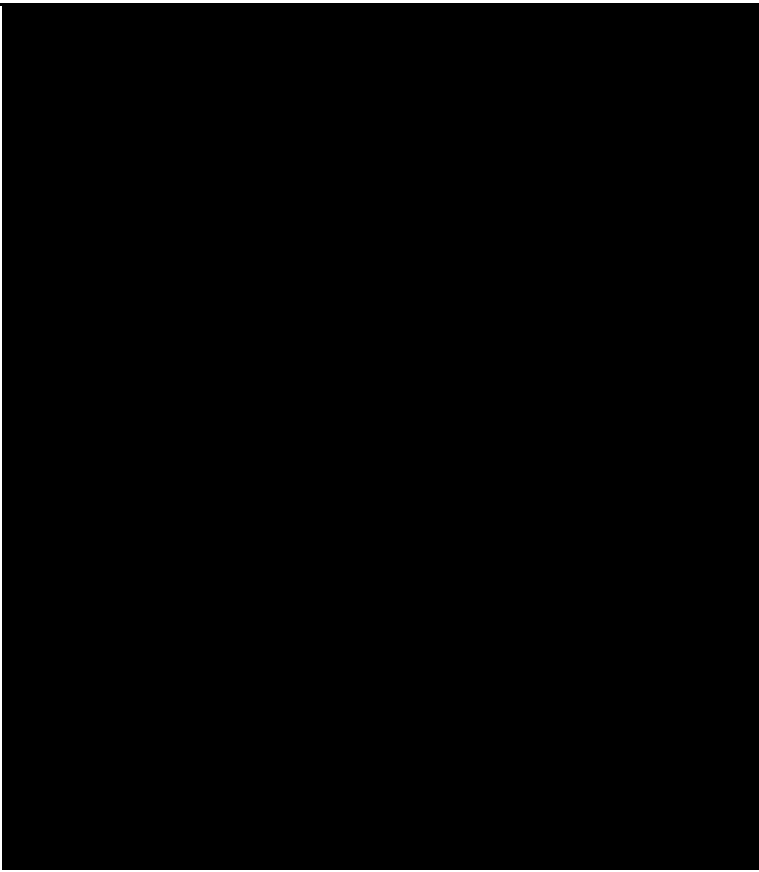




Mapping of Forest Management History Report

UNE, LNE and Southern Regions

A project undertaken as part of the NSW Comprehensive Regional
Assessments



MAPPING OF FOREST MANAGEMENT HISTORY REPORT

**UNE, LNE AND SOUTHERN
REGIONS**

State Forests of NSW

A project undertaken for
the Joint Commonwealth NSW Regional Forest Agreement Steering Committee
as part of the
NSW Comprehensive Regional Assessments
project number NA21/EH

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PROJECT SUMMARY

This report describes a project undertaken as part of the comprehensive regional assessments of forests in New South Wales. The comprehensive regional assessments (CRAs) provide the scientific basis on which the State and Commonwealth Governments will sign regional forest agreements (RFAs) for major forest areas of New South Wales. These agreements will determine the future of these forests, providing a balance between conservation and ecologically sustainable use of forest resources.

Project objective/s

The Mapping of Forest Management History (MANHIC) Project was established to document and map the management history of public forested land in the Upper North East (UNE), Lower North East (LNE) and Southern CRA Regions of New South Wales. This report relates to all three regions.

Methods

The project was established primarily as a mapping exercise to collect data for use by other CRA projects. Data were collated and digitised with regard to the following agents:

- Logging and silvicultural treatment;
- Prescribed burning and wildfire;
- Grazing; and
- Roads and other infrastructure.

Specific stages of the project were identified as: data audit and gap analysis; establishment of data collection and validation methods; data collation and capture; validation; analysis; and reporting. Stakeholder workshops were conducted for all of the major stages in the project.

Key results and products

The primary outputs of the project were attributed and validated Geographic Information Systems (GIS) layers representing particular management types. This project did not undertake analysis on the data collected.

These layers were provided to the following projects:

- Old Growth Forest Assessments;
- Response to Disturbance;
- Wilderness Assessments;
- Forest Resource and Management System (FRAMES); and
- Change Detection using Multi-Temporal LANDSAT.

1. INTRODUCTION

1.1 BACKGROUND

The Mapping of Forest Management History (MANHIC) Project was established to map the history of the management of forested land of public tenure (State forests, Vacant Crown Land, Crown Leases and National Parks which were formerly State forests), in the Upper North East (UNE), Lower North East (LNE), and Southern CRA regions. This report relates to all three regions.

The specific objectives of this project were to:

- fulfil the requirements of the assessment criteria enunciated in both the Joint ANZECC/MCFFA National Forest Policy Statement Implementation Sub-committee (JANIS) Report and the Scoping Agreement for New South Wales Regional Forest Agreements (RFAs);
- audit, summarise and evaluate data collected to date on forest management history in NSW;
- improve, augment and refine existing data on forest management;
- identify and describe the agents of forest management;
- access, collect and analyse data relating to the various forest management agents;
- develop criteria to assess the consistency, adequacy and reliability of this data;
- map information that will assist in describing the magnitude, extent and temporal characteristics of the various forest management events;
- develop a series of digitised Geographic Information Systems (GIS) layers attributed with relevant management history information; and
- produce a well-documented methodology which fully describes the processes used to evaluate and map the forest management agents, thereby enabling validation and verification.

The necessity to undertake comprehensive forest disturbance (management) history mapping, and to update, refine and improve existing forest management data, during the NSW CRA was identified in the following:

- National Forest Policy Statement (1992) (NFPS);
- Commonwealth/NSW RFA Scoping Agreement (1996);
- JANIS criteria (1997);
- Joint Old Growth Mapping Project (1995);
- Broad Old Growth Mapping Project (1996) (BOGMP);
- National Wilderness Inventory (1995); and
- Interim Assessment Wilderness Project (1996).

The *Mapping of Forest Disturbance History Environment and Heritage Background Paper* summarises those aspects of the above policies and reports which relate to the conduct of a NSW CRA forest management history mapping project.

1.1.1 Other Disturbance Mapping Projects

The North East Forests Biodiversity Study

The MANHIC project built upon, improved and refined existing information and data relating to forest management in NSW. In 1994, the NSW National Parks and Wildlife Service (NPWS) produced an internal report for the North East Forests Biodiversity Study (NEFBS) entitled *Collation of Disturbance History Data for North-East NSW Forests*. The geographic scope of this report was limited to the study area of the NEFBS, namely from the Hunter Region to the Queensland border and east of the New England Highway. The project digitised and analysed data relating to the following forest disturbance agents: logging; grazing; and fire. There were several limitations of this project in both the methodology and outcomes. These were:

- private property was disregarded;
- data on mining, as a disturbance agent, was not collected;
- data on roading and other cultural features were not collected;
- logging histories were recorded by way of the most significant recent logging event;
- grazing information was consistently recorded only for 'active' leases and permits though some areas of known 'unpermitted' grazing activity and previous grazing permits were also mapped on an ad hoc basis;
- information on stocking rates was not utilised;
- in some districts, summary maps, rather than individual compartment histories were consulted, precluding the extraction of more detailed information relating to logging, fire and silvicultural history;
- information relating to wildfire, and hazard reduction and top disposal burns was not analysed separately where a wildfire had since occurred in the area, ie. "wildfire assumed precedence over the other categories in terms of representing the most recent significant fire event" (NPWS 1994:26); and
- data necessary to assess, quantitatively and qualitatively, logging, grazing and fire intensity were not collected.

The Broad Old Growth Mapping Project

The Broad Old Growth Mapping Project (BOGMP) was conducted in 1996 by the NSW NPWS under the auspices of the Resource and Conservation Assessment Council (RACAC) as part of the Interim Forestry Assessment Process (IAP). This process utilised the data contained in the NEFBS 1994 disturbance history project, plus supplementary State Forests of NSW (SFNSW) data for the period post-1992.

The GIS layers produced by NPWS were used "to assist interpreters in the assessment of disturbance from aerial photographs" (BOGMP 1996:72). The BOGMP also utilised a number of disturbance attributes linked to the resource spatial unit layer of the IAP Wood Resources Study (BOGMP 1996:72). However, it should be noted that the disturbance history contained in the Wood Resources Study (WRS) was limited to the most recent significant logging event in relation to the present stand structure, the most recent significant silvicultural treatment, and year of last severe fire.

Other Projects

The collection and collation of forest disturbance history data was also an essential part of the South-East Queensland, Victorian and Tasmanian CRA Old-Growth, Wilderness and National Estate projects. Elements of the methods used in these projects were applied here.

1.1.2 Project Outputs

The primary outputs of this project were a set of digital data layers produced using a GIS. These layers have both spatial and textual information, a past shortcoming of disturbance data, resulting in opportunities for more complex analysis by other projects.

1.1.3 Project Linkages

The CRA projects which used the GIS layers produced include:

- Wilderness Assessments;
- Old Growth Forest Assessment;
- Response to Disturbance;
- FRAMES; and
- Change Detection Using Landsat.

1.1.4 Project Limitations

While it is emphasised that this project was designed as a mapping exercise, it was also stated explicitly (CRA Steering Committee 6/5/97) that intensity of forest management was an appropriate layer and should be included in this project. However, it was agreed by stakeholders during the first project workshop that, while data that could assist in the development of indices of intensity and frequency should be compiled, a detailed analysis of data collected would not be undertaken by this project and indices of intensity would not be derived.

2. METHODS

2.1 INTRODUCTION

This project was undertaken as a data collation and mapping exercise. A primary objective was, therefore, the development of a method for the collection and capture of information relating to forest management history. This method had several key stages:

- data audit and trial project for the development of data collection and capture methods;
- implementation of methods for data collation and capture;
- review of and agreement on data validation methods; and
- stakeholder workshops.

An audit of existing data and a trial project to develop project methods were undertaken and reported on for the first stakeholder workshop for the project. The report entitled '*A Report on the Data Audit and Trial Project with Recommendations for Project Methodology*' (SFNSW 1997) was submitted to the Environment and Heritage Technical Committee (EHTC) for review and comment prior to the workshop. Workshop participants provided comment on and participated in discussion about proposed methods which were to be used by the project. For a detailed description of and discussion about the data audit and trial project this report should be consulted. Copies of the report are held by the Resource and Conservation Division (RACD).

These processes are summarised below. The agreed method that resulted from the workshop is presented in section 2.4 below.

2.2 DATA AUDIT

Data relating to all management types were investigated and examined for possible utility to the project. Data were examined on a management area and management type basis.

Those management activities for which sources of data were investigated during the data audit were:

- logging;
- silviculture;
- fire: wild fire and prescribed burns;
- grazing;
- mining, quarrying and sawmills; and
- roads and other infrastructure.

The data audit included a review of all digital and non-digital data that relate to these management types. Set criteria were used for the assessment of data. These were:

2.2.1 Digital Datasets

- GIS format compatibility;
- data form;
- availability;
- accuracy;
- scale of capture;
- spatial data unit;
- attached attributes/textual information;
- metadata; and
- currency.

2.2.3 Non-digital Datasets

- consistency across regions/districts;
- accuracy/reliability;
- available attributes;
- spatial component present/unit;
- scale of source data;
- cost of capture (time/money/resources); and
- linkages to existing datasets.

Data investigated were summarised by management type and appear in Appendices 1, 2, 3 and 4.

2.3 TRIAL PROJECT

The trial project was implemented to determine the most time and resource efficient methods of collating and capturing the available data and to develop options and recommendations for the methods which were to be used for all CRA regions.

The trial was undertaken in Orara East State Forest in the Coffs Harbour and Urunga Management Area and was reported on at the first stakeholder workshop.

2.4 PROJECT METHODS

The methods adopted by the project were developed on the basis of the outcomes of data audit, literature review, trial project and consequent stakeholder workshop. The following methods were applied to all three regions.

Where there were variations in the methods used between the three regions these are explicitly stated.

2.4.1 Data Collation

Data collation was undertaken on a SFNSW management area basis. Within each area a general assessment of the data available was made to identify the most efficient method of collation and capture. As requested at the first stakeholder workshop, sub-compartment detail of events was sought as a matter of priority.

A database (Microsoft MS ACCESS 97) was developed for the collation of textual information about logging, silvicultural and fire events. Database fields and descriptions are presented in Appendices 5 and 6.

Where available hard copy maps of data contained in SFNSW Environmental Impact Statement (EIS) reports or the NEFBS were provided to data capture officers at the commencement of each area. Where

events represented on these maps were found to accurately represent events recorded in other sources, the base map from the EIS or NEFBS data was utilised.

Where it was necessary to utilise the maps within original sources, a set format was utilised for the representation of events and associated information. This format was utilised by each data capture officer during the project.

Where original mapped sources were utilised the process of data capture required that the maps were photocopied for each individual event and the relevant attributes be entered into the MS ACCESS database with the unique identifier (joining item) attached. The hard copies were then transferred to SFNSW-GIS for digitisation.

Primary sources of hard copy data used in all management areas included:

- SFNSW compartment history records;
- logging and silviculture summary maps;
- fire summary maps;
- fire incidence reports; and
- yield and revenue folders.

Existing databases used were:

- Forest Sales (Forsale) (all Management Areas);
- Forested Area Management Information System (FAMIS) (Urbenville, Coffs Harbour and Urunga); and
- Wood Resources Study (WRS) (Southern CRA Region only).

Maps produced from GIS data were from the following sources:

- NEFBS logging and fire history;
- SFNSW EIS logging history data (where available);
- SFNSW compartmental and State forest boundaries;
- roads and drainage; and
- forest types.

Data were collected on a compartment by compartment basis. Management types were prioritised for collection in the following way:

1. logging;
2. silviculture;
3. wildfire;
4. prescribed burning;
5. grazing; and
6. other.

Each management event was identified, copied and attributed with a unique identifier. The identifier (based on management area number) was then entered in the MS ACCESS database with the relevant attributes. Hard copy maps were then transferred to GIS for digitisation.

Copies of each event recorded have been retained and archived by the project.

A high degree of variation between management areas was found with regard to the level of information available. This variation is reflected in the reliability indices attached to the data.

A short description of the management history of each area and the ways which this is reflected in the records which were used for this project, is given below. Primary sources utilised for each are also listed.

2.4.2 Upper North East Data

For the UNE region data were collected for the following management areas:

Casino

Timber harvesting in the Casino Management Area historically targeted the more accessible forests and was only selective in nature. Improved access and supervision of operations increased the harvested area in the 1960s but in some forests harvesting did not commence until the 1970s.

Silvicultural treatment commenced in the 1920s following extensive logging operations. In some forests, such as Bunawalbin, Carwong and Ellangowan, a combination of heavy culling and grazing during the 1920s resulted in poor regeneration. During the 1950s and 60s Timber Stand Improvement (TSI) was introduced.

Compartment history records have been kept for the Casino Management Area since 1965 but for some areas these were poorly maintained. These, along with summary maps to supplement spatial detail, were the main sources of data used.

Coffs Harbour and Urunga

The Coffs Harbour and Urunga Management Areas have had an intensive history of timber harvesting and silviculture dating from the 1890s and this has been well documented. Timber harvesting records were available from 1921, with the exceptions being some of the smaller forests such as Boambee and Brooklana. These records provided net volume of hardwoods, brushwoods and other products.

Detailed histories of existing compartments were available from the 1960's for most forests with annual yields and details of silvicultural events being recorded. Yield and revenue folders were available for many areas.

Fire records for events attended by the Forestry Commission were available for the last 30 years, with some records dating back to the 1920s.

Much of the logging and silvicultural history has been incorporated into the FAMIS database, and maps for many of the events therein were also collated. These were the main sources of information utilised by the project. Summary maps were utilised to supplement these where required.

Grafton and Dorrigo

All of the Grafton Management Area has been selectively logged over the last 80 years. Timber and other forest product records from 1962 were available for the Bom Bom forest group, while production records, by compartment area, were compiled on a uniform basis since 1977. Earlier accounts of events were only available from an analysis of sales accounts and annual summaries, with no associated maps.

Fire occurrence data were available for fires attended by the Forestry Commission.

Compartment histories provided the main source of data for the Grafton and Dorrigo Management Areas. For Grafton, the compartment histories also held good records of recent wildfire and hazard reduction burns. For Dorrigo, this information was collated from summary maps and individual fire incidence reports.

Glen Innes and Tenterfield

The first major demands for timber from Tenterfield and Glen Innes Management Areas was in the 1860s. Some timber yield records were available on a whole-of-State Forest basis from 1922 and from leasehold since 1958, however, detailed management records and timber yields were only held on a compartmental basis since 1967.

Records of silvicultural treatments by compartment were maintained for some forests since 1962, while records of fire incidence extend back to 1946.

The records utilised for Glen Innes and Tenterfield were variable in detail with little or no silvicultural data found for Tenterfield reflecting the limited investment in silvicultural activities in this area.

Urbenville and Murwillumbah

Compartment history records of yields and treatment since 1967 were available for the Murwillumbah Management Area and since 1964 in the Urbenville Management Area. In Urbenville timber production records were available for most State forests since 1920.

Silvicultural history in Urbenville Management Area extends back to the 1930s, however, detailed records were not found. In the Murwillumbah Management Area the most intensive period of silvicultural treatment was between 1960 and 1990 in the wet sclerophyll forests.

Some logging and silvicultural data for Urbenville Management Area has been summarised into a FAMIS database and this was used as the basis of collated yield information. While spatial details of silvicultural events were scarce in some areas, detail had been summarised in the EIS prepared for this management area in 1995.

2.4.3 Lower North East Data

Due to time constraints, digital data capture was not completed in some management areas within the Lower North East CRA Region. For this reason some of these descriptions may not match the digital information provided for the LNE CRA Region.

Bulahdelah

Data available for the Bulahdelah Management Area was found to be relatively comprehensive. Forest products, mainly sawlogs, have been harvested in this area for a period in excess of 100 years, with reasonable records existing from 1921 onwards. The peak supply period for most products in this area was 1940-1955, however, large quantities of sleepers were cut in the early 1900s.

Stand treatments have been implemented in the area since the 1920s but were relatively small scale in nature.

Various sources of data were located for harvesting in the Bulahdelah Management Area. Compartment histories were found to hold considerable detail about events that have taken place.

Likewise, the history of fires in Bulahdelah has been relatively well documented and summary maps were available for several decades.

Wallaroo

Due to the flat nature of the country and Deep Water river access from Newcastle, much of the timber in the Wallaroo Management Area had been cut over by the 1920s. The first silvicultural treatment, which commenced in the early 1920s, was ringbarking operations to remove useless overstorey species.

Early records dealing with development and treatment of forests in this area were incomplete and as such data collected was considered to be unreliable.

Use of the data in these records should be undertaken with caution as major errors and discrepancies were identified, eg overlapping years, non-recording of some years, recording of logging in years when no logging took place. This has been corrected where possible however inconsistencies still exist.

Within this management area all yields recorded in compartment histories under the 'brushwood' heading were disregarded as being obtained from this type as brushwood does not exist in the Wallaroo Management Area and it was assumed during data collation that this form was used to record standard yields.

Some volume information has been given in compartment histories without records of the products taken. In most situations the quantity of yield indicated either mining timber or low quality logs for production of masonite.

Gloucester

Compartment histories were formally commenced in the Gloucester Management Area in 1968. Previous logging records were sketchy as much of the logging operations were carried out on the leasehold tenures.

Records kept for the Barrington Tops, Coneac, Bowman and Stewarts Brook State Forests were generally good, however records for Stewarts Brook prior to 1966 were incomplete.

Copeland Tops State Forest had very poor records as it lacked compartmentalisation until 1982. However, much of the forest was logged in the 1940s when it was vacant crown land.

Other records available for this management area included: logging history maps; and silvicultural treatment records for Craven State Forest.

Wyong

Compartment histories were available for all State forests in the Wyong Management Area. Records of timber yields were available in the Forestry Commission's annual reports from 1923.

Detailed records of silvicultural treatment since 1920 have been kept, although substantial gaps were found in these up to 1973.

Wildfire history has been well documented since the 1950s.

Walcha/Nundle/Styx River

The management history of Walcha/Nundle Management Area centred on the development of plantations in this area. Hardwood logging is known to have commenced in 1949, however records were not actively kept until 1978.

In the Styx River area, detailed yield records of hardwood and brushwood logging have been maintained since 1956, and records of silvicultural treatment were also available.

Wauchope

Timber harvesting in the coastal areas of the Wauchope Management Area commenced in the late 1800s for sawlogs, poles and sleepers. In the Bellangry forest, selective logging did not commence until 1914, with more intensive operations beginning in the 1940s. In the coastal forests, intensive harvesting began with the introduction of the group selection system in the 1920s.

Management records for the whole area were mostly maintained since the 1950s, except for the Doyles River forest where records were sketchy prior to 1977.

Kempsey

Hardwood logging commenced in the Kempsey Management Area in the 1900s. Early operations were often restricted to *Eucalyptus pilularis* (blackbutt) stands, but associated dry hardwood species were also taken.

In some of the coastal forests, sawlog harvesting was restricted by access and was only selectively logged in the 1960s.

Silvicultural treatment in the area was directed towards enhancing natural regeneration following harvesting.

Records of timber production in the Kempsey Management Area were available from 1935. Earlier records (from 1920) were available for some forests. Yield records on a compartment basis have been compiled since the 1960s and management maps detailing logging and silvicultural history have been maintained since 1945.

Kendall

Early harvesting in the Kendall Management Area, which began in the 1880s, relied on rivers for water transportation of timber. Many of the eastern forests were heavily logged by the end of the 1930s. Further west, operations were much more selective and often confined to the accessible ridges.

Silvicultural treatments evolved in conjunction with the heavier logging operations and became more intense in the 1950s.

Compartment history folders were maintained in Kendall since 1951 and records of yield, areas logged and areas treated were included in these. In some instances records date back to the 1920s. Major wildfires were recorded for the same period.

Taree

Taree has had a long management history. The forests were described in the 1918 working plan for Kiwarrak State Forest as heavily cut over. Prior to the 1960s, most of the forests in the area had been grossly over cut so that no areas of accessible unlogged forests remained. In recent years the majority of sawlog harvesting has taken place in regrowth forest.

Individual compartment histories were maintained since 1959 for all management activities.

Mount Royal

There were no records of harvesting in Mount Royal prior to 1931. Some harvesting in the Carrow Brook Catchment may have preceded regeneration treatments known to have occurred in the early 1920s.

Management records were available from 1939, and records of silvicultural treatment from 1964. Detailed compartment histories were kept since 1964.

Fire occurrence data were available for those fires attended by the Forestry Commission.

Wingham

Harvesting of general purpose timbers of both hardwood and rainforest commenced in Wingham in about 1920. With some notable exceptions, operations were selective, generally only taking straight and mature stems. Harvesting intensity varied with the nature of the stand. The earliest attempt at silvicultural history in this area was during 1928 to 1931, in the form of ringbarking. Various methods have been employed at irregular intervals since.

Timber production records for this area were available from 1922. Compartment histories of harvesting, silvicultural treatment and significant fires have been maintained since 1955 and were updated to a consistent standard in 1988.

Coopernook

Coopernook has had a long and intensive history of forest management with the first extensive logging occurring between 1915 and 1918.

Compartment histories for this area were started in 1931, but they have been most actively maintained since 1954. Records of yields, areas logged, silvicultural treatments and wildfire history have been well maintained.

2.4.4 Southern data**Narooma Management Area**

The Narooma Management Area has had a long history of logging. Compartment history records dated back to 1949 and were the main source of forest management history information for Narooma. Other sources of historical information included summarised compartment history datasets, post harvest maps and Forsale data.

Silviculture in the Narooma Management Area dated back to the 1920s and 1930s. Activities at this time included ringbarking and felling of unmerchantable stems after selective logging. Silvicultural records, in the form of TSI Summary Maps, dated back to the 1940s. Prior to the 1970s the majority of TSI was carried out

on spotted gum stands. In the 1970s TSI treatments progressed into mixed species stands. Some compartment histories also contained silvicultural information.

The importance of hazard reduction burning (as a fire management tool) was recognised in the mid-1950s and has been used in the area since this time. The 'Fire Records Atlas' held records for wildfire and hazard reduction fire events from 1902 to 1993. A number of compartment histories were used to record fire events in the Narooma Management Area. The compartment histories used dated from the early 1980s, reporting post-logging, hazard reduction and wildfire events. In the late 1980s, records were maintained in the form of fire histories (for wildfire events only) and in 1996 'burn plan folders' were introduced recording hazard reduction and post-logging fire events.

Batemans Bay Management Area

Historically, this area has been logged since the 1870s with logging controls in place since the 1930s. Area allocations were replaced in the 1950s by annual quotas. The earliest written record of logging in the area is a yield summary map from 1910. The most reliable form of logging information were compartment histories, which have been maintained for the area since 1951. Other forms of logging records used included treatment history maps, yield summary maps and Forsale data.

The first signs of silviculture (ringbarking of cull trees) occurred around 1911. Silvicultural techniques used in various degrees since this time included single tree selection, group selection and clearfelling (with and without seed tree retention). Over the years, silvicultural events have been recorded in the form of compartment histories (1955 – 1987), treatment summary maps (1918 – 1979) and treatment history maps (1955 – 1984).

The close proximity of forest to coastal towns in the area saw the introduction of hazard reduction burning in the 1950s as a fire protection and prevention tool. The 'Fire Records Atlas' held records for wildfire and hazard reduction fire events from 1902 to 1993. Available compartment history records of hazard reduction, post logging and wildfire events dated from 1988 to 1997 whilst fire summary maps containing hazard reduction and wildfire events covered from 1994 to 1997. There were also post burn maps available for post logging and hazard reduction burns from 1996 to 1998.

Nowra Management Area

The Nowra Management Area, in particular the coastal lowlands spotted gum and blackbutt forests, have had a long history of logging (dating back to the 1820s). Timber was cut in these early days for use in the colonising of Sydney. Compartment history folders containing logging and silviculture history information have been kept for the area since 1975. This was the most reliable form of recording for this particular management area.

Very little silviculture was carried out in the Nowra Management Area until the 1940s. Silvicultural activities during the 1940s and up until 1975 included ringbarking of blackbutt stands and some of the higher quality spotted gum stands. Since 1975, silviculture after harvesting focused on ringbarking or culling of the poor form stems.

Fire has had a major influence on the forests of the Nowra Management Area. Records of severe wildfires dated back to 1928 although Forestry Commission records only dated back to 1984. The 'Fire Records Atlas' held records for wildfire and hazard reduction fire events from 1902 to 1993. Other than the 'Fire Records Atlas', fire history information was collected from fire summary maps and compartment histories.

Badja Management Area

Badja has had a long history of logging although compartment histories were only maintained since 1974. Prior to 1974, highly selective logging took place in the northern part of Badja State Forest.

There was little to no record of any silvicultural activity in this management area.

Fires records were available for Badja Management Area (1987 only) in the form of compartment histories.

Moss Vale Management Area

Native logging occurred in the Moss Vale Management Area from the early 1800s although logging intensity slowly declined from the 1950s onwards. Harvest plans were the main source of logging information. The first available record of logging dated back to 1950. No other records were available until 1991 in the form of harvest plans, accounts, logging summaries, compartment histories and Forsale data.

A small amount of silviculture has taken place in the Moss Vale area. Some ringbarking occurred around the 1930s and 1940s for which little benefits were observed. For this reason the practice was not extensively used.

Wildfire and prescribed burning have been important activities in the management area. Wildfire regularly affects the area and has been a major risk to a substantial plantation resource. Prescribed burning was adopted as an important form of protection. The 'Fire Records Atlas' held records for wildfire and hazard reduction fire events from 1968 to 1990.

Queanbeyan Management Area

Logging began in Queanbeyan Management Area in the late 1800s. Logging progressively increased from the 1930s to the 1970s at which time a plan was developed which reduced the level of harvesting. Records were available from 1956. For the period to 1974 the most reliable source of information was the Queanbeyan EIS history logging (HISLOG) database. Compartment histories, yield summaries and Forsale data were also used.

Silvicultural events in the area included selective logging, reject tree felling and top disposal burning, however there were no records available for silvicultural events.

Significant wildfire events were recorded in the Tallaganda State Forest for the years 1939, 1955 and 1961. Hazard reduction burning was used in this management area as a fuel reduction tool to protect high priority areas such as plantations. The 'Fire Records Atlas' held records for wildfire and hazard reduction fire events from 1951 to 1993. Other records used included compartment histories and post burn maps.

Tumut Management Area

History of logging in the Tumut Management Area dated back to the early 1800s. A large proportion of State forest in the area occurs as plantation. Logging information from 1955 until 1985 was available in the form of the FAMIS/Wood Resources Study (WRS) database. Since 1985 compartment histories have been the most reliable source of logging information.

The FAMIS database and compartment histories was the source of silvicultural information for the area although data is only available from 1985 to 1992 – events were enrichment plantings only. Written reports state that silviculture has been minimal with selective logging and low intensity hazard reduction burning also used.

The protection of assets such as catchments and property saw the introduction of a Bushfire Prevention Scheme to the Tumut Management Area in 1951. The scheme involves a number of organisations, to detect and suppress fires, conduct hazard reduction burns and maintain an effective fire trail system. The only fire records available for this management area were in the FAMIS/WRS database.

Bago-Maragle Management Area

Compartment history folders have been maintained with logging information in the Bago-Maragle Management Area since 1925. In addition to compartment histories, logging information was sourced from the FAMIS/WRS database as well as old summary maps.

Early silvicultural techniques included heavy logging followed by ringbarking of low quality trees. As part of the implementation stage of the 1954 management plan, regeneration fellings and intermediate thinnings were introduced. Silvicultural events have been recorded in compartment histories since 1917. There was also information held in the FAMIS/WRS database.

Fire management was an important issue here as the ash type species, which occur in this management area, are very sensitive to fire. Historic fire information was held in the FAMIS/WRS GIS database. Information was only available from 1933 to 1942.

2.4.3 Data Capture

The objective of the project, to provide spatial information with relevant linked attributes at a sub-compartment level, required that data be captured and stored in a format that was compatible with these outcomes. Thus, data capture was restricted by a number of factors (which apply to the capture of information for all management types):

- the nature of the source data;
- the attributes to be attached;
- available data capture packages and their limitations;
- storage restrictions;
- query and analysis requirements;
- the nature of digital data produced by other projects (eg EIS, NEFBS); and
- the final CRA planning unit.

The complexity of the hard copy spatial data captured proved a challenge with regard to digital capture and storage, as hard copy sources provided multiple year, multiple attribute sub-compartment and compartment level information.

Formats and programs for capture and storage were trialed with the requirements for analysis and integration in mind. The GIS package ARC/INFO 7.1.1 was chosen for data capture and storage because it is most commonly used by SFNSW and most other organisations undertaking CRA projects. The GIS outputs from this project needed to be immediately compatible with other related CRA projects and useable in ARC-VIEW and C-PLAN.

Past projects, such as the capture of data for EIS reports have utilised ARC/INFO facilitating integration of this information.

The capture of multiple attribute data at a sub-compartment level, over a period of several decades, required that either a large number of databases be established for each management type or that data be summarised to a smaller number of layers. The resultant problems of the first option included the requirement for large amounts of “drive space” for data storage, joining and interrogating a large number of GIS layers and attributing that large number of layers with textual data. The most apparent problem with the second option was the loss of detailed information which would have otherwise been available.

The GIS outputs from the project were required to represent and contain multiple-layer multiple attribute data. In the data collected in this project, multiple feature polygons (eg fire events) were found to occur in a single area. The problem with managing data such as this was that in the past data layers in polygon format could only contain discrete, non-overlapping area features. As a consequence of this, the options for data capture were to either use a separate coverage for each feature type (the thematic layer approach) or to consider each feature type combination as a unique polygon (the polygon approach).

The problems with either of these approaches are:

- multiple copies of objects stored in different layers increases database size;
- many layers share common physical boundaries (eg tenure);
- the basic data cannot handle complex objects without extensions;
- the number overlapping polygons may be large and difficult to manage (imagine a combination of logging, grazing and fire);

- all polygons must have the same attribute schema resulting in multiplication and redundancy of attributes and a dramatic increase in database size; and
- management of different coverages becomes difficult.

To overcome these problems this project utilised the 'region' feature of ARC/INFO to capture the multiple event, multiple attribute data collected by this project.

ARC/INFO regions can be used like polygons but they more efficiently represent complex area features that overlap, composite area features composed of many polygons, and multiple classes of features that share common boundaries. Features may overlap, for example logging and fire histories, or they may occur as non-planar features with spatio-temporal variation, for example fire in one area over several years. ARC/INFO regions can be exported as ARC-VIEW shape files and interrogated in this format as long as attribute tables are also available.

Regions handles overlapping data and attribute schemas and removes the problem of integrity between multiple coverages by representing data in a single coverage where different themes are region sub-classes. Regions can represent areas that overlap such as:

- two (or more) wildfire events in one season;
- non-contiguous areas, such as 3 logged areas which are part of one logging operation; or
- nested features, such as grazing permits which lie within State forest (but use only one set of arcs to represent their borders).
- The most important difference between polygons and regions is that when using polygons and combining thematic layers new polygons must be created and all polygons must have the same attribute schema, ie. values must be stored for every attribute of every polygon for all polygons even if that attribute relates to only one polygon. This redundancy dramatically increases database size.
- When using regions, themes can have the same or different attribute schemas, can be mutually exclusive or overlapping and do not require the duplication of redundant attributes. Thus all management history data (eg fire, grazing and logging) could be represented and interrogated as one layer of regions.

2.4.4 Logging, Silviculture and Fire

The capture of spatial information relating to each logging, silviculture and fire event relied on a combination of existing digital sources and manual digitisation of additional linework.

Where hard copy data was mapped using the EIS and NEFBS GIS covers, the digital linework was utilised during capture. Examples of areas in which these covers were utilised were:

- Urunga Management Area (EIS Logging data);
- Walcha/Nundle Management Area (EIS for Styx River logging data);
- Morisset (EIS logging and fire data); and
- Urbenville (NEFBS for logging on National Parks which were State forests)

For logging and silvicultural events, boundaries commonly followed forest type boundaries and the linework contained within the SFNSW forest type cover was utilised.

Compartment history maps show compartment boundaries, which originally followed the drainage shown on Forestry Commission forest type maps. These were found not to match the current Land Information Centre (LIC) drainage. Similarly, as a result of changes in compartment boundaries it was found that in some cases past events intersected two current compartments.

To overcome these problems the following general rules were used as a guide:

- Existing digital spatial data were utilised as backcovers where possible to limit duplication of existing features. A list of covers used is included in Appendix 8.
- Where required, additional linework was manually digitised and incorporated using Arc/Edit.
- Events were mapped to current compartment boundaries and where events crossed two current compartments these were mapped separately at the data collation stage.
- The current LIC drainage cover was utilised but where event boundaries followed the drainage on Forestry Commission type maps this linework was entered manually.
- SFNSW Preferred Management Priority (PMP) classification coverage was used to delimit areas which were less likely to have been disturbed by logging only for those events which have occurred since 1980 and had PMP already represented on individual maps.
- Exclusion zones were 'buffered out' of the coverage where appropriate using a set of 'across-the-board' rules. For example, streams were buffered to ten metres unless otherwise stated on the relevant map.
- Where arcs were derived from existing covers, these were attributed with the appropriate feature and metadata number from that cover.

With respect to fire events it was found that common features of these event boundaries were also available from existing covers such as drainage, roads and sometimes forest type. Tenure boundaries, such as State forest and compartment did not apply. However, two issues did arise:

- Fire events were often incompletely mapped where the event continued into private property or other crown tenures.
- Fire maps, particularly of historical events, were often of poor quality with linework difficult to read (eg a very thick pen was used to map it or where original copies has diminished in quality).

As a consequence, the maps relating to historical fire events were considered to be of lower reliability than current events. Where event boundaries were difficult to interpret but appeared to follow existing features, such as roads or rivers, these features were used to build the polygons.

Captured linework was built into polygons from which regions were constructed. Each region-based cover included subclasses for the following management types:

- 'logging' (logging information mapped to the sub-compartment level or known extent);
- 'un-mapped' logging (logging mapped to the compartment level where other detail was not available);
- 'silviculture' (silviculture mapped to sub-compartment and compartment level); and
- 'fire' (fire extent for wild fire and prescribed burning).

Each event captured was attributed with a unique code, State forest number, compartment number and year of event. However, during the course of the data capture process, these attributes were minimised to avoid unnecessary duplication with data included in the associated database. As a result the unique code attributed to each event remained the only consistent attribute.

Due to constraints in the timelines, LNE fire and silviculture were not supplied to aid in negotiations. Capture continued after negotiations and the silviculture layer is now available. LNE fire is still awaiting capture. All layers were supplied for UNE although the validation and checking process had not been completed. It is intended to supply all Southern layers prior to the Southern negotiations.

2.4.5 Grazing

Grazing information was digitally captured where available, however this drew heavily on existing covers, particularly the SFNSW EIS datasets and the NEFBS data. Existing SFNSW data of occupation permits and lease boundaries were also utilised.

A model based on expert decision rules was used to augment this information. Final decision rules for expected grazing levels are included in Appendix 9. Layers have been prepared for both the grazing potential

and grazing leases (occupational permits) for the UNE and region and grazing leases (occupational permits) for the LNE region. These layers were not prepared, as part of this project, for the Southern CRA region. Grazing leases (occupational permits) may be developed (where applicable) in the Southern CRA Region as part of the Planning Unit Layer project.

2.4.6 Linear Datasets

Linear datasets relating to roads, railways, rivers, and transmission lines were derived from other existing databases.

- Roads: SFNSW Roads Cover
- Roads, railways and transmission lines: LIC Cover

2.4.7 Point Datasets.

Coverages of point information including mines and apiary sites were constructed from existing databases and can be accessed through Resource and Conservation Division (RACD), Department of Urban Affairs and Planning (DUAP).

2.5 DATA VALIDATION

The validation of all data collected was identified as an important component of this project because spatial accuracy of the data collected was considered to be of significance to the related projects.

It was agreed that components of the validation process would be by way of an assessment process performed jointly by NPWS and SFNSW. A review of field validation procedures was undertaken and a discussion paper was circulated to Environment and Heritage Technical Committee members for review prior to the second stakeholder workshop. The resultant report, entitled 'Data Validation and Assessment Methods', was circulated for comment by the workshop participants. The agreed methods are summarised below.

A four tiered approach to data validation was devised for this project. This approach incorporated source data reliability indices, cross validation, field-based assessment and participant/stakeholder evaluation. This multiple stage approach helped to ensure that:

- the data which was collated was properly sourced and that its nature was reflected in the associated reliability index;
- the spatial nature of this information was accurately captured in a digital format and related to the relevant attributes;
- the detail contained within the digital coverage reflects what is apparent from other mapped sources;
- the detail contained within the digital coverage was also reflected in field based observations; and
- people with the most experience/knowledge in forest management agreed that the mapped data accurately reflected, on a gross level, the management history of that forest.

It should be noted that the aims of the validation and assessment process were not to assign indices of intensity or frequency to each management/disturbance type or to determine what constitutes significant or negligible disturbance.

The data for the Southern CRA Region was re-checked and edited to improve reliability. This process was not carried out for the UNE and LNE data due to time constraints.

2.5.1 Reliability Indices

The accuracy of datasets collected as part of this project was highlighted as an important issue and as such criteria for the assessment of the reliability of each dataset were developed and implemented. The derived reliability index was applied to the logging and fire datasets. The officer responsible for the collection of the

data entered the index into the database. Other database fields provided supporting documentation of data characteristics.

These indices provide the most basic level of assessment. A focus of these indices was on assessing the reliability of the source information; the 'remoteness' and 'time' events were mapped as well as the scale of capture and number of attributes available (Appendix 10).

2.5.2 Field Checking

Validation of mapped information in the field was identified as a necessary component of this project; however, no allocation of funds to this process was made in the project budget. Given the intensive data collection and capture components of the project, limited time was available to establish a comprehensive field validation program. The result was that field based assessment was limited in time per region. A further consequence of these limitations was that field validation was limited to the assessment of polygon attributes rather than to whole events or boundaries between events, which had been identified by stakeholders as one of the key issues regarding data accuracy.

The assessment of mapped data through field validation was primarily conducted by SFNSW. A stratification and sampling protocol was developed based on a review of the options presented at the second stakeholder workshop. A review of field based assessment procedures used in other projects and research was undertaken, as described in SFNSW (1998).

Stratification and Sampling Strategy

The data layers collated during the project were stratified on the basis of logging history, although all disturbance types were assessed at each site. Field validation focused on events that occurred between 1960 and 1990, although some sites of more recent disturbance were also assessed.

A single plot sampling method using a small range of criteria (see Appendix 11) was used to validate the occurrence of disturbance events and assess the accuracy of the reliability index. Plots were randomly located within the derived stratum and located using a Global Positioning System (GPS). A photo reference was taken at each site sampled. The location of plots was maintained as a separate GIS layer.

Examination of these allowed some interpretation of the overall reliability of data collected. Other plot data held by SFNSW and NPWS was used to augment the plot data collected.

2.5.3 Data Cross Validation

While not specifically identified as a validation procedure for this project, cross validation using remote data was identified as a potentially useful approach to assess the accuracy of larger areas of the mapped disturbance data. Sources of data include Aerial Photograph Interpretation (API), CRA Aerial Photography Interpretation (CRAFTI), BOGMP and satellite imagery such as Landsat Thematic Mapper (TM).

Data cross validation was identified as useful for broad assessment of the level of agreement between GIS layers. It was originally the intention of this project to utilise GIS output from the CRAFTI project for API cross validation. However, this data was not available for use by this project in either the UNE or LNE regions.

Environment Australia undertook a pilot project using sequential LANDSAT imagery to detect change in vegetation following disturbance. This project investigated the relationship between the mapped disturbance history information produced by this project and sequential LANDSAT imagery from 1987, 1994 and 1998. The outcomes of this project were agreed as appropriate validation of the management history data.

2.6 STAKEHOLDER WORKSHOPS

Stakeholder workshops were seen as an essential component of this project and were conducted at three stages during the project:

- after the data audit and trial project and for the development of project methods for data collation and capture;

- for the development of agreed validation methods and criteria; and
- for the demonstration of the resultant GIS layers.

Workshops were attended by representatives from the EHTC and by stakeholders from associated CRA projects.

Discussion papers were prepared and circulated to all workshop participants prior to the first two workshops. These were commented on and subsequently revised.

Stakeholders contributed significantly to derivation of data collection methods and for the identification of attributes to be collected.

The detail to which management history information was collected and mapped was undertaken on the direction of stakeholders at these workshops.

2.7 WORK SCHEDULE & PRIORITISATION

It should be noted that given the requirements and objectives of this project, it was severely restricted with regards to both the time and resources available. In order to meet the required deadlines, data collection was prioritised in accordance with a number of factors including:

- CRA Region;
- management type;
- tenure; and
- the requirements of related CRA projects, most specifically old growth and wilderness assessments.

As such, logging and silviculture information were seen as the most important layers for use by other CRA projects and were collected and captured prior to data collation for any other management type to ensure their completion. All stakeholders saw capture of information to a sub-compartment level as a priority.

3 ANALYSIS

It was determined during the first and second stakeholder workshops held for this project that analysis of data collected during the project would not be undertaken. Stakeholders were of the opinion that analysis of the information collected, for example to determine indices of intensity, was more properly the domain of related projects such as old growth and wilderness assessments and response to disturbance projects. Interpretation of the data was restricted to summaries of attribute fields.

4 RESULTS

4.1 INTRODUCTION

The outcomes of this project were identified in the project specifications as ‘forest management history data in both report and GIS mapped format’.

The restrictions placed on this project, by stakeholders, with regard to undertaking analysis of data collated for the derivation of intensity and frequency indices means that the results of this project are:

- the GIS layers produced;
- validation of these layers; and
- this report which documents the methods of data collation and capture.

4.2 GIS LAYERS

As this project was primarily a mapping project, the results are provided in the form of GIS layers depicting each management type. ARC/INFO covers representing the following management types were developed for the UNE, LNE and Southern CRA regions:

- mapped logging (delimiting mapped records of area logged);
- unmapped logging (depicting areas where the extent of logging events is unknown – mapped to compartment level);
- TSI (mapped and unmapped silvicultural events);
- fire (wildfire and prescribed burning events for UNE and Southern only);
- grazing (occupation permit and lease boundaries (UNE and LNE) with potential grazing based on forest type (UNE only); and
- roads (LIC cultural heritage layer which contains roads as well as SFNSW roads layer).

The complexity of the data collated makes graphic representation difficult, however maps representing the extent of the data collected for each of the CRA regions have been included (refer Maps 1, 2 and 3).

Access to these layers should be obtained through the NSW Resource and Conservation Division (RACD) of the Department of Urban Affairs and Planning (DUAP) on (02) 9228 4960.

4.3 DATABASE

The information collected to accompany the GIS layers, was entered and stored as MS ACCESS databases. The attribute fields are summarised in Appendices 5 and 6. Appendix 7 describes the coding used within these databases.

Access to these databases should be obtained through the NSW Resource and Conservation Division (RACD) of the Department of Urban Affairs and Planning (DUAP) on (02) 9228 4960

4.4 VALIDATION

4.4.1 Desktop Validation

Desktop validation of the textual and spatial data collated was undertaken in all regions. This process involved:

- re-checking the collated data, in GIS format, against records held in offices
- amendment of attributes, linework and reliability indices as required
- the utilisation of local knowledge held by past and present employee of SFNSW.

This process was more intensive for the Southern CRA region than for other regions. Changes to the data base have been recorded in a separate spreadsheet.

4.4.2 Field Validation

Field officers from State Forests of NSW carried out the field validation for UNE and LNE regions after the majority of the data had been collated. It is intended to carry out field validation in Southern prior to negotiations. Unfortunately the timelines put in place did not allow for the validation to be carried out concurrently in each of the regions. Historic information from each chosen site was entered onto a proforma (see Appendix 10).

Once the data were collected they were entered into a database. The data were then transferred to a GIS layer of reference points to allow interpretation of overall reliability.

Access to this layer should be obtained through the NSW Resource and Conservation Division (RACD) of the Department of Urban Affairs and Planning (DUAP) on (02) 9228 4960.

UNE

A total of 22 plots were sampled, over roughly a one-week period, in the UNE CRA region. They were taken from the Coffs Harbour and Urunga Management Areas.

LNE

A total of nine 1:25 000 map sheets with five random plots per sheet were randomly chosen to be validated for the LNE. This validation was carried out over a two-week period. A total of 44 plots were sampled for the LNE. Sampling was done in the Urunga, Wauchope, Manning and Hunter Management Areas.

Southern

The field validation for data collected in the Southern CRA region was still being undertaken at the time this report was being produced. At the time this report was written it was anticipated that over 250 plots would be assessed. Most of these would be located in mapped areas of logged forest since aerial photographs for the CRAFTI API assessment were taken and in areas with low reliability. In the South Coast Sub-Region sites were sampled across all management areas, with the exception of Moss Vale. Within the Tablelands Sub-Region the majority of sites were samples in Buccleuch State Forest because Bago-Maragle was inaccessible, due to snow, at the time validation was being undertaken.

4.4.3 LANDSAT and API

Multi-Temporal LANDSAT

Environment Australia (EA) undertook a pilot project to test the utility of Landsat TM data as a monitoring/change detection tool in selectively logged areas of Northern (UNE and LNE) and Southern NSW RFA Regions (CRA Project NA46/EH). The multi-temporal Landsat data (1987, 1994 and 1998) from the project was cross-validated with the draft output from the Mapping of Forest Management History Project.

The initial cross validation of these two datasets for the Upper North East CRA Region showed a very strong spatial conformity to the management boundaries and in many areas good correlations with the logging history (EA 1998). While in some areas there were discrepancies between the satellite data and the management history GIS data, at the landscape level the patterns of disturbance were very clear. Results for the LNE and Southern Region were not available at the time this document was written.

This cross validation exercise enhances the reliability and degree of confidence that can be placed on the spatial accuracy of the management history data. Further, the results of the pilot Landsat project verify the textual attributes of the logging history data, for the UNE Region, in so far as they relate to the year of the event mapped

API

It was agreed that data cross validation would be undertaken using the GIS output from the CRAFTI-API project. The data was not available within the timeframe for the UNE and LNE regions and as such validation was not undertaken.

Cross validation of the management history data with the growth stage data from the BOGMP project was undertaken for UNE and LNE.

Areas interpreted as logged in the BOGMP project did not show any consistent relationship with areas mapped as logged from historical sources. However, there was a good relationship between areas mapped as having more than 30% regrowth and those with a history of TSI and other silvicultural practices.

The broad nature of the growth stage assessment and limited interpretation of disturbance features undertaken during the BOGMP project makes cross validation with this data very limited. It is intended to carry out cross validation with the Southern CRAFTI-API data.

4.5 REPORTING

The documentation of the processes employed by this project are:

‘A Report on the Data Audit and Trial Project with Recommendations for Project Methods’ was submitted to the EHTC for review and discussion at the first stakeholder workshop.

‘Options for Data Validation and Assessment Methods’ was submitted to the EHTC for review and discussion at the second stakeholder workshop. This workshop resulted in the redrafting of this document, with stakeholder comments incorporated, as the ‘Data Validation and Assessment Methods’ report.

This report details the following:

- summary of the objectives of the project;
- description of the relationships between the project and other CRA projects, in particular the data requirements of these other projects;
- description of the project methodology;
- documentation of the processes used for data collection, coding, analysis and evaluation;
- description of the specifications for data capture, attribute classification and mapping;
- provision of GIS data layers (including drafting/review/redrafting of maps);
- summary of project findings; and
- evaluation of findings (validation/audit).

These documents are not included in this report but can be viewed by contacting the NSW Resource and Conservation Division (RACD) of the Department of Urban Affairs and Planning (DUAP) on (02) 9228 4960.

APPENDIX 1 LOGGING HISTORY DATA SOURCES

Dataset/Program	Spatial	Digital	Unit	Attributes	Currency
Yield & Revenue	N	N	Compartment	Year, volume, product	Pre-1972
Foprac	N	Y	Compartment	Year, volume, product, Species	1979-1980
Forsale	N	Y	Compartment	Year, volume, product, size class, species	1992-present
Wood Resources (see Specs V 1.1 30/9/96)	Y	ArcInfo	Resource unit	Management Unit and Resource Unit, last major event	
Harvesting Plans (District)	Y	ArcView	Compartment	Total harvestable area, exclusion zones, PMP	post 1993 (digital)
PMP Classification	Y	Y	Sub-compartment	PMP Classification	Post 1980 (Circular No. 1100)
EIS Logging History					
Casino	N	N	None	None	
Murwillumbah	Y	Y	Compartment	None	1996 (based on DFA)
Grafton	N	N	None	None	
Urbenville	Y	Y	SF	Cutting Cycle	By Decade Post 1940
CHUMA	Y	Y	SF	Order of Working	Since 1982 in 5 year periods
Tenterfield	Y	Y	SF	Logging History	By decade since 1930, also indicates pre 1900.
Dorrigo	N	N	N	None	
Walcha	Y	Y	SF	Logging History	By decade since 1930, also indicates pre 1900.
Morisset	Y	Y	Compartment	Harvesting Disturbance	By decade from 1919
MorissetQueanbeyan	YN	YY	CompartmentCo mpartment	Harvesting DisturbanceLogging History	By decade from 19191956 - 1994
Current Cpt Files	Y	N	Compartment	Various information about current logging plans plus some historical information amalgamated from other sources	Present Operations
Cpt Histories	Y	N	Compartment	Date, Yield, Harvest type, TSI etc.	Vary according to district
State Forest	N	N	State Forest	date,	Early 1900s

'Covers' (HO)				dedication/revocation OP info to 1980.	(first dedications) - present (OPs to 1980 only)
Old Cpt Maps	Y	N	Compartment	Various: Logging History, TSI, Forest Type	Variable generally 1920s +

APPENDIX 2 – GRAZING HISTORY DATA SOURCES

Advantages	Disadvantages
<p>EIS DATA</p> <p>Dorrigo: OP , Lease, Grazing Permit with Number Walcha: OP, Lease, without number CHUMA: Crown Lease, Forest Lease, OP with number Urbenville: OP without number Casino: OP or Lease without number Grafton: OP and Leases without numbers and Ungrazable areas Murwillumbah: OP with number Tenterfield: OP and Crown Lease Morisset: Permit, without number. Eden: Kempsey/Wauchope: Grazing permit/OP and Forest Lease. Gloucester/Chichester: OP and CL.</p>	<p>Requires digitisation of some of the internal boundaries and attachment of Permit/Lease numbers. Give gross permit/lease area only.</p>
<p>Hard Copy Maps available in files</p>	<p>Requires attributing with relevant fields and, therefore, a unique identifier</p>
<p>OPALs data base contains current OP information (some regions only)</p>	<p>Requires linking back from OPALs to covers/OP number and conversion to FL etc and then to file for more detailed information.</p>
<p>Relevant attributes available in files in head office and summarised in SF Covers</p>	<p>Purely anecdotal evidence will be difficult to link to polygons unless spatially represented</p>
<p>Treatment information exists textually and sometimes spatially.</p>	<p>Irregular and unreliable</p>

APPENDIX 3 – WILD FIRE DATA

TABLE 3.1 WILD FIRE DATA CONTAINED IN EIS REPORTS

Management Area	Description	Advantages	Disadvantages
Dorrigo	Fire History	Extent in periods from 1984-1994	No attributes, gross area.
Walcha	SF Affected by Wildfire	Extent in annual periods: 1989-1995	No attributes, gross area.
CHUMA	None	None	none
Urbenville	Fire History	5-year periods: 1980-1994.	No attributes given gross area only.
Casino	Fire History	Extent in 5 year periods:1977-1994.	No attributes, gross area.
Grafton	None	None	None
Murwillumbah	Fire History	Extent in 5 year periods since 1965.	No intensity, gross area.
Morisset	Fire since 1950	Fires by decade and area burnt	No frequency or intensity, gross area.

TABLE 3.2 WILD FIRE DATA SOURCES – NON-EIS

Period	Format	Spatial Attributes
pre-1965	A variety of sources of information eg compartment histories, fire reports and summary maps.	Present but hard copy only.
1965-1979	DBF database stored in Oracle and is based on original fire reports	No digital coverage. Hard copy available.
1979-1995	Excel/DBF format database based on forms FC81	Ignition points in GIS. Other spatial details in original reports.
1996	Wildfires V1.0 DBF format with ACCESS front end stored as an Oracle database	Ignition Points available as GIS. Fire extent available in original reports.
1997-	Wildfires V 2.0	Ignition points available in GIS. Fire extent available in original reports.
1902-1993	Fire Records Atlas as arcview shape files.	Digital coverage only. Atlas includes location (easting & northings), area and year.

APPENDIX 4 – EIS PRESCRIBED BURNING DATA

Management Area	Description	Advantages	Disadvantages
Dorrigo	Fuel Management	Burning Intent	No past management or frequency
Walcha	Fuel Management zones	Each zone has specific objectives,	No burning extent of cycles
CHUMA	Fuel Management Intent	Proposed cycles for different zones	no burn extent or frequency
Urbenville	Fuel Management	Burning intent cycles	no indication of actual extent
Casino	Fuel Management	Burning intent plus exclusion zones	no indication of extent or frequency
Grafton	Strategic Fuel management plan	Burning cycles	no indication of extent or frequency
Murwillumbah	Fuel Management Plan	Burning cycles and exclusion zones	no indication of extent or frequency
Morisset	Hazard Reduction Burning	Frequency since 1960	gross area only

APPENDIX 5 ATTRIBUTES OF LOGGING HISTORY DATABASE

Field	Description
Code	Unique identifier links to GIS layer
F_Year	Financial year
Year	Year the event ended
Cpt/Cpt No	Current compartment number
Cpt2	Other compartment number
Sfno	State forest number
Region	CRA Region
MA	Management Area
Start/Start Year	Date the event started (default beginning of that financial year)
End/End Year	Date the event ended (default end of that financial year)
Event	Nature of event - LOGGING, SILVICULTURE etc
Type	Type of event - HARV = Harvest op, CLEAR = Harvest op then cleared and planted, HARVF = post fire harvest, HARVU = Harvest op confirmed with unspecified volume, TSI = formally treated, PLT = area planted (comments denote sown or planted), TREAT = treatment
Product	Products taken eg Q=quota, SAL = salvage, PSM = poles posts girders, sleepers & mining; UPM = smalls, pulp, masonite and mis V = veneer; U = unspecified; NIL = no product; INT = integrated op; ALL = all products; BWD = brushwood
Quota vol	Quota volume harvested (gross in cubic metres)
Other vol	Volume of products other than quota harvested in an operation (in cubic metres)
Total vol	Total volume of all products taken (cubic metres)
Species/veg	Tree species, recorded in any given area, as per Research Note 17 typing.
Map	Whether the event mapped delimits a Net area (y = yes; n = no). Where 'N' the event is mapped to the whole compartment.
Scale	The scale of the source map, eg 25000 = 1:25000; imperial scales are converted to metric.
Data Source/Source Type	The source of the data, eg volumes etc which may come from hard copy reports in compartment histories or from existing databases such as FAMIS, Forsale etc.
Map Source	The source of the mapped information, eg. compartment history, summary map, harvesting plan etc.
Location/Source Location	The location of the source data, eg. which office, shed or store room the original is located in.
Reliability/Accuracy	The reliability of the combined data as per reliability index (1 = good; 5 = bad)
Comments	Additional comments which may help to understand the history of the event.

APPENDIX 6 – ATTRIBUTES OF FIRE HISTORY DATABASE

Field	Description
ID/Code	Unique Identifier
SF/SF No	State Forest Number
Cpt/Cpt No	Current Compartment Number
CPT 2	Other Compartment Number
Region	CRA Region
MA	Management Area
Fire/Fire No	District Fire number as per report
F_Type/Fire Type	Type of Fire - w = wild fire or p = post logging h/hrb = hazard reduction or o = others or u = unknown
Start/Start Date	Date the fire started
End/End Date	Date the fire finished
Category	The category of fire (as per report)
FDR	The Fire Danger Rating
Severity	Fire severity
TAREA/Total Area	Total area burnt in hectares
SFAREA/Area SF	The total area of State forest burnt in hectares
NPAREA/Area NP	The total area of National Park burnt in hectares
OAREA/Area Other	The area of other tenures burnt in hectares
Forest/Forest Type	The forest type
OTENURE/Other Tenures	Any other tenures affected by the fire
Mapped	Whether the event has been mapped
MSOURCE/Source Map Type	The type of map sourced
MSCALE/Source Map Scale	The scale of the source map
Comments	Additional comments
Location/Source Location	The location of the original information
Accuracy	The reliability of the source data (1 = good - 5 = bad)

APPENDIX 7 DATABASE CODE DESCRIPTIONS

FIELD	DESCRIPTION
EVENT	
LOGGING	Any event recorded as an official timber harvesting operation resulting in the removal of timber from a forest stand for usually for commercial purposes.
SILVICULTURE	Any operation undertaken to modify the structure or condition of a forest stand for the purpose of improving timber production or wood products.
TYPE	
CLEAR	Clearing, usually associated with plantation establishment.
HARV	A standard harvesting operation.
HARV/RF	A harvesting event including rainforest species
HARVF	A harvesting event associated with a fire (eg post fire salvage).
HARVU	Harvest operation confirmed with unspecified type or products.
LINE	Operation associated with the development of road or transmission line.
NIL	No recorded type of event
PLT	An area which has been planted but which is not necessarily recognised under the Plantations Guarantee Act. Methods of planting: jiffy pot, broadcast seeding, enrichment planting etc. Comments field expands on type.
QUAR	Event associated with the development of a Quarry site.
RES	Area may now be flora reserve.
REVOKE	Area since revoked from State Forests
RF	Rainforest Operation
RING	Ringbarking of trees, but not removal of stags unless associated with clearing
SOFT	Removal of Softwood products
THIN	Thinning of forest stands, usually of regeneration, to improve the growth of the remaining trees. Operations may or may not result in a commercial yield. Volumes indicate commercial operation.
TREAT	Treatment of stand usually associated with the removal of older trees but not formally identified as TSI
TSI	Timber Stand Improvement usually associated with the removal of older/veteran trees.
TYPE	Event associated with a particular forest type
U	Unknown Event Type
PRODUCT	
ALL	All commercial products removed during operation.
BWD	Brushwood products removed.
HP	Hoop Pine products removed.
INT	Integrated harvesting. Harvesting of more than one product from a forest in a single operation.
MERC. WATTLE	Merchantable wattle products removed
NIL	No recorded products
PSM	Harvesting of: poles, piles, girders (straight, sound, bole sections of a tree which are processed in the round and are generally 6 metres or more in length. As the diameter increases in relation to length sections are referred to poles, piles and girders respectively), sleepers (squared sawn timber, either free or inclusive of heart, used in railway construction. Larger end dimensions and longer lengths are referred to as transoms and junk) and mining products.

Q	Harvesting of quota sawlogs. Quota sawlogs are logs having dimensions and quality that are equal to or greater than those specified. Logs which form part of a sawmill's annual sawlog allocation.
SAL	Salvage operation.
THIN	Thinning of regeneration, may or may not be commercial.
U	Unknown/unspecified products
UPM	Harvesting of small logs, pulpwood, masonite and miscellaneous wood products.
<p>NB 1: Types of events and products harvested may occur in combination. Where this is the case they will be denoted by a '/' in the 'Type' field and by a '+' in the 'Product' class.</p> <p>NB 2: Pulpwood (tonnes) converted to m3 at a 1:1 ratio on the basis of: average density at 12%, moisture content for Blackbutt (<i>Eucalyptus pilularis</i>) is 900 kgm-3, Ironbark (<i>E. crebra</i>) is 1170 kgm-3 and Spotted Gum (<i>Corymbia maculata</i>) is 970 kgm-3.</p>	

APPENDIX 8 –LIST OF COVERS USED IN DATA CAPTURE PROCESS

Organisation/Custodian	Cover Name
State Forests	Compartment Boundaries
State Forests	Tenure
State Forests	Forest Types
State Forests	Roads
LIC	Drainage
LIC	Contours
LIC	Cadastre
NPWS	NEFBS Logging History
NPWS	Fire Records Atlas
State Forests	Preferred Management Priority (PMP)
State Forests	EIS drainage
State Forests	Walcha Nundle Management Area EIS Logging History
State Forests	Urbenville Management Area EIS Fire History
State Forests	Casino Management Area EIS Fire History
State Forests	Urunga Management Area EIS Logging History
State Forests	Morisset Management Area EIS Logging History
State Forests	Morisset Management Area EIS Fire History

APPENDIX 9 – GRAZING MODEL DECISION RULES

BVG	BVG Description	League	RN 17 Types	Expected Grazing
1	Maritime	Maritime	30, 31, 32, 33, 30/31, 30/31/92, 30/92, 31/39, 31/32, 31/62/92, 31/92, 31/92/11, 31/92/93, 31/97, 32/92, 30/32	Low
2a	Moist Blackbutt	Blackbutt	36, 36/10, 36/46, 36/48, 36b, 36-31, 36-37, 36-48,	Low
2b	Dry Blackbutt	Blackbutt	37, 38, 39, 40, 41, 42, 37/234, 37/48. 37a, 37b, 37b/38, 38/39, 38/97, 38a,, 38b, 39a, 39b, 40/41, 41/26, 41/234, 41/92, 41/97, 41b, 37/62, 37A, 37B, 37O, 41+234	Mod
3a	Wet Sclerophyll - Obligate Seeders	Sydney Blue Gum/Bangalay	48, 45, 45+234, 45+64, 45/10, 45a, 45b, 48/10, 48/53, 48c, 45g, 48+2,	Absent
3b	Other Wet Sclerophyll	Sydney Blue Gum/Bangalay	46, 47, 49, 50, 51, 52, 54, 46+11, 46+53, 46/48, 46/53, 46a, 46b, 47a, 47b, 47c, 47+3, 49/53, 46+10, 46/54, 46A, 46B, 46a/15, 46a/159, 46a/23, 46a/3, 46a/54, 46b/163, 46b/234, 46b/54, 47-53, 47/48/53, 47/53, 47/60/74, 47A, 47R, 47f, 47s, 49+10, 49+13, 49b, 54/167b, 54/214, 54/61, 54/87, 54b,	Low
4	Grey Gum - Grey ironbark	Grey Gum - Grey ironbark	60, 61, 62, 63, 64, 65, 66, 67, 68, 60/70, 60a, 60c, 60e, 62+220, 62+234, 62/126, 62/128, 62/74a, 62/74c, 62/74b, 62/92, 62a, 62a/74a, 62ac, 62as, 62b, 62b/122, 62b/234, 62c, 62r, 62ra, 62rb, 63a, 63b, 64+234, 65/126, 65/161, 65/234, 65/70b, 65/74, 65/74,65/74b, 65/85, 65b, 65c, 60+234, 60.c, 60R, 60a.r, 60as.c, 60f, 61/3, 61/54, 62/121, 62/121/2, 62/234, 62A, 62B, 62B+234, 62R, 62a.c, 62a.r, 62aO, 62ai, 62ar, 62as.c, 62b/65, 62b/74b, 62br, 62d, 64/167, 64/234, 64/65, 64/65+23, 64O, 64a, 64b, 64c, 64d, 64o, 65+234, 65/123	Mod

5a	Moist Spotted Gum	Spotted Gum	70, 71, 73, 75, 70+122, 70+163, 70/72, 70/74, 70a, 70b, 71a, 71b, 70/234, 70A, 70B, 70a,	Mod
5b	Dry Spotted Gum	Spotted Gum	72, 74, 76, 72/74, 72/74a, 72/74ac, 72/74b, 72a, 72ac, 72b, 74/126, 74/234, 74/92, 74a, 74b, 74c/234, 74bc, 74c, 74ra, 74rb, 76a, 72A, 72B, 74/121, 74A, 74B,	High
6a	Moist Grey Box-Ironbark	Grey Box - Ironbark	81, 86, 87, 87c,	Mod
6b	Dry Grey Box-Ironbark	Grey Box - Ironbark	80, 82, 83, 84, 85, 88, 82c, 84/119, 84/126, 84/92, 82a, 82b,	Mod
7	Red Gum	Red Gum	92, 92/105, 92/119, 92/126, 92c, 93, 93bx	High
8a	Silver Top Ash	Scribbly Gum - Stringybark - Silver Top ash	112, 113, 114, 121, 123, 130, 123a, 123b, 113/114, 121+234	Low
8b	Coastal	Scribbly Gum - Stringybark - Silver Top ash	107, 108, 1261, 26/234, 126c, 126a, 126b	Low
8c	Tablelands	Scribbly Gum - Stringybark - Silver Top ash	97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 109, 111, 115, 116, 117, 118, 119, 120, 122, 124, 125, 127, 128, 129, 131, 132, 133, 101+163, 101/234, 111+234, 117/119, 119/126, 122+234, 122/163, 122L, 122a, 122b, 1221, 131+142, 97/117, 97/119, 97/126, 97/234, 100+234, 105+234, 105/234, 106+234, 119+234, 122b/159, 129+234, 129/234	Mod
9	Snow Gum	Snow Gum	136, 137, 138, 139, 140, 141, 142, 143, 138/234, 142/163, 142/163c	High
10	Alpine Ash	Alpine Ash	148, 147	High
11a	Moist 'Messmate - Brown Barrel	Messmate - Brown Barrel	151, 153, 154, 155, 157, 158, 159, 162, 163, 165, 166, 168, 169, 153b, 162a, 162b/234, 163+234, 163+64, 163/234, 163N, 163T, 163a, 163a/230, 163b, 163b+234, 163b/234, 163c, 163c, 163c+234, 163c/234, 151/12, 153a, 159/12, 159v, 162b, 163aS, 163as, 163bS, 163bs, 168/234, 168a, 168a/11, 168a/3, 168b, 168b/234	High
11b	Dry 'Messmate - Brown Barrel	Messmate - Brown Barrel	150, 152, 156, 160, 161, 164, 167, 152/234, 161+234, 191+93, 161a, 161b, 150/12, 152a, 152b, 152c, 164c, 167/234, 167/54, 167a, 167b, 167b/54	High

12	Yellow Box - White Box - Red Gum	Yellow Box - White Box - Red Gum	171, 172, 173, 174, 175, 176, 177, 178	High
13	Black Cypress Pine	Black Cypress Pine	180, 181, 182, 183, 184, 185	High
14	White Cypress Pine	White Cypress Pine	188, 189, 190, 192, 193, 194, 195	High
15	River Red Gum	River Red Gum	199, 200	Mod
16	Western Box - Ironbark	Western Box - Ironbark	202, 203, 204, 205, 206, 207, 208, 209, 210	High
17	Brushbox	Brushbox	53, 53+12, 53+3, 53/10, 53/2, 53/46, 53/46+11, 53/46+12, 53a, 53b, 53+10, 53+7, 53c, 53fg	Low
18	Rainforest	Subtropical Rainforest, Warm Temperate Rainforest, Cool Temperate Rainforest, Dry and Depauperate Rainforest	1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, ½, 10/21, 11/12, 1a, 1b, 2/21, 2/26, 2/3, 21/87, 23/26, 26/234, 3/11, 3b, 5/11, 6/21, 6/23, 6/26, 7c, 7c/220, 8b, 1/12, 1/23, 1/26, 1/3, 1/6, 12/15, 12/17, 12c, 23/234, 23-26, 23a, 23c, 3/12, 3/26, 6-23, 6-26, 7/26, 7b	Absent
19	Non-Eucalypt	Non-Eucalypt	211, 212, 213, 214, 215, 211/233, 214/234	Low
20a	Artificial Communities	Artificial Communities - non pastoral	217, 219, 221, 218h 218s, 218H, 218s, , P17, P18, P18/P19, P18/P6, P19, P20, P21, P48, 218hm, 218sm,	Low
20b	Artificial Communities	Artificial Communities - pastoral	216, 218, 220, 220+122, 220/62, 220/80, 220/85,P1, P12, P13/P14, P13/P28, P14, P15,	High
21a	Shrub dominant	Shrub dominant - non-pastoral	223, 224, 225, 227, 55, 224/234	Absent
21b	Shrub dominant	Shrub dominant - pastoral	226	High
22a	Herb dominant	Herb dominant - non-pastoral	231, P41, P46	Absent
22b	Herb dominant	Herb dominant - pastoral	230, 232	High
23	Vegetation largely absent	Vegetation largely absent	233, 234, 235, 234/62, P39, P54, P55,	Absent

APPENDIX 10 – RELIABILITY INDICES

Class	Logging History	Fire
1	Polygons mapped from 1:10000-1:25000 maps that represent accurate post event detail of actual logged area (Net logged area mapped in the field at the time of the event) and volumes taken, with all other attributes available. Examples include detailed post harvest map drawn by operation Foreman at the time of the event.	Maps with all data set attributes present. Linework should be mapped at 1:10000 - 1:25 000 from official fire reports. Fire intensity given and Net burnt area delimited.
2	Post logging net area mapped to a scale of 1:25 000 scale at the time of the event (but may have been drawn in the office) with volumes given and all other attributes available. Examples included maps contained within detailed compartment histories clearly derived from field maps.	Maps with all data set attributes present. Linework should be mapped at 1:10000 - 1:25 000 from official fire reports. Fire intensity given.
3	Logging events mapped post operations in the office, on source maps of 1:25000-1:50 000 scale with all attributes present or mapped from 1:25 000 source maps with at least 50% of attributes present. Volumes should be given if applicable. Examples: post logging summary maps in compartment histories folders.	Fire mapped on source maps of 1:25 000 scale with at least 75% of attributes available.
4	Logging mapped from 1:50 000-1:100 000 source maps, with less than 50% of attributes available or from maps of 1:25000 - 1:50 000 scale but of doubtful quality (ie source and time of mapping unknown). Post harvest summary maps or harvesting plan maps with expected net area logged indicated.	1:25 000 - 1:50 000 source maps, with 50% of attributes filled.
5	Events mapped from 1:75 000-1:100 000 scale source maps with less than 50% of attributes available. Time and location of map unknown, volumes delimited at the whole of compartment level only or unknown or mapped from harvest plans with no net area delimited. Examples, Harvest Plans with no evidence of post operation extent, mapped events with no other information available.	Polygons taken from summary maps of 1:50 000 - 1:100 000 scale with less than 50% or less of attributes present.

APPENDIX 11– FIELD VALIDATION CRITERIA AND DESCRIPTIONS

TABLE 11.1 FIELD VALIDATION CRITERIA

Site Details					
Date			Tenure		
Polygon Id			SF No		
MA			CPT		
GPS			Officer		
Forest Characteristics					
Canopy Species	1	2	3		
Understorey (layers by morphology)	1	2	3	4	5
Evidence of Logging/Silviculture					
Stumps (size)	1	2	3		
Stumps (age in years)	1	2	3		
Log Dump	1	2			
Debris (heads etc)	1	2			
Open Earth	1	2			
Evidence of Fire					
Leaf Scorch	1	2			
Epicormic Growth	1	2			
Fire Scars (on trees)	1	2			
Evidence of Grazing					
cows/sheep present	1	2			
dam/watering point clearly used by stock	1	2			
cattle yard	1	2			
cow/sheep trails	1	2			
treated trees	1	2			
Cow/sheep faeces	1	2			
Other					
Mine site	1	2			
Mine activity	1	2			
Sawmill	1	2			
Other Infrastructure/site	1	2			
Brief Description					

TABLE 11.2 FIELD CRITERIA DESCRIPTIONS

Field	Description
Date	Date
Polygon Id	Field site number from sequentially from 1
GPS	GPS coordinates
CPT	Compartment Number if on State Forest
CRA Region	UNE, LNE, S
Officer	Who is filling in the form
Forest Characteristics	
Canopy Species	List the 3 main canopy species if known (use botanical names if known)
Understorey	Identify the understorey layer by morphology where 1 is ground cover and 5 is the highest (not canopy).
Logging/Silviculture	
Stumps (size)	Indicate the size of stumps 1 = 0-20cm; 2 = 20-60cm; 3 >60cm (tick more than 1 if necessary).
Stumps (age)	Estimate age of stumps in each size class where 1 = 0-5 yrs (no weathering/no coppice); 2 = 5-20 yrs (some weathering/ coppice); 3 > 20 yrs (weathering/coppice spring board stumps/decomposed).
Log Dump	Indicate whether a log dump is within the polygon 1 = yes; 2 = no.
Debris	Indicate whether logging debris is present within the polygon, 1 = yes; 2 = no.
Open Earth	Indicate whether there is a significant amount of open earth in the polygon caused by logging activities
Fire	
Leaf Scorch	1 = minor (will recover); 2 = severe (killed).
Epicormic Growth	1= present; 2 = absent.
Fire Scars	1 = present; 2 = absent
Grazing	
Cows/Sheep present	Are cows/sheep present in the polygon?: 1 = yes; 2 = no.
dam with evidence of cattle	Is there a dam(s) present in the polygon?: 1 = yes; 2 = no.
yard	Are there cattle yards or other related infrastructure present in the polygon?: 1 = yes; 2 = no.
trails	Are there <u>livestock</u> trails evident in the polygon?: 1 = yes; 2 = no.
treated trees	Is there evidence of tree treatment which is likely to be due to grazing (eg poisoning, ringbarking)?: 1= yes; 2 = no.
Cow/sheep faeces	1 = present; 2 = absent.
Other	
Mine Site	1 = present; 2 = not present.
Mine activity	1 = active; 2 = inactive
Sawmill	1 = present; 2 = not present.
Other Infrastructure/Site	1 = present; 2 = not present.
Description	BRIEFLY describe the above site(s).

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