Forest Audit Program 2015: Audit of In-coupe Roads

Department of Environment, Land, Water and Planning

Environmental audit of the construction and maintenance of in-coupe roads

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Executive Summary

Audit scope and objectives

Environmental audits of timber harvesting operations in State forests (the Forest Audit Program; FAP) have been undertaken since 2002. The FAP has sought to assess compliance with the regulatory framework for those operations and identify and assess any risk of harm they pose to the environment. The program was initially managed by the Environment Protection Authority (EPA), but has been managed by the Department of Environment, Land, Water and Planning (DELWP) since 2010.

In 2015, DELWP commissioned three audits under the FAP. Each audit addressed a specific compliance priority, namely:

- *Construction and maintenance of in-coupe roads:* these include temporary roads and coupe driveways which occur within a timber harvesting coupe boundary (but not snig, forwarding or boundary tracks).
- *Construction and rehabilitation of waterway crossings*: crossings include those by in-coupe roads, boundary and/or snig tracks.
- *Protection of mandatory exclusion areas from the impacts of harvesting*: these are areas in General Management or Special Management Zones where the Code provides for harvesting operations to be excluded.

Jacobs Group (Australia) Pty Ltd (Jacobs) was commissioned by DELWP to undertake the audit of construction and maintenance of in-coupe roads. It assessed compliance by VicForests and their contractors or licensees with aspects of the regulatory framework for timber harvesting which relate to the full in-coupe road life-cycle, from planning and design, through to closure and rehabilitation, as well as any environmental impacts. The regulatory framework for forest roads primarily exists to maintain environmental values associated with soils, water and waterways which could be jeopardised if those roads are not planned, designed, constructed and/or maintained appropriately.

This report documents the findings of the 2015 FAP audit of the construction and maintenance of in-coupe roads.

Audit approach

The in-coupe roads which were included in this audit were distributed between 35 timber harvesting coupes located in the Central Gippsland, East Gippsland, Midlands and Tambo Forest Management Areas (FMA; Figure ES.1). One of the coupes in Central Gippsland FMA was located in a Melbourne Water Corporation catchment area.

Prospective audit coupes were selected at random from a list of coupes included in VicForests' current *Timber Release Plan* or *Wood Utilisation Plan* with at least 400 m of planned in-coupe roading. The actual length of roading in the selected coupes ranged between about 100 m and over 1600 m. Field assessments of the selected coupes and their roads took place during September and October 2015.

Source: Department of Environment, Land Water and Planning.

Figure ES.1 Victorian Forest Management Areas

In-coupe roading and harvesting operations on one of the audited coupes (in Midlands FMA) was managed by the Department of Environment and Primary Industries (now DELWP) prior to the transfer of management responsibility to VicForests in November 2014.

Audit criteria were based on mandatory requirements of the two key regulatory documents, the *Code of Practice for Timber Production 2014* (the Code) and the *Management standards and procedures for timber harvesting operations in Victoria's State forests 2014* (the MSP). The mandatory actions applicable to in-coupe roads were grouped into six compliance themes, as follows:

- *Water quality, river health and soil protection:* which largely draws on Code mandatory actions relating to the protection of soil condition, river health and water quality. These compliance elements apply to in-coupe roads, as well as other infrastructure and harvest-related activities.
- *Pests, weeds and diseases:* drawn from compliance elements which are concerned with minimising the risk of introducing weeds and soil-borne pathogens into previously unaffected areas.
- *Road planning and design:* mandatory actions from the Code and MSP relating to the planning and design of forest roads, including in-coupe roads.
- *Road construction:* mandatory actions from the Code and MSP relating to road construction, including the management of erosion and sediment during the construction phase, construction of fill batters and road surfacing.
- *Road drainage:* mandatory actions from the MSP relating to the placement, design and construction of road drainage infrastructure, including waterway crossings. This compliance theme potentially considers culverts, bridges and fords, although only culverts were encountered during this audit.
- *Road maintenance, operations and closure:* mandatory actions drawn from the Code and MSP concerning road maintenance, operations during wet and dry weather and closure and rehabilitation following the completion of harvesting and regeneration.

Assessments, considering up to 110 compliance elements[1] across these six themes, were carried out for all 35 coupes included in the audit. These assessments involved completing an audit workbook and examining the in-coupe roads, any drainage structures and/or waterway crossings to identify any instances of non-compliance with the regulatory framework, their environmental impact and causation. VicForests personnel accompanied the audit team on many of the coupe assessments. This enabled useful discussions about in-coupe roading practice, applicable elements of the regulatory framework and of any non-compliances which were observed.

Example of temporary in coupe road used for timber haulage from Hubadub coupe (892-509-0001).

Audit findings

Full compliance with applicable audit criteria was assessed to be 80% overall, with compliance varying between 75% and 100% for individual compliance themes. Approximately half of the non-compliances required an assessment to be made of the potential for environmental impact. Over 60% of these assessments found the potential environmental impacts to be negligible or minor.

Environmental impacts arising from non-compliances were assessed using the environmental impact assessment (EIA) tool provided by DELWP. Environmental impacts were assessed as "major" for 15% of the non-compliances. These related to incidents on just two of the 35 audited coupes (Dapples Creek [720-505-0018]; Buttons [894-504-0018]) and were all connected with in-coupe road waterway crossings.

[1] Of the 110 potentially applicable audit compliance elements, only 86 criteria were found to be regularly applicable to the audited coupes. This generally reflected the life cycle stages of the coupes included in the audit. This audit report is based on assessments against those 86 criteria.

While deficiencies with in-coupe roading practice were observed on some coupes (as discussed below), the auditors considered that VicForests' planning and design practices generally located roads to avoid higher risk environments and prevented unavoidable disturbance to soils and contamination of waterways with road sediments. In-coupe roads were typically found to be constructed, used and rehabilitated with minimal impact on soil and water quality values.

Compliance with the regulatory framework for timber harvesting operations

This audit of the construction and maintenance of in-coupe roads found that VicForests fully complied with 80% of the criteria which were applicable to the 35 audited coupes and the almost 17 km of in-coupe road surveyed. While 20% of applicable criteria were not fully complied with, individual "incidents" often give rise to multiple partial and/or non-compliance assessments. Thirty-six individual incidents were responsible for the 143 non-compliances (10% of applicable criteria) for which assessments of potential environmental impact were required. They were also responsible for many of the "partial" compliances which were assessed not to have any direct environmental impact.

Several main underlying non-compliance issues were identified:

- *Waterway crossings:* while only four of the 35 audit coupes had waterway crossings, these made a disproportionate contribution to the overall level of non-compliance. Construction of drainage structures and management of post-harvest culvert removal were the main issues identified. Non-compliances in these areas were responsible for the highest levels of environmental impact observed during the audit. This reflected the observed movement of sediments into and within waterways.
- *Drainage spacing:* distances between drainage structures on 11 of the 35 coupes did not fully satisfy requirements of the MSP for the respective soil erosion hazard class and slope. This arose for several reasons, including: minor construction errors, which led to the distances between of constructed drainage slightly exceeding MSP prescriptions; failure to construct the necessary drainage structures; and the failure of poorly constructed or traffic-damaged drainage structures. The excess spacing of drainage structures beyond MSP requirements ranged from less than 10 m (in 2 coupes) to almost 400 m. The potential environmental impact associated with this issue was assessed to be minor or negligible in each of the coupes in which drainage spacing was non-compliant. This reflected the very localised nature of any impacts observed.

Example of in-coupe road used to access Superstop (480-508-0007) and several other coupes over a period of several years. While this road was generally very well-constructed, some sections were not effectively drained on both sides. There were no observable environmental impacts associated with this.

- *Embankments:* the design and construction of embankments or fill slopes was a frequent source of non-compliances. The key issues were:
  - management of unavoidable drainage over fill slopes: which has potential to erode and damage the embankment and mobilise sediments into waterways;
  - not seeking specialist design advice for large embankments on roads which crossed steep and/or wet terrain.

  The assessed environmental impact ranged between negligible and moderate, with the latter assessed on one coupe (Staff [526-502-0007]) in which a large embankment across a steep slope had begun to fail.
- *Drainage onto roads:* in some coupes, road construction or upgrading did not prevent drainage from one road onto another. Potential environmental impacts assessed using the EIA tool ranged up to moderate, although this reflected the issue being located outside the planned harvest area rather than the potential for environmental impact.

- *Access closure:* not correctly draining in-coupe roads following the completion or suspension of harvesting and not permanently closing off access to the coupes was a common source of non-compliances. The latter reflects a tendency for VicForests to avoid permanently closing access to coupes and the practical difficulties in actually doing so. Any observed environmental impacts were small, localised and were assessed using the EIA tool to be minor or negligible. Most appear to have been the result of post-harvest 4WD vehicle traffic not connected with VicForests' operations.
- *Construction varying from approved design:* VicForests' internal Utilisation Procedures (UP) typically specify its in-coupe road design requirements. Most of the observed non-compliance incidents occurred when construction practice was not consistent with those requirements.

Findings in relation to environmental impact

While this audit found that a variety of issues contributed to non-compliance with applicable elements of the regulatory framework, there were two main issues posing environmental risk to sustainable forest management objectives:

- *Waterway crossings:* these contributed the highest level of environmental impact assessed in this audit and were responsible for a disproportionately large share of the non-compliances recorded (since only 4 of 35 audit coupes had waterway crossings). The key deficiencies identified were that: sediment was delivered directly to waterways from road drainage; and that an embankment from which a culvert was removed was not rehabilitated as required to prevent sediment from being mobilised into the waterway.
- *Roading through high risk areas:* in general, in-coupe roads were located so that they avoided areas with high environmental risk (e.g. waterways, wet areas and steep slopes). However, where in-coupe roads had to traverse such areas, the attention to design and construction was sometimes found to be insufficient to prevent road embankments, side cuts or road drainage from failing in some way and/or discharging sediment into waterways.

The most significant environmental impacts which were observed during this audit were the delivery of sediment into streams and the slumping of a road embankment.

Road through a steeply sloping wet area on Staff coupe (526-502-0007). The embankment has begun to fail and further mass soil movement is likely.

Recommendations

A series of recommendations were formulated on the basis of the findings of this audit. Seven recommendations each were made to VicForests (as auditees) and DELWP (as the environmental regulator of timber harvesting activities). Recommendations for VicForests were prioritised according to the auditor's assessment of the significance of the issue and the urgency of a response[2]. High priority recommendations for VicForests should be implemented within 6 months and moderate priority recommendations should be implemented within 2 years. Recommendations to DELWP largely concern the regulatory framework for timber harvesting. Review and revision processes for that framework operate over longer timescales and involve broad stakeholder engagement. As such, priority for DELWP recommendations reflected only the auditor's assessment of their relative importance.

Recommendations to VicForests

Seven recommendations are made to VicForests as the entity responsible for the management of in-coupe roading in timber harvesting operations. Several relate to the implementation of VicForests own design and

[2] The numbering of recommendations is based on the order in which they appear in this audit report.

management standards (outlined in their internal UP) by their contractors and have only been included because non-compliance issues were observed in multiple FAP audits.

High priority recommendations:

- *VF-02:* VicForests should be more proactive in seeking engineering advice on the design and construction of in-coupe roads where they will traverse areas of steep slope and require deep side cuts and/or large fill embankments to be constructed. The precise limits for seeking engineering advice prescribed by the MSP (i.e. 30°/25° for areas with lower/higher soil erodibility) are not necessarily consistent with the limited accuracy of available topographic mapping, digital elevation models or field measurement. It is recommended that engineering advice is sought in these higher risk areas, based on the possibility (>50% chance) that:
  - Side slopes will be within 5° of the respective MSP limit; and/or
  - Side cuts or embankments greater than 2 m in height will need to be constructed.
- *VF-05:* VicForests should ensure that contractors construct MSP-compliant cross drainage systems along temporary in-coupe roads with less than 6 months intended use. This drainage should be constructed prior to a forecast significant rainfall event and/or to the temporary or permanent removal of harvesting machinery from the coupe. Construction of appropriate drainage systems must be confirmed through VicForests' temporary or final clearance monitoring process. Drainage systems should be constructed prior to the use of any in-coupe road which is intended to be used for more than 6 months.
- *VF-06:* VicForests should regularly communicate with its contractors about the risks to the environment which are posed by poorly constructed, maintained and/or rehabilitated waterway crossings. Contractors should be instructed in the construction and maintenance of waterway crossings which comply with the requirements of the Code, MSP and VicForests' internal Utilisation Procedures (UP). VicForests should regularly monitor compliance with waterway crossing requirements and assess the potential for sediment movement into waterways in the vicinity of crossings.

  Corrective actions should also be taken by VicForests and its contractors if waterway crossings are not constructed in compliance with the regulatory framework or if sediments are entering waterways at or near crossings. Any non-compliance issues and corrective actions should be recorded in the Forest Coupe Plan (FCP) and the potential environmental impact assessed using the FAP's environmental impact assessment (EIA) rating tool. Non-compliance issues and corrective actions should be reported to DELWP's Timber Harvesting Compliance Unit where the EIA rating is major or greater.

Moderate priority recommendations:

- *VF-01:* VicForests should document its planning of in-coupe roads in the "Roading" section of the FCP. Documented evidence of planning should include:
  - Map of the planned road alignment;
  - Explanation of rationale for the planned alignment;
  - Analysis and discussion of the environmental and other risks posed by the road and which are to be managed through planning;
  - Discussion of any alternatives routes to manage risks from waterway crossings, other wet areas, steep slopes etc.

  If the actual and planned alignment of an in-coupe road differ substantively, an additional entry should be made in the FCP to explain the divergence and a map should be included which shows the actual alignment.
- *VF-03:* VicForests' FCP records should include the actual basis for design of its in-coupe roads, road drainage, larger embankments and waterway crossings. Record keeping should be proportional to the level of risk which is addressed through road design. The minimum requirement should be to specify the class of road (as per MSP Appendix 4) and explicitly reference which UP provisions are addressed by the road design. Evidence of engineering advice and how this has been incorporated into road design and construction should also be included whenever it has been sought.
- *VF-04:* VicForests should actively seek to reduce the incidence of road fill embankments covering the base of live trees which are retained within coupes. The mandatory nature of this requirement should be

reinforced with contractors by targeted training, monitoring, reporting and corrective action (if non-compliance is detected).

- *VF-07:* VicForests should explore the more widespread use of rollovers or similar, trafficable cross-drainage structures for in-coupe roads. This type of structure has been observed to be used effectively by VicForests in some settings and by other Victorian forestry operators. They are also widely-used in forest and rural roading in tropical and sub-tropical regions of Australia. Rollover structures reduce the need for culverts and, if properly constructed, should function effectively through and following harvesting. They are generally more stable and resilient to damage by post-harvest traffic than traditional "bar and breach" cross drainage structures.

Recommendations to DELWP

Seven recommendations are made to DELWP in its role as environmental regulator for timber harvesting operations in State forests. They concern potential changes in the regulatory framework to strengthen protections to environmental values and improve the framework's auditability. The priority given to recommendations reflects the auditor's view of their importance for consideration when the regulatory framework is next being reviewed. It is recognised that with the regulatory framework having been updated in 2014, further changes are unlikely to be considered for some time.

High priority recommendations:

- *DE-01:* DELWP should modify the wording of MSP section 6.1.1.3 regarding the requirement to seek engineering advice for road construction across steep slopes. The revised wording should reflect the limited accuracy of slope measurements taken from available topographic data or taken in the field in unharvested coupes.

  It is suggested that engineering advice is sought for the design of roads traversing areas where it is possible (>50% chance) that: side slopes will be within 5° of the respective MSP limit; and/or side cuts or embankments greater than 2 m in height will need to be constructed.

- *DE-03:* Given the significant non-compliance issues which were observed for waterway crossings in the 2015 FAP, DELWP should maintain a focus on waterway crossings in the 2016 audit program.

- *DE-04:* DELWP should include a mandatory action in the MSP to ensure that VicForests and its contractors take appropriate action to stabilise former waterway crossing sites following the removal of culverts.

Moderate priority recommendations:

- *DE-02:* VicForests does not routinely construct cross drainage on many temporary in-coupe roads in lower risk settings until heavy rainfall is forecast or harvesting is suspended or completed. While this practice is arguably not compliant with the MSP, it is operationally effective and the audit found no evidence it poses a significant environmental risk. It is recommended that this practice be explicitly incorporated within the regulatory framework to specify conditions under which it can be safely adopted.

  The MSP for road drainage (Section 6.2.4) should be amended to prescribe conditions under which temporary in-coupe roads need not be drained until harvesting is suspended or completed. Suggested conditions include:

  - The coupe is planned to be harvested within 6 months of roading and road use will only occur within a single harvesting season;
  - Average slope of the in coupe road is 4° or less and never greater than 6°;
  - Soil erosion hazard is low or moderate;
  - The road is located well away from waterways and there is limited or no potential for sustained overland sediment flow;
  - Appropriate cross drainage is constructed when: heavy rainfall is forecast; harvesting is suspended (for any reason or period) and harvesting machinery is removed from the coupe; and harvesting is completed and roads are no longer required for operational purposes.

- *DE-05:* In the response to the challenges in controlling access to coupes following the completion of harvesting and of the damage that this may cause to drainage structures, DELWP should provide an alternative to the Code's mandatory requirement to close coupe access following harvesting completion.

This alternative should require the construction of effective drainage structures along in-coupe roads which will be resilient to post-harvest vehicle traffic for at least 3 years, while the coupe is regenerating and ground cover being restored. After this period, regrowth will typically stabilise soils, trap any sediment flow and prevent further erosion.

- *DE*-07: DELWP should strengthen mandatory actions in the Code, to reduce the potential for weeds and pathogens to be spread by road construction and maintenance activities. Suggested improvements are that:
  - All harvesting and road construction machinery are thoroughly cleaned and inspected before being brought onto a new coupe (unless it is adjacent to the one from which the machinery is being moved);
  - Quarries from which materials are sourced for forest road construction are checked annually by a competent, independent party to confirm disease and weed free status;
  - Gravel obtained from quarries which are not confirmed as weed and disease free should be treated to mitigate any weed or disease threat prior to use within a harvest coupe.

  Evidence of machinery inspections, disease and weed free status of quarries and/or treatment should be retained in the FCP for all applicable coupes.

Low priority recommendations:

- *DE-06:* To enhance the capability of the regulatory framework to support auditing, DELWP should review mandatory actions in the Code and MSP to reduce the subjectivity sometimes created by their wording. Consideration should be given to the comments and suggested wording for Code mandatory actions relating to in-coupe roads provided in Section 5.2.1 of this report.

Glossary

Audit criteria	Criteria used to assess whether timber harvesting and related activities are consistent with mandatory requirements of the Code and MSP.
Code	The *Code of Practice for Timber Production* 2014, which lists mandatory actions for timber harvesting activities in native forests and plantations in Victoria.
Compliance	Compliance with audit criteria. Activities were assessed to comply (or fully comply), not comply or partly comply with audit criteria. Part compliance was determined where the actions did not fully comply with the compliance element, but no environmental impact assessment was required or applicable. Environmental Impact Assessment (EIA) ratings were applicable to instances of non-compliance.
Coupe	An individual management unit within forests and plantations where timber harvesting or thinning activities are planned and conducted. Under the *Sustainable Forests (Timber) Act* 2004, a coupe is a specific area of State forest identified for the purposes of timber harvesting and regeneration in a Timber Release Plan.
Coupe driveway	A temporary coupe access road established to provide access to a timber harvesting operation. For planning purposes, a coupe driveway is less than 500 m long and is located on land managed by DELWP. Coupe driveways are considered to be part of a coupe.
DELWP	Department of Environment, Land, Water and Planning: DELWP has responsibility for environmental regulation of timber production activities in State forests.
EIA rating tool	A tool developed for the FAP to provide a consistent basis for assessing the potential environmental implications of non-compliance with audit criteria.
FAP	Forest Audit Program – an annual program of environmental audits coordinated by DELWP to ensure that timber production operations in State forests provide for sustainable forest management.
Filter strip	A protective boundary around a drainage line, temporary stream or buffer strip. Trees may be harvested from within the filter strip, although they may not generally be entered by harvesting machines.
Forest coupe plan (FCP)	A plan that is prepared for each coupe that describes the biophysical character of the coupe and the nature of planned harvesting operations. The minimum content requirements of a FCP are specified in the Code. The FCP is contained within a coupe file that includes other information, including coupe monitoring records, traffic management provisions and silvicultural operations. The coupe file may also refer to information about the coupe and its operations that is held within a VicForests or DSE information management system.
Forest Management Area (FMA)	The basic regional unit for forest planning used for public land in Victoria. These forest planning units are not administrative units.
Incident	An event, action or lack of action on a coupe that gives rise to an assessment of non or partial compliance with an audit criterion. The nature of the audit criteria and various prescriptions mean that a single incident may result in multiple non-compliances.
In-coupe road	A temporary road constructed to provide access to landings and/or allow haulage of timber from the coupe.
Landing	An area within the coupe that is specifically developed to sort, process and/or load trees or parts of trees for transport from the forest. Top soil is removed before landings are developed. Landings must be rehabilitated at coupe closure unless they are to be used for an adjacent coupe.
MSP	*Management standards and procedures for timber harvesting operations in Victoria's State forests 2014.* They are designed to help interpret the Code for timber harvesting and related activities in State forests. They are a secondary source of mandatory prescriptions for forest management.
Riprap	Rocks and other materials which are arranged to prevent erosion by water. Also called rock armouring.
Rough heaping	A method of preparing coupes for regeneration, generally following failure of initial attempts. Remaining woody material is pushed into heaps and burnt. Soils, understorey and coupe infrastructure are disturbed to create a receptive seed bed.
Snig track	A track through a harvested coupe along which harvested logs are towed or winched, normally towards a landing.

Soil erosion hazard	Soil erosion hazard (or SEH) is a composite index of the potential for soil erosion to occur within a forest coupe. SEH is based on field assessments of soil texture, aggregate stability, structure, colour, organic content, mottling and stoniness. It also takes account of the erosivity of rainfall at the location, average slope, slope length, tree size and revegetation capacity. The method of calculation is described in the MSP (DEPI, 2014b). SEH is assessed for each coupe during harvest planning.
State forest	Publicly-owned and managed forest estate. Victoria has 3.4 million ha of State forest. State forest is managed for multiple beneficial uses, including conserving flora and fauna, protecting water catchments and water supply, providing timber for sustainable forestry, protecting landscape, archaeological and historic values, and providing recreational and educational opportunities.
Timber Release Plan (TRP)	Timber resources in State forests in eastern Victoria are allocated to VicForests for the purposes of harvesting and/or selling through the Allocation to VicForests Order 2004 (as amended). The Allocation Order specifies the extent and location of the forest stands to which VicForests has access under this Order. VicForests must prepare a Timber Release Plan for allocated areas. Timber Release Plans (TRPs) are publicly available documents that must include: a schedule of coupes selected for timber harvesting and associated access road requirements; details of the location and approximate timing of timber harvesting in the proposed coupes; and details of the location of any associated access roads. They are prepared by VicForests in accordance with Part 5 of the *Sustainable Forests (Timber) Act* 2004, and may be reviewed and changed in accordance with section 43.
UP	*Utilisation Procedures for all Commercial Harvesting and Haulage Managed by VicForests*. VicForests documentation which provides the basis for design and construction of in-coupe roads and contains other specifications for how VicForests manage timber harvesting operations in accordance with the mandatory requirements of the Code and MSP.

1. Introduction

1.1 Sustainable Forest Management in Victoria

The legislative framework for the harvesting and management of timber resources in Victoria's State forests is provided by the *Forests Act 1958,* the *Conservation, Forests and Lands Act 1987* (the CFL Act) and the *Sustainable Forests (Timber) Act 2004* (the SFT Act). The latter establishes the current regulatory framework for the sustainable harvesting of timber resources from State forests in Victoria.

Under the SFT Act, harvesting of timber from public land by VicForests is to be conducted in a manner which is consistent with the principles of ecologically sustainable development. The Act provides for the development of a Sustainability Charter (DSE, 2006), which sets out the State's objectives for sustainable forest management. These objectives are to:

- Maintain and conserve biodiversity in State forests;
- Maintain and improve the capacity of forest ecosystems to produce wood and non-wood products;
- Promote healthy forests by actively managing disturbance;
- Maintain and conserve the soil and water resources of State forests;
- Maintain and better understand the role of Victoria's State forests in global carbon cycles;
- Maintain and enhance the socio-economic benefits of State forests to Victorian communities;
- Ensure Victoria's legal, institutional and economic frameworks effectively support the sustainable management of State forests.

The SFT Act requires VicForests and its contractors to comply with relevant Codes of Practice. Under the CFL Act, the Minister may make such Codes of Practice, including for sustainable forest management, to specify management standards and procedures. The SFT Act provides for the Minister to seek an audit of VicForests' compliance with relevant Codes of Practice. In reviewing VicForests' Allocation Order, the Minister will also have regard to VicForests' compliance with such Codes.

The regulatory framework for sustainable forest management requires organisations and individuals undertaking commercial timber harvesting on public land to comply with two Codes of Practice, the *Code of Practice for Timber Production 2014* (the Code) and the *Code of Practice for Bushfire Management on Public Land 2012*, as well as various management prescriptions and guidelines. These Codes of Practice are administered by the Department of Environment, Land, Water and Planning (DELWP) on behalf of the Minister for Environment and Climate Change.

1.2 Forest Audit Program

Since 2002, auditors (appointed under the *Environment Protection Act 1970*) have been engaged to undertake environmental audits of timber harvesting operations in State forests to assess compliance with the Code and related standards and management procedures. This program of audits was initially administered by the Environment Protection Authority (EPA), but has been delivered by DELWP[3] since 2010.

The Forest Audit Program (FAP) has undergone several major changes since its transfer to DELWP. This has reflected changes to the regulatory framework (including the revision of the Code and Management Standards and Procedures in 2014), as well as the adoption of a risk-based approach to the selection of audit compliance priorities.

[3] The audits have been delivered by DELWP and its predecessor agencies, Department of Sustainability and Environment (DSE) and Department of Environment and Primary Industries (DEPI).

DELWP has chosen to focus the 2015 FAP on three compliance priorities, namely:

- *Construction and maintenance of in-coupe roads:* these include temporary roads and coupe driveways which occur within a timber harvesting coupe boundary (but not snig, forwarding or boundary tracks). Values considered under this compliance priority relate to water quality, river health and soil protection. Code compliance elements are primarily those associated with the planning, design, construction, maintenance, operation, closure and rehabilitation of roads.
- *Construction and rehabilitation of waterway crossings*: a similar set of values to the first compliance priority are considered. Code compliance elements address water quality, river health and soil protection issues, as well as road design and coupe management. Waterway crossings include those by in-coupe roads, boundary and/or snig tracks.
- *Protection of mandatory exclusion areas from the impacts of harvesting*: these include Special Protection Zones and areas in General Management or Special Management Zones where the Code provides for harvesting operations to be excluded. Protected values include biodiversity, water quality, river health and soils.

Audit projects for each compliance priority were commissioned separately. This audit report addresses the *construction and maintenance of in-coupe roads.* The scope of this audit overlaps somewhat with the FAP audit of the construction and rehabilitation of waterway crossings in that it also considers waterway crossings by in-coupe roads.

Roading frequently been examined under the FAP. In 2014, auditors found that roading compliance elements group was appropriately managed by VicForests (URS, 2015). The overall compliance rate was assessed to be 87%. Several systematic issues were identified, including: the sourcing of quarry materials from disease-free areas; issues relating to the closure of temporary roads; and management of erosion and sedimentation. The previous Forest Audit Program (SKM, 2013) found that overall, VicForests complied with 95% of applicable roading criteria. No systemic issues were observed, although lack of diversion of road drainage prior to waterway crossings was identified on two of the 35 coupes included in that audit.

1.3 Regulatory framework for in-coupe roads in State forests

The *Forests Act 1958* provides the Secretary (of DELWP) with special powers to construct and maintain “roads, tracks and tramways” in State forests and other public lands under its control. Under the SFT Act, VicForests is enabled to extend the forest road network by constructing access roads to timber harvesting coupes referred to in their Allocation Order.

The regulatory framework for forest roading undertaken by VicForests is established by the *Code of Practice for Timber Production* (DEPI, 2014a) and the associated *Management Standards and Procedures for Timber Harvesting Operations in Victoria’s State forests*, (the MSP; DEPI, 2014b). Section 2.4 of the Code (Roading for Timber Harvesting Operations) deals with permanent and temporary roads used for timber haulage and machinery transport. The operational goal for this section is to ensure that roads are *fit-for-purpose and protect environmental and cultural values and the safety of all road users*. A set of mandatory actions are prescribed for road planning, design, construction, maintenance, suspension of haulage and closure.

The environmental values which are at greatest risk from forest roading are associated with soils, water and riverine and aquatic ecosystems. Section 2.2.1 of the Code specifies operational goals for these values, including:

- Water quality and river health are maintained or improved by protecting waterways and aquatic and riparian habitat from disturbance;
- Water pollution is minimised and soil productive capacity is maintained by avoiding harvesting in inappropriate areas or slopes and undertaking necessary preventive measures;
- During or following wet weather, timber harvesting operations are modified or where necessary suspended to minimise risks to soil and water quality values.

The MSP apply to all commercial timber harvesting operations conducted in Victoria's State forests where the Code applies. They provide standards and procedures to assist in interpreting the Code's requirements, but do not take the place of the Code's mandatory actions. Section 6 of the MSP details standards and procedures for road planning, construction maintenance and rehabilitation. Since roading activities pose risks to environmental values, some standards and procedures in Section 3 *Water quality, river health and soil protection* and Section 4 *Biodiversity* were also relevant to this audit.

Section 6 of the MSP also identifies five classes of forest road. Two of these, classes 5C and 5D (Table 1.1), provide the construction standards for most of VicForests' in-coupe roads (VicForests, 2013).

Table 1.1 Road classification system for the State forest road network in Victoria.

Source: MSP Appendix 4 (DEPI, 2014b).

Class	Type	Service function	Description	Relevance to this audit
5A	Primary road	Provides for the main traffic movements into and through a region. Caters for higher travel speed and all vehicle types.	Generally 2 lane, sealed, all-weather road. Design speed 50-80 km/h. 7 m minimum width.	Standard not typically applicable to in-coupe roads.
5B	Secondary road	Provides access to moderate use visitor sites and forest areas. Collects and distributes traffic to or from primary or minor roads. Caters for moderate travel speed for full range of vehicles.	All-weather 2 lane formed gravel road formed or single lane sealed road with gravel shoulders. Design speed 30-70 km/h.	Standard not typically applicable to in-coupe roads.
5C	Minor road	Provides link to low and moderate use visitor sites and forest areas. Forms a feeder link to a logging coupe access track/road or fire track. Links traffic generators to secondary or primary roads. Caters for lower travel speed and full range of vehicles.	Generally all-weather, single lane, 2-way unsealed formed road. Lightly gravelled. Design speed standard 20-60 km/h.	High quality in-coupe road. Would typically service multiple coupes over several harvest seasons
5D	Access track/road	Provides access to low use visitor sites and forest areas. Can be short term, temporary or feeder roads to access individual timber harvesting coupes. Provides for fire protection and management access. Caters for low travel speed and a range of vehicles in dry weather. May be seasonally closed.	Single lane 2-way, generally dry-weather track/road formed from natural materials. Design speeds of <20-40 km/h. May be restricted to 4 wheel-drive vehicles.	Temporary in-coupe road used to access 1-2 coupes over a single harvest season.
5E	Rough track	Provides primarily for 4 wheel-drive vehicles. Mainly used for fire protection purposes, management access and limited recreational activities. Caters for very low travel speed. May be seasonally closed.	Single lane 2-way unformed earth tracks at or near the natural surface level. Predominantly not conforming to any geometric design standards.	Not suitable for use as in-coupe road.

2. Audit scope

2.1 Audit objectives

The FAP's objectives are to assess VicForests' compliance with the regulatory framework for timber harvesting activities in Victoria's State forests, as well as any risks these activities pose to the State's sustainable forest management objectives. This audit focussed specifically on the construction and maintenance of in-coupe roads.

2.2 Audit scope

The audit addresses the in-coupe road life cycle, including planning, design, construction, maintenance, rehabilitation and closure. Compliance elements were drawn from both the Code and MSP, with the latter providing greater detail on the mandatory requirements. The audit also addressed regulatory requirements designed to minimise the potential impacts of roading activities on soil, water quality and river health values and avoid the dispersal of weeds and soil-borne diseases during roading activities. The full set of regulatory compliance elements considered in the audit is given in Appendix A.

2.3 Audit timing

This environmental audit of in-coupe roads in Victorian State forests commenced in July 2015. The data collection component of the audit, including its field assessment program, was largely completed during September and October 2015. Discussions on audit findings with DELWP and the auditee, VicForests, continued through October and November 2015.

2.4 Audit team

The team for this audit of in-coupe roads included:

- Craig Clifton (Lead auditor and Project Manager): Craig is an EPA-appointed environmental auditor (natural resources). He developed the audit methodology, led the field assessments and their analysis and is lead author of this document;
- Mark Poynter (Audit field team member): Mark is an independent forestry consultant with extensive experience in auditing compliance with the Code. He supported the audit's data collection activities and contributed to their analysis and discussion in this report.
- Stacey Fernandes (GIS analyst): Stacey developed the spatial data collection tools used to capture field data for the audit.
- Doris Pallozzi (Project Director and technical reviewer): Doris is an EPA-appointed environmental auditor (industrial facilities) and has been Project Director and technical reviewer on three previous FAP audit projects conducted by Jacobs (then SKM).

3. Audit approach

3.1 Coupe selection

DELWP specified that this audit consider roadline and harvesting coupes in four Forest Management Areas (FMA): Central Gippsland, East Gippsland, Midlands and Tambo (Figure ES.1). A total of 35 coupes were to be included in the audit, with the distribution between FMAs shown in Table 3.1.

Table 3.1 Number of coupes to be included in the environmental audit of in-coupe roads, by FMA.

FMA	# target coupes	# reserve coupes
Central Gippsland	6	3
East Gippsland	19	4
Midlands	2	None available
Tambo	8	3
Total program	**35**	

1. Two Central Gippsland coupes were to be located in Melbourne Water Corporation catchment areas. For logistical reasons, one of these was not included in the audit. The substitute coupe was located in the Glenmaggie catchment.

DELWP provided a list of prospective target coupes in the four FMA based on data provided by VicForests. With the exception of coupes in Midlands FMA, each of these coupes were originally planned to have at least 400 m of in-coupe road.

The auditor used a stratified random sampling procedure to select the target coupes from the list provided by DELWP and VicForests. The number of coupes selected from each district within the respective FMA was proportional to the percentage of prospective target coupes in that district relative to the overall number of coupes to be audited in the FMA. Several “reserve” coupes were also identified in each FMA (except Midlands) in case the randomly selected coupes were unsuitable or unavailable for audit (Table 3.1).

The preliminary set of target and reserve coupes was provided to VicForests to verify accessibility, status and the presence of constructed in-coupe roads. The final audit targets were selected after several iterations of this verification process: many of the initial set of coupes were excluded because of lack of access or (more commonly) because they had insufficient length of in-coupe road. Several of the selected coupes were replaced during the field stage of the audit due to access constraints and the limited length of in-coupe road.

While the audit targets were drawn from a set of coupes with at least 400 m of planned in-coupe road, 19 of the 35 audited coupes had less than this length of road (Figure 4.13). The total actual length of road inspected in each coupe ranged from 100 to over 1600 m, with the average length being 478 m. In some cases the “in-coupe road” included or was predominantly an access track into the coupe.

In-coupe roads in one of the two available coupes in Midlands FMA were known prior to the audit to have been disturbed by rough heaping for regeneration. However, as there were no other available audit coupes in this FMA, it was still included in the audit. Harvesting operations in this particular coupe were managed by the Department of Environment and Primary Industries (now DELWP) prior to responsibility for the coupe being transferred to VicForests in November 2014.

One of the target coupes with seasonal access restrictions in Tambo FMA was replaced with a reserve coupe during the audit. One of the targets coupes in East Gippsland FMA was found in the field not to have an in-coupe road and was replaced by one of the reserve coupes for that region.

The location and characteristics of the audited coupes is summarised in Table 3.2. Maps showing their location are given in Appendix B.

Table 3.2. Location and characteristics of audit coupes

#	Coupe ID	FMA	Name	Total ICR length[1]	WWX[2]	Culverts[3]	Surfaced[4]	Soil EH[5]	WSC[6]
1	185-517-0003	Mid	Switchback Track South	647	0	N	N	M	Y
2	185-519-0001	Mid	Sledging Point Rd Nth	158	0	N	N	M	Y
3	459-503-0003	CG	Saxtons Bend	1081	0	N	N	M	Y
4	461-510-0011	CG	Calloway	1644	0	Y	Y	H	N
5	462-507-0023	CG	Major Max	360	0	N	Y	L	Y
6	480-508-0007	CG	Superstop[7]	520	0	N	Y	H	Y
7	524-503-0004	CG	Funfair	1098	0	N	Y	M	Y
8	526-502-0007	CG	Staff	403	0	N	Y	L	Y
9	720-505-0018	Ta	Dapples Creek	906	4	Y	Y	M	Y
10	735-510-0020	Ta	No Bull	312	0	N	N	L	Y
11	739-511-0008	Ta	Old Punt	953	0	N	N	M	Y
12	740-506-0004	Ta	Old Man Hill	957	0	N	N	M	Y
13	760-503-0015	Ta	Joes Track	502	0	N	N	M	Y
14	774-503-0013	Ta	Burwood Road	278	0	N	Y	M	Y
15	774-503-0014	Ta	Big Moose	619	1	Y	Y	M	Y
16	774-503-0015	Ta	Billy Goat	765	0	Y	Y	M	Y
17	894-504-0018	EG	Buttons	138	1	N	Y	M	N
18	893-502-0006	EG	Green Gully	110	0	N	N	M	N
19	892-509-0001	EG	Hubadub	151	0	N	N	M	N
20	892-507-0005	EG	Badgers Foot	312	0	N	Y	VH	N
21	873-502-0011	EG	Nettball	167	0	N	N	L	N
22	873-502-0007	EG	Rumble	146	0	N	N	L	N
23	872-511-0013	EG	Donkey	780	0	N	N	M	N
24	872-511-0009	EG	Lumpy	792	1	N	Y	M	N
25	867-501-0021	EG	Horizon	293	0	N	Y	L	Y
26	867-501-0015	EG	Sunbury	175	0	N	Y	L	Y
27	866-508-0014	EG	Middle road	342	0	Y	Y	M	N
28	831-512-0012	EG	Hoggs Back	201	0	Y	Y	M	Y
29	830-511-0012	EG	Well done	424	0	N	N	L	Y
30	830-510-0008	EG	Tunza Fun	457	0	N	N	M	Y
31	830-510-0004	EG	Behind Pikes farm	117	0	N	N	L	Y
32	830-503-0019	EG	Dancer	376	0	N	N	M	Y
33	829-510-0020	EG	Thunder Bird	316	0	Y	Y	M	Y
34	829-507-0011	EG	Think Big	140	0	Y	Y	L	Y
35	825-518-0021	EG	Mighty Duck	101	0	Y	Y	M	Y

Key:

1. Total ICR length – total length of in-coupe road (m).
2. WWX – number of waterway crossings.
3. Culverts – constructed drainage included culverts.
5. Soil EH – highest soil erosion hazard (from FCP): L – low, M – Medium, H – high, VH – very high.
6. WSC – coupe located in a designated water supply catchment.

4. Surfaced – in-coupe road at least partly surfaced by materials imported into coupe.
7. Superstop coupe is located in a Melbourne Water Corporation catchment (Thomson River dam)

3.2 Audit criteria and workbook

Audit criteria were based on mandatory requirements of the Code and MSP which relate to in-coupe roads. Mandatory actions were grouped into six compliance themes, as follows:

- *Water quality, river health and soil protection:* which largely draws on Code mandatory actions relating to the protection of soil condition, river health and water quality. While these compliance elements apply to in-coupe roads, they also have application to other coupe infrastructure and harvest-related activities.
- *Pests, weeds and diseases:* a small set of compliance elements, drawn largely from the MSP, which are concerned with minimising the risk of introducing weeds and soil-borne pathogens into new areas. This group of mandatory actions was included because these pathogens (particularly *Phytophthora cinnamomi*) can be introduced by road construction machinery and surfacing materials.
- *Road planning and design:* mandatory actions from the Code and MSP relating to planning and design of forest roads, including in-coupe roads.
- *Road construction:* mandatory actions from the Code and MSP relating to road construction, including the management of erosion and sediment during the construction phase, construction of fill batters and road surfacing technique.
- *Road drainage:* mandatory actions from the MSP relating to the placement, design and construction of road drainage, including waterway crossings. This compliance theme potentially considers culverts, bridges and fords, although only culverts were encountered in this audit.
- *Road maintenance, operations and closure:* mandatory actions drawn from the Code and MSP concerning road maintenance, operations during wet and dry weather and closure and rehabilitation following the completion of harvest activities.

The complete set of compliance criteria included in the audit is tabulated in Appendix A. The relationship between compliance criteria and theme is flagged there. Some mandatory elements with potential application to in-coupe roads were not included in the assessment of audit results because they were not applicable to the coupes targeted by the audit.

In some instances, additional criteria were created to assist in the assessment process. These were designed to ensure its transparency. They were generally concerned with either the existence of documentary or other evidence demonstrating compliance with an audit criterion or the auditor's professional opinion about the adequacy or appropriateness of actions undertaken in response to a mandatory action. Audit criteria were compiled into a workbook which was used to capture each of the coupe assessments. An example of this workbook with all of the audit criteria is given in Appendix A.

3.3 Field assessments

Audit assessments were carried out in the field for each of the 35 selected coupes. The field assessment comprised completion of an audit workbook (Appendix A) and assessments of the in-coupe roads and any drainage structures. Each of the compliance elements in the workbook were assessed as to their applicability to the in-coupe road and coupe in question. The assessment was based on documentary evidence in VicForests' coupe files or related records and observations by the field audit team. Coupes and their in-coupe roads were assessed to either fully, partly or not comply with each element, as per Table 3.3. The workbook was also used to capture the basis for the assessment.

A set of field measurements and observations were taken in each of the target coupes to support the assessments against compliance elements. Data were gathered for the full length of in-coupe road and/or the driveway constructed (or upgraded) to access the coupe. The set of potential measurements and observations taken on each coupe are described below. Only those measurements and observations which were relevant to the target coupe were taken. Road drainage was the only aspect assessed for each audit coupe.

- *Road drainage:* Appendix 4 of the MSP specifies the maximum allowable distances between drainage structures for given road grades and soil erosion hazard. Longitudinal surveys of in-coupe roads and coupe driveways were undertaken to assess compliance with those standards. The surveys measured the road grade and distance between drainage structures. Observations of the type of structure (e.g. culvert, invert, along-road out-sloping, run-offs), their effectiveness and the appropriateness of drainage water dispersal were also recorded.

  Any environmental impact potentially arising from drainage water dispersal was assessed (using the environmental impact assessment [EIA] tool; Appendix C) for each point at which water was shed from the road alignment[4]. The presence and breaching of any soil windrows on the outer edge of in-coupe roads was also assessed.
- *Road clearing width:* Table 20 in Appendix 4 of the MSP specifies minimum clearing widths for construction of each forest road class. This was only assessed for roads constructed to access the coupe through native vegetation which was to be retained. It was not assessed for previously existing roads or tracks or where the native vegetation was yet to be harvested.
- *Waterway crossings:* the MSP include various requirements for the location and construction of waterway crossings in forest roads. Observations and measurements were taken to determine if the design, construction, use and rehabilitation of the crossing were consistent with applicable standards.
- *Waterway crossing structures:* the MSP consider three main forms of crossing structure: culverts, bridges and fords. Only culverts were encountered during this audit. Observations and measurements were taken to assess compliance with relevant mandatory actions.
- *Fill batters:* the MSP also includes several criteria relating to fill batters (Appendix A) which are applicable to this audit. Observations of fill batters were taken during the longitudinal road survey to assess compliance with mandatory requirements.

Table 3.3 Descriptors for assessments against audit compliance elements

Level of compliance	Fully complies	Partly complies	Does not comply
Description	All requirements of the compliance element are fully satisfied.	Not all requirements of the compliance element are fully satisfied, however there is no evidence or suggestion of risk of harm to the environment as a result.	The level of non-compliance with requirements is such that there is an assessable risk of harm to the environment (based on the Environmental Impact Assessment [EIA] tool, Appendix C).

3.4 Environmental impact assessment

DELWP requested that auditors assess the environmental impacts of any non-compliance using the EIA tool (Appendix C). This tool assesses the potential severity of environmental impact based on:

- *Extent of impact:* which measures the proportion of the coupe area affected by the non-compliance and/or the length over which its impact extends beyond the authorised harvesting area. The length assessment considers land beyond the coupe boundary and in defined exclusion areas (e.g. Special Protection Zones).
- *Duration of impact:* the anticipated duration of any effect on environmental values.
- *Likelihood of recovery:* the anticipated extent to which cessation of harvest, coupe rehabilitation and regeneration would mitigate potential environmental impacts.
- *Significance of impact:* which is based on the value or environmental aspect experiencing or potentially experiencing an impact stemming from the non-compliance. General forest areas are valued less than riparian or rainforest buffers and Special Protection Zones.

The overall five-point EIA rating is based on the total score for each component. Ratings range from negligible to severe. No severe EIA ratings were detected in this audit.

[4] Environmental impact was always assessed to be negligible, hence these observations were not recorded and are not discussed.

4. Audit findings

This discussion of the findings of this environmental audit of the construction and maintenance of in-coupe roads is structured around the six main compliance themes (Section 3.2). It follows a brief description of the characteristics of the audited coupes.

4.1 Characteristics of audit coupes and in-coupe roads

A summary of characteristics of the coupes in which this audit was conducted is given in Table 4.1. The majority of these coupes (25 of 35) were located in proclaimed water supply catchments. As a result, they were potentially sensitive to any sediment movement resulting from poorly planned, constructed and/or maintained in-coupe roads. This sensitivity was mitigated to some extent by the relatively stable soils of most coupes (only 3 of 35 with high soil erosion hazard[5] or greater in the A, B and/or C horizon) and the relatively low frequency of waterway crossings (only 4 of 35 coupes had crossings).

Figure 4.1 Road (Class 5C) in Saxtons Bend coupe located in wet, mountain forests and used to access multiple coupes. The road was surfaced with gravel and had a variety of effective constructed drainage structures (although no culverts).

The auditor found that coupe planning by VicForests and their contractors typically reduced the length of in-coupe road to the minimum necessary to access the coupe. This helped to constrain harvest costs and comply with Code requirements to develop coupe infrastructure (including roads) only to the extent required to safely harvest the coupe. Wherever possible, pre-existing roads or tracks were used by VicForests to access coupes. Landings were typically located as close to these as was feasible, although sometimes in-coupe roads were used by contractors to reduce the costs and disturbance associated with snigging. Roads were typically surfaced with gravel only where this was necessary to maintain access during wet conditions or where the road was to be used over several harvest seasons.

Figure 4.2 Temporary in-coupe road (Class 5D) constructed to access Dancer coupe over a harvest period of 1-2 months. The road was constructed from local materials. Cross drainage was constructed following harvesting and prevents uncontrolled water movement along the road surface while regeneration takes place on the road and coupe.

Drainage during the operational use of many roads was found to be developed only to the extent required. Roads within coupes which were harvested over a few weeks during summer typically had minimal constructed drainage until harvesting was completed. Cross drains were constructed only as harvesting machinery exited the coupe. Surfaced roads with well-developed drainage tended only to be constructed within coupes which were to be accessed over winter or where the in-coupe road was intended to be used to access multiple coupes (often) over several seasons. This was reflected in the relatively low frequency of surfaced roads within the audited coupes and the even smaller number of roads in which culverts had been installed (Table 4.1). Contrasting examples of in-coupe roads

[5] Soil erosion hazard is a composite index of soil condition which indicates the likelihood of erosion. It is assessed for each coupe during harvest planning.

encountered during the audit are provided in Figure 4.1 and Figure 4.2.

The actual length of in-coupe road varied markedly between audited coupes (Figure 4.13). Despite the audit targets being selected from a set of coupes with planned in-coupe road lengths exceeding 400 m, the actual length of road ranged from as little as 101 m in Mighty Duck coupe to over 1600 m in Calloway coupe . The average length of road in the audited coupes was 478 m. Only in East Gippsland FMA was the average length of road within audited coupes less than 400 m (Table 4.1).

Table 4.1 Summary of relevant characteristics of audit coupes.

Details for individual audit coupes are given in Table 3.2.

	Forest Management Area			
Characteristic	**Central Gippsland**	**East Gippsland**	**Midlands**	**Tambo**
# audited coupes	6	19	2	8
Coupes with waterway crossings	0	2	0	2
Coupes with culverts	1	5	0	3
Coupes with surfaced roads	5	10	0	4
Coupes in water supply catchments	5[1]	10	2	8
Coupes with soil erosion hazard ≥ high	2	1	0	0
Average length of in-coupe road	851 m	291 m	403 m	662 m

1. One of the coupes (Superstop) was located in a Melbourne Water Corporation catchment area (of the Thomson River Dam).

4.2 Water quality, river health and soil protection

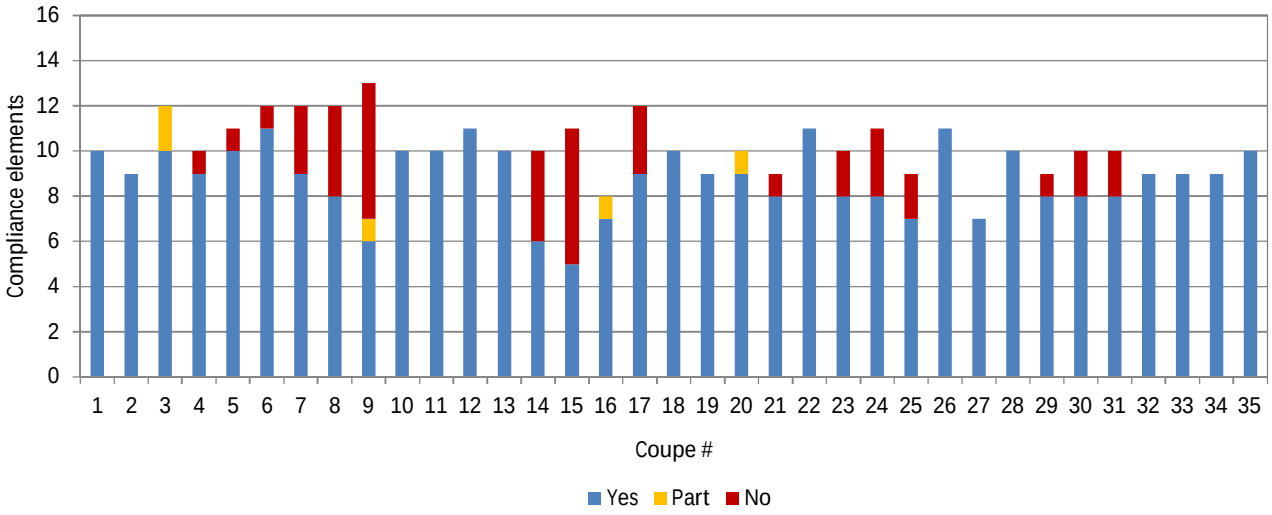
This compliance theme draws on Code mandatory actions which are intended to minimise the impact of timber harvesting operations on water quality, river health and soils. Most actions are not specific to roads, but address the potential impacts of various forms of coupe infrastructure (also including landings, snig tracks and boundary tracks). Some mandatory actions reference specific actions within the MSP which aim to protect these values. This compliance theme is important as unsealed roads are generally among the main sources of sediment mobilised into waterways within forested catchments (Reid and Dunne, 1984).

Compliance with applicable criteria is summarised in Figure 4.3. No more than 13 of the 16 criteria were applicable in any particular coupe. Overall, the audit found 87% full compliance with applicable criteria, with 100% compliance for 16 of the 35 audited coupes.

Non-compliance assessments triggered an assessment of environmental impact (using the EIA tool; Appendix C) for 13% of applicable criteria. These were the result of 20 individual “incidents” within 16 coupes (Figure 4.3), five of which were found in Dapples Creek coupe (#9). The assessed environmental impact ranged between negligible and major.

Three main types of non-compliance “incident” were identified in the audit:

- *Distances between effective drainage structures exceeded MSP standards for the applicable road grade and soil erosion hazard*: this type of incident most commonly occurred as the result of the failure of some drainage structures due to poor construction technique and/or damage sustained from subsequent vehicle traffic. There were also instances where drainage structures were not constructed following completion of harvesting and where they were constructed several metres further apart than the maximum allowed under the MSP. The assessed environmental impact associated with this type of incident was either negligible or minor. This issue is discussed further in Section 4.6.1.



a) Compliance assessment: number of compliance elements fully, partly or not satisfied. Yes – compliance element fully satisfied. Part – compliance element partly or not satisfied, no environmental impact. No – compliance element partly or not satisfied – environmental impact assessed.

Coupe	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Incidents & EI	0	0	0	1	1	1	1	1	5	0	0	0	0	1	1	0	1	0	0	0	1	0	1	1	1	0	0	0	1	1	1	0	0	0	0

	Fully compliant		Partial non-compliance. No EI.		Non-compliance. Negligible EI.
	Non-compliance. Minor EI.		Non-compliance. Moderate EI.		Non-compliance. Major EI.
	Non-compliance. Severe EI.	#	No. incidents causing non-compliance & EI to be assessed.		

b) Environmental impact assessment: number of non-compliance incidents and the level of environmental impact (EI) assessed using the EIA tool (Appendix C).

Figure 4.3 Summary of audit assessment results for individual coupes. Compliance elements relate to water quality, river health and soil protection. Coupe name and FMA are given in Table 3.2.

- *Waterway crossings which do not satisfy Code and MSP requirements*: while waterway crossings were present at only four of the audited coupes, this issue was among the major sources of non-compliance requiring environmental impact assessments. Waterway crossings for in-coupe roads associated with three coupes were observed to be delivering sediment directly into waterways (e.g. Figure 4.4). Assessed environmental impacts associated with poor waterway crossing construction were either moderate or major. Waterway crossing issues are discussed in detail in Section 4.6.2.

Figure 4.4 Waterway crossing at the boundary of Lumpy coupe (#24). The road did not have the necessary drainage diversion structures and consequently sediment has entered the drainage line.

- *Excessive disturbance to soils or waterways*: several instances were observed where the scale of post-harvest road drainage construction was considered to be disproportionate to the risk. This took the form of very large cross drains which were used to "bar and breach" the in-coupe road or of unnecessarily large run-off structures. For Nettball coupe (#21), which had minimal slope, the disturbance associated with constructed run-off structures was assessed as having caused minor environmental impact.

In general, in-coupe roads were found to have been located so that avoidable disturbance to waterways did not occur. There was typically sufficient separation between the roads and waterways for mobilised sediments to be

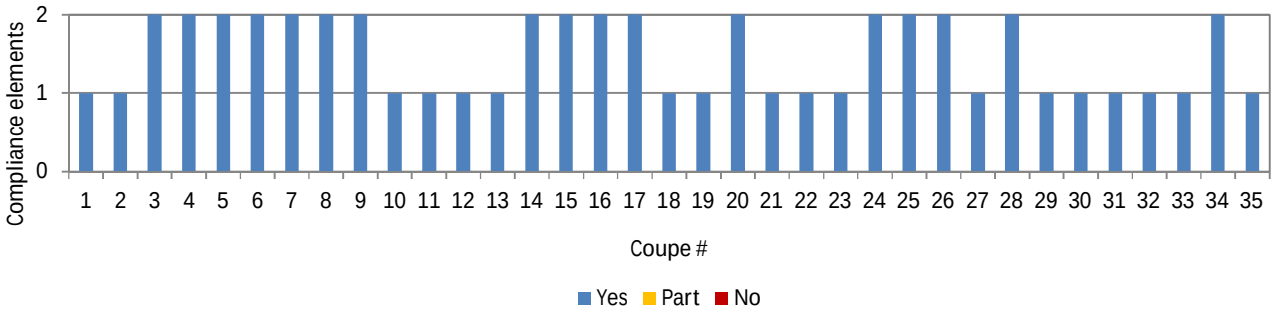
intercepted before reaching waterways. Where used waterway crossings, were found to be unavoidable and and appropriately located.

Where seasonal closure restrictions were required in water supply catchments (under the MSP), these were found to have been observed. One instance of activity within a coupe outside the prescribed season was identified, however documentary evidence was produced by VicForests to demonstrate prior approval had been provided by DELWP.

4.3 Pests, weeds and diseases

The movement of machinery, soil, gravel and crushed rock during the construction of in-coupe roads provides opportunities for dispersal of weeds and forest pathogens. The Code and MSP seek to reduce the risk of weed or pathogen introduction during roading through mandatory coupe hygiene procedures. Two compliance elements were identified (Figure 4.6), only one of which was applicable to coupes with unsurfaced roads.

Based on standard VicForests hygiene procedures, the sourcing of road surfacing materials from established quarries and, in some cases treatment of gravel, all of the coupes included in the audit were assessed to fully comply with the applicable criteria (Figure 4.6).



Number of compliance elements fully, partly or not satisfied. Yes – compliance element fully satisfied. Part – compliance element partly or not satisfied, no environmental impact. No – compliance element partly or not satisfied – environmental impact assessed. As all coupes were assessed as fully complying with applicable criteria, no assessment of potential environmental impact was required.

Figure 4.6 Summary of audit assessment results for individual coupes. Compliance elements relate to pests, weeds and diseases. Coupe name and FMA are given in Table 3.2.

4.4 Road planning and design

The Code's operational goals for roading are that permanent and temporary roads are fit-for-purpose, safe for all users and do not impair environmental and cultural values. Planning and design are considered to be critical in achieving these goals. Timber harvesting road design must move water from roads onto undisturbed vegetation to reduce its velocity and trap sediments before reaching a waterway (DEPI, 2013a). Since there is limited undisturbed vegetation during and immediately after harvesting, the location of in-coupe roads away from waterways helps to protect water quality and river health values. The design of any waterway crossings and road drainage leading up to them is also critical.

Road planning and design should consider road location, configuration, drainage and surfacing

Figure 4.5 Road in Funfair coupe (#7) traversing a steep slope. The embankment failed due to water movement below it and is likely to continue to collapse. Engineering advice on construction was not sought. EIA rating is currently moderate, but the environmental impact may worsen as the embankment continues to fail.

materials. It also requires that consideration be given to the use of existing roads and tracks within or near the coupe.

Planning and design requirements should escalate with risk. Greater effort should be applied to locating roads in coupes with waterways, steep slopes and/or erodible soils. Specialist design advice may be required where roads have to traverse steep and/or wet terrain and require large side cuts and embankments to be constructed (Figure 4.5). Waterway crossings and the associated drainage also require design effort to prevent the discharge of road drainage sediment into waterways.

"Planning" was expressed in the audited coupes in the form of in-coupe roads generally being located away from higher risk areas, such as waterways, wet areas and steep slopes. Documented evidence of planning was generally represented as the marking (in GIS) of the planned in-coupe road location(s) on the Operations Map. Several of the Forest Coupe Plans (FCP) reviewed in this audit included "Roadworks Plans", but these were for construction and did not document any planning or specific design elements. In only one coupe (Funfair) was there evidence of alternative in-coupe road alignments being considered. Where the actual route of the road differed from the planned route, there was generally no documentation as to why this was the case.

Recommendation VF-01	Priority: moderate

VicForests should document its planning of in-coupe roads in the "Roading" section of the FCP. Documented evidence of planning should include:

- Map of the planned road alignment;
- Explanation of rationale for the planned alignment;
- Analysis and discussion of the environmental and other risks posed by the road and which are to be managed through planning;
- Discussion of any alternatives routes to manage risks from waterway crossings, other wet areas, steep slopes etc.

If the actual and planned route of an in-coupe road differ substantively, an additional entry should be made in the FCP to explain the divergence and a map should be included which shows the actual route taken.

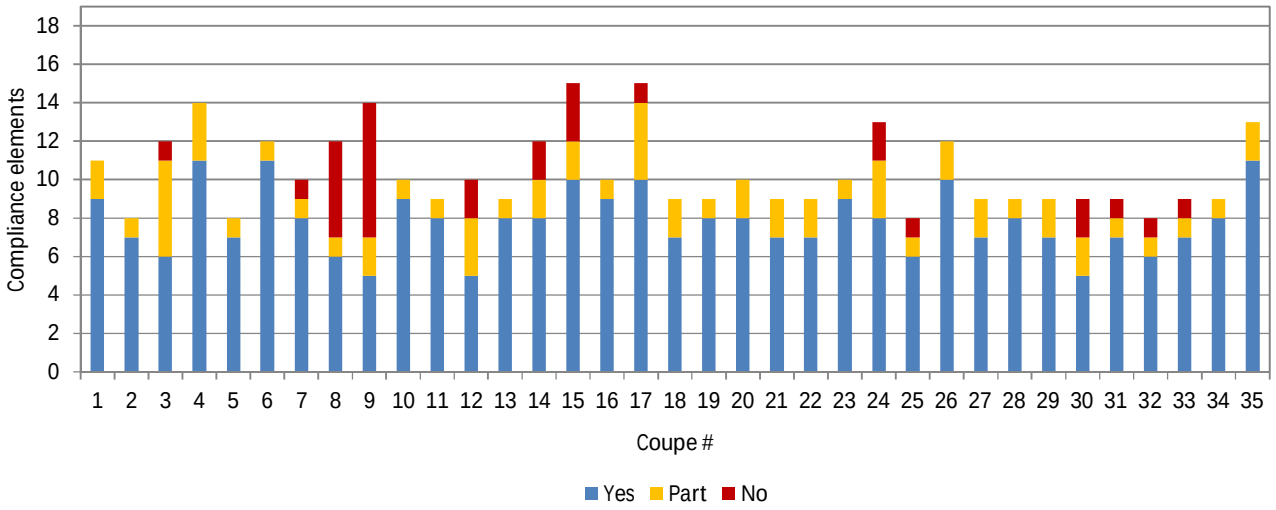
In some respects, "design" was even less conspicuous than planning in VicForests management of in-coupe roads. Coupe files reviewed in this audit rarely included explicit evidence of design considerations. VicForests advised the auditor that its standard practice was to follow relevant specifications contained in their *Utilisation Procedures* (UP; VicForests, 2013). This document is VicForests' basis for design and draws on relevant Code and MSP requirements. The UP specify high risk situations for which additional specialist advice should be sought (and is required under the MSP).

Nineteen compliance elements were identified for road planning and design, although no more than 15 were applicable to any of the audit coupes (Figure 4.7). Overall, the audit found 75% full compliance with applicable criteria. None of the coupes recorded 100% compliance with audit criteria, which reflects a (minor) systemic issue with VicForests in their planning and design processes (see below).

Environmental impacts were assessed for non-compliances related to 9% of applicable criteria (Figure 4.7). Overall, 18 non-compliance incidents in 13 coupes triggered environmental impact assessments. Multiple incidents were recorded in two coupes. The assessed environmental impacts ranged between negligible and major.

The main types of non-compliance incident for road planning and design which were identified in this audit were:

- *Waterway crossings which did not satisfy Code and MSP requirements*: the issues for this compliance theme are similar to those canvassed in Section 1 and are discussed in greater detail in Section 4.6.2.



a) Compliance assessment: number of compliance elements fully, partly or not satisfied. Yes – compliance element fully satisfied. Part – compliance element partly or not satisfied, no environmental impact. No – compliance element partly or not satisfied – environmental impact assessed.

Coupe	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Incidents & EI	0	0	1	0	0	1	0	1	5	0	0	1	0	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2	1	1	1	0	0

	Fully compliant		Partial non-compliance. No EI.		Non-compliance. Negligible EI.
	Non-compliance. Minor EI.		Non-compliance. Moderate EI.		Non-compliance. Major EI.
	Non-compliance. Severe EI.	#	No. incidents causing non-compliance & EI to be assessed.		

b) Environmental impact assessment: number of non-compliance incidents and the level of environmental impact (EI) assessed using the EIA tool (Appendix C).

Figure 4.7 Summary of audit assessment results for individual coupes. Compliance elements relate to road planning and design. Coupe name and FMA are given in Table 3.2.

- *Not seeking and/or documenting engineering advice for the design of roads passing through steep areas and for embankments:* the MSP mandates that engineering advice is to be sought for road alignments traversing slopes of 25° or more in areas with high soil erodibility or slopes of 30° or more in other areas. Roads within two coupes (Saxtons Bend, Staff; #3,8) with moderate soil erodibility traversed slopes of about 30°. Engineering advice was not sought in either case. In Staff coupe, the road embankment had begun to fail at the time of the audit (Figure 4.5). In Saxtons Bend coupe, some minor slumping was observed in part of a side cut, but no environmental impact assessment was recorded.

  Section 2.4.2.3 of the Code requires that embankments be planned and designed to minimise soil erosion, mass movement and water quality deterioration. No evidence of such planning or design was obtained for any of the coupes with significant embankments (>1 m in height). In most cases, there was no evidence that this posed additional risk to soil and water quality values for the coupe. However, seeking engineering advice for Saxtons Bend and Staff coupes may have avoided the issues observed there. Such advicemay also have prevented the likely failure of part of a landing embankment located on a steep slope (>20°) in Dapples Creek coupe (#9; Figure 4.8).

Figure 4.8 Cracking in a landing embankment located on a steep slope in Dapples Creek coupe. It is likely that part of the landing will fail, resulting in mass soil movement down slope. No evidence that engineering advice was sought for the construction of this landing was found during the audit.

- *Absence of energy dissipating structures or silt traps:* in locations where these were required to trap sediments before road

drainage entered waterways. Local topography in the Dapples Creek coupe (#9) and the placement of the road in a box cutting in the Lumpy coupe (#24) made it difficult to direct road drainage through adjacent vegetation and avoid the discharge of sediment directly into waterways. Silt traps or related devices could have been used in both cases to reduce the environmental impact of the crossings.

- *Drainage over exposed erodible soil or fill slopes*: the Code requires that drainage over exposed erodible soils and fill slopes is avoided where possible and that structures to manage this are incorporated into planning and construction. Numerous instances were observed (in over half the coupes) where some uncontrolled drainage over fill slopes was observed. This was generally unavoidable and observed to have no or negligible environmental impact. However, in some cases the flow of discharging drains was observed to have initiated erosion of high embankments, without any apparent consideration of the construction of any mitigating measures.
- *Discharge of drainage onto a road:* this was observed in six coupes in contravention of the Code. In one case this was due to the failure of cross drainage on a snig track, but in most other cases it was the result of design and construction shortcomings. The assessed environmental impact associated with this non-compliance ranged up to moderate.

  A good practice example of avoiding discharge of drainage onto a road was observed on Saxtons Bend coupe. A silt trap was successfully used above a road switchback to capture road drainage and sediment, rather than allow it to discharge onto the segment of road below (Figure 4.9).

Figure 4.9 An example of a silt trap being used to capture drainage from one side of a road to avoid direct discharge onto a lower segment of the same road (Saxtons Bend coupe).

- *Non-identification of the road class:* The MSP requires the intended class of a new road or road upgrade to be identified. While VicForests' UP specifies that in-coupe roads are to be constructed to class 5C or 5D design specifications, there was no evidence from the FCP reviewed in this audit that the actual classification was identified and recorded. While there is no environmental impact associated with this issue, it does represent a (minor) systemic source of non-compliance.

Despite the limited formal and documented planning or design of in-coupe roads by VicForests, road construction outcomes were acceptable in most cases considered in this audit. This informal level of planning and design was generally found by the auditor to avoid high risk locations for the in-coupe roads and any associated environmental impacts. This appears to reflect the expertise of the personnel involved and the consideration which goes into coupe and in-coupe road planning.

The auditor recognises that it may sometimes be necessary for in-coupe roads to be constructed through high risk locations. Where they do so and require large embankments and side cuts to be constructed, the lack of formal road planning and (particularly) design may have contributed to the avoidable failure of an embankment and the resulting environmental impact.

Recommendation VF-02	Priority: high

VicForests should be more proactive in seeking engineering advice on the design and construction of in-coupe roads where they will traverse areas of steep slope and require deep side cuts and/or large fill embankments to be constructed. The precise limits for seeking engineering advice prescribed by the MSP (i.e. 30°/25° for areas with lower/higher soil erodibility) are not necessarily consistent with the limited accuracy of available topographic mapping, digital elevation models or field measurement. It is recommended that engineering advice is sought in these higher risk areas, based on the possibility (>50% chance) that:

- Side slopes will be within 5° of the respective MSP limit; and/or
- Side cuts or embankments greater than 2 m in height will need to be constructed.

Recommendation VF-03	Priority: moderate
VicForests' FCP records should include the actual basis for design of its in-coupe roads, road drainage, larger embankments and waterway crossings. Record keeping should be proportional to the level of risk which is addressed through road design. The minimum requirement should be to specify the class of road (as per MSP Appendix 4) and explicitly reference which UP provisions are addressed by the road design. Evidence of engineering advice and how this has been incorporated into road design and construction should also be included whenever it has been sought.	
Recommendation DE-01	**Priority: moderate**
DELWP should modify the wording of MSP section 6.1.1.3 regarding the requirement to seek engineering advice for road construction across steep slopes. The revised wording should reflect the limited accuracy of slope measurements taken from available topographic data or taken in the field in unharvested coupes. It is suggested that engineering advice is sought for the design of roads traversing areas where it is possible (>50% chance) that: side slopes will be within 5° of the respective MSP limit; and/or side cuts or embankments greater than 2 m in height will need to be constructed.	

4.5 Road construction

The Code requires roads to be constructed in a manner which is consistent with planning and design and hence the applicable Code and MSP compliance elements. Since VicForests' UP specifies design requirements for in–coupe roads, these must also be adhered to. Specific criteria for this compliance theme are concerned with mitigating the risk of erosion and sediment movement during the construction period, the construction of fill batters, road paving and prior clearing of the planned route.

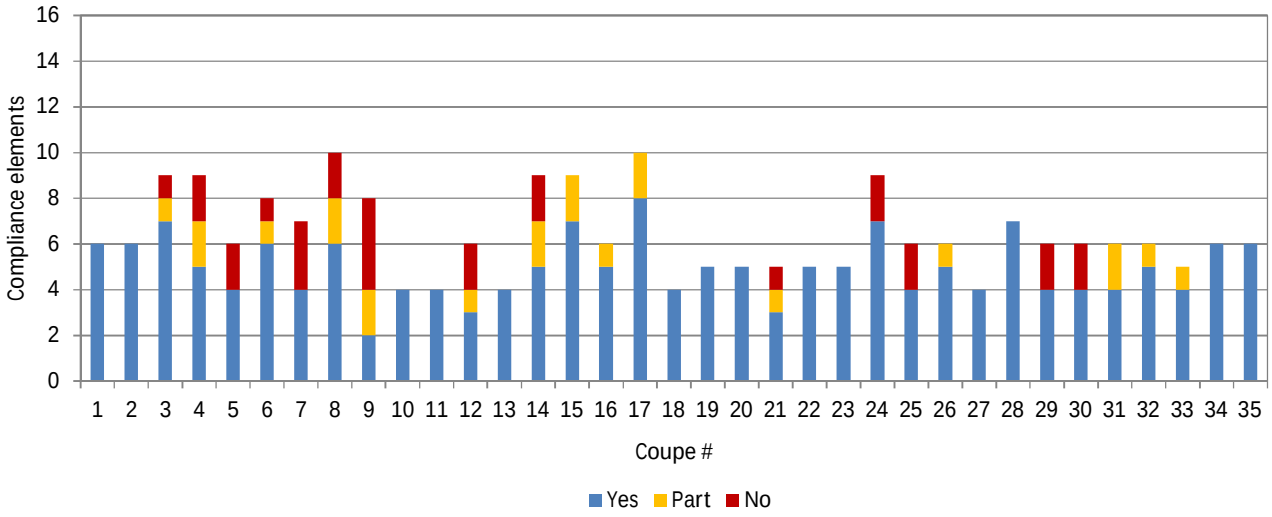
Construction-phase erosion and sedimentation risks vary widely with location and the scale of in-coupe road. Many of the in-coupe roads inspected in this audit (particularly in East Gippsland FMA) were short, used only to access a single coupe and were not elaborately constructed. Construction occurred during drier months, took days rather than weeks and thereby effectively mitigated most construction-phase risks. Other in-coupe roads were located in more difficult terrain, were longer and were planned to be used over several harvest seasons. These roads were surfaced, required constructed drainage infrastructure and were built over an extended period. This exposed them to much greater construction-phase erosion and sedimentation risk and should have been accompanied by greater risk mitigation effort.

Sixteen compliance elements were identified for road construction, although no more than 10 were found to be applicable to any of the audited coupes (Figure 4.10). Overall, the audit found 77% full compliance with applicable criteria. Fourteen coupes recorded 100% compliance.

Environmental impacts were assessed for non-compliances related to 13% of applicable criteria (Figure 4.10). Overall, 25 non-compliance incidents in 16 coupes triggered environmental impact assessments. Multiple incidents were recorded in five coupes, with assessed environmental impact ranging between negligible and major (Figure 4.10).

Several sources of non-compliance for road construction were identified, including:

- *Failure to construct in-coupe roads in accordance with plans and designs*: this typically occurred when waterway crossings and/or drainage structures were not constructed to UP specifications and Code or MSP requirements. These issues are discussed in detail in Section 4.6.
- *Mechanical consolidation of fill batters*: the MSP require the use of engineer-approved methods for the consolidation of fill batters. There was no evidence from the FCP which were reviewed in this audit that such methods had been identified or applied during construction for any of the in-coupe roads with significant embankments. Generally there was no observable environmental impact associated with this issue. However a moderate environmental impact was recorded for Staff coupe (#8), in which a road embankment was failing (see Section 4.4).



a) Compliance assessment: number of compliance elements fully, partly or not satisfied. Yes – compliance element fully satisfied. Part – compliance element partly or not satisfied, no environmental impact. No – compliance element partly or not satisfied – environmental impact assessed.

Coupe	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Incidents & EI	0	0	1	1	1	1	1	1	6	0	0	2	0	2	0	0	0	0	0	0	1	0	0	1	2	0	0	0	1	2	1	0	1	0	0

	Fully compliant		Partial non-compliance. No EI.		Non-compliance. Negligible EI.
	Non-compliance. Minor EI.		Non-compliance. Moderate EI.		Non-compliance. Major EI.
	Non-compliance. Severe EI.	#	No. incidents causing non-compliance & EI to be assessed.		

b) Environmental impact assessment: number of non-compliance incidents and the level of environmental impact (EI) assessed using the EIA tool (Appendix C).

Figure 4.10 Summary of audit assessment results for individual coupes. Compliance elements relate to road construction. Coupe name and FMA are given in Table 3.2.

- *Embankments covering the base of live trees*: the MSP requires that this be avoided during road construction. For this audit of in-coupe roads, non-compliance was only assessed where the base of trees which were to be retained to provide long-term habitat or were located outside of the planned harvest area was at least partly covered. Four coupes were identified with embankments or fill batters which had at least partly covered the base of retained trees (Figure 4.11). The environmental impact associated with this non-compliance was always assessed as negligible.

Figure 4.11 Fill batter covering the bases of live trees outside the harvest area of Dapples Creek coupe.

It was not apparent from the audit that measures to mitigate erosion and sedimentation risks were undertaken during the construction of higher risk roads (e.g. those with greater length, crossing steep slopes or wet areas, used over longer periods). Some construction risk mitigation measures are specified in VicForests' UP and were presumably followed. However, there was no documentary evidence of this within the FCP which were reviewed. Nor was there evidence (for coupes without waterway crossings) that such measures were required.

Recommendation VF-04	Priority: moderate
VicForests should actively seek to reduce the incidence of road fill embankments covering the base of live trees which are retained within coupes. The mandatory nature of this requirement should be reinforced with contractors by targeted training, monitoring, reporting and corrective action (if non-compliance is detected).	

The road in Lumpy coupe was found not to comply with the requirement for erosion and sediment control during construction on the basis that there was no apparent effort to prevent (the observed) delivery of sediment into the waterway at the crossing: which had been upgraded by VicForests to allow access to this and an adjoining coupe. The environmental impact associated with sediment delivery into the waterway was assessed to be moderate.

MSP compliance elements relating to road construction also address consolidation of the road base and use of surfacing materials. This was not considered to be relevant to unsurfaced roads and could not be definitely assessed for surfaced roads which had already been constructed.

Construction of in-coupe roads by VicForests and their contractors was generally successful in reducing avoidable disturbance to soils and waterways. This largely reflected their usual placement away from higher risk areas and a level of effort in road construction which was typically proportional to risk.

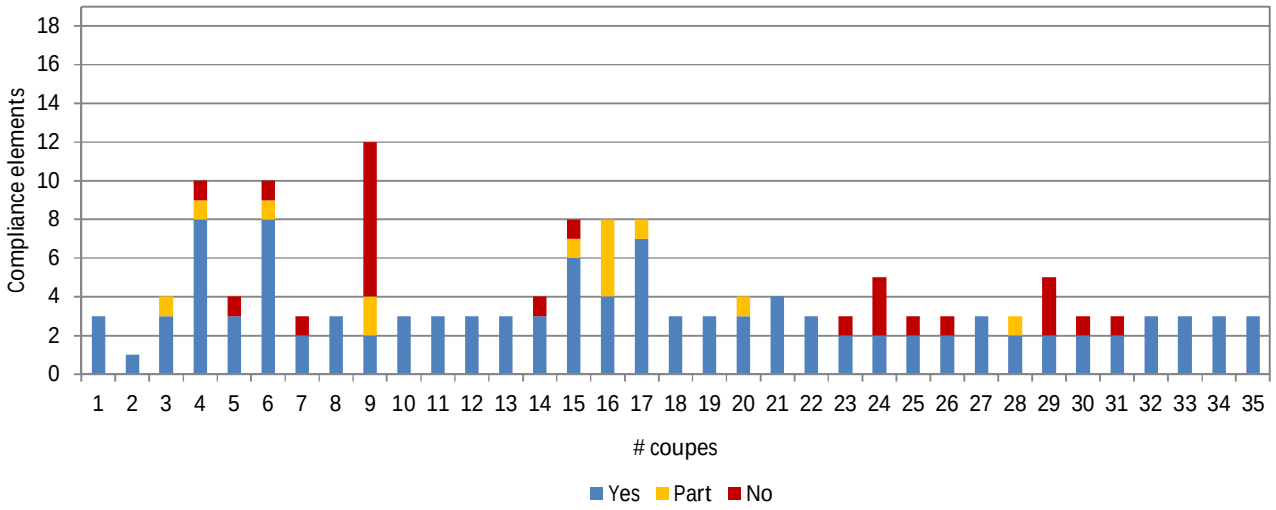
4.6 Drainage

The main risks to environmental values from in-coupe roads are posed by road drainage and waterway crossings. These are critical considerations in road planning and design, as poorly located, designed and/or constructed drains and crossings have potential to lead to erosion and the delivery of sediments into streams. Depending on the scale of impact, this may adversely affect river health and the human and environmental uses of the water.

Nineteen compliance elements were identified for road drainage. These related to the placement and function of drainage structures along roads, waterway crossings, the use of culverts and the management of drainage discharge to avoid sediment delivery into waterways. Each group of compliance elements is discussed below. MSP criteria relating to bridges and fords were not applicable to any of the audited coupes.

No more than 12 compliance elements were found to be applicable to any of the audited coupes (Figure 4.12). Overall, the audit found 75% full compliance with applicable criteria. Fourteen of the coupes recorded 100% compliance. These typically had short lengths of in-coupe road, which were for temporary use and were not elaborately constructed.

Environmental impacts were assessed for non-compliances related to 13% of applicable criteria (Figure 4.12). Overall, 19 non-compliance incidents in 14 coupes triggered environmental impact assessments. Multiple incidents were recorded in two of these coupes, including five incidents in coupe #9. The assessed environmental impact ranged between negligible and major.



a) Compliance assessment: number of compliance elements fully, partly or not satisfied. Yes – compliance element fully satisfied. Part – compliance element partly or not satisfied, no environmental impact. No – compliance element partly or not satisfied – environmental impact assessed.

Coupe	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Incidents & EI	0	0	0	1	1	1	1	0	5	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1	1	1	0	0	2	1	1	0	0	0	0

	Fully compliant		Partial non-compliance. No EI.		Non-compliance. Negligible EI.
	Non-compliance. Minor EI.		Non-compliance. Moderate EI.		Non-compliance. Major EI.
	Non-compliance. Severe EI.	#	No. incidents causing non-compliance & EI to be assessed.		

b) Environmental impact assessment: number of non-compliance incidents and the level of environmental impact (EI) assessed using the EIA tool (Appendix C).

Figure 4.12 Summary of audit assessment results for individual coupes. Compliance elements relate to road drainage. Coupe name and FMA are given in Table 3.2.

4.6.1 Spacing between along-road drainage structures

Surveys were conducted along the full length of roads in all of the audited coupes to determine the spacing and functionality of drainage structures and their compliance with MSP requirements. Figure 4.13 plots the total length of road assessed for each coupe[6] and the total length of road which was in excess of the permitted spacing between drainage structures ("excess length").

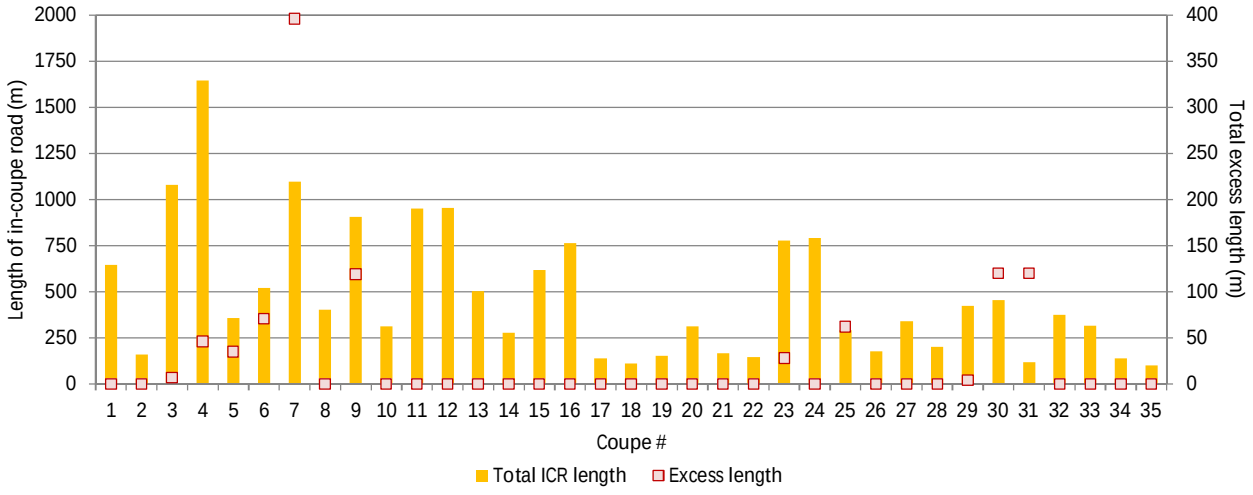


Figure 4.13 Total length of in-coupe road included in field assessments for each of the audited coupes and the total length of road in excess of permitted distances between functioning drainage structures (excess length). Excess length values for coupes 30 and 31 (Tunza Fun, Behind Pikes Farm) relate to the same length of road, which extends from coupe 30 to coupe 31. Details of coupe name and FMA are given in Appendix B.

[6] In some cases the road which was assessed was at least partly a driveway into the coupe from a nearby road and was not necessary all located "in-coupe". In most cases the survey considered the full length of in-coupe road.

Excessive distance between drainage structures was found to have been caused in several ways. In a small number of coupes, it resulted from drainage structures being placed slightly further apart than prescribed by the MSP for the appropriate combination of soil erosion hazard and slope. The most common issue was the failure of drainage structures which were placed well within the required distances. Failure resulting from poor construction and/or damage caused by post-harvest vehicle traffic left the remaining working structures placed too far apart for the road to satisfy MSP requirements. For three of the audited coupes (Funfair #7; Tunza Fun #30; Behind Pikes Farm #31), excessive distance between drainage structures resulted from failure to construct the structures at any stage in the operational life of the road, including after the cessation of harvesting[7]. Environmental impacts associated with excessive spacing between drainage structures was never assessed as being greater than minor.

The issues identified in coupes 7, 30 and 31 are considered by the auditor to reflect risks inherent in VicForests' construction practices for some in-coupe roads, particularly shorter and not elaborately-constructed roads. Roads in many such coupes had no or only minimal constructed drainage systems during their operational lives. Drainage was only constructed following harvesting completion, when cross drains (inverts, roll-overs or snig-track like "bars and breaches") were installed as harvest machinery were being withdrawn.

Risks inherent in this practice may be exposed in three main scenarios, two of which were identified during this audit. The first is that a severe rainfall event occurs during the operational life of the coupe. In the absence of drainage structures (and other protective measures), this may damage the road, contribute to erosion and lead to sediment being mobilised into waterways. The second main scenario (which applied to Tunza Fun and Behind Pikes Farm coupes) is that harvesting ceases temporarily and machinery is removed. If drainage is not constructed as this occurs and there are unexpected delays in the resumption of harvesting (as occurred with these coupes), the road may erode and sediment may be mobilised towards waterways. The third scenario is that drainage construction is neglected when harvesting is completed and use of the road ceases. This occurred in Funfair coupe. When harvesting in a coupe further along the road was completed, the connecting section to this coupe was appropriately drained. However no drainage was constructed along the remainder of the road.

It is arguable that VicForests' practice of not constructing drainage on many in-coupe roads with very short operating lives (i.e. weeks to <3 months) until the suspension or completion of harvesting is not compliant with the Code (2.4.2.5 *Road drainage must be provided*) and their own UP (12.7.1 *A Contractor must ensure that … in-coupe roads are effectively drained … and run-offs, cross-drains or culverts are constructed*). However, the auditor only took this view where in-coupe roads were left without any effective drainage for an extended period, including over the seasonal closure period and/or in the vicinity of waterway crossings. Not constructing formal drainage on these very temporary and non-elaborate roads when they are located in low risk areas is not considered to pose an undue risk of harm to the environment. However, it is essential that contractors drain roads correctly on their exit from coupes and that this is confirmed during temporary and/or final coupe clearance monitoring.

Recommendation VF-05	Priority: high
VicForests should ensure that contractors construct MSP-compliant cross drainage systems along temporary in-coupe roads with less than 6 months intended use. This drainage should be constructed prior to a forecast significant rainfall event and/or to the temporary or permanent removal of harvesting machinery from the coupe. Construction of appropriate drainage systems must be confirmed through VicForests' temporary or final clearance monitoring process. Drainage systems should be constructed prior to the use of any in-coupe road which is intended to be used for more than 6 months.	

4.6.2 Waterway crossings

Despite only four coupes with waterway crossings being included in the audit, crossings were the most significant compliance issue identified and the main cause of the most severe environmental impact assessments. Case studies (Box 1) for three of these coupes highlight the issues observed and some of their consequences:

- *Failure to appropriately divert or manage road drainage before it enters a waterway*: relevant MSP prescriptions seek to minimise the delivery of sediment from forest roads into waterways. Road drainage is

[7] Cessation of harvesting in Tunza Fun and Behind Pikes Farm coupes resulted from legal action rather than harvesting completion.

to be diverted into vegetation approximately 20 m before the crossing. On its final approach drainage is then to be routed through a silt trap or similar structure. As observed in Buttons coupe, such practices can, with good road surfacing, be effective in preventing the delivery of sediment into waterways. In contrast, Lumpy coupe, particularly, demonstrates that large quantities of sediment can be delivered into waterways if such actions are not taken (Figure 4.4).

- *Inappropriate installation of culverts:* the MSP includes 12 individual prescriptions which are intended to ensure that culverts are stable, operate effectively and their embankments do not become a source of sediment. They are to be installed so that the flow path (and fish passage in larger streams) is maintained and that when water is returned it does not initiate erosion. The Dapples Creek coupe provides several examples of inappropriate culvert installation in a waterway crossing. This has resulted in one of the culverts being almost filled with sediment and others being potential points of downstream erosion.
- *Failure to stabilise embankments following removal of a culvert*: temporary crossings are to be removed when they are no longer required. The Code requires that crossings are removed in a way that minimises soil and habitat disturbance. This requires either that the embankment is entirely removed or that any retained soil is rehabilitated so that it is not mobilised during higher flow events. Buttons coupe illustrates that unstabilised embankments left after culverts are removed can generate sediments if not appropriately rehabilitated.

Including this audit, at least the last three FAP audits which have considered in-coupe roads (SKM, 2013, URS 2015; see Section 5.1) have identified issues with drainage and other matters associated with the construction of waterway crossings. Non-compliances associated with waterway crossings have typically been at the highest level of environmental impact recorded in these audits.

Given the small number of waterway crossings included in this audit, it is not possible to conclude whether there are systemic shortcomings in VicForests' approach to waterway crossings. However the consistency of non-compliance issues associated with crossings within the FAP suggests that they require further management focus by VicForests. Waterway crossings are high risk locations for environmental impacts from timber harvesting activities. Current practices do not appear to achieve consistent compliance with VicForests' own basis for crossing design (the UP), nor Victoria's regulatory framework for timber harvesting.

Recommendation VF-06	Priority: high
VicForests should regularly communicate with its contractors about the risks to the environment which are posed by poorly constructed, maintained and/or rehabilitated waterway crossings. Contractors should be instructed in the construction and maintenance of waterway crossings which comply with the requirements of the Code, MSP and VicForests' internal Utilisation Procedures (UP). VicForests should regularly monitor compliance with waterway crossing requirements and assess the potential for sediment movement into waterways in the vicinity of crossings. Corrective actions should be taken by VicForests and its contractors if waterway crossings are not constructed in compliance with the regulatory framework or if sediments are entering waterways at or near crossings. Any non-compliance issues and corrective actions should be recorded in the Forest Coupe Plan (FCP) and the potential environmental impact assessed using the FAP's environmental impact assessment (EIA) rating tool. Non-compliance issues and corrective actions should be reported to DELWP's Timber Harvesting Compliance Unit where the EIA rating is major or greater.	

Box 1: Case studies of waterway crossings by in-coupe roads

Case study #1 Dapples Creek coupe: Four waterway crossings. EIA rating for non-compliance issues: up to major.

Road drainage delivered directly to waterway and culvert entrance.

Culvert discharging water from above the base of the waterway crossing embankment.

Soil from embankment has been used to divert flow towards the culvert entry.

Dapples Creek coupe is located at high elevation (1300-1500 m) in Alpine Ash forests which are closed to harvesting throughout winter. The coupe runs along a steep slope (up to or exceeding 30° in places) which is traversed by four temporary streams (which were flowing during the audit). Such conditions increase the risk to water quality and the Code (2.2.1.3) requires that "additional" measures are taken to protect water quality and aquatic habitat. No such measures were observed.

The in-coupe road was constructed across the slope and included four waterway crossings, each with a steel culvert installed within a deep embankment. A further section of in-coupe road extended to a landing further upslope. Only parts of the main section of the in-coupe road were surfaced.

None of the four waterway crossings fully complied with MSP requirements. Compliance issues observed included:

- Running road drainage directly into the waterway at the collection point of the culvert. This was done rather than diverting it 20 m away into undisturbed vegetation (MSP 6.2.4.5) and/or using a silt trap or similar structure to manage sediment discharge (Code 2.4.2.6; MSP 6.2.4.7). Diversion of drainage would have required a structure on the road (e.g. invert or rollover) to take water across the road and another structure to manage its descent across the embankment.
- Soil had been pushed into the upstream section of the waterway to divert its path towards the culvert opening. This soil was being mobilised by some of the streams.
- There was minimal protection from erosion at either the entrance to or exit from the culverts (as required by MSP 6.2.4.4, 6.2.5.10). One of the culverts was consequently at least half-filled with sediment at its entry and exit.
- One culvert was elevated significantly above the base of the embankment (~0.5 m; not compliant with MSP 6.2.5.11). While fish passage was unlikely to be relevant so high in the landscape, the practice was non-compliant and added to the erosion risk by draining water onto the base of the embankment.
- There was no management of drainage from the road across the embankment (Code 2.4.2.7) with the result that it was eroding and delivering sediment into the waterway.
- Culverts which diverted flow from its natural course did not return it via a constructed structure designed to minimise erosion (MSP 6.2.5.12).

As a result of the observed deficiencies in construction of the crossings, sediment has been mobilised into several small waterways and at this stage has extended up to 10 m beyond the base of the embankments. As these waterways were located in marked riparian buffer areas the EAI rating was **major**.

This coupe is located in a sensitive environment. The auditor notes that the waterway crossings posed considerable design and construction challenges. However, the risk factors and MSP requirements for waterway crossings, culverts and related road drainage appeared to have largely been disregarded.

Case study #2 Buttons coupe: Single waterway crossing. EIA rating for non-compliance issues: up to major.

Site of former waterway crossing on approach to Buttons coupe. No remedial work had been undertaken to stabilise the embankment following removal of the culvert.

Sediment deposited in the waterway, downstream of the former crossing.

Buttons coupe is located in high elevation mixed species forests in East Gippsland. A temporary waterway crossing had been required to access the coupe. It crossed a temporary stream with over 50 ha of catchment above the crossing.

Road drainage on the approaches to the crossing was exemplary. Water was diverted from the road through undisturbed vegetation (MSP 6.2.4.5). This allowed it to infiltrate and sediment to be deposited rather than enter the stream. Road surfacing was stable and appeared to yield minimal sediment. There was no evidence of any delivery of sediment to the waterway during the operations period.

The culvert appears to have been installed in a manner which is consistent with MSP requirements and did not appear to have presented a significant barrier to fish passage. However in the absence of the culvert, this cannot be verified.

As required by the MSP (6.4.1.1), the culvert had been removed following harvesting completion. Embankment materials from above the culvert were formed into a stable barrier on the approach to the former crossing. The remaining embankment materials were left in place and some have subsequently eroded during higher flow events. Sediment has been mobilised and deposited as much as 10 m downstream of the former crossing.

This waterway crossing appears to have fully complied with Code and MSP requirements during its operation. However, its removal is inconsistent with the Code requirement (2.2.1.6) to minimise soil and habitat disturbance following the removal of temporary crossings. In the auditor's opinion, more of the embankment materials should have been removed to reduce the opportunity for sediment to be mobilised during higher flow events and (potentially) rock riprap or armouring put in place. However, no specific action appears to have been taken to manage potential water quality and aquatic habitat impacts following culvert removal.

The temporary stream is marked as a riparian buffer and as a result the EIA rating was assessed to be **major**. The auditor considers that remedial action is still required to stabilise the embankment and reduce opportunities for further mobilisation of sediments.

Case study #3 Lumpy coupe: Single waterway crossing. EIA rating for non-compliance issues: up to moderate.

Sediment delivery into the downstream side of the waterway crossing.

Sediment delivery into the upstream side of the waterway crossing.

Lumpy coupe is located in foothill forests in East Gippsland. An existing road was used to access this and an adjacent coupe and was upgraded by VicForests prior to harvesting. The waterway crossing was located on the boundary of Lumpy coupe and the roadline coupe within which the existing road had been constructed.

The existing road was set in a box cutting as it descended towards the waterway. This limited opportunities for the diversion of road drainage into surrounding vegetation. The pre-existing log-fill crossing was not upgraded as part of the road works, despite VicForests' UP specifying that log-fill crossings may only be used on snig tracks.

Drainage along both approaches to the crossing did not conform with MSP requirements. Sediment-bearing road drainage water was allowed to directly enter the waterway from three of the four approaching table drains. It was not (as per MSP 6.2.4.4) diverted into undisturbed vegetation about 20 m before the crossing. While this would have required significant earthworks where the road was located in a box cutting, no attempt was made to capture sediment by use of a silt trap or some other structure in the final approach (as per MSP 6.2.4.6). The approach to the crossing from Lumpy coupe was not constrained by the box cutting, yet there were no effective structures to prevent discharge of sediment into the waterway.

There was no evidence that the accumulation of sediment was observed or addressed in road maintenance (as per Code 2.4.4.3).

As is evident from the photographs, the drains delivered a significant quantity of sediment into both upstream and downstream sides of the crossing. The sediment had moved up to about 10 m from the crossing.

The EIA rating associated with this crossing was **moderate** due to its location in a riparian filter area.

Recommendation DE-02	Priority: moderate

VicForests does not routinely construct cross drainage on many temporary in-coupe roads in lower risk settings until heavy rainfall is forecast or harvesting is suspended or completed. While this is arguably not compliant with the MSP, it is operationally effective and the audit found no evidence it poses a significant environmental risk. It is recommended that this practice be explicitly incorporated within the regulatory framework to specify conditions under which it can be safely adopted.

The MSP for road drainage (Section 6.2.4) should be amended to prescribe conditions under which temporary in-coupe roads need not be drained until harvesting is suspended or completed. Suggested conditions include:

- The coupe is planned to be harvested within 6 months of roading and road use will only occur within a single harvesting season;
- Average slope of the in coupe road is 4° or less and never greater than 6°;
- Soil erosion hazard is low or moderate;
- The road is located well away from waterways and there is limited potential for sustained overland sediment flow;
- Appropriate cross drainage must be constructed when: heavy rainfall is forecast; harvesting is suspended (for any reason or period) and harvesting machinery is removed from the coupe; and harvesting is completed and roads are no longer required for operational purposes.

Recommendation DE-02	Priority: moderate

VicForests does not routinely construct cross drainage on many temporary in-coupe roads in lower risk settings until heavy rainfall is forecast or harvesting is suspended or completed. While this is arguably not compliant with the MSP, it is operationally effective and the audit found no evidence it poses a significant environmental risk. It is recommended that this practice be explicitly incorporated within the regulatory framework to specify conditions under which it can be safely adopted.

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- Average slope of the in coupe road is 4° or less and never greater than 6°;
- Soil erosion hazard is low or moderate;
- The road is located well away from waterways and there is limited potential for sustained overland sediment flow;
- Appropriate cross drainage must be constructed when: heavy rainfall is forecast; harvesting is suspended (for any reason or period) and harvesting machinery is removed from the coupe; and harvesting is completed and roads are no longer required for operational purposes.

Recommendation DE-03	Priority: high

Given the significant non-compliance issues which were observed for waterway crossings in the 2015 FAP, DELWP should maintain a focus on waterway crossings in the 2016 audit program.

Recommendation DE-04	Priority: moderate

DELWP should include a mandatory action in the MSP to ensure that VicForests and its contractors take appropriate action to stabilise former waterway crossing sites following the removal of culverts.

4.6.3 Culverts

The coupes included in this audit provided examples where culverts were used in waterway crossings and as a form of cross-drainage along in-coupe roads (Figure 4.14). Issues associated with waterway crossings were discussed in Section 4.6.2.

Culverts were only used for cross drainage in six of the 35 audited coupes and were generally constructed in a manner which was compliant with the MSP. One exception was in Billy Goat coupe, where a 100 mm culvert was used to drain a small depression adjacent to the in-coupe road. This was not consistent with the MSP, which requires culverts to be a minimum of 300 mm in diameter.

Figure 4.14 Example of culvert used for cross drainage of the road in Billy Goat coupe.

VicForests indicated that their contractor had installed this culvert without their authorisation. No observable environmental impact was associated with this issue.

The MSP requires culverts which are used in waterway crossings and road drainage to be designed to withstand a 1 in 10 year rainfall event. While this is specified in the UP and is presumably considered by VicForests during culvert specification, no evidence was found which suggests that relevant analyses had been undertaken. Non-compliance without environmental impact (i.e. partial compliance) was assessed for such coupes.

Culverts are also required (under the MSP) to be buried to a depth which is consistent with the manufacturer's specifications. This is interpreted in VicForests' UP as at least the diameter of the pipe and appeared to be their standard practice. A review of pipe manufacturer's specifications suggests that this is appropriate for culverts of at least the minimum permitted diameter (of 300 mm).

4.6.4 Prevention of road drainage entering waterways

Road drainage is to be constructed so that any sediment entrained is captured by vegetation or logging debris before it can enter waterways. This is particularly important for waterway crossings, as discussed in Section 4.6.2.

In most of the audited coupes, the delivery of road drainage sediments into waterways was successfully avoided by locating the roads well away from drainage lines. This meant that even during the period immediately following harvesting and regeneration, when there is little vegetation on the coupe, there is sufficient distance between the drainage discharge point and waterway for water to infiltrate and sediment be deposited. This was observed to take up to 30-50 m in some coupes with erodible soils and little vegetation cover (Figure 4.15).

Figure 4.15 Sediment from road drainage in Lumpy coupe was observed to run for up to 50 m during the regeneration period, when groundcover is limited. In-coupe roads are typically sufficiently remote from waterways that sediments are not discharged into them. Sediment transport distances quickly decline as the understorey regenerates.

4.7 Road maintenance, operations, closure and rehabilitation

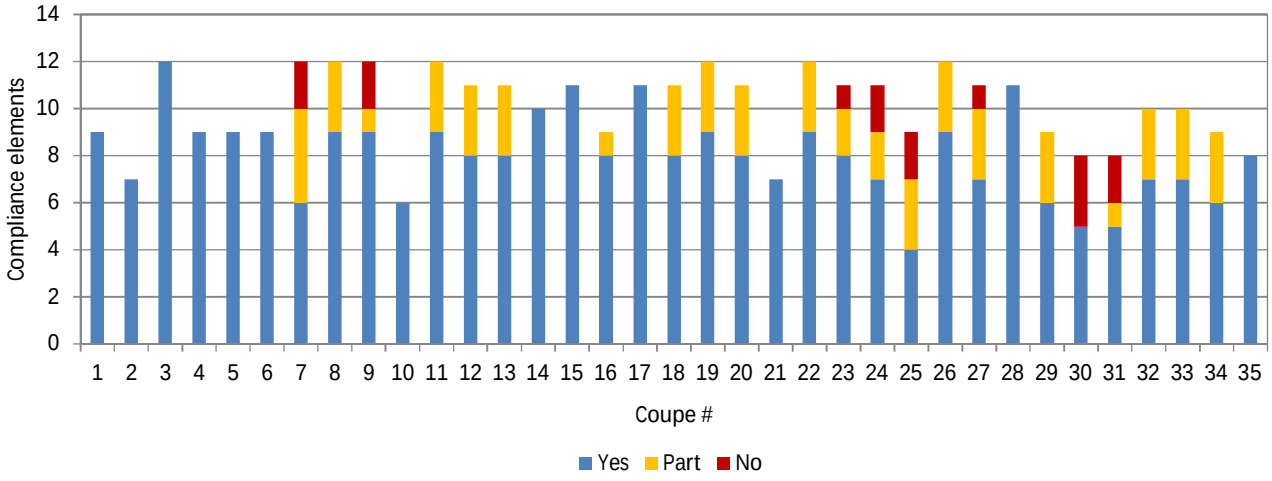
The final compliance theme addressed the post-construction life cycle of in-coupe roads and includes maintenance, closure and rehabilitation. These elements are important in controlling on-going risks to water quality, soil and river health values from the existence and use of the road. The following discussion of audit findings addresses each of these life cycle components.

Fourteen compliance elements were identified for this theme, with up to 12 compliance elements found to be applicable to the audited coupes (Figure 4.16). Overall, the audit found full compliance with 80% of the applicable criteria. Environmental impacts were assessed for 10 non-compliance incidents in eight coupes. Multiple incidents were recorded in two of these coupes. Potential environmental impacts ranged between negligible and moderate (Figure 4.16).

4.7.1 Maintenance of in-coupe roads

VicForests monitors the condition of in-coupe roads as part of its routine coupe monitoring activities (which are recorded in the FCP), but does not appear to undertake programmed maintenance. The limited operational life of many in-coupe roads (less than a single harvest season) means that maintenance is either not required or occurs only in response to trafficability, drainage management or other issues. Generally, the only intervention following initial road construction is to install cross drainage as the harvesting machinery is permanently or temporarily withdrawn from the coupe.

VicForests reported to the auditor that even more elaborately constructed in-coupe roads, which are planned to operate over several harvesting seasons, only receive limited and mostly responsive maintenance. In part, this reflects drainage construction techniques which are intended to reduce the requirements for maintenance.



a) Compliance assessment: number of compliance elements fully, partly or not satisfied. Yes – compliance element fully satisfied. Part – compliance element partly or not satisfied, no environmental impact. No – compliance element partly or not satisfied – environmental impact assessed.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0	1	0	0	2	1	0	0	0	0

	Fully compliant		Partial non-compliance. No EI.		Non-compliance. Negligible EI.
	Non-compliance. Minor EI.		Non-compliance. Moderate EI.		Non-compliance. Major EI.
	Non-compliance. Severe EI.	#	No. incidents causing non-compliance & EI to be assessed.		

b) Environmental impact assessment: number of non-compliance incidents and the level of environmental impact (EI) assessed using the EIA tool (Appendix C).

Figure 4.16 Summary of audit assessment results for individual coupes. Compliance elements relate to road drainage. Coupe name and FMA are given in Table 3.2.

Based on the observations made during this audit, VicForests approach to in-coupe road drainage generally appears to be satisfactory and poses little risk to the environment.

Two main non-compliance incidents were identified in relation to road maintenance. In Funfair coupe, no cross drainage was constructed at the end of the road's operational life, except on a small section connecting it with an adjacent coupe. Since the road had no formally constructed drainage, this left a long section with no effective drainage (396 m; Figure 4.13). The relative stability of soils on this coupe meant that there was only minor environmental impact. This incident was also identified as a non-compliance incident for coupe closure and rehabilitation (Section 4.7.3).

Drainage management issues at the waterway crossing at the entry to Lumpy coupe have been discussed previously (Box 1). Sediment deposition at the waterway crossing is conspicuous and, in the auditor's opinion, should have been detected during VicForests routine coupe monitoring. As a minimum, remedial drainage management measures should have been put in place to reduce the impact of the inadequately-constructed crossing. This incident was assessed to have moderate EIA rating.

4.7.2 Road operations

The Code requires that timber haulage on roads in State forests is suspended when wet weather or excessive dust affect road condition, public safety and/or water quality values. No evidence was found to suggest any non-compliance with these elements. Coupe diary entries for some coupes specifically noted haulage suspensions as a result of wet weather and trafficability concerns. Excessive dust generation is not a relevant issue for most in-coupe roads, due to the typically low speed of vehicles and limited traffic volume.

4.7.3 Closure and rehabilitation

The Code and MSP require that temporary roads used in timber harvesting are closed as soon as possible after harvesting and/or regeneration activities are complete. Roads may be left open until harvesting and regeneration is completed on all of the coupes which are accessed by it. Closure requires that any waterway crossings are removed, their approaches are drained appropriately and that they are permanently closed to traffic.

This audit identified contrasting examples of how Code and MSP prescriptions for road closure and rehabilitation have been interpreted and implemented (see case studies in Box 2). In most cases, in-coupe roads were found to be effectively cross-drained upon completion of harvesting and even seasonal closure. However, there were exceptions where cross drainage was not constructed: this was despite coupe finalisation (Funfair coupe) or the indefinite suspension harvesting activities (Tunza Fun and Behind Pikes Farm coupes).

Box 2 Case studies of in-coupe road closure and rehabilitation.

Case study #4 Burwood Road coupe: Good practice, low environmental risk	Case study #5 Dapples Creek coupe: Non-compliant practice, elevated environmental risk
Burwood Road coupe is located in mixed species forest at 900-1000 m elevation and is subject to seasonal closure requirements under the MSP. The coupe was accessed by a (mostly) surfaced in-coupe road with well-constructed drainage. Burwood Road coupe was the third of three coupes being accessed by the road. At the time of audit, harvesting and regeneration had been completed in the first two coupes, but not in Burwood Road coupe. This meant that the entire length of in-coupe road was required to remain open. Despite road drainage complying with MSP requirements, additional cross drains were constructed in this and the preceding coupe (Big Moose) prior to seasonal closure. This example of good practice enhanced the effectiveness of drainage over the winter closure period and reduced environmental risk from roading.  Cross drain on the road in Burwood Road coupe, which supplemented constructed drainage during the winter closure period. Run-off was diverted through logging debris, prior to entering undisturbed vegetation above a waterway.	Dapples Creek coupe is located in alpine ash forest at 1300-1500 m elevation and is subject to seasonal closure restrictions. The coupe includes two road segments: one which extended the entire length of the coupe and was planned to be used to access an adjoining coupe; and the other which was used to access a (now rehabilitated) landing higher in the coupe. Harvesting and regeneration burning on Dapples Creek coupe had been completed at the time of audit. Harvesting had not commenced on the adjoining coupe and so the main in-coupe road could not be closed. Cross drainage on the segment of road to the landing had been constructed and generally complied with MSP requirements. The main in-coupe road included four waterway crossings (see Box 1), but had little constructed drainage apart from this. Despite seasonal closure and the potential for rainfall and snow melt to generate significant drainage flows, no temporary cross drainage was constructed. Water flows along the road were effectively unmanaged, leading to extended flow paths along the road, flows directly into waterways and across embankments.  Lack of seasonal and constructed drainage along the main road in Dapples Creek coupe resulted in unmanaged water flows over the winter closure period.

The Code requires that access to coupes be “permanently” closed upon completion of the harvesting operation. Although this occurs in some settings (e.g. where access can be prevented by removal of a culvert), it did not

appear to be rigorously implemented by VicForests. This accounted for many of the partial non-compliances recorded for this theme.

In most of the audited coupes, non-compliance did not result in observable environmental impact. However, it did in some coupes where post-harvest vehicle traffic (not connected with VicForests operations) had damaged the road drainage structures (Figure 4.17). In several coupes this resulted in the interval between effective structures exceeding MSP requirements. The environmental impact associated with these incidents was localised and never assessed to be greater than minor.

Figure 4.17 Failure of cross drains in Donkey coupe. Cross drains were constructed upon completion of harvesting, but have been damaged by subsequent to vehicle traffic.

The auditor's observation is that VicForests generally tend not to "permanently" close access to coupes following the completion of harvesting and initial regeneration operations. This practice appears to be influenced by several factors, including the continuing need to access coupes: to confirm or remediate regeneration; for firewood collection, apiary and/or bushfire responses; and because it is difficult to keep traffic out of many coupes.

Wide availability of 4WD vehicles means that for coupes located near settlements (at least), it is almost inevitable that the general public will enter coupes following completion of harvesting and regeneration. Vehicle entry can damage cross drainage structures constructed following harvesting and lead to erosion of notionally closed in-coupe roads. Sediments may then be mobilised towards waterways.

Good practice by VicForests in mitigating this risk was observed in coupes in Tambo FMA which were subject to considerable domestic firewood collection traffic. It involved the use of rollovers or inverts rather than the standard "bar and breach" cross drains (see case study in Box 3). These appear to be more resilient to post-harvest or regeneration traffic and consequently reduce risk to soil and water quality values in coupes during the early stages of regeneration.

Recommendation DE-05	Priority: moderate
In the response to the challenges in controlling access to coupes following the completion of harvesting and of the damage that this may cause to drainage structures, DELWP should provide an alternative to the Code's mandatory requirement to close coupe access following harvesting completion. This alternative should require the construction of effective drainage structures along in-coupe roads which will be resilient to post-harvest vehicle traffic for at least 3 years, while the coupe is regenerating and ground cover being restored. After this period, regrowth will typically stabilise soils, trap any sediment flow and prevent further erosion.	
Recommendation VF-07	**Priority: moderate**
VicForests should explore the more widespread use of rollovers or similar, trafficable cross-drainage structures for in-coupe roads. This type of structure has been observed to be used effectively by VicForests in some settings and by other Victorian forestry operators. They are also widely used in forest and rural roading in tropical and sub-tropical regions of Australia. Rollover structures reduce the need for culverts and, if properly constructed, should function effectively through and following harvesting. They are generally more stable and resilient to damage by post-harvest traffic than traditional "bar and breach" cross drainage structures.	

Box 3 Case study of resilient cross drainage structures in coupes subject to considerable post-harvest traffic.

Case study #6: Resilient post-harvest cross drainage structures

Rollover (above) and invert (below) along in-coupe roads within regenerating coupes which are subject to firewood collection traffic. They both operate effectively as cross drains and are trafficable, but are not usually damaged by that traffic.

Standard cross-drainage practice for closing in-coupe roads involves "barring and breaching". An angled trench (of varying depths) is excavated in the road surface and any adjacent soil windrow and the spoil is deposited to create a barrier on the downslope side of the trench. Water drains into the trench and is diverted off the road onto adjacent soil or logging debris. The unconsolidated spoil (the "bar") settles over time.

Where the excavations are deep and bars are high, these structures provide effective drainage as the coupe regenerates. They may also preclude vehicle traffic. However in many settings, the trenches and bars (after settling) are unable to prevent 4WD vehicle access. As illustrated in Figure 4.17, these structures (particularly in sandy soils) may be damaged by traffic and breached by drainage along the road.

The use of rollovers or inverts as illustrated here provides a consolidated drain which is more resistant to traffic and maintains effective drainage while the coupe regenerates. Rollover-like structures (called "whoa-boys") are widely used to manage cross drainage in tropical and subtropical regions subject to intense and highly erosive rainfall events (Queensland Government, undated).

Rollovers may be incorporated into road design and constructed as part of the initial road formation. If constructed well, they will be trafficable by log trucks and can be retained following completion of harvesting.

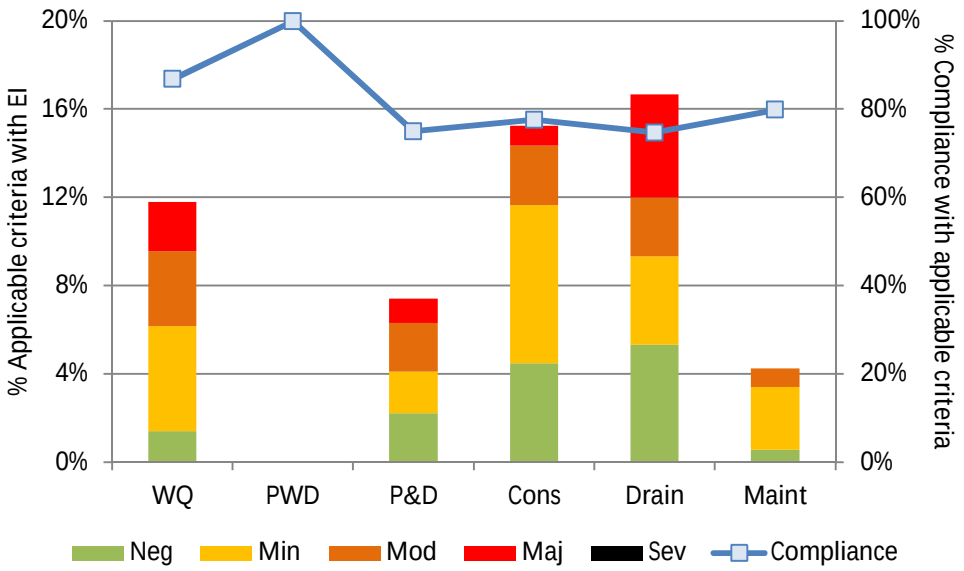
4.8 Overall audit findings

This audit's objectives were to assess VicForests' compliance with aspects of the regulatory framework which relate to in-coupe roads and any environmental impacts which may result. This section and Figure 4.18 provide a summary of the audit's findings in relation to both of these components.

Overall compliance with applicable criteria was assessed to be 80%, with compliance varying between 75% and 100% for individual compliance themes. Over 60% of non-compliances with assessed environmental impact were either negligible or minor. Major environmental impact was recorded for 15% of non-compliances. However these related to incidents on just two coupes (Dapples Creek and Buttons). All of these incidents were connected with waterway crossings.

4.8.1 Findings in relation to regulatory compliance

This audit found that VicForests fully complied with 80% of applicable criteria or compliance elements related to the construction and maintenance of in-coupe roads. This was across 35 audited coupes, with almost 17 km of road and 86 compliance elements considered in the final assessment and being potentially applicable to each coupe.



Compliance themes: WQ – Water quality, river health & soil protection, PWD – Pests, weeds & diseases, P&D – Planning & design, Cons – Construction, Maint – Maintenance, operations, closure & rehabilitation.

EIA ratings: Neg – negligible, Min – minor, Mod – moderate, Maj – major, Sev – severe (not recorded).

Figure 4.18 Summary of findings of environmental audit of construction and maintenance of in-coupe roads: compliance with applicable criteria and assessed environmental impact (EI) from non-compliances.

While the rate of non-compliance with applicable criteria was 20%, it should be noted that individual "incidents" may give rise to multiple partial and/or non-compliance assessments. Thirty-six individual incidents were responsible for the 143 non-compliances (10% of applicable criteria) for which assessments of potential environmental impact were required. They also were responsible for many "partial" compliances (with no direct environmental impact).

The auditor found that there were several main underlying non-compliance issues:

- *Waterway crossings:* while only four coupes had waterway crossings, these made a disproportionate contribution to the overall level of non-compliance. Construction of associated road drainage and the management of culvert removal were the main issues identified. Non-compliances in these areas were responsible for the highest levels of environmental impact observed during the audit (major EIA rating).
- *Drainage spacing:* intervals between drainage structures on 11 of the 35 coupes did not fully satisfy MSP requirements for the respective combination of soil erosion hazard class and slope. This arose for several reasons, including: small errors in the spacing of constructed drainage; failure to construct the necessary drainage structures; and the failure of poorly constructed or traffic-damaged structures. The excess spacing of drainage structures beyond MSP requirements ranged from less than 10 m (in 2 coupes) to almost 400 m. Any environmental impact associated with this issue was always localised and the EIA rating was minor or negligible.
- *Embankments:* the design and construction of embankments or fill slopes was a frequent source of non-compliances. The key issues were the management of unavoidable drainage over fill slopes and the absence of specialist design advice for large embankments on roads crossing steep and/or wet terrain. Most EIA ratings were negligible. However, a failing road embankment on Staff coupe was rated as having moderate environmental impact.
- *Drainage onto roads:* in some coupes, insufficient attention was paid during road construction or upgrading to avoid drainage from one road running onto another. EIA ratings for these non-compliances ranged up to moderate, reflecting the location of the incident outside the coupe boundary, rather than the severity of environmental impact.
- *Access closure:* not correctly draining in-coupe roads following the completion or suspension of harvesting and not permanently closing off access to the coupes was a common source of non-compliance. The latter

reflects delays in VicForests permanently closing access to coupes and the practical difficulties in actually doing so. Any environmental impacts associated with this were localised and rated as minor or negligible.

- *Construction varying from design:* VicForests' UP specify most in-coupe road design requirements. Non-compliance incidents generally occurred when construction practice was not consistent with those requirements.

4.8.2 Findings in relation to environmental impact

VicForests' planning, design, construction and maintenance practices typically successfully mitigate environmental risks associated with in-coupe roads. However, this audit found that there were two main issues posing environmental risk to sustainable forest management objectives:

- *Waterway crossings:* these contributed the highest level of environmental impact assessed in this audit and were responsible for a disproportionately large share of the non-compliances recorded. The key deficiencies were the direct delivery of road sediments into the waterway and inadequate rehabilitation of an embankment following culvert removal.
- *Roading through high risk areas:* in general in-coupe roads were located so that they avoided areas with high environmental risk, such as waterways, wet areas and steep slopes. However it is not always possible for in-coupe roads to avoid such areas. Where they were required to pass through them, the attention to design and construction was generally not sufficient to prevent them failing and/or discharging sediment into waterways.

  This is true for waterway crossings and roads traversing steep and/or wet slopes. As was identified in this audit, road or landing embankments and cuttings may fail if their design and construction does not appropriately mitigate the risks posed. Failure following harvesting completion potentially has greater environmental impact than was observed in this audit (for Saxtons Bend, Staff and Dapples Creek coupes). Failure of an embankment during coupe operations would pose a serious risk to health and safety.

5. Discussion

5.1 Comparison of findings from previous audits

The 2015 FAP is the first to consider operations conducted under the 2014 *Code of Forest Practice for Timber Production* and its associated MSP. Although the regulatory framework for in-coupe roading and structure of the FAP have changed somewhat, the findings of previous audits are relevant to this one. A comparison of key findings from this audit and the roading component of the 2014 FAP audit of harvesting and coupe closure (URS, 2015) is given in Table 5.1. The comparison is structured around the main compliance themes.

Table 5.1 A comparison of key issues related to in-coupe roading identified in the 2014 and 2015 FAP audits.

2014 FAP audit of harvesting and coupe closure (URS, 2015)	2015 FAP audit of in-coupe roading
Water quality, river health and soil protection	
Findings in relation to in-coupe roading were limited to what the auditor considered to be an unnecessary waterway crossing at one coupe.	Audit findings in relation to this theme were based on non-compliances which had their origin (mostly) in road design, construction and drainage (see below). No unavoidable waterway crossings were identified in the audited coupes. However measures to prevent sediment entering waterways from in-coupe roads were found to be deficient in three of the four coupes with crossings. Good practice was generally observed in siting in-coupe roads at locations where there was minimal opportunity for sediment in road drainage from reaching waterways.
Pests, weeds and diseases	
The audit found a systemic non-compliance in relation to prevention of *P.cinnamomi* introduction via infected quarry materials. It found no evidence that VicForests had assessed the risk of disease transmission on coupes where gravel was used in road construction.	This audit noted VicForests' standard hygiene procedures, which aim to reduce transmission of pests and soil borne diseases via harvesting and roading machinery. Private commercial and DELWP quarries were used to source gravel. Material from one quarry is treated prior to use. Other quarries are not known to be subject to *Phytophthora* infestation (the test applied by the Code) and others are known not to be. This was the basis for compliance assessment.
Road planning and design	
The auditor found that road planning was mostly conducted in an appropriate manner. Observed good practice included reuse of previous temporary road alignments and landings, minimal construction of stream crossings and avoidance of new road construction in steep areas. The two major issues identified were construction of one avoidable crossing in a Spotted Tree Frog catchment and not specifically conducting targeted field surveys of intended road alignments. The auditor made a high priority recommendation that such surveys be conducted because of the level of disturbance associated with roading. The auditor noted a high level of compliance with road design requirements. Good practice was observed in the avoidance of road alignments across steep slopes. Drainage infrastructure spacing was found to exceed specifications based on slope and soil erosion hazard on some coupes. New roads were constructed within 20 m of waterways on some coupes. Waterway crossings on three of four coupes were appropriately designed, except that the culvert projected above the stream and would have impeded fish passage.	This audit found while planning was barely documented, it generally resulted in the protection of soil and water values. Previous road alignments were used where possible and waterway crossings were only constructed where necessary. While alignments generally avoided high risk locations, including waterways and steep slopes, this was not always possible. This audit found that field surveys were conducted of coupes prior to harvest, although there was no evidence of their having been targeted towards road alignments[1]. No assessment of non-compliance was made in this respect. This audit noted that VicForests' UP provides a sound basis for road design. However documentation of how this was applied is absent. There was no evidence of design advice being sought in (uncommon) high risk locations, where side cuts and road embankments were constructed across steep slopes. Drainage infrastructure spacing was found to exceed specifications in some instances, although this was a construction and/or coupe closure rather than design issue. Implementation of waterway crossings design principles was found to be lacking in some coupes.

2014 FAP audit of harvesting and coupe closure (URS, 2015)	2015 FAP audit of in-coupe roading
Road drainage was observed to discharge over an unstabilised fill batter.	Roads were also observed to have drainage discharge over unstabilised fill batters.
Road construction	
Road construction was generally found to comply with plans, designs and related requirements. Observed non-compliances arose from the management of fill embankments and barriers to fish passage at crossings. Stabilisation issues were observed with embankments and cuttings on some coupes, particular on steep slopes. This included road drainage running over fill batters. Fill batters were observed to cover the base of a live tree on one coupe. Culverts were not installed to maintain fish passage in three of four coupes with crossings. Head and discharge areas were generally not protected from erosion. The use of sediment management procedures and structures during road construction was not able to be assessed	The audit found that most non-compliance issues occurred because road construction did not follow the design requirements described in VicForests' UP. A similar set of non-compliance issues were observed in this audit. Fish passage was only a relevant concern for one coupe with a waterway crossing, but could not be assessed because the culvert had been removed at the time of audit. The use of sediment management procedures and structures during road construction could not be assessed during this audit.
Road drainage	
See applicable comments on road design and construction.	This audit identified a similar set of non-systemic issues with the construction of road drainage.
Road maintenance, operations, closure and rehabilitation	
The audit made comments on permanent haulage roads, which are not within the scope of an audit of in-coupe roads. Specific maintenance issues were identified on a small number of coupes, including an ineffective silt trap and scouring along a length of road. Cross drainage of in-coupe roads following temporary cessation of harvesting was found to follow good practice in several coupes. Several administrative non-compliances were observed with arrangements for the closure of temporary or permanent roads following harvesting. Minor issues were observed with road rehabilitation on some coupes. These included failure to remove culverts and poor construction of a bar on a rehabilitated road.	This audit observed variable practice in cross drainage of in-coupe roads following temporary cessation and completion of harvesting. Practice was generally good, but was deficient with negligible or minor environmental impact in several coupes.

Notes:

1. VicForests, in their response to the 2014 audit, did not accept the need for specific surveys of the road alignment as recommended by the auditor in the 2014 FAP report (URS, 2015).

The 2012-13 audit of harvesting and coupe closure (SKM, 2013) identified a variety of issues with roading in several VicForests coupes. These related to non-compliant drainage at waterway crossings, fill from road embankments covering the base of live trees and non-closure of coupe access following harvesting, leading to damage to cross drains and failure to maintain the prescribed maximum spacing between effective drainage structures. Two recommendations were made in relation to waterway crossings, including that VicForests ensure prescribed drainage measures are implemented and that VicForests audit its compliance with waterway crossing specifications and remedy any deficiencies.

Recent FAP audits confirmed that in-coupe roading by VicForests was generally located to minimise risks to water and related values and is well-designed and constructed. They also revealed continuing deficiencies in the implementation of their own basis for design (in the UP) in relation to waterway crossings.

5.2 Regulatory framework improvement opportunities

DELWP sought advice from the auditor on potential issues with the regulatory framework for forest roading and in-coupe roads (particularly), which were highlighted by this audit. These are discussed below.

5.2.1 Improving auditability

The Code states that its purpose is to *provide direction to timber harvesting managers, harvesting entities and operators to deliver sound environmental performance when planning for and conducting timber harvesting operations* (DEPI, 2014a). While it is not necessarily written with auditing in mind, audits are an important component of the accountability and adaptive management process which is required to deliver and demonstrate sound and improving environmental performance during timber harvesting activities.

One way in which the regulatory framework can be strengthened is by improving its auditability. The wording of some mandatory elements does not allow an objective assessment (e.g. by an auditor) of whether the action has been complied with. Many, but not all of these relate to the use of "minimise" in the mandatory actions. Mandatory actions applicable to in-coupe roads to which this concern applies are discussed in Table 5.2. There are similar (although fewer) issues with the MSP.

Table 5.2 also includes alternative wordings for most of the mandatory actions which have been discussed. However, it is acknowledged that any changes to the Code would not be considered or implemented until its next scheduled review (in several years' time).

Table 5.2 Analysis of Code mandatory actions applicable to in-coupe roads for which objective assessment of compliance is not possible.

Code mandatory action	Comment
2.2.1.6 Where crossings are required, minimise the extent of habitat damage, constriction to stream flow and barriers to fish and other aquatic fauna.	The aim of this mandatory action is to prevent unnecessary habitat damage at waterway crossings and prevent avoidable restrictions to streamflows (particularly during low flows) and fish passage. It is impossible to determine if these have been "minimised", although it is possible to determine if the level of damage and flow and fish passage impairment is excessive. The wording of this action could be revised to, *Where crossings are necessary, ensure stream flow and fish passage are maintained during low flows and that habitat damage is confined to the crossing pathway and applicable clearing widths on either side.*
2.2.1.10 Minimise the extent and duration of soil disturbance adjacent to or within waterways.	Aside from the use of "minimise", the context for this action is unclear. It could be applicable to roading and/or harvesting operations and could apply to one or all three classes of waterway. The wording of this action should be modified to clarify its intent.
2.2.1.11 Use management practices such as modified harvesting techniques, scheduling, wet weather suspensions or progressive rehabilitation to minimise the potential for sediments and other pollutants to move into streams.	"Minimise" is used, but the action is concerned with implementing particular types of actions which reduce sediment supply and mobilisation. The wording of this action could be revised to, *Restrict the mobilisation of sediments or other pollutants into waterways through practices such as modified harvesting techniques, scheduling, wet weather suspensions or progressive rehabilitation.*
2.2.1.12 Design, construct and maintain roads, crossings, coupe infrastructure and drainage structures to withstand foreseeable rainfall events and traffic conditions, and protect water quality.	All flows (and hence rainfall) up to the maximum permissible flood are "foreseeable". The intent of the action is to ensure design handles relatively low frequency/high intensity rainfall and flow events. The wording could be revised to be consistent with the MSP requirement for culvert design to handle a 1 in 10 year (10% Annual Exceedance Probability) rainfall or flow event.

Code mandatory action	Comment
2.2.1.14 Minimise potential for soil erosion or mass movement by planning and using operational methods and restrictions appropriate to the assessed soil erosion risk and slope.	The point of this action is the use of planning and operational methods. The wording could be modified to, *Use planning and operational methods and restrictions which are proportional to the risk of erosion and mass movement.*
2.2.1.15 Locate coupe infrastructure and roads to minimise soil erosion and degradation.	The point of the action is to locate coupe infrastructure appropriately. The wording could be modified to, *Wherever possible, locate coupe infrastructure and roads away from areas with high risk of erosion and soil degradation.*
2.2.1.17 Limit the area of soil affected by coupe infrastructure and roads to the minimum required to safely complete timber harvesting operations to the required standard.	Objectively determining the "minimum possible" level of soil disturbance for safe harvesting is not possible, particularly given the diversity of slopes, soil conditions and harvesting methods likely to be encountered. In the absence of objective criteria on what an appropriate limit to soil disturbance might be, it is suggested the wording could be changed to, *Develop coupe infrastructure and roads to enable timber harvesting operations to be completed safely, to the required standard and without excessive soil disturbance.*
2.4.1.3 Road planning must: i. locate roads so as to minimise risks to safety and environmental values, particularly soil, water quality and river health, during both construction and ongoing road use; and ii. ensure that the timing of construction activities minimises risks associated with unsuitable weather conditions and provides for completion to the required standard in advance of timber harvesting operations.	Use of "minimise" is unnecessary in both components of this action and makes them impossible to audit objectively. The wording should be revised to focus on locating roads to avoid high risk areas for safety and soil disturbance and to undertake construction activities during periods when there is a low likelihood of unsuitable weather.
2.4.1.4 Existing roads must be used for access to a coupe or work site and to haul timber, except where it can be clearly demonstrated that a new or relocated road further minimises or removes existing threats to soil, water quality or biodiversity.	It is not possible to "further minimise" a threat. "Reduce" should be used in place of "minimise".
2.4.2.3 All fill disposal areas and embankments must be planned and designed to minimise soil erosion, mass soil movement, and potential water quality deterioration.	Planning and design of fill disposal areas and embankments are intended to reduce the risk of various forms of erosion and subsequent water quality impairment. The wording could be revised to, *Plan and design fill disposal areas to effectively manage risks to soils and water quality from soil erosion and mass movement.*
2.4.3.6 Road construction must ensure that: i. disturbance to stream beds and banks is kept to a minimum;	A "minimum" level of disturbance is difficult to quantify. This component of the action could be rephrased to, *confine disturbance to stream beds and banks to the pathway of any crossing.*
2.4.4.3 Road drainage systems must be maintained at sufficient frequency to minimise erosion and the discharge of sediment into waterways.	The point of road design and maintenance is to prevent discharge of sediment into waterways. The outcome rather than the frequency of maintenance is the point. This action could be reworded as follows, *Road drainage systems must be maintained to prevent the discharge of sediment into waterways*.

Recommendation DE-06	Priority: low
To enhance the capability of the regulatory framework to support auditing, DELWP should review mandatory actions in the Code and MSP to reduce the subjectivity sometimes created by their wording. Consideration should be given to the comments and suggested wording for Code mandatory actions relating to in-coupe roads provided in Table 5.2 of this report.	

5.2.2 Pests, weeds and diseases

The 2014 FAP audit of harvesting and coupe closure (URS, 2015) found a systemic non-compliance in relation to the prevention of *P.cinnamomi* introduction via infected quarry materials. It found no evidence that VicForests had assessed the risk of disease transmission on coupes where gravel was used to surface roads. While no similar finding was made in this audit, the auditor considered that the management of disease risk is not sufficiently rigorous. Rather than reflecting a systemic operational issue with VicForests, it is considered that the systemic issue lies with the Code.

Code mandatory actions relating to pests, weeds and diseases which are applicable to roading are:

- 2.2.2.13 Implement appropriate vehicle and equipment hygiene precautions when moving from areas of known pest plant, pest animal and pathogen infestations.
- 2.4.3.5 Quarry materials known to be infected with any pest plant or pathogen must not be used.

Both of these require action on the basis of knowledge of a disease issue, rather than the risk or assessment of it. The auditor considers that to mitigate this risk more effectively, hygiene procedures should be adopted as a matter of course and that all quarries should be subject to regular checks to assess their disease and pest status. Complementation mandatory actions in the MSP are more pro-active than those in the Code, but still only apply when infection is known.

Wash-down procedures, as recommended in DE-06, are routinely applied for weed management purposes to the movement of vehicles and heavy machinery in many tropical regions of Australia and parts of the national Defence estate.

Recommendation DE-07	Priority: moderate
DELWP should strengthen its mandatory actions, particularly in the Code, to reduce the potential for weeds and pathogens to be spread by road construction and maintenance activities. Suggested improvements are that: • All harvesting and road construction machinery are thoroughly cleaned and inspected before being brought onto a new coupe (unless it is adjacent to the one from which the machinery is being moved); • Quarries from which materials are sourced for forest road construction are checked annually by a competent, independent party to confirm disease and weed free status; • Gravel obtained from quarries which are not confirmed as weed and disease free should be treated to mitigate any weed or disease threat prior to use within a harvest coupe. Evidence of machinery inspections, disease and weed free status of quarries and/or treatment should be retained in the FCP for all applicable coupes.	

6. Conclusions and recommendations

6.1 Conclusions

This audit is one of three commissioned by DELWP in 2015 under its FAP. Its objectives were to assess VicForests' compliance with aspects of the regulatory framework for timber harvesting which relate to the full in-coupe road life cycle and any associated environmental impacts.

In-coupe roads which were the subject of this audit were distributed between 35 timber harvesting coupes located in the Central Gippsland, East Gippsland, Midlands and Tambo FMA and included one coupe in a Melbourne Water Corporation catchment area. Coupes were selected at random from those included in VicForests' current *Timber Release Plan* which had planned in-coupe roading of at least 400 m. The average length of roading in the selected coupes was 478 m, but ranged between about 100 m and over 1600 m. Field assessments of in-coupe roads took place during September and October 2015.

Audit criteria were based on relevant, mandatory requirements of the Code and MSP. Mandatory actions were grouped into six compliance themes. Key findings for each theme were:

- *Water quality, river health and soil protection:* the audit found 87%full compliance with applicable criteria. A total of 20 non-compliance incidents in 16 coupes were responsible for non-compliances which triggered environmental impact assessments. In general, in-coupe roads were located and constructed so that unnecessary disturbance to waterways and soils was avoided and drainage from in-coupe roads did not discharge sediments into waterways. However, where waterway crossings were required, they were generally not executed in compliance with the Code and MSP. In two coupes this resulted in major environmental impacts being assessed.
- *Pests, weeds and diseases:* VicForests were assessed to fully comply with applicable Code and MSP mandatory actions concerned with controlling the risk of introducing weeds and soil-borne pathogens into new areas. However, the auditor considers that these mandatory actions should be modified to require a more rigorous approach to weed and disease hygiene.
- *Road planning and design:* the audit found 75% full compliance with applicable criteria. Environmental impacts were assessed for non-compliances associated with 9% of applicable criteria. These resulted from 18 separate incidents on 13 coupes. The audit found that VicForests carried out minimal formal, documented planning and design for in-coupe roads[8]. This level of planning and design appears to generally be successful in avoiding high risk locations for roads and in preventing adverse impacts on soils and water quality. However, in-coupe roads cannot always avoid higher risk locations such as steep slopes and waterways. In these settings, the lack of formal road planning and (particularly) design may have contribute to the avoidable failure of side cuts and/or embankments and the resulting environmental impact.
- *Road construction:* the audit found 77% full compliance overall with applicable criteria. Environmental impacts were assessed for 25 separate non-compliance incidents in 16 coupes. Most construction incidents occurred where design and construction requirements in VicForests' UP were not followed. Key issues noted were: not constructing compliant drainage systems at waterway crossings; failure of a large embankment on a road traversing a very steep slope; fill embankments covering the base of retained live trees and not always constructing the required level of cross-drainage for the slope and soil erosion hazard.
- *Road drainage:* the audit found 75% full compliance with applicable criteria. Altogether, 19 non-compliance incidents on 14 coupes triggered environmental impact assessments. Drainage infrastructure is not typically constructed on in-coupe roads which have short operating lives and are located in low risk situations until after harvesting is completed and machinery is being withdrawn. This practice is arguably not compliant with the Code and MSP, but was not assessed as such in this audit. Nor did it result in any environmental impact, except in several coupes where drainage structures were not constructed prior to temporary or final coupe clearance.

[8] VicForests UP provide a formal, documented basis for design for in-coupe roads. There is typically little or no additional documentation to describe how this basis for design is applied to the specific context of the individual coupe.

Waterway crossings were a significant source of the non-compliances recorded in this audit and were responsible for the more significant environmental impacts. The main issues included drainage not being diverted away from the waterway, culverts not being installed as required by the MSP and VicForests' UP and failure to stabilise embankments when a culvert was removed after completion of harvesting and regeneration.

- *Road maintenance, operations and closure:* the audit found 80% full compliance with applicable criteria. Ten non-compliance incidents on eight coupes required environmental impact assessments. While VicForests routinely monitors road condition, it does not appear to undertake programmed maintenance of in-coupe roads. Even elaborately-constructed roads which are scheduled to operate over several seasons appear to only receive reactive maintenance. These practices appear to generally be satisfactory and pose minimal environmental risk, although several exceptions were observed.

  Road operations appear to comply with seasonal and wet weather closure requirements. While VicForests' contractors routinely cross drain roads following the completion or suspension of harvesting, coupes are not necessarily "permanently" closed to vehicle access as required by the regulatory framework. While this is understandable, given the inherent practical difficulties, post-harvest vehicle traffic sometimes damages drainage structures and destabilises roads.

Overall the audit found that VicForests fully complied with 80% of applicable criteria, with many individual non-compliance incidents contributing to multiple assessments of partial and or non-compliance with individual criteria. A total of 36 individual incidents were responsible for the 140 non-compliance assessments with actual or potential environmental impact and many of those for which partial compliance (and no environmental impact) was assessed.

Two main issues were identified which posed the greatest environmental risk to sustainable forest management objectives:

- *Waterway crossings:* these contributed the highest level of environmental impact assessed by this audit and were responsible for a disproportionately large share of the non-compliances recorded. The key deficiencies which were identified in the audit were in avoiding the delivery of sediment from road drainage into waterways and in rehabilitation of an embankment following culvert removal. Waterway crossings have been a consistent risk issue for forest roading in this and the previous two FAP audits.
- *Roading through high risk areas:* in general, in-coupe roads were found to be located so that they avoided areas with high environmental risk, such as waterways, wet areas and steep slopes. However it may not always be possible for in-coupe to avoid such areas. On the few occasions where they must pass through these areas, greater effort in design and construction is required to prevent them failing and damaging the regenerating coupe and (potentially) impairing water quality.

Aside from these main issues, VicForests' planning, design, construction and maintenance practices typically successfully mitigate environmental risks associated with in-coupe roads.

6.2 Recommendations

Findings of this audit have led to a series of recommendations for VicForests (the auditees) and DELWP as the environmental regulatory of timber harvesting activities. Recommendations are prioritised according to the significance of the issue addressed and the process changes required for implementation[9]. High priority recommendations should and are able to be implemented within 6 months. Moderate priority recommendations should be able to be implemented within 2 years and low priority recommendations can only be implemented as part of the next review and revision of the Code. Some lower priority recommendations reflect important issues, but because they require change in the regulatory framework, they cannot be implemented quickly.

[9] The numbering of recommendations is based on the order in which they appear in this audit report.

6.2.1 Recommendations for VicForests

Recommendation	Rationale
VF-01: Moderate priority VicForests should document its planning of in-coupe roads in the "Roading" section of the FCP. Documented evidence of planning should include: • Map of the planned road alignment; • Explanation of rationale for the planned alignment; • Analysis and discussion of the environmental and other risks posed by the road and which are to be managed through planning; • Discussion of any alternatives routes to manage risks from waterway crossings, other wet areas, steep slopes etc. If the actual and planned route of an in-coupe road differ substantively, an additional entry should be made in the FCP to explain the divergence and a map should be included which shows the actual route taken.	This recommendation is designed to provide an audit trail to demonstrate that planning requirements of the Code and MSP have been complied with, as well as to encourage the consideration of alternative routes in coupes with high risk situations (e.g. steep slopes, waterway crossings).
VF-02: High priority VicForests should be more proactive in seeking engineering advice on the design and construction of in-coupe roads where they will traverse areas of steep slope and require deep side cuts and/or large fill embankments to be constructed. The precise limits for seeking engineering advice prescribed by the MSP (i.e. 30°/25° for areas with lower/higher soil erodibility) are not necessarily consistent with the limited accuracy of available topographic mapping, digital elevation models or field measurement. It is recommended that engineering advice is sought in these higher risk areas, based on the possibility (>50% chance) that: • Side slopes will be within 5° of the respective MSP limit; and/or • Side cuts or embankments greater than 2 m in height will need to be constructed.	The MSP requires that engineering advice is sought where roads traverse high slope locations. Only seeking such advice where mapped or measured slopes exceed the MSP's precisely defined benchmarks is not considered to appropriately address risks from constructing roads through high slope areas.
VF-03: Moderate priority VicForests' FCP records should include the actual basis for design of its in-coupe roads, road drainage, larger embankments and waterway crossings. Record keeping should be proportional to the level of risk which is addressed through road design. The minimum requirement should be to specify the class of road (as per MSP Appendix 4) and explicitly reference which UP provisions are addressed by the road design. Evidence of engineering advice and how this has been incorporated into road design and construction should also be included whenever it has been sought.	As per VF-01 this provides an audit trail to demonstrate how the basis for design in the UP has been applied. It also seeks to ensure that appropriate design effort is applied (and documented) in higher risk situations.
VF-04: Moderate priority VicForests should actively seek to reduce the incidence of road fill embankments covering the base of live trees which are retained within coupes. The mandatory nature of this requirement should be reinforced with contractors by targeted training, monitoring, reporting and corrective action (if non-compliance is detected).	Embankments covering the base of retained, live trees have been observed in this and the previous two audits dealing with in-coupe roads. This consistent source of non-compliance and minor environmental impact should be addressed.

Recommendation	Rationale
VF-05: High priority VicForests should ensure that contractors construct MSP-compliant cross drainage systems along temporary in-coupe roads with less than 6 months intended use. This drainage should be constructed prior to a forecast significant rainfall event and/or to the temporary or permanent removal of harvesting machinery from the coupe. Construction of appropriate drainage systems must be confirmed through VicForests' temporary or final clearance monitoring process. Drainage systems should be constructed prior to the use of any in-coupe road which is intended to be used for more than 6 months.	Several instances were observed in this audit where drainage structures were not constructed following suspension or completion of harvesting. As no other form of drainage had been provided during road constructed, the roads were not adequately protected from erosion.
VF-06: High priority VicForests should regularly communicate with its contractors about the risks to the environment which are posed by poorly constructed, maintained and/or rehabilitated waterway crossings. Contractors should be instructed in the construction and maintenance of waterway crossings which comply with the requirements of the Code, MSP and VicForests' internal Utilisation Procedures (UP). VicForests should regularly monitor compliance with waterway crossing requirements and assess the potential for sediment movement into waterways in the vicinity of crossings. Corrective actions should be taken by VicForests and its contractors if waterway crossings are not constructed in compliance with the regulatory framework or if sediments are entering waterways at or near crossings. Any non-compliance issues and corrective actions should be recorded in the Forest Coupe Plan (FCP) and the potential environmental impact assessed using the FAP's environmental impact assessment (EIA) rating tool. Non-compliance issues and corrective actions should be reported to DELWP's Timber Harvesting Compliance Unit where the EIA rating is major or greater.	Waterway crossings have been a persistent and, in some cases, disproportionate source of non-compliance and environmental impact. Action is required by VicForests to ensure its contractors consistently comply with the regulatory framework and control the risks crossings pose to water quality and associated beneficial water uses.
VF-07: Moderate priority VicForests should explore the more widespread use of rollovers or similar, trafficable cross-drainage structures for in-coupe roads. This type of structure has been observed to be used effectively by VicForests in some settings and by other Victorian forestry operators. They are also widely used in forest and rural roading in tropical and sub-tropical regions of Australia. Rollover structures reduce the need for culverts and, if properly constructed, should function effectively through and following harvesting. They are generally more stable and resilient to damage by post-harvest traffic than traditional "bar and breach" cross drainage structures.	Where well-constructed, such structures may provide a resilient form of road drainage through the operational life of a road and during coupe regeneration.

6.2.3 Recommendations for the Department of Environment, Land, Water and Environment

Recommendation	Rationale
DE-01: High priority DELWP should modify the wording of MSP section 6.1.1.3 regarding the requirement to seek engineering advice for road construction across steep slopes. The revised wording should reflect the limited accuracy of slope measurements taken from available topographic data or taken in the field in unharvested coupes. It is suggested that engineering advice is sought for the design of roads traversing areas where it is possible (>50% chance) that: side slopes will be within 5° of the respective MSP limit; and/or side cuts or embankments greater than 2 m in height will need to be constructed.	The MSP has very precise slope limits at which engineering advice on road construction are required. This precision is inconsistent with the accuracy of field and map-based slope assessments. Applying this precise definition to the seeking of engineering advice is not considered by the auditor to adequately manage risks to the environment and operator safety from in-coupe roads through steep slope areas.
DE-02: Moderate priority VicForests does not routinely construct cross drainage on many temporary in-coupe roads in lower risk settings until heavy rainfall is forecast or harvesting is suspended or completed. While this practice is arguably not compliant with the MSP, it is operationally effective and the audit found no evidence it poses a significant environmental risk. It is recommended that this practice be explicitly incorporated within the regulatory framework to specify conditions under which it can be safely adopted. The MSP for road drainage (Section 6.2.4) should be amended to prescribe conditions under which temporary in-coupe roads need not be drained until harvesting is suspended or completed. Suggested conditions include: • The coupe is planned to be harvested within 6 months of roading and road use will only occur within a single harvesting season; • Average slope of the in coupe road is 4° or less and never greater than 6°; • Soil erosion hazard is low or moderate; • The road is located well away from waterways and there is limited potential for sustained overland sediment flow; Appropriate cross drainage must be constructed when: heavy rainfall is forecast; harvesting is suspended (for any reason or period) and harvesting machinery is removed from the coupe; and harvesting is completed and roads are no longer required for operational purposes.	VicForests do not appear to routinely construct drainage on temporary in-coupe roads in low risk situations until harvesting is suspended or completed (or in advance of heavy rainfall). This is operationally efficient and appears to pose minimal risk to the environment. Since this practice is not strictly recognised in the MSP, this recommendation is proposed to prescribe situations where it may be safely applied.
DE-03: High priority Given the significant non-compliance issues which were observed for waterway crossings in the 2015 FAP, DELWP should maintain a focus on waterway crossings in the 2016 audit program.	Waterway crossings have been a persistent source of non-compliance and environmental impact from timber harvesting activities. Audits should continue to focus on this issue until there is a demonstrable improvement in audit outcomes for these features.
DE-04: High priority DELWP should include a mandatory action in the MSP to ensure that VicForests and its contractors take appropriate action to stabilise former waterway crossing sites following the removal of culverts.	The MSP do not specify clear actions for culvert removal on waterways to protect water quality values. Lack of rehabilitation following removal may result in embankment sediments being mobilised into the waterway.

Recommendation	Rationale
DE-05: Moderate priority In the response to the challenges in controlling access to coupes following the completion of harvesting and of the damage that this may cause to drainage structures, DELWP should provide an alternative to the Code's mandatory requirement to close coupe access following harvesting completion. This alternative should require the construction of effective drainage structures along in-coupe roads which will be resilient to post-harvest vehicle traffic for at least 3 years, while the coupe is regenerating and ground cover being restored. After this period, regrowth will typically stabilise soils, trap any sediment flow and prevent further erosion.	Unplanned post-harvest use of in-coupe roads is almost unavoidable in some areas. This proposal seeks to mitigate risks associated with damage that such traffic causes to drainage structures and reflects some good practice examples in VicForests in-coupe roads.
DE-06: Low priority To enhance the capability of the regulatory framework to support auditing, DELWP should review mandatory actions in the Code and MSP to reduce the subjectivity sometimes created by their wording. Consideration should be given to the comments and suggested wording for Code mandatory actions relating to in-coupe roads provided in Section 5.2.1 of this report.	The proposed wording changes seek to improve the capacity the Code and MSP to audited objectively and clarify the actual intent of some mandatory actions.
DE-07: Moderate priority DELWP should strengthen mandatory actions in the Code to reduce the potential for weeds and pathogens to be spread by road construction and maintenance activities. Suggested improvements are that: • All harvesting and road construction machinery are thoroughly cleaned and inspected before being brought onto a new coupe (unless it is adjacent to the one from which the machinery is being moved); • Quarries from which materials are sourced for forest road construction are checked annually by a competent, independent party to confirm disease and weed free status; • Gravel obtained from quarries which are not confirmed as weed and disease free should be treated to mitigate any weed or disease threat prior to use within a harvest coupe. Evidence of machinery inspections, disease and weed free status of quarries and/or treatment should be retained in the FCP for all applicable coupes.	Code requirements relating to weed and disease hygiene are considered to be too passive. They should require specific action and knowledge and not, as is the currently the case, require action only after an issue is known or identified.

7. References

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DEPI 2014b. *Management standards and procedures for timber harvesting operations in Victoria's State forests 2014.* DEPI.

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VicForests 2013. *Utilisation procedures for all commercial harvesting and haulage managed by VicForests*. Version 7.0. VicForests

Spatial data sources:

- Victorian government: www.data.vic.gov.au
- ESRI

Limitation statement

The purpose of this report and the associated services performed by Jacobs was to conduct an environmental audit of the construction and maintenance of in-coupe roads in Victorian State forests. The work has been undertaken in accordance with the scope of services set out in the contract between Jacobs and the Department of Environment, Land, Water and Planning (DELWP).

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by DELWP. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from field observations and information sourced from DELWP, VicForests and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report.

Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

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This report has been prepared on behalf of, and for the exclusive use of, DELWP, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and DELWP. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

Appendix A. In-coupe roading regulatory compliance elements

A.1 Regulatory compliance elements considered in the environmental audit of in-coupe roads

The full set of regulatory compliance elements considered in this audit are included in Table A.1. They were drawn from both the *Code of Practice for Timber Production* (DEPI, 2014a) and the associated *Management Standards and Procedures for Timber Harvesting Operations in Victoria's State forests* (DEPI, 2104b).

Table A.1 Regulatory compliance elements included in the environmental audit of in-coupe roads.

Source	Compliance theme	Compliance theme[1]
	Water quality, river health and soil protection	
Code 2.2.1	2.2.1.1 Planning and management of timber harvesting operations must comply with relevant water quality, river health and soil protection measures specified within the Management Standards and Procedures.	Water quality
	2.2.1.2 Management actions to protect waterways, river health and soil must be appropriate to the waterway class, soil category, and potential water quality risk posed by timber harvesting operations at each site.	Water quality
	2.2.1.3 Additional measures to protect water quality and aquatic habitat (including widening buffers or filter strips) must be adopted within coupes where there is a high local risk due to: i. local topography; ii. the intensity and magnitude of the timber harvesting operation; iii. events such as wildfire that reduce the effectiveness of protection measures; or iv. the location of the timber harvesting operation in a declared Special Water Supply Catchment or any other water supply protection area.	Water quality
	2.2.1.5 Where practical exclude roads and snig tracks from aquatic and riparian habitats.	Water quality
	2.2.1.6 Where crossings are required, minimise the extent of habitat damage, constriction to stream flow and barriers to fish and other aquatic fauna.	Water quality
	2.2.1.7 Remove temporary crossings immediately after harvesting or any subsequent regeneration work is complete using a technique that minimises soil and habitat disturbance.	Water quality
	2.2.1.8 Use drainage, artificial structures, buffers and filters of effective width to slow and disperse surface flows and deposit sediment before reaching waterways.	Water quality
	2.2.1.9 Locate coupe infrastructure, roads and other activities that generate sediment or other potential pollutants in places where risk of entry into waterways is lowest unless otherwise sanctioned.	Water quality
	2.2.1.10 Minimise the extent and duration of soil disturbance adjacent to or within waterways.	Water quality
	2.2.1.12 Design, construct and maintain roads, crossings, coupe infrastructure and drainage structures to withstand foreseeable rainfall events and traffic conditions, and protect water quality.	Water quality
	2.2.1.15 Locate coupe infrastructure and roads to minimise soil erosion and degradation.	Water quality
	2.2.1.17 Limit the area of soil affected by coupe infrastructure and roads to the minimum required to safely complete timber harvesting operations to the required standard.	Water quality
	2.2.1.18 Employ topsoil conservation techniques in timber harvesting areas affected by coupe infrastructure and roads.	Water quality
	2.2.1.19 During timber harvesting operations maintain effective drainage of coupe infrastructure and roads. Complies with #67,68,70-73,100-101,107	Water quality
	2.2.1.20 Minimise the time soil is left unvegetated, except at coupe infrastructure sites that are required in the longer term.	Water quality
	Waterway classification	
MSP 3.1.1	3.1.1.1 Use the following categories when determining buffer (B) and filter (F) widths for waterways within and immediately adjacent to each coupe. Aids to the identification of each class of waterway are provided in the Code Glossary. (a) Permanent streams, pools and wetlands. (b) Temporary streams. (c) Drainage	Water quality

Source	Compliance theme	Compliance theme[1]
	lines.	
	Water supply protection areas	
MSP 3.5.1	3.5.1.1 Apply the slope limits, seasonal closures, buffer and filter strip widths and other relevant management actions specified in Appendix 3 Table 11 (Water supply protection areas) for timber harvesting operations and associated roading and regeneration in water supply protection areas.	Water quality
	Conservation of biodiversity	
Code 2.2.2	2.2.2.4 During planning identify biodiversity values listed in the Management Standards and Procedures prior to roading, harvesting, tending and regeneration. Address risks to these values through management actions consistent with the Management Standards and Procedures such as appropriate location of coupe infrastructure, buffers, exclusion areas, modified harvest timing, modified silvicultural techniques or retention of specific structural attributes.	Not used
	2.2.2.5 Protect areas excluded from harvesting from the impacts of timber harvesting operations.	Planning & design
	2.2.2.13 Implement appropriate vehicle and equipment hygiene precautions when moving from areas of known pest plant, pest animal and pathogen infestations.	Pests, weeds & diseases
	Vegetation communities	
MSP 4.4	4.4.2.1 Avoid road construction across areas of heathland or within 40 m of heathlands unless no reasonable alternative exists.	Not used
	4.4.3.2 In all other FMAs apply the heathland prescriptions listed above in 4.4.2 – applies to other than Tambo FMA and Montane Riparian Thicket communities.	Not used
	Pests, weeds and diseases	
MSP 4.5	4.5.1.1 Minimise the risk of introduction or movement of Cinnamon Fungus (Phytophthora cinnamomi) and Root Rot (Armillaria) from known infected areas, into uninfected areas by: (a) washing machinery before moving into uninfected areas; (b) restricting activities where the movement of soil or gravel is likely to cross from infected sites into healthy vegetation; (c) minimising the relocation or movement of infected gravel or soil during road and track construction or maintenance works, or logging operations; (d) restricting or controlling drainage water run-off from roads and tracks away from healthy vegetation; (e) testing gravel from infected areas and using only uncontaminated gravel in uninfected areas; and (f) cleaning and disinfecting vehicles, machinery, tools and equipment used in infected areas.	Pests, weeds & diseases
	Operational planning	
Code 2.3.1	2.3.1.3 Coupes associated with roading, must be approved with adequate time to construct the required standard of access without compromising safety, water quality and other values.	Not used
	Road planning	
Code 2.4.1	2.4.1.1 Planning and management of timber harvesting operations must comply with this Code and relevant road planning measures specified within the Management Standards and Procedures unless the road is covered by a formal roading agreement with DEPI that would supersede this requirement.	Planning & design
	2.4.1.2 Road planning and design for new and substantially upgraded roads must ensure the road network is safe and adequate for the intended range of uses and users, while ensuring the protection of water quality and conservation values, including river health.	Planning & design
	2.4.1.3 Road planning must: i. locate roads so as to minimise risks to safety and environmental values, particularly soil, water quality and river health, during both construction and ongoing road use; and ii. ensure that the timing of construction activities minimises risks associated with unsuitable weather conditions and provides for completion to the required standard in advance of timber harvesting operations.	Planning & design

Source	Compliance theme	Compliance theme[1]
	2.4.1.4 Existing roads must be used for access to a coupe or work site and to haul timber, except where it can be clearly demonstrated that a new or relocated road further minimises or removes existing threats to soil, water quality or biodiversity.	Planning & design
	2.4.1.5 Forest Coupe Plans for roads must be based on field surveys to ensure that all environmentally sensitive locations are identified and appropriate design and construction techniques are adopted.	Planning & design
MSP 6.1.1	6.1.1.1 Plan new roads and major road upgrades to minimise construction through SMZ, SPZ, wet, unstable areas, and slopes greater than 30 degrees.	Planning & design
	6.1.1.2 Application may be made to the Minister or delegate to obtain approvals for roading activities conducted in SPZ in accordance with section 1.4.	Planning & design
	6.1.1.3 Seek engineering advice for road alignments traversing cross slopes of 30 degrees or greater or 25 degrees and greater in areas of high soil erodibility.	Planning & design
	6.1.1.4 Identify the intended class of a new road or road upgrade in accordance with the appropriate service function description in Appendix 4 Table 18 (Road classification system).	Planning & design
	6.1.1.5 Design new roads and road upgrades to conform to the geometric design standards in Appendix 4 Table 19 (Guidelines to the main geometric design standards – unsealed roads) for the intended road class.	Planning & design
MSP 6.1.2	6.1.2.1 Minimum clearing widths for roads are specified in Appendix 4 Table 20 (Minimum clearing widths (m) required for typical road construction).	Road construction
	6.1.2.2 When planning clearing widths for road intersections on permanent roads include the minimum formation width plus any additional width required for the construction of batters.	Planning & design
	6.1.2.3 Where a slashed verge is necessary, plan clearing widths for permanent roads sufficiently wide to enable efficient control of unwanted regrowth.	Planning & design
	6.1.2.4 Limit clearing widths to those specified in Appendix 4 Table 20 (Minimum clearing widths (m) required for typical road construction) plus any additional width required to construct batters.	Planning & design
	Road design	
Code 2.4.2	2.4.2.1 Planning and management of timber harvesting operations must comply with this Code and relevant road design measures specified within the Management Standards and Procedures unless the road is covered by a formal roading agreement with DEPI that would supersede this requirement.	Planning & design
	2.4.2.2 New or upgraded roads must be designed to a standard capable of carrying anticipated traffic with reasonable safety, and ensure the protection of water quality and river health, and biodiversity conservation values.	Planning & design
	2.4.2.3 All fill disposal areas and embankments must be planned and designed to minimise soil erosion, mass soil movement, and potential water quality deterioration.	Planning & design
	2.4.2.4 Stream crossings must be designed according to traffic requirements and the nature, size and period of flow (both pre and anticipated post-harvest) and characteristics of the bed and banks of the stream.	Planning & design
	2.4.2.5 Appropriate drainage must be provided. Spacing of drainage outlets along a road must take into account the soil erodibility, rainfall frequency and intensity, and the proximity of the road to streams.	Drainage
	2.4.2.6 Energy dissipating structures or silt traps must be used where necessary to reduce water velocity and trap sediments.	Planning & design
	2.4.2.7 Drainage onto exposed erodible soil or over fill slopes must be avoided where possible. Structures and earthworks required to avoid such discharges are to be identified during planning and construction as required.	Planning & design
	2.4.2.8 Drainage must be prevented from discharging directly onto any road.	Planning & design

Source	Compliance theme	Compliance theme[1]
	2.4.2.9 Before entering a waterway road drainage must discharge onto vegetation or through a structure that effectively dissipates the velocity of drainage flows.	Planning & design
	2.4.2.10 Materials or techniques with low sediment generating potential must be applied to the road area on bridge approaches and on unsurfaced bridges or culverts, when crossing permanent or temporary streams.	Planning & design
	Road construction	
Code 2.4.3	2.4.3.1 Planning and management of timber harvesting operations must comply with this Code and relevant road construction measures specified within the Management Standards and Procedures unless the road is covered by a formal roading agreement with DEPI that would supersede this requirement.	Road construction
	2.4.3.2 Road construction must be conducted in a manner consistent with plans and designs.	Road construction
	2.4.3.3 All fill disposal areas and embankments must be appropriately stabilised. Where revegetation is used to stabilise fills or embankments, the species must be suitable for the site and where possible indigenous to the area.	Planning & design
	2.4.3.4 Erosion and sediment control must be an ongoing activity over the duration of the construction activity, integrated with the works schedule. Road construction sites must have erosion mitigation measures in place and appropriate temporary drainage to ensure that the site is left protected between construction activities.	Road construction
	2.4.3.5 Quarry materials known to be infected with any pest plant or pathogen must not be used.	Pests, weeds & diseases
	2.4.3.6 Road construction must ensure that: i. disturbance to stream beds and banks is kept to a minimum; ii. soil and rock fill is not pushed into waterways, nor placed into a position where there is a risk that it can erode into a waterway; and iii. cement, raw concrete, soil fill and other road making materials are not spilt or disposed of into waterways during road construction.	Road construction
MSP 6.2.1	6.2.1.1 Undertake road construction when rainfall and soil conditions minimise the risk of erosion and impact on water quality, and when soil moisture is adequate to achieve compaction and stabilisation of the sub-grade.	Road construction
	6.2.1.2 Clear road alignments prior to road formation.	Road construction
	6.2.1.3 For permanent roads, remove all stumps, logs and other debris from within the formed width of the road site.	Road construction
	6.2.1.4 Where road construction requires the removal of topsoil in large quantities maintain the topsoil in a stockpile where practicable, clear of logging debris for use in batter stabilisation, snig track rehabilitation or other coupe infrastructure rehabilitation.	Road construction
	6.2.1.5 Create table drains by extending the road when it is formed, and not by subsequent excavation.	Road construction
	6.2.1.6 Limit earthworks to the least possible to achieve the road design specification.	Road construction
MSP 6.2.2	6.2.2.1 Prevent fill batters from covering the base of live trees.	Road construction
	6.2.2.2 Only use clean and weed free mulch in batter rehabilitation works.	Road construction
	6.2.2.3 Use engineer approved methods of mechanical consolidation of fill batters. Complies with 64-66 or other documented and engineer-approved procedures.	Road construction

Source	Compliance theme	Compliance theme[1]
MSP 6.2.3	6.2.3.1 Consolidate sub-grades before placing pavement material.	Road construction
	6.2.3.2 Consolidate and level the base course material prior to placing the wearing course material.	Road construction
	6.2.3.3 On permanent roads use surfacing materials appropriate to passenger vehicles and timber harvesting operations.	Road construction
MSP 6.2.4	6.2.4.1 The maximum distance between drainage structures for road grade and soil erosion hazard is specified in Appendix 4 Table 21 (Maximum distance between drainage structures).	Drainage
	6.2.4.2 Construct cross-drains at an angle sufficient to discharge any water from the surface of the road.	Drainage
	6.2.4.3 On soils of high erosion hazard, use temporary sediment traps to prevent erosion during road construction.	Drainage
	6.2.4.4 Appropriate discharge areas for drainage include: (a) a strip of undisturbed vegetation at least 20 m wide; (b) a rock spill; or(c) some other structure that dissipates the velocity of drainage flows.	Drainage
	6.2.4.5 Place drainage structures approximately 20 m from permanent or temporary streams, to allow discharge onto undisturbed vegetation and to maximise the flow distance between the drainage outlet and the waterway.	Drainage
	6.2.4.6 Within 20 m of a permanent or temporary stream: (a) use crown or cross fall techniques to drain roads into undisturbed vegetation; or (b) pass drainage through an appropriate sediment control structure such as a sediment pond or silt trap before entering a permanent or temporary stream.	Drainage
	6.2.4.7 Construct table drains to: (a) allow water to flow, without ponding; (b) include run-offs of sufficient length to allow the table drain and run-offs to be cleaned; (c) be supported by rock or otherwise stabilised in soils of a high erosion hazard; and (d) have silt traps constructed at the end if discharging directly into a stream or wetland buffer.	Drainage
MSP 6.2.5	6.2.5.1 Culverts used in permanent roads are a minimum of 375 mm in diameter.	Drainage
	6.2.5.2 Culverts used in temporary roads are a minimum of 300 mm in diameter.	Drainage
	6.2.5.3 All culverts are designed to withstand a 1 in 10 year rainfall event.	Drainage
	6.2.5.4 Construct culverts in catchment areas exceeding 100 ha in accordance with engineering advice.	Drainage
	6.2.5.5 On drainage lines, stream and river crossings or soils of High Erosion Hazard place sandbags, timber, concrete or rock at the head of the culvert and at the point of discharge to hold the culvert in place and protect it from erosion.	Drainage
	6.2.5.6 Include a road sump for all culverts on Class 5C and higher roads.	Drainage
	6.2.5.7 If constructed of concrete, have a minimum cover of 600 mm as measured from the road surface to the top of the pipe and a maximum cover as specified in the Installation of Steel-Reinforced Concrete Drainage Pipelines, Concrete Pipe Association of Australasia.	Drainage
	6.2.5.8 If constructed of a material other than concrete, have a minimum cover over the pipe as recommended in the manufacturer's specifications.	Drainage
	6.2.5.9 On permanent streams, include a fish ladder if the diameter of the culvert is greater than 750 mm.	Drainage
	6.2.5.10 Protect any fill face upstream or downstream of a culvert in a way that prevents erosion.	Drainage
	6.2.5.11 Ensure culverts do not project above the bed of a waterway in a way which may prevent the passage of aquatic fauna.	Drainage
	6.2.5.12 Where culvert construction diverts water from its natural course, return water to its natural course over a flume, rock spill, or other hard surface.	Drainage

Source	Compliance theme	Compliance theme[1]
MSP 6.2.6	6.2.6.1 Design bridges in accordance with the DSE Bridge Policy 2007.	Not used
	6.2.6.2 Design bridges to prevent constriction of any clearly defined channel.	Not used
	6.2.6.3 Source earth borrow from outside waterway buffers.	Not used
	6.2.6.4 Ensure that excavations, sills, abutments, stringers and girders are made or placed above the high watermark of the stream, wetland or drainage line.	Not used
	6.2.6.5 Protect bridges from erosion by use of natural groundcover, a retaining wall, a bulkhead or a rock surface.	Not used
	6.2.6.6 Only construct temporary crossings to carry machinery during bridge construction if the bed of the stream, wetland or drainage line is capable of bearing the weight of that machinery without being damaged.	Not used
	6.2.6.7 Temporary crossings to carry machinery during bridge construction: (a) include a corduroy crossing of logs; (b) are adequately drained, along with any access tracks, when construction is complete; and (c) are removed and rehabilitated on completion of works.	Not used
MSP 6.2.7	6.2.7.1 The base and entry points of fords are constructed of rock, concrete, heavy timber or other erosion-resistant material.	Not used
	6.2.7.2 Fords are only as wide as the crossing place will allow.	Not used
	6.2.7.3 Ensure fords do not project above the bed of a waterway in a way which may prevent the passage of aquatic fauna.	Not used
	Road maintenance	
Code 2.4.4	2.4.4.1 Planning and management of timber harvesting operations must comply with this Code and relevant road maintenance measures specified within the Management Standards and Procedures unless the road is covered by a formal roading agreement with DEPI that would supersede this requirement.	Maintenance
	2.4.4.2 Roads used for timber haulage must be maintained in a manner that minimises erosion and protects water quality and other environmental values.	Maintenance
	2.4.4.3 Road drainage systems must be maintained at sufficient frequency to minimise erosion and the discharge of sediment into waterways.	Maintenance
	2.4.4.4 Blading-off of roads must be sanctioned and recorded in the coupe diary and is only permitted where measures are in place to prevent potential adverse impacts on water quality and where effective side drainage can be maintained.	Maintenance
MSP 6.3.1	6.3.1.1 Breach at regular intervals any soil windrow erected on the outside of a road.	Maintenance
	6.3.1.2 Maintain drainage structures free of debris.	Maintenance
	Road operations	
Code 2.4.5	2.4.5.1 Planning and management of timber harvesting operations must comply with relevant suspension of haulage measures specified within the Management Standards and Procedures unless the road is covered by a formal roading agreement with DEPI that would supersede this requirement.	Maintenance
	2.4.5.2 Heavy vehicle traffic associated with timber harvesting operations must not use roads in State forests when persistent wet weather or road stability compromise road drainage and water quality.	Maintenance
	2.4.5.3 Heavy vehicle traffic associated with timber harvesting operations must not use roads in State forests when persistent dry weather causes the surface materials to disintegrate to a degree that poses a threat to water quality, in the absence of suitable preventative or remedial actions to manage the risk to water quality.	Maintenance

Source	Compliance theme	Compliance theme[1]
Code 2.4.6	2.4.6.1 Planning and management of timber harvesting operations must comply with relevant road closure measures specified within the Management Standards and Procedures unless the road is covered by a formal roading agreement with DEPI that would supersede this requirement.	Maintenance
	2.4.6.2 Roads no longer required for timber harvesting operations or other forest management purposes, must be permanently closed to vehicle traffic and effectively drained following completion of the timber harvesting operation.	Maintenance
MSP 7.3.2	7.3.2.1 Carting must be suspended when: (a) snow is lying on any road used to access or exit the coupe, (b) water is flowing down any unsealed road or track; or (c) truck movement will deposit mud on a gravelled or sealed road.	Maintenance
	Road closure and rehabilitation	
MSP 6.4.1	6.4.1.1 Close temporary roads (including removal of all bridges, crossings and culverts on streams or drainage lines) as soon as possible after harvesting and/or regeneration is complete in all coupes that use the road.	Maintenance
	6.4.1.2 Drain the approach to any bridge, culvert or log fill crossing that has been removed to restrict soil movement into a stream or waterway.	Maintenance
	6.4.1.3 Use an effective barrier to close to all vehicles temporary roads that will not be used to access a coupe for a period of 12 months or more.	Maintenance

A.2 Audit workbook

#	When		Source	Replace with coupe # and name Audit criteria	Class Cross Ref #1	5? #2	Applies to coupe (Y/N)	Complies (Y/P/N)	EIA if complies = P/N Ext	Dur	Rec	Asset	EIA	Basis of assessment	Source[2] F	D	A
WQ			C 2.2.1	**Water quality, river health and soil protection**												
1	End		C 2.2.1	2.2.1.1 Planning and management of timber harvesting operations must comply with relevant water quality, river health and soil protection measures specified within the Management Standards and Procedures. Compliance assessed with #16, 17, 23, 30-32, 55, 57-60, 67-95, 107-110.	17	55									Y	Y	Y
2	End		C 2.2.1	2.2.1.2 Management actions to protect waterways, river health and soil must be appropriate to the waterway class, soil category, and potential water quality risk posed by timber harvesting operations at each site.											Y	Y	Y
	File rev	2a		FCP provides evidence of waterway class & soil erosion hazard assessed for the coupe	16											Y	
	End	2b		Auditor confirmation of waterway class & soil erosion hazard assessment.													Y
	End	2c		Compliance assessed with #17, 69.	17	69											
	Field	2d		Management actions appropriate in auditor's professional opinion.											Y		Y
3	End		C 2.2.1	2.2.1.3 Additional measures to protect water quality and aquatic habitat (including widening buffers or filter strips) must be adopted within coupes where there is a high local risk due to: i. local topography; ii. the intensity and magnitude of the timber harvesting operation; iii. events such as wildfire that reduce the effectiveness of protection measures; or iv. the location of the timber harvesting operation in a declared Special Water Supply Catchment or any other water supply protection area.											Y	Y	Y
	End	3a		Compliance assessed with #17, 30, 32, 55,78	17	30											
	Field	3b		In auditor's professional opinion, additional measures are appropriate to high local risk issues.													
4	Field		C 2.2.1	2.2.1.5 Where practical exclude roads and snig tracks from aquatic and riparian habitats.											Y	N	Y
5	Field		C 2.2.1	2.2.1.6 Where crossings are required, minimise the extent of habitat damage, constriction to stream flow and barriers to fish and other aquatic fauna.											Y	N	Y
	End	5a		Complies with #74-77, 82, 84, 87, 88, 89, 93-95													
	Field	5b		In auditor's professional opinion, crossing is required and minimises environmental impacts.													Y
6	Field		C 2.2.1	2.2.1.7 Remove temporary crossings immediately after harvesting or any subsequent regeneration work is complete using a technique that minimises soil and habitat disturbance.											Y	N	Y
7	Field		C 2.2.1	2.2.1.8 Use drainage, artificial structures, buffers and filters of effective width to slow and disperse surface flows and deposit sediment before reaching waterways.											Y	N	Y
8	End		C 2.2.1	2.2.1.9 Locate coupe infrastructure, roads and other activities that generate sediment or other potential pollutants in places where risk of entry into waterways is lowest unless otherwise sanctioned.											Y	Y	Y
	Field	8a		In auditor's professional opinion in-coupe road is located to minimise risk of entry to waterway.											Y		Y
	File rev	8b		FCP provides evidence of sanction of higher risk location.												Y	
9	Field		C 2.2.1	2.2.1.10 Minimise the extent and duration of soil disturbance adjacent to or within waterways.											Y	N	Y
10	End		C 2.2.1	2.2.1.12 Design, construct and maintain roads, crossings, coupe infrastructure and drainage structures to withstand foreseeable rainfall events and traffic conditions, and protect water quality. Complies with #16,17, 30,32-38, 55, 60, 63, 66-79, 87-95, 100, 107.											Y	Y	Y
11	Field		C 2.2.1	2.2.1.15 Locate coupe infrastructure and roads to minimise soil erosion and degradation.											Y	N	Y
12	End		C 2.2.1	2.2.1.17 Limit the area of soil affected by coupe infrastructure and roads to the minimum required to safely complete timber harvesting operations to the required standard.											Y	N	Y
12a	End			Complies with #35-38	35	38											
12b	File rev			In auditor's professional opinion the area of soil affected is the minimum required.													Y
13	Field		C 2.2.1	2.2.1.18 Employ topsoil conservation techniques in timber harvesting areas affected by coupe infrastructure and roads.											Y	N	Y
14	End		C 2.2.1	2.2.1.19 During timber harvesting operations maintain effective drainage of coupe infrastructure and roads. Complies with #67,68,70-73,100-101,107	67	100									Y	N	Y
15	Field		C 2.2.1	2.2.1.20 Minimise the time soil is left unvegetated, except at coupe infrastructure sites that are required in the longer term.											Y	N	Y
Wway			MSP 3.1	**Waterway classification**													
16	End		MSP 3.5	3.1.1.1 Use the following categories when determining buffer (B) and filter (F) widths for waterways within and immediately adjacent to each coupe. Aids to the identification of each class of waterway are provided in the Code Glossary. (a) Permanent streams, pools and wetlands. (b) Temporary streams. (c) Drainage lines.	2										Y	Y	Y
WSPA			MSP 3.5	**Water supply protection areas**													
17	File rev		MSP 3.5	3.5.1.1 Apply the slope limits, seasonal closures, buffer and filter strip widths and other relevant management actions specified in Appendix 3 Table 11 (Water supply protection areas) for timber harvesting operations and associated roading and regeneration in water supply protection areas.											Y	Y	N
Biod			C 2.2.2	**Conservation of biodiversity**													
18	End		C 2.2.2	2.2.2.4 During planning identify biodiversity values listed in the Management Standards and Procedures prior to roading, harvesting, tending and regeneration. Address risks to these values through management actions consistent with the Management Standards and Procedures such as appropriate location of coupe infrastructure, buffers, exclusion areas, modified harvest timing, modified silvicultural techniques or retention of specific structural attributes.	29										Y	Y	Y
19	End		C 2.2.2	2.2.2.5 Protect areas excluded from harvesting from the impacts of timber harvesting operations.	30										Y	N	Y
20	End		C 2.2.2	2.2.2.13 Implement appropriate vehicle and equipment hygiene precautions when moving from areas of known pest plant, pest animal and pathogen infestations.	23										N	Y	Y
Veg			MSP 4.4	**Vegetation communities**													

21	Field		MSP 4.4	4.4.2.1 Avoid road construction across areas of heathland or within 40 m of heathlands unless no reasonable alternative exists.					Y	Y	Y
22	Field		MSP 4.4	4.4.3.2 In all other FMAs apply the heathland prescriptions listed above in 3.4.2. (4.4.2?) – Applies to other than Tambo FMA and Montane Riparian Thicket communities.					Y	Y	Y
Dis			MSP 4.5	**Pests, weeds and diseases**							
23	End		MSP 4.5	4.5.1.1 Minimise the risk of introduction or movement of Cinnamon Fungus (Phytophthora cinnamomi) and Root Rot (Armillaria) from known infected areas, into uninfected areas by: (a) washing machinery before moving into uninfected areas; (b) restricting activities where the movement of soil or gravel is likely to cross from infected sites into healthy vegetation; (c) minimising the relocation or movement of infected gravel or soil during road and track construction or maintenance works, or logging operations; (d) restricting or controlling drainage water run-off from roads and tracks away from healthy vegetation; (e) testing gravel from infected areas and using only uncontaminated gravel in uninfected areas; and (f) cleaning and disinfecting vehicles, machinery, tools and equipment used in infected areas.					N	Y	Y
	File rev	23a		Evidence exists which documents locations of known disease risk areas within FMA, including testing of quarries used in construction of in-coupe roads.						Y	
	File rev	23b		Evidence of procedures to minimise the movement of infected soil or gravel during in-coupe road construction.						Y	
	File rev	23c		In auditor's professional opinion the measures in place to manage risks of disease movement in road construction are adequate.							Y
OpPl			C 2.3.1	**Operational planning**							
24	File rev		C 2.3.1	2.3.1.3 Coupes associated with roading, must be approved with adequate time to construct the required standard of access without compromising safety, water quality and other values.					N	Y	Y
Road			C 2.4	**Roading for timber harvesting operations**							
Rplan			C 2.4.1	**Road planning**							
25	End		C 2.4.1	2.4.1.1 Planning and management of timber harvesting operations must comply with this Code and relevant road planning measures specified within the Management Standards and Procedures unless the road is covered by a formal roading agreement with DEPI that would supersede this requirement. Complies with #30-38, 46-51.	30	46			Y	Y	Y
26	End		C 2.4.1	2.4.1.2 Road planning and design for new and substantially upgraded roads must ensure the road network is safe and adequate for the intended range of uses and users, while ensuring the protection of water quality and conservation values, including river health.	25				Y	Y	Y
27	End		C 2.4.1	2.4.1.3 Road planning must: i. locate roads so as to minimise risks to safety and environmental values, particularly soil, water quality and river health, during both construction and ongoing road use; and ii. ensure that the timing of construction activities minimises risks associated with unsuitable weather conditions and provides for completion to the required standard in advance of timber harvesting operations.					Y	Y	Y
	End	27a		Complies with #21,22,30-32,55.	21	55			Y	Y	Y
	Field	27b		In auditor's professional opinion road planning has located the in-coupe road to minimise risks to [safety and] environmental values.							Y
28	File rev		C 2.4.1	2.4.1.4 Existing roads must be used for access to a coupe or work site and to haul timber, except where it can be clearly demonstrated that a new or relocated road further minimises or removes existing threats to soil, water quality or biodiversity.					Y	N	Y
29	File rev		C 2.4.1	2.4.1.5 Forest Coupe Plans for roads must be based on field surveys to ensure that all environmentally sensitive locations are identified and appropriate design and construction techniques are adopted.					N	Y	Y
	File rev	29a		FCP provides evidence that roads are based on appropriate field surveys of environmentally sensitive locations.						Y	
	End	29b		In auditor's professional opinion in-coupe road design and construction accounts for environmentally sensitive locations.							Y
			MSP 6.1	**Road planning**							
30	File rev		MSP 6.1	6.1.1.1 Plan new roads and major road upgrades to minimise construction through SMZ, SPZ, wet, unstable areas, and slopes greater than 30 degrees.					Y	Y	Y
31	File rev		MSP 6.1	6.1.1.2 Application may be made to the Minister or delegate to obtain approvals for roading activities conducted in SPZ in accordance with section 1.4.					N	Y	N
32	File rev		MSP 6.1	6.1.1.3 Seek engineering advice for road alignments traversing cross slopes of 30 degrees or greater or 25 degrees and greater in areas of high soil erodibility.					N	Y	N
	File rev	32a		FCP or other documentation demonstrates that professional engineering advice sought and received.						Y	
	End	32b		In auditor's professional opinion, appropriate use was made of the engineering advice obtained.							Y
33	File rev		MSP 6.1	6.1.1.4 Identify the intended class of a new road or road upgrade in accordance with the appropriate service function description in Appendix 4 Table 18 (Road classification system).					N	Y	N
34	File rev		MSP 6.1	6.1.1.5 Design new roads and road upgrades to conform to the geometric design standards in Appendix 4 Table 19 (Guidelines to the main geometric design standards – unsealed roads) for the intended road class.					Y	Y	N
35	End		MSP 6.1	6.1.2.1 Minimum clearing widths for roads are specified in Appendix 4 Table 20 (Minimum clearing widths (m) required for typical road construction).	38						
36	Field		MSP 6.1	6.1.2.2 When planning clearing widths for road intersections on permanent roads include the minimum formation width plus any additional width required for the construction of batters.					Y	Y	y
37	Field		MSP 6.1	6.1.2.3 Where a slashed verge is necessary, plan clearing widths for permanent roads sufficiently wide to enable efficient control of unwanted regrowth.					Y	Y	Y

38	Field		MSP 6.1	6.1.2.4 Limit clearing widths to those specified in Appendix 4 Table 20 (Minimum clearing widths (m) required for typical road construction) plus any additional width required to construct batters.						Y	N	N
			C 2.4.2	**Road design**								
39	End		C 2.4.2	2.4.2.1 Planning and management of timber harvesting operations must comply with this Code and relevant road design measures specified within the Management Standards and Procedures unless the road is covered by a formal roading agreement with DEPI that would supersede this requirement. Complies with #34,67,71,72,74-77,82,86,87,93-95.	67	82				Y	Y	Y
40	End		C 2.4.2	2.4.2.2 New or upgraded roads must be designed to a standard capable of carrying anticipated traffic with reasonable safety, and ensure the protection of water quality and river health, and biodiversity conservation values.	27					Y	Y	Y
41	Field		C 2.4.2	2.4.2.3 All fill disposal areas and embankments must be planned and designed to minimise soil erosion, mass soil movement, and potential water quality deterioration.						Y	Y	Y
	File rev	41a		Evidence that fill disposal areas and embankments planned and designed to manage soil and water quality risks.							Y	
	Field	41b		In auditor's professional opinion, planning and design of fill disposal areas and embankments adequately manage soil and water quality risks.								Y
42	End		C 2.4.2	2.4.2.4 Stream crossings must be designed according to traffic requirements and the nature, size and period of flow (both pre and anticipated post-harvest) and characteristics of the bed and banks of the stream.	10					Y	Y	Y
43	End		C 2.4.2	2.4.2.5 Appropriate drainage must be provided. Spacing of drainage outlets along a road must take into account the soil erodibility, rainfall frequency and intensity, and the proximity of the road to streams.	67					Y	N	Y
44	Field		C 2.4.2	2.4.2.6 Energy dissipating structures or silt traps must be used where necessary to reduce water velocity and trap sediments. Complies with #69,71-73,109.	69	109				Y	N	Y
45	Field		C 2.4.2	2.4.2.7 Drainage onto exposed erodible soil or over fill slopes must be avoided where possible. Structures and earthworks required to avoid such discharges are to be identified during planning and construction as required.						Y	Y	Y
	Field	45a		In auditor's professional opinion drainage onto erodible soil or fill slopes was unavoidable.								Y
	File rev	45b		FCP provides evidence that structures to avoid or minimise impacts were considered during planning and construction.							Y	
	Field	45c		In auditor's professional opinion those measures were appropriate.								Y
46	Field		C 2.4.2	2.4.2.8 Drainage must be prevented from discharging directly onto any road.						Y	N	N
47	Field		C 2.4.2	2.4.2.9 Before entering a waterway road drainage must discharge onto vegetation or through a structure that effectively dissipates the velocity of drainage flows. Complies with #70-72.	70	72				Y	N	N
48	Field		C 2.4.2	2.4.2.10 Materials or techniques with low sediment generating potential must be applied to the road area on bridge approaches and on unsurfaced bridges or culverts, when crossing permanent or temporary streams.						Y	N	Y
Rcon			C 2.4.3	**Road construction**								
49	End		C 2.4.3	2.4.3.1 Planning and management of timber harvesting operations must comply with this Code and relevant road construction measures specified within the Management Standards and Procedures unless the road is covered by a formal roading agreement with DEPI that would supersede this requirement. Complies with #55-66.	55	66				Y	Y	Y
50	Field		C 2.4.3	2.4.3.2 Road construction must be conducted in a manner consistent with plans and designs.						Y	Y	Y
51	End		C 2.4.3	2.4.3.3 All fill disposal areas and embankments must be appropriately stabilised. Where revegetation is used to stabilise fills or embankments, the species must be suitable for the site and where possible indigenous to the area.	41					Y	N	Y
52	End		C 2.4.3	2.4.3.4 Erosion and sediment control must be an ongoing activity over the duration of the construction activity, integrated with the works schedule. Road construction sites must have erosion mitigation measures in place and appropriate temporary drainage to ensure that the site is left protected between construction activities. Complies with #55,59,60,67-73,78,83,85,88-92.						Y	Y	Y
53	End		C 2.4.3	2.4.3.5 Quarry materials known to be infected with any pest plant or pathogen must not be used.	23					N	Y	N
54	Field		C 2.4.3	2.4.3.6 Road construction must ensure that: i. disturbance to stream beds and banks is kept to a minimum; ii. soil and rock fill is not pushed into waterways, nor placed into a position where there is a risk that it can erode into a waterway; and iii. cement, raw concrete, soil fill and other road making materials are not spilt or disposed of into waterways during road construction.						Y	N	Y
	Field	54a		In auditor's professional opinion road construction has minimised disturbance to stream beds and banks.								Y
	Field	54b		There is no evidence of soil, rock fill or concrete being pushed or disposed into a waterway during construction.						Y		
Rcon			MSP 6.2	**Road construction**								
55	File rev		MSP 6.2	6.2.1.1 Undertake road construction when rainfall and soil conditions minimise the risk of erosion and impact on water quality, and when soil moisture is adequate to achieve compaction and stabilisation of the sub-grade.						N	Y	Y
56	File rev		MSP 6.2	6.2.1.2 Clear road alignments prior to road formation.						Y	Y	N
57	Field		MSP 6.2	6.2.1.3 For permanent roads, remove all stumps, logs and other debris from within the formed width of the road site.						Y	N	N
58	Field		MSP 6.2	6.2.1.4 Where road construction requires the removal of topsoil in large quantities maintain the topsoil in a stockpile where practicable, clear of logging debris for use in batter stabilisation, snig track rehabilitation or other coupe infrastructure rehabilitation.						Y	N	Y
	Field	58a		In auditor's professional opinion the management of top soil was consistent with the MSP requirement.								Y

	File rev	58b		Evidence is available that stockpiled soil has been or will be used as intended by this MSP requirement.						Y	Y
59	Field		MSP 6.2	6.2.1.5 Create table drains by extending the road when it is formed, and not by subsequent excavation.						Y N	N
60	Field		MSP 6.2	6.2.1.6 Limit earthworks to the least possible to achieve the road design specification.						Y N	Y
FillB			MSP 6.2	**6.2.2 Fill Batter Construction**							
61	Field		MSP 6.2	6.2.2.1 Prevent fill batters from covering the base of live trees.						Y N	Y
62	Field		MSP 6.2	6.2.2.2 Only use clean and weed free mulch in batter rehabilitation works.						Y N	Y
63	End		MSP 6.2	6.2.2.3 Use engineer approved methods of mechanical consolidation of fill batters. Complies with 64-66 or other documented and engineer-approved procedures.	64	66				N Y	N
Rsurf			MSP 6.2	**6.2.3 Surfacing**							
64	Field		MSP 6.2	6.2.3.1 Consolidate sub-grades before placing pavement material.						N Y	N
65	Field		MSP 6.2	6.2.3.2 Consolidate and level the base course material prior to placing the wearing course material.						N Y	N
66	Field		MSP 6.2	6.2.3.3 On permanent roads use surfacing materials appropriate to passenger vehicles and timber harvesting operations.						Y N	Y
Rdrain			MSP 6.2	**6.2.4 Road Drainage**							
67	Field		MSP 6.2	6.2.4.1 The maximum distance between drainage structures for road grade and soil erosion hazard is specified in Appendix 4 Table 21 (Maximum distance between drainage structures).						Y N	N
68	Field		MSP 6.2	6.2.4.2 Construct cross-drains at an angle sufficient to discharge any water from the surface of the road.						Y N	Y
69	Field		MSP 6.2	6.2.4.3 On soils of high erosion hazard, use temporary sediment traps to prevent erosion during road construction.						Y N	Y
70	Field		MSP 6.2	6.2.4.4 Appropriate discharge areas for drainage include: (a) a strip of undisturbed vegetation at least 20 m wide; (b) a rock spill; or(c) some other structure that dissipates the velocity of drainage flows.						Y N	N
71	Field		MSP 6.2	6.2.4.5 Place drainage structures approximately 20 m from permanent or temporary streams, to allow discharge onto undisturbed vegetation and to maximise the flow distance between the drainage outlet and the waterway.						Y N	N
72	Field		MSP 6.2	6.2.4.6 Within 20 m of a permanent or temporary stream: (a) use crown or cross fall techniques to drain roads into undisturbed vegetation; or (b) pass drainage through an appropriate sediment control structure such as a sediment pond or silt trap before entering a permanent or temporary stream.						Y N	Y
73	Field		MSP 6.2	6.2.4.7 Construct table drains to: (a) allow water to flow, without ponding; (b) include run-offs of sufficient length to allow the table drain and run-offs to be cleaned; (c) be supported by rock or otherwise stabilised in soils of a high erosion hazard; and (d) have silt traps constructed at the end if discharging directly into a stream or wetland buffer.						Y N	Y
Cul			MSP 6.2	**6.2.5 Culverts**							
74	Field		MSP 6.2	6.2.5.1 Culverts used in permanent roads are a minimum of 375 mm in diameter.						Y N	N
75	Field		MSP 6.2	6.2.5.2 Culverts used in temporary roads are a minimum of 300 mm in diameter.						Y N	N
76	File rev		MSP 6.2	6.2.5.3 All culverts are designed to withstand a 1 in 10 year rainfall event.						Y Y	Y
	File rev	76a		Evidence that culvert design is consistent with this requirement.						Y	
	Field	76b		Constructed culvert is consistent with design requirement.						Y	Y
77	End		MSP 6.2	6.2.5.4 Construct culverts in catchment areas exceeding 100 ha in accordance with engineering advice.						Y Y	Y
	File rev	77a		Evidence of engineering advice on culvert sized was sought and provided.						Y	
	Field	77b		Size of culvert and method of construction consistent with engineering advice.						Y	Y
78	Field		MSP 6.2	6.2.5.5 On drainage lines, stream and river crossings or soils of High Erosion Hazard place sandbags, timber, concrete or rock at the head of the culvert and at the point of discharge to hold the culvert in place and protect it from erosion.						Y N	Y
79	Field		MSP 6.2	6.2.5.6 Include a road sump for all culverts on Class 5C and higher roads.						Y N	N
80	Field		MSP 6.2	6.2.5.7 If constructed of concrete, have a minimum cover of 600 mm as measured from the road surface to the top of the pipe and a maximum cover as specified in the Installation of Steel-Reinforced Concrete Drainage Pipelines, Concrete Pipe Association of Australasia.						Y N	N
81	Field		MSP 6.2	6.2.5.8 If constructed of a material other than concrete, have a minimum cover over the pipe as recommended in the manufacturer's specifications.						Y N	N
82	Field		MSP 6.2	6.2.5.9 On permanent streams, include a fish ladder if the diameter of the culvert is greater than 750 mm.						Y N	N
83	Field		MSP 6.2	6.2.5.10 Protect any fill face upstream or downstream of a culvert in a way that prevents erosion.						Y N	Y
84	Field		MSP 6.2	6.2.5.11 Ensure culverts do not project above the bed of a waterway in a way which may prevent the passage of aquatic fauna.						Y N	Y
85	Field		MSP 6.2	6.2.5.12 Where culvert construction diverts water from its natural course, return water to its natural course over a flume, rock spill, or other hard surface.						Y N	Y
Bridge			MSP 6.2	**6.2.6 Bridges**							
86	File rev		MSP 6.2	6.2.6.1 Design bridges in accordance with the DSE Bridge Policy 2007.						Y Y	Y
87	Field		MSP 6.2	6.2.6.2 Design bridges to prevent constriction of any clearly defined channel.						Y Y	Y
88	Field		MSP 6.2	6.2.6.3 Source earth borrow from outside waterway buffers.						Y Y	N
89	Field		MSP 6.2	6.2.6.4 Ensure that excavations, sills, abutments, stringers and girders are made or placed above the high watermark of the stream, wetland or drainage line.						Y Y	N
90	Field		MSP 6.2	6.2.6.5 Protect bridges from erosion by use of natural groundcover, a retaining wall, a bulkhead or a rock surface.						Y Y	Y

91	Field	MSP 6.2	6.2.6.6 Only construct temporary crossings to carry machinery during bridge construction if the bed of the stream, wetland or drainage line is capable of bearing the weight of that machinery without being damaged.			Y	Y	Y
92	Field	MSP 6.2	6.2.6.7 Temporary crossings to carry machinery during bridge construction: (a) include a corduroy crossing of logs; (b) are adequately drained, along with any access tracks, when construction is complete; and (c) are removed and rehabilitated on completion of works.			Y	Y	Y
Ford		MSP 6.2	**6.2.7 Fords**					
93	Field	MSP 6.2	6.2.7.1 The base and entry points of fords are constructed of rock, concrete, heavy timber or other erosion-resistant material.			Y	N	N
94	Field	MSP 6.2	6.2.7.2 Fords are only as wide as the crossing place will allow.			Y	N	Y
95	Field	MSP 6.2	6.2.7.3 Ensure fords do not project above the bed of a waterway in a way which may prevent the passage of aquatic fauna.			Y	N	Y
Rmaint		C 2.4.4	**Road maintenance**					
96	End	C 2.4.4	2.4.4.1 Planning and management of timber harvesting operations must comply with this Code and relevant road maintenance measures specified within the Management Standards and Procedures unless the road is covered by a formal roading agreement with DEPI that would supersede this requirement. Complies with #99,100,101.	99	101	Y	Y	Y
97	Field	C 2.4.4	2.4.4.2 Roads used for timber haulage must be maintained in a manner that minimises erosion and protects water quality and other environmental values.			Y	N	Y
98	Field	C 2.4.4	2.4.4.3 Road drainage systems must be maintained at sufficient frequency to minimise erosion and the discharge of sediment into waterways.			Y	N	Y
99	File rev	C 2.4.4	2.4.4.4 Blading-off of roads must be sanctioned and recorded in the coupe diary and is only permitted where measures are in place to prevent potential adverse impacts on water quality and where effective side drainage can be maintained.			Y	Y	Y
Rmaint		MSP 6.3	**Road Maintenance**					
100	Field	MSP 6.3	6.3.1.1 Breach at regular intervals any soil windrow erected on the outside of a road.			Y	N	Y
101	Field	MSP 6.3	6.3.1.2 Maintain drainage structures free of debris.			Y	N	N
Haul		C 2.4.5	**Suspension of haulage**					
102	File rev	C 2.4.5	2.4.5.1 Planning and management of timber harvesting operations must comply with relevant suspension of haulage measures specified within the Management Standards and Procedures unless the road is covered by a formal roading agreement with DEPI that would supersede this requirement.			N	Y	N
103	Field	C 2.4.5	2.4.5.2 Heavy vehicle traffic associated with timber harvesting operations must not use roads in State forests when persistent wet weather or road stability compromise road drainage and water quality.			Y	Y	Y
104	File rev	C 2.4.5	2.4.5.3 Heavy vehicle traffic associated with timber harvesting operations must not use roads in State forests when persistent dry weather causes the surface materials to disintegrate to a degree that poses a threat to water quality, in the absence of suitable preventative or remedial actions to manage the risk to water quality.			Y	Y	Y
Rclos		C 2.4.6	**Road closure**					
105	File rev	C 2.4.6	2.4.6.1 Planning and management of timber harvesting operations must comply with relevant road closure measures specified within the Management Standards and Procedures unless the road is covered by a formal roading agreement with DEPI that would supersede this requirement.			N	Y	Y
106	Field	C 2.4.6	2.4.6.2 Roads no longer required for timber harvesting operations or other forest management purposes, must be permanently closed to vehicle traffic and effectively drained following completion of the timber harvesting operation.			Y	N	Y
OpRes		MSP 7.3	**Operational restrictions**					
107	File rev	MSP 7.3	7.3.2.1 Carting must be suspended when: (a) snow is lying on any road used to access or exit the coupe, (b) water is flowing down any unsealed road or track; or (c) truck movement will deposit mud on a gravelled or sealed road.			N	Y	N
Rrehab		MSP 6.4	**6.4 Road Rehabilitation**					
108	File rev	MSP 6.4	6.4.1.1 Close temporary roads (including removal of all bridges, crossings and culverts on streams or drainage lines) as soon as possible after harvesting and/or regeneration is complete in all coupes that use the road.			Y	Y	N
109	Field	MSP 6.4	6.4.1.2 Drain the approach to any bridge, culvert or log fill crossing that has been removed to restrict soil movement into a stream or waterway.			Y	N	Y
110	Field	MSP 6.4	6.4.1.3 Use an effective barrier to close to all vehicles temporary roads that will not be used to access a coupe for a period of 12 months or more.			Y	N	Y

Comments

Positive

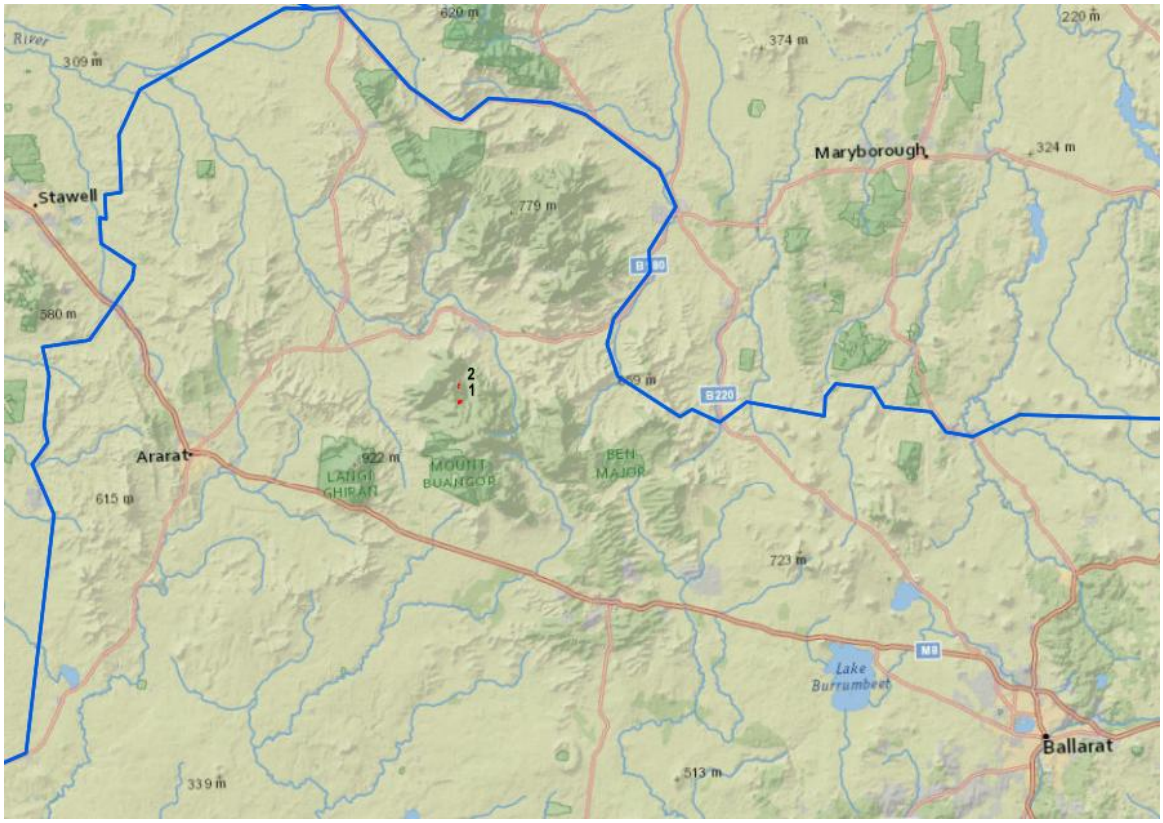
Negative:

Other comments:

Appendix B. Location of audit coupes

Locations of audited coupes within the four FMA in which this audit was conducted are given in Figures B.1 – B.4.

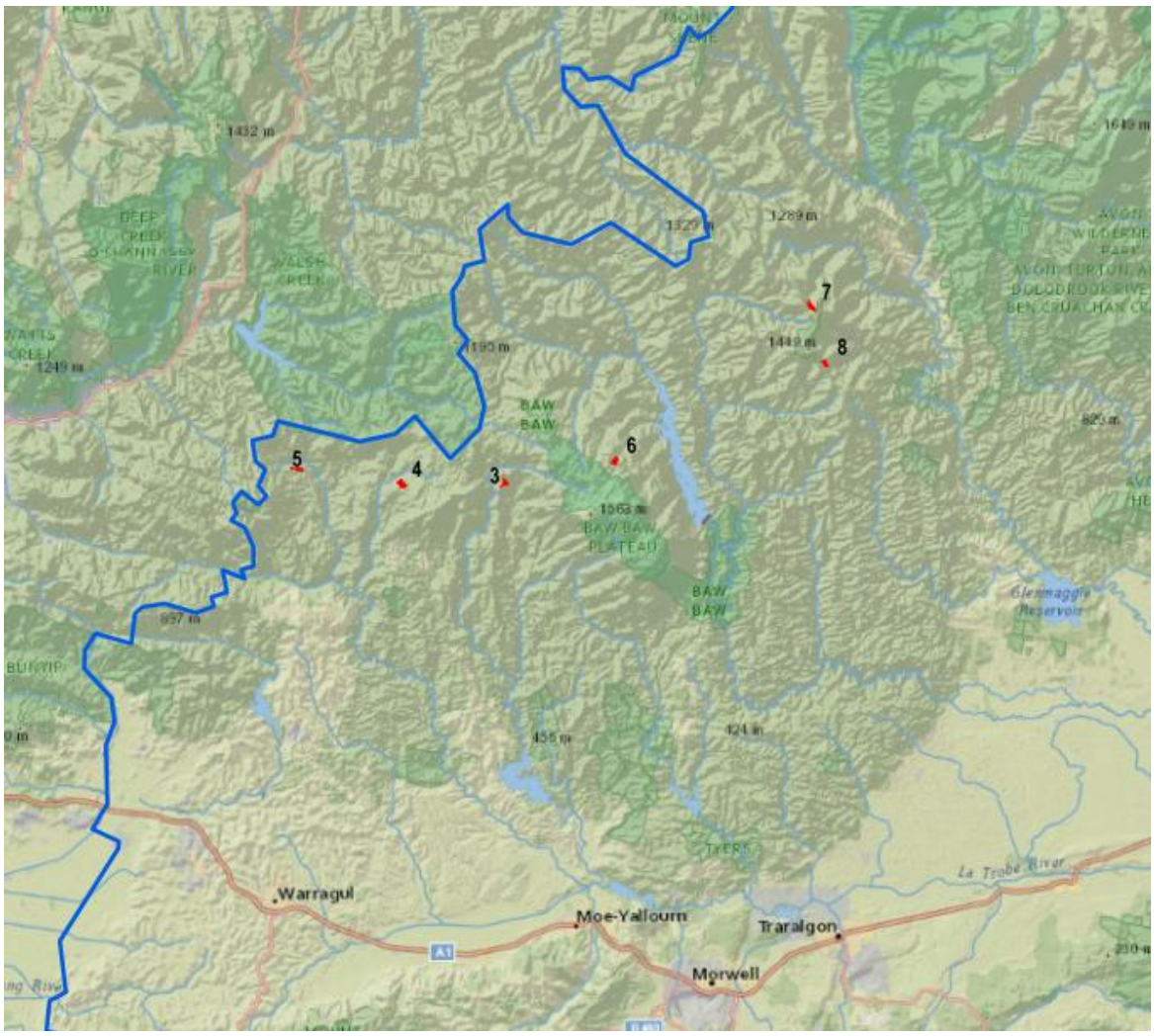
B.1 Midlands FMA



Details of coupes given in Table B.1.

Figure B.1 Coupe locations in Midlands FMA.

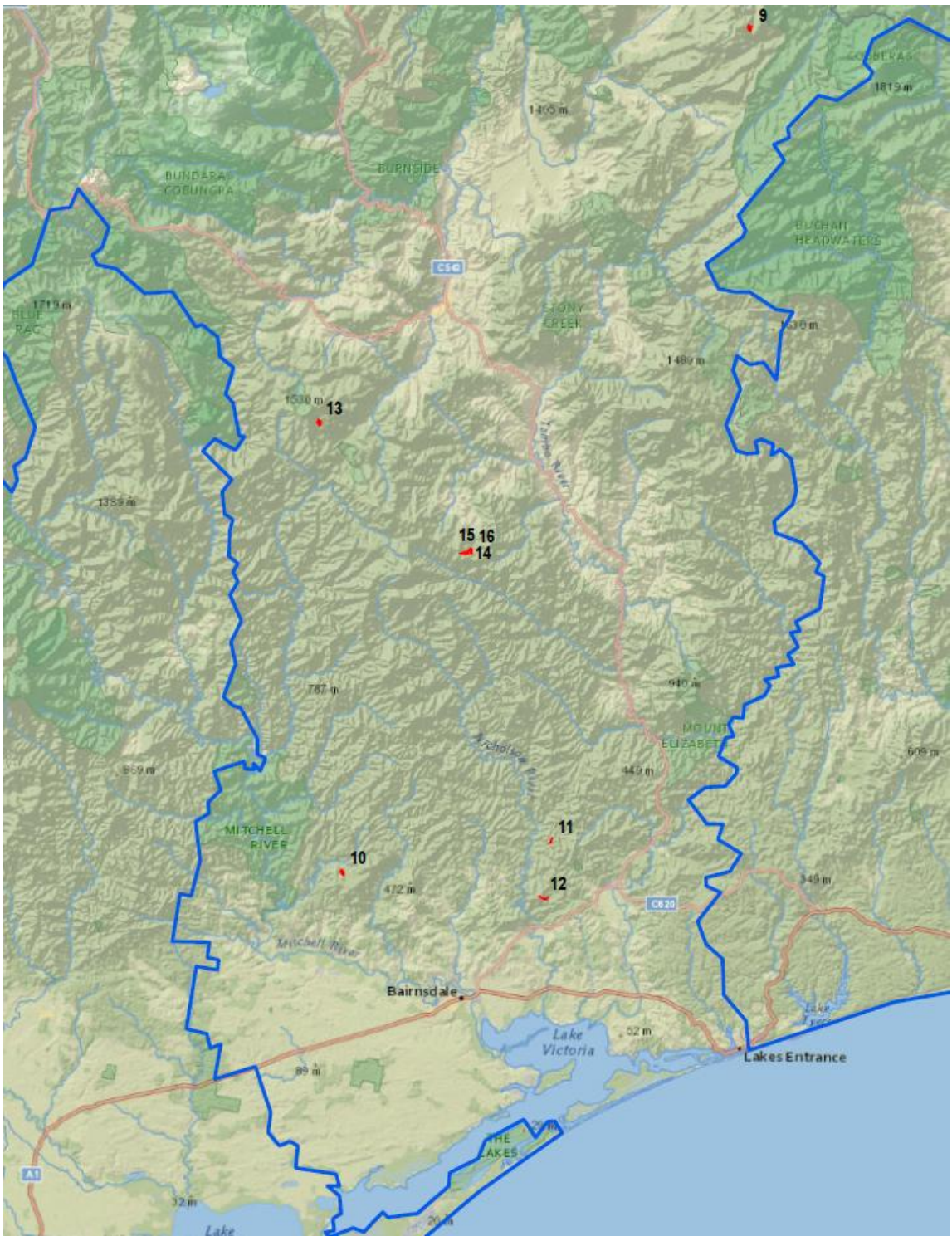
B.2 Central Gippsland FMA



Details of coupes given in Table B.1.

Figure B.2 Coupe locations in Central Gippsland FMA.

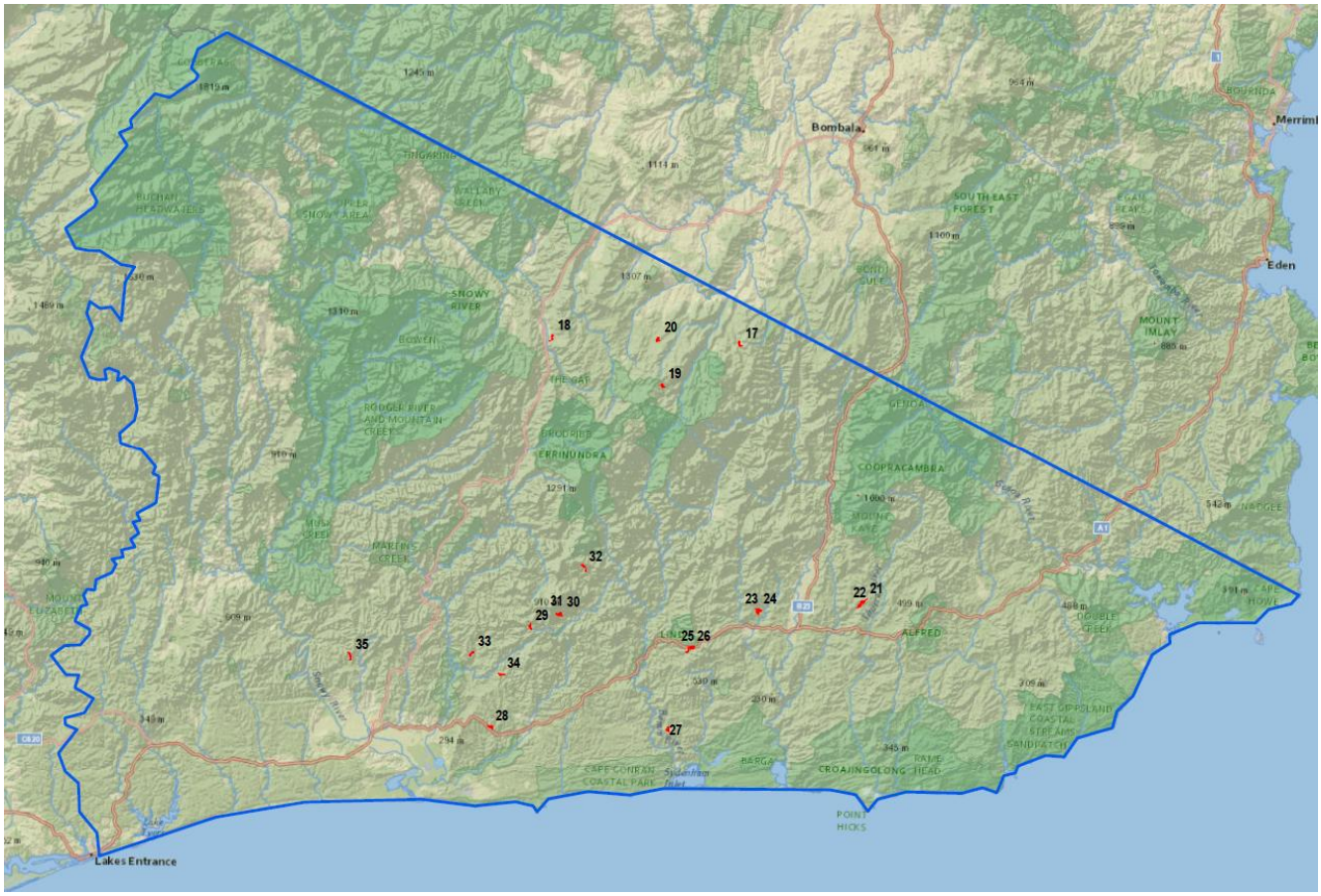
B.3 Tambo FMA



Details of coupes given in Table B.1.

Figure B.3 Coupe locations in Tambo FMA.

B.4 East Gippsland FMA



Details of coupes given in Table B.1.

Figure B.4 Coupe locations in East Gippsland FMA.

Appendix C. Environmental impact assessment tool

Assessment of environmental impact may include actual impact that is observed by the audit team and/or the likely impact that would be reasonably expected to result. Use of this EIA approach by FAP audits was requested by DELWP.

C.1 Environmental risk

Environmental risk is calculated as the sum of the scores for each of three attributes:

- Extent (size) of impact: observed or the potential impact (Table C.1);
- Duration of the impact: observed or the potential (Table C.2);
- Likelihood of recovery of the forest from the impact (Table C.3).

Table C.1 Extent assessment

Extent of impact	Score
0-10% of the authorised harvesting area	1
11-25% of the authorised harvesting area	2
26-50% of the authorised harvesting area	3
>50% of the authorised harvesting area	4
Impact extends 0-10m outside authorised harvesting area Involves disturbance or harvesting of small area (0-10m) within the authorised harvesting area that should have been excluded from harvesting under regulatory rules (e.g. threatened species habitat or rainforest)	5 5
Impact extends 10-100m outside harvesting area Involves disturbance or harvesting of moderate area (10-100m) within the authorised harvesting area that should have been excluded from harvesting under regulatory rules (e.g. threatened species habitat or rainforest)Involves moderate area (10-100m) of authorised harvesting area that should have been protected	6 6
Impact extends >100m outside harvesting area Involves disturbance or harvesting of large area (>100m) within the authorised harvesting area that should have been excluded from harvesting under regulatory rules (e.g. threatened species habitat or rainforest)	7 7

Table C.2 Duration assessment

Duration of impact	Score
≤1 year (short term)	1
1-3 years (medium term)	2
>3 years (long term)	3

Table C.3 Likelihood of recovery assessment

Likelihood of recovery	Score
Expected/likely to fully recover	1
Expected/likely to mostly recover	2
Expected/likely to partially recover	3
Expected/likely to never recover	4

C.2 Significance of the impact

Once the environmental risk score has been calculated, the “significance” of the actual or potential impact to an asset or value is determined (Table C.4).

Table C.4 Asset or value significance score

Asset or value	Score
General forest	1
Filters	2
Landscape buffers, representative Special Protection Zones (based on modelled values)	3
Riparian Buffers, Rainforest and Rainforest Buffers, Special Protection Zones; other protected forest values such as threatened species habitat; National Parks or other formally acknowledged reserves.	4

C.3 Total environmental impact

Total environmental impact is the sum of the environmental risk and significance scores. EIA scores are ranked as per Table C.5.

Table C.5 Ranking of EIA scores

EIA class	Total score
Negligible	4-5
Minor	6-7
Moderate	8-10
Major	11-14
Severe	15-18