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Department of Environment, Land, Water and Planning

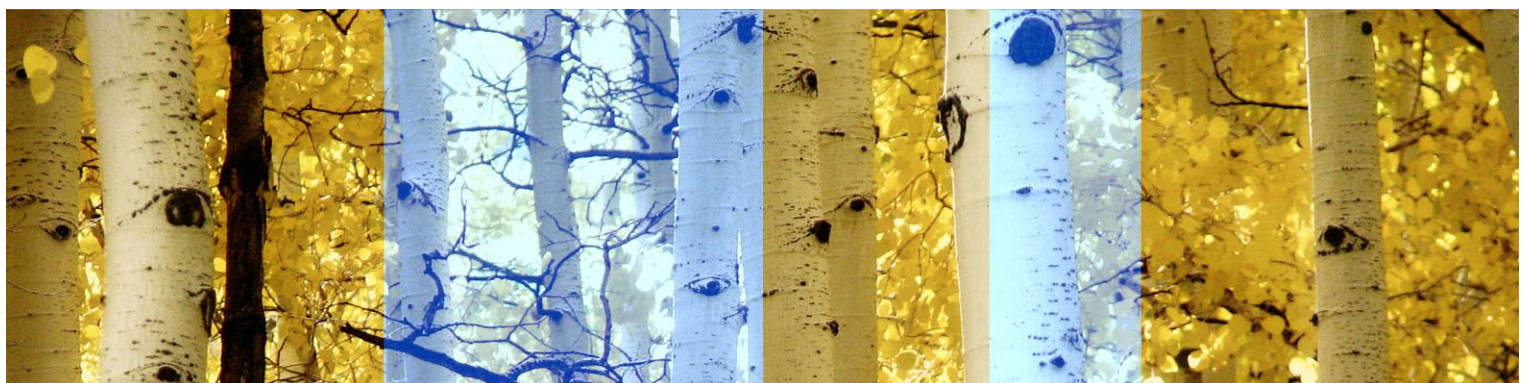
Forest Audit Program 2015 Environmental Audit of the Construction & Rehabilitation of Waterway Crossings

Final Report

24 February 2016

A15-20915

Melbourne





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PREFACE

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The methodology adopted and sources of information used by the Indufor Environmental Auditor Jodie Mason (the auditor) and the support team are outlined in this report. Jodie Mason and the support team have made no independent verification of this information beyond the agreed scope of works and we assume no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to Jodie Mason and the support team was false.

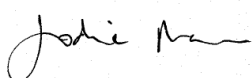
This report was prepared based on documents reviewed, interviews conducted and activities and conditions observed at the audited sites during visits between 14 and 21 September 2015 and is based on the conditions encountered and information reviewed at the time of preparation. The auditor, Indufor and the support team disclaim responsibility for any site changes that may have occurred after this time.

This audit was limited to the visual observation of conditions at the audited sites, interviews with personnel and other selected stakeholders and a review of records and procedural documents. Opinions and recommendations contained in this report are based upon data provided by representatives of VicForests, information gained during site inspections and interviews with VicForests personnel. This approach reflects current professional practice for environmental audits. No warranty or guarantee of property conditions is given or intended.

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This report may only be used for the purpose for which it was prepared and its use is restricted to consideration of its entire contents. The conclusions presented are subject to the assumptions and limiting conditions noted within.

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EXECUTIVE SUMMARY

Introduction, objectives and scope

This report documents the methodology and findings of an environmental audit of VicForests' compliance with regulatory requirements for the construction and rehabilitation of waterway crossings associated with timber harvesting in Victoria's State forests. The Timber Harvesting Compliance Unit within the Department of Environment, Land, Water and Planning (DELWP) engaged Indufor Asia Pacific (Australia) Pty Ltd ('Indufor') to undertake the audit. The audit team was led by Jodie Mason (the auditor), an Environmental Auditor (Natural Resources) appointed pursuant to the *Environment Protection Act, 1970*.

The objectives of the audit project were to:

1. Assess and report on compliance with environmental prescriptions and associated environmental performance of timber harvesting activities undertaken in the 2013/14 and 2014/15 financial years on public land, with relevant Code prescriptions that relate to the planning, construction and rehabilitation of waterway crossings; and
2. Review and report on the effectiveness of the relevant environmental regulatory instruments in the context of the scope of the audit.

Waterway crossings were selected by DELWP as one of three key compliance priorities to be assessed under the audit program in 2015.

VicForests is responsible for planning and managing commercial timber harvesting, the sale of timber products and the regeneration of harvested areas in Victoria's State forest. VicForests' activities include the planning, construction and rehabilitation of roads and waterway crossings associated with timber harvesting.

All commercial timber harvesting in Victoria's State forests is governed by the legislative requirements outlined in the *Sustainable Forests (Timber) Act 2004*, including compliance with the *Code of Practice for Timber Production 2014* (the Code). The Code is the key regulatory instrument applicable to commercial timber harvesting and is established under the *Conservation, Forests and Lands Act 1987*. It prescribes the minimum standards to which timber harvesting and subsequent regeneration activities in Victoria must comply. The Code requires that Forest Management Plans are developed for State forests in all Forest Management Areas (FMAs) in Victoria and these plans have been used as one of the key inputs for the creation of the current regulatory rules (see Figure ES 1 for an indicative map of FMA boundaries).

Figure ES 1: The 14 Forest Management Areas established in Victoria



Source: DELWP

In 2014 DELWP consolidated the relevant rules and regulations that apply to timber harvesting conducted on public land, resulting in changes to the regulatory framework and the publication of the current version of the Code (2014) and associated *Management Procedures for timber harvesting, roading and regeneration in Victoria's State forests 2014* (MSPs).

The MSPs consolidate the requirements of relevant source documents such as forest management plans created under the *Forest Act (1958)* and Action Statements created under the *Flora and Fauna Guarantee Act (1988)*; and replace directions related to timber harvesting operations within these documents. The MSPs are an incorporated document under the Code and compliance with the requirements within the MSPs is mandatory for timber harvesting operations undertaken in Victoria's State forests.

The scope of the audit project was defined by DELWP's selection of Code prescriptions of relevance to waterway crossing planning, construction and rehabilitation; and auditor-defined criteria for each prescription.

Audit approach

In commissioning the audit DELWP instructed the auditor to limit the audit to timber harvesting operations that had been conducted in three Forest Management Areas (FMAs), namely the Central, Central Gippsland and North East FMAs, during the 2013/14 and 2014/15 financial years. The auditor selected the 18 coupes for audit from a list of 27 eligible coupes, with the following distribution as specified by DELWP:

- Two coupes in the North East FMA;
- Six coupes in the Central Gippsland FMA (two of which were from within a recognised Melbourne Water catchment area); and

- Ten coupes in the Central FMA.

In selecting coupes the auditor gave consideration to minimising travel time and the number of higher elevation coupes that were likely to become inaccessible in the event of snowfall.

The audit commenced in September 2015 with document review and field inspections conducted over six days. Further analysis and reporting continued in the following months.

Site inspections included observations and measurements of key parameters; and discussion of crossing features, planning and operational processes with VicForests staff. Compliance or non-compliance was noted for each defined audit criteria.

Where an instance of non-compliance was identified, the actual or potential environmental impact was assessed and an Environmental Impact Assessment (EIA) risk rating of severe, major, moderate, minor, negligible or no impact was allocated.

The auditor has included audit recommendations where VicForests' documented procedures or practices did not adequately address the audit criteria and the auditor has assessed that environmental outcomes can be improved. The auditor has also provided recommendations to DELWP where the auditor considers that clarification of, or a change to, a prescription is required to reduce the risk of harm to the environment.

Audit findings

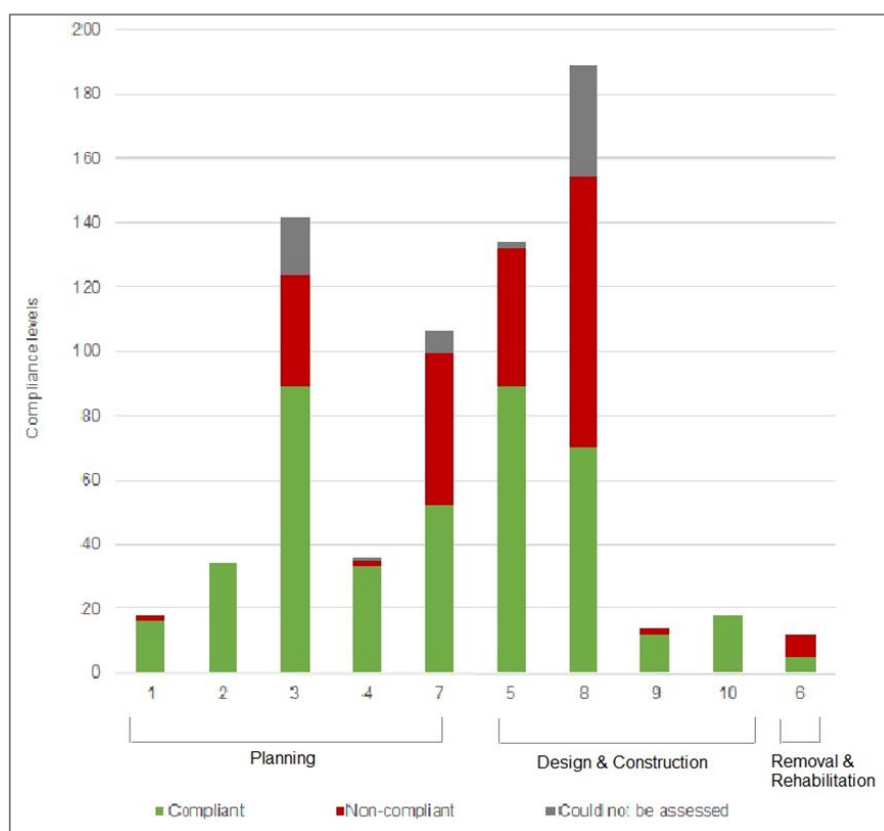
The audit found a moderate level of compliance with Code prescriptions for waterway crossing design, construction and rehabilitation, with full compliance achieved with two of the ten relevant prescriptions and partial compliance with eight. An overall compliance score of 65% was achieved with the audit criteria. In terms of environmental impact, no severe environmental risk ratings were identified; and 87% of environmental risk ratings were in the lower categories of minor, negligible or no impact. There were 19 instances of more significant environmental impacts (2 major and 17 moderate), which should be reviewed closely by DELWP.

This report groups the ten Code prescriptions into three compliance groups, specifically:

- Planning for crossings (Code prescriptions 1, 2, 3, 4 and 7);
- Design and construction of crossings (Code prescriptions 5, 8, 9 and 10); and
- Removal and rehabilitation of crossings (Code prescription 6).

Figure ES 2 shows the level of compliance with each of the audited Code prescriptions.

Figure ES 2: Compliance levels for each Code prescription



Source: Indufor

The compliance score was highest for the *planning for crossings* compliance group (72%). The compliance score was lowest in the *removal and rehabilitation of crossings* compliance group (42%); however, it should be noted that the audit only allowed for assessment of a small number (three) of coupes where the crossings had been removed and rehabilitated. The design and construction of crossings achieved a compliance score of 59%.

VicForests demonstrated the ability to implement sound crossing design features to minimise sedimentation and habitat disturbance impacts; however, they were not implemented consistently across all crossings and FMAs. These features included using rock or gravel to minimise sediment movement; and the installation of fish ladders.

Crossing engineering, design and construction records were not well documented, resulting in the identification of a number of systemic issues:

- Use of an excavator-mounted sheepsfoot roller for compaction of fill faces not having been approved by an engineer, and lack of compaction observed for some fill faces (negligible and minor environmental risk ratings);
- No records to demonstrate assessment of one in ten-year rainfall events for some coupes (negligible environmental risk ratings);
- Not having considered post-harvest flows in crossing design (negligible environmental risk ratings); and
- Not having undertaken capacity checks for heavy loads on steel pipe culverts (negligible environmental risk ratings).

Other systemic issues were identified in relation to management of flora and fauna values:

- Culvert pipe outlets projected above the stream potentially inhibiting the passage of aquatic fauna (moderate and negligible environmental risk ratings, depending on the suitability of habitat in which each crossing was located); and
- Weaknesses in desktop searches for known and potential environmentally sensitive locations of rare or threatened flora, fauna or vegetation communities (minor environmental risk ratings).

Two major environmental risk ratings were identified. In one instance a crossing had not been completed prior to the closure of the Melbourne Water's Thomson catchment over winter, and had multiple ongoing sources of sedimentation at the time of the audit.

The second major risk rating was identified for a waterway crossing where snig track cording had not been removed from the crossing approaches, which were situated in rainforest and rainforest buffer areas. The cording is expected to inhibit recolonization of the narrow snig track area for an extended period of time and negatively impact on the site's provision of natural understorey habitat structures.

Six of the 17 moderate environmental risk ratings resulted from the various contributing sources of waterway sedimentation, including the absence of or ineffective drainage structures on crossing approaches; and unprotected and eroding fill faces. Most of the remaining moderate risk ratings reflect impacts of waterway sedimentation resulting from planning deficiencies (two crossings); projection of culvert pipes above the stream in a way that is likely to prevent the passage of fish (four crossings); and the absence of fish ladders in pipes larger than 750 mm (two crossings).

Findings in relation to desktop and ground-based searches at waterway crossings for significant (rare or threatened) environmental values were similar to those reported for the 2014 Forest Audit. These included the need to expand the desktop search area; and review site survey methods to ensure they are adequate to address the increased number of potentially present taxa. The auditor acknowledges that the 2014 audit report was released shortly before the 2015 audit, leaving little time for implementation of 2014 recommendations in relation to the audited coupes.

Twelve recommendations were made for VicForests, in relation to:

- Expansion of desktop searches around waterway crossings for rare and threatened species;
- Contacting DELWP, as a precautionary approach, for management advice in the event that a rare or threatened species is identified as potentially present but not listed in the MSPs;
- Reviewing and revising documented procedures relating to field surveys for environmentally sensitive locations on planned roadlines;
- Obtaining engineering advice for construction of log bridge crossings;
- Obtaining revised data for pre- and post- harvest flows that inform crossing design;
- Considering alternate crossing designs that require less excavation of streams on steep slopes;
- Modification of culvert construction methods to prevent streambeds eroding beneath culvert outlets;
- Completion of VicForests' current engineer review of waterway crossing construction methods and materials;
- Maintenance of current and accessible copies of manufacturers' specifications for all pipes used in waterway crossings;
- Review of key culvert design elements that contribute to protecting water quality to ensure all future culvert crossings are constructed using a consistent approach;

- Development of a register of waterway crossings; and
- Development of a procedure that ensures the removal of cording, with minimum damage to retained vegetation and soils, from stream buffers, filters and other areas of significance.

Assessment of the regulatory framework

The audit identified some similar or repetitive issues as identified in the preceding 2014 audit report regarding the currency and completeness of management prescriptions in the MSPs and Central Highlands Forest Management Plan for rare or threatened taxa.

Opportunities have been identified for DELWP to improve guidance and clarity for a number of Code and MSP requirements where there is currently ambiguity or little detail. The relevant issues include the requirements for removal of cording from buffer areas; 'catch-all' groupings of fish and fauna in the MSPs such as 'rich reptile and amphibian sites' and 'significant fish'; and various elements of crossing design guidance for aquatic fauna habitat protection.

Seven recommendations to improve the regulatory framework were made in relation to:

- Provision of additional guidance for VicForests regarding the management of rare or threatened species that are not specifically mentioned in the MSPs;
- Continue the revision of the MSPs and Central Highlands Forest Management Plan to ensure the currency and completeness of taxa listing status and management prescriptions, including those that are likely to occur in riparian habitat;
- Definition of terms in the MSPs such as 'rich reptile and amphibian sites' and 'significant fish' in a manner that better facilitates VicForests' identification and protection of them.
- Consideration of more detailed prescriptions for culvert design for species susceptible to poor water quality from sedimentation;
- Expansion of crossing design guidance to address requirements of all native fish and aquatic fauna species;
- Provision of guidance for appropriate measures to prevent streambed erosion beneath pipe outlets; and
- Provision of additional guidance or prescriptions to require the removal of snig track cording in areas such as streamside and rainforest buffers that cannot be burnt.

Conclusions and summary of recommendations

The audit found a moderate level of compliance with the audit prescriptions and criteria, with an overall score of 65%. In terms of environmental impact, there were no severe environmental risk ratings, and 87% of risk ratings allocated to areas of non-compliance were in the lower categories of minor, negligible or no impact. There were 19 environmental risk ratings of more significance associated with identified areas of non-compliance, which will require more detailed consideration by DELWP.

The audit made 12 recommendations for VicForests to change processes and practices to improve compliance and environmental performance; and seven recommendations for DELWP aimed at improving the regulatory framework. The auditor also notes that some of the findings in relation to planning for the management of rare and threatened species were similar to those identified in the 2014 audit report, therefore some of the recommendations re-state or build on the 2014 recommendations.

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6.2 Recommendations for DELWP

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1. INTRODUCTION

This report documents the methodology and findings of an environmental audit of VicForests' compliance with regulatory requirements for the construction and rehabilitation of waterway crossings associated with timber harvesting in Victoria's State forests. The Timber Harvesting Compliance Unit within the Department of Environment, Land, Water and Planning (DELWP) engaged Indufor Asia Pacific (Australia) Pty Ltd ('Indufor') to undertake the audit.

The audit team was led by Jodie Mason (the auditor), an Environmental Auditor (Natural Resources) appointed pursuant to the *Environment Protection Act, 1970*. Jodie was supported by Peter Gannon, an ecologist; and Stephen Newman, an engineering geologist. Indufor provided additional logistical and administrative support, as well as peer review of the audit plan and reports.

1.1 Management of timber harvesting operations in Victoria

VicForests is responsible for planning and managing commercial timber harvesting, the sale of timber products and the regeneration of harvested areas in Victoria's State forest. VicForests' activities include the planning, construction and rehabilitation of roads and waterway crossings associated with timber harvesting.

All commercial timber harvesting in Victoria's State forests is governed by the legislative requirements outlined in the *Sustainable Forests (Timber) Act 2004*, including compliance with the *Code of Practice for Timber Production 2014* (the Code). The Code is the key regulatory instrument applicable to commercial timber harvesting and is established under Part 5 of the *Conservation, Forests and Lands Act 1987*. It prescribes the minimum standards to which timber harvesting and subsequent regeneration activities in Victoria must comply. The Code requires that Forest Management Plans are developed for State forests in all Forest Management Areas (FMAs) in Victoria and these plans have been used as one of the key inputs for the creation of the current regulatory rules (see Figure 1-1 for an indicative map of FMA boundaries).

In 2014 DELWP completed a project to consolidate the relevant rules and regulations that apply to timber harvesting conducted on public land, resulting in changes to the regulatory framework and the publication of the current version of the Code (2014) and an associated document, titled *Management Standards and Procedures 2014* (MSPs).

The MSPs consolidate the requirements of relevant source documents such as forest management plans created under the *Forest Act (1958)* and Action Statements created under the *Flora and Fauna Guarantee Act (1988)*; and replace directions related to timber harvesting operations within these documents.

The MSPs are an incorporated document under the Code and compliance with the requirements within the MSPs is mandatory for timber harvesting operations undertaken in Victoria's State forests.

Figure 1-1 The 14 Forest Management Areas established in Victoria



Source: DELWP

VicForests has also developed internal procedural documents to assist their staff, contractors and forest produce licence holders in implementing regulatory requirements. These include the VicForests *Utilisation Procedures*.

1.2 Benefits of the audit

The audit is intended to benefit DELWP as the environmental regulator of timber harvesting, the Victorian forestry industry, catchment managers and the community by providing an independent and objective assessment of the environmental performance of timber harvesting operations and the effectiveness of the regulatory framework. The audit is also intended to assist VicForests in its continual improvement objective (<http://www.vicforests.com.au/forest-management>). Furthermore, public reporting of the audit findings helps to inform the public on the management of State forests and contribute to the level of transparency.

The environmental regulator uses the results of the audit and other compliance monitoring activities to identify issues and potential improvements to the regulatory framework to achieve appropriate environmental outcomes from timber harvesting operations. Any regulatory action undertaken by DELWP in response to the findings of this audit is outside the scope of this report.

2. AUDIT OBJECTIVES AND SCOPE

2.1 Objectives of the audit

The objectives of the audit project were to:

1. Assess and report on compliance with environmental prescriptions and associated environmental performance of timber harvesting activities undertaken in the 2013/14 and 2014/15 financial years on public land, with relevant Code prescriptions that relate to the planning, construction and rehabilitation of waterway crossings; and
2. Review and report on the effectiveness of the relevant environmental regulatory instruments in the context of the scope of the audit.

The definition of waterway crossings included crossings of permanent and temporary streams and drainage lines by either in-coupe roads or logging snig tracks.

DELWP commissioned this audit using a risk-based approach to allocate available compliance resources. Waterway crossings were selected as one of three key compliance priorities to be assessed under the audit program in 2015.

2.2 Scope of the audit

The scope of the audit project was defined by DELWP and confirmed in the procurement process that engaged Indufor to undertake the required work. DELWP identified Code prescriptions of relevance to waterway crossing planning, construction and rehabilitation. The auditor then developed relevant audit criteria to enable the systematic audit of each prescription. Some criteria were taken directly from the MSPs and some were developed by the auditor to enable the systematic and step-by-step audit of multi-part prescriptions. The selected Code prescriptions and associated criteria are contained in Appendix A of this report.

The relevant Code prescriptions are listed in Table 2-1.

Table 2-1: Code references and prescriptions audited

Reference	Code Prescription
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 (MSPs).
2	2.2.1.5 Where practical exclude roads and snig tracks from aquatic and riparian habitats.
3	2.4.1.3 Road planning must: - 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 - 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.
4	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.
5	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.

Reference	Code Prescription
6	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.
7	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.
8	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.
9	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.
10	2.5.1.5 Timber harvesting operations (excluding haulage on existing or approved roads) are not permitted in special protection zones, buffers, or other exclusion areas identified on the Forest Coupe Plan, except where the removal of a limited number of trees is necessary for the construction and use of stream crossings or for river health.

Source: Indufor, adapted from DELWP

Elements excluded from scope

The following elements were specifically excluded by DELWP from the scope of the audit:

- The development and amendments of the Allocation Order, Timber Release Plans (TRPs) and Wood Utilisation Plans (WUPs);
- Development of Forest Management Plans and broader forest management planning processes. Note that this exclusion does not relate to the assessment of compliance against relevant prescriptions contained in such planning documents (e.g. those relating to forest operational planning, roading, harvesting and regeneration practices);
- Compliance with rules, regulations or guidelines that relate to Occupational Health and Safety (OH&S) matters;
- Timber harvesting practices undertaken on private (freehold) land (e.g. private plantation forestry);
- Roading activities conducted on public land that are not associated with timber production;
- Silvicultural practices conducted on public land that are not associated with commercial timber production (i.e. fire recovery silviculture and ecological thinning);
- Land use decisions and associated “forest industry policy”;
- Assessing planning, management, impact or potential impact of timber harvesting on aboriginal heritage values in State forest;
- Practices associated with the production and collection of domestic forest produce (including domestic firewood) across all land tenures;
- Recreational activities undertaken on public land;
- Livestock grazing activities undertaken on public land;
- Apiary activities undertaken on public land; and
- Fire suppression and management practices undertaken on public land (e.g. fuel reduction burning and habitat enhancement burning). This does not include exclusion of use and

outcomes of any post-harvest regeneration burning (which falls within the scope of the FAP).

The audit project comprised a full desktop and field assessment of 18 timber harvesting coupes containing waterway crossings where harvesting was planned or active in the 2013/14 and 2014/15 financial years, specifically:

- Two coupes (as a sample from five potential audit targets) in the North East Forest Management Area (FMA);
- Ten coupes (from twelve potential audit targets) in the Central FMA; and
- Six coupes (from seven potential audit targets) in the Central Gippsland FMA, two of which were required to be located within the Thomson catchment, managed by Melbourne Water for water supply to Melbourne.

The auditor selected the target coupes from a list of potential audit targets supplied by DELWP. The method for target selection is outlined in section 3.1 of this report.

3. AUDIT APPROACH

3.1 Target selection

DELWP provided a list of 49 potential target coupes from which Indufor selected audit targets. DELWP advised the auditor that the coupe target list was based on information supplied by VicForests.

The potential audit targets nominated by DELWP were all coupes from the Central, Central Gippsland and North East FMAs that had either planned, constructed or rehabilitated waterway crossings; and where harvesting activities were planned or occurred in the 2013/14 or 2014/15 financial years.

Indufor selected audit targets in accordance with the following specifications from DELWP:

- Two coupes in the North East FMA;
- Six coupes in the Central Gippsland FMA (at least two of which must be from within a recognised Melbourne Water catchment area); and
- Ten coupes in the Central FMA.

In the initial round of audit target selection, coupes were selected in geographic clusters of two and four where possible to minimise travel time between coupes and improve audit efficiency. In addition, for most of the audit targets that were located higher than approximately 1,100 metres above sea level, Indufor nominated lower elevation contingency coupes to replace them in the event that access to primary audit targets was prevented by snow or dangerous forest road conditions.

Subsequently however, VicForests advised Indufor that 27 of the 49 coupes originally nominated as potential audit targets did not have waterway crossings due to changes made during its coupe planning processes. VicForests nominated a further five potential audit targets during the coupe selection process. At the time of final coupe selection there were 27 potential audit targets. Eighteen coupes were selected as primary audit targets and the remaining nine were reserved as contingency coupes.

Indufor provided a list of primary and contingency audit targets to VicForests for comments on accessibility and other issues that would preclude audit. Indufor then developed the audit schedule in consultation with VicForests.

During the site inspections, VicForests advised the audit team that a further three selected audit targets either did not have planned or actual crossings, were not readily accessible, or were not at a stage of development that would allow the crossings to be audited in the field (Tanglefoot Stretch [300-517-0003]; Robotsky [288-510-0009]; and Giraffe [288-518-0008]). This reduced the total pool of potential audit targets to 24 coupes. The auditor replaced these three unavailable coupes with three contingency coupes.

The auditor notes that there is an opportunity for VicForests to improve the efficiency of the audit process by maintaining current, accurate and accessible records of coupe attributes that can be queried in an efficient manner.

The final selected audit targets included both road and snig track crossings of streams and drainage lines; and included a mix of partially constructed, in-use and rehabilitated crossings. Table 3-1 lists the audited coupes.

Table 3-1: Audit targets

Count	FMA	Coupe Number	Coupe Name
1	Central	309-508-0014	Aheek
2	Central	287-511-0001	Apollo
3	Central	288-510-0006	Aquaman
4	Central	287-508-0005	Dangermouse



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Count	FMA	Coupe Number	Coupe Name
5	Central	288-518-0009	Gazelle
6	Central	312-512-0007	Germain
7	Central	287-517-0004	Humerus
8	Central	300-917-0005	Mosquito
9	Central	286-509-0004	Trevor
10	Central	288-518-0010	Zebra
11	Central Gippsland	480-505-0010	Alstergrens Road (Melbourne Water)
12	Central Gippsland	462-511-0001	Bobs Road
13	Central Gippsland	458-506-0006	Makybe Diva (Melbourne Water)
14	Central Gippsland	462-506-0015	Polar
15	Central Gippsland	463-505-0008	Turkey Neck
16	Central Gippsland	469-502-0012	West Davis Link (Roadline access to Sammy Davis - 469-502- 0008)
17	North east	676-528-0004	Magnum
18	North East	676-528-0005	Ruger

Source: Indufor, adapted from DELWP and VicForests

The coupes selected from within Melbourne Water catchments were Alstergrens Road (480-505-0010) and Makybe Diva (458-506-0006).

3.2 Coupe assessment

The assessment of each coupe comprised document review, field inspections and interviews with VicForests staff responsible for planning, construction and rehabilitation of waterway crossings.

Initial document review and field inspections were conducted over six days from 14 to 21 September 2015, with document review and reporting continuing into the weeks and months following.

The auditor held a short briefing meeting with relevant VicForests staff at the start of the coupe assessment process to introduce the audit team, outline the audit process and confirm logistical arrangements.

3.3 Document review

The audit team reviewed coupe files for each of the 18 audit targets in VicForests' regional office in Woori Yallock. Waterway crossing planning processes and data were sighted and discussed with relevant staff.

Documents reviewed by the auditor in the coupe files included Forest Coupe Plans for road construction and harvesting, coupe diaries and coupe monitoring forms. A full list of documents reviewed by the audit team is provided in Appendix B.

3.4 Site inspections

Following the initial document review, the audit team undertook field inspections of the audit targets, completing between two and six coupes each day. The audit team made observations, and discussed crossing features, planning and operational processes with VicForests staff. Photographs were taken to assist with compliance assessment and for communication of audit findings.

One waterway crossing was assessed at each coupe.

The extent of the visual assessment conducted by the audit team of waterway crossings for established roads included the following features:

- The waterway crossing;
- Road drainage approximately 20 metres (m) each side of the waterway crossing, to include assessment of adjacent drainage structures;
- Buffer or filter width at the marking tape nearest the waterway crossing on each side of the crossing;
- Adjacent vegetation and other habitat upstream and downstream to the extent of the minimum prescribed clearing widths for each class of road, or the extent of the construction activity, whichever is greater; and
- The condition of the streambed downstream, and of the waterway crossing up to approximately 20 m (this was done to assess the level of sedimentation).

The extent of the visual assessment of waterway crossings established for snig tracks considered the following features:

- The waterway crossing;
- Snig track drainage approximately 20 m each side of the waterway crossing, to include assessment of adjacent drainage structures;
- Buffer or filter width at the marking tape nearest the waterway crossing on each side of the crossing;
- Adjacent vegetation and other habitat upstream and downstream to the extent of the construction activity; and
- The condition of the streambed downstream, and of the waterway crossing up to approximately 20 m (this was done to assess the level of sedimentation).

At the completion of the assessment of each crossing the audit team reviewed the findings with operational staff on site. A debriefing session with VicForests staff was also held at the conclusion of the field program to provide a summary of preliminary findings for each coupe and to identify any issues where further evidence or clarification was required.

3.5 Recording of audit findings

The audit team completed workbooks for each coupe according to the evidence observed and collected by the audit team. Assessment of compliance was recorded against each compliance criterion, and recorded as “compliant” where sufficient evidence was available to demonstrate that an audit criterion had been met. Conversely “non-compliance” was recorded where insufficient evidence existed.

The audit team also considered whether there were any additional issues where poor environmental outcomes were observed in association with timber harvesting practices, or where any other opportunities for improvement to the regulatory framework were observed.

3.6 Assessment of environmental impact

For each non-compliance issue identified, the auditor made a qualitative assessment of actual or potential environmental impact using an Environmental Impact Assessment (EIA) Tool provided by DELWP. The EIA Tool is attached as Appendix C.

Where the auditor considered that non-compliance with two or more criteria collectively contributed to a particular environmental impact (e.g. waterway sedimentation), only one environmental risk rating was allocated to that ‘cluster’ of non-compliances, rather than to each

individual instance of non-compliance. This way the number of environmental risk ratings more accurately reflects the actual or potential environmental impacts on site.

The EIA tool is a useful mechanism for consistently assessing the environmental significance of a non-compliance and provides additional context to the audit findings. It seeks to assess the significance of a non-compliance objectively within the following environmental impact categories: negligible, minor, moderate, major or severe. It can consider the actual impact observed or the potential risk and environmental impact that can reasonably be expected to be caused by a non-compliance.

Where the auditor considered that there was no actual or potential environmental impact associated with a non-compliance, an additional category of “No impact” was used. It should be noted that the EIA tool is based on the auditor’s professional (albeit subjective) assessment, and does not provide an absolute measure of environmental impact (such as a parts per million sedimentation concentration impact on water quality).

The EIA risk rating is based on the auditor’s review of the following factors:

- Extent/potential extent of impact or disturbance (i.e. localised versus widespread impact);
- Duration/potential duration of impact (short term versus longer term impact);
- Likelihood of recovery from impact/potential impact; and
- The nature of the environmental asset value(s) impacted/potentially impacted.

For non-compliance issues encountered in the coupe planning criteria, and for some other non-compliances where the EIA tool was not considered applicable, a simplified classification was used:

- Severe risk - poses a severe threat to human life, or irreversible or extensive impact to the environment;
- Major risk - poses a potential threat to human life, or significant impact to the environment;
- Moderate risk - poses a moderate impact to the environment;
- Minor risk - poses a minor impact to the environment, however further risk reduction opportunities exist;
- Negligible risk - poses little impact to the environment and/or provides opportunity for continuous improvement; and
- No impact – poses no impact to the environment and/or provides opportunity for continuous improvement.

DELWP has advised the auditor that the environmental risk ratings inform its response as the environmental regulator to instances of non-compliance are generally as follows:

- Severe risk - requires detailed consideration of case and corrective action;
- Major risk - requires consideration of case and corrective action;
- Moderate risk - may be of a significance that requires consideration/corrective action (based on a case by case assessment) or may be included under broader continual improvement program;
- Minor risk – informs and is included under DELWP’s broader continual improvement program;
- Negligible risk – informs and is included under DELWP’s broader continual improvement program; and
- No impact - generally no further action.

3.7 Reporting of audit findings

Audit findings are presented in Section 4 of this report. A list of areas of non-compliance and respective environmental risk ratings is contained in Appendix D.

Audit recommendations have been provided by the auditor in cases where VicForests' documented procedures or practices do not adequately address the audit criteria and the auditor has assessed that environmental outcomes can be improved. The auditor has also provided recommendations to DELWP where the auditor considers that clarification of, or a change to, a prescription is required to reduce the risk of harm to the environment.

A priority of High, Medium or Low was allocated by the auditor to each audit recommendation, based on the auditor's assessment of environmental risk; and whether the non-compliances were systemic or only individual instances. The matrix, developed by the auditor, used for determination of priority in these instances is shown as Table 3-2.

Table 3-2 - Matrix used to assign priorities to recommendations

	Recommendation priority					
EIA risk rating	Severe	Major	Moderate	Minor	Negligible	No impact
Systemic non-compliance	High	High	High	High	Medium	Low
Individual non-compliance	High	Medium	Medium	Medium	Low	Low

Source: Indufor

For recommendations not directly related to a non-compliance (for example, an observed weakness in a process in the absence of a corresponding observed non-compliance or actual environmental impact), priorities have been assigned based on potential environmental impact in the absence of implementing the recommendation, as noted in Section 3.6 of this report.

Recommendations for changes to VicForests' practices are introduced in this section. Opportunities for improvement in the regulatory framework are discussed in Section 5 and conclusions and a summary of audit recommendations is provided in Section 6.

A draft of this report was provided to DELWP and to VicForests for comment on factual matters. Comments received were considered for incorporation into this report.

4. AUDIT FINDINGS

Audit findings are presented and discussed in the following sections of this report.

A summary of the main findings including the level of compliance and environmental risk ratings of non-compliances is presented in Section 4.1. A description of practices used to construct waterway crossings is provided in Section 4.2; and detailed findings are presented in Section 4.3.

This report groups the ten Code prescriptions into three compliance groups, specifically:

- Planning for crossings (Code prescriptions 1, 2, 3, 4 and 7);
- Design and construction of crossings (Code prescriptions 5, 8, 9 and 10); and
- Removal and rehabilitation of crossings (Code prescription 6).

Three case studies that provide a more detailed discussion on the design and management of individual waterway crossings are also included in Section 4.3.

4.1 Summary of audit findings

VicForests had constructed waterway crossings at 27 (10%) of the 276 coupes in the Central, Central Gippsland and North East FMAs where harvesting had been undertaken in the 2013/14 and 2014/15 financial years. The findings of this audit pertain to the audited sample of the 27 coupes with waterway crossings.

4.1.1 Overall compliance

The audit found that VicForests' management of waterway crossings was in full compliance with two of the ten audited Code prescriptions and in partial compliance with the remaining eight.

The overall compliance score was 65%¹. This incorporates assessment against all relevant criteria across all 18 audited coupes. In terms of environmental impact, 87% of environmental risk ratings were in the lower categories of minor, negligible or no impact. No severe environmental risk ratings were determined. There were 19 instances of more significant environmental impacts (2 major and 17 moderate), which should be reviewed closely by DELWP.

Table 4-1 shows compliance scores for each compliance group across all audited coupes.

Table 4-1: Compliance scores

Compliance group	Compliance with criteria	Non-compliance with criteria	Compliance score (%)
Planning for crossings	224	86	72
Design and construction of crossings	189	129	59
Removal and rehabilitation of crossings	5	7	42
Total	418	222	65

Source: Indufor

Compliance scores were highest for the *planning for crossings* compliance group. The compliance score was lowest in the *removal and rehabilitation of crossings* compliance group; however, it should be noted that the audit only allowed for assessment of a small number (three) of coupes where the crossings had been removed and rehabilitated.

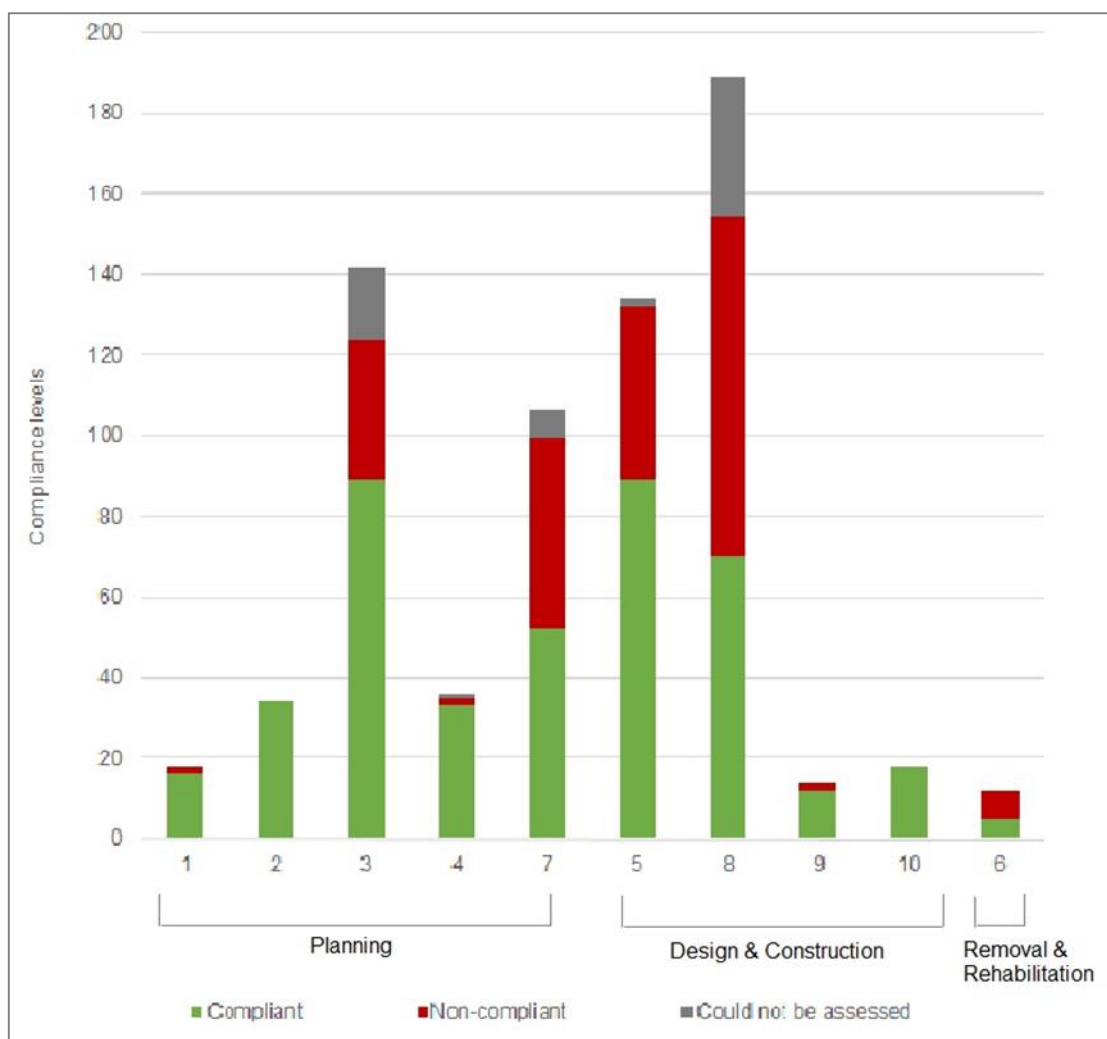
Compliance with two criteria was not able to be assessed for most of the audited coupes due to the absence of records of crossing design and construction. These criteria related to whether

¹ It should be noted by the reader that the compliance score incorporates both mandatory MSPs criteria and other criteria developed by the auditor to facilitate systematic audit of multi-part Code prescriptions. The full list of audit criteria and the source of each are included in Appendix A of this report.

the crossing had been constructed prior to use and whether crossings had been constructed to withstand foreseeable rainfall events, including post-harvest flows. For the three rehabilitated coupes, a number of other criteria could not be assessed.

Figure 4-1 shows the distribution of the instances of compliance and non-compliance across the Code prescriptions.

Figure 4-1: Compliance status for each Code prescription across all coupes



Source: Indufor

The high incidence of non-compliance for Code prescriptions 3, 5, 7 and 8 are influenced by a number of systemic issues across many or all coupes, specifically for:

- Weaknesses in desktop searches for known and potential environmentally sensitive locations of rare or threatened flora, fauna or vegetation communities (minor environmental risk ratings);
- Use of an excavator-mounted sheepfoot roller for compaction of fill faces not having been approved by an engineer, and lack of compaction observed for some fill faces (negligible and minor environmental risk ratings);
- No records to demonstrate assessment of one in ten-year rainfall events for some coupes (negligible environmental risk ratings);
- Not having considered post-harvest flows in crossing design (negligible environmental risk ratings); and

- Not having undertaken capacity checks for heavy loads on steel pipe culverts (negligible environmental risk ratings).

Sedimentation levels were also carefully considered during the audit. VicForests had implemented sound design elements to minimise sediment movement, such as rock-lining table drains and fill faces and construction of a berm² along the road edge to prevent runoff over the fill face; although these good practices and features were not applied consistently for all audited culverts.

Sources of sediment were most commonly observed from erosion of fill faces from road runoff and pipe discharge, and a lack of or ineffective drainage structures to divert water off the road. In some coupes weaknesses in planning regarding the timing of construction had increased both the risk to and impact on water quality.

Figure 4-2 shows an example of the use of rock and a berm to control water runoff; and resultant erosion in the absence of protection of a fill face from water runoff.

Figure 4-2: Rock-lined table drain and berm; and erosion of an unprotected fill face



Design features for fish and other aquatic fauna was similarly variable. A fish ladder had been installed and establishment of a natural gravel base facilitated at one crossing; however, at two other crossings where fish ladders were prescribed, they had not been installed.

A high proportion of culverts had the pipe suspended above the stream which can potentially inhibit the migration of fish and other aquatic fauna along the waterway. It appeared that several of these culverts would have been compliant at the time of installation, but the non-inclusion of rock armouring of the stream bed at the pipe outlet had resulted in erosion post installation. A similar finding was noted in the 2014 audit report.

Figure 4-3 shows two examples of pipe outlet positioning.

² An elongated low mound of soil or gravel formed as a barrier.

Figure 4-3: Pipe outlet positioning at the West Davis Link and Bobs Road coupes



VicForests used a systematic process of database searches for environmental values during coupe planning and had documented and successfully implemented processes for identification of some of the more complex habitats and vegetation communities including Leadbeater's Possum habitat and Rainforest. However, some weaknesses (which were also identified as reported by the 2014 Forest Audit) were observed. The auditor considered that the desktop/database searches should be expanded to a broader area around the coupe being planned to help mitigate the shortcomings of the available data; and that methods for field-based searches conducted at waterway crossing points should be reviewed to ensure they are adequate to address the higher numbers of potentially present taxa that could result from broader desktop searches.

Structurally, all waterway crossings appeared to be adequately bearing the traffic loads, but the design process was not well documented, either in regards to traffic load requirements, or of construction meeting the planned design.

4.1.2 Environmental risk ratings

A total of 149 environmental risk ratings were assessed and allocated across the audited 242 non-compliance instances recorded at the audited coupes; the majority being in the minor or negligible categories³. Table 4-2 shows the total numbers of each category of environmental risk rating.

Table 4-2: Total number of each category of environmental risk rating identified

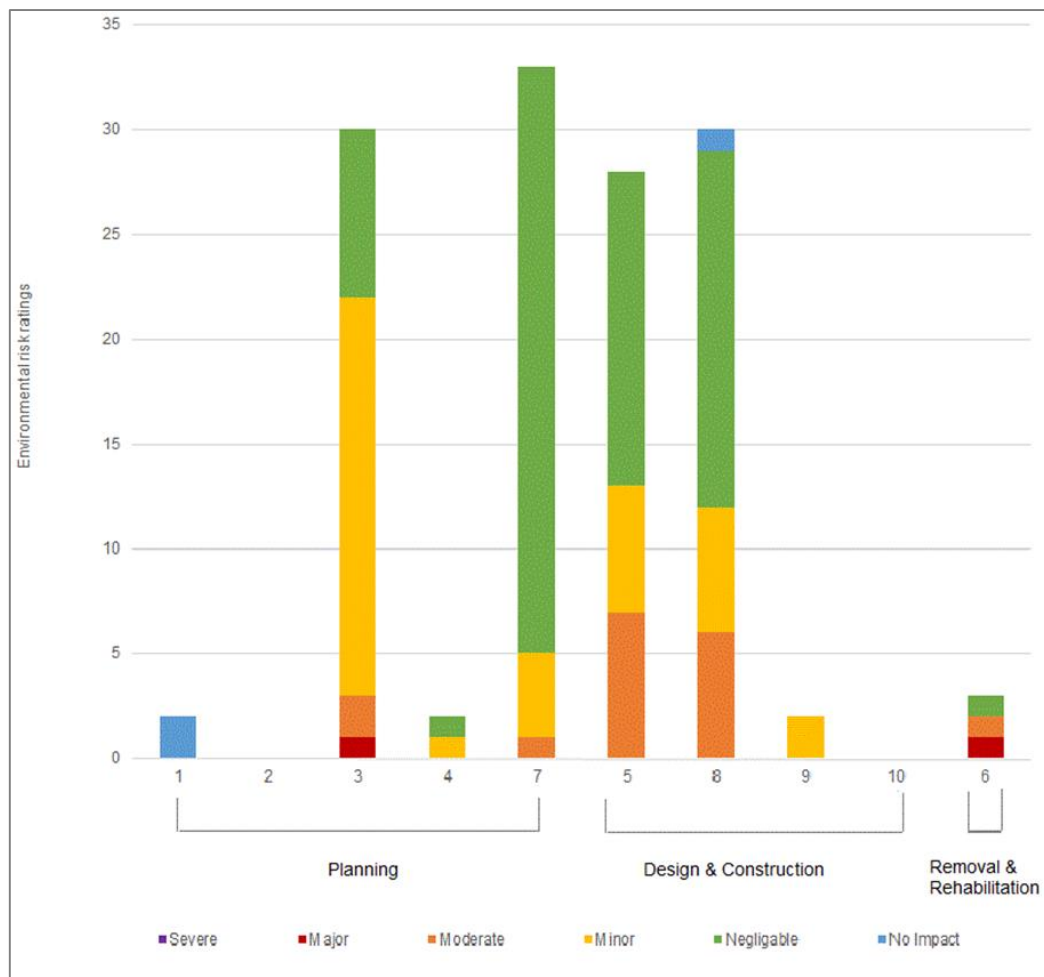
Environmental risk rating	Number identified across all coupes
Severe (more significant)	0
Major (more significant)	2
Moderate (more significant)	17
Minor	38
Negligible	70
No impact	3

Source: Indufor

³ The number of environmental risk ratings is lower than the total number of non-compliances due to the allocation of one rating to a 'cluster' of non-compliances in some instances (refer to Section 3.6 of this report).

Figure 4-4 shows the distribution of environmental risk ratings for areas of non-compliance, across all coupes.

Figure 4-4: Environmental risk ratings for each Code prescription across all coupes



Source: Indufor

No severe environmental risk ratings were identified during the audit.

One of the two major environmental risk ratings was identified for a crossing that had not been completed prior to the closure of the Melbourne Water's Thomson catchment over winter, and had multiple ongoing sources of sedimentation at the time of the audit. The second major risk rating was identified for a waterway crossing where snig track cording had not been removed from the crossing approaches in rainforest and rainforest buffer areas. The retained cording is expected to inhibit recolonization of the area for an extended period of time and negatively impact on the site's provision of natural understorey habitat structures.

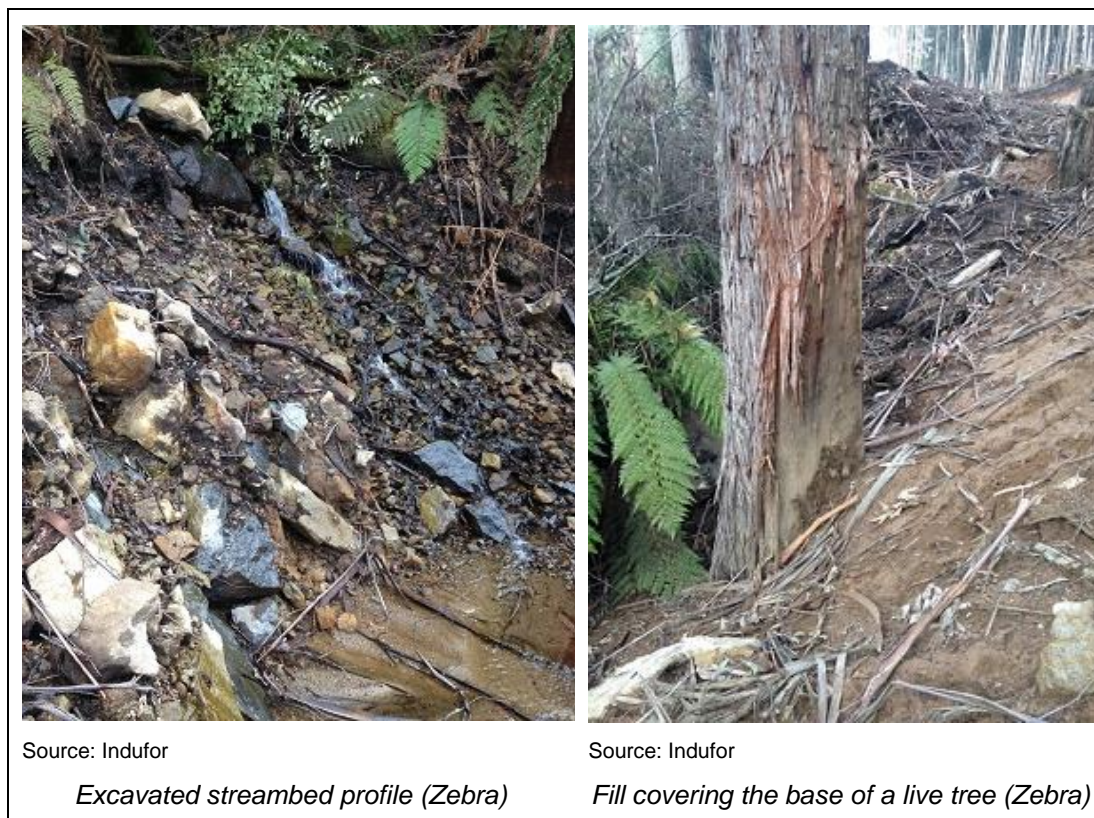
Six of the 17 moderate environmental risk ratings resulted from the various contributing sources of waterway sedimentation, including absence of or ineffective drainage structures on crossing approaches; and unprotected and eroding fill faces. Most of the remaining moderate risk ratings reflect impacts of waterway sedimentation resulting from planning deficiencies (two crossings); projection of culvert pipes above the stream in a way that is likely to prevent the passage of fish (four crossings); the absence of fish ladders in pipes larger than 750 mm (two crossings).

The 38 minor environmental risk ratings were largely attributable to systemic non-compliances relating issues with desktop searches for environmental values and inadequate fill face compaction as mentioned in Section 4.1.1. Others included instances of not having protected fill faces from erosion; construction of a log bridge snig track crossing without documented

reference to design criteria or records of load design; and two instances of deep excavation established across the profile of the waterway at the culvert inlet in order to balance cut and fill. At two crossings, fill excavated during construction was observed covering the bases of live trees.

Figure 4-5 shows examples of non-compliance issues for which minor environmental risk ratings were determined.

Figure 4-5: Excavated stream bed profile; and fill covering the base of a live tree at the Zebra coupe



The 70 negligible environmental risk ratings included systemic absence of documented design input, heavy load checks and other records as mentioned in Section 4.1.1. Six crossings had pipes projecting above the stream bed, with negligible negative impact on fish and other aquatic fauna. Other instances included anomalies in soil assessment; suboptimal drainage structures; and planning for construction of a crossing in autumn when, based on average weather conditions, the likelihood of wet weather and slower evaporation rates resulting in unsuitable conditions for crossing construction is significantly greater than in the summer months. The auditor notes that there were no records noted and no visual evidence during the audit that construction had been undertaken during wet conditions, therefore a negligible risk rating was allocated.

In three instances, absence of documentation resulted in non-compliance with audit criteria for which the auditor determined that there was no environmental impact.

4.2 Waterway crossing practices

Waterway crossings were generally found to have been planned either in conjunction with coupe access roads or harvest planning. Larger crossings were planned and designed by VicForests' roading foresters and constructed by specialist road construction contractors using bulldozers, excavators and excavator mounted rollers to assist soil compaction on fill faces. In some instances, completion of construction was delayed until gravel trucks became available. Snig

track crossings of waterways involved less formal planning and design and were generally constructed by harvesting contractors, using excavators.

The majority of the crossings assessed were culverts over permanent or temporary streams. Corrugated steel pipes were the most common pipes in use, however black plastic corrugated pipes and recycled plastic pipes were also used in a small number of crossings. Snig track crossings used either log fill crossings, a combination of a pipe and logs covered by soil and/or bark, and in one instance a log bridge structure.

All crossings assessed during the audit were planned as temporary crossings being used to access up to four or five coupes. Most crossings were usually intended to be in place for around three to five years, with a limited number proposed to be in place for up to ten years. Snig track crossings are required to be removed at the completion of harvesting operations and were generally removed within 12 months of construction.

4.3 Compliance results for each grouping

The ten Code prescriptions and associated audit criteria are divided into three compliance groups:

- Planning for crossings (Code prescriptions 1, 2, 3, 4 and 7);
- Design and construction of crossings (Code prescriptions 5, 8, 9 and 10); and
- Removal and rehabilitation of crossings (Code prescription 6).

The audit findings for each of the compliance groups are presented in sections 4.3.1, 0 and 4.3.3 of this report respectively.

4.3.1 Planning for crossings (Code prescriptions 1, 2, 3, 4 and 7)

Code prescription 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 (Code section 2.2.1.1).*

In most instances, waterways had been appropriately classified as permanent or temporary streams or drainage lines, in accordance with the Code. The exceptions were two coupes for which the waterway classifications were not documented in the FCP; however the crossing operations were appropriate in both cases so no environmental risk rating was recorded.

Code prescription 2: *Where practical exclude roads and snig tracks from aquatic and riparian habitats (Code section 2.2.1.5).*

The audit found that roads and snig tracks had been excluded from aquatic and riparian habitats where practical in the audited coupes. The auditor also noted the low overall use of waterway crossings by VicForests, with only 10% of 2013/14 and 2014/15 financial year coupes in the three audited FMAs requiring the crossing of a stream.

Code prescription 3: *Road planning must:*

- *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*
- *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 (Code section 2.4.1.3).*

VicForests undertook desktop searches for significant flora and fauna values listed in the MSPs and known historic sites using various databases including the Victorian Biodiversity Atlas (VBA). The desktop searches focussed within the coupes and within 500 m of the coupe. The audit found that VicForests had recently changed its practice in response to 2014 audit findings by expanding database searches at waterway crossings to within a buffer of one kilometre from the crossing. However, VBA searches of the audited coupes had usually been limited to a 500 m buffer as they had been undertaken prior to the procedural change. In the auditor's opinion, a desktop search of a buffer of 500 m is not a sufficient area to adequately mitigate the inherent limitations of the VBA data (environmental risk rating of minor for each of the 18 coupes to reflect the potential impact of failure to detect a threatened species that may be present). The auditor acknowledges that VicForests has recently expanded standard desktop search buffers from 500 m to 1 km from waterway crossings; however, the basis for the use of 1 km was not clear to the auditor and should be reviewed for the following reasons:

- The VBA database is limited in its usefulness for some threatened taxa, particularly flora, as it is solely based on actual records of species that have been recorded from searches conducted. The intensity of searches and interest in various target species varies across species and localities. Therefore, in some areas there are few records because there have been few on-ground searches conducted. The auditor also notes that records are generally more comprehensive for fauna species than for flora. Furthermore, the integrity and utility of the VBA database are reliant on the locations of records being entered accurately and precisely. For records that were added prior to the widespread use of GPS the nearest major map grid reference was often used as the record location. In the case of particularly rare or threatened flora, or flora that are actively collected for commercial trade, the locations of records may be entered at a catchment level rather than as a specific location to afford a level of protection.
- Common practice among professional ecologists using the VBA is to initially query the database for flora and fauna records within a 5 km buffer of the target study area. In instances where few records are found (usually the result of few historical on-ground searches in the area) the buffer is extended, often up to 10 km from the target study area. The auditor notes for illustration purposes of the difference in scale of coverage of the various buffers that a 500 m buffer on a point⁴ equates to a search area of around 78 ha; a 5 km buffer equates to a search area of around 7,800 ha; and a 10 km buffer equates to a search area of over 30,000 ha.

The Auditor notes that the 2014 *Environmental Audit* made two recommendations in relation to desktop searches: REG4 and VF3, which are copied below:

Excerpt from *Environmental Audit – Forest Audit Program 2014*:

Recommendation 2014 REG4 – It is recommended that DEPI reviews threatened flora and fauna models developed in association with the Permitted Clearing of Native Vegetation: Biodiversity Assessment Guidelines policy to assess applicability for forestry applications; and if appropriate, they be made available for use by VicForests and DEPI Forestry Services.

Rationale: DEPI has recently produced over 1,500 threatened flora and fauna models for the purpose of identifying offset requirements under the Permitted Clearing of Native Vegetation: Biodiversity Assessment Guidelines policy. The models were not developed for use in a forestry context; however they may be applicable.

Recommendation 2014 VF3 – It is recommended that VicForests extends its desktop searches for threatened flora values beyond 500 m from the coupe to the broader catchment or landscape level, until such time as threatened flora models are deemed appropriate for use in this context (refer to Recommendation REG4).

⁴ The auditor notes that VF searches coupes as polygons rather than points. The auditor has made the area comparison for indicative illustrative purposes.



Indufor

Rationale: The Victorian Biodiversity Atlas (VBA) database is limited in its usefulness in detecting threatened taxa, particularly flora. VicForests' standard procedure is to search the coupe for flora values mapped within 500 m of the coupe, which may miss values mapped at a catchment level more than 500 m from the coupe. Under the current reliance on the VBA, there is a risk that there may be threatened flora present on a coupe that have not been identified as part of the desktop assessment process, and which are therefore not being actively searched for during the pre-harvest reconnaissance or in determining new road alignments or landing locations. Desktop searches over a broader area, and/or the use of modelled habitat would be expected to reduce this risk.

The auditor understands that DEPI has recently produced over 1,500 threatened flora and fauna models for the purpose of identifying offset requirements under the recently gazetted (December 2013) *Permitted Clearing of Native Vegetation: Biodiversity Assessment Guidelines* policy. The models were not developed for use in a forestry context; however they may be applicable. VicForests currently use modelled habitat data for a number of threatened fauna species, but not for threatened flora.

Recommendation 2015 VF1: It is again recommended that VicForests implements Recommendation VF3 from the 2014 audit report and increases the desktop VBA search area around waterway crossings to reflect common practice among other professional users of the VBA. The auditor understands that the threatened flora and fauna models referred to in Recommendation 2014 REG4 were reviewed by DELWP and found in their current form to be inadequate for use in forested areas. DELP has advised that it is assessing if these models can be amended for future forest use.

One planning issue in relation to threatened flora and fauna values was detected during the audit. The Germain coupe was located within a recognised Spotted Tree Frog catchment, which requires implementation of specific construction methods to minimise sedimentation of waterways⁵. The audit found that the FCP did not include reference to the specific measures nor were they implemented during construction of the log bridge crossing. The two issues of most relevance were that the crossing was not designed for a one in fifty year rainfall event; and that there were no rock armoured overflow sections to allow overtopping⁶ without road washouts (environmental risk rating of major). It should be noted however that the use of a log bridge crossing resulted in minimal soil exposure and disturbance compared with a conventional culvert and the auditor considers that the actual environmental outcome was likely better than would have been provided by a culvert that complied with the prescribed measures (see *Case study 1 - the Germain coupe* below for further detail).

Soil assessments had been undertaken as required for the majority of the coupes. Soil assessment records were not available for three coupes (environmental risk ratings of negligible); and for two other coupes there were inconsistencies between the soil assessment sheet and the soil assessment outcomes recorded in the FCP (environmental risk ratings of negligible).

The auditor noted that VicForests' soil assessments rarely assessed the C horizon⁷, unless a suitable road cutting was available at the time. In one of the audited coupes (West Davis Link roadline) a highly erodible C horizon was identified during road construction (refer to Figure 4-6 for a stylised diagram of a typical soil profile). VicForests responded by reducing the distances between road drainage structures and using more extensive rock armouring. The soil assessment procedure intends that all horizons planned to be exposed during operations should be assessed during planning. However, other than the soil not being fully assessed before construction commenced (which would have likely required the use of a backhoe), the procedure had been followed and drainage designs were adjusted when the C horizon was subsequently

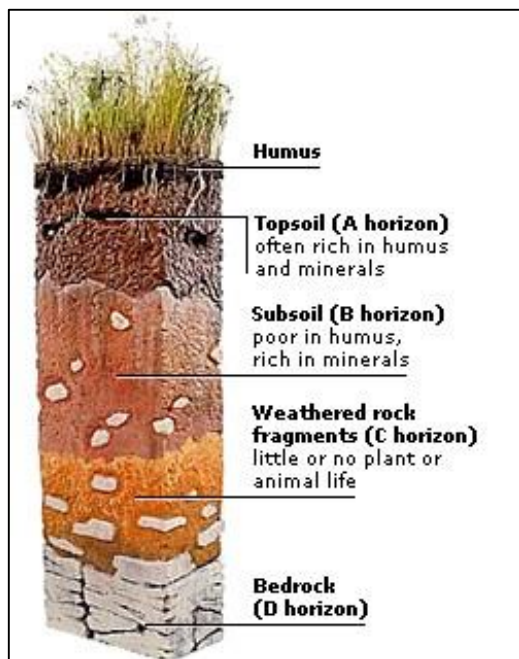
⁵ See Appendix 3, Table 13, *Management Standards and Procedures for timber harvesting operations in Victoria's State forests*, 2014.

⁶ Flow of water across the road or running surface of the crossing due to the stream flow volume exceeding the capacity of the culvert pipe or stream channel beneath the bridge to accommodate the flow.

⁷ The soil layer beneath the A and B horizons, characterised by little or no organic matter accumulation or soil structure development and often comprising unconsolidated parent material from which the A and B horizons have formed.

assessed. The auditor considers that in this instance the outcome would not have been significantly different had the C horizon been assessed during planning (environmental risk rating of negligible).

Figure 4-6: Stylised diagram of a soil profile



Source: Google Images⁸

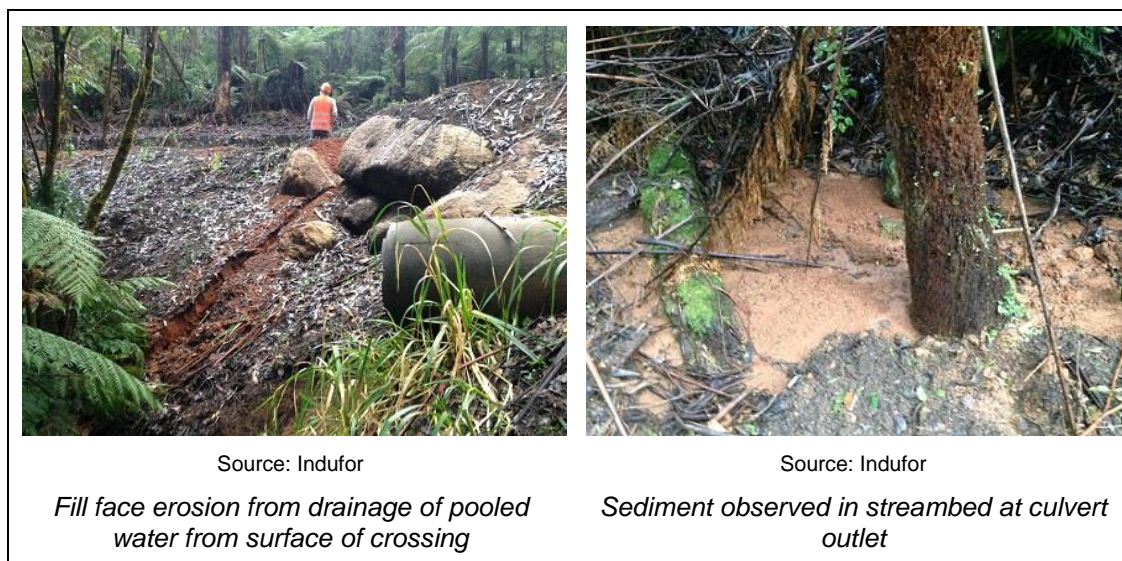
The Code requires that “*Road planning must ... ensure that the timing of construction activities minimises risks associated with unsuitable weather conditions and provides for completion to the required standard in advance of timber harvesting operations*” (Code section 2.4.1.3). The majority of crossings were assessed as having been planned and constructed with reasonable consideration of seasonal weather conditions to minimise the risks to soil and water. Seven of the 13 crossings for which there was sufficient information to make an assessment were constructed in the seasonally drier months between December and March. Five crossings were constructed in April or later, which the auditor considers presents a higher risk for wet conditions occurring mid-construction, based on long term average rainfall and temperature records. Four of these five crossings were completed without significant apparent environmental impact (environmental risk ratings of negligible). However, one crossing (Alstergrens Road coupe) was unable to be completed before the seasonal closure of the Thomson catchment on 1 May and remained incomplete over winter with several sources of sedimentation to the waterway (environmental risk rating of moderate).

In a similar instance, another crossing (Turkey Neck coupe) was partially constructed by a roading crew and left to be completed by the harvesting contractors. However, harvesting was delayed, resulting in the crossing remaining incomplete for two years. A significant volume of water had accumulated on the surface of the crossing. Attempts by a VicForests maintenance crew to drain the water had resulted in erosion of the crossing fill face and sediment entering the waterway (environmental risk rating of moderate).

Figure 4-7 shows examples of soil movement into the waterway at the Turkey Neck crossing.

⁸ Fact Monster website (<http://www.factmonster.com/dk/encyclopedia/soil.html>)

Figure 4-7: Erosion and sedimentation at Turkey Neck coupe



In most cases, VicForests' records were not adequate to enable assessment of whether the crossing had been completed prior to use. With the exception of the Alstergrens Road coupe, which had been used to extract timber prior to completion (environmental risk rating of moderate), there was nothing apparent during the audit to suggest that any other crossings had been used to extract timber prior to completion.

Code prescription 4: *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 (Code section 2.4.1.5).*

Notwithstanding that the auditor considers the desktop search area of a 500 m buffer to be insufficient to mitigate the VBA data limitations (see discussion under the heading *Code prescription 3* in section 4.3.1 of this report), the audit found that VicForests had appropriately identified a range of environmental values in the field that were identified as potentially present through its desktop searches. Data sources reviewed by VicForests included VBA records of rare and threatened flora and fauna species; Ecological Vegetation Class (EVC) mapping and extent modelling; modelled habitat for a range of threatened fauna; and known locations of historic sites.

VicForests has documented, systematic processes in place for field identification of some of the more complex values such as Rainforest and Leadbeater's Possum habitat, which had been successfully implemented in the field on a number of the audited coupes.

VicForests Instruction - Pre-Harvest Surveys (March 2015) includes requirements for various types of desktop and field-based pre-harvest surveys by VicForests for a range of fauna species and three vegetation communities. However, the auditor considers that this does not adequately address rare and threatened flora species. The auditor also notes that the document refers to the 2007 Code and *Management Procedures for timber harvesting, roading and regeneration in Victoria's State forests*, which were superseded by the 2014 Code and MSPs.

As was raised in the report for the 2014 Forest Audit *Environmental Audit – Forest Audit Program 2014*, construction of waterway crossings by necessity completely removes vegetation and topsoil in riparian habitats, which for example are noted to be habitat for a number of rare or threatened plants in the Central Highlands. The auditor considers that some threatened plants are difficult to detect without the use of appropriately targeted field surveys, the adoption of which by VicForests is required to adequately manage the risk of disturbance.

Targeted field surveys involve systematic sampling of a site to determine the presence and location of particular values using methods that are most likely to detect those values. Surveys are generally tailored for particular species, for example to align timing of surveys with flowering growth stages and/or to target areas that meet a species' preferred habitat requirements (e.g. riparian zones, wetland margins, dry slopes, sandy soils).

Flora in particular can be difficult to identify outside of flowering seasons or when characteristic floristic material is not available. For example, Forest Sedge (*Carex alsophila*) is listed as 'rare' under the DELWP Advisory List⁹ and the Central Highlands Forest Management Plan and was identified by VicForests as potentially being present at the Gazelle coupe. It is taxonomically similar to more common Tall Sedge (*Carex appressa*), Bergalia Tussock (*Carex longebrachiata*) and Dotted Sedge (*Carex punctate*), all of which have been recorded in the VBA from the region. These species have a similar form and growth habit, but can be readily distinguished from each other when seed-heads are present. Searches targeting the seeding/flowering cycle of Forest Sedge would therefore be required to adequately identify this species on site, and to ensure that this rare species is not mistaken for one of the more common sedge species.

Forest Sedge, along with Baw Baw Berry (*Wittsteinia vacciniacea*), another plant species also listed as 'rare' under the DELWP Advisory List and the Central Highlands Forest Management Plan, were identified by VicForests as present within the boundary of the Gazelle coupe based on a desktop review using the VBA. However there were no records of targeted searches for these species by VicForests, although VicForests did advise the auditor that site inspections were undertaken. Additionally VicForests advised the auditor that protective measures were not prescribed in the FCP because the species were not included in the MSPs. An environmental risk rating of negligible was allocated as the audit team did not note either of the species in the vicinity of the waterway crossing, and therefore considered it unlikely that they had occurred at the crossing point. However, in the event that the species had occurred at the crossing point and not been detected, the potential environmental impact would have been higher. The Code requires that VicForests applies the "precautionary principle" to the conservation of biodiversity values. The auditor queries whether the action taken by VicForests is consistent with the precautionary principle and considers that contacting DELWP to seek further management advice would have been one appropriate course of action in this instance (see also Recommendation REG2015-1).

Recommendation 2015 VF2: It is recommended that if a rare or threatened species is identified as present or potentially present in the coupe but is not listed in the MSPs, VicForests as a minimum should contact DELWP for management advice, as a precautionary approach.

The auditor considers that, in conjunction with broader desktop searches, targeted surveys are required at crossing points in order to identify all environmentally sensitive locations. The auditor notes that VicForests employs a number of ecologists, however there was no evidence available to suggest that such expertise had been involved in planning or undertaking systematic or targeted field surveys for rare or threatened flora at waterway crossings.

The report for the 2014 Forest Audit *Environmental Audit – Forest Audit Program 2014* included a recommendation in relation to site surveys (Recommendation VF4). With the implementation of Recommendation VF2015-1 (expansion of desktop search areas), the auditor expects that a higher number of taxa will be identified at the desktop level as potentially present at a particular site; and it will be important that site survey methodologies are sufficiently well considered and robust to detect the presence of the potential range of species. The auditor acknowledges that the 2014 audit report was released shortly before the 2015 audit, leaving little time for implementation of 2014 recommendations by VicForests prior to the current audit. Recommendation VF2014-4 is copied below:

⁹ Advisory list of rare or threatened plant in Victoria, 2014, Department of Environment and Primary Industries: http://www.depi.vic.gov.au/data/assets/pdf_file/0005/277565/Advisory-List-of-Rare-or-Threatened-Plants-in-Victoria-2014.pdf

Excerpt from *Environmental Audit – Forest Audit Program 2014*:

Recommendation 2014 VF4 – It is recommended that VicForests reviews, revises and implements its documented procedures to ensure that its operations systematically comply with the Code prescription that “*Plans for roads must be based on field surveys to ensure that all environmentally sensitive locations are identified*”; and that records are kept of findings (including nil findings) and management actions taken in response to findings.

Rationale: Road construction activities by necessity completely remove vegetation and topsoil from new road alignments. New road alignments at some of the audited coupes also traversed riparian areas. Riparian areas are noted to be habitat for a number of threatened plants in the Central Highlands. The auditor considers that some threatened plants are difficult to detect without the use of targeted field survey.

Field surveys involve systematic sampling of a site, or in this case a road alignment, to determine the presence and location of targeted values using methods that are most likely to detect those values. There was insufficient evidence that VicForests had conducted detailed field surveys of the final alignment of the audited roads. The auditor therefore finds the field survey processes used for new road alignments to be insufficient and non-compliant with the Code prescription that “*Plans for roads must be based on field surveys to ensure that all environmentally sensitive locations are identified.*”

Recommendation 2015 VF3: It is recommended that VicForests implements Recommendation VF4 from the 2014 audit report.

In terms of minimising sedimentation, appropriate waterway crossing design and construction techniques had generally been used; however, some issues are noted and these are discussed elsewhere in this report. Rock armouring of table drains was widely (but not always) used, contributing to minimisation of sediment reaching the waterways.

The audit team considered that the use of a bulldozer for roadline clearing at the Aquaman coupe had resulted in excessive log, soil and rock material being deposited in the waterway buffer (environmental risk rating of moderate). The use of excavators fitted with harvesting heads was observed in similar situations at other coupes, which had allowed directional felling and the recovery of logs, and lower levels of debris than achieved at the Aquaman coupe.

Code prescription 7: *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 (Code section 2.4.2.4).*

The audit found that VicForests generally designed road waterway crossings on site with reference to relevant documents such as pipe manufacturers’ specifications (for required depth of cover and compaction methods) and reports prepared for the Department and Parks Victoria (for road geometries and design speeds for various classes of road)¹⁰. VicForests also made appropriate design decisions and variations on site during construction (in response to site conditions). The auditor also noted that examples of these decisions were documented in coupe diaries.

VicForests demonstrated measurement of catchment sizes to determine minimum culvert diameters required for a one in ten-year rainfall event at five coupes. These were based on hydrology curves for the various locations of their operations. Documentation of such assessments however was not available for 10 of the 18 coupes (the remaining three coupes were either log crossings or the crossing had been removed and it was not clear whether a pipe

¹⁰ Guimmarra, G. 2001. Road classifications, geometric designs and maintenance standards for low volume roads. ARRB Transport Research Ltd, Vermont South, Victoria. Research report ARR 354.
Guimmarra, G., Blanksby, C. and Di Christoforo, 2005. Engineering requirements for logging truck operations on forest roads. ARRB Consulting.

had been used). Environmental risk ratings of negligible were allocated as there was no apparent visual evidence of flows having exceeded the pipe capacity at any of the 10 coupes. However, in the event that flows exceed the capacity of pipes and result in overtopping of the crossing, the potential environmental impact would have been higher.

Crossing designs were generally not otherwise documented, nor were periodic systematic checks of compliance with design documented during construction. Therefore it is not possible for a third party, including VicForests' staff not involved in the construction, to reliably assess whether the crossing has been constructed as designed.

While the audit found that the design process was not well documented and few design records were available, it was evident in the field through visual inspections of the pipes and running surfaces that the crossings were adequately supporting the traffic loads. VicForests advised the audit team that they had not had a crossing fail to date.

The one log bridge crossing, at the Germain coupe, was assessed as not being designed in accordance with the *DSE Bridge Policy*, nor to meet anticipated traffic requirements due to the absence of any documentation or data available as to the design (environmental risk ratings of negligible). The log crossing had been used successfully by harvesting machinery such as skidders prior to the audit.

Recommendation 2015 VF4: It is recommended that VicForests obtains and documents engineering advice in relation to the construction of log bridge crossings to meet relevant Code and MSPs requirements.

While VicForests has considered a one in ten-year rainfall event for design of temporary crossings, it is not clear whether the hydrology charts used by VicForests incorporate consideration of post-harvest flows (environmental risk ratings of negligible). A temporary increase in water yield is generally expected in forested catchments following harvesting, followed by a reduction in flow as the regrowth increases its water uptake for growth.

Discussions with VicForests staff during the audit indicated that a small number of temporary crossings audited were likely to be in use for up to ten years. While theoretically a design based on a one in ten-year rainfall event should be adequate for use for up to ten years, it would be prudent to consider designs for longer serving culverts in instances where VicForests considers it possible that crossings may be in place for longer than ten years.

Recommendation 2015 VF5: It is recommended that VicForests obtains revised datasets to accommodate pre- and post-harvest flows and considers design requirements for longer serving crossings.

In most coupes the audit found that the crossings had been designed in an appropriate manner for the stream bed and banks that were observed. For example, at the West Davis Link coupe, soil excavation was minimised by retaining the downslope bank and creating a box cutting, and the pipe was laid low in the streambed to enhance habitat values in the pipe.

In four instances it was assessed that the crossing had not been designed in accordance with the stream bed and banks, with steep side cuts (refer to Figure 4-5) having been made through the stream bed (environmental risk ratings of moderate and minor). The cuts were necessary in order to balance the cut and fill, but they will now become permanent features of the stream as rehabilitation back to the original profile is not feasible.

Recommendation 2015 VF6: It is recommended that VicForests considers whether there are alternate crossing designs that require less cutting back of the stream bed, for example, using more fill and less cut at crossings with steep side slopes.

CASE STUDY 1 – THE GERMAIN COUPE

The Germain coupe is located near Cambarville, east of Marysville, in the Central FMA.

The waterway crossing at the Germain coupe was a snig track crossing of a permanent waterway within the Taponga Spotted Tree Frog catchment. The harvesting contractor had constructed a crossing using logs in the form of a bridge spanning between the banks. There were also logs that had been laid along the streambed and more at 90 degrees to the stream on top of the streambed logs. The spanning logs however appeared to be largely unsupported by the lower logs and for this reason, the auditor assessed this crossing as a bridge structure. VicForests considers the crossing to be a log fill crossing, however the support is not provided by the bed logs and fill; it is provided by the spanning logs.

Figure 4-8 shows the bark-lined running surface of the crossing and the stream below the structure.

Figure 4-8: Germain snig track log bridge



Despite not having been constructed to any documented structural standards or in accordance with the DSE Bridge Policy (which is of more relevance to higher traffic road bridges), the crossing appeared to be bearing the traffic loads (harvesting machinery) well at the time of the audit.

The prescriptions for construction of waterway crossings in Spotted Tree Frog catchments include specific design features that are intended to minimise waterway sedimentation. Most relate to minimising sedimentation from culverts where there is usually exposed soil and loose fill. Because the Germain coupe log crossing utilized a bridge design (not a culvert), there had been little soil excavation and the surface of the crossing was covered with bark rather than soil or gravel. The two relevant design prescriptions that were not implemented were that the crossing was not designed for a one in fifty-year rainfall event; and that there were no rock armoured overflow sections to allow overtopping without road washouts (environmental risk rating of major).

The auditor considers that the main environmental risk from this crossing is that a rainfall event occurs that exceeds the crossing's capacity. If the structure is destabilised or fails as a result, significant amounts of debris and soil (potentially pulled in from the banks by the logs used for the bridge) may enter the waterway.

Other than the identified deficiencies for this design (relating to the Spotted Tree Frog prescriptions) stream sedimentation appeared to have been minimised at this site, with negligible waterway sediment evident at the crossing at the time of the audit.

The auditor notes that other than the general crossing requirements outlined in the Code and MSPs, there are no specific prescriptions or guidelines specific to the construction of log bridge crossings in the regulatory framework. The Germain coupe is an example of how this type of crossing could contribute significantly to minimising habitat disturbance as long as construction is based on sound and tested design parameters.

4.3.2 Design and construction of crossings (Code prescriptions 5, 8, 9 and 10)

Code prescription 5: *Where crossings are required, minimise the extent of habitat damage, constriction to stream flow and barriers to fish and other aquatic fauna. (Code section 2.2.1.6).*

VicForests operations were fully compliant with three of the 20 criteria under Code prescription 5 across all audited coupes. Buffer and filter widths at waterway crossing points were assessed as being at least as wide as the minimum prescribed by the Code in all coupes. Similarly, clearing widths were only as wide as necessary for the waterway crossings. The audit team noted one coupe in particular (Humerus) where clearing through a rainforest gully was limited to the minimum width required for a snig track and the crossing location was chosen to align with a natural break in the rainforest canopy. The audit team considered that constriction to stream flow had also been minimised at all culvert crossings.

In the case of the log bridge crossing at the Germain coupe, the auditor considers that the logs placed on the stream bed as part of the crossing construction, as well as bark falling from the logs, contributed to a constriction of the stream flow at this location (environmental risk rating of moderate).

Three coupes had pipes larger than 750 mm diameter on permanent streams, triggering a requirement in the MSPs to include a fish ladder within each pipe. One of the three coupes had a fish ladder and the other two did not (Mosquito and Apollo, environmental risk ratings of moderate). The auditor notes that the environmental risk rating associated with these two non-compliance matters was mitigated by the temporary nature of the crossings.

Ten of the fourteen culverts assessed had the outlet projecting above the bed of the waterway in a manner that creates a 'step' or 'waterfall' effect. In six cases the auditor considers that the step was unlikely to significantly inhibit the passage of aquatic fauna due to the location of the crossing within the landscape. These crossings were located high in catchments in steep gullies where fauna affected by such structures are less likely to occur (environmental risk ratings of negligible). In the other four cases (Bobs Road, Mosquito, Gazelle and Apollo) the auditor considers that the step was likely to significantly inhibit the passage of aquatic fauna (environmental risk ratings of moderate). As was the case with the absence of fish ladders, the temporary nature of the crossings at these sites mitigates the potential environmental impact to some degree.

During site inspections it appeared that the pipes may have originally been aligned with the streambed, but the undercutting action of the streamflow at the pipe outlet had eroded the streambed to a lower level over time. A similar case was also reported on in the 2014 audit report. The high frequency of this type of occurrence suggests a need for VicForests to address a systemic issue and make changes to construction methods. The auditor considers that rock-armouring of the streambed at the culvert outflow would reduce the likelihood of a step developing. The auditor also recommends the inclusion of additional guidance in the regulatory framework to encourage the adoption of appropriate measures (refer to Recommendation 2015 REG6). DELWP has also highlighted that it investigated an issue raised in the 2014 audit report which involved the construction of a culvert across a waterway on a permanent road which also blocked the migration of fish. DELWP indicated in its response to the 2014 audit report that this issue will be addressed in the next review of the Code.

Recommendation 2015 VF7: It is recommended that VicForests considers the modification of current culvert construction methods to prevent streambeds eroding beneath culvert outlets.

Section 6.2.2.1 of the MSPs requires that fill batters should be prevented from covering the base of live trees. Covering of tree roots with excess soil is understood to cause changes in soil aeration and moisture availability that can have negative impacts on tree health. Similarly covering the trunk of a tree with soil can result in rot girdling the tree at ground level in some species.

At all but two crossings (Aquaman and Zebra) fill did not cover the base of live trees. In the case of Zebra the fill was forming part of the crossing structure and was therefore necessary.

Compliance with this requirement could have been achieved by removing the trees in question, but this was not the preferred outcome as it would have resulted in increasing the clearing width. In the case of the Aquaman coupe however, the fill did not appear to be integral to the crossing structure and was therefore avoidable (environmental risk ratings of minor).

The MSPs require that fill batters are mechanically consolidated using engineer approved methods. This prescription has been established to help assure minimisation of sediment entering waterways. VicForests advised the auditor during the audit that it generally uses an excavator mounted sheepsfoot roller to consolidate fill slopes. While it was not possible for the auditor to verify where the roller had been used, fill batters were observed to be adequately consolidated at the majority of the culvert crossings audited. There were however two different styles of culvert crossing and the auditor considers it unlikely that approved mechanical methods were used for two crossings where logs were used to contain fill slopes (Aquaman and Dangermouse); and VicForests advised that the technique was also not generally used in the North East FMA (Magnum and Ruger coupes – environmental risk ratings of minor).

The audit found that the excavator mounted roller had not been approved by an engineer (a towed or self-propelled version had been approved for standard vertical fill compaction, but this equipment was not used by VicForests. Environmental risk rating of negligible) (Refer to Figure 4-9 for images of an excavator-mounted sheepsfoot roller and a self-propelled sheepsfoot roller).

The auditor considers that the current use of the sheepsfoot roller is appropriate for the purpose of consolidating fill faces at crossings; however equally important is the vertical compaction of the crossing fill in thin layers to support the fill face. VicForests stated that fill was compacted by bulldozers, but the auditor was unable to verify whether appropriately thin layers were compacted, as required by the pipe manufacturers' specifications. VicForests also did not mention the use of hand-held compactors required by the specifications for compacting the soil under the haunches of the pipe and up the sides of the pipe, which helps to transfer the load from the pipe to the soil. As there was little evidence of collapsing pipes during visual inspections of the crossings (with the exception of water bypassing the pipe at Mosquito – see findings for Code prescription 8 below), compaction is either adequate and/or the pipe grades used are sufficiently strong without optimal compaction.

Figure 4-9: Example images of sheepsfoot roller compactors



Source: Google images

Excavator-mounted sheepsfoot roller compactor



Source: Google images

Self-propelled sheepsfoot roller compactor

The auditor understands that at the time of the audit VicForests was working with an engineer to review pipe size and grade requirements. If construction methods are at a lower standard than required by the manufacturers' specifications, it will be important to review construction methods actually used in the field in conjunction with a review of pipe specifications to ensure that optimising pipe size/strength to reduce costs does not compromise crossing integrity.

Recommendation 2015 VF8: It is recommended that VicForests completes the current engineer review and approval of waterway crossing construction methods and materials used.

The auditor considers that habitat damage had been minimised by VicForests at eight of the 15 crossings assessed that were still in use. Some of the good practices used to minimise damage included rock armouring of table drains; use of plastic fluming as a temporary measure to minimise fill face erosion; minimisation of clearing widths; the construction of small berms along the road edge to prevent water flowing down fill faces and into the waterway; the use of a gravel base in a large pipe; and the construction of a log bridge crossing rather than a culvert (notwithstanding potential impacts of non-compliance with rainfall design requirements). Seven other coupes were assessed as non-compliant for habitat damage, mainly due to presence of sedimentation and physical barriers to the movement of aquatic fauna (also discussed in section 0 of this report).

Code prescription 8: *[Design,] construct and maintain [roads,] crossings, [coupe infrastructure and drainage structures] to withstand foreseeable rainfall events and traffic conditions, and protect water quality (Code section 2.2.1.12).*

The audit found that the quality of construction and features used on waterway crossings was variable. This was attributable to site conditions that required adaptation of design, such as surface rock preventing installation of drainage structures; and discharge from the pipe outlet directed onto a fill face as a result of a steeply sloping waterway. A number of crossings appeared to lack features that the auditor considers should have been in place, as required by the MSPs, such as protection (e.g. rock-armouring) of fill faces on headwalls and at culvert outlets. Variability was also noted between FMAs. In particular the two crossings in the North East FMA lacked a number of sediment mitigation features commonly used at other crossings, including gravelled approaches and mechanically consolidated fill faces.

A number of design features contributed positively to mitigating environmental impacts of crossings, but again these features were not used consistently on all waterway crossings. Examples of good practice included: berms along edges of the road surface of the crossing to prevent water discharging from the road surface to the fill faces; and rock lining of table drains and fill faces. Another measure that was used to mitigate other design weaknesses was the use of plastic fluming tube to protect fill faces from pipe outlet discharge; however, this should be viewed as a temporary measure only.

All but one of the culverts were found to have at least the minimum depth of fill cover as prescribed in the pipe manufacturers' specifications. The minimum required fill cover ranges from 600 mm to 750 mm for the pipe types used; and depth of fill cover was measured at between approximately 800 mm and 3,000 mm for the compliant crossings. The plastic recycled pipe at the one crossing with insufficient depth of fill (Magnum) was showing deformation and cracks at each end; however, it was not possible to determine whether the damage had occurred during handling or in service. The auditor allocated an environmental risk rating of negligible; note that the potential environmental impact would be higher if the pipe was to fail structurally.

The Australian Standard relevant to the steel pipes used on ten of the audited crossings (AS1762 (1984) *Helical lock-seam corrugated steel pipes – Design and installation*) requires a check for individual loads from heavy vehicles. There was no evidence that VicForests undertook capacity checks for any of the crossings that used steel pipes but they appeared to be bearing the loads involved at the time of inspection (environmental risk ratings of negligible).

VicForests was also unable to locate a copy of the manufacturers' specifications and installation guidelines for the black plastic pipes used in two culverts so compliance could not be assessed for these crossings.

Recommendation 2015 VF9: It is recommended that VicForests maintains current and accessible copies of manufacturers' specifications for all pipes used in waterway crossings.

In one instance a culvert was constructed in a catchment of over 100 ha (Mosquito coupe). Engineering advice was sought but not implemented as VicForests considered the 2 x 1,200 mm

pipes recommended by the engineer would not fit in the narrow streambed. A single 900 mm pipe was used instead. Records of pipe size calculations for a one in ten year rainfall event were not available from VicForests (environmental risk rating of minor).

During the audit a small (~150 mm) channel of water was also observed to be bypassing the pipe at the Mosquito coupe, suggesting that the headwall did not have adequate protection and/or that the fill had not been adequately compacted under the haunches of the pipe. Maintenance had also not occurred to rectify the failure (environmental risk rating of minor). This type of undermining should be monitored on a periodic basis as there is potential for the channel to increase in size over time, leading to increased sediment movement to the waterway and impact on the structural integrity of the crossing (and increasing the environmental risk rating from minor).

The audit found some degree of non-compliance with drainage requirements at most crossings. Environmental risk ratings were generally relatively minor (environmental risk ratings of moderate, minor and negligible), however drainage deficiencies may be ongoing for the life of the crossing, which can be for three years and up to ten-year in some cases. Many crossings were also in need of maintenance. Deficiencies included that:

- Some drainage structures had not been placed within 20 m of the stream;
- Some drainage structures had not been placed 20 m from the stream;
- Some drainage structures were in place but were ineffective, such as silt traps not having been maintained;
- Some fill faces were not adequately protected to prevent erosion or pipes not secured by sandbags, timber, concrete or rock or other means;
- Some culvert pipes discharged onto unprotected fill faces; and
- Some crossings had not been maintained to protect water quality.

The audit team was not able to assess whether 14 of the crossings had been constructed to withstand a one in ten-year rainfall event as pipe size calculation records were not available for these coupes. VicForests did however advise the auditor that these calculations were generally undertaken during the planning process. Similarly, the audit team was not able to determine whether the crossings were constructed to withstand foreseeable traffic conditions as records of compliance with design specifications were not available in the coupe files. It was however evident in the field through visual inspections of the pipes and running surfaces that the crossings were adequately supporting the traffic loads at the time of assessment (see also findings for prescription 7).

Recommendation 2015 VF10: It is recommended that VicForests considers, documents and internally communicates the key culvert design elements that contribute to protecting water quality to ensure all future culvert crossings are constructed using a consistent approach across all FMAs.

The auditor also noted that VicForests had not established a register of all current waterway crossings, and could not easily provide details on their current status (planned, installed, rehabilitated, etc.), or a clear process or program of scheduled maintenance of waterway crossings. Such a register could potentially improve VicForests' management of maintenance, particularly monitoring of the stability of waterway beds and banks once crossings have been removed.

Recommendation 2015 VF11: It is recommended that VicForests develops a register of waterway crossings to monitor current installation status for its removal and rehabilitation program, and to also assist in scheduling and recording appropriate maintenance.

Code prescription 9: *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 (Code section 2.4.2.10).*

Rock and gravel had been applied to road surfaces at approaches to the majority of culverts where construction was complete. VicForests planned to gravel the Turkey Neck crossing once construction recommenced. Gravel was not applied, nor was outsloping effectively used on the road approaches to the waterway crossings (environmental risk ratings of minor) at two coupes in the North East FMA, Ruger and Magnum coupes.

Code prescription 10: *Timber harvesting operations (excluding haulage on existing or approved roads) are not permitted in special protection zones, buffers, or other exclusion areas identified on the Forest Coupe Plan, except where the removal of a limited number of trees is necessary for the construction and use of stream crossings or for river health (Code section 2.5.1.5).*

The audit found that at all coupes assessed, removal of trees to construct waterway crossings had been limited to the minimum number required to safely construct and operate each crossing. Records showed that approval had been granted by VicForests for the harvesting contractor to remove trees that were considered hazardous from within the stream buffer at the Aquaman coupe.

CASE STUDY 2 – THE WEST DAVIS LINK COUPE

West Davis Link is a roadline built to access a group of coupes to the west of Noojee in the Central Gippsland FMA. The roadline includes a culvert waterway crossing of a permanent stream. VicForests advised the auditor that the road and crossing have been planned as temporary structures to access a cluster of coupes over several years.

During construction of the road VicForests identified a highly erodible C horizon of the soil profile in a cutting adjacent to the waterway crossing. The C horizon had not been sampled during the soil assessment prior to road construction, which VicForests advised is commonly the case where suitably representative road cuttings are not available. VicForests responded by reducing the distances between road drainage structures and using more extensive rock armouring. During the audit the cut slope appeared stable, however the fill appeared to be mobile (with some evidence of active erosion).

Figure 4-10 provides some images of the design features of the West Davis Link crossing.

Figure 4-10: West Davis Link crossing



Source: Indufor

Culvert installed partially below the streambed to improve habitat and facilitate passage of aquatic fauna



Source: Indufor

Box cutting and stable subsoil in cut



Source: Indufor

Sediment discharge onto rock beaching adjacent to waterway



Source: Indufor

Fish ladder installed in pipe

VicForests had adapted the crossing design to fit with the approach to the waterway, choosing to create a box cut in preference to moving a large volume of soil on the waterway side of the road. This design had implications for drainage as it left fewer options for culverts to drain the table drain and road approach. VicForests addressed this lack of drainage by channelling the runoff across the crossing and discharging it into a rock-lined swale via a plastic half-pipe flume. The auditor considers that the design is a reasonable compromise, with the weakness being that sediment will

be continually deposited on the rock-lined swale adjacent to the waterway. As the vegetation at this site re-establishes however, the sediment will stabilise.

VicForests had installed a fish ladder in the 900 mm steel corrugated pipe, which reached halfway through the pipe. The pipe had also been sunk into the streambed so that the bottom would fill with sediments to represent a more natural streambed habitat. The auditor considers that these features were installed well, and when combined with the large pipe diameter letting in adequate natural light contribute to minimising any negative impact of the culvert on passage of fish and other aquatic fauna.

4.3.3 Removal and rehabilitation of crossings (Code prescription 6)

Code prescription 6: *Remove temporary crossings immediately after harvesting or any subsequent regeneration work is complete using a technique that minimises soil and habitat disturbance (Code section 2.2.1.7).*

Three of the 18 audited crossings had been removed and rehabilitated at the time of the audit. One crossing was a road access to a coupe (Aheek coupe) and two were snig track crossings (Trevor and Humerus coupes). All were assessed as having been removed in a timely manner following completion of harvesting and regeneration activities.

Based on field observations during the audit the auditor considered that the natural bed and bank profile had been restored appropriately at Humerus and the banks appeared stable. However, snig track cording (small logs) used at this crossing had not been removed from the adjacent rainforest and rainforest buffer, which the auditor considers will likely inhibit rainforest species from recolonising along the snig track for an extended period of time and negatively impact on the site's provision of natural understorey habitat structures (environmental risk rating of major). The environmental impact of this issue is mitigated by the minimal clearing width that was achieved (refer to *Case study 3 – the Humerus coupe* below for further detail).

Recommendation 2015 VF12: It is recommended that VicForests documents, communicates and implements a procedure that ensures the removal of cording, with minimum damage to retained vegetation and soils, from stream buffers, filters and other areas of significance, such as rainforest. (See also Recommendation 2015 REG7).

The methods used to remove and rehabilitate crossings at the Aheek and Trevor coupes had also resulted in some minor soil and habitat disturbance that the auditor considered could have been further reduced. Limited access along a narrow snig track corridor at the Trevor coupe and the limitations of machinery available on site had impacted on the quality of the rehabilitation, with some cording left in the waterway (environmental risk rating of negligible). Otherwise the auditor considered that the rehabilitation had been undertaken appropriately and a good environmental outcome achieved overall through the use of a single crossing to access multiple coupes through a narrow corridor through regrowth forest.

The rehabilitation of Aheek appeared to have been largely appropriate, with the exception that unconsolidated soil (estimated at between 0.5m³) had been left at the stream edge and will continue to be a source of sediment to the waterway (environmental risk rating of moderate). Shallow excavator track marks leading to the edge of the waterway should also have been drained or re-contoured as a matter of good practice, however due to the stable nature of the soils there was little apparent soil movement from this source at the time of the audit.

Harvesting was complete in coupes accessed by a number of other waterway crossings (Apollo, Dangermouse, Aquaman, Bobs Road coupes) however VicForests advised the auditor that the crossings would remain in place in the near future to be used to access additional coupes in coming years; however, VicForests was not able to specify a timeframe.

CASE STUDY 3 – THE HUMERUS COUPE

The Humerus coupe, north-east of Marysville in the Central FMA, was accessed by a snig track from an adjacent coupe via a log fill crossing of a permanent stream. The harvesting operation was completed in March 2015. At the time of the audit the crossing had been removed and the bed and bank profile resembled that of the undisturbed waterway upstream and downstream. There appeared to have been little soil disturbance created through the excavation or fill, and the log crossing had been surfaced with bark rather than soil.

In planning the waterway crossing VicForests correctly identified modelled rainforest through a database search; and also confirmed the presence of rainforest through field inspections. A 40 m harvesting exclusion buffer was also correctly applied. VicForests achieved a minimal snig track clearing width through the rainforest and rainforest buffer of around nine metres; and selected a natural gap in the canopy to locate the crossing. The crossing point also featured naturally gently sloping approaches, thereby minimising the need for soil excavation.

The audit found that VicForests achieved a good environmental outcome at this waterway crossing through the location of the crossing and minimising soil and habitat disturbance. The one main exception noted during the audit was that the snig track cording had not been removed from the rainforest and rainforest buffer, which the auditor considers will likely inhibit rainforest species from recolonizing and negatively impact on the site's provision of natural understorey habitat structures for at least ten years (environmental risk rating of major). The cording had been aerated for burning, rather than removed, even though it would not have been practical to burn in the narrow snig track corridor and would have presented an unacceptable risk to the surrounding rainforest values.

The auditor considers that there is still opportunity for VicForests to remove the cording using an excavator, however it may require a machine to be floated to the coupe as all harvesting machinery has been removed from the site.

Figure 4-11 contains images of the crossing after removal at the Humerus coupe.

Figure 4-11: Humerus snig track crossing after removal



Source: Indufor

Minimal gap created in the buffer canopy from snig track construction leading to the waterway crossing



Source: Indufor

Bed and bank profile reflects that of the undisturbed portion of waterway after crossing removal.



Source: Indufor

Narrow crossing width in middleground; retained cording in foreground



Source: Indufor

This retained cording will likely inhibit rainforest species from recolonizing for an extended period of time

5. ASSESSMENT OF THE REGULATORY FRAMEWORK

In 2014 DELWP consolidated the relevant rules and regulations that apply to timber harvesting conducted on public land, resulting in changes to the regulatory framework and the publication of the current version of the Code (2014) and associated *Management Standards and Procedures 2014* (MSPs).

The MSPs consolidate the requirements of relevant source documents such as forest management plans created under the *Forest Act (1958)* and Action Statements created under the *Flora and Fauna Guarantee Act (1988)*; and replace directions related to timber harvesting operations within these documents.

The audit identified a number of opportunities to improve the current regulatory framework and for DELWP to facilitate potentially improved environmental outcomes. Some findings were similar to those reported on in the 2014 Forest Audit and therefore some recommendations in this report therefore restate or build on those provided in that report.

Recommendations include ensuring that the MSPs lists of rare or threatened species and respective management prescriptions reflect the current conservation status each species; and the development of more prescriptive guidance or rules around crossing design to minimise disruption to the passage of fish and the range of other aquatic fauna. This may be best achieved collaboratively with VicForests and a specialist aquatic ecologist to pool collective scientific and practical knowledge.

At one coupe (Gazelle) VicForests' search of the VBA showed known locations within the coupe of two plants listed as 'rare' under the DELWP Advisory List and the Central Highlands Forest Management Plan (Forest Sedge - *Carex alsophila*; and Baw Baw Berry - *Wittsteinia vacciniacea*). However, there were no records of on-ground searches being conducted for these species by VicForests. VicForests advised the auditor that protective measures were not prescribed in the FCP because the species were not listed in the MSPs as requiring special protection. The auditor queries whether this approach would be consistent with the intent of the "precautionary principle" outlined in section 2.2.2.2 of the 2014 Code, but recommends DELWP considers providing further regulatory guidance.

Recommendation 2015 REG1: It is recommended that DELWP provides additional guidance on the requirements to look for and protect any recognised 'rare' species that may be associated with or impacted by timber harvesting operations; and where they are not listed in the MSPs, to seek management guidance from DELWP.

The management recommendations for both of these species in the Central Highlands Forest Management Plan infer that because the species occur in riparian areas timber harvesting is not considered a threat to their respective habitats. However, by necessity road and waterway crossing construction require the removal of vegetation and topsoil within riparian areas at crossing points. The management procedures for the two species are copied in Table 5-1.

Table 5-1: Management procedures for two rare species as listed in the Central Highlands Management Plan

Scientific name	Common name	Status (DELWP Advisory List)	Central Highlands Forest Management Plan management recommendations
<i>Carex alsophila</i>	Forest Sedge	Rare	Grows in riparian areas. Riparian area prescriptions protect the majority of habitat in State forest.
<i>Wittsteinia vacciniacea</i>	Baw Baw Berry	Rare	Grows in sub-alpine and riparian areas. Timber harvesting is not considered a threat to its habitat in State forest.

Source: Indufor

The *Environmental Audit – Forest Audit Program 2014* made two recommendations relevant to this finding: REG5 and REG7 copied below:

Recommendation 2014 REG5 – It is recommended that the Central Highlands FMP be updated to:

- Ensure that Appendix J and K include all current FFG listed taxa and threatened taxa on the DEPI Advisory List, including but not limited to, VBA entries since 1995;
- Update the conservation status of all taxa in Appendix J and K to reflect the DEPI Advisory list and/or the EPBC Advisory list; and
- Update the management prescriptions to align conservation efforts with current conservation significance status.

Rationale: The auditor notes that Appendix J of the Central Highlands FMP was compiled in 1998. The Flora Information System (FIS) database (1995) is cited as the source for records. The FIS has been superseded by the Victorian Biodiversity Atlas. The conservation status of some of the flora listed has since been revised, for example, Crimson Spider Orchid (*Caladenia concolor*) is listed in Appendix J as vulnerable at a State level. The conservation status of this species has been elevated to Endangered at a State level, it is now also listed as Vulnerable at a Federal level. There are other, similar examples, including (but not limited to) Tree Geebung (*Persoonia arborea*) elevated to Vulnerable at a State level, and Slender Tree-fern (*Cyathea cunninghamii*) also elevated to Vulnerable conservation status at a State level. The conservation status, and the data source, of flora identified in Appendix J are now out-dated.

Similarly, the auditor identified outdated data in Appendix K of the Central Highlands FMP. Discrepancies include that the conservation status of Smoky Mouse (*Pseudomys fumeus*) has changed to being Endangered at a Federal level, FFG-listed, and Near Threatened at State level; but shown in Appendix K as Vulnerable.

Furthermore, the Code requires that “*Forest management planning and all forestry operations must comply with measures specified in relevant Flora and Fauna Guarantee Action Statements and Flora and Fauna Guarantee Orders.*” The auditor notes that Action Statements or Guarantee Orders have not yet been developed for many threatened species. In the absence of Action Statements, the management prescriptions in the FMP need to be reviewed and amended to ensure they are adequate and current - to reflect the current conservation significance status of each species.

The auditor notes that VicForests and DEPI Forestry Services may need to reassess the suitability of their on-ground species detection methodologies to ensure they are appropriate for detection of all target species. Changes required may include additional training; more targeted field methodologies; searching by specialists; and seasonal searches.

Recommendation 2014 REG7 - It is recommended that management prescriptions for the protection of threatened flora within riparian zones be reviewed to better manage potential impacts associated with construction of waterway crossings.

Rationale: The management prescriptions for significant flora outlined in Appendix J of the Central Highlands FMP apply to harvesting operations without giving due consideration to roading operations. In particular, the Central Highlands FMP does not specify management actions for species that grow in riparian areas, as it states they are adequately protected by waterway buffers and filters prescribed by the Code. The auditor notes however that roads do impact riparian zones at crossings.

The 2014 MSPs were created to consolidate the prescriptions contained in various documents including FFG Action Statements and Forest Management Plans. However the prescriptions in the MSPs still contain the limitations of the Central Highlands Forest Management Plan (also highlighted in the 2014 audit report). The auditor understands that DELWP has made some progress in its review of the Central Highlands Forest Management Plan to address these

recommendations but further work is required to ensure an appropriate level of regulatory guidance. The audit also noted that some species listed as 'rare' in the DELWP Advisory List have been included in the MSPs and some have not, and the rationale for inclusion or exclusion is not evident.

Recommendation 2015 REG2: It is recommended that DELWP completes work to review, update and revise the current MSPs and Central Highlands Forest Management Plan to meet the intent of both 2014 REG 5 and 2014 REG 7.

The auditor also notes that the MSPs contain prescriptions for 'catch-all' generic values that are not defined elsewhere, such as '*rich reptile and amphibian sites*' and '*significant fish*'. These values are unlikely to be listed in the VBA and it is unlikely that VicForests' GIS-based desktop search process for ecological values would result in a positive record and incorporation of the requisite prescriptions in the coupe management procedures.

Recommendation 2015 REG3: It is recommended that DELWP ensures that all values are defined in a manner that facilitates VicForests and auditors to identify and assess them in a less subjective manner (e.g. '*rich reptile and amphibian sites*' and '*significant fish*').

The auditor considers that the regulatory framework does not adequately provide prescriptions or guidance for the protection of rare or threatened species of fish and aquatic fauna at waterway crossings. Table 14 of the MSPs provides prescriptions for rare or threatened species, however with the exception of Spotted Tree Frog, relevant prescriptions are limited to avoiding or minimising crossings and establishing wider buffers. Examples include Barred Galaxias (minimise stream crossings); Alpine Stonefly (30 and 50 m buffers on permanent streams and 15 m filter strips); Mallecoota Burrowing Crayfish (100 m buffers and avoid stream crossings); Narracan Burrowing Crayfish (avoid stream crossings); Mountain Galaxias (minimise stream crossings). In comparison the prescriptions for management of crossings in Spotted Tree Frog catchments, in the event that crossings cannot be avoided, include detailed prescriptions for culvert design aimed at minimising risk to habitat. Spotted Tree Frog prescriptions include designing the crossing to a one in fifty year flow; construction of rock armoured overflow sections to allow overtopping without road washouts; a minimum pipe diameter; diversion drains and discharge dissipation features; and the use of excavators for construction.

Recommendation 2015 REG4: It is recommended that DELWP considers whether prescriptions similar to the higher environmental standard established for the protection of the Spotted Tree Frog would be appropriate for other rare or threatened species that may also be susceptible to poor water quality associated with sedimentation.

The audit team's search of the VBA for the general area in which the audited coupes were located showed records for a range threatened aquatic fauna including *Canthocamptus* spp. (small aquatic crustaceans), caddisfly, several species of endangered crayfish, Alpine Bog Skink, three Galaxias species and a number of frogs and toadlets¹¹. Furthermore, the auditor notes that the intent of the Code is to minimise disruption to the passage of all aquatic fauna, not just rare or threatened species.

The *Environmental Audit – Forest Audit Program 2014* made a recommendation in relation to the specific design of waterway crossings for the native fish most often found in harvesting areas: REG9, which is copied below.

Recommendation 2014 REG9 – It is recommended that DEPI reviews the requirements for road crossings of waterways and provides guidance relating to movement of native fish through crossing structures.

Rationale: Standard culverts are likely to present barriers for native fish species most often found in catchment headwaters. Appropriate crossing designs and structures can reduce these barriers, enabling natural migration cycles of native fish to continue. Culvert discharges

¹¹ Approximately 180 square kilometres bounded approximately by Taggerty, Buxton and Woods Point and including Narbethong and Marysville; and another area of approximately 120 square kilometres incorporating Mt Baw Baw, Toorong and Noojee.

at three coupes were found to be non-compliant as they project above the bed of the stream in a way that is likely to inhibit the passage of native fish. The EIA risk ratings were assessed as Major for one coupe with a permanent road and Moderate for two coupes with temporary roads. In all three cases, the stream beds were on gradients and of variable terrain such that installation of culverts without suspended outlets would require considerable excavation or result in significant acceleration of water flow. In these cases, a crossing type other than a conventional culvert is likely to be more appropriate.

Recommendation 2015 REG5: It is recommended that DELWP expands recommendation 2014 REG9 to include appropriate crossing designs for the range of fish and aquatic fauna that are known or expected to occur in areas managed for timber production. This work would include a review of the lifecycle, habitat and migration requirements of all fish and aquatic fauna species throughout all Forest Management Areas to provide recommendations or prescriptions for crossing designs that meet the needs of the indigenous species.

As discussed in section 0 of this report, ten of the fourteen culverts assessed had the outlet projecting above the bed of the waterway in a manner that creates a 'step' or 'waterfall' effect. In four cases (Bobs Road, Mosquito, Gazelle and Apollo) the auditor considers that the step is likely to significantly inhibit the passage of aquatic fauna (environmental risk ratings of moderate). It appeared that the pipes may have originally been aligned with the streambed, but the undercutting action of the streamflow at the pipe outlet had eroded the streambed to a lower level over time. A similar case was also reported on in the 2014 audit report and DELWP indicated in its response to the 2014 audit report that this issue will be addressed in the next review of the Code. The high frequency of this type of occurrence suggests a need for addressing this as a systemic issue and a recommendation has also been provided for VicForests. The auditor considers that rock-armouring the streambed at the culvert outflow would reduce the likelihood of a step developing.

Recommendation 2015 REG6: It is recommended that DELWP includes additional guidance in the regulatory framework to encourage the adoption of appropriate measures to prevent the streambed eroding after construction of waterway crossings and ensure that pipes do not become suspended above the streambed (inhibiting the passage of fish and other aquatic fauna).

Snig track cording (small logs) used at the Humerus coupe had not been removed from the adjacent rainforest and rainforest buffer, which the auditor considers will likely inhibit rainforest species from recolonising along the snig track for an extended period of time and negatively impact on the site's provision of natural understorey habitat structures (environmental risk rating of major). The MSPs (section 7.2.2.4) require that cording is aerated in preparation for burning, however there are no prescriptions for removal of cording in areas that cannot be burnt, such as snig tracks through buffers.

Recommendation 2015 REG7: It is recommended that DELWP provides additional guidance or prescriptions for the removal of cording in streamside buffers and waterway crossings after harvesting is complete to minimise impacts on regeneration and avoid damage to retained vegetation and soils.

6. CONCLUSIONS AND SUMMARY OF RECOMMENDATIONS

The audit found a moderate level of compliance with Code prescriptions for waterway crossing design, construction and rehabilitation with full compliance with two of the ten relevant prescriptions and partial compliance with eight. An overall compliance score of 65% was achieved with the audit criteria.

VicForests demonstrated the ability to implement sound crossing design features to minimise sedimentation and habitat disturbance impacts; however, they were not implemented consistently across all crossings and FMAs. Engineering and crossing design and construction records were not well documented; and opportunities exist for VicForests to apply a more systematic approach in monitoring the status of its crossings, and in scheduling and undertaking maintenance and removal works and rehabilitation monitoring.

Findings in relation to desktop and ground-based searches at waterway crossings for significant environmental values were similar to those reported for the 2014 Forest Audit. These included the need to expand the desktop search area; and review site survey methods to ensure they are adequate to address the increased number of potentially present taxa. The auditor acknowledges that the 2014 audit report was released shortly before the 2015 audit, leaving little time for implementation of 2014 recommendations in relation to the audited coupes.

In terms of environmental impact, no severe environmental risk ratings were identified; and 87% of environmental risk ratings were in the lower categories of minor, negligible or no impact. This information will be helpful for VicForests and DELWP to incorporate into their respective continual improvement processes. It will be up to DELWP as the regulator to determine what actions are taken in response to the non-compliance issues that scored more significant impact ratings of moderate and major.

The audit made 12 recommendations for VicForests to make changes to processes and practices to improve compliance and environmental performance; and seven recommendations for DELWP aimed at improving the regulatory framework.

6.1 Recommendations for VicForests

Recommendation 2015 VF1: It is again recommended that VicForests implements Recommendation VF3 from the 2014 audit report and increases the desktop VBA search area around waterway crossings to reflect common practice among other professional users of the VBA. The auditor understands that the threatened flora and fauna models referred to in Recommendation 2014 REG4 were reviewed by DELWP and found in their current form to be inadequate for use in forested areas. DELWP has advised that it is assessing if these models can be amended for future forest use.

Rationale: VicForests undertook desktop searches for significant flora and fauna values listed in the MSPs and known historic sites using various databases including the Victorian Biodiversity Atlas (VBA). The desktop searches focussed within the coupes and within 500 m of the coupe. The audit found that VicForests had recently changed its practice in response to 2014 audit findings by expanding database searches at waterway crossings to within a buffer of one kilometre from the crossing. However VBA searches of the audited coupes had usually been limited to a 500 m buffer as they had been undertaken prior to the procedural change. In the auditor's opinion, a desktop search of a buffer of 500 m is not a sufficient area to adequately mitigate the inherent limitations of the VBA data. The auditor acknowledges that VicForests has recently expanded standard desktop search buffers from 500 m to 1 km from waterway crossings; however, the basis for the use of 1 km was not clear to the auditor and should be reviewed for the following reasons:

- The VBA database is limited in its usefulness for some threatened taxa, particularly flora, as it is solely based on actual records of species that have been recorded from searches conducted. The intensity of searches and interest in various target species varies across species and localities. Therefore in some areas there are few records because there have been few on-ground searches conducted. The auditor also notes that records are generally more comprehensive for fauna species than for flora. Furthermore, the integrity and utility

of the VBA database are reliant on the locations of records being entered accurately and precisely. For records that were added prior to the widespread use of GPS the nearest major map grid reference was often used as the record location. In the case of particularly rare or threatened flora, or flora that are actively collected for commercial trade, the locations of records may be entered at a catchment level rather than as a specific location to afford a level of protection.

- Common practice among professional ecologists using the VBA is to initially query the database for flora and fauna records within a 5 km buffer of the target study area. In instances where few records are found (usually the result of few historical on-ground searches in the area) the buffer is extended, often up to 10 km from the target study area.

The report *Environmental Audit – Forest Audit Program 2014* made two recommendations in relation to desktop searches: VF3 and REG4, which are copied below:

Recommendation 2014 REG4 – It is recommended that DEPI reviews threatened flora and fauna models developed in association with the Permitted Clearing of Native Vegetation: Biodiversity Assessment Guidelines policy to assess applicability for forestry applications; and if appropriate, they be made available for use by VicForests and DEPI Forestry Services.

Rationale: DEPI has recently produced over 1,500 threatened flora and fauna models for the purpose of identifying offset requirements under the Permitted Clearing of Native Vegetation: Biodiversity Assessment Guidelines policy. The models were not developed for use in a forestry context; however they may be applicable.

Recommendation 2014 VF3 – It is recommended that VicForests extends its desktop searches for threatened flora values beyond 500 m from the coupe to the broader catchment or landscape level, until such time as threatened flora models are deemed appropriate for use in this context (refer to Recommendation REG4).

Rationale: The Victorian Biodiversity Atlas (VBA) database is limited in its usefulness in detecting threatened taxa, particularly flora. VicForests' standard procedure is to search the coupe for flora values mapped within 500 m of the coupe, which may miss values mapped at a catchment level more than 500 m from the coupe. Under the current reliance on the VBA, there is a risk that there may be threatened flora present on a coupe that have not been identified as part of the desktop assessment process, and which are therefore not being actively searched for during the pre-harvest reconnaissance or in determining new road alignments or landing locations. Desktop searches over a broader area, and/or the use of modelled habitat would be expected to reduce this risk.

The auditor understands that DEPI has recently produced over 1,500 threatened flora and fauna models for the purpose of identifying offset requirements under the recently gazetted (December 2013) *Permitted Clearing of Native Vegetation: Biodiversity Assessment Guidelines policy*. The models were not developed for use in a forestry context; however they may be applicable. VicForests currently use modelled habitat data for a number of threatened fauna species, but not for threatened flora.

Priority: High

Recommendation 2015 VF2: It is recommended that if a rare or threatened species is identified as present or potentially present in the coupe but is not listed in the MSPs, VicForests as a minimum should contact DELWP for management advice, as a precautionary approach.

Rationale: At one coupe two plants listed as 'rare' under the DELWP Advisory List and the Central Highlands Forest Management Plan (Forest Sedge - *Carex alsophila*; and Baw Baw Berry - *Wittsteinia vacciniacea*) were identified as present within the coupe boundary by the VBA. However, there were no records of searches for these species by VicForests, although VicForests did advise the auditor that site inspections were undertaken. VicForests advised that protective measures were not prescribed in the Forest Coupe Plan because the species were not included in the *Management Standards and Procedures*. The Code requires that VicForests applies the "precautionary principle" to the conservation of biodiversity values. The auditor

queries whether the action taken by VicForests is consistent with the precautionary principle and considers that contacting DELWP to seek further management advice would have been one appropriate course of action in this instance (see also Recommendation 2015 REG1).

Priority: Low

Recommendation 2015 VF3: It is recommended that VicForests implements Recommendation VF4 from the 2014 audit report.

Rationale: As was raised in the report for the 2014 Forest Audit *Environmental Audit – Forest Audit Program 2014*, construction of waterway crossings by necessity completely removes vegetation and topsoil in riparian habitats, which for example are noted to be habitat for a number of rare or threatened plants in the Central Highlands. The auditor considers that some threatened plants are difficult to detect without the use of appropriately targeted field surveys.

Targeted field surveys involve systematic sampling of a site to determine the presence and location of particular values using methods that are most likely to detect those values. Surveys are generally tailored for particular species, for example to align timing of surveys with flowering growth stages and/or to target areas that meet a species' preferred habitat requirements (e.g. riparian zones, wetland margins, dry slopes, sandy soils).

VicForests Instruction - Pre-Harvest Surveys (March 2015) includes requirements for various types of desktop and field-based pre-harvest surveys by VicForests for a range of fauna species and three vegetation communities. However, the auditor considers that this does not adequately address rare and threatened flora species. The auditor also notes that the document refers to the 2007 Code and *Management Procedures for timber harvesting, roading and regeneration in Victoria's State forests*, which were superseded by the 2014 Code and MSPs.

Flora in particular can be difficult to identify outside of flowering seasons or when characteristic floristic material is not available. Forest Sedge (*Carex alsophila*), listed as 'rare' under the DELWP Advisory List¹² and the Central Highlands Forest Management Plan and identified by VicForests as potentially being present at the Gazelle coupe, is taxonomically similar to more common Tall Sedge (*Carex appressa*), Bergalia Tussock (*Carex longibrachinata*) and Dotted Sedge (*Carex punctate*), all of which have been recorded in the VBA from the region. These species have a similar form and growth habit, but can be readily distinguished from each other when seed-heads are present. Searches targeting the seeding/flowering cycle of Forest Sedge may be required to adequately identify this species on site, and to ensure that this rare species is not mistaken for one of the more common sedge species.

Forest Sedge, along with Baw Baw Berry (*Wittsteinia vacciniacea*), another plant species also listed as 'rare' under the DELWP Advisory List and the Central Highlands Forest Management Plan, were identified by VicForests as present within the boundary of the Gazelle coupe based on a desktop review using the VBA. However, there were no records of targeted searches for these species by VicForests.

It is important to review methods for field-based searches at waterway crossing points to ensure they are adequate to address the higher numbers of potentially present taxa expected to result from broader desktop searches (Recommendation 2015 VF1).

Recommendation 2014VF4 – It is recommended that VicForests reviews, revises and implements its documented procedures to ensure that its operations systematically comply with the Code prescription that "*Plans for roads must be based on field surveys to ensure that all environmentally sensitive locations are identified*"; and that records are kept of findings (including nil findings) and management actions taken in response to findings.

Rationale: Road construction activities by necessity completely remove vegetation and topsoil from new road alignments. New road alignments at some of the audited coupes also traversed riparian areas. Riparian areas are noted to be habitat for a number of threatened

¹² Advisory list of rare or threatened plant in Victoria, 2014, Department of Environment and Primary Industries

plants in the Central Highlands. The auditor considers that some threatened plants are difficult to detect without the use of targeted field survey.

Field surveys involve systematic sampling of a site, or in this case a road alignment, to determine the presence and location of targeted values using methods that are most likely to detect those values. There was insufficient evidence that VicForests had conducted detailed field surveys of the final alignment of the audited roads. The auditor therefore finds the field survey processes used for new road alignments to be insufficient and non-compliant with the Code prescription that *“Plans for roads must be based on field surveys to ensure that all environmentally sensitive locations are identified.”*

Priority: High

Recommendation 2015 VF4: It is recommended that VicForests obtains and documents engineering advice in relation to the construction of log bridge crossings to meet relevant Code and MSPs requirements.

Rationale: The audit found that the use of log bridge crossings can provide better environmental outcomes with respect to minimal soil exposure and disturbance compared with conventional culverts in some circumstances. The audit also found that, for the one log bridge crossing audited, there was no documentation or data available about the load capacity or other design features intended to meet anticipated traffic requirements.

Priority: Low

Recommendation 2015 VF5: It is recommended that VicForests obtains revised datasets to accommodate pre- and post-harvest flows and design requirements for longer serving crossings.

Rationale: While VicForests has considered a one in ten year rainfall event for design of temporary crossings, it is not clear whether the hydrology charts VicForests uses incorporate consideration of post-harvest flows. A temporary increase in water yield is generally expected in forested catchments following harvesting, followed by a reduction as the regrowth increases its uptake for growth.

Discussions with VicForests staff during the audit indicated that a small number of temporary crossings audited were likely to be in use for up to ten years. While theoretically a design based on a one in ten year rainfall event should be adequate for use for up to ten years, it would be prudent to consider designs for longer serving culverts in instances where VicForests considers it possible that crossings may be in place for longer than ten years.

Priority: Medium

Recommendation 2015 VF6: It is recommended that VicForests considers whether there are alternate crossing designs that require less cutting back of the stream bed, for example, using more fill and less cut at crossings with steep side slopes.

Rationale: In four instances it was assessed that the crossing had not been designed in accordance with the stream bed and banks, with steep side cuts having been made through the stream bed. The cuts were necessary in order to balance the cut and fill, but they will now become permanent features of the stream as rehabilitation back to the original profile is not feasible.

Priority: Medium

Recommendation 2015 VF7: It is recommended that VicForests considers the modification of current culvert construction methods to prevent streambeds eroding beneath culvert outlets.

Rationale: The majority of culvert crossings (ten out of fourteen) had the outlet projecting above the bed of the waterway in a manner that creates a ‘step’ or ‘waterfall’ effect. In six cases the auditor considers that the step is unlikely to significantly inhibit the passage of aquatic fauna due to the location of the crossing within the landscape. In these cases the crossings were located high in catchments in steep gullies where fauna affected by such structures are less

likely to occur. In the other four cases the auditor considers that the step is likely to inhibit the passage of aquatic fauna.

During site inspections it appeared that the pipes may have originally been aligned with the streambed, but the undercutting action of the streamflow at the pipe outlet had eroded the streambed to a lower level over time. A similar case was also reported on in the 2014 audit report. The high frequency of this type of occurrence suggests a need for VicForests to address a systemic issue and make changes to construction methods. The auditor considers that rock-armouring of the streambed at the culvert outflow would reduce the likelihood of a step developing. The auditor also recommends the inclusion of additional guidance in the regulatory framework to encourage the adoption of appropriate measures (refer to Recommendation 2015 REG 6). DELWP has also highlighted that it investigated an issue raised in the 2014 audit report which involved the construction of a culvert across a waterway on a permanent road which also blocked the migration of fish. DELWP indicated in its response to the 2014 audit report that this issue will be addressed in the next review of the Code.

Priority: High

Recommendation 2015 VF8: It is recommended that VicForests completes the current engineer review and approval of waterway crossing construction methods and materials used.

Rationale: The MSPs require that fill batters are mechanically consolidated using engineer approved methods. VicForests advised the auditor during the audit that it generally uses an excavator mounted sheepsfoot roller to consolidate fill slopes. Where the roller had been used was not able to be verified, however there was nothing to suggest that it had not been used on most of the in-use culvert crossings audited. There were however two different styles of culvert crossing and the auditor considers it unlikely that it was used for two crossings where logs were used to contain fill slopes; and VicForests advised that the technique was also not generally used in the North East FMA.

The audit found that the excavator mounted roller had not been approved by an engineer (a towed or self-propelled version had been approved for standard vertical fill compaction, but this equipment was not used by VicForests). The auditor considers that the use of the sheepsfoot roller is appropriate for the purpose of consolidating fill faces at crossings; however equally important is the vertical compaction of the crossing fill in thin layers to support the fill face. VicForests stated that fill was compacted by bulldozers, but the auditor was unable to verify whether appropriately thin layers were compacted, as required by the pipe manufacturers' specifications. VicForests also did not mention the use of hand-held compactors required by the specifications for compacting the soil under the haunches and up the sides of the pipe, which helps to transfer the load from the pipe to the soil (one instance of water bypassing the pipe was identified). As there was little evidence of collapsing pipes during visual inspections of the crossings (with the exception of water bypassing the pipe at one crossing), compaction is either adequate and/or the pipe grades used are sufficiently strong without optimal compaction.

The Australian Standard relevant to the steel pipes used on ten of the audited crossings (AS1762 (1984) *Helical lock-seam corrugated steel pipes – Design and installation*) requires a check for individual loads from heavy vehicles. There was no evidence that VicForests undertook capacity checks for any of the crossings that used steel pipes. VicForests was also unable to locate a copy of the manufacturers' specifications and installation guidelines for the black plastic pipes used in two culverts.

In one instance engineering advice was sought but not implemented by VicForests for a culvert in a catchment of greater than 100 ha as VicForests considered the advice impractical.

The audit team was not able to assess whether 14 of the crossings had been constructed in to withstand a one in ten-year rainfall event as pipe size calculation records were not available for these coupes. VicForests did however advise the auditor that these calculations were generally undertaken. Similarly, the audit team was not able to determine whether the crossing were constructed to withstand foreseeable traffic conditions as records of compliance with design specifications were not available. It was however evident in the field through visual inspections of the pipes and running surfaces that the crossings were adequately supporting the traffic loads.

The auditor understands that at the time of the audit VicForests was working with an engineer to review pipe size and grade requirements. If construction methods are at a lower standard than required by the manufacturers' specifications, it will be important to review construction methods actually used in the field in conjunction with a review of pipe specifications to ensure that optimising pipe size/strength to reduce costs does not compromise crossing integrity.

Priority: Medium

Recommendation 2015 VF9: It is recommended that VicForests maintains current and accessible copies of manufacturers' specifications for all pipes used in waterway crossings.

Rationale:

VicForests was also unable to locate a copy of the manufacturers' specifications and installation guidelines for the black plastic pipes used in two culverts. Installation in accordance with the specifications is important to ensure the pipes retain the structural properties they are intended to possess.

Priority: Low

Recommendation 2015 VF10: It is recommended that VicForests considers, documents and internally communicates the key culvert design elements that contribute to protecting water quality to ensure all future culvert crossings are constructed using a consistent approach across all FMAs.

Rationale: The audit found that the quality of construction and features used on waterway crossings was variable. Some variability was attributable to site conditions that required adaptation of design, such as surface rock preventing installation of drainage structures; and discharge from the pipe outlet directed onto a fill face as a result of a steeply sloping waterway. However, a number of crossings appeared to lack features that the auditor considers should have been in place, as required by the MSPs, such as protection (e.g. rock-armouring) of fill faces on headwalls and at culvert outlets. Variability was also noted between FMAs. In particular, the two crossings in the North East FMA lacked a number of sediment mitigation features commonly used at other crossings, including gravelled approaches and mechanically consolidated fill faces.

A number of design features contributed positively to mitigating environmental impacts of crossings, but again these features were not used consistently on all waterway crossings. Such features included berms along edges of the road surface of the crossing to prevent water discharging from the road surface to the fill faces; and rock lining of table drains and fill faces. Another measure that was used to mitigate other design weaknesses was the use of plastic fluming tube to protect fill faces from pipe outlet discharge; however, this should be viewed as a temporary measure only.

Priority: High

Recommendation 2015 VF11: It is recommended that VicForests develops a register of waterway crossings to monitor current installation status for its removal and rehabilitation program, and to also assist in scheduling and recording appropriate maintenance.

Rationale: The audit found some degree of non-compliance with drainage requirements at most crossings. Environmental risk ratings were generally relatively minor, however drainage deficiencies may be ongoing for the life of the crossing, which can be for three years and up to ten-year in some cases. Many crossings were in need of maintenance, and there did not appear to be a register of all current waterway crossings and their status, or a clear process or program of scheduled maintenance of waterway crossings. Such a register could potentially improve VicForests' management of maintenance, including monitoring of the stability of waterway beds and banks once crossings have been removed.

Priority: High

Recommendation 2015 VF12: It is recommended that VicForests documents, communicates and implements a procedure that ensures the removal of cording on completion of harvesting,

with minimum damage to retained vegetation and soils, from stream buffers, filters and other areas of significance, such as rainforest. (See also Recommendation 2015 REG7).

Rationale: Snig track cording (small logs) used at one crossing had not been removed from the adjacent rainforest and rainforest buffer following harvesting. The auditor considers the retained cording will likely inhibit rainforest species from recolonising along the snig track for an extended period of time and negatively impact on the site's provision of natural understorey habitat structures.

Priority: Medium

6.2 Recommendations for DELWP

Recommendation 2015 REG1: It is recommended that DELWP provides additional guidance on the requirements to look for and protect any recognised 'rare' species that may be associated with or impacted by timber harvesting operations; and where they are not listed in the MSPs, to seek management guidance from DELWP.

Rationale: At one coupe VicForests' search of the VBA showed known locations within the coupe of two plants listed as 'rare' under the DELWP Advisory List and the Central Highlands Forest Management Plan (Forest Sedge - *Carex alsophila*; and Baw Baw Berry - *Wittsteinia vacciniacea*). However, there were no records of on-ground searches being conducted for these species by VicForests. VicForests advised the auditor that protective measures were not prescribed in the FCP because the species were not listed in the MSPs as requiring special protection. This may not be consistent with the intent of the "precautionary principle" outlined in section 2.2.2.2 of the 2014 Code, but recommends DELWP considers providing further regulatory guidance.

Priority: Low

Recommendation 2015 REG2: It is recommended that DELWP completes work to review, update and revise the current MSPs and Central Highlands Forest Management Plan to meet the intent of both 2014 REG 5 and 2014 REG 7.

Rationale: The 2014 MSPs were created to consolidate the prescriptions contained in various documents including FFG Action Statements and Forest Management Plans. However, the prescriptions in the MSPs still contain the limitations of the Central Highlands Forest Management Plan (also highlighted in the 2014 audit report). The auditor understands that DELWP has made some progress in its review of the Central Highlands Forest Management Plan to address these recommendations but further work is required to ensure an appropriate level of regulatory guidance. The audit also noted that some species listed as 'rare' in the DELWP Advisory List have been included in the MSPs and some have not, and the rationale for inclusion or exclusion is not evident.

The management recommendations for both species in the Central Highlands Forest Management Plan infer that because the species occur in riparian areas timber harvesting is not considered a threat to their respective habitats. However, by necessity road and waterway crossing construction require the removal of vegetation and topsoil within riparian areas at crossing points.

The *Environmental Audit – Forest Audit Program 2014* made two recommendations relevant to this finding: REG5 and REG7 copied below:

Recommendation 2014REG5 – It is recommended that the Central Highlands FMP be updated to:

- Ensure that Appendix J and K include all current FFG listed taxa and threatened taxa on the DEPI Advisory List, including but not limited to, VBA entries since 1995;
- Update the conservation status of all taxa in Appendix J and K to reflect the DEPI Advisory list and/or the EPBC Advisory list; and

- Update the management prescriptions to align conservation efforts with current conservation significance status.

Rationale: The auditor notes that Appendix J of the Central Highlands FMP was compiled in 1998. The Flora Information System (FIS) database (1995) is cited as the source for records. The FIS has been superseded by the Victorian Biodiversity Atlas. The conservation status of some of the flora listed has since been revised, for example, Crimson Spider Orchid (*Caladenia concolor*) is listed in Appendix J as vulnerable at a State level. The conservation status of this species has been elevated to Endangered at a State level, it is now also listed as Vulnerable at a Federal level. There are other, similar examples, including (but not limited to) Tree Geebung (*Persoonia arborea*) elevated to Vulnerable at a State level, and Slender Tree-fern (*Cyathea cunninghamii*) also elevated to Vulnerable conservation status at a State level. The conservation status, and the data source, of flora identified in Appendix J are now out-dated.

Similarly, the auditor identified outdated data in Appendix K of the Central Highlands FMP. Discrepancies include that the conservation status of Smoky Mouse (*Pseudomys fumeus*) has changed to being Endangered at a Federal level, FFG-listed, and Near Threatened at State level; but shown in Appendix K as Vulnerable.

Furthermore, the Code requires that “*Forest management planning and all forestry operations must comply with measures specified in relevant Flora and Fauna Guarantee Action Statements and Flora and Fauna Guarantee Orders.*” The auditor notes that Action Statements or Guarantee Orders have not yet been developed for many threatened species. In the absence of Action Statements, the management prescriptions in the FMP need to be reviewed and amended to ensure they are adequate and current - to reflect the current conservation significance status of each species.

The auditor notes that VicForests and DEPI Forestry Services may need to reassess the suitability of their on-ground species detection methodologies to ensure they are appropriate for detection of all target species. Changes required may include additional training; more targeted field methodologies; searching by specialists; and seasonal searches.

Recommendation 2014REG7 - It is recommended that management prescriptions for the protection of threatened flora within riparian zones be reviewed to better manage potential impacts associated with construction of waterway crossings.

Rationale: The management prescriptions for significant flora outlined in Appendix J of the Central Highlands FMP apply to harvesting operations without giving due consideration to roading operations. In particular, the Central Highlands FMP does not specify management actions for species that grow in riparian areas, as it states they are adequately protected by waterway buffers and filters prescribed by the Code. The auditor notes however that roads do impact riparian zones at crossings.

The 2014 MSPs were created to consolidate the prescriptions contained in various documents including FFG Action Statements and Forest Management Plans. However the prescriptions in the MSPs still contain the limitations of the Central Highlands Forest Management Plan. The auditor understands that DELWP has made some progress in its review of the Central Highlands Forest Management Plan to address these recommendations.

Priority: Medium

Recommendation 2015 REG3: It is recommended that DELWP ensures that all values are defined in a manner that facilitates VicForests and auditors to identify and assess them in a less subjective manner (e.g. ‘rich reptile and amphibian sites’ and ‘significant fish’).

Rationale: The auditor notes also that the MSPs contain prescriptions for ‘catch-all’ generic values that are not defined elsewhere (e.g. ‘rich reptile and amphibian sites’ and ‘significant fish’). These values are unlikely to be listed in the VBA and it is unlikely that VicForests’ GIS-based desktop search process for ecological values would result in a positive record and incorporation of the requisite prescriptions in the coupe management procedures.

Priority: Medium

Recommendation 2015 REG4: It is recommended that DELWP considers whether prescriptions similar to the higher environmental standard established for the protection of the Spotted Tree Frog would be appropriate for other rare or threatened species that may also be susceptible to poor water quality associated with sedimentation.

Rationale: The auditor considers that the regulatory framework does not adequately provide prescriptions or guidance for the protection of rare or threatened species of fish and aquatic fauna at waterway crossings. Table 14 of the MSPs provides prescriptions for rare or threatened species, however with the exception of Spotted Tree Frog, relevant prescriptions are limited to avoiding or minimising crossings and establishing wider buffers. Examples include Barred Galaxias (minimise stream crossings); Alpine Stonefly (30 and 50 m buffers on permanent streams and 15 m filter strips); Mallacoota Burrowing Crayfish (100 m buffers and avoid stream crossings); Narracan Burrowing Crayfish (avoid stream crossings); Mountain Galaxias (minimise stream crossings). In comparison the prescriptions for management of crossings in Spotted Tree Frog catchments, in the event that crossings cannot be avoided, include detailed prescriptions for culvert design aimed at minimising risk to habitat. Spotted Tree Frog prescriptions include designing the crossing to a one in fifty year flow; construction of rock armoured overflow sections to allow overtopping without road washouts; a minimum pipe diameter; diversion drains and discharge dissipation features; and the use of excavators for construction.

Priority: Medium

Recommendation 2015 REG5: It is recommended that DELWP expands Recommendation REG9 from the 2014 Forest Audit to include appropriate crossing designs for the range of fish and aquatic fauna that are known or expected to occur in areas managed for timber production.

Rationale: The audit team's search of the VBA for the general area in which the audited coupes were located showed records for a range threatened aquatic fauna including *Canthocamptus* spp. (small aquatic crustaceans), caddisfly, several species of endangered crayfish, Alpine Bog Skink, three Galaxias species and a number of frogs and toadlets¹³. Furthermore, the auditor notes that the intent of the Code is to minimise disruption to the passage of all aquatic fauna, not just rare or threatened species.

The *Environmental Audit – Forest Audit Program 2014* made recommendations in relation to the specific design of waterway crossings for the native fish most often found in harvesting areas: REG9, which is copied below.

Recommendation 2014 REG9 – It is recommended that DEPI reviews the requirements for road crossings of waterways and provides guidance relating to movement of native fish through crossing structures.

Rationale: Standard culverts are likely to present barriers for native fish species most often found in catchment headwaters. Appropriate crossing designs and structures can reduce these barriers, enabling natural migration cycles of native fish to continue. Culvert discharges at three coupes were found to be non-compliant as they project above the bed of the stream in a way that is likely to inhibit the passage of native fish. The EIA risk ratings were assessed as Major for one coupe with a permanent road and Moderate for two coupes with temporary roads. In all three cases, the stream beds were on gradients and of variable terrain such that installation of culverts without suspended outlets would require considerable excavation or result in significant acceleration of water flow. In these cases, a crossing type other than a conventional culvert is likely to be more appropriate.

¹³ Approximately 180 square kilometres bounded approximately by Taggerty, Buxton and Woods Point and including Narbethong and Marysville; and another area of approximately 120 square kilometres incorporating Mt Baw Baw, Toorong and Noojee.

This work would include a review of the lifecycle, habitat and migration requirements of all fish and aquatic fauna species throughout all Forest Management Areas to provide recommendations or prescriptions for crossing designs that meet the needs of the indigenous species.

Priority: High

Recommendation 2015 REG6: It is recommended that DELWP includes additional guidance in the regulatory framework to encourage the adoption of appropriate measures to prevent the streambed eroding after construction of waterway crossings and ensure that pipes do not become suspended above the streambed (inhibiting the passage of fish and other aquatic fauna).

Rationale: Ten of the fourteen culverts assessed had the outlet projecting above the bed of the waterway in a manner that creates a 'step' or 'waterfall' effect. In four cases the auditor considers that the step is likely to significantly inhibit the passage of aquatic fauna. It appeared that the pipes may have originally been aligned with the streambed, but the undercutting action of the streamflow at the pipe outlet had eroded the streambed to a lower level over time. A similar case was also reported on in the 2014 audit report and DELWP indicated in its response to the 2014 audit report that this issue will be addressed in the next review of the Code. The high frequency of this type of occurrence suggests a need for addressing this as a systemic issue and a recommendation has also been provided for VicForests. The auditor considers that rock-armouring the streambed at the culvert outflow would reduce the likelihood of a step developing.

Priority: High

Recommendation 2015 REG7: It is recommended that DELWP provides additional guidance or prescriptions for the removal of cording in streamside buffers and waterway crossings after harvesting is complete to minimise impacts on regeneration and avoid damage to retained vegetation and soils.

Rationale: Snig track cording (small logs) used at one coupe had not been removed from the adjacent rainforest and rainforest buffer, which the auditor considers will likely inhibit rainforest species from recolonising along the snig track for an extended period of time and negatively impact on the site's provision of natural understorey habitat structures. The MSPs (section 7.2.2.4) require that cording is aerated in preparation for burning, however there are no prescriptions for removal of cording in areas that cannot be burnt, such as snig tracks through buffers.

Priority: Medium



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Appendix A

Audit Criteria



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Code reference	Ref	Code Prescription	Criteria Source	Sub Ref	Audit Criteria F=Field; D=Desktop	Audit Findings	Compliance Full/Partial/No	EIA Risk Rating
2.2 Environmental Values in State forests 2.2.1 Water Quality, River Health and Soil Protection	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 (MSP).	MSP 3.1.1.1	1.1	Where crossings are planned or have been constructed, in the auditor's professional opinion waterways have been classified in accordance with the Code as: a) Permanent streams, pools and wetlands b) Temporary streams c) Drainage lines			
2.2 Environmental Values in State forests 2.2.1 Water Quality, River Health and Soil Protection <i>Protecting waterways and aquatic and riparian habitat</i>	2	2.2.1.5 Where practical exclude roads and snig tracks from aquatic and riparian habitats.	Auditor	2.1	Roads have been excluded from aquatic and riparian habitats; or If roads have not been excluded from aquatic and riparian habitat, in the auditor's professional opinion, it was not practical to avoid it.			
			Auditor	2.2	Snig tracks have been excluded from aquatic and riparian habitats; or If snig tracks have not been excluded from aquatic and riparian habitat, in the auditor's professional opinion, it was not practical to avoid it.			



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Code reference	Ref	Code Prescription	Criteria Source	Sub Ref	Audit Criteria F=Field; D=Desktop	Audit Findings	Compliance Full/Partial/No	EIA Risk Rating
2.4 Roading for Timber Harvesting Operations 2.4.1 Road Planning	3	2.4.1.3 Road planning must: - 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 - 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.	Auditor	3.1	Road planning included sound desktop searches for known and potential environmentally sensitive locations of rare or threatened flora, fauna, vegetation communities, cultural heritage sites and special water supply catchments, using all reasonably available data.			
			Auditor	3.2	Forest Coupe Plan prescriptions to protect identified values are consistent with prescriptions in the MSPs.			
			Auditor	3.3	Forest Coupe Plan prescriptions to protect identified values have been implemented in the field.			



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Code reference	Ref	Code Prescription	Criteria Source	Sub Ref	Audit Criteria F=Field; D=Desktop	Audit Findings	Compliance Full/Partial/No	EIA Risk Rating
	3 cont.	Continued: 2.4.1.3 Road planning must: - 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 - 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.	Auditor	3.4	Soil erosion hazard and water quality risk were assessed in accordance with Section 3.2 of the MSPs.			
			Auditor	3.5	In the professional opinion of the auditor, VicForests' assessment of soil erosion hazard appears to be consistent with field observations of behaviour of exposed soil.			
			Auditor	3.6	Road planning included reasonable consideration of timing to ensure that risks associated with unsuitable weather conditions were minimised.			



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Code reference	Ref	Code Prescription	Criteria Source	Sub Ref	Audit Criteria F=Field; D=Desktop	Audit Findings	Compliance Full/Partial/No	EIA Risk Rating
	3 cont.	Continued: 2.4.1.3 Road planning must: - 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	Auditor, MSP 6.2.1.1	3.7	Waterway crossings were constructed when rainfall and soil conditions minimised the risk of erosion and impact on water quality.			
		- 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.	Auditor	3.8	Construction of waterway crossings has been completed to the required standard in advance of timber harvesting operations.			



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Code reference	Ref	Code Prescription	Criteria Source	Sub Ref	Audit Criteria F=Field; D=Desktop	Audit Findings	Compliance Full/Partial/No	EIA Risk Rating
2.4 Roading for Timber Harvesting Operations 2.4.1 Road Planning	4	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.	Auditor	4.1	In the professional opinion of the auditor, appropriate field surveys have been undertaken at waterway crossing points to identify environmentally sensitive values.			
			Auditor	4.2	In the professional opinion of the auditor, appropriate design and construction techniques have been used to protect identified environmentally sensitive values.			
2.2 Environmental Values in State forests 2.2.1 Water Quality, River Health and Soil Protection <i>Protecting waterways and</i>	5	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.	MSP 6.1.2.4, App 4 Table 20 Auditor	5.1	Clearing width at waterway crossing does not significantly exceed minimum prescribed clearing widths (MSP App 4 Table 20) or clearing widths specified in Forest Coupe Plan, whichever is less.			



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Code reference	Ref	Code Prescription	Criteria Source	Sub Ref	Audit Criteria F=Field; D=Desktop	Audit Findings	Compliance Full/Partial/No	EIA Risk Rating
<i>aquatic and riparian habitat</i>	5 cont.	Continued: 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.	Code, Table 9	5.2	The prescribed minimum buffer or filter widths have been retained adjacent to the waterway crossing.			
			MSP 6.2.5 Culverts MSP 6.2.5.9	5.3	On permanent streams where the culvert is greater than 750mm diameter, a fish ladder has been included.			
			MSP 6.2.5.11	5.4	Culverts do not project above the bed of the waterway in a way that may prevent the passage of aquatic fauna, in the auditor's professional opinion.			
			MSP 6.2.6 Bridges MSP 6.2.6.2	5.5	Bridges have been designed to prevent constriction of any clearly defined channel, in the auditor's professional opinion.			



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Code reference	Ref	Code Prescription	Criteria Source	Sub Ref	Audit Criteria F=Field; D=Desktop	Audit Findings	Compliance Full/Partial/No	EIA Risk Rating
	5 cont.	Continued: 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.	MSP 6.2.6.3	5.6	Earth borrow for bridges has been sourced from outside waterway buffers.			
			MSP 6.2.6.4	5.7	Excavations, sills, abutments, stringers and girders of bridges are made or placed above the high water mark of the stream, wetland or drainage line.			
			MSP 6.2.6.6	5.8	Temporary crossings to carry machinery during bridge construction have only been constructed where the bed of the stream, wetland or drainage line is capable of bearing the weight of that machinery without being damaged.			
			Auditor	5.9	Documented evidence of the assessment by a qualified person of capability of the bed to bear the weight of the machinery without being damaged exists.			



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Code reference	Ref	Code Prescription	Criteria Source	Sub Ref	Audit Criteria F=Field; D=Desktop	Audit Findings	Compliance Full/Partial/No	EIA Risk Rating
	5 cont.	Continued: 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.	Auditor	5.10	There is no visible evidence of damage to the bed of the stream.			
			MSP 6.2.6.7	5.11	Temporary crossings to carry machinery during bridge construction: a) Included a corduroy crossing of logs; b) Were adequately drained, along with any access tracks, when construction was complete; and c) Were removed and rehabilitated on completion of works.			
			Auditor	5.12	In the auditor's professional opinion, habitat damage at the waterway crossing has been minimised.			
			MSP 6.2.2.1	5.13	Fill batter does not cover the base of live trees.			
			MSP 6.2.2.2	5.14	If mulch has been used in batter rehabilitation works of waterway crossings, only clean and weed free mulch has been used.			



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Code reference	Ref	Code Prescription	Criteria Source	Sub Ref	Audit Criteria F=Field; D=Desktop	Audit Findings	Compliance Full/Partial/No	EIA Risk Rating
	5 cont.	Continued: 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.	MSP 6.2.2.3	5.15	Fill batters have been mechanically consolidated using engineer approved methods.			
			Auditor	5.16	In the auditor's professional opinion, constriction to stream flow at the waterway crossing has been minimised.			
			Auditor	5.17	In the auditor's professional opinion, barriers to fish and other aquatic fauna have been minimised.			
			MSP 6.2.7 Fords MSP 6.2.7.1	5.18	The base and entry points of fords are constructed of rock, concrete, heavy timber or other erosion-resistant material.			
			MSP 6.2.7.2	5.19	In the auditor's professional opinion, Fords are only as wide as the crossing place will allow (excavation has not occurred to widen the crossing place).			



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Code reference	Ref	Code Prescription	Criteria Source	Sub Ref	Audit Criteria F=Field; D=Desktop	Audit Findings	Compliance Full/Partial/No	EIA Risk Rating
			MSP 6.2.7.3	5.20	In the auditor's professional opinion, Fords do not project above the bed of a waterway in a way that may prevent the passage of aquatic fauna.			
2.2 Environmental Values in State forests 2.2.1 Water Quality, River Health and Soil Protection <i>Protecting waterways and aquatic and riparian habitat</i>	6	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.	MSP 6.4.1.1	6.1	In the auditor's professional opinion, temporary crossings have been removed as soon as possible upon completion of harvesting (where they are not required for subsequent regeneration work).			
			MSP 6.4.1.1	6.2	Where the temporary crossing is required for regeneration works, and these have been undertaken, in the auditor's professional opinion temporary crossings have been removed as soon as possible after regeneration works (review regeneration timeframes and what works require crossings).			
			MSP 6.4.1.2	6.3	The approaches to bridges, culverts and log fill crossings have been removed and drained to restrict soil movement into waterways.			



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Code reference	Ref	Code Prescription	Criteria Source	Sub Ref	Audit Criteria F=Field; D=Desktop	Audit Findings	Compliance Full/Partial/No	EIA Risk Rating
	6 cont.	Continued: 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.	Auditor	6.4	In the auditor's professional opinion, temporary crossings were removed using a technique that has minimised soil and habitat disturbance.			
			Auditor	6.5	In the auditor's professional opinion, soil and habitat disturbance visually appear to have been minimised (there has been no obvious movement of soil into the waterway associated with the removal of the crossing; or where soil movement has occurred, in the auditor's professional opinion, it has been minimised).			



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Code reference	Ref	Code Prescription	Criteria Source	Sub Ref	Audit Criteria F=Field; D=Desktop	Audit Findings	Compliance Full/Partial/No	EIA Risk Rating
2.4 Roading for Timber Harvesting Operations 2.4.2 Road Design	7	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.	MSP 6.2.5.7	7.1	Culverts to be constructed of concrete have been designed to 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 <i>Installation of Steel-Reinforced Concrete Drainage Pipelines</i> , Concrete Pipe Association of Australasia.			
			MSP 6.2.5.8	7.2	Culverts to be constructed of a material other than concrete have been designed to have a minimum cover over the pipe as recommended in the manufacturer's specifications. (Note during audit: how readily accessible are these specifications, for transparency/clarity of information during planning and construction?)			



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Code reference	Ref	Code Prescription	Criteria Source	Sub Ref	Audit Criteria F=Field; D=Desktop	Audit Findings	Compliance Full/Partial/No	EIA Risk Rating
	7 cont.	Continued: 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.	MSP 6.2.6 Bridges 6.2.6.1	7.3	Bridges have been designed in accordance with the <i>DSE Bridge Policy 2007</i> .			
			Auditor	7.4	Crossings have been designed according to the foreseeable (ref Code 2.2.1.12) traffic requirements.			
			MSP 6.2.5.3	7.5	Culverts have been designed to withstand a 1 in 10 year rainfall event.			
			Auditor (Code 2.4.2.4)	7.6	Crossings have been designed according to the nature, size and period of pre-harvest flow.			



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Code reference	Ref	Code Prescription	Criteria Source	Sub Ref	Audit Criteria F=Field; D=Desktop	Audit Findings	Compliance Full/Partial/No	EIA Risk Rating
	7 cont.	Continued: 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.	Auditor (Code 2.4.2.4)	7.7	Crossings have been designed according to the nature, size and period of anticipated post-harvest flow.			
			Auditor (Code 2.4.2.4)	7.8	Crossings have been designed according to the characteristics of the bed and banks of the stream.			



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Code reference	Ref	Code Prescription	Criteria Source	Sub Ref	Audit Criteria F=Field; D=Desktop	Audit Findings	Compliance Full/Partial/No	EIA Risk Rating
2.2 Environmental Values in State forests 2.2.1 Water Quality, River Health and Soil Protection <i>Minimising water pollution</i>	8	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. Design element is addressed by Code prescription 2.4.2.4	MSP 6.2.5.7	8.1	Culverts 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 <i>Installation of Steel-Reinforced Concrete Drainage Pipelines</i> , Concrete Pipe Association of Australasia.			
			MSP 6.2.5.8	8.2	Culverts constructed of a material other than concrete have a minimum cover over the pipe as recommended in the manufacturer's specifications.			
			MSP 6.2.6 Bridges 6.2.6.1	8.3	Documented evidence exists that Bridges have been certified by a qualified engineer as having been constructed in accordance with the <i>DSE Bridge Policy 2007</i> .			
			MSP 6.2.4.5	8.4	Drainage structures [in roads approaching waterway crossings] have been placed approximately 20 m from permanent or temporary streams, to allow discharge onto undisturbed			



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Code reference	Ref	Code Prescription	Criteria Source	Sub Ref	Audit Criteria F=Field; D=Desktop	Audit Findings	Compliance Full/Partial/No	EIA Risk Rating
	8 cont.	Continued: 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. Design element is addressed by Code prescription 2.4.2.4			vegetation and to maximise the flow distance between the drainage outlet and the waterway.			
			MSP 6.2.4.6 [and MSP 6.2.4.7 (d)]	8.5	Within 20 m of a permanent or temporary stream; a) Crown or cross fall techniques have been used to drain roads into undisturbed vegetation; or b) Drainage [e.g. from table drains] has been passed through an appropriate sediment control structure such as a sediment pond or silt trap before entering a permanent or temporary stream.			
			Auditor	8.6	In the professional opinion of the auditor, the sediment ponds or silt traps installed to drain roads within 20 m of waterway crossing have been, and continue to be, working effectively.			



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Code reference	Ref	Code Prescription	Criteria Source	Sub Ref	Audit Criteria F=Field; D=Desktop	Audit Findings	Compliance Full/Partial/No	EIA Risk Rating
	8 cont.	Continued: 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. Design element is addressed by Code prescription 2.4.2.4	MSP 6.2.5.5	8.7	On drainage lines, stream and river crossings, sandbags, timber, concrete or rock has been placed at the end of the head of the culvert and at the point of discharge to hold the culvert in place and protect it from erosion.			
			MSP 6.2.5.10	8.8	In the auditor's professional opinion, the fill face upstream and downstream of a culvert has been protected in a way that prevents erosion.			
			MSP 6.2.5.12	8.9	Where culvert construction diverts water from its natural course, the water has been returned to its natural course over a flume, rock spill, or other hard surface.			
			MSP 6.2.6.5	8.10	Bridges have been protected from erosion by use of natural groundcover, a retaining wall, a bulkhead or a rock surface.			
			Auditor	8.11	Waterway crossings have been constructed to withstand foreseeable rainfall events. [Refer to 7.5 – 1 in 10 year rainfall event; 7.6 pre-harvest flow; 7.7 post-harvest flow]			



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Code reference	Ref	Code Prescription	Criteria Source	Sub Ref	Audit Criteria F=Field; D=Desktop	Audit Findings	Compliance Full/Partial/No	EIA Risk Rating
	8 cont.	Continued: 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. Design element is addressed by Code prescription 2.4.2.4	Auditor	8.12	Waterway crossings have been constructed to withstand foreseeable traffic conditions. [Refer to 7.4 – design]			
			Auditor	8.13	Waterway crossings have been constructed to protect water quality.			
			Auditor	8.14	Waterway crossings have been maintained to withstand foreseeable rainfall events.			
			Auditor	8.15	Waterway crossings have been maintained to withstand foreseeable traffic conditions.			
			Auditor	8.16	Waterway crossings have been maintained to protect water quality.			
2.4 Roading for Timber Harvesting Operations 2.4.2 Road Design	9	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.	Auditor	9.1	Materials or techniques with low sediment generating potential have been applied to the road area on bridge approaches and on unsurfaced bridges or culverts, when crossing permanent or temporary streams.			



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Code reference	Ref	Code Prescription	Criteria Source	Sub Ref	Audit Criteria F=Field; D=Desktop	Audit Findings	Compliance Full/Partial/No	EIA Risk Rating
2.5 Timber Harvesting 2.5.1 Coupe Management - Timber harvesting operations within areas that are not available for harvesting	10	2.5.1.5 Timber harvesting operations (excluding haulage on existing or approved roads) are not permitted in special protection zones, buffers, or other exclusion areas identified on the Forest Coupe Plan, except where: i. the removal of a limited number of trees is necessary for the construction and use of stream crossings or for river health.	Auditor	10.1	Timber harvesting operations conducted within an exclusion area at waterway crossings are limited to the removal of a limited number of trees as necessary, in the auditor's professional opinion, for the construction and use of the stream crossings or for river health.			



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Appendix B

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Appendix C

Environmental Impact Assessment Tool

The following approach should be adopted by the environmental auditor during assessment of the environmental impact of a non-compliance. DELWP should be consulted and must endorse any variation to this approach.

Assessment of environmental impact may include actual impact that is observed by the audit team and/ or the potential (likely) impact that would be reasonably expected to result (flow on) from any non-compliance with a mandatory compliance obligation.

Environmental impact assessment is a three step process

STEP 1: CALCULATE ENVIRONMENTAL RISK

In this context, risk is a function of the consequence of the impact on the environment, and the likelihood of the environment recovering from the impact.

Arithmetically the environmental risk = consequence + likelihood of recovery

The environmental risk of an impact for the purpose of the audit has three variables:

- 1) Extent (size) of impact (observed or the potential impact) which is one consequence;
- 2) Duration of the impact (observed or the potential impact) which is also a consequence; and
- 3) Likelihood of recovery which relates to the ability of the forest to recover from the impact (observed or the potential impact).

Score each element from Tables 1 - 3 and then add them together to create the environmental risk score.

Arithmetically: **Environmental risk score = Extent (size) of impact + Duration of impact + Likelihood of recovery**

Example (i): If the impact covers 30% of the area being assessed, the duration of the impact is short-term (0-12 months) and it is likely that the forest will mostly recover then:

Environmental risk = 3 + 1 + 2 = 6

Table 1: Extent of Impact

Extent of impact	Score
<ul style="list-style-type: none"> 0-10% of the authorised harvesting area 	1
<ul style="list-style-type: none"> 11-25% of the authorised harvesting area 	2
<ul style="list-style-type: none"> 26-50% of the authorised harvesting area 	3
<ul style="list-style-type: none"> >50% of the authorised harvesting area 	4
<ul style="list-style-type: none"> Impact extends 0-10m outside authorised harvesting area Involves disturbance or harvesting of small area (0-10 m) within the authorised harvesting area that should have been excluded from harvesting under regulatory rules (e.g. threatened species habitat or rainforest) 	5
<ul style="list-style-type: none"> Impact extends 10-100m outside harvesting area Involves disturbance or harvesting of moderate area (10-100 m) 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 (10-100 m) of authorised harvesting area that should have been protected 	6
<ul style="list-style-type: none"> 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

Table 2: Consequence Score for Duration of Impact

Duration of impact	Score
0-12 months (short term)	1
12-36 months (medium term)	2
> 3 years (long term)	3

Table 3: Likelihood score for ability of forest to recover from impact

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

Minimum environmental risk score for a non-compliance = 3

Maximum environmental risk score for a non-compliance = 14

STEP 2: SCORE THE “SIGNIFICANCE” OF THE NON-COMPLIANCE TO DETERMINE THE TOTAL ENVIRONMENTAL IMPACT SCORE

Once the environmental risk score has been calculated in step 1, the “significance” of the non-compliance (actual or potential impact) needs to be determined.

The environmental asset values impacted should be considered and scored using Table 4 to ascertain the significance of the environmental impact.

Table 4: Asset value score

Asset	Score
General Forest	1
Filters	2
Landscape Buffers, Representative Special Protection Zone (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

The total environmental impact is calculated by combining the environmental risk and asset value scores

Minimum total environmental impact score = 4

Maximum total environmental impact score = 18

Example (ii): The environmental risk score calculated in example (i) was equal to 6.
 The impact described in example (i) happened to occur in a landscape buffer (score 3).
 Total environmental impact = 6 + 3 = 9

STEP 3 – ASSIGN AN ENVIRONMENTAL IMPACT ASSESSMENT (EIA) RANKING

The final step is to determine the overall impact using the value ranges in Table 5.

Table 5: Overall environmental impact for non-compliance

Environmental impact	Environmental Impact Score Range
Negligible	4-5
Minor	6-7
Moderate	8-10
Major	11-14
Severe	15-18

Example (iii): The environmental impact score calculated in Example (ii) was equal to 9. Therefore, the impact of the non-compliance in this example is 'Moderate'.

Hypothetical Examples

Compliance Element/ Sub-element	Breach	Extent	Duration	Likelihood of recovery	Asset value	Assessed impact
Coupe planning	<i>Note: Where no actual impact has occurred due to a non-compliance (such as through a failure of planning), the auditor will need to consider the potential (expected) level of impact that would have likely occurred if the operation had proceeded as planned.</i>					
Coupe planning	Small area (0-10m) of threatened species habitat not protected (area marked for harvest) – So likely impact is that would have been harvested	Small area of authorised harvesting area that should have been protected (5)	Likely > 3 years (3)	Mostly recover (2)	Relates to a protected forest value (4)	Score: 14 Major
Landscape values	No landscape buffer is applied along a major tourist road/route	Offsite 10-100m (6)	> 3 years (3)	Mostly recover (2)	Landscape Buffer (3)	Score: 14 Major
Water yield protection	Harvesting in a small proportion of coupe occurred outside the prescribed period	0-10% of coupe (1)	0-12 months (1)	Fully recover (1)	Riparian Buffer (4)	Score: 7 Minor
Log landings and dumps	Ripping depth <0.4m and erosion	Offsite 0-10m (5)	> 3 years (3)	Mostly recover (2)	Filter (2)	Score: 13 Major
Camp maintenance areas	Hydrocarbon (oil) spills/contamination	26-50% (3)	> 3 years (3)	Mostly recover (2)	General (1)	Score: 9 Moderate
Litter removal	Esky or minor litter left on site	0-10%(1)	> 3 years (3)	Mostly recover (2)	General (1)	Score: 7 Minor
Habitat trees	Insufficient numbers protected in coupe	> 50% (4)	> 3 years (3)	Partially recover (3)	General (1)	Score: 11 Major



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Compliance Element/ Sub-element	Breach	Extent	Duration	Likelihood of recovery	Asset value	Assessed impact
Management of exclusion areas and boundaries – flora and fauna	Example 1: Fire damage to rainforest outside the prescribed burn area	> 50% (4)	> 3 years (3)	Never recover (4)	SPZ – rainforest (4)	Score: 15 Severe
	Example 2: Fire damage outside the prescribed burn area (filter strip)	26-50% (3)	12-36 months (2)	Mostly recover (2)	Filter (2)	Score: 9 Moderate
	Example 3: Fire damage outside the prescribed burn area (escapes 100 m into general forest outside containment line)	Offsite 10-100m (6)	0-12 months (1)	Mostly recover (2)	General (1)	Score: 10 Moderate
Reserved area protection - buffers	50m section of buffer of insufficient width. Adjacent area has been harvested.	11-25% (2)	> 3 years (3)	Mostly recover (2)	Riparian Buffer (4)	Score: 11 Major
Reserved area protection – National Park	Machinery tracks 200m into a National Park	Offsite >100m (7)	12-36 months (2)	Mostly recover (2)	National Park (4)	Score: 15 Severe
Reserved area protection - filters	Machinery entry into filter strip	0-10% (1)	0-12 months (1)	Fully recover (1)	Filter (2)	Score: 5 Negligible
Snig and forwarding tracks	Poor drainage requires blading off of track	11-25% (2)	12-36 months (2)	Mostly recover (2)	General (1)	Score: 7 Minor
Boundary tracks	Inadequate drainage	26-50% (3)	> 3 years (3)	Mostly recover (2)	General (1)	Score: 9 Moderate
Roading	Section of in-coupe road damaged due to inappropriate use during wet weather. No offsite impact evident.	11-25% (2)	> 3 years (3)	Mostly recover (2)	General (1)	Score: 8 Moderate



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Appendix D

Areas of Non-compliance

Code Prescription 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 (MSP).

Coupe Name	Description of Non-compliance	EIA Risk Rating
Magnum	(1.1) There was no documentation of the stream classification in the FCP.	No impact
Ruger	(1.1) There was no documentation of the stream classification in the FCP.	No impact

Code Prescription 3

2.4.1.3 Road planning must:

- 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
- 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.

Coupe Name	Description of Non-compliance	EIA Risk Rating
Systemic	(3.1) Road planning did not include sound desktop searches for known and potential environmentally sensitive locations of rare or threatened flora, fauna or vegetation communities. VicForests undertook desktop searches within the coupes and within 500 m of the coupe and had recently changed its practices to search within 1 km of the crossing point. However these search distances are significantly less than the 5 km used as a minimum by other professional users of the VBA as common practice in order to help mitigate weaknesses in the databases.	Minor
Alstergrens Road	(3.6) Road planning did not minimise risks associated with unsuitable weather conditions. Construction commenced in April, rainfall and Thomson catchment closure necessitated extraction of contractors before completion of crossing. (3.7) Crossing remained incomplete over winter. Soil erosion mitigation measures were implemented prior to catchment closure, however at the time of the audit, maintenance of sumps and silt traps was required. (3.8) Crossing construction was not complete before it was used for timber haulage.	Moderate
Turkey Neck	(3.6) Road planning did not minimise risks associated with unsuitable weather conditions. Crossing remained undrained and incomplete for harvesting crew to finish. Crowning and	Moderate



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Coupe Name	Description of Non-compliance	EIA Risk Rating
	<p>table drains were incomplete as a proactive measure by VicForests intended to minimise runoff over winter. Delay in harvest commencement resulted in incomplete crossing over two winters. Maintenance crew constructed cut-off drain resulting in rilling on the crossing embankment and entry of sediment to the waterway.</p> <p>(3.7) Crossing remained incomplete over two winters.</p>	
West Davis Link	<p>(3.4) There are inconsistencies between the soil assessment sheet and the FCP (ie soil assessment permeability H (A horizon), H (B horizon), H (C horizon) but FCP has L (A horizon), M (B horizon), M (C horizon).</p> <p>(3.5) Highly erodible subsoil exposed in road cutting adjacent to waterway crossing, not identified by soil assessment. Subsoil was noted by VicForests during road construction and drainage spacing was adjusted accordingly. At the time of the audit the cut face appeared stable however the areas of fill were more mobile.</p> <p>(3.6) Road planning did not minimise risks associated with unsuitable weather conditions. Road and crossing construction occurred during late April and early May. There were no records or no visual evidence during the audit to suggest that works had been inappropriately undertaken in wet conditions.</p>	<p>Minor</p> <p>See criteria 3.4</p> <p>Negligible</p>
Mosquito	<p>(3.4) There are inconsistencies between the soil assessment sheet and the FCP (ie soil assessment sheet has soil erodibility as Low (A horizon), High (B horizon), whereas roadworks FCP has Low (A horizon), Low (B horizon). No significant erodibility noted at the waterway crossing.</p>	Negligible
Trevor	<p>(3.6) Road planning did not minimise risks associated with unsuitable weather conditions. Road and crossing construction occurred between April and June. There were no records or no visual evidence during the audit to suggest that works had been inappropriately undertaken in wet conditions.</p>	Negligible
Humerus	<p>(3.6) Road planning did not minimise risks associated with unsuitable weather conditions. Road and crossing construction occurred between June and August. There were no records or no visual evidence during the audit to suggest that works had been inappropriately undertaken in wet conditions.</p>	Negligible
Aquaman	<p>(3.4) There was no soil assessment sheet for the coupe, but values were assigned in FCP.</p>	Negligible
Dangermouse	<p>(3.6) Road planning did not minimise risks associated with unsuitable weather conditions. Road and crossing construction occurred in late April. There were no records or</p>	Negligible



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Coupe Name	Description of Non-compliance	EIA Risk Rating
	no visual evidence during the audit to suggest that works had been inappropriately undertaken in wet conditions.	
Germain	(3.2) Special values management prescriptions for operating in a Spotted Tree Frog catchment were not detailed in FCP. (3.3) Prescriptions for operating in a Spotted Tree Frog catchment were not implemented in the field. In particular, the crossing was not designed for a 1 in 50 year rainfall event; and rock armoured overflows to allow overtopping without washouts were not constructed as required.	Major
Ruger	(3.4) There was no soil assessment sheet for the coupe	Negligible
Magnum	(3.4) There was no soil assessment sheet for the coupe.	Negligible

Code Prescription 4

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.

Coupe Name	Description of Non-compliance	EIA Risk Rating
Gazelle	(4.1) Field survey was not conducted at the crossing location for identified rare flora species. Species were listed as 'rare' in Victoria.	Negligible
Aquaman	(4.2) Road construction technique resulted in excessive logs, soil and rocks in the vicinity of the waterway.	Minor

Code Prescription 5

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.

Coupe Name	Description of Non-compliance	EIA Risk Rating
Systemic issue	(5.15) The use of an excavator-mounted sheepsfoot roller for compaction of fill faces has not been approved by an engineer.	Negligible
Alstergrens Road	(5.12) In the auditor's professional opinion, habitat damage at the waterway crossing has not been minimised. Turbid outflow associated with sedimentation observed up to 20 m downstream of crossing (see also criterion 3.6).	See criterion 3.6
Polar	(5.4, 5.17) Culvert projects above the bed of the waterway but due to the location of the crossing in the landscape it is unlikely to prevent the passage of aquatic fauna, in the auditor's professional opinion.	Negligible
Bobs Road	(5.4, 5.17) Two culverts project above the bed of the waterway (~90 mm and ~120 mm respectively) in a way that may prevent the passage of aquatic fauna, in the auditor's professional opinion.	Moderate
Turkey Neck	(5.12) In the auditor's professional opinion, habitat damage at the waterway crossing has not been minimised. Turbid outflow associated with sediment loss observed up to 20 m downstream of crossing (see also 3.6).	See criterion 3.6
Mosquito	(5.3) Culvert pipe larger than 750 mm (900 mm) did not have a fish ladder. (5.4, 5.17) Culvert projects above the bed of the waterway (~100 mm) in a way that may prevent the passage of aquatic fauna, in the auditor's professional opinion.	Moderate Moderate

Coupe Name	Description of Non-compliance	EIA Risk Rating
Gazelle	<p>(5.4, 5.17) Culvert projects above the bed of the waterway (~350 mm) in a way that may prevent the passage of aquatic fauna, in the auditor's professional opinion.</p> <p>(5.12) In the auditor's professional opinion, habitat damage at the waterway crossing has not been minimised. Sediment noted up to 5 m downstream of crossing (see also 8.8).</p>	<p>Moderate</p> <p>See criterion 8.8</p>
Zebra	<p>(5.13) Fill covers the base of live trees.</p> <p>(5.12) In the auditor's professional opinion, habitat damage at the waterway crossing has not been minimised. Sediment noted up to 10 m downstream of crossing (see also 8.4 and 8.8).</p>	<p>Minor</p> <p>See criteria 8.4 and 8.8</p>
Apollo	<p>(5.3) Culvert pipe larger than 750 mm (900 mm) did not have a fish ladder.</p> <p>(5.4, 5.17) Culvert projects above the bed of the waterway in a way that may prevent the passage of aquatic fauna, in the auditor's professional opinion.</p> <p>(5.12) In the auditor's professional opinion, habitat damage at the waterway crossing has not been minimised. Sediment noted up to 10 m downstream of crossing (see also 8.4 and 8.5).</p>	<p>Moderate</p> <p>Moderate</p> <p>See criteria 8.4 and 8.5</p>
Aquaman	<p>(5.4, 5.17) Culvert projects above the bed of the waterway but due to the location of the crossing in the landscape it is unlikely to prevent the passage of aquatic fauna, in the auditor's professional opinion.</p> <p>(5.12) In the auditor's professional opinion, habitat damage at the waterway crossing has not been minimised. Sediment noted up to 10 m downstream of crossing and debris in buffer (see also 4.2, 5.15, 8.5, 8.7, 8.8).</p> <p>(5.13) Fill covers the base of live trees.</p> <p>(5.15) Fill face had not been mechanically consolidated and was eroding around pipe.</p>	<p>Negligible</p> <p>See criteria 4.2, 5.15, 8.5, 8.7, 8.8</p> <p>Minor</p> <p>Minor</p>
Dangermouse	<p>(5.4, 5.17) Culvert projects above the bed of the waterway but due to the location of the crossing in the landscape it is unlikely to prevent the passage of aquatic fauna, in the auditor's professional opinion.</p> <p>(5.12) In the auditor's professional opinion, habitat damage at the waterway crossing has not been minimised. Cording from snig track had been left within the filter.</p> <p>(5.15) Fill face had not been mechanically consolidated and was eroding around pipe.</p>	<p>Negligible</p> <p>Negligible</p> <p>Minor</p>



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Coupe Name	Description of Non-compliance	EIA Risk Rating
Germain	(5.5) Bridge has not been designed to prevent constriction of the channel, in the auditor's professional opinion.	Moderate
Ruger	(5.4, 5.17) Culvert projects above the bed of the waterway but due to the location of the crossing in the landscape it is unlikely to prevent the passage of aquatic fauna, in the auditor's professional opinion. (5.15) Fill face had not been mechanically consolidated and was being eroded by water discharge from pipe outlet.	Negligible Minor
Magnum	(5.4, 5.17) Culvert projects above the bed of the waterway but due to the location of the crossing in the landscape it is unlikely to prevent the passage of aquatic fauna, in the auditor's professional opinion. (5.15) Fill face had not been mechanically consolidated and was being eroded by water discharge from pipe outlet.	Negligible Minor

Code Prescription 6

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.

Coupe Name	Description of Non-compliance	EIA Risk Rating
Trevor	(6.4, 6.5) The technique used to remove the crossing did not minimise habitat disturbance. Removal resulted in cording in the waterway; however, the auditor acknowledges that site access has placed limitations on rehabilitation works at this location.	Negligible
Humerus	(6.4, 6.5) The technique used to remove the crossing did not minimise habitat disturbance. Rehabilitation resulted in cording being left along the snig track through within rainforest and rainforest buffer.	Major
Aheek	(6.3, 6.4, 6.5) The approaches to the crossing had not been drained to restrict soil movement into waterways. Unconsolidated soil had been left at the stream edge and will continue to be a source of sediment into waterway. Track ruts left by excavator lead to edge of waterway, but due to stable soils there is little apparent soil movement from this source.	Moderate

Code Prescription 7

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.



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Coupe Name	Description of Non-compliance	EIA Risk Rating
Systemic	(7.5) (7.6) Records were not kept and/or calculations were not made of one in ten-year rainfall events and the nature, size and period of pre-harvest flows and how they affect culvert design for all but five crossings. Records were available for Alstergrens Road, Aheek, Polar, Apollo (via Hot Rocks roadworks) and Turkey Neck.	Negligible
Systemic	(7.7) The nature, size and period of anticipated post-harvest flow have not been considered in crossing design.	Negligible
Germain	(7.3) The log bridge was not designed in accordance with the DSE Bridge Policy. VicForests did not consider the log bridge snig track crossing to be a bridge; however it spanned from bank to bank unsupported from below. (7.4) There were no records or design specifications to support that the crossing had been designed to withstand foreseeable traffic conditions.	Minor Minor
Zebra	(7.8) Crossing has not been designed according to the bed and bank of the stream. A steep side cut was made through the stream bed in order to balance cut and fill.	Moderate
Trevor	(7.8) Crossing has not been designed according to the bed and bank of the stream. A steep side cut was made through the stream bed in order to balance cut and fill.	Minor
Ruger	(7.8) Crossing has not been designed according to the bed and bank of the stream. A steep side cut was made through the stream bed in order to balance cut and fill.	Minor

Code Prescription 8

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.

Coupe Name	Description of Non-compliance	EIA Risk Rating
Systemic	(8.12) AS1762 (1984) <i>Helical lock-seam corrugated steel pipes – Design and installation</i> requires a check for individual loads from heavy vehicles. There was no evidence that VicForests undertook capacity checks for any of the ten crossings that used steel pipes. VicForests was also unable to provide a copy of the manufacturers' specifications and installation guidelines for the black plastic pipes used in two crossings.	Negligible
Alstergrens Road	(8.4) Drainage structures had not been placed approximately 20 m from the stream to allow discharge onto undisturbed vegetation and to maximise the flow distance between the drainage outlet and the waterway.	Moderate



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Coupe Name	Description of Non-compliance	EIA Risk Rating
	<p>(8.6) Drainage structures (sump and silt trap) within 20 m of the waterway crossing were ineffective, in the professional opinion of the auditor.</p> <p>(8.7) Sandbags, timber, concrete or rock had not been placed at the end of the head of the culvert and at the point of discharge to hold the culvert in place and protect it from erosion.</p> <p>(8.8) In the auditor's professional opinion, the fill face upstream and downstream of the culvert has not been protected in a way that prevents erosion. Fill faces had been covered with topsoil but were being eroded by runoff from road.</p> <p>(8.13) Waterway crossing has not been constructed to protect water quality. Bunds had not been constructed along the road edge to prevent water flowing over the fill faces (see also 8.4, 8.6, 8.7, 8.8).</p> <p>(8.14) Waterway crossing has not been maintained to withstand foreseeable rainfall events. Sump and silt trap failing.</p> <p>(8.16) Waterway crossing has not been maintained to protect water quality. Sump and silt trap failing.</p>	
Makybe Diva	<p>(8.5) Drainage had not been directed either into undisturbed vegetation or an appropriate sediment control structure such as a sediment pond or silt trap before entering the stream.</p> <p>(8.7) Sandbags, timber, concrete or rock had not been placed at the point of discharge to hold the culvert in place and protect it from erosion.</p> <p>(8.8) In the auditor's professional opinion, the fill face upstream and downstream of the culvert has not been protected in a way that prevents erosion.</p> <p>(8.13) Waterway crossing has not been constructed to protect water quality. Fill faces were not protected from erosion and runoff from road not directed into a sediment control structure before entering the stream (see also 8.5, 8.7, 8.8).</p> <p>(8.14) Waterway crossing has not been maintained to withstand foreseeable rainfall events. Rollover drain on road had failed resulting in water flowing along road and onto fill face at culvert outlet.</p> <p>(8.15) Waterway crossing has not been maintained to withstand foreseeable traffic conditions. Rollover drain on road had failed resulting in water flowing along road and onto fill face at culvert outlet.</p> <p>(8.16) Waterway crossing has not been maintained to protect water quality (see 8.14, 8.15)</p>	Minor
Polar	<p>(8.7) Sandbags, timber, concrete or rock had not been placed at the end of the head of the culvert and at the point of discharge to hold the culvert in place and protect it from erosion.</p>	Negligible



Indufor

Coupe Name	Description of Non-compliance	EIA Risk Rating
	(8.8) In the auditor's professional opinion, the fill face upstream and downstream of the culvert has not been protected in a way that prevents erosion (see 8.7).	
Bobs Road	(8.4) Drainage structures had not been placed approximately 20 m from the stream to allow discharge onto undisturbed vegetation and to maximise the flow distance between the drainage outlet and the waterway.	Negligible
Turkey Neck	<p>(8.5) Drainage had not been directed either into undisturbed vegetation or an appropriate sediment control structure such as a sediment pond or silt trap before entering the stream.</p> <p>(8.7) Sandbags, timber, concrete or rock had not been placed at the end of the head of the culvert and at the point of discharge to hold the culvert in place and protect it from erosion.</p> <p>(8.8) In the auditor's professional opinion, the fill face upstream and downstream of the culvert has not been protected in a way that prevents erosion.</p> <p>(8.9) Water has not been returned to its natural course over a flume, rock spill or other hard surface. Culvert pipe discharges onto unprotected fill.</p> <p>(8.13) Waterway crossing has not been constructed to protect water quality (see 8.5, 8.7, 8.8, 8.9).</p> <p>(8.14) Waterway crossing has not been maintained to withstand foreseeable rainfall events. Unfinished crossing not maintained adequately over winter. Channel dug by maintenance crew to drain pooling water on road surface, but water was directed onto outlet fill face resulting in erosion a channel.</p> <p>(8.16) Waterway crossing has not been maintained to protect water quality (see 8.15).</p>	Moderate
West Davis Link	(8.4) Drainage structures had not been placed approximately 20 m from the stream to allow discharge onto undisturbed vegetation and to maximise the flow distance between the drainage outlet and the waterway, due to the specific site conditions. However to compensate for this, alternative drainage structures (rock beaching) had been established closer to the stream.	Negligible
Mosquito	<p>(8.11) Culvert is on a catchment of over 100 ha. Engineering advice was sought but not implemented as VicForests considered the 2 x 1 200 mm pipes recommended by the engineer would not fit in the narrow streambed. A single 900 mm pipe was used instead. No 1:10 year rainfall event flow calculation records were available from VicForests.</p> <p>(8.4) Drainage structures had not been placed approximately 20 m from the stream to allow discharge onto undisturbed</p>	<p>Minor</p> <p>Minor</p>



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Coupe Name	Description of Non-compliance	EIA Risk Rating
	<p>vegetation and to maximise the flow distance between the drainage outlet and the waterway.</p> <p>(8.8) In the auditor's professional opinion, the fill face upstream and downstream of the culvert has not been protected in a way that prevents erosion.</p> <p>(8.13) Waterway crossing has not been constructed to protect water quality (see 8.4, 8.8).</p> <p>(8.14) Waterway crossing has not been maintained to withstand foreseeable rainfall events. Water was bypassing culvert pipe and turbid water overtopping coir log in table drain.</p> <p>(8.16) Waterway crossing has not been maintained to protect water quality (see 8.14).</p>	
Gazelle	<p>(8.7) Sandbags, timber, concrete or rock had not been placed at the end of the head of the culvert and at the point of discharge to hold the culvert in place and protect it from erosion.</p> <p>(8.8) In the auditor's professional opinion, the fill face upstream and downstream of the culvert has not been protected in a way that prevents erosion.</p> <p>(8.13) Waterway crossing has not been constructed to protect water quality (see 8.8).</p>	Moderate
Zebra	<p>(8.4) Drainage structures had not been placed approximately 20 m from the stream to allow discharge onto undisturbed vegetation and to maximise the flow distance between the drainage outlet and the waterway.</p> <p>(8.7) Sandbags, timber, concrete or rock had not been placed at the end of the head of the culvert and at the point of discharge to hold the culvert in place and protect it from erosion.</p> <p>(8.8) In the auditor's professional opinion, the fill face upstream and downstream of the culvert has not been protected in a way that prevents erosion.</p> <p>(8.9) Water has not been returned to its natural course over a flume, rock spill or other hard surface. Culvert pipe discharges onto unprotected fill.</p> <p>(8.13) Waterway crossing has not been constructed to protect water quality (see 8.4, 8.8, 8.9).</p>	Moderate
Trevor	<p>(8.5) Drainage had not been directed either into undisturbed vegetation or an appropriate sediment control structure such as a sediment pond or silt trap before entering the stream.</p>	Negligible
Humerus	<p>(8.4) Drainage structures had not been placed approximately 20 m from the stream to allow discharge onto undisturbed vegetation and to maximise the flow distance between the drainage outlet and the waterway.</p>	Negligible



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Coupe Name	Description of Non-compliance	EIA Risk Rating
Apollo	<p>(8.4) Drainage structures had not been placed approximately 20 m from the stream to allow discharge onto undisturbed vegetation and to maximise the flow distance between the drainage outlet and the waterway.</p> <p>(8.5) Drainage had not been directed either into undisturbed vegetation or an appropriate sediment control structure such as a sediment pond or silt trap before entering the stream.</p> <p>(8.13) Waterway crossing has not been constructed to protect water quality (see 8.4, 8.5).</p>	Moderate
Aquaman	<p>(8.5) Drainage had not been directed either into undisturbed vegetation or an appropriate sediment control structure such as a sediment pond or silt trap before entering the stream.</p> <p>(8.7) Sandbags, timber, concrete or rock had not been placed at the end of the head of the culvert and at the point of discharge to hold the culvert in place and protect it from erosion.</p> <p>(8.8) In the auditor's professional opinion, the fill face upstream and downstream of the culvert has not been protected in a way that prevents erosion.</p> <p>(8.13) Waterway crossing has not been constructed to protect water quality (see 8.5, 8.7, 8.8).</p>	Moderate
Dangermouse	<p>(8.4) Drainage structures had not been placed approximately 20 m from the stream to allow discharge onto undisturbed vegetation and to maximise the flow distance between the drainage outlet and the waterway.</p> <p>(8.5) Drainage had not been directed either into undisturbed vegetation or an appropriate sediment control structure such as a sediment pond or silt trap before entering the stream.</p> <p>(8.6) Drainage structures (silt trap) within 20 m of the waterway crossing were ineffective, in the professional opinion of the auditor.</p> <p>(8.7) Sandbags, timber, concrete or rock had not been placed at the end of the head of the culvert and at the point of discharge to hold the culvert in place and protect it from erosion.</p> <p>(8.8) In the auditor's professional opinion, the fill face upstream and downstream of the culvert has not been protected in a way that prevents erosion.</p> <p>(8.13) Waterway crossing has not been constructed to protect water quality (see 8.4, 8.5, 8.6, 8.7, 8.8).</p> <p>(8.14) Waterway crossing has not been maintained to withstand foreseeable rainfall events. Turbid water bypassing silt trap as it had become full and was damaged.</p> <p>(8.16) Waterway crossing has not been maintained to protect water quality (see 8.14).</p>	Minor



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Coupe Name	Description of Non-compliance	EIA Risk Rating
Germain	<p>(8.3) The log bridge crossing has not been certified by a qualified engineer as having been constructed in accordance with the <i>DSE Bridge Policy 2007</i>.</p> <p>(8.4) Drainage structures had not been placed approximately 20 m from the stream to allow discharge onto undisturbed vegetation and to maximise the flow distance between the drainage outlet and the waterway.</p> <p>(8.5) Drainage had not been directed either into undisturbed vegetation or an appropriate sediment control structure such as a sediment pond or silt trap before entering the stream.</p>	<p>No impact</p> <p>Negligible</p> <p>Negligible</p>
Ruger	<p>(8.4) Drainage structures had not been placed approximately 20 m from the stream to allow discharge onto undisturbed vegetation and to maximise the flow distance between the drainage outlet and the waterway.</p> <p>(8.7) Sandbags, timber, concrete or rock had not been placed at the end of the head of the culvert and at the point of discharge to hold the culvert in place and protect it from erosion.</p> <p>(8.8) In the auditor's professional opinion, the fill face upstream and downstream of the culvert has not been protected in a way that prevents erosion. Subsoil was not covered.</p> <p>(8.13) Waterway crossing has not been constructed to protect water quality (see 8.4, 8.8).</p>	Minor
Magnum	<p>(8.2) The culvert had less than the minimum cover over the pipe that was recommended in the manufacturer's specifications.</p> <p>(8.4) Drainage structures had not been placed approximately 20 m from the stream to allow discharge onto undisturbed vegetation and to maximise the flow distance between the drainage outlet and the waterway.</p> <p>(8.5) Drainage had not been directed either into undisturbed vegetation or an appropriate sediment control structure such as a sediment pond or silt trap before entering the stream.</p> <p>(8.7) Sandbags, timber, concrete or rock had not been placed at the end of the head of the culvert and at the point of discharge to hold the culvert in place and protect it from erosion.</p> <p>(8.8) In the auditor's professional opinion, the fill face upstream and downstream of the culvert has not been protected in a way that prevents erosion. Subsoil was not covered.</p> <p>(8.9) Water has not been returned to its natural course over a flume, rock spill or other hard surface. Culvert pipe discharges onto unprotected fill.</p> <p>(8.13) Waterway crossing has not been constructed to protect water quality (see 8.4, 8.5, 8.8, 8.9).</p>	Minor

Coupe Name	Description of Non-compliance	EIA Risk Rating
	<p>(8.14) Waterway crossing has not been maintained to withstand foreseeable rainfall events. Water running along road and onto outlet fill face.</p> <p>(8.15) Waterway crossing has not been maintained to withstand foreseeable traffic conditions. Cover over pipe is less than specified by the manufacturer. Pipe has cracks at each end.</p> <p>(8.16) Waterway crossing has not been maintained to protect water quality (see 8.14).</p>	

Code Prescription 9

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.

Coupe Name	Description of Non-compliance	EIA Risk Rating
Ruger	(9.1) Material of low sediment generating potential had not been applied to the road surface of the crossing. Outsloping had been used, but not effectively.	Minor
Magnum	(9.1) Material of low sediment generating potential had not been applied to the road surface of the crossing. Outsloping had been used, but not effectively.	Minor



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