

NSW native vegetation regulatory map method — Technical review and endorsement - 2021

Shanti Reddy, Jane Stewart, Elizabeth Morse-McNabb, Paul Lawrence

Technical Review Committee
14 May 2021

Mr Jeremy Black
Director
Remote Sensing and Landscape Science Branch
Department of Planning, Industry and Environment
Locked Bag 9018
Grafton NSW 2460

Email: jeremy.black@environment.nsw.gov.au

Re: Technical Review of the NSW Native Vegetation Regulatory Map 2021

Dear Mr Black,

The Technical Review Committee is pleased to conclude the review of the 'Native Vegetation Regulatory Map: method statement', and accompanying appendices, describing the enhancements in science and analytical processes used to develop the 2021 Native Vegetation Regulatory map for New South Wales.

Based on the review, the Committee concludes that the updated methodology and datasets are appropriate for the intended purpose under the NSW Local Land Services Act and Regulation. The Committee further notes that the current methodology is fit for purpose and meets the expected standards.

In finalising the review, the Committee identified areas where improvements can be undertaken to achieve greater effectiveness and efficiency of the Native Vegetation Regulatory Map process and its delivery methods, and these are provided in the form of six recommendations. These recommendations cover areas of tactical operational improvement in mapping methods, through to strategic positioning in data processing and successional planning.

A copy of the Terms of Reference for the Review Committee is included as Attachment 1. The findings from the 2017 review were revisited with updated information captured in Attachment 2. The chronology of the interactions with Environment, Energy and Science staff to complete the technical review is provided for your information in Attachment 3, section 2.

From materials provided to the Committee, it is evident that considerable work and updates have been achieved by the Native Vegetation Regulatory Map team. These updates and enhancements in the mapping methods demonstrate a high level of understanding of the available technology and the

applications to meet the information requirements of agency regulators and government decision making.

The Committee would like to thank Ms. Heidi Mawbey and the senior technical staff for their full support in preparing relevant documentation and availability to consult with the Committee.

The Committee hopes that the comments and recommendations from this review have been helpful to Environment, Energy and Science in continuing to deliver quality and trusted science for decision making to achieve sustainable environmental outcomes.

Sincerely,



Dr Shanti Reddy



Dr Jane Stewart



Dr Elizabeth Morse-McNabb



Dr Paul Lawrence

Technical Review Committee
14 May 2021

Attachment

1. 2021 Review findings including responses from EES

NSW Native Vegetation Regulatory Map Method – Technical Review (2021 update)

Elizabeth Morse-McNabb, Paul Lawrence, Shanti Reddy, Jane Stewart

1. Introduction

This report provides an independent, technical peer-review of the Native Vegetation Regulatory (NVR) Map within New South Wales being delivered through the NSW Department of Planning, Industry and Environment. The NVR Map is a legislative requirement under Part 5A of the Local Land Services Act 2013 (LLS Act) with the objective to provide evidence-based science to inform the government in decision making that protects native (woody and non-woody) vegetation, and to provide clarity and certainty for landholders on identifying if their proposed clearing activity is subject to any regulatory requirements.

The NVR Map method was originally reviewed in 2017, with recommendations. The first review occurred at the commencement of the new legislation. With government amendments (Table 1), and 3 years of implementation, this second review focuses on the efficiency and effectiveness of the map method (including updated input datasets) and its performance to meet legislation and stakeholder requirements. As per the terms of reference (Attachment 1) the focus of the 2021 review was to:

- assess whether the updated method still meets the intent for the NVR Map under the current Local Land Services Act and Regulation
- review and provide advice and recommendations regarding the efficiency of the method in respect to design and data elements
- review and provide any advice and recommendations on the technologies used in the preparation of the map or proposed in future updates.

Table 1. Summary of legislative changes and updated datasets incorporated in the 2021 map method

Applicable legislation	Legislation /policy requirement from 2017 legislation	Revised/updated requirement in 2021	Impact on the NVR Map method
State Environmental Planning Policy (Coastal Management) 2018	Designation of additional subcategory of regulated land – Category 2 – Sensitive. Inclusion of miscellaneous lands including SEPP Coastal Management Act 2018 Coastal Wetlands	cl. 108 (2) (b) requires 'proximity area for coastal wetlands' or 'proximity area for littoral rainforest' to be categorised as Category 2 – Regulated land if the land is not required to be otherwise categorised as Category 2 – Sensitive by s. 60I (2) (I) of the LLS Act 2013.	Proximity areas of Coastal Management SEPP mapping (100m buffer) have been recategorised as Category 2 – Regulated and are mapped as such on lands, unless another Category 2 – Sensitive prescription dataset has been applied.
Local Land Services Amendment (Private Native Forestry) Regulation 2018	Designation of additional subcategory of regulated land – Category 2 – Sensitive. Inclusion of miscellaneous lands including 'private native forestry plans'.	Omit cl. 108 (2) (d) from Local Land Services Regulation 2014.	(1) Active Private Native Forestry Plan (PNFP) areas are no longer explicitly designated as Category 2 – Sensitive Regulated Land. (2) Areas of land within active or expired PNFPs are still required to be mapped as Category 2 – Regulated by 60I (2) (a) – grown or preserved with assistance of public funds.
Local Land Services Act 2013s60I (2)(m) Local Land Services Regulation 2014 108 (2)(b) s	Land containing Critically Endangered Ecological Communities (listed under NSW Biodiversity Conservation Act 2016) as Category 2 – Sensitive Regulated Land.	Designation/listing of new Critically Endangered Ecological Communities.	Addition of Sydney Turpentine Ironbark Forest
Local Land Services Act 2013 s60I (2)(I) Local Land Services Regulation 2014 Cl. 108 (2)(b)	Land containing Critically Endangered Plants (listed under NSW Biodiversity Conservation Act 2016) as Category 2 – Sensitive Regulated Land.	Designation/listing of new Critically Endangered Plants	<i>Pterostylis vernalis</i> <i>Thelymitra kangaloolica</i> <i>Acacia dangarensis</i> <i>Gentiana wingecarriensis</i>
Local Land Services Act 2013 s60I (2)(j) Local Land Services Regulation 2014 Cl. 111; 108 (2)(b)	Koala habitat that is 'in the opinion of the Environment Agency Head' core koala habitat under an approved koala plan of management (Koala Habitat Protection SEPP – formerly SEPP 44) to be mapped as Category 2 – Sensitive Regulated Land.	Approval of new Koala Plans of Management.	Core koala habitat added from: 1. Campbelltown Comprehensive Koala Plan of Management 2. Port Macquarie Area 13 3. Port Macquarie Area 14 4. Port Macquarie King Creek
60I 2b LLS Act land is eligible for designation as Category 2 Vulnerable Regulated Land	Steep slopes defined as ≥ 18 degrees.	Revised steep slopes from SRTM DEM to 5m SME steep lands.	Chapter 7.3.6 Appendix 6.2

Applicable legislation	Legislation /policy requirement from 2017 legislation	Revised/updated requirement in 2021	Impact on the NVR Map method
60I 2b LLS Act land is eligible for designation as Category 2 Vulnerable Regulated Land	Protected Riparian Land – stream bed plus 20m from upper bank.	Where map reviews have been undertaken, the 5m SME has been used to develop updated streamlines to a greater accuracy.	Chapter 7.3.6
LLS Act 60I 2d, LLS reg 108 2b	Application of setasides under the Land Management (native vegetation) Code to be applied as Sensitive Regulated Land (offsetting treatment\clearing areas).	No data available in 2017, setasides are now being applied as data becomes available from LLS (approx. 3 monthly).	Appendix 6, placeholder already existed in map method so no change.
Application of prescribed layers LLS ACT 60I and 60H and LLS Reg 108-113	All other prescribed layers (other than those outlined above) applied as available in 2017.	Updated datasets provided from custodians and applied as per legislated.	Appendix 6, outlines all prescribed layers where updates would have been sourced.

From materials provided to the Technical Review Committee, it is evident that considerable work and updates have been achieved by the NVR Map team (Table 2). These updates and enhancements in the mapping methods are based on a high level of understanding of the available technology and the applications to meet the information requirements of agency regulators and government decision making. Furthermore, these advances are underpinned through the research, development and verification, particularly of the SCDI tool, to update the 2017 mapping products. It is also apparent that the agency's involvement in the Joint Remote Sensing Research Program hosted through the University of Queensland continues to be productive and effective.

Table 2. Summary of technical changes to the NVR Map method between 2017 and 2021

NVR Map method component	Application in 2017	Application in 2021
Land use updated to 2017 (Chapter 4)	2013 imagery and ancillary layers used to create a 2013 land use map. To allow for compliance activity to be resolved between 2013 and 2017. Only land legislated under the LLS ACT was mapped for land use.	2017 imagery and ancillary layers used to create a 2017 land use product as per legislation. New imagery included Sentinel, Planet and Google Earth to assist with interpretation. Land excluded from the LLS Act was also included in the NSW Landuse 2017 v1.2 to cater for future updates.
Land use updated to 2017 – SCDI seasonal fractional cover V1 to SCDI products and SCD Differencing Index. (Chapter 4/5, Appendices 3a/4)	SCDImage V1 was used as an input to the land use mapping along with other imagery and ancillary layers.	SCDImage V2 replaced version 1. Version 2 was more successful in accounting for differences in cover over time across the state. An SCDIndex was also available for this update, based on regression model incorporating many time series fractional cover statistic layers and calibration points. This product was used to review the NVR Map in areas where the mapping of disturbance has been the most challenging. SCD Difference Index was developed to highlight changes in disturbance between 2013 and 2017 to assist land use mappers.

NVR Map method component	Application in 2017	Application in 2021
Woody Vegetation Cover (Chapter 6)	Revised SLATS mapping up until 2009. Application of SLATS clearing 2011 - 2013	Includes additional years of SLATS clearing from 2013 to August 2017.
Map Refinement (Appendices 7b)	Category 1 land use refined to ensure where tree canopy (Category 2) was absent it was added and where incorrectly mapped it was removed. Tree maps from high resolution ADS aerial imagery used where available, and SPOT5 satellite imagery for the other areas.	2017 land use was refined on new areas of Category 1 land, supported by additional availability of 1990 historic aerial photos. Refinement was also undertaken on land use classes identified as Category 1 that fell within excluded land, or under prescribed layers to make future changes to the map more efficient. Map refinements using ADS imagery where previously not available.
Display classes (Executive Summary)	5 display classes one per category, Sensitive land had greater restrictions and therefore where they overlapped, land was shown as Sensitive.	6 display classes, additional class to show where vulnerable and sensitive land overlap.
Change to Government Structure (Executive Summary)	Environment Agency Head, Chief Executive, Office of Environment and Heritage	Environment Agency Head, Secretary Department Industry Planning and Environment
Geoscape © Buildings, Surface Cover and Trees (Chapter 4.4)	The buildings dataset became available to DPIE EES in 2020. It was not a known data consideration in 2017.	The building footprints data was used to create a 5m buffer of established buildings in NSW. This dataset was used to refine land use and woody mapping. It has been applied to the land use mapping and woody extent is not applied over these polygons.
Prescribed layer formatting (Appendix 6)	1) Precedence sorted by category. 2) Includes prescribed layers, 'Recategorised by Agency Head' Category 1 and 2 and approved by Native Vegetation Panel (Category 1)	1) Precedence replaced by build order. Highest number at the top (in any location the highest build order is the data presented). 2) These prescribed layers have been removed, as they are placeholders and yet to be tested in application.

As a result of legislative and technical changes summarised in Tables 1 and 2, our review found that the methods used to map, analyse, collate and display native vegetation and changes in land use are based on sound science and are delivered meeting the current needs of the legislation. The method uses nationally recognized high-resolution imagery appropriate for decision making combined with finer resolution information available from landholders where this exists. The combined information is defensible and rigorous, and importantly responsive to landholder inputs ensuring credibility.

The presentations by the NVR Map team made it evident the high importance placed on the credibility of the data analysis from the perspective of stakeholders. In their view, the image analysis must be accurate and technically validated from on-ground surveys, as well as trusted by landholders, and free

from any perception that it is generated from a 'black box'. This is admirable and preserves a culture of scientific trust and rigour on which decisions can be made with confidence.

While generally supportive of the mapping and modelling approach, our review identifies several areas that could be better justified, clarified, or improved. In particular, there are opportunities to incorporate innovative image analyses such as machine learning and computer vision techniques to aid processing efficiency and to reduce manual processing, albeit recognising the importance of ground validation of these algorithms. The review also identified further work in the documentation of mapping methods for compliance purposes and knowledge transfer, and to quantify and assess data uncertainty, particularly where there are multiple lines of evidence being aggregated.

2. Chronology of Review Process

All meetings were held virtual via Microsoft Teams between February and May 2021.

Date	Activity	Response/materials
February 2021	Committee re-established	Revised terms of reference (Attachment 1)
24 February 2021	Briefing #1 on method update (Part 1)	February version of revised map method statement including appendices Presentations
2 March 2021	Briefing #2 on method update (Part 2)	Presentations
5 March 2021	Committee met and requested DPIE provide 1. High level summary of legislative and technical changes between 2017 and 2021 method 2. Comments / updates to the Technical Review submitted in 2017	Structure of Tables 1 and 2 presented in this Review; Comments and updates to the Technical Review submitted in 2017 are shown in Attachment 2.
10 March 2021	Responses provided to Committee's request for additional information	Tables 1 and 2 presented in this Review; Comments and updates from 2017 Technical Review are shown in Attachment 2
11 & 17 March 2021	Committee met to discuss review approach; requested additional information on the landholder evaluations of the NVR Map (provided by DPIE 16 March)	NVR Landholder perspectives (Independent report undertaken in August 2017) EES-LLS 2020 NVR Map consultation (presentation)
19 March 2021	Committee provided questions to NVR Map team and sought clarification on responses received	Review Committee findings and follow up questions (Attachment 3) Clarification/discussion on additional inputs (Tables 1 and 2) and 2021 updates (Attachment 2)
22 March 2021	Briefing #3 to discuss the initial Committee findings	Clarification and discussion remaining issues and questions from the Review Committee members
26 April 2021	Committee provided with responses to questions and additional reference materials	Map Team Response (Attachment 3) April version of revised map method statement including appendices <u>Additional resources</u> • EES-LLS 2020 NVR Map Consultation (also provided 16/3) • Process_LMBC Update_February_2021.pdf • Evaluation FACTSHEET - Vulnerable Regulated Land.PDF • Evaluation Project FACTSHEET - Excluded Land.PDF • Evaluation Project FACTSHEET - Map Review.PDF • Evaluation Project FACTSHEET - Sensitive Regulated Land.PDF • FACTSHEET Requesting a Category Explanation Report.PDF • FACTSHEET What is the NVR Map.PDF • FACTSHEET Regulated Land.PDF • FACTSHEET Unregulated Land.PDF • Monaro Grasslands Pilot - summary_Draft.docx • NVR landholder perspectives_RMCG final report.PDF (also provided 16/3)

Date	Activity	Response/materials
29 April 2021	Briefing #4 to respond to Committee findings - answer questions and provide further detail	Provided further detail and clarification of remaining questions.
30 April 2021	Committee meet to discuss next steps	Agreed on report structure and main headings
7 & 13 May 2021	Committee report check-ins	Draft Committee report – final edits
14 May 2021		Draft Committee report to DPIE

3. 2021 Review Findings

The Committee grouped its findings on issues related to:

1. Accuracy and product suitability
2. Map compilation and efficiencies
3. Scale
4. Version control
5. Definitions
6. Other issues

The Review Committee approached the NVR Map Team with a request to provide an update to the comments and issues from the 2017 Review. Attachment 2 shows the responses provided by the NVR Map Team. It is clear that changes to the legislation have impacted on the categories and implementation of the map method. The updated information also showed excellent progress in many areas of concern in the 2017 Review. Areas of note are a series of landholder engagement processes and the completion of a state-wide land use layer for 2017.

The current review highlighted areas that are still of concern. These are the ongoing resourcing requirement for the current manual process, the need to clearly identify dependencies throughout the workflow, and the importance of clarity in the mapping documentation.

Following a detailed review of the 2021 documentation, the Committee raised a series of themed questions, covering the concepts of what is considered detectable and significant, the scale of mapping, map compilation and efficiencies, accuracy assessment, versioning and other specific issues. Each question was individually addressed by the mapping team. The Committee appreciated the detailed responses to the questions raised as the process significantly improved the understanding of the 2021 NVR Map method.

Attachment 3 details the Committee's findings and the responses from the Environment, Energy and Science (EES) Group of the NSW Department of Planning, Industry and Environment. Attachment 3 has informed the recommendations of this review.

4. Recommendations

While the NVR mapping methods are sound and rigorous to meet their current requirements, there are opportunities to further enhance the efficiency and effectiveness of the NVR Map method through improvements in science and adoption of new technologies. Our review identified several areas that could be better clarified, adopted and resourced. The following recommendations are provided for consideration by the NVR Map team:

4.1. Map Method Documentation

The Committee has had the opportunity to read, question and review the very detailed documentation around the NSW NVR Map method. Documentation is an important mechanism to enable stakeholder trust in the process and provide clear direction on future requirements for mapping longevity. It is recommended that the method statement documents including appendices are reviewed by a technical editor to improve readability. This process should include the Executive summary, the development of a factsheet for the public and ensure that all documentation has a glossary and list of acronyms. The importance of scientific publication was noted in the 2017 review and is noted again in this review.

4.2. Mapping Methods

4.2.1 Setasides – The NVR Map method currently does not monitor setasides establishment and any management activities. Not all types of management activities can be monitored using remote sensing, but where possible certain activities, particularly disturbance of woody and non-woody vegetation, can be monitored and adapted on a case-by-case basis. The Committee encourages the NVR Map team to consider such an approach where applicable.

4.2.2 Future Improvements – The Committee recommends that the NVR Map team consider reviewing where refinements occurred to identify issues and areas for improvement. For example, mapping of exotic vegetation species would require new products able to overcome the limitations of existing ones. Another area for improvement is to reduce manual editing tasks by making better use of existing products.

4.2.3 Default Zoom Level - The Committee recommends the default zoom level for the web map service to be set at 1:10,000 scale. This will assist ease of use with properties being easily located at this scale.

4.2.4 Workflow Diagram – The Committee recommends including a detailed workflow diagram showing dependencies and documentation for components, IT system, tables, documents etc. of the NVR Map. This can be part of the Method documentation.

4.2.5 Risk Assessment - For a state-wide program that underpins native vegetation clearing legislation, it is good practice to undertake a detailed risk assessment. For the annual map update, a risk register and mitigation approach has recently been initiated. However, it is understood more work is required to make it reliable and useful to manage risks. Detailed documentation of technical methods and internal processes is an immediate requirement, so the NVR Map remains fit-for-purpose.

4.2.6 Factsheets – Given the complexity of the NVR Map method, the Committee recommends developing factsheets communicating the overall approach in plain English. The audience would include stakeholders as well as the general public. This would provide confidence in the NVR Map by nontechnical users of the web map service.

4.3. Data Uncertainty

The multiple lines of evidence approach in the current NVR Map method uses skilled analysts to interpret each dataset. This approach is valued by NVR Map team as it can reduce community perception that the map is machine driven and not transparent. However, this benefit needs to be considered in terms of the risk of bias, consistency, reproducibility, and accuracy. There are long term benefits of adopting a hybrid approach that utilises programable computational procedures. This would allow more time in the field for ongoing calibration and validation of the data product and engagement with stakeholders.

4.4. Application of new technology

It is evident that the NVR Map team have not developed a strong adoption of new image analysis techniques such as machine learning and computer vision in their operational mapping methods. These techniques are no longer emerging and in the sole domain of research. They can be incorporated into operational mapping processes for state-wide applications when supported by on-ground field validation. The NVR Map team is well placed to embrace new image analysis techniques through their involvement in the Joint Remote Sensing Research Program hosted through the University of Queensland and their existing processes to undertake field validation and incorporate landholder information into the maps. To an extent, the Seasonal Cover Disturbance Imagery (SCDI) tool is a type of machine learning approach which reduces the manual checking required to retain accuracy in the land use map. Components of the mapping processes that could benefit from the application of new technologies include:

- development of a woody extent map for NSW, reducing the area of the state deemed nonwoody and requiring assessment by mappers. This transition to developing a woody extent map may also support the next iteration of the current NVR Map.
- algorithm-based methods to identify vegetation regrowth and the mapping of changes in regrowth in time and space.

4.5. Computational Infrastructure

The capture, processing, data archiving and delivery of high-resolution satellite imagery requires significant computational infrastructure and support. The NVR Map team indicated the processing infrastructure and network capability were approaching its level of capacity. Modernisation of the computational systems with appropriate technical support and funding, should be a high agency priority to ensure delivery of the NVR Map is not impeded. Consideration should look beyond replacement of

hard, on-premise infrastructure. Options for hybrid or burst systems and cloud-based platforms should be evaluated. In addition, cost-effective methods and infrastructure for data storage should be in scope.

Identifying all aspects of the NVR Map method workflow in terms of data dependencies, software, infrastructure, and staff is also needed to ensure interoperability of any new systems and to enable future mapping requirements.

4.6. Staff Training and Successional Planning

The NVR Map team have developed into a cohesive unit of remote sensing and data analysis scientists, with demonstrated capability to apply technology and image mapping methods to meet the current requirements of the LLS Act. Notwithstanding this capability, it is important to have a platform that enables knowledge transfer to new team members, and for the organisation to be strategically positioned for successional planning. Documentation of the mapping methods is one component, however opportunities for staff training to understand the details of the current and new machine learning techniques would generate future benefits and minimise disruptions to operational workflow processes that can occur with changes in staffing. The Committee supports the assignment of permanent core staff to manage this level of risk in delivering quality science effectively and efficiently.

The Committee also recommends that a process for successional planning be initiated, that is fit for purpose and designed to allow ample time for sharing of critical knowledge amongst the team leaders and provides opportunities for emerging leaders to be professionally developed.