The Application and Definition of Attributes for Defining Survey Plots for Vegetation Condition Assessment in Western Australia

April 2010

Prepared for
Department of Environment and Conservation

This project is funded by the Australian Government and the Government of Western Australia

Australian Government

Department of Environment and Conservation
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Report Reference: 15202rvA_100428

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Revision Status

Rev	Date	Description	Author	Reviewer	Approval
A	28/04/2010	Draft Issued For Review	M. Garkaklis	S. van Leeuwen - DEC	K. Claymore

astron environmental services

Report Reference: 15202rvA_100428

Report Parameters	
Format	Word 2007
Network Location	P:\Reimbursible\DEC 15200\15202 Plot Attributes Database Review\2009\Reports\Plot attributes database review report.docx
Figures	IR
Referencing	Harvard

Checking Status	
Text	IR
Figures	IR
Tabulations	IR
Calculations	NR
Statistics	NR

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Executive Summary

Astron Environmental Services was commissioned by the Department of Environment and Conservation (DEC) to undertake a review of definitions and terms used in identifying and describing survey plots in Western Australia. The aim of this review is to provide the department with a guidance that outlines the minimum requirement for recording the attributes of survey plots installed for the purposes of botanical survey or research. These are presented as a Draft Plot Attribute Dictionary.

In addition, the review has identified some key issues that are presented within the following four recommendations.

Recommendation 1: Design and implementation of initially a DEC plot series that allocates plot numbers as unique identifiers. Ultimately the series would become a State-based initiative
The centralised system could be designed with individual Plot Series for each Division, mirroring the departmental structure. The outcomes would be:

- Allocation of plot numbers to program or project leaders with a requirement for the collection of essential plot attributes.
- A coordinated capture of all departmental plots numbers and attributes in one centralised warehouse; and
- Flexibility to maintain current plot series allocation procedures within each division.

Recommendation 2: Phasing out or prohibition of individual officers designing their own plot unique identifiers.
The outcome would be unification of common plot identifiers that are issued in sequence over time.

Within the Forest Management Branch a record or measurement of environmental threats for each survey plot was also deemed to be important. On discussions with FMB officers, it was clear that the management reporting requirement meant that establishment of plots outside of a Pressure-State-Response framework did not allow a clear evaluation of the information measured. For wider application of plot-based data in management effectiveness evaluation in DEC, such as *State of the Environment* reporting, similar attributes would also be required. This leads to the following recommendation.

Recommendation 3: Plot attributes defining plot spatial, temporal and plot numbers as unique identifiers are used. Ideally, all plots should have a record of Pressures (Threatening Processes) allowing interpretation of the information within a Pressure-State-Response management effectiveness evaluation framework if required. However, the indices used in recording Pressures must be approved by appropriately qualified departmental officers.

The outcome would be a capability to report on the effectiveness of management across a broad range of management responses and in an auditable fashion.

Recommendation 4: Unique identifiers for all plot-based survey in Western Australia must comply with and be issued by the Department of Environment and Conservation.

The outcome of this recommendation will be coordinated capture of the plot information from surveys conducted under the *Wildlife Conservation Act* legislation, in a form that aligns with the departmental plot attributes requirements.

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1 Introduction

1.1 Background

The Department of Environment and Conservation (DEC) has a divisional business structure designed to implement policy and management across a range of Nature Conservation, Forestry and Parks and Visitor Services activities. There is a requirement for the department to deliver a wide range of natural resource and emergency management outcomes. This potentially creates a situation where a number of separate divisions, and sections/branches/programs within divisions, are required to gather biodiversity data often in a repeat measurements framework from plot-based survey points over a wide area of Western Australia. The potential outcome is a degree of inconsistency in recording the attributes of plots where repeat measurement of information is obtained. A hypothetical example of such a scenario would involve Nature Conservation and Science Division staff undertaking measurements from identical sized quadrats (say $100m^2$), but with each survey team recording meta-data using different terminology in the definition of like-attributes. This would increase the risk for misinterpretation of raw data.

The aim of this report is to compile and review the application and definition of attributes to plot-based information from a number of case studies within the department, and to recommend a number of terms to be used when recording the attributes for a survey plot. The output is a brief report, including recommended terms. After review from across the department, the outcome should be a plot attribute dictionary that can be applied by all staff within DEC. Although not defined in the current scope of works, an additional outcome should also be guidance to Regional Services staff with regard to recording plot attributes as part of inventory/survey, monitoring and management evaluation programs, and some guidance or timeframe with regard to an eventual centralised housing of survey plot data.

1.2 Scope and Objectives

This report:

- Summarises the terms used in a number of specific programs or departmental branches including;
    - Science Division – Forest Check.
    - Forest Management Branch.
    - Environmental Management Branch.
    - Gnangara Sustainability Strategy.
- Compares and contrasts the definitions used to describe the attributes of a plot;
- Identifies common language – the recommendation is the immediate application of common terms; and

Identifies differences in language – the recommendation is to provide senior departmental officers the opportunity to justify the use of a single term to be applied across the DEC.

This brief report does not intend to:

- provide guidance on what should be measured within a plot; or
- review measurement procedures.

The Species and Communities Branch Resource Condition Monitoring Project (2010) was also reviewed. Plot-based data derived from the Species and Communities Branch RCM project are specific for the measurement of the condition of populations of Threatened and Priority flora. Location attributes of Rare and Priority flora populations are similar to those for plot-based survey and are provided in Section 3.3 and Appendix 11 of the Threatened and Priority Flora Report Form – Field Manual (2010). However, survey areas for Threatened and Priority Flora are dictated by population size rather than plot size. Therefore, specific details of recording Threatened and Priority Flora are not included in this review.

2 Review of Plot Attribute Definition Case Studies

Documented procedures for defining the attributes of plots were accessed from programme leaders or Branch Managers. The summary provided in this section lists the attributes used by four of these groups, namely:

- Science Division – Forest Check (Lachie McCaw).
- Forest Management Branch (Martin Rayner)
- Environmental Management Branch (Amanda Moncrieff/Stephen van Leeuwen/ Nic Woolfrey);
- Gnangara Sustainability Strategy (Leonie Valentine).

In addition, discussions were conducted with DEC staff to understand the datasets and projects, specifically within Science Division, that are pivotal to a plot/quadrat database. These planned projects include:

- Science Division Science Scientific Site Register; and
- BioSIS and Nature Map. Strategic planning by the department has identified a goal for a consolidated biological survey information management system (the BioSIS).

Although not discussed in this review, the target outcome of a consolidated information system has influenced the intent of all recommendations within this review.

2.1 Science Division – Forest Check

The Forest Check Operating Procedure (2006) provides a methodology for plot-based measurements of vascular and non-vascular flora and fauna in south-west forests. It is not the intention of this document to review and report on the specific measurement criteria. However, a brief summary of the attributes of the main Forest Check plot and associated subplots is listed below. The design of the survey plots is to allow their placement within specific forestry management units or spatial scales.

Within the Forest Check Operating Plan, there is no specific direction on the overarching allocation of plot numbers or the overarching allocation of particular plot attributes. These details are captured within specific survey programs nested within the overall operating plan. These are:

- Forest structure and regeneration stocking;
- Soil and foliar nutrients;
- Soil disturbance;
- Coarse Woody debris, small wood, twigs and litter;
- Vascular flora;

- Macroinvertbebrates;
- Vertebrate fauna;
- Birds;
- Nocturnal birds;
- Invertebrates;
- Cryptogams; and
- Macrofungi;

The operating plan also outlines database management and storage, such as meta-data requirements. Survey Plots in Forest Check are called Grids and the essential information listed on each specific survey programs nested within the overall operating plan are:

- Grid number;
- Treatment;
- Location;
- Date;
- Observer; and
- Last Burnt;

In addition there is a range of sub-plot and transect survey information. These include, but are not limited to:

- Field number (invertebrates);
- Collection method (invertebrate);
- Forest Block (invertebrates);
- Trap;
- Replicate number;
- Voucher specimen ID;
- Transect number (vertebrates);
- Weather conditions (vertebrates);
- Transect distance; and
- Transect time.

This preceding list is provided as an indication of the plot-specific data gathered. It is clear that each program has some common attributes that are required for each plot. These are:

- Plot (grid) unique identifier
- Sub-plot numbers or codes depending on the program;
- Date;
- Location;
- Observer; and
- Measurement of environmental pressure from Fire.

Value can added to this program by including a short plot attribute definitions section to the operating plan, and to report on the alignment of the Forest Check Grid unique identifiers (plot numbers) with other systems used within the department (see Recommendation 1).

2.2 Forest Management Branch (FMB)

The FMB approach to definition and application of attributes to survey plots is driven by a monitoring program that has evolved from an understanding of the forest inventory across Western Australia (the current state of the forest resource), determining sustainable yield targets (for example, the Regional Forests Agreement process) and a requirement for state, national and international reporting that allowed audit of the forest management outcomes (*State of the Forests* reporting, EPA reporting and Forest Management Plan reporting). To achieve these reporting requirements, monitoring at permanent plots is essential, that is "plots intended for relocation and re-measurement" (M. Rayner Pers. Comm.). The outcomes are very precise and clear definitions of plot attributes related to the forestry requirements. A summary of these attributes is in Table 1.

Table 1: Definitions of plot-level descriptors developed within Forest Management Branch (DEC) for permanent sample plots (i.e. plots intended for relocation and re-measurement).

Plot Attribute Label	Definition/Description	Comment
Plot Type	Plot identifier that describes the type of plot relevant to the field data collection program.	A range of labels are used which describe the plot series and type. For example 'PSP' denotes a permanent sample plot within the tree measurement and inventory program.
Plot Number	A unique number for each plot within the plot type.	Numbers are allocated sequentially within the FMB plot series.
Location	Geographic location of the centre or north east corner of the plot defined by MGA coordinates (Northings and Eastings).	Plot location has historically been recorded from tie sketches and updated as remeasured using GPS.
Forest Block	Geographic location of the plot within one of the approximately 300 forest blocks throughout the south west. (Note: other location references are used	Forest block is an administrative unit and encompasses an area of 3,000 to 8,000 hectares within the forest regions.

	for plots established outside of the forest regions such as in the South Coast and Goldfields).	
Plot Size	Total area (in hectares) or lineal extent of plot sides (in metres).	Recorded as plot dimensions for square or rectangular plots. Recorded as plot radius (in metres) for circular plots or as Basal Area Factor for variable radius plots.
Subplot Sizes	Subplot size (if subplots are measured).	Recorded as plot radius or dimensions in metres.
Forest Type	Dominant forest type within the plot. (Note: other vegetation type descriptions have been recorded depending on the plot series e.g. the Mattiske / Havel vegetation complexes have been recorded for recent plot series).	Recorded within standardized aerial photo interpretation categories for subsequent stratification.
Site Quality	A derived index of the productive capacity of the site for timber.	Recorded as the height in metres of the co-dominant or dominant forest species.
Assessor	Person conducting plot measurements and responsible for quality control of data.	Individual officers recorded to enable subsequent statistical analysis to detect bias in tree measurements.
Measurement Date	Date of plot measurement.	Recorded as day/month/year to enable precise calibration of measurement intervals and adjustment for seasonal growth or impacts.
Stand Events:		
Fire	Occurrence of a fire event within the whole or portion of a plot since last r-measurement.	Recorded as a flag '0' or '1' to indicate occurrence and potential for impacts on measured change or condition.
Disease	Presence or absence of symptoms within the plot of *Phytophthora* dieback, *Armillaria* and (in future) *Quambaleria* (marri canker).	Recorded as a flag '0' or '1' for each disease to indicate potential impact on measured change or condition.
Pests	Presence or absence of symptoms within the plot of jarrah leaf miner, pinhole borer and skeletoniser.	Recorded as a flag '0' or '1' for each pest to indicate potential impact on measured change or condition.
Harvest Event	Occurrence of a harvest event within the whole or portion of a plot since last re-measurement.	Recorded as a flag '0' or '1' to indicate potential impact on measured change or condition.

The attributes listed are framed by the Forest Management Plan and State of the Forests reporting mechanisms and each specific attribute is not necessarily applicable across the department. However, review of the FMB attributes definition table does highlight extremely important issues.

These are:

- Plot attribute definitions are precise;
- Prerequisite to obtaining the plot attribute information is the requirement to recording Stand Events. In a Pressure-State-Response model, this is equal to recording information on environmental pressure; and
- Plot numbers are allocated sequentially within the FMB plot series.

It is clear from the management reporting conducted by FMB that the definitions and procedures work effectively. It is important to note that the system dictates the allocation of plot unique identifies (plot numbers are allocated). This is crucial since it allows coordinated distribution and capture of the plot information under one central custodian. Review of the FMB model leads to the following recommendations.

Recommendation 1: Design and implementation of initially a DEC plot series that allocates plot numbers as unique identifiers. Ultimately the series would become a State-based initiative
The centralised system could be designed with individual Plot Series for each Division, mirroring the departmental structure. The outcomes would be:

- Allocation of plot numbers to program or project leaders with a requirement for the collection of essential plot attributes.
- A coordinated capture of all departmental plots numbers and attributes in one centralised warehouse; and
- Flexibility to maintain current plot series allocation procedures within each division.

Recommendation 2: Phasing out or prohibition of individual officers designing their own plot unique identifiers.

The outcome would be unification of common plot identifiers that are issued in sequence over time. The record of Stand Events is also important. On discussions with FMB officers, it was clear that the management reporting requirement meant that establishment of plots outside of a Pressure-State-Response framework did not allow a clear evaluation of the information measured. For wider application of plot-based data in management effectiveness evaluation in DEC, similar attributes would also be required. This leads to the following recommendation.

Recommendation 3: Plot attributes defining plot spatial, temporal and plot numbers as unique identifiers are used. Ideally, all plots should have a record of Pressures (Threatening Processes) allowing interpretation of the information within a Pressure-State-Response management effectiveness evaluation framework if required. However, the indices used in recording Pressures must be approved by appropriately qualified departmental officer.

The outcome would be a capability to report on the effectiveness of management across a broad range of management responses and in an auditable fashion. However, this is contingent on appropriate measurement of the threats or pressures.

2.3 Environmental Management Branch (EMB)

As part of the state-wide Environmental Impact Assessment (EIA) process, the EMB are developing guidelines for Terrestrial Vascular Flora and Vegetation survey. As part of this process, a minimum standard of information is required. This is summarised in Table 2.

Table 2: Information fields for vegetation and flora survey conducted as part of EIA in Western Australia.

Information Field	Minimum Required (Essential)	Description
Quadrat/ Site No./ Code		Provide a unique number or code for each quadrat / sample site (max. 10 characters).
Floristics and Structural Description	Floristics/species list	Record all plant species present in the quadrat.
	Voucher reference number and collection number	Provide the Herbarium voucher reference number where applicable and/or a collection number allocated by the consultant (Scientific Licence Number followed by consultant's specimen number is recommended).
	Identifier	Identify the individual responsible for identification of plants in the field and/or voucher specimens.
	Cover estimate	The percentage cover for each species is estimated and recorded.
	Method of assessing cover	Indicate which of the three cover methodologies in the Hnatiuk, Thackway and Walker chapter 'Field Survey for Vegetation Classification' from the 2008 Australian Soil and Land Survey Field Handbook was used.

In terms of departmental outcomes, the measurement information linked to the plot attributes will greatly improve the access to the large volume of survey work conducted by independent consultants and other private industry. Perhaps one issue to consider is the provision of the unique number or code by the independent vegetation surveyor. As defined, these attributes are not specific and could result in double handling on the part of the department if the plot identifiers needed to be modified to fit the department's procedures. It may be beneficial for the department to act as custodians and managers of the plot codes. These can be provided to the independent consultants as part of planning and logistics for each survey. Review of the proposed plot-based attributes for IA vegetation survey leads to the following recommendation.

Recommendation 4: Unique identifiers for all plot-based survey in Western Australia must comply with and be issued by the Department of Environment and Conservation.

The outcome of this recommendation will be coordinated capture of the plot information from surveys conducted under the Wildlife Conservation Act legislation in a form that aligns with the departmental plot attributes requirements.

The plot attributes that define the spatial and temporal characteristics of the vegetation survey plots are all specific and applicable.

2.4 The Gnangara Sustainability Strategy

The Gnangara Sustainability Strategy (GSS) was a multi-agency project aimed to address issues of water abstraction on the Gnangara Mound Aquifer. The project considered issues of environmental, economic and social tradeoffs for various water abstraction scenarios.

As part of project planning, a Survey Methods Discussion Paper was written. This included reference to data protocols and information management. The outcome of this process was to enable capture of information by departmental officers, as well as consultants and other sources if applicable. Therefore, the nature of the plot attribute criteria is somewhat broad.

With regard to vegetation survey, the following census form and location form criteria were adopted.

- Census Form ID or Location Form ID;
- Report/survey name;
- Author/Organisation;
- Year;
- Observer;
- Polygon ID;
- Photo ID;
- Location ID;
- Date;
- Time;
- Easting (MGA 50 Datum – GSA 94);
- Northing (MGA 50 Datum – GSA 94);
- Slope (degrees);
- Aspect (degrees); and
- Altitude (metres).

Missing from the guidelines was direction for storage of information within the department, or directions with regard to aligning plot unique identifiers with departmental requirements.

3 Conclusions

All programs that require the definition of plot attributes reviewed in the current review have attributes in common. The outcomes suggest that a process is needed to unify this information under a centralised storage mechanism. It is the recommendation of this review that a system of DEC issued plot unique identifiers (plot numbers) be developed and tested. These DCEC issued plot numbers should be for survey information captured within the department and also from external sources that are given licence under the *Wildlife Conservation Act*.

4 Draft Plot Attribute Dictionary

The following list of terms that define the attributes of a plot are drawn from the FMB procedures. They are provided to initiate discussion and allow modification to suit a wider departmental application.

Plot Type	Plot identifier that describes the type of plot relevant to the field data collection program.

Plot Number	A unique number for each plot within the plot type.

Location	Geographic location of the centre or designated and recorded corner of the plot defined by coordinates, either northings and eastings or latitude and longitude. Datum used to record coordinates must be reported.

Plot Size	Plot dimensions (in metres).

Sub-plot number	Sub-plot number nested within plot unique identifier

Subplot Sizes	Subplot size (if subplots are measured).

Assessor	Person conducting plot measurements and responsible for quality control of data.

Measurement Date	Date of plot measurement.

5 References

Department of Environment and Conservation (2010). *Resource Condition Monitoring Project. Threatened and Priority Flora Report Form – Filed Manua*l. Prepared for the Significant Species and Communities RCM Project, DEC. Kensington. WA.

Department of Environment and Conservation (2006). Forest Check Operating Plan. Prepared by Science Division for the DEC. Manjimup, WA.