Walking the landscape—

A whole-of-system framework for understanding and mapping environmental processes and values

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Contents

List of figures

List of tables

Introduction

Walking the landscape is a systematic and transparent science synthesis process that integrates existing data with expert knowledge to develop robust conceptual models which are spatially linked to real world landscapes (Figure 1). It incorporates diverse knowledge on the collective landscape components and processes to support identification, description and confirmation of a phenomenon in the landscape. It takes its name from the facilitated workshop process where experts 'walk the landscape' by systematically working through a defined landscape extent, recollecting knowledge of environmental function, in order to develop a common understanding.

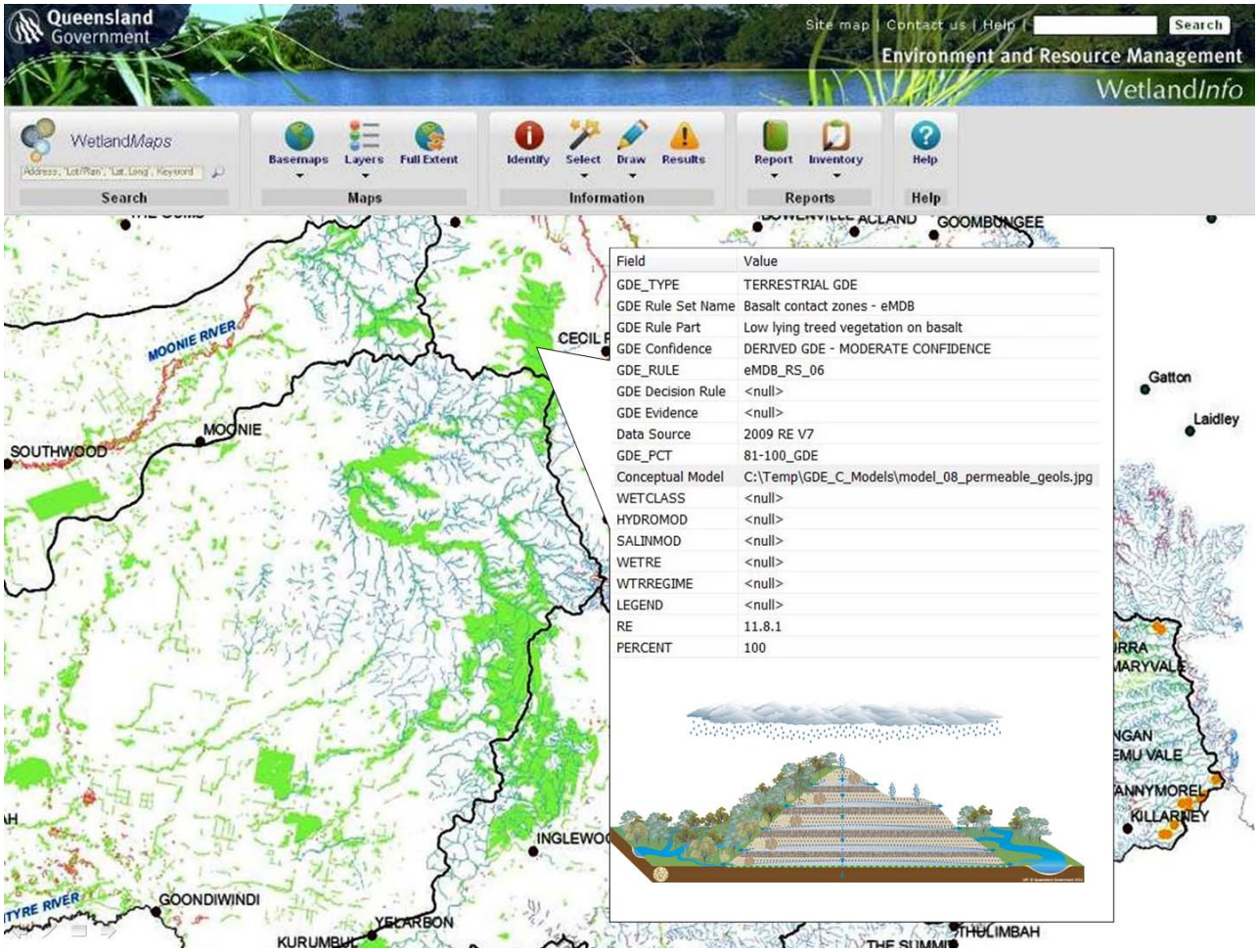

Figure 1 – A demonstration of the final mapping and spatially linked pictorial conceptual models for the Queensland groundwater dependent ecosystem (GDE) mapping and classification project. An area of the landscape, as displayed through an online mapping tool (Wetland*Maps*) has been identified as a terrestrial ecosystem potentially dependent on groundwater. This terrestrial GDE is linked to a pictorial conceptual model representing the key attributes supporting groundwater and ecosystem interaction that are likely to be relevant to this GDE.

History and development of 'Walking the landscape'

'Walking the landscape' is a framework which provides a process for examining environmental function in terms of its components and processes at multiple levels of scale. Historically, broad scale government decision-making activities focus on the components of the environment, in effect taking stock of what we have. In some cases, it is necessary to understand the processes (e.g. what it is doing and why things happen) to make better decisions. The consideration of environmental processes has primarily been limited to much smaller spatial extents (e.g. wetland management). 'Walking the landscape' integrates the components and their processes within the real world landscape context for better system understanding and targeting of solutions by management and decision makers.

The framework integrates landscape ecology, scientific research principles, and expert opinion through a spatial analysis platform and was the culmination of collaboration between a number of different government departments and research organisations. There were a few key projects that directly contributed to the principles found in the framework:

- Aquatic Biodiversity Assessment and Mapping Method, Queensland Department of Environment and Heritage Protection
- Groundwater dependent ecosystem mapping and classification project, Queensland Department of Science, Information Technology, Innovation and the Arts, Queensland Department of Environment and Heritage Protection and the Queensland Department of Natural Resources and Mines
- Coastal ecosystems project, Great Barrier Reef Marine Park Authority
- Connectivity project: Tools for decision making, Queensland Wetlands Program, Queensland Department of Environment and Heritage Protection

Outcomes – What does the framework achieve?

The primary aim of the framework is to aid in the development of a whole-of-landscape understanding to improve evidence-based decision making for the sustainable management and restoration of ecological systems. This information is then presented in a simple accessible format, using familiar mapping tools (ArcGIS, Google maps etc.), for easy interrogation and scenario evaluation.

'Walking the landscape' integrates existing information to generate improved understanding. The rigorous method of data capture allows the expert information to be combined with the scientific and spatial data to establish a powerful integrated output. The outcomes and achievements of the framework are:

- a focus on building on available knowledge, resulting in a product which complements the science and projects from which it obtained data
- a shared understanding, through a transparent process, that incorporates the 'best information available'
- a systematic and thorough evaluation of the entire landscape, not just small parts of it.
- the integration of knowledge from regional experts into datasets used by decision makers which addresses one of the major criticisms of broadscale mapping is that integration was lacking
- maps linked to conceptual models which can be hosted on publically available mapping platforms (e.g. Wetland*Maps* Google map server) and are accessible by non-technical audiences
- rapid assessment and integration of existing expert knowledge for:
  - situations where there is not a deep formal knowledge base
  - the initial data/knowledge synthesis stages of complex or multidisciplinary projects.

Method

In broad terms the framework for 'Walking the landscape' involves three stages: Assimilating available information, synthesising and developing the information into a revised understanding or product and verifying the product through field validation. The steps included in these stages are summarised in Table 1.

Table 1 – The steps and stages of 'Walking the landscape'

Stage	Step		Step description
Stage 1: Assimilation	Step 1		Collate baseline data and review existing knowledge
Stage 2: Synthesis and development	Step 2: Facilitated technical workshops	Step 2a	Develop conceptual models based on expert knowledge
		Step 2b	Develop decision rules based on expert knowledge
		Step 2c	Identify data needs for the application of decision rules
	Step 3		Develop consolidated conceptual models and decision rules
	Step 4		Implement mapping rule sets
	Step 5		Develop mapping product
Stage 3: Verification	Step 6		Verify draft mapping products using field validation

Step 1: Collate available information

This is an initial scoping of the data and review of the science available to the project. The information collected here forms part of the tools to bring to the expert workshop.

As part of this process an inventory of the datasets is created including information on:

- their relevance, accuracy and reliability
- their scale and extent
- any significant data gaps.

Step 2: The expert workshop

It is important that proper tools are prepared prior to the workshop, relevant experts are included, and that the process for reporting and recording is rigorous. The workshop needs to include:

- the development of conceptual models in a form which allows the experts to articulate the nature of how the landscape functions from their perspective and observations. This will vary depending on the exact problem, but a useful concept is to evaluate this in terms of the components (what you have) and processes (what they are doing) across the landscape and how they interact.
- a collection of any references, links, datasets or reports which validate the conceptual models and instil a level of confidence in their assumptions. This is necessary to validate limitations of the information on which the expert opinion is based.
- the development of decision rules, which can be used as the basis for the mapping rule sets that define the spatial area to which the conceptual model applies.

The range of experts should be carefully selected as each expert will bring different knowledge to the process. The best outcomes are derived from a facilitated workshop where a diverse range of experts can contribute their information to deliver a consolidated outcome. While expert information can be incorporated outside the facilitated workshop process, this should be avoided where possible as it is the interplay between experts from different disciplines that provides rigour to the process, enables cross-fertilisation of ideas and produces outcomes and consensus which is difficult to achieve from individual experts in isolation of each other.

If the expected outcome of the expert input process is landscape-level information the experts should be landscape experts from a wide range of disciplines such as hydrologists, hydrographers, geomorphologists, soil scientists, ecologists, ecological engineers and planners to name a few. If the outcomes sought are on a local level, the experts should be local experts. It is difficult to mix experts with expertise in different spatial scales; however, information from one group can be cross-checked for consistency at another spatial scale in order to improve the conceptual understanding.

The expertise and technical skills of the experts are important to consider when developing the tools and structure of the workshop. For example, in order to capture the appropriate information it may be necessary to bring in experts without a formal technical background. In these cases it may be more appropriate to engage the experts with more familiar mapping tools (e.g. Google Earth) rather than the more abstract data driven maps used by technical professionals.

Steps 3-5: Synthesis and development

After the workshop the information needs to be consolidated and refined before it can be applied to the final mapping product. Work needs to be done to consolidate the conceptual models, refine the decision rules from the workshop and apply the rule sets to the mapping product. This can include the investigation of new datasets and further refinement and development of the conceptual understanding, including any necessary re-engagement with workshop participants to clarify and refine the outputs.

Prior to further development it is necessary to group the conceptual models based on functional similarities (i.e. similarities in the processes depicted in the model, which could involve the landscape, drivers, processes, and/or key conditions). The way the conceptual models were consolidated also needs to be captured.

The decision rules developed at the workshop capture a combination of attributes that describe the un-grouped conceptual models, and may apply to the entire landscape or a smaller defined area. Where appropriate, decision rules also need to be consolidated in order to streamline the mapping process, but not at the expense of misrepresenting the information collected.

The next step is to produce the mapping product. This involves finalising the rule sets based on the decision rules, applying them to the GIS data to delineate spatial areas and producing maps that contain all the relevant information required for the project which include:

- links to the consolidated conceptual models
- attributes of the datasets used to generate the map
- supporting documentation elaborating on the specific process collected.

The final datasets and conceptual models need to be checked for accuracy prior to any release of the outputs. Depending on the complexity of the problem and the way in which the data is collected there may be a need to revisit some parts of the framework. This can be part of a broader quality assessment procedure which is important because not thoroughly completing this final stage could jeopardise future collaborative processes.

Step 6 (optional): Verify draft mapping products using field validation

Mapping, pictorial conceptual models and/or mapping rule sets may be verified through systematic field validation or comparison with existing maps that have been validated in the field.

Final outputs

The 'Walking the landscape' framework covers the stages of linking expert opinion rigorously to existing scientific data in order to develop conceptual models, mapping rules and a mapping product for improved whole-of-system understanding. At the end of the process you will have:

- a series of conceptual models describing aspects of landscape function in terms of its components and processes
- a series of decision rules and rule sets that describe the application of the conceptual models to spatial data
- a map of the landscape and datasets, derived from the application of the rule sets and linked to the conceptual models
- supporting documentation (e.g. literature review, metadata, workshop reports, technical reports and method document).