape; wood very soft or largely disintegrated; sometimes only outline visible beneath moss, invading roots.

Condition

- The condition module surveys the following attributes:
  - Tree condition
    - Growth stage
    - Life stage
    - Height
    - DBH
  - Tree health
    - Canopy cover
    - Crown damage
    - Mistletoe
    - Hollows
    - Insect damage
    - Other damage
    - Leaf litter depth
- Requires Floristics vouchers
- When combined with other EMSA modules that asses the structure, function and species composition, condition measures provide insight in the overall health and ecological function of a system

Habitat Condition Assessments

Recommended modules:

- Condition
- Basal Area
- Coarse Woody Debris
- Recruitment

Pre-requisites

- Plot Selection and Layout
- Floristics

Optional modules for collecting condition attributes:

- Sign-based Fauna Surveys
- Fire Severity
- Photopoints
- Cover
- Herbivory and Physical Damage
- Plot Description

EMSA Modules – Fauna Monitoring

Invertebrate Fauna

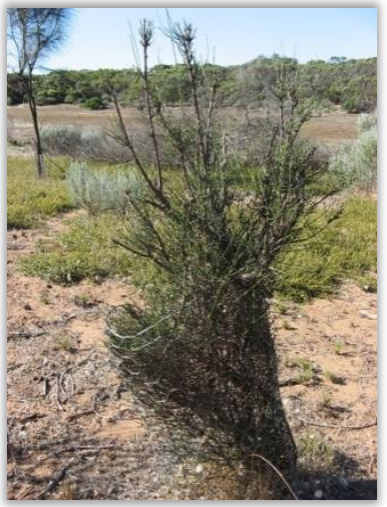
- Wet pitfall trapping
- Rapid ground trapping
- Malaise trapping
- Pan trapping
- Active search

Collect invertebrate samples.

Herbivory and Physical Damage

- Within-plot belt transect
- Off-plot transect
- Active Plot Search

Record signs of herbivory and physical damage to vegetation, land and other infrastructure.



Vertebrate Fauna

- Bird survey
- Trapping survey set up
- Identify, measure and release
- Trapping survey closure
- Active and passive search
- Acoustic and ultrasonic recordings

Survey techniques to identify the diversity of the vertebrate fauna community.

Sign-based Fauna Surveys

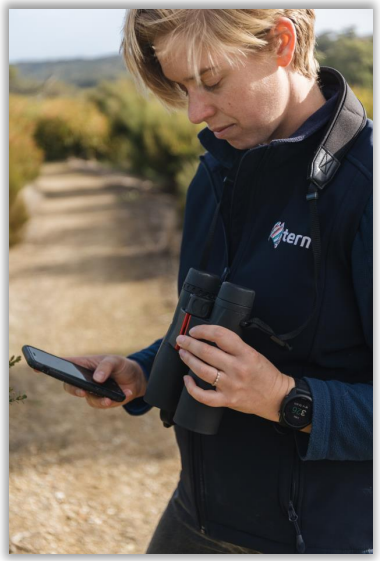
- Within-plot Belt Transect
- Off-plot Belt Transect
- Plot Sign Search
- Vehicle Track
- Track Station

Record signs of fauna presence within the plot or on off-plot transects.

EMSA Modules – Fauna Monitoring

Fauna Aerial Surveys

Record the survey details, distance travelled and species counts for surveys undertaken from an aircraft.



Opportune

Record opportune observations of species across a project area.

Camera Trapping

- Deployment
- Re-equipping
- Retrieval

Record the placement and details of camera traps.

Fauna Ground Counts

- Transects
- Vantage point

Record observations of fauna from vantage points or transects.

EMSA Exemptions – Recording monitoring using other methods

If you are granted an exemption from using the EMSA monitoring methods, you may be asked to enter information into EMSA via the Targeted Survey Module.

- **Targeted Surveys Module**
  - Meta data collection module
  - Projects that conduct monitoring that does not fit into the standardised EMSA monitoring framework
  - Monitoring is already contributing to a long-term data set
  - Threatened species monitoring

Preparing your device for field data collection

- Best practice app management
  - Prepare for offline collections
  - Load map tiles if necessary
  - Syncing data with a stable internet connection
- Have copies of the Module Manuals to refer to
  - The app's main function is as electronic datasheets
  - Has lots of information to guide users through monitoring steps, but much more detail is provided in the protocols

EMSA
Ecological Monitoring System Australia

EMSA Tutorials

Best practice workflow in Monitor

Caching map tiles in Monitor

- Caching saves map ‘tiles’ at selected levels of zoom for offline use
- Monitor doesn’t hold cached tiles for all of Australia (and neither does google maps!)
  - Manually cache tiles for plots expected to have poor or no mobile connection.
  - Location functions will still work without caching map tiles, only the map will have no topographic reference view.

EMSA
Ecological Monitoring System Australia

EMSA Tutorials

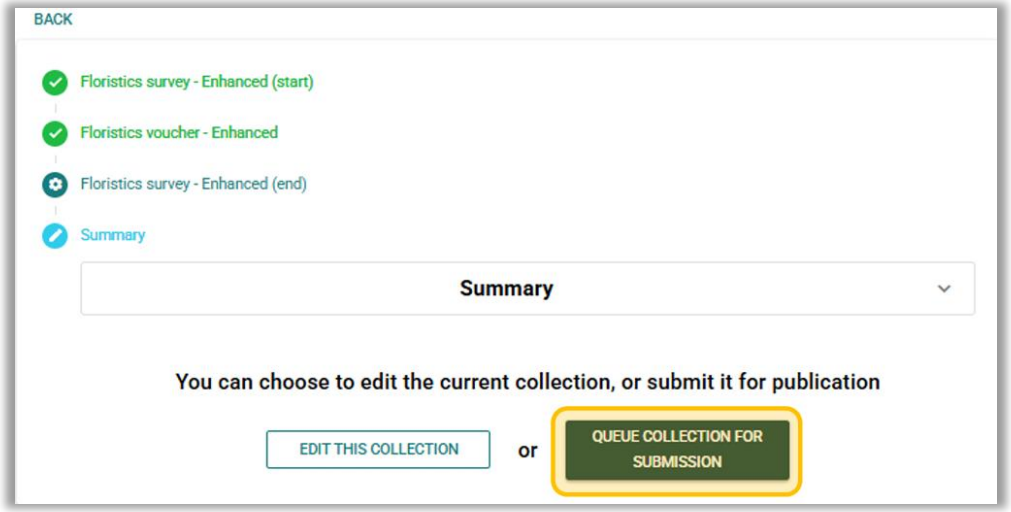
Caching map tiles in Monitor

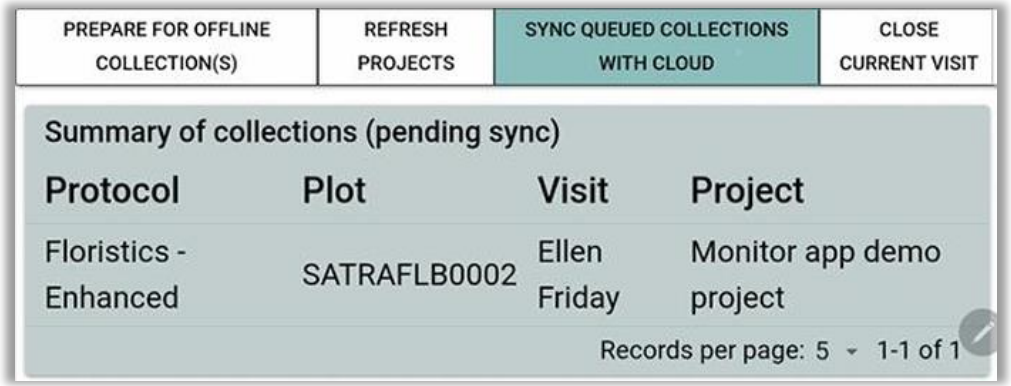
Syncing

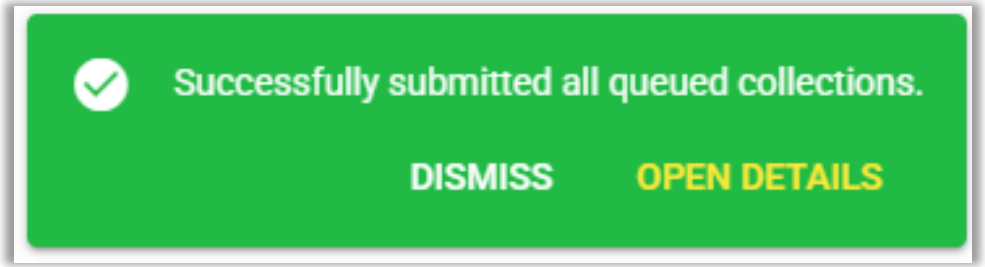
1. Review the **Summary of your collected data**
2. **Queue Collection for Submission**
3. **Sync Queued Collections with Cloud**
4. Wait for the loading bar to complete
5. Wait for the green **'Successfully submitted all queued collections'** message banner to appear

Completed surveys in Monitor are stored on your device's 'local storage' and are listed in the ***Summary of Collections Pending Sync*** until they are synced with the cloud

Once your queued collections have been **synced with the cloud** the data has been sent from your device to MERIT database

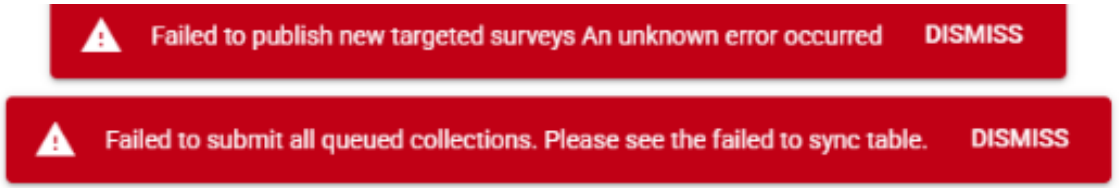






Trouble shooting sync errors

- Sync errors occur when
  - A network collection is lost
  - The receiving server is down
  - Your data doesn't match the database fields
- If a sync error occurs:
  - Check your network connection
  - Wait 5 mins
  - Try syncing again
  - **Leave the app open** as it attempts to sync
  - If the error persists, **contact the EMSA Help Desk**

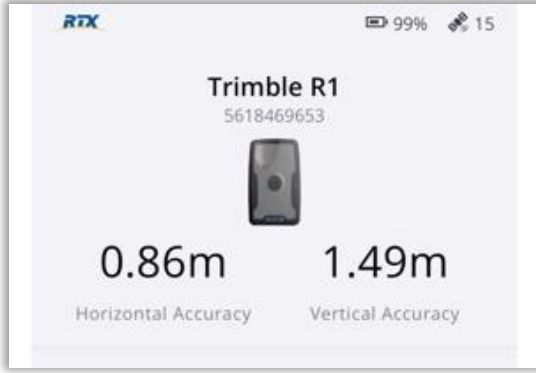


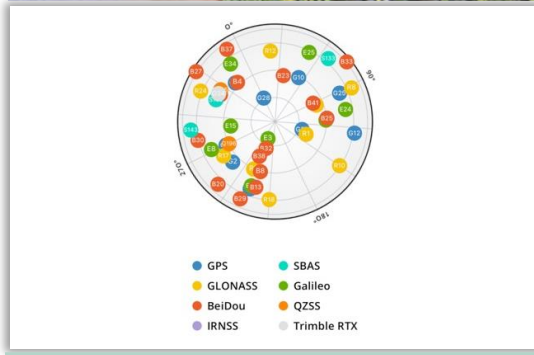
Setting the *Current Context* in Monitor

1. Open the **Plot Selection and Layout Module** and start the **Plot Layout and Visit protocol**
2. **Select existing**
3. Select the name of the plot you're working in
4. Select **Complete Plot Layout Component**
5. Select **Complete Plot Fauna Layout Component**
6. **Select Existing**
7. Select the name of the visit you are working in
8. **Complete the Plot Visit Component**
9. Review the data
10. Select the **Set Plot Context**

GNSS receiver

- EMSA protocols require **sub metre** location precision for laying out plots
- GNSS - Global Navigation Satellite Systems
  - GPS - Global Positioning System (US Gov owned and operated)
  - GLONASS (Russian Gov owned and operated)
  - Galileo (European union agency for space program owned and operated)
  - NAVIC (Indian Gov owned and operated)
  - BeiDou (China Gov owned and operated)
  - QZSS (Japanese Gov owned, QZS operated)
- TERN Hire out DGPS (Trimble R1)
  - Differential GPS
  - We provide instructions for connect an external location receiver to your hand-held android device (including setting up the mock location)
- It may take some time to connect and to provide a precise location the first time you use it in a region.
  - Plan for this –turn it on in the car





Check list

Before you go out in the field

- ✓ Ensure Plot Selection has been undertaken for your project
  - ✓ Contractors can't do this step – it must be undertaken by someone with MERIT access before field work is undertaken
- ✓ Prepare your device/s for offline data collection
- ✓ Ensure you have the relevant EMSA module manuals downloaded or printed to refer to
- ✓ Ensure your GNSS receiver and device are compatible and linked
- ✓ Ensure you have all the equipment you require
- ✓ Plan for sample and data storage/management

Habitat Condition Assessments

- Condition attributes are collected in the following EMSA Modules:
  - **Condition** – measures individual tree health and condition
  - **Recruitment –** an assessment of age class structure of vegetation within the plot
  - **Course Woody Debris –** contributes to a range of ecosystem processes that that impact the condition of a system including structure, habitat and fuel load.
  - **Fire Severity –** recommended if the plot has been recently burnt (shows signs of recovery from fire (estimated to be from the last 5-10 years).
  - **Herbivory and Physical Damage -** record any herbivory or physical damage present in the project area.
  - **Sign based surveys –** collect indicators of pest fauna presence and/or impact
- Data collected in the following modules also feed into condition assessments
  - **Floristics Module –** provides an inventory of species and information on the composition of native and introduced species
  - **Cover Module –** results of the Cover Module feed into the overall condition assessments and analysis and provide information about native and weed cover.

Floristics Module

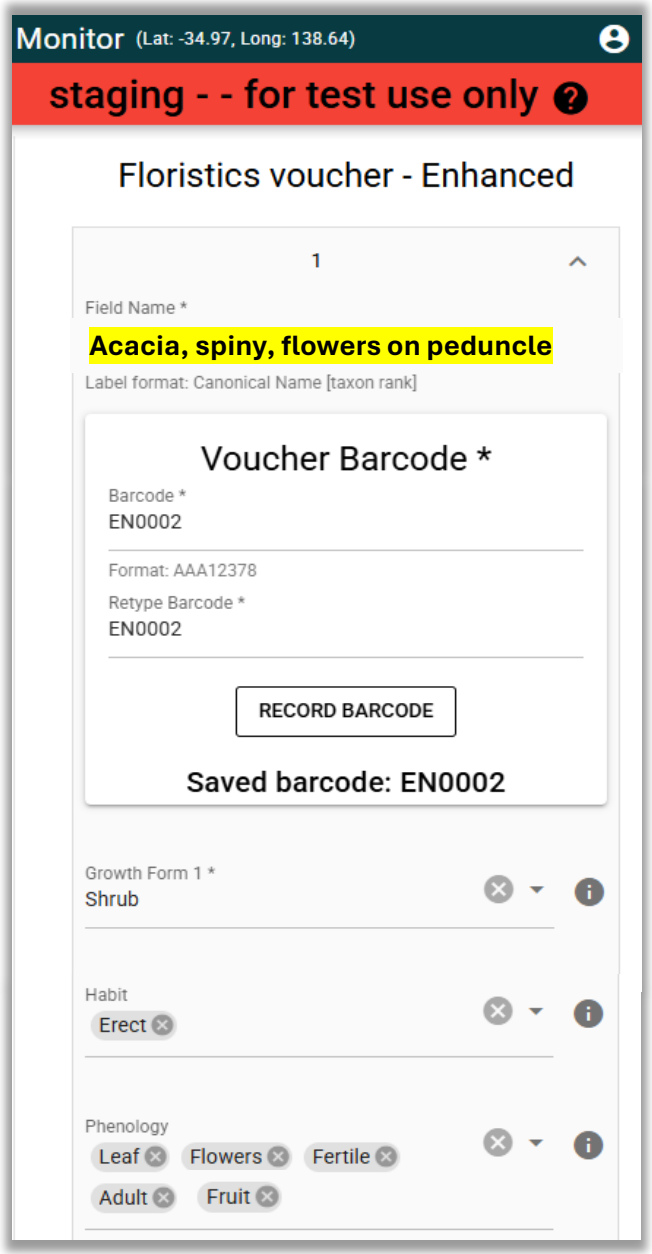
- Collect voucher specimens for of all the species appearing on a plot
- Collect specimens that:
  - Representative of the population at the site,
  - Include distinguishing ID features (flowers and seeds etc.)
  - Are fertile (if possible)
  - Have above and below ground structures (where possible)
- Collect into a day press on the plot and then transfer into a field press when barcoding and naming.
- Voucher specimens are pressed and dried.
  - Photographs may be taken to accompany the pressed specimen (e.g. of bark, habit etc.)
- On revisits only collect voucher specimens for new species
  - Photograph species that have already been inventoried
- Use field names to identify unknown species
  - Field names carry over to other protocols such as Cover and Recruitment
- Herbarium or approved botanist will verify the species for voucher specimens

Floristics Module
Field name conventions

- Field names are used when a plant cannot be confidently identified to species in the field.
- Field names should be descriptive and use clear botanical language where possible.
- Consider who else may be referring to Floristics vouchers during their surveys and if they will be able to identify the plant correctly from the field name.

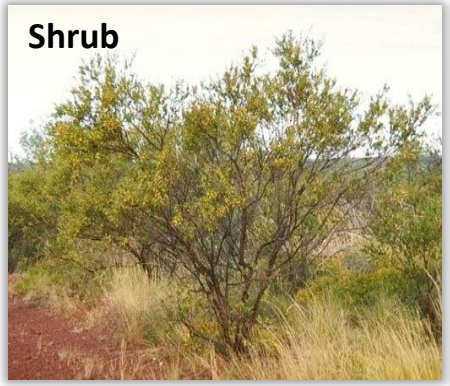
How descriptive are these field names for the plant in the pictures?

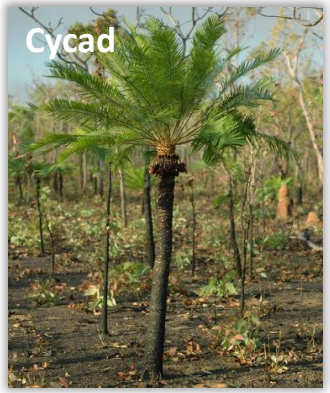
- Wattle 1
- Yellow flower, tall, prickly
- A.para
- Kangaroo thorn
- Hedge wattle
- Acacia, spiny, flowers on peduncle
- Acacia paradoxa

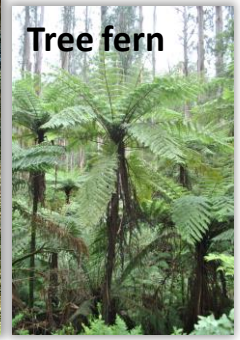


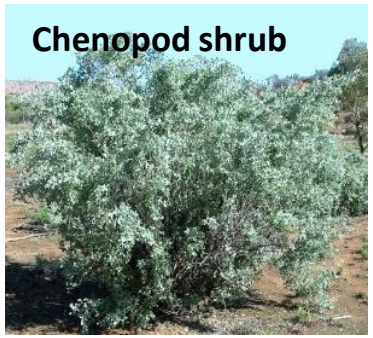
Floristics Module

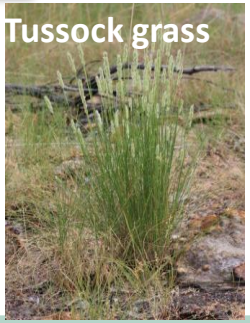
growth forms

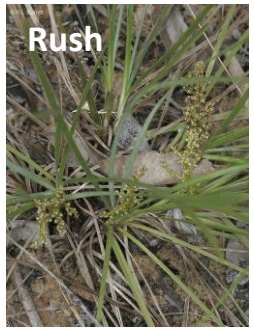


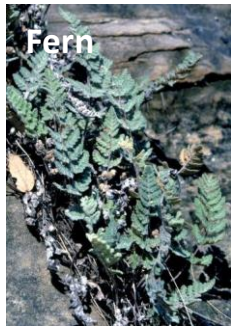




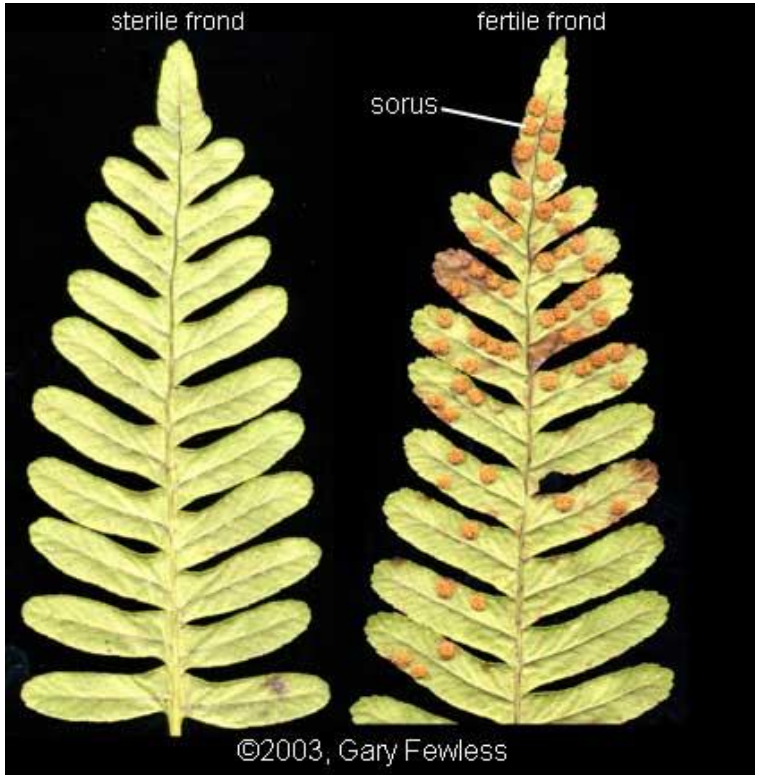






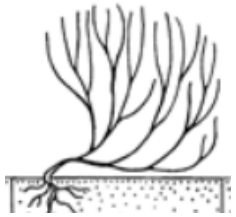
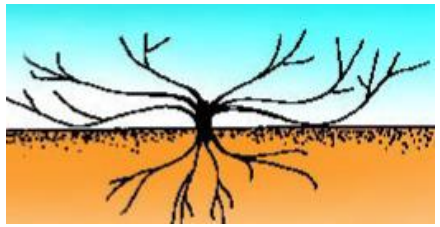
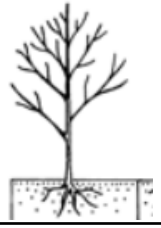
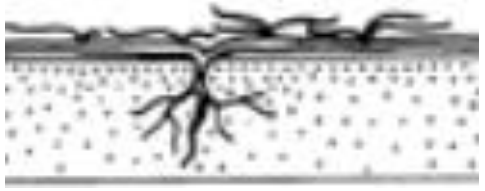
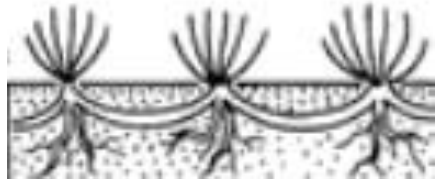


Floristics Module
phenology



- **Phenology**
  - Flowers
  - Fruit
  - Buds
  - Leaf
- Ferns
  - Sterile
  - Fertile

Floristics Module
habit

Ascending 	Decumbent 	Procumbent	Succulent
Climbing	Erect 	Prostrate 	Tufted
Creeping	Pendulous	Rhizomatous 	Twinning
			Straggling

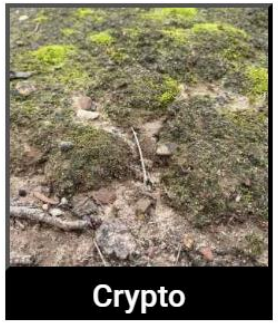
Cover Module

point intercept

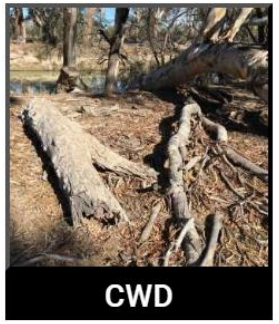
Cover Module

point intercept - substrate

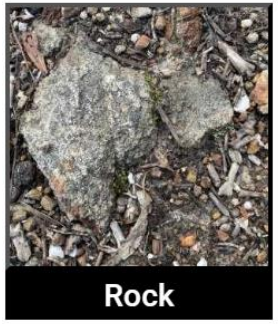
Bare

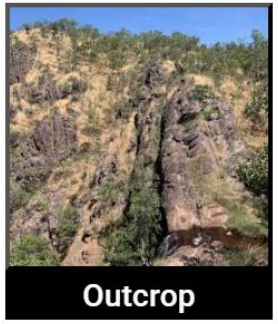

Crypto

Litter


CWD

Gravel


Rock


Outcrop

Lichen on rock

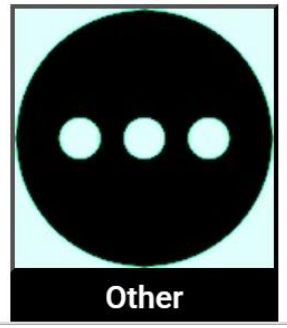
Lichen on outcrop

Water

Black ash

White ash

Unknown


Other

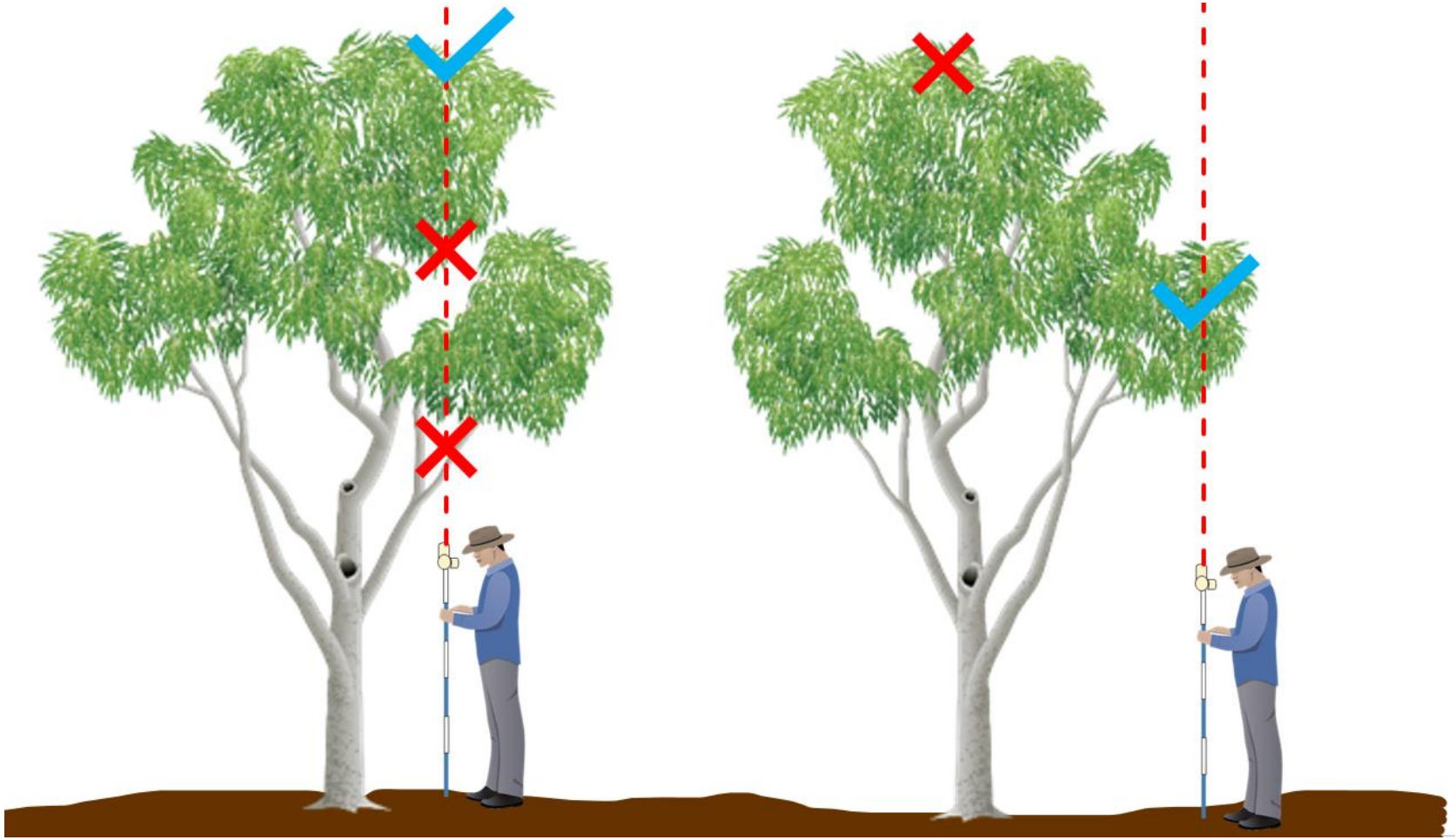
Not Collected

Cover Module

point intercept - substrate

Cover Module

point intercept – intercept height



Cover Module

point intercept – in canopy sky

Record:

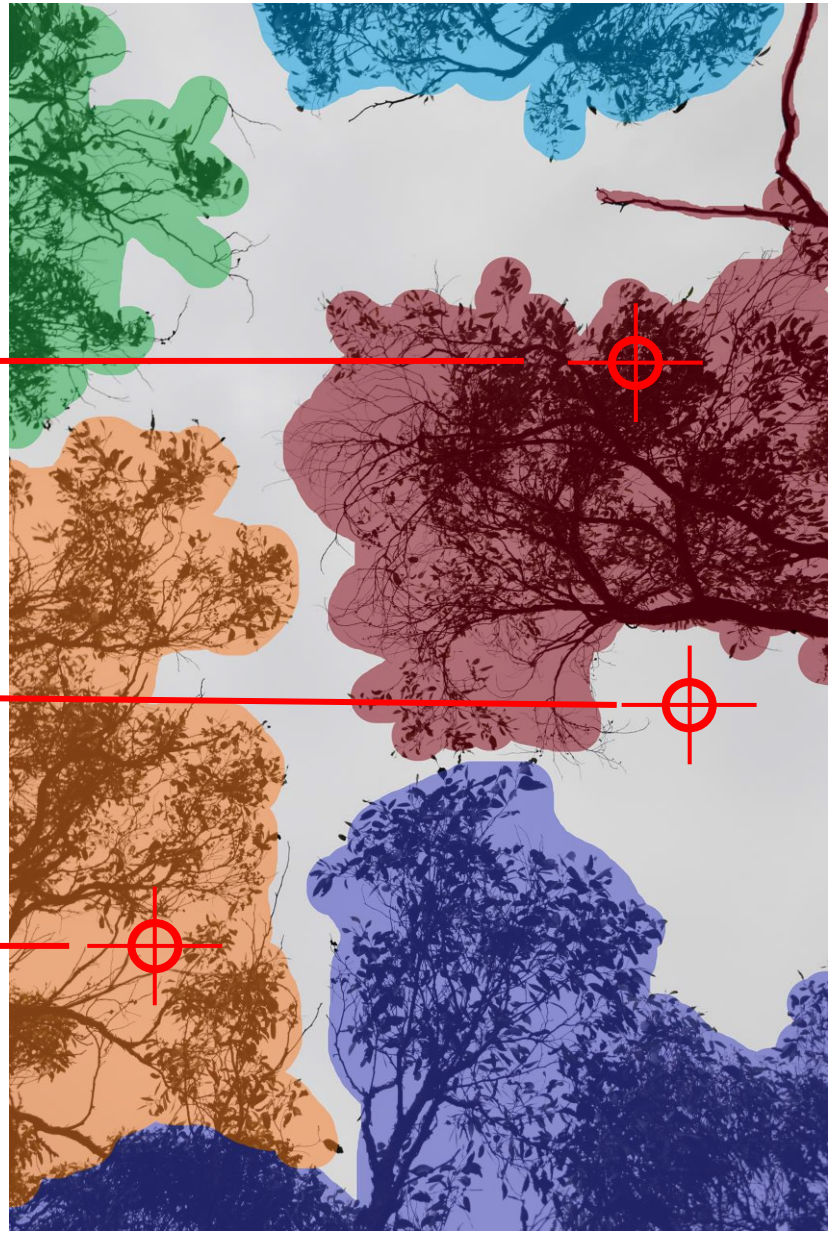
+ Floristics voucher*
+ Growth form*
+ Estimated height of intercept

No record

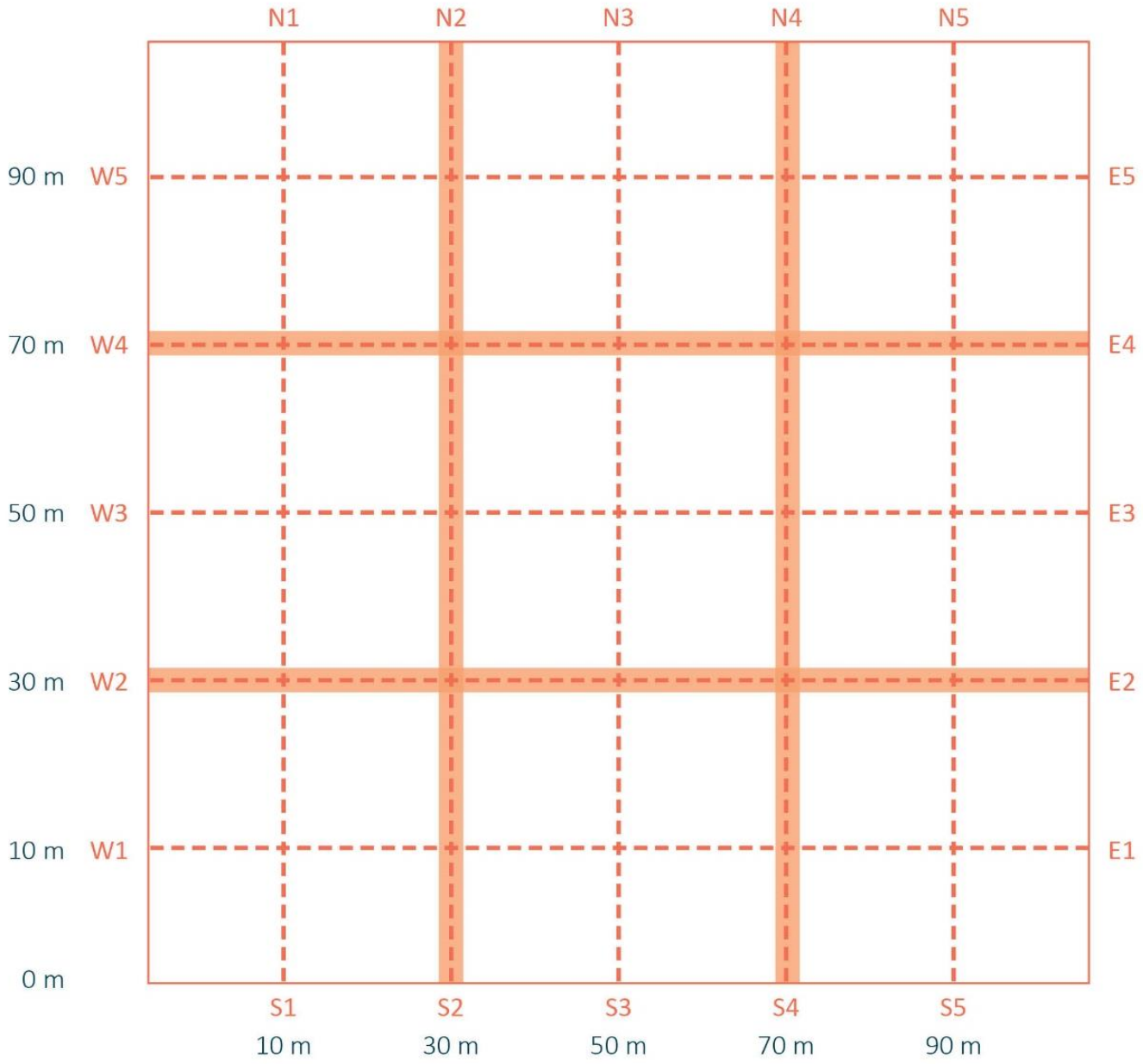
Record:

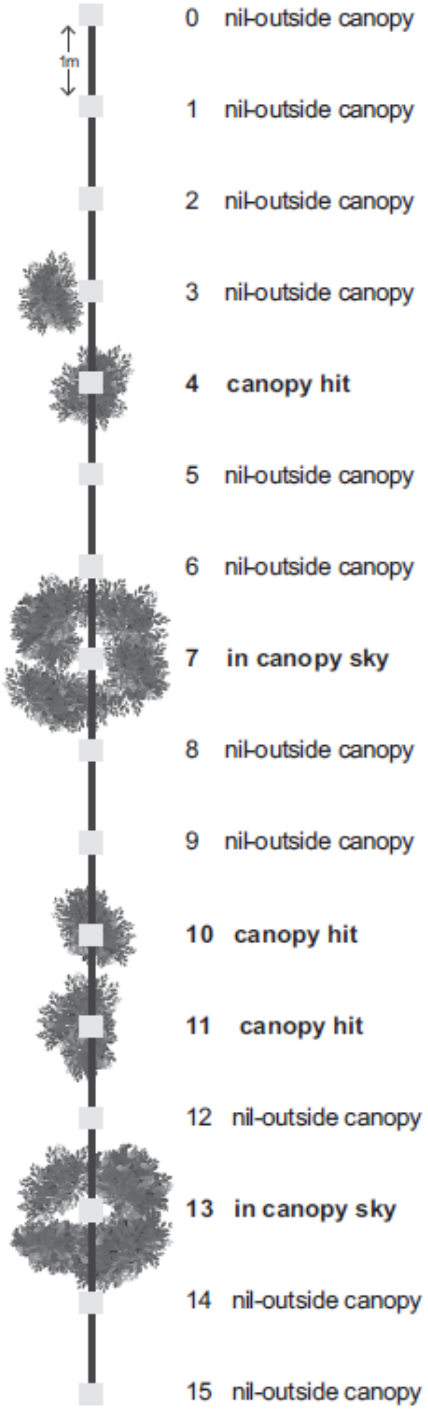
☑ In canopy sky

+ Floristics voucher*
+ Growth form*
+ Estimated height of surrounding canopy

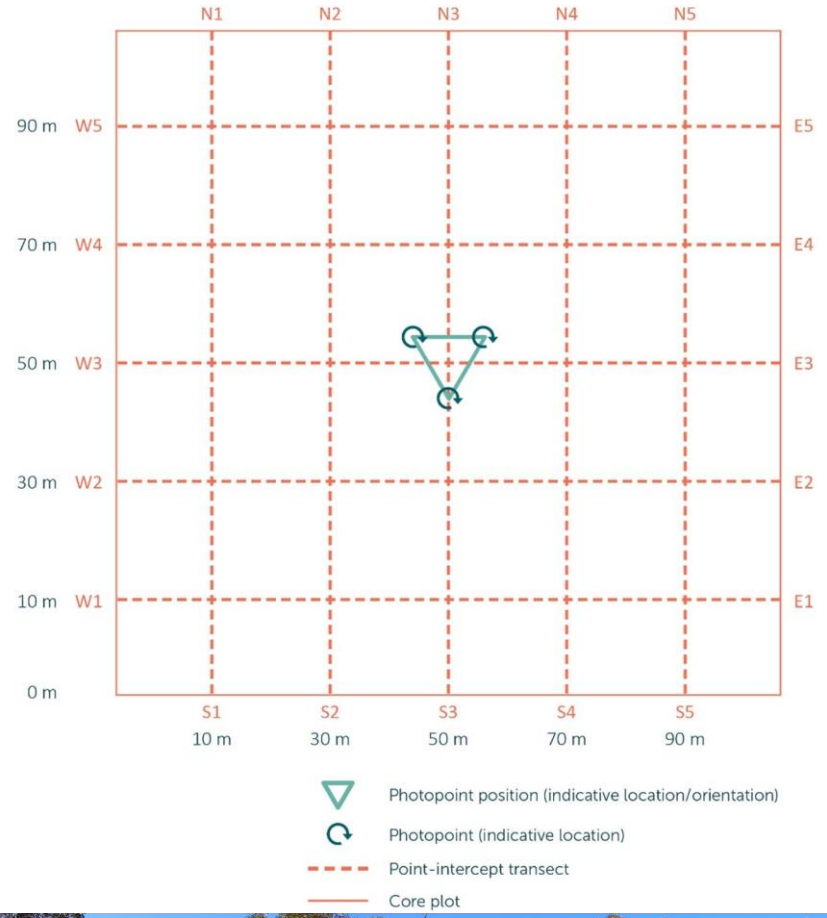


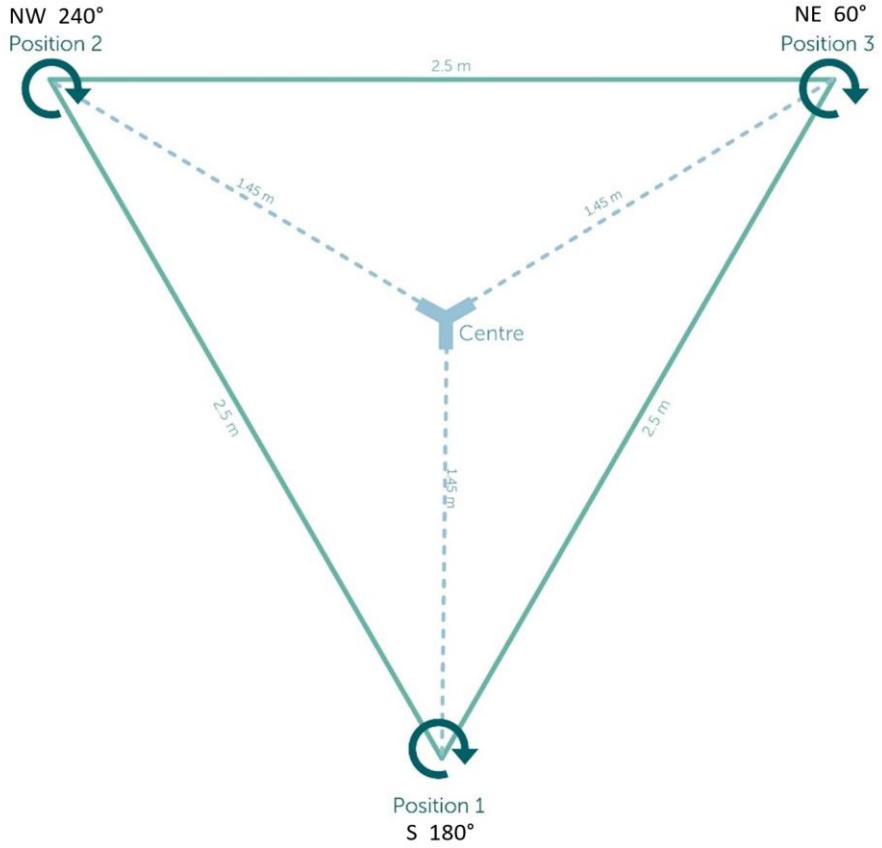
* Only required in Cover – Enhanced protocol

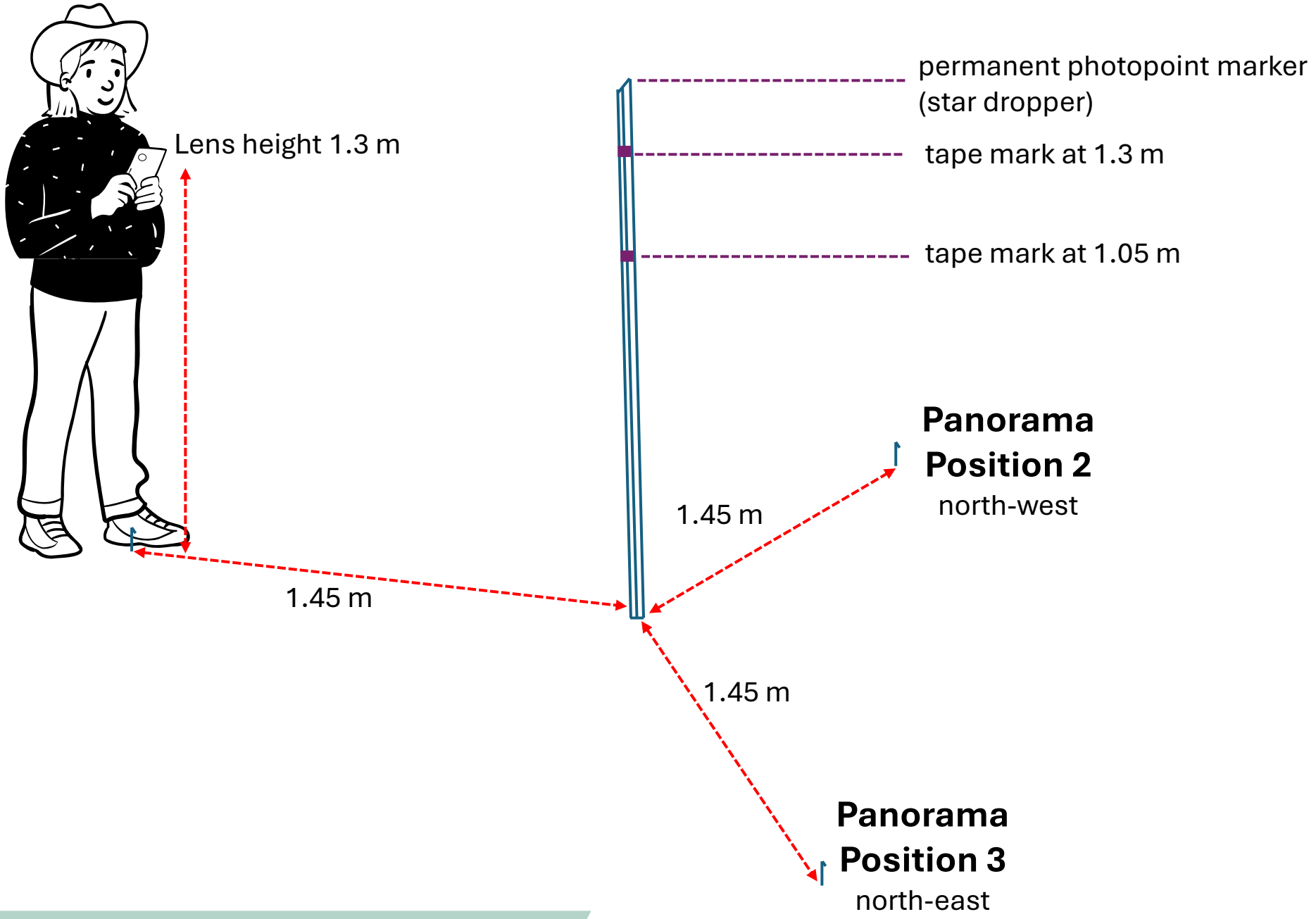

N1
N2
N3
N4
N5
90 m
W5
E5
70 m
W4
E4
50 m
W3
E3
30 m
W2
E2
10 m
W1
E1
0 m
S1
10 m
S2
30 m
S3
50 m
S4
70 m
S5
90 m

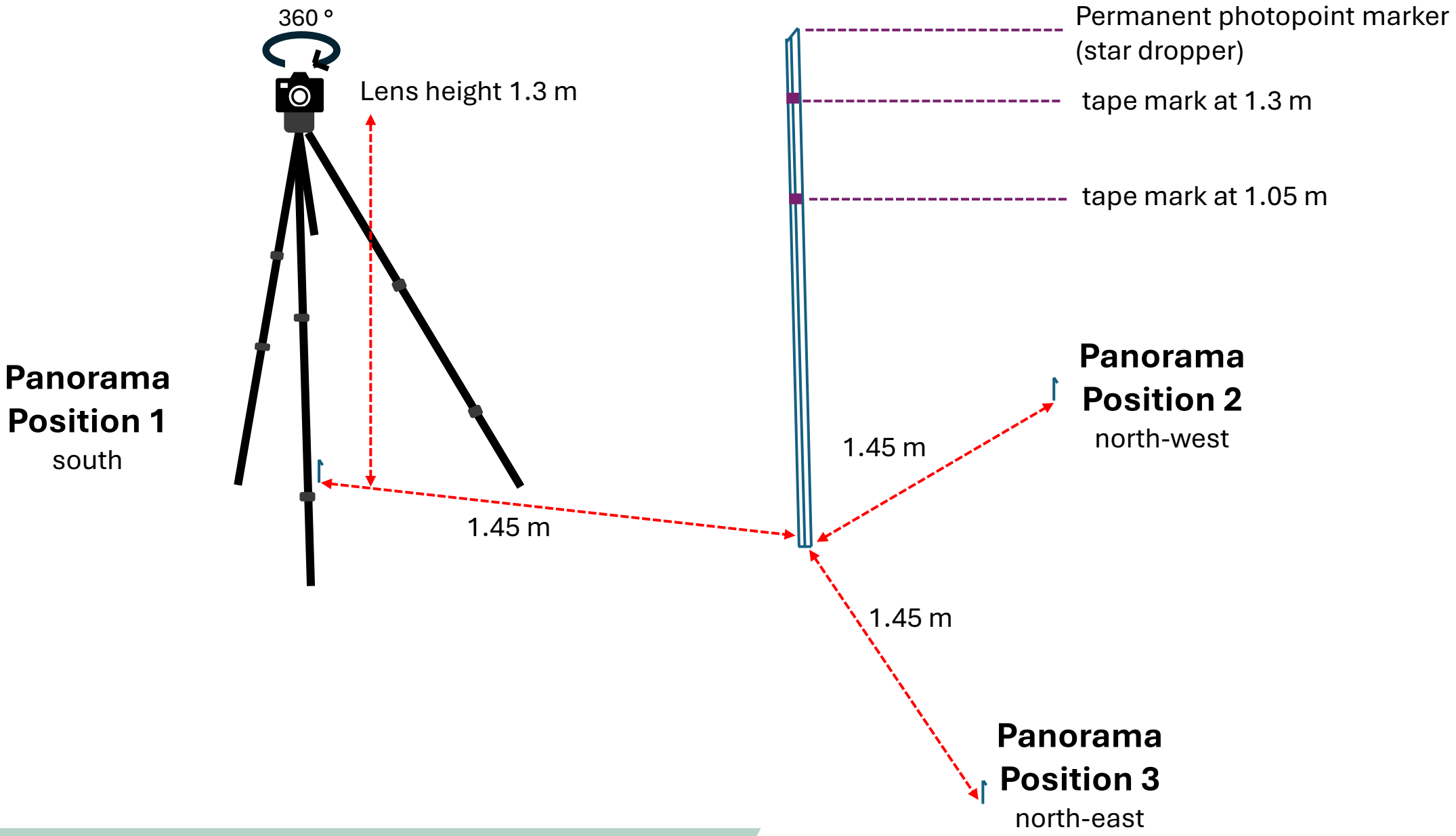

1m
0 nil-outside canopy
1 nil-outside canopy
2 nil-outside canopy
3 nil-outside canopy
4 canopy hit
5 nil-outside canopy
6 nil-outside canopy
7 in canopy sky
8 nil-outside canopy
9 nil-outside canopy
10 canopy hit
11 canopy hit
12 nil-outside canopy
13 in canopy sky
14 nil-outside canopy
15 nil-outside canopy

Photopoints Module






permanent photopoint marker
(star dropper)
tape mark at 1.3 m
tape mark at 1.05 m
Lens height 1.3 m
Panorama
Position 1
south
1.45 m
Panorama
Position 2
north-west
1.45 m
1.45 m
Panorama
Position 3
north-east


360 °
Lens height 1.3 m
Permanent photopoint marker
(star dropper)
tape mark at 1.3 m
tape mark at 1.05 m
Panorama
Position 1
south
Panorama
Position 2
north-west
1.45 m
1.45 m
1.45 m
Panorama
Position 3
north-east

Condition module

Tree condition and health

- For every tree within the survey area record:
  - Tree condition
    - Species *
    - Growth stage *
    - Life stage
    - Height
    - DBH
  - Tree health
    - Canopy cover
    - Crown damage
    - Mistletoe
    - Hollows
    - Insect damage
    - Other damage
    - Leaf litter depth

* Required field

Plot Description

Landscape observations

- Plot Description puts the plot and surveys in context within a landscape.
- Observations within a representative area of the plot:
  - Slope*
  - Aspect*
  - Relief*
  - Landform element* (e.g. plain, hillslope, drainage depression)
  - Outcrop Lithology
  - Coarse Fragment Lithology
- Observations of the surrounding landscape ~300 m radius:
  - Modal slope* (category: e.g. level, gently inclined etc.)
  - Landform pattern* (e.g. alluvial plain)

Plot Description
Flora observations

- Plot Description puts the plot and surveys in context within a landscape.
- Landscape observations are only recorded on the first visit to a site (in the Plot Description - Enhanced protocol)
  - Observations within a representative area of the plot
    - Slope*
    - Aspect*
    - Relief*
    - Landform element* (e.g. plain, hillslope, drainage depression)
    - Outcrop & coarse fragment Lithology
  - Observations of the surrounding landscape ~300 m radius
    - Modal slope* (category: e.g. level, gently inclined etc.)
    - Landform pattern* (e.g. alluvial plain)

Vegetation Mapping

Collect vegetation attributes for the three dominant strata (with foliage projective cover ≥5%)

- Dominant growth form
- Average height
- Visual estimate of foliage projective cover

Traditional 3 strata

Upper storey

- Species 1 – U1
- Species 2 – U2
- Species 3 – U3

Mid storey

- Species 1 – M1
- Species 2 – M2
- Species 3 – M3

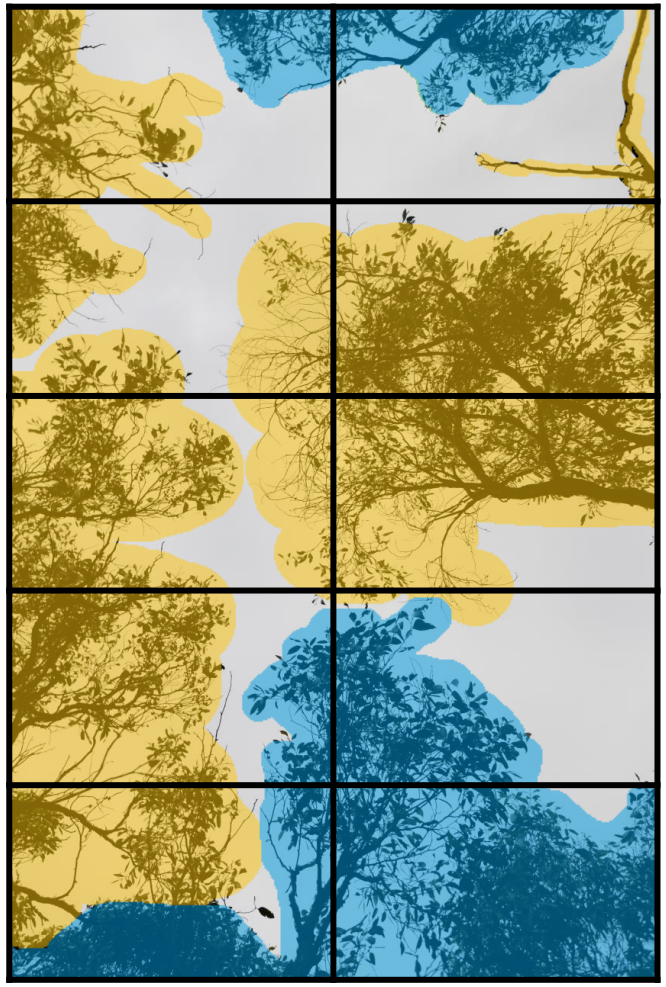
Ground storey

- Species 1 – G1
- Species 2 – G2
- Species 3 – G3

Vegetation Mapping

Collect vegetation attributes for the three dominant strata (with foliage projective cover ≥5%)

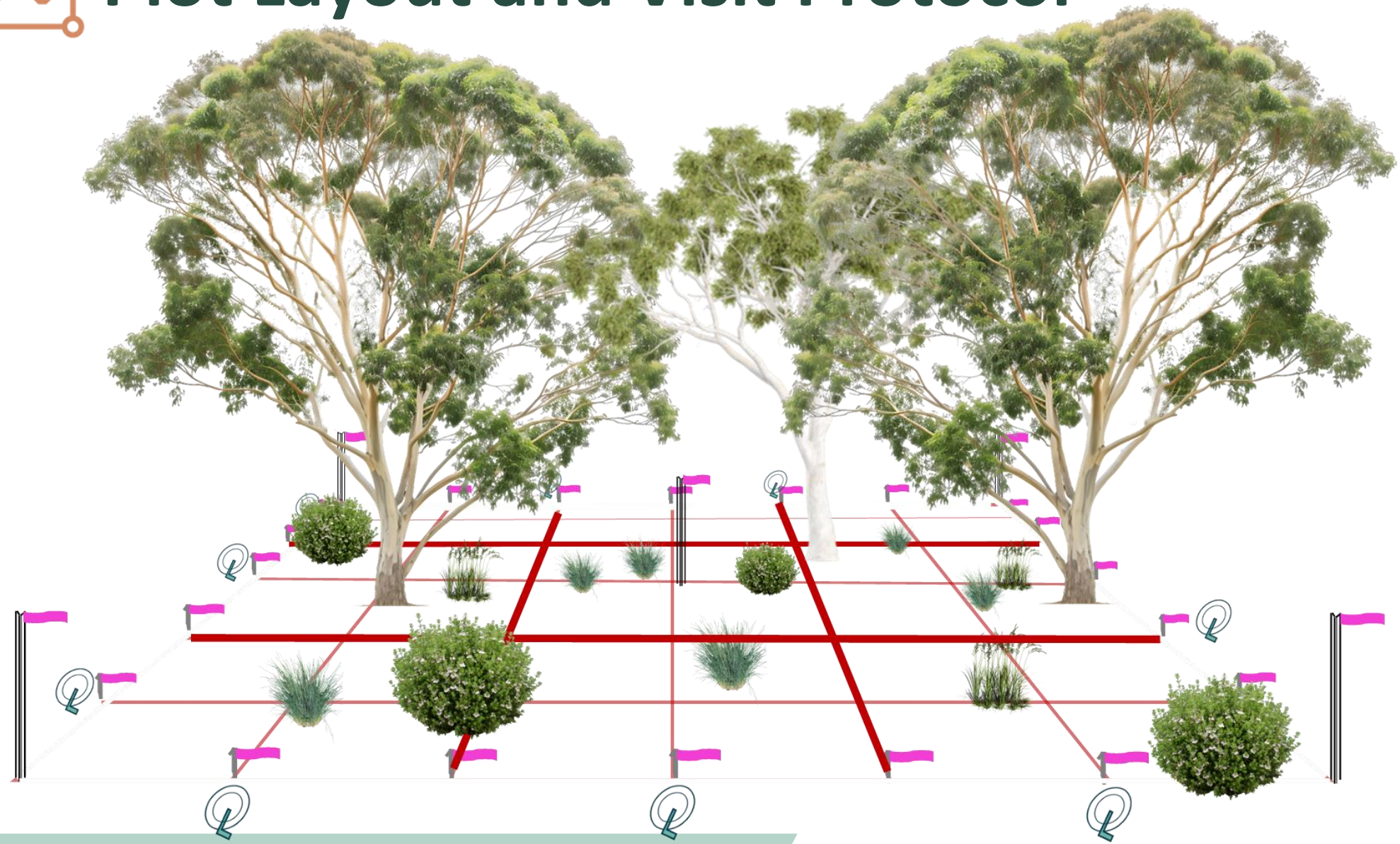
- Dominant growth form
- Average height
- Visual estimate of foliage projective cover



Ground Counts

- Survey setup
  - Record the proposed survey locations and give them permanent names
  - These survey set ups will be saved for future surveys.
- Vantage point/ Transect setup
  - Survey Date/Time
  - Observer Names
  - Equipment
  - Target species
  - Weather Conditions and ‘sightability’
- Conduct survey
  - Species observed
  - Other observation details (#, age, sex etc.)
  - Distance and direction (if distance sampling)

Plot Layout and Visit Protocol



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