# NSW native vegetation regulatory map method — Technical review and endorsement - 2015-2017

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

Technical Review Committee
24 August 2017

Mr Jeremy Black
Director
Native Vegetation Information Science Division
NSW Office of Environment & Heritage
Locked Bag 9018
Grafton NSW 2460

Re: Technical Review of the NSW Native Vegetation Regulatory Map

Dear Mr Black,

The Technical Review Committee is pleased to conclude the review of the Native Vegetation Regulatory Map: method statement (August 2017) and accompanying appendices, describing the science and analytical processes used to develop the native vegetation regulatory map for New South Wales.

Based on the review, the Committee concludes that the proposed methodology and datasets are appropriate for the intended purpose. The Committee further notes that the proposed methodology conforms to expected standards and is consistent with similar types of mapping methods adopted in other jurisdictions, such as the Queensland Statewide Landcover and Tree Study (SLATS) and the National Greenhouse Gas Inventory.

The review of the methodology and our recommendations is supported by the Technical Review (draft) Report submitted to the Office of Environment and Heritage (OEH) in November 2015 (Attachment 1). An addendum report was subsequently prepared containing an update to the assessment of the map method design and its implementation, the Committee's reviewed comments to the responses from OEH technical staff, and a list of actions, recommendations and technical considerations provided by the Technical Committee subsequent to the detailed discussion with the OEH staff at a meeting in Sydney in May 2017 (Attachment 2). Throughout the course of the review, the Committee also provided various other communications and feedback on the document although these were of a grammatical and format nature, and not referenced here. Nonetheless, we were pleased to see this feedback was taken into consideration in producing the final version of the Native Vegetation Regulatory Map: method statement, and associated appendices.

A chronology of the interactions with OEH staff to complete the technical review is provided for your information (Attachment 3). A copy of the Terms of Reference for the Review Committee is also attached (Attachment 4).

It should be noted that the scope of the review did not include visual inspection and verification of input datasets or final map data as this was not within the scope of the Committee's responsibility. However, the Committee is pleased to note that the method will be enabled for annual updates as this provides an

opportunity for external users and stakeholders, where applicable, to submit additional data and evidence to improve the useability of the map.

The Committee would like to thank Mr Richard Hicks and his senior technical staff for their full support in providing relevant material and clarifications. The Committee hopes that the comments and recommendations from this review have been helpful to OEH in improving the quality and rigour of the proposed methodology.

Sincerely

[redacted]

Dr Shanti Reddy

[redacted]

Dr Jane Stewart

[redacted]

Dr Elizabeth Morse-McNabb

[redacted]

Dr Paul Lawrence

Technical Review Committee
24 August 2017

Attachments

1. Technical Review report, November 2015
2. Technical Review report addendum, November 2015 – August 2017
3. Technical Review Committee Chronology of Review Process

# NSW native vegetation regulatory map method — Technical review

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

## Introduction

### Background and policy requirement

The NSW Office of Environment and Heritage (OEH) Science Division is tasked with delivering a native vegetation regulatory map under the proposed *Biodiversity Conservation Act*. The map is to provide clarity and certainty for landholders on whether their proposed clearing activity is subject to any regulatory requirements. A method document which describes the production process used to deliver the NSW-wide map will be published along with the new legislation.

The need for a native vegetation regulatory map arose from the following recommendations of Byron and colleagues (2014) who reviewed the *Native Vegetation Act 2003, Threatened Species Conservation Act 1995* and related legislation:

- **Recommendation 4:** Amend Local Environmental Plans to provide landholders with certainty about which types of agricultural development that includes native vegetation clearing would require development consent under the *Environmental Planning and Assessment Act 1979* and use maps to identify areas of land (based on mapped vegetation and previous land use) which does or does not require development consent to allow clearing.
- **Recommendation 5:** Provide OEH with adequate resources to ensure the maps are developed and ready to use before the new arrangements for agricultural development commence, to ensure the maps will be updated annually and for reviews requested by landholders to be processed efficiently.

These proposed new arrangements to regulate native vegetation clearing will repeal the *Native Vegetation Act 2003* and move clearing regulation into the *Environmental Planning and Assessment Act 1979* and the *Local Land Services Act 2013*, with supporting provisions in the new *Biodiversity Conservation Act*. The native vegetation regulatory map, made under the *Biodiversity Conservation Act*, will be used to identify areas that are:

- unregulated based on historical and ongoing agricultural land use (category 1 land)
- regulated under either the *Local Land Services Act 2013* or *Environmental Planning and Assessment Act 1979* (category 2 land).

The native vegetation regulatory map method is to deal with the:

- technical requirements of the map—such as scale, format and use within the NSW ePlanning system
- data sources used to identify Category 1, Category 2 and excluded land
- methods used to interpret data, including assumptions and margins of error.

## Scope of review

The Technical Review Committee is tasked with reviewing the map method developed by OEH to produce the NSW native vegetation regulatory map. Specifically this involves review and advice on the:

- method design and data collation
- technologies proposed for preparing the map
- other technical and methodological issues, including remote sensing, fractional cover analysis, land use classification, and identification and mapping of vegetation categories.

This draft report is based on the draft method statement of 30 October provided to the Committee. A final report will be delivered by the Committee following public consultation on the draft legislation, likely to be in mid-June 2016.

# Review framework and approach

The draft method statement assigns land to category 1 based on evidence of 'agricultural disturbance' and some legislated policy rules. Agricultural disturbance is defined as *'the modification of vegetation by mechanical or chemical means that results in a system of predominantly exotic vegetation'* since circa 1990.

The inputs used to establish agricultural disturbance are:

(i) historical and current land use (Chapter 4 of draft method statement)
(ii) disturbance of non-woody vegetation (fractional cover analysis) for agricultural activity (Chapter 5 of draft method statement)
(iii) detectable woody vegetation clearing (Chapter 6 of draft method statement).

The method is to define and identify specific thresholds for agricultural disturbance—woody vegetation clearing and disturbance of non-woody vegetation, excluding grazing by livestock. Where there is uncertainty regarding the categorisation of land, it is included in category 2 (regulated). High spatial precision—where individual trees are identifiable—is required for landholders and regulators to determine the category of any relevant vegetation at a specific point in time.

## Design—method design and data collation

To assess the map method design, the Technical Review Committee considered whether the:

- data is 'fit for purpose'
- proposed data analysis is sound and rigorous
- visual interpretation methods are consistent and repeatable between operators
- accuracy and map errors have been considered
- final product is robust, reliable and technically defensible
- method achieves the intended policy outcomes

- system is flexible to incorporate future enhancements and improvements
- proposed methodology has any systemic bias

This assessment is summarised in Table 1. Table 2 provides an overview of the Committee's understandings of the various data layers used to classify land as category 1, 2 or excluded and any general issues with this process. Findings and recommendations for each of the key input data layers—land use, fractional cover, woody vegetation clearing—and then all other layers are given with reference to the relevant parts of the draft method statement.

**Table 1 Summary of assessment of map method design**

| Criteria | Land use | Fractional cover | Woody vegetation clearing | Other | Regulatory map |
|---|---|---|---|---|---|
| Data fit for purpose | ✓✓ | ✓✓ | ✓✓ | ? | ✓ |
| Data analysis is sound and rigorous | ✓✓ | ✓✓ | ✓✓ | ? | ✓ |
| Visual interpretation methods are consistent and repeatable | ? | ? | ? | ? | ? |
| Accuracy and map errors are considered | ✓✓ | ? | ✓ | ? | ✓ |
| Final product is robust, reliable and technically defensible | ✓✓ | ? | ✓ | ? | ✓ |
| Method achieves the policy context | To be tested | To be tested | To be tested | To be tested | To be tested |
| Incorporation of future enhancements/improvements | ✓ | ? | ? | ? | ✓ |
| No systemic bias in method | ✓✓ | ? | ? | ? | ✓ |

Note: ✓✓ meets criteria; ✓ partially meets criteria; ? insufficient detail to assess; × currently does not meet criteria

**Table 2 Overview of draft method statement to classify land as category 1, 2 or excluded**

| Layers (Chapter #) | Inputs | Process | Issues | Classification |
|---|---|---|---|---|
| Exclusions (3) | • Excluded local government areas<br>• Excluded local environmental plan zones<br>• Other (i.e. national park estate, wilderness areas) | • NSW Digital Cadastral Database<br>• OEH databases | • Cadastral misalignment<br>• Treatment of water bodies | • Excluded |
| Land use (4) | • ALUM 2003<br>• ADS & SPOT 5 imagery<br>• Fractional cover<br>• Analysts | • Visual interpretation of ADS & SPOT 5 up to 2014<br>• Fractional cover for disturbance<br>• Edit polygons and ALUM codes | • Minimum mapping unit 2 hectares<br>• Completed as 1: 100 000 map sheet tiles | • ALUM 1 & 2 = category 2<br>• ALUM 3 or 4 = category 1 (except 3.1.4, 4.1.4 = category 2)<br>• ALUM 5 = category 1 (except 5.4.2 and 5.5.0 = excluded)<br>• ALUM 6 = category 1 |
| Non-woody vegetation (5) | • Fractional cover derived from Landsat | • Change in cover measured using angle and amplitude of change of pixel value over time in feature space | • Development and validation of the fractional cover analysis is not yet complete | • Either confirm category 1 or clarify non-woody category 2 |

**Table 2 cont'd**

| Layers (Chapter #) | Inputs | Process | Issues | Classification |
|---|---|---|---|---|
| Baseline woody vegetation (6) | • Woody vegetation 2011<br>• SLATS 2011-2012 and SLATS 2013-14 | • Remove clearing events in SLATS data from Woody Vegetation 2011 | • Will SLATS refinement process be used for 2011-2013 data here too?<br>• Not really a 2015 product if data only current to 2013<br>• Mapping to individual trees? | • Category 2 |
| Baseline detectable (legal) clearing (6) | • All eras SLATS (1988-2014)<br>• Total image archive (aerial photography and remote sensing)<br>• Analysts<br>• Woody disturbance (NEW)<br>• Persistent green (NEW) | • Create an 'all eras' SLATS layer<br>• Analysts to check for errors of omission and commission using NEW layers and total image archive<br>• Create refinements layer that covers all eras of SLATS<br>• Update all new SLATS data using refinements layer | • May be very labour intensive<br>• Confusing description of NEW layers<br>• NEW layers seem very similar products derived from fractional cover so could process potentially fit with update of land use to save analysis time | • Legal clearing = category 1<br>• Illegal clearing = category 2 (process in Chapter 7) |
| Legality of detectable clearing (7) | • Currently identifying and establishing the datasets required | • Compliance layer (illegal clearing)<br>• Overrides all other map layers | • Addresses unexplained clearing or clearing permitted under other legislated schemes by using 2013 imagery | • Category 2 |
| Native grassland overlay (8) | • Land use<br>• Seasonal fractional cover | • Areas of native grasslands are extracted from land use and seasonal fractional cover - conservation value uncertain | • No regulatory effect, communication tool | • Category 2<br>• Following a site based assessment could change to category 1 |
| Overriding map layers (9) | • Native vegetation regrown with public funds<br>• Vulnerable lands | • Second and third last override to map layers created from land use, woody vegetation and clearing layers | • Required by legislation<br>• Many required datasets are incomplete or poorly attributed | • Either category 1 or category 2 |
| Regulatory map (10) | • All the above | • Built in 3 groups and combined for final map layer<br>• Each land parcel/polygon attributed with the override reason | • Assembled at 1:100 000 map sheets | • Category 1, category 2 and excluded land with stippled overlay of category 2 native grassland |

Note: ALUM Australian Land Use and Management (classification system); SLATS Statewide Landcover and Trees Study

## Land use findings

1. The definition and thresholds for 'agricultural disturbance' underpins the determination of category 1. These must be transparent, understood and accepted as reasonable by

landholders and the community. Testing 'agricultural disturbance' with a focus group before the public consultation phase could be advantageous to the acceptance of the regulatory map. Currently these rules or thresholds are not described (see Table 2 of the draft method statement). The selection of 'since circa 1990' for agricultural disturbance will also require clear guidance on when or whether landholders can question this date.

2. The misalignment of the NSW digital cadastre (although addressed in the production of the regulatory map, section 3.3.4) could be a potential source of unnecessary reviews and potential challenges regarding what is category 1, category 2 or excluded land. This is an issue that needs to be addressed by NSW Land and Property Information as spatial digital data is used more as an instrument of legislation. NSW OEH will need to provide clear caveats with the regulatory map stating that it is not appropriate currently to overlay the NSW digital cadastre with the map. Likewise NSW Land and Property Information should have caveats on where the digital cadastre is not aligned and the degree of this misalignment.

3. Difficult to comment fully on the method without access to the rules/guidelines that analysts use in interpreting images as these are not currently in the method statement—for example the interpretation of spatial patterns and signatures in the imagery to classify to land use (ALUM) classes (section 4.3.3).

4. The input datasets (and their metadata) to the regulatory map should be publically accessible (subject to legislative restrictions) to enable scrutiny of the resulting map, for example the provisional land use layer (or the spatially rectified/update d NSW 2003 land use data).

5. Table 3 (in draft method statement) needs to be clearer as to what land uses are mapped to inform category 1, category 2 and excluded land and to what level of the ALUM classification version 7. For example:

    a. are all Conservation and Natural Environments classes part of the Land use 2014 product, or only 1.1.7 Other conserved areas (as category 2)
    b. are only those specified land uses to ALUM tertiary codes mapped to that level and all other land uses are mapped to secondary or primary level—such as sugar but not cotton

6. It appears from Table 3 (in draft method statement) that some land uses are mapped to different ALUM classes then the classification specifies. Where the feature is clear this should be recorded in the attribution if not in the classification, such that a fully ALUM classified land use map can be produced. This particularly relates to production from dryland versus irrigated agriculture and plantations which are lumped together. A specific example is irrigation infrastructure such as channels which are currently grouped under 3.3.0 Cropping rather than 6.4.0 Channel/aqueduct. It is also unclear if temporary changes in land use (for example fire scars/flood damage) are mapped and recorded.

## Land use recommendations

1. Test the definition and thresholds for 'agricultural disturbance' with a focus group/s before

the public consultation.

2. Provide caveats with the regulatory map that state the misalignment of the map with the existing NSW digital cadastre.

3. Provide rules/guidelines used by analysts to interpret images for assignment to category 1, category 2 and excluded land.

4. Where legislation allows make datasets and associated metadata that are inputs to the regulatory map publically accessible.

5. Document on the Australian Land Use and Management Classification Version 7 (summary) which land uses are category 1, category 2 and excluded land and to what level of the classification land uses are mapped to (for the purposes of the regulatory map)—colour code classes. This would be more detailed version of ALUM_Classification_V7_May_2010_summaryBCA.PDF supplied by OEH and would support a revised and clearer version of Table 3.

6. Confirm the date stamp for the land use inputs to the regulatory map—31 March 2014 (most commonly stated) or 2015 (Table 3)

## Fractional cover analysis findings

1. Seasonal, time series Landsat fractional cover data, acquired from 1988 to March 2014, are used to identify non-woody vegetation change. This information is then used to update the 2014 Land use map to detect additional, previously unmapped, disturbance events.

2. While the intent of this dataset is clear, how it is applied to which datasets and at what stages of the processing chain is unclear. There are four seasonal products per year and 27 years of data to be analysed, however, further details on data processing are still being developed and tested. For example, the length of time series to be analysed in the feature space to calculate the change angle and amplitude are yet to be decided.

3. Visual interpretation and field validation of seasonal, time series fractional cover data can be subjective depending of the interval between data capture and the site visit. Equally, visual interpretations can be variable between analysts in the absence of structured calibration and documentation. It is strongly recommended that OEH develop a consistent interpretation key based on the RGB colour scheme along with the supporting evidence required to confirm the disturbance event. In interpreting this data, it is important to take into account natural events such as historic bushfires or other activities listed on page 59-60, which may or may not result in permanent land use change. If not considered properly, there is a possibility that some of these events could be incorrectly mapped. In general, use of the fractional cover product should be limited to highlight areas of interest and potential disturbance events, which are then subject to further analysis including use of supporting data to prove that there has been a real land use change. Given the level of ambiguity in interpreting fractional cover data, it cannot be used in an automated manner to update the land use map.

4. Since a single event observed from remote sensing data could tip lands into category 1, it is essential to ensure there is sufficient additional information to support the fractional cover data interpretation. When in doubt, leave the lands in question in category 2, as they can be moved to category 1 when presented with further information. Technically it is possible for category 1 lands to be reclassified as category 2 though there is an increased risk that such lands could be subject to clearing prior to reclassification.

5. Figure x, page 30 depicts a two year seasonal fractional cover data that has been used to detect recent changes highlighted in yellow. Please annotate the two year window for which this data was analysed (2013-2014?) and also include a comment whether or not these change events have been detected and verified during the visual interpretation of high resolution data (ADS and SPOT 5) discussed in Chapter 4. This would further demonstrate the multiple lines of evidence approach of this method and increase user confidence.

6. It is expected that the fractional cover product would show changes in both woody and non-woody cover, however, the methods developed by OEH are entirely focussed on isolating non-woody change. This is fine, but further explanation is required to clarify how this issue is addressed. By deriving only the green and non-green cover indicates that 'bare' cover accumulates all the errors of the other 2 forms of cover. Furthermore, deriving the fractional bare ground by difference is not scientifically defensible when the land is dominated by this form of cover.

7. Use of seasonal fractional cover data to assess the level of disturbance of non-woody vegetation combined with field data requires further discussion. It is mentioned in Chapter 8 but lacks detail.

8. The Committee noted that the time series fractional ground cover data analysis and methods are still being developed and refined. Important issues such as the length of the time series to be analysed is yet to be determined. This needs to be resolved prior to finalising the method document.

9. The description of the fractional cover analysis would benefit from a greater use of references to the published literature on this method, applications by other jurisdictions and consistent terminology for the three cover fractions.

### Fractional cover analysis recommendations

1. The use of fractional cover product allows capturing of land use changes since 1990, however, the Committee recommends OEH to address the above findings.

2. The Committee would like to review Chapter 5 of the draft method statement once the method is fully developed and tested.

### Woody vegetation clearing findings

1. The 'baseline woody vegetation' dataset is noted to be circa 2015, however, section 6.3.3 indicates that SLATS layers for 2011/2012 and 2012/2013 will be used for the initial update and SPOT 5 2013-2014 used when available. This still doesn't bring the woody vegetation

current to 2015. The issues surrounding the cross checking compliance timeframes are discussed in section 7.4.2 which suggest the date needs to be 2013. The method statement needs to clarify the actual date of last measurement, the dataset required for the regulatory mapping process and clarify the name of the dataset.

2. The process for creating the 2011 woody vegetation layer is comprehensively described in the draft method statement. There is a note that section 6.3.4 will be shortened in future by referencing a journal publication. This will help the flow of this section as there is currently a lot of detail making it difficult to understand the process for regulatory mapping compared to input datasets.

3. A process for identifying detectable clearing events is outline in a figure at the top of page 45 in section 6.4.1, with all existing SLATS woody vegetation loss layers used. This process also uses the newly created 2015 baseline woody vegetation dataset that incorporates the most recent SLATS woody vegetation loss layers. The process in section 6.4.1 will be checking the SLATS woody loss layers for omission and commission errors. The 'baseline woody vegetation' layer would benefit from this refinement process but it is unclear from the method statement if both new datasets will be created at the same time or if they are separate processes.

4. There are references to sections 4.4.3 and 4.4.4 on page 46 that should be referring to section 6. This continues to occur throughout the chapter.

5. New research outlined in section 6.4.4 is confusing and difficult to follow. It seems to describe the creation of a 'woody vegetation disturbance' layer and a 'persistent green' layer using linear trends in fractional vegetation cover. At the end of this section they are called 'vegetation phenology and linear trends layers'. Consideration should be given to the benefit that these two new layers provide compared to the effort required to create and validate them, the spatial accuracy of the product and any added benefit or time required by the analyst to assess. This needs to be clearly described in the method statement.

6. The development of the baseline woody vegetation and baseline detectable clearing layers requires extensive analyst input. Analysts must review at least four layers of information on presence and absence of vegetation before making additions or deletions to the baseline datasets. The analyst must decide which pixel code to use for areas of change.

## Woody vegetation clearing recommendations

1. A flow chart showing the datasets, their interactions, the analyst action points (describing actions) and the order of processing would greatly benefit the reading of this chapter.

2. Clearly describe the date of the 'baseline woody vegetation' data inputs to clarify the name of the dataset and its role in confirming legality of detectable clearing (refer to section 7.4.2).

3. Section 6.3.4 could either be moved to an appendix or reference the forthcoming scientific journal publication.

4. Clearly describe and state the benefit that the new research layers provide compared to the

effort required to create and validate them, the spatial accuracy of the product and any added benefit or time required by the analyst to assess.

5. Provide rules/guidelines used by analysts to interpret images.

### Other findings

1. Compliance layer (Chapter 7 in draft method statement) needs to be more clearly defined as to how it is attributed. Confusing terminology used regarding 'lawful' and 'unlawful' clearing. A 'clearing non-compliance layer' might be a more apt description.

2. In Chapter 10 it states that the 'compliance layer' (Chapter 7) will override all other map layers, but Chapter 9 states the 'overriding map layers' will override the processes in Chapters 4-7. Which is correct?

3. It is not clear the attribution of the input data layers. Are they all simplified to category 1, category 2 and excluded land or are look-up tables used to do this categorisation as part of the processing? Will the input data layers be released as stand alone products, that is without the categorisation of the regulatory map?

### Other recommendations

1. Consider restructuring the method statement to reflect the order of the data layers in the production of the final map (i.e. current Chapter 7, 'compliance layer' should be at the end of the data layer chapters). The structure should align with the flow diagram (Chapter 10).

2. Consider carefully the naming of data layers such that they convey meaning—as to their purpose used in the construction of the regulatory map—and avoid confusion. This assumes that new data layers are constructed purely for the purposes of the production of the regulatory map rather than reclassified.

## Implementation—technologies proposed for preparing the map

To assess the implementation of the map method, the Technical Review Committee considered:

- data management and version control
- information and communications technology (ICT) infrastructure to meet the operational requirements
- funding to maintain and update
- technical capacity and capability
- clarity and transparency to landholders of the map method
- clarity and transparency of the decision rules to internal and external users

The Committee's assessment is summarised in Table 3. With particular reference to Chapters 10 ('Forming the final map product') and 11 ('Reviewing and updating the map') the Committee provide their findings and recommendations for the implementation of the regulatory map.

**Table 3 Summary of assessment of implementation of map method**

| Criteria | Land use | Fractional cover | Woody vegetation clearing | Other | Regulatory map |
|---|---|---|---|---|---|
| Data management and version control | ? | ? | ? | ? | ? |
| ICT infrastructure to meet operational requirements | ? | ? | ? | ? | ? |
| Funding to maintain and update | ? | ? | ? | ? | ? |
| Technical capacity and capability | ✓✓ | ✓✓ | ✓✓ | ? | ✓ |
| Clarity and transparency to landholders of the map method | ✓ | ? | ? | ? | To be tested |
| Clarity and transparency of the decision rules to internal and external users | ✓ | ? | ? | ? | ? |

Note: ✓✓ meets criteria; ✓ partially meets criteria; ? insufficient detail to assess; ✗ currently does not meet criteria

## Findings

1. The discussion and comments regarding the representation of private land conservation agreements (to use 'hatching') in Chapter 10 is noted. These issues will need to be confirmed as soon as possible.

2. From a stakeholder perspective, the colour representation of the categories used for the regulatory map should be tested for its effectiveness and clarity when printed in black and white, and at an A4 size.

3. The ongoing refinement, reviewing and maintenance of the spatial data and the map are essential to maintain the technical credibility of the mapping product and its application to support the *Biodiversity Conservation Act*.

4. While the draft method statement recognises that the regulatory map will be reviewed on an 'ad hoc' and annual basis (Chapter 11), it is not clear how these two processes will be the undertaken, and if one process will over-ride the other. For example, if an annual review has been completed, would an 'ad hoc' review take precedent, and does this re-set the cycle for the next annual review?

5. The method is open to planned annual updates and as well as ongoing property level updates driven by landholders. What is the mechanism to check property level update is correct before it is uploaded online? Who makes the final call? Documentation on the update procedure for daily ('ad hoc') and annual updates, including roles and responsibilities is required. Who can and cannot challenge the map? What evidence do you need to confirm their identity?

6. Using more accurate local data—landholder review process (section 2.6.3, page 10)—if the data is published, credible and accurate, then OEH is obliged to update the map rather than relying on OEH analysts' opinion. Text to be revised to clarify how local more accurate data is qualified and included in the final map.

7. Currently, the discussion in the draft method statement does not suggest an acknowledgement of the resources and capacity required to re-analyse the spatial imagery, re-validate and produce an updated map. This maintenance exercise is not trivial particularly

if a new or revised algorithm is developed and requires a resetting of the 2003 baseline and 'back-casting' of the previously reported information. Any changes of the analytical procedures and code would require documentation and reporting in peer reviewed literature. Any legal or legislative issues associated with revised information will also need to be considered by OEH as part of the methods process.

8. Associated with the process of reviewing and updating the map is the clear distinction between an 'operational' mode and a 'development' mode of the map. For efficiency, the skills required for the 'operational' mode may be different from those required for the 'development' mode. Equally, the time required to undertake the reviews (annual and ad hoc) would need to be factored into the scheduled sequencing of operationally completing the analyses and producing the map.

9. The draft method statement has little discussion about the level of supporting documentation and the publication of technical reports. Access to technical reports and publications in the peer review literature in a transparent way is important for the credibility for the regulatory map and its applications. It is recommended that a tier-approach of reports be developed to support the analyses and the map. For example, this may consist of:

    a. Tier 1 – detailed technical documentation and analysis
    b. Tier 2 – synthesis and summary of the methods and outcomes
    c. Tier 3 – a 1-2 page executive summary style report.

10. In addition, there is value in establishing a Reference Group comprising of members across key stakeholder groups and sectors. The Reference Group would provide independent guidance to the spatial products being developed and advice on the most effective means to communicate the information. The Reference Group should also be an independent advocate for the technical approaches being used.

### Recommendations

1. Provide transparency and credibility for the regulatory map and its applications through publication of technical reports and in the peer review literature.

2. The establishment of a Reference Group to provide independent guidance on the spatial products and advice on the communicating the derived information.

3. The Committee would like to review Chapters 10 and 11 of the draft method statement once completed.

## Other issues

Any other issues not covered in the design or implementation assessment of the regulatory map method are reported here by the Technical Review Committee.

1. Excluded land (Chapter 2)

    a. Is the excluded land a static mask or is it open to update (dynamic) like other classes?

b. Is the exclusion of lands the first step in the processing chain? Refer page 23—no further analysis is undertaken on these lands. If this is correct, then show this in the correct order in the process flowchart.
c. Section 3.3, Page 14—the method is not applicable to mangroves etc land types. This statement contradicts with Appendix 3, page 83 where it states these lands are category 2.
d. Section 3.4.5—water mask—is this a static or dynamic map? Appendix 1, page 78, statement implies this is still to be confirmed. This is an inconsistent message.

2. In Chapter 2, it would be useful to list all the input data layers, the first and current date of capture, the frequency of capture, the data custodian for the imagery, the database where the data are stored, and the system owner for the database. Similarly, it would be useful to document the dependencies that other agencies or councils have on the input data and the map in order to satisfy their legislative requirements or priorities. This has the benefit of demonstrating the value of the analyses for other government plans and policies, as well as leveraging for funding in the future.

## References

Byron N, Craik W, Keniry J and Possingham H 2014, *A review of biodiversity legislation in NSW: Final report*, prepared by the Independent Biodiversity Legislation Review Panel, State of NSW and the Office of Environment and Heritage.

# NSW native vegetation regulatory map method — Technical review

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

## Addendum

The Committee was first briefed on the NSW native vegetation regulatory map method on 16 October 2015. A draft report was provided by the Committee on 17 November 2015 on the method statement of 30 October 2015 before public consultation on the draft legislation. NSW Office of Environment and Heritage (OEH) provided feedback on how they had addressed the Committee's findings and recommendations in the draft report on 15 March 2017. This Addendum is based on the Bill Release Version (December 2016) of the method statement provided to the Committee on 16 January 2017. It provides updated Tables 1 and 3 as given in the draft report reflecting changes to the method statement and the Committee's assessment of the design (Table A1) and implementation of the map method (Table A2).

**Table A1 Summary of assessment of map method design**

| Criteria | Land use | Fractional cover | Woody vegetation clearing | Regulatory map |
|---|---|---|---|---|
| Data fit for purpose | ✓✓ | ✓✓ | ✓✓ | ✓✓ |
| Data analysis is sound and rigorous | ✓✓ | ✓✓ | ✓✓ | ✓✓ |
| Visual interpretation methods are consistent and repeatable | ✓✓ | ✓ | ✓✓ | ✓✓ |
| Accuracy and map errors are considered | ✓✓ | ✓✓ | ✓✓ | ✓✓ |
| Final product is robust, reliable and technically defensible | ✓✓ | ✓ | ✓✓ | ✓✓ |
| Method achieves the policy context | ✓✓ | ✓✓ | ✓✓ | ✓✓ |
| Incorporation of future enhancements/improvements | ✓✓ | ✓✓ | ✓✓ | ✓✓ |
| No systemic bias in method | ✓✓ | ✓✓ | ✓✓ | ✓✓ |

Note: ✓✓ meets criteria; ✓ partially meets criteria

**Table A2 Summary of assessment of implementation of map method**

Note: ✓✓ meets criteria; ✓ partially meets criteria; ? not assessed

| Criteria | Land use | Fractional cover | Woody vegetation clearing | Regulatory map |
|---|---|---|---|---|
| Data management and version control | ? | ? | ? | ? |
| ICT infrastructure to meet operational requirements | ? | ? | ? | ? |
| Funding to maintain and update | ? | ? | ? | ? |
| Technical capacity and capability | ✓✓ | ✓✓ | ✓✓ | ✓✓ |
| Clarity and transparency to landholders of the map method | ✓✓ | ✓ | ✓✓ | ✓✓ |
| Clarity and transparency of the decision rules to internal and external users | ✓✓ | ✓ | ✓✓ | ✓✓ |

Tables A1 and A2 were not provided to NSW OEH but informed the Committee's discussions at its second briefing on 18 May 2017. Before Briefing 2 the Committee provided to NSW OEH comments on NSW OEH's response to its earlier findings and recommendations (Attachment A – OEH responses with Committee's comments to responses).

Following the second briefing the Committee documented its additional comments and considerations to NSW OEH on 24 May 2017. NSW OEH's responded to these additional comments and considerations on the 31 July 2017 (Attachment B) when they provided the Transitional period version – August 2017 of the method statement and the draft Local Lands Services Amendment (Land Management – Native Vegetation) Regulation 2017 under the Local Land Services Act 2013 to the Committee.

The signed letter to NSW OEH of 25 August 2017 is the Committee's response to the Transitional period version – August 2017 of the method statement.

# Attachment A

**OEH responses to Technical Review 17 November 2015 and Committee's comments to responses**

| Peer review findings / recommendations (17 November 2015) | How peer review comments have been addressed in the method (15 March 2017) | Committee's comments to responses (7 April 2017) |
|---|---|---|
| **Land use findings** | | |
| 1. The definition and thresholds for 'agricultural disturbance' underpins the determination of category 1. These must be transparent, understood and accepted as reasonable by landholders and the community. Testing 'agricultural disturbance' with a focus group before the public consultation phase could be advantageous to the acceptance of the regulatory map. Currently these rules or thresholds are not described (see Table 2 of the draft method statement). The selection of 'since circa 1990' for agricultural disturbance will also require clear guidance on when or whether landholders can question this date. | The revised policy positions regarding uncoupling the Bill and the method remove the legislative effect of the map method. The bill clearly defines which land is to be included as category 1 and the regulations 60J(2) defines what is significantly disturbed or modified.. The Bill also identifies that the 'baseline date' is 1 January 1990.<br>DPI will be leading a closed consultation process with stakeholders during the transitional period to trial the maps. During this transitional period maps are available for review but not activated as part of the legislation.<br>Chapter 9 identifies that a review process is available for landholders who believe their land was incorrectly categorised. A review mechanism for changing the baseline date from 1990 to an earlier date is being discussed between agencies (similar to the existing Change the Regrowth Date PVPs).<br>The remotely sensed data and map method are not the only information used in landholder reviews. Other historic information and field measurements based on a defined grassland method can be used. | Uncoupling of the Bill and the method noted.<br>Committee to check Bill and Regulations 60J(2) to see definitions.<br>Although DPI may lead the engagement process, technical staff from OEH will need to be closely involved to clarify technical issues or challenges to the information. This will maintain credibility in the mapping products.<br>Supplementary [historic] sources of information must be demonstrated as being credible, accurate and consistent with the imagery analysis in the eyes of the community. |

| Peer review findings / recommendations (17 November 2015) | How peer review comments have been addressed in the method (15 March 2017) | Committee's comments to responses (7 April 2017) |
|---|---|---|
| | | |
| 2. The misalignment of the NSW digital cadastre (although addressed in the production of the regulatory map, section 3.3.4) could be a potential source of unnecessary reviews and potential challenges regarding what is category 1, category 2 or excluded land. This is an issue that needs to be addressed by NSW Land and Property Information as spatial digital data is used more as an instrument of legislation. NSW OEH will need to provide clear caveats with the regulatory map stating that it is not appropriate currently to overlay the NSW digital cadastre with the map. Likewise NSW Land and Property Information should have caveats on where the digital cadastre is not aligned and the degree of this misalignment. | This is a significant issue and Science and Policy Divisions have made LPI aware of the issue.<br><br>We looked at the options to fix the problems but it is a major project that will take significant time and resources to resolve so not within the scope of the NVR mapping project. We have minimised the use of cadastral boundaries to exclusion areas and some overrides to minimise the problem. Section 8.5 contains a caveat regarding the cadastral misalignment. | If the misalignment continues to generate a high risk to the policy, costing the government time and money, then the efficient solution is to prepare a funding submission to remove / reduce this risk. It is recognised this is a decision outside the technical review, however remains a comment for senior management in OEH. |
| 3. Difficult to comment fully on the method without access to the rules/guidelines that analysts use in interpreting images as these are not currently in the method statement—for example the interpretation of spatial patterns and signatures in the imagery to classify to land use (ALUM) classes (section 4.3.3). | This has been addressed in the map method statement with additional details from guides added including a flowchart – see Appendix 3. | Land use has been addressed. What about other products that involve interpretation of imagery? |
| 4. The input datasets (and their metadata) to the regulatory map should be publically accessible (subject to legislative restrictions) to enable scrutiny of the resulting map, for example the provisional land use layer (or the spatially rectified/update d NSW 2003 land use data). | Key datasets will be made available via SEED https://www.seed.nsw.gov.au/<br>Or Tern Auscover http://www.auscover.org.au/<br>Or https://iar.environment.nsw.gov.au/ | |
| 5. Table 3 (in draft method statement) needs to be clearer as to what land uses are mapped to inform category 1, category 2 and excluded land and to what level of the ALUM classification version 7. For example:<br>a. are all Conservation and Natural Environments classes part of the Land use 2014 product, or only 1.1.7 Other conserved areas (as category 2) | Figure 6 has been revised to replace Table 3. Figure 6 identifies the primary and secondary classes that apply to Cat 1 and Cat 2.<br><br>Excluded land is identified in the amended *LLS Act* and mapped using datasets outlined in Appendix 6. | |

| Peer review findings / recommendations (17 November 2015) | How peer review comments have been addressed in the method (15 March 2017) | Committee's comments to responses (7 April 2017) |
|---|---|---|
| b. are only those specified land uses to ALUM tertiary codes mapped to that level and all other land uses are mapped to secondary or primary level—such as sugar but not cotton | Ideally the whole state would be mapped as landuse and then excluded land applied. However due to time constraints in some cases excluded lands were not landuse mapped. The intent is to fill these gaps in future updates.<br><br>Tertiary classes were only mapped when sufficient information was available (pg22).<br><br>The next version of the method will note that the" *ALUM figure includes land that is ultimately excluded from the application of the map*". | Does this mean another review is required by the technical review committee? |
| 6. It appears from Table 3 (in draft method statement) that some land uses are mapped to different ALUM classes then the classification specifies. Where the feature is clear this should be recorded in the attribution if not in the classification, such that a fully ALUM classified land use map can be produced. This particularly relates to production from dryland versus irrigated agriculture and plantations which are lumped together. A specific example is irrigation infrastructure such as channels which are currently grouped under 3.3.0 Cropping rather than 6.4.0 Channel/aqueduct. It is also unclear if temporary changes in land use (for example fire scars/flood damage) are mapped and recorded. | This table has been removed and replaced with the ALUM land use classification table (Figure 6), which notes which classes are mapped as category 1 and category 2.<br><br>It is not currently proposed to produce a fully classified ALUM land use map of the state, given that this is only one input to the designation of land as category 1 and category 2, and additional steps in the method may change these designations. | Is the land use map now just used to assign category 1 and 2 and therefore what the individual land uses are is not so relevant? |
| **Land use recommendations** | | |
| 1. Test the definition and thresholds for 'agricultural disturbance' with a focus group/s before the public consultation. | A definition of significantly disturbed or modified is now included in the drafting instructions for the | As noted earlier – access to these drafting instructions would seem important when assessing the method |

| Peer review findings / recommendations (17 November 2015) | How peer review comments have been addressed in the method (15 March 2017) | Committee's comments to responses (7 April 2017) |
|---|---|---|
| | regulations. A closed consultation process with stakeholders will test the maps soon. | statement (or are these definitions also included in the method statement?) |
| 2. Provide caveats with the regulatory map that state the misalignment of the map with the existing NSW digital cadastre. | Caveats have been provided in section 8.5, and a legal solution to this issue is being pursued. | See earlier comments regarding longer term solution to misalignment. |
| 3. Provide rules/guidelines used by analysts to interpret images for assignment to category 1, category 2 and excluded land. | Completed, see Appendix 3. | |
| 4. Where legislation allows make datasets and associated metadata that are inputs to the regulatory map publically accessible. | Key datasets will be made available via SEED https://www.seed.nsw.gov.au/<br>Or Tern Auscover http://www.auscover.org.au/<br>Or https://iar.environment.nsw.gov.au/ | |
| 5. Document on the Australian Land Use and Management Classification Version 7 (summary) which land uses are category 1, category 2 and excluded land and to what level of the classification land uses are mapped to (for the purposes of the regulatory map)—colour code classes. This would be more detailed version of ALUM_Classification_V7_May_2010_summaryBCA.PDF supplied by OEH and would support a revised and clearer version of Table 3. | Addressed, above (Land use finding 5). | |
| 6. Confirm the date stamp for the land use inputs to the regulatory map—31 March 2014 (most commonly stated) or 2015 (Table 3) | Addressed throughout chapter 4. | Still not clear and inconsistencies between text and Figure 4.<br>Updated land use map is 2005- July 2013? – median age? Seasonal cover disturbance image 1988 to 2015? |
| **Fractional cover analysis findings** | | |
| 1. Seasonal, time series Landsat fractional cover data, acquired from 1988 to March 2014, are used to identify non-woody vegetation change. This information is then used to update the 2014 Land use | The information on the development and use of the SCDI has been updated in chapter 5 and appendix 4. | Check these dates – have they changed? From Chapter 4 it now suggests a 2013 land use map. Is this correct? |

| Peer review findings / recommendations (17 November 2015) | How peer review comments have been addressed in the method (15 March 2017) | Committee's comments to responses (7 April 2017) |
|---|---|---|
| map to detect additional, previously unmapped, disturbance events.<br>2. While the intent of this dataset is clear, how it is applied to which datasets and at what stages of the processing chain is unclear. There are four seasonal products per year and 27 years of data to be analysed, however, further details on data processing are still being developed and tested. For example, the length of time series to be analysed in the feature space to calculate the change angle and amplitude are yet to be decided. | The seasonal cover disturbance image covers the 26 year period from summer 1987/88 to autumn 2013. There are also three SCDI images covering the same time period but in consecutive periods of approximately 8 years.<br><br>Flow chart figure 5 sets out method for using these SCDI images in land use interpretation. | Are these [processing] details now provided? Check Chapter 5 and relevant Appendix. |
| 3. Visual interpretation and field validation of seasonal, time series fractional cover data can be subjective depending of the interval between data capture and the site visit. Equally, visual interpretations can be variable between analysts in the absence of structured calibration and documentation. It is strongly recommended that OEH develop a consistent interpretation key based on the RGB colour scheme along with the supporting evidence required to confirm the disturbance event. In interpreting this data, it is important to take into account natural events such as historic bushfires or other activities listed on page 59-60, which may or may not result in permanent land use change. If not considered properly, there is a possibility that some of these events could be incorrectly mapped. In general, use of the fractional cover product should be limited to highlight areas of interest and potential disturbance events, which are then subject to further analysis including use of supporting data to prove that there has been a real land use change. Given the level of ambiguity in interpreting fractional cover data, it cannot be used in an automated manner to update the land use map. | No RGB colour scheme key - generally based on analyst discretion, in accordance with analyst rules in Appendix 3.<br>The decision tree for mapping using the available satellite and aerial imagery and SCDI is shown in figure 5. This is also supplemented by the analyst interpretation rules in appendix 3.<br><br>Appendix 4 provides notes for interpretation and details of an image classification approach which was used to assist with consistency of interpretation where the SCDI was more complex.<br><br>The SCDI is intended to be used to highlight areas of interest and potential disturbance events for non-woody vegetation, and is then supported by the ADS and SPOT imagery, woody vegetation layer and other inputs such as override layers to come up with the final product. The method takes account of natural | Check. This [analyst rules] addresses Point 3 under Land use findings.<br><br>Check [Appendix 4]. |

| Peer review findings / recommendations (17 November 2015) | How peer review comments have been addressed in the method (15 March 2017) | Committee's comments to responses (7 April 2017) |
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| | events through the land use layers and visual signatures. While the fractional data is put together in an automated manner, it is interpreted by analysts. This is outlined in the method statement. | |
| 4. Since a single event observed from remote sensing data could tip lands into category 1, it is essential to ensure there is sufficient additional information to support the fractional cover data interpretation. When in doubt, leave the lands in question in category 2, as they can be moved to category 1 when presented with further information. Technically it is possible for category 1 lands to be reclassified as category 2 though there is an increased risk that such lands could be subject to clearing prior to reclassification. | Agree with the position that when in doubt, land should be category 2. This approach is covered in "2.3.4 Responding to uncertainty" in the method document. | Check [2.3.4] |
| 5. Figure x, page 30 depicts a two year seasonal fractional cover data that has been used to detect recent changes highlighted in yellow. Please annotate the two year window for which this data was analysed (2013-2014?) and also include a comment whether or not these change events have been detected and verified during the visual interpretation of high resolution data (ADS and SPOT 5) discussed in Chapter 4. This would further demonstrate the multiple lines of evidence approach of this method and increase user confidence. | Figure 6 image (a) is a Landsat colour composite image for 2013, and image (b) is the seasonal cover disturbance image to 2013.<br><br>The caption has been edited and the discussion references the use of ADS and Spot with the SCDI to assist interpretation. | |
| 6. It is expected that the fractional cover product would show changes in both woody and non-woody cover, however, the methods developed by OEH are entirely focussed on isolating non-woody change. This is fine, but further explanation is required to clarify how this issue is addressed. By deriving only the green and non-green cover indicates that 'bare' cover accumulates all the errors of the other 2 forms of cover. Furthermore, deriving the fractional bare ground by difference is not scientifically defensible | The SCDI does show change in woody cover but we have other woody extent and change products that are used for that purpose.<br><br>The SCDI is only based on the two vegetation cover components (green and dead) and doesn't use bare fraction. They are the unmixed fractions and not | |

| Peer review findings / recommendations (17 November 2015) | How peer review comments have been addressed in the method (15 March 2017) | Committee's comments to responses (7 April 2017) |
|---|---|---|
| when the land is dominated by this form of cover. | derived from the bare fraction. | |
| 7. Use of seasonal fractional cover data to assess the level of disturbance of non-woody vegetation combined with field data requires further discussion. It is mentioned in Chapter 8 but lacks detail. | Detail added in Appendix 4 | |
| 8. The Committee noted that the time series fractional ground cover data analysis and methods are still being developed and refined. Important issues such as the length of the time series to be analysed is yet to be determined. This needs to be resolved prior to finalising the method document. | This has been addressed above in Fractional cover Findings 1 | |
| 9. The description of the fractional cover analysis would benefit from a greater use of references to the published literature on this method, applications by other jurisdictions and consistent terminology for the three cover fractions. | References are added in Appendix 4 | Check that this has been addressed [consistent terminology]. Dead cover is inaccurate. Green and non-green preferred. |
| **Fractional cover analysis recommendations** | | |
| 1. The use of fractional cover product allows capturing of land use changes since 1990, however, the Committee recommends OEH to address the above findings. | See above. | |
| 2. The Committee would like to review Chapter 5 of the draft method statement once the method is fully developed and tested. | Noted. | Check that the committee is happy the method has been fully developed and tested. |
| **Woody vegetation clearing findings** | | |
| 1. A flow chart showing the datasets, their interactions, the analyst action points (describing actions) and the order of processing would greatly benefit the reading of this chapter. | Addressed, see Figure 10. | |
| 2. Clearly describe the date of the 'baseline woody vegetation' data inputs to clarify the name of the dataset and its role in confirming legality of detectable clearing (refer to section 7.4.2). | Addressed – the section on unlawful clearing has been revised (7.5.1). | |
| 3. Section 6.3.4 could either be moved to an appendix or reference the forthcoming scientific journal publication. | Addressed – this is now in Appendix 5. | |

| Peer review findings / recommendations (17 November 2015) | How peer review comments have been addressed in the method (15 March 2017) | Committee's comments to responses (7 April 2017) |
|---|---|---|
| 4. Clearly describe and state the benefit that the new research layers provide compared to the effort required to create and validate them, the spatial accuracy of the product and any added benefit or time required by the analyst to assess. | The benefit of the new research layers is outlined in the method, but not in relation to the effort required to create and validate them.<br><br>Further work required on spatial accuracy – validation of trial areas is occurring by other parts of OEH. | [Spatial accuracy] Not yet established, but underway.<br><br>Check [Appendix 3] that this covers all imagery/products |
| 5. Provide rules/guidelines used by analysts to interpret images. | Addressed, see Appendix 3. | |
| **Other findings** | | |
| 1. Compliance layer (Chapter 7 in draft method statement) needs to be more clearly defined as to how it is attributed. Confusing terminology used regarding 'lawful' and 'unlawful' clearing. A 'clearing non-compliance layer' might be a more apt description. | Addressed - the section has been revised (7.5.1). | Check [7.5.1] |
| 2. In Chapter 10 it states that the 'compliance layer' (Chapter 7) will override all other map layers, but Chapter 9 states the 'overriding map layers' will override the processes in Chapters 4-7. Which is correct? | This has been revised in section 7.5.1. | |
| 3. It is not clear the attribution of the input data layers. Are they all simplified to category 1, category 2 and excluded land or are look-up tables used to do this categorisation as part of the processing? Will the input data layers be released as stand alone products, that is without the categorisation of the regulatory map? | Data layers have been re-named to reflect the data they address (land use mapping, woody extent, SLATS, SCDI etc) and Chapter 8 outlines how these layers are compiled to form the map product that ultimately categorises the land.<br><br>Where possible data layers will be released but some individual data layers will not be released as standalone products. In some cases they cannot be meaningfully interpreted without the other layers. | |
| **Other recommendations** | | |

| Peer review findings / recommendations (17 November 2015) | How peer review comments have been addressed in the method (15 March 2017) | Committee's comments to responses (7 April 2017) |
|---|---|---|
| 1. Consider restructuring the method statement to reflect the order of the data layers in the production of the final map (i.e. current Chapter 7, 'compliance layer' should be at the end of the data layer chapters). The structure should align with the flow diagram (Chapter 10). | Addressed, and flow diagram updated. | |
| 2. Consider carefully the naming of data layers such that they convey meaning—as to their purpose used in the construction of the regulatory map—and avoid confusion. This assumes that new data layers are constructed purely for the purposes of the production of the regulatory map rather than reclassified. | Addressed. | |
| **Implementation findings** | | |
| 1. The discussion and comments regarding the representation of private land conservation agreements (to use 'hatching') in Chapter 10 is noted. These issues will need to be confirmed as soon as possible. | This has been removed. Hatching is not proposed. Private land conservation agreements are to be included as category 2, see Appendix 6. | |
| 2. From a stakeholder perspective, the colour representation of the categories used for the regulatory map should be tested for its effectiveness and clarity when printed in black and white, and at an A4 size. | Noted. The colour representations are being tested for accessibility. | |
| 3. The ongoing refinement, reviewing and maintenance of the spatial data and the map are essential to maintain the technical credibility of the mapping product and its application to support the *Biodiversity Conservation Act*. | Noted. The Bill proposes an annual review of the map. Given that the method will no longer be legislatively linked to the Bill, OEH will need to have a review process in place to update and review the method itself, to reflect latest data sources and new technology (some of which may be gained through review processes).<br><br>Maintenance of spatial data will be pursued as part of OEH's existing program of work, including developing of mapping, and mapping | Does this [method no longer legislatively linked to Bill] have consequences for OEH in having the budget to undertake an annual review? |

| Peer review findings / recommendations (17 November 2015) | How peer review comments have been addressed in the method (15 March 2017) | Committee's comments to responses (7 April 2017) |
|---|---|---|
| | for compliance monitoring purposes. | |
| 4. While the draft method statement recognises that the regulatory map will be reviewed on an 'ad hoc' and annual basis (Chapter 11), it is not clear how these two processes will be the undertaken, and if one process will over-ride the other. For example, if an annual review has been completed, would an 'ad hoc' review take precedent, and does this re-set the cycle for the next annual review? | Further detail has been provided in chapter 9. | |
| 5. The method is open to planned annual updates and as well as ongoing property level updates driven by landholders. What is the mechanism to check property level update is correct before it is uploaded online? Who makes the final call? Documentation on the update procedure for daily ('ad hoc') and annual updates, including roles and responsibilities is required. Who can and cannot challenge the map? What evidence do you need to confirm their identity? | The Bill provides that only landholders can request internal reviews.<br><br>The re-categorisation will be based on application of the method at site scale, using verified additional data provided by the applicant, and must be appropriate in the view of the CE OEH.<br><br>OEH will provide guidelines on internal reviews, including evidence required, as well as an internal review and update protocol, at a later date. | Provision of the Bill (and associated regulations) would assist assessing the method and required detail.<br><br>Noted. But affects Committee's assessment. |
| 6. Using more accurate local data—landholder review process (section 2.6.3, page 10)—if the data is published, credible and accurate, then OEH is obliged to update the map rather than relying on OEH analysts' opinion. Text to be revised to clarify how local more accurate data is qualified and included in the final map. | The method now identifies that the CE retains discretion to determine whether or not local data is of sufficient quality or accuracy to be adopted (section 9.4). Data that is published, credible and accurate would meet this requirement, and be used by OEH to update the map in any of the map review processes. It should also be noted that only landholders will now be able to request a review of their land, not local councils. | Note [only landholders will be able to request a review of their land] |

| Peer review findings / recommendations (17 November 2015) | How peer review comments have been addressed in the method (15 March 2017) | Committee's comments to responses (7 April 2017) |
|---|---|---|
| 7. Currently, the discussion in the draft method statement does not suggest an acknowledgement of the resources and capacity required to re-analyse the spatial imagery, re-validate and produce an updated map. This maintenance exercise is not trivial particularly if a new or revised algorithm is developed and requires a resetting of the 2003 baseline and 'back-casting' of the previously reported information. Any changes of the analytical procedures and code would require documentation and reporting in peer reviewed literature. Any legal or legislative issues associated with revised information will also need to be considered by OEH as part of the methods process. | Noted. This comment should inform the application fee discussion.<br><br>Noted also that since the method is no longer a legislative document, legal issues associated with revised information will not be an issue. | Has this [maintenance exercise] been recognised as a budgetary requirement for OEH? |
| 8. Associated with the process of reviewing and updating the map is the clear distinction between an 'operational' mode and a 'development' mode of the map. For efficiency, the skills required for the 'operational' mode may be different from those required for the 'development' mode. Equally, the time required to undertake the reviews (annual and ad hoc) would need to be factored into the scheduled sequencing of operationally completing the analyses and producing the map. | As above.<br><br>Noted this also will depend on how the final map is published and that has not been finalised. | |
| 9. The draft method statement has little discussion about the level of supporting documentation and the publication of technical reports. Access to technical reports and publications in the peer review literature in a transparent way is important for the credibility for the regulatory map and its applications. It is recommended that a tier-approach of reports be developed to support the analyses and the map. For example, this may consist of:<br>a. Tier 1 – detailed technical documentation and analysis<br>b. Tier 2 – synthesis and summary of the methods and outcomes<br>c. Tier 3 – a 1-2 page executive summary style report. | Noted, for discussion (see recommendation 1 below). | |

| Peer review findings / recommendations (17 November 2015) | How peer review comments have been addressed in the method (15 March 2017) | Committee's comments to responses (7 April 2017) |
|---|---|---|
| 10. In addition, there is value in establishing a Reference Group comprising of members across key stakeholder groups and sectors. The Reference Group would provide independent guidance to the spatial products being developed and advice on the most effective means to communicate the information. The Reference Group should also be an independent advocate for the technical approaches being used. | Noted, for discussion (see recommendation 2 below). | |
| **Recommendations** | | |
| 1. Provide transparency and credibility for the regulatory map and its applications through publication of technical reports and in the peer review literature. | Noted for discussion. Noted that some inputs to the appendices are intended for publication in technical journals. | |
| 2. The establishment of a Reference Group to provide independent guidance on the spatial products and advice on the communicating the derived information. | Noted for discussion. | |
| 3. The Committee would like to review Chapters 10 and 11 of the draft method statement once completed. | Agreed – these are now Chapters 8 and 9 and have been significantly revised. The Committee will be able to review the revised method as phase 2 of the peer review. | Check [Chapters 8 and 9] |
| **Other issues (p 11)** | | |
| 1. Excluded land (Chapter 2)<br>a. Is the excluded land a static mask or is it open to update (dynamic) like other classes?<br>b. Is the exclusion of lands the first step in the processing chain? Refer page 23—no further analysis is undertaken on these lands. If this is correct, then show this in the correct order in the process flowchart.<br>c. Section 3.3, Page 14—the method is not applicable to mangroves etc land types. This statement contradicts with Appendix 3, page 83 where it states these lands are category 2.<br>d. Section 3.4.5—water mask—is this a static or dynamic map? Appendix 1, page 78, statement implies this is still | a. Open to update if land changes such that it meets the criteria for exclusion or inclusion – e.g. rezoning from urban to rural etc. This is outlined in section 3.1 of the method. It can also be updated in response to cadastral misalignment issues (either in landholder reviews, or by OEH in annual reviews and updates etc.)<br>b. Agreed – this is reflected in the method (Figure 3/Figure 12).<br>c. Method has been revised. Mangroves etc. are category 2 layers in both | |

| Peer review findings / recommendations (17 November 2015) | How peer review comments have been addressed in the method (15 March 2017) | Committee's comments to responses (7 April 2017) |
|---|---|---|
| to be confirmed. This is an inconsistent message. | the method (section 7.3) and appendices.<br><br>d. This section has been removed as a water mask is no longer applied. Water bodies are captured in the landuse mapping if >2ha.<br><br>The water prevalence image is used to assist with the interpretation of the SCDI (4.4.2). This image can be updated as more imagery becomes available. | |
| 2. In Chapter 2, it would be useful to list all the input data layers, the first and current date of capture, the frequency of capture, the data custodian for the imagery, the database where the data are stored, and the system owner for the database. Similarly, it would be useful to document the dependencies that other agencies or councils have on the input data and the map in order to satisfy their legislative requirements or priorities. This has the benefit of demonstrating the value of the analyses for other government plans and policies, as well as leveraging for funding in the future. | This is largely addressed in Appendix 2, which lists the datasets, dates of capture, source of the imagery, and the relationship with the map.<br><br>Appendix 6 lists the datasets used to create excluded areas (Chapter 3) and overriding map layers (Chapter 7).<br><br>These appendices do not document the dependencies that other agencies or councils have on the input data or their other uses. | |

# Attachment B

**OEH responses (in italics) to additional comments and considerations by the Committee of 24 May 2017**

Following the discussions [at second briefing on 18 May], the Independent Review Committee note the following actions, recommendations and considerations to the NSW OEH:

ACTIONS

1. NSW OEH to provide Independent Review Committee with a copy of the Act and links to publically available information (draft regulations).

   *LLS Act and draft regulations will be sent with other documents.*

2. NSW OEH to provide Review Committee with access to test portal before site goes live.

   *The current test portal link can only be viewed from the OEH network. We have asked if there is an option to allow access directly but haven't heard back from IT yet. Alternatively we can run an online meeting with shared screens to demonstrate the map viewer.*

3. NSW OEH to provide revised methods report for signoff by Review Committee in sufficient time before clearance and release on 25 August (likely the week of the 17 July).

   *We recognise that there were delays in getting the documents to the committee. If possible we would like signoff within a week of receiving these final documents.*

4. Review Committee to provide signed letter to NSW OEH stating their views on the native vegetation regulatory map methodology (1 -2 weeks after receiving the revised methods report).

RECOMMENDATIONS

1. Metadata (spreadsheet to geodatabase) to include software version.

   a. *There is a complete image processing history in each 1:100k or statewide map (image file) which shows the scripts run and input layers used to create it. Software versions used in all products and inputs can be traced using the link to the source code repository.*

   b. *In addition spreadsheet for each maps sheet product/version listing all the input data sets. An example of this will be sent.*

   c. *An ISO 19139 metadata statement that describes the maps on a statewide basis is being produced but is not yet completed.*

2. Provide output file so landholder can upload the map to their data layers

   *This is a currently not part of the design but it has been requested as an enhancement.*

CONSIDERATIONS

The project team should consider the following technical issues:

1. What processes will be used to re-baseline the changes if and when the remote sensing algorithms are updated, requiring a re-calculation of the spatial coverage as at 2013. These processes will need to be documented and incorporated into the technical report.

   *There is no plan to re-baseline the map using new data other than updating the currency of the layers in the map. Updating is already covered in the methods.*

2. The method document needs a clear introduction that states the context of the map method in the legislation, describing how a process of improvement will be managed and noting the interaction of any changes in 'over-rides'.

   *An additional comment was added to the executive summary highlighting that the NVR will need to be updated if prescribed layers (overrides) change.*

3. The method report also needs to document the process of these 'over-rides', so that it is clear how these values were derived. This should also consider any issues of prioritisation of the over-writes, which also should be described in the document. This goes to the heart of data provenance, and the credibility of the spatial analyses and mapping, particularly if the method is tested under legal scrutiny or other audits. It is suggested this information can be included as an appendix to the report to allow future updates to be more efficiently communicated without the need to update the full document.

   *The appendix contains a table of prescribed layers (overrides) and there is a column that indicates the order of precedence used in producing the maps. The name and version of the overrides used in each map and version are captured in a spreadsheet when each map is produced. An example has been supplied.*

4. It needs to be clear that the 2013 baseline is just a place to start and that the temporal lag will improve in the future, but still be determined by image acquisition.

   *An additional comment was added to the executive summary to make that clear.*

5. A key learning from the Queensland experiences is the importance of publications in peer-review literature. This adds to the credibility and the transparency of the technical methods. It is suggested that the technical team consider the approach to publish the methods framework in recognised literature.

   *We recognise this and our Joint Research Program has enabled us to publish most components of the system. There are some parts of the method such as SCDI that still need to be published. It is listed in the publications plan as a future publication and will commence when time becomes available again.*

The team should consider the following administrative and communication issues:

*6.* There seems to have been a shift from a change in 'agriculture' to a more focused assessment of native vegetation for regulatory purposes. This should be reflected in the method report.

*The method has always been focused on mapping clearing or significant disturbance of vegetation as unregulated except for where other prescribed layers overide.*

7. The communication of the annual updates of the vegetation mapping, and the technical review of the mapping method every 5 years, or as required.

*The Act/Regulation sets out requirements for communicating changes to the maps. Annual updates to the maps can be advised through the media such as SMH or the Land. For more localised updates that aren't part of the annual update we need to advise landholders. The requirements for this is being assessed as part of a separate IT project.*

8. The team should work closely with the technical editor to ensure the technical credibility of the report is maintained while examining any ways to improve the structure of the report. It is suggested that the editor is embedded with the technical team so that issues or questions can be quickly addressed. This approach should also reduce the time for the editing to be completed.

*The technical editor has reviewed both the methods statement and the appendices, except for recent changes. The documents will go back to her for further checking once final changes are made. They will then be sent to OEH publishing for further work on formatting of figures etc.*

9. It may be helpful for the editor to engage with the policy team as well as the mapping team, as policy people are often good at 'translation'!

*We have been getting policy to review changes to the documents to ensure the meaning hasn't been changes away from that intended.*

ATTACHMENT 3

# Technical Review Committee Chronology of Review Process

1. September 2015: Committee established and terms of reference provided
2. 16 October 2015: 1st Briefing held at OEH office Sydney
3. 17 November 2015: Committee provided Draft report with findings and recommendations on method
4. December/January 2017: Revised methods document provided to Committee
5. 15 March 2017: Document detailing addressing of Committee's earlier recommendations provided to Committee
6. 7 April 2017: Committee provided additional comments on methods document and the addressing of original recommendations
7. 18 May 2017: 2nd Briefing held at OEH office in Sydney
8. 24 May 2017: Committee provided additional comments and considerations on method document
9. 31 July 2017: Edited and revised methods document provided to Committee with draft legislation and response to Committee's additional comments and considerations of May 2017
10. 25 August 2017: Committee provided letter to OEH supporting method document.