UPPER MURRUMBIDGEE ACTIONS for CLEAN WATER PLAN







ACWA PLAN

Appendix A- Prioritisation Report







1 Contents

APP	ENDIX A- PRIORITISATION REPORT	.172
1	CONTENTS	.173
2	DOCUMENT HISTORY AND STATUS	.174
3	PROJECT INTRODUCTION	.175
4	PROJECT MANAGEMENT UNITS	.176
5	INFORMATION SOURCES	.178
6	REVIEW OF INFORMATION FOR EACH MANAGEMENT UNIT	.187
7	SUMMARY	.203
8	ATTACHMENT A- GIS DATA ANALYSIS	.204







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3 Project Introduction

A consortium of natural resource management organisations in the Upper Murrumbidgee River catchment have come together to prepare an action plan (Actions for Clean Water - ACWA) to enhance surface water quality and reduce turbidity in the Upper Murrumbidgee River catchment within NSW and the ACT.

Catchment Management Authority

The project is a partnership between the Murrumbidgee Catchment Management Authority (CMA), ACTEW, ActewAGL, ACT WaterWatch, the ACT Natural Resource Management Council and the Upper Murrumbidgee Catchment Coordinating Committee (UMCCC).

The outcomes of the ACWA Plan process will be a plan which will provide direction to all stakeholders in the Upper Murrumbidgee River catchment, and will assist in achieving improvements in water quality and reducing turbidity by identifying:

- Prioritised on-ground actions (with business cases) over the short, medium and long term; and
- Other actions (community engagement, incentives or policy changes) which contribute directly to the goals of the project.

The ACWA Plan is being prepared using the State, Pressure, Impact and Response model.

The initial phase of this project is to develop a high level understanding of the condition of the catchment (State, Pressure and Impact). Three sources of information have been used to develop this general understanding of catchment condition. They are:

- Relevant spatial datasets;
- Relevant literature; and
- Relevant reports and information held by catchment stakeholders.

This document consolidates these three information sources to begin to develop an understanding of the condition of the upper Murrumbidgee River catchment and to inform planning for field based assessments that will to occur as part of ACWA development.

Given the scale of the ACWA Plan area this prioritisation report is not definitive regarding the location and severity of particular land management issues that may be impacting on water quality in the Murrumbidgee River and its tributaries. Instead, the intent of this document is to act as a filter whereby additional emphasis is placed on areas in the catchment where issues are likely to be present.

The next stage of the ACWA Plan preparation will be a series of ground truthing field assessments. The issues and locations identified in this document will be used as the basis for planning those assessments. The intent of the field assessments will be to (where possible) provide a greater understanding about the condition of priority areas of the catchment (State, Pressure and Impact) and hence assist in the development of the "Response" element of the plan.



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4 **Project Management Units**

The ACWA project area is located both in NSW and in the ACT and covers an area of approximately 6400 km². In order to develop a cohesive method of considering the range of issues that have been identified it has been necessary to divide the upper Murrumbidgee River catchment into a series of Management Units. The nominated Management Units are based on catchments and are collated groups of the nodes (river reaches) used in the SedNet Model. These Units allow for the ready comparison of different areas of the catchment.

A total of 17 Management Units have been nominated. The Management Units are listed in **Error! Reference source not found.**

Management Unit	Location
 Big Badja	NSW
Bredbo	NSW
Bridle & Slacks	NSW
Cooma Back	NSW
Gudgenby	ACT
Kybeyan	NSW
Murrumbidgee 1 North	NSW
Murrumbidgee 1 South	NSW
Murrumbidgee 2 North ACT	ACT
Murrumbidgee 2 North NSW	NSW
Murrumbidgee 2 South	NSW
Naas	ACT
Numeralla	NSW
Paddys	ACT
Rock Flat	NSW
Strike A Light	NSW
Tantangara	NSW

Table 4-1 ACWA Plan Management Units

A Map of the Management Units is contained in Figure 4-1.

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5 Information Sources

5.1 GIS Data Analysis

The GIS Data analysis utilises a range of GIS datasets to identify locations within the ACWA Plan area that have been identified as either having erosion present, or areas potentially generating fine sediment (turbidity) as determined from modelling.

Three data sets have been used as the basis for this analysis. These are:

- SedNet Model data (2004);
- NSW Erosion Data (2004); and
- Murrumbidgee River Styles Data (2011).

These three datasets have been chosen because they all contain information specifically related to the location and severity of erosion and/or sediment generation. The GIS Data Analysis recognises that each of these datasets have varying degrees of reliability and consideration is made of this through the analysis process. Specifically it is recognised that the SedNet data is modelled data only and hence cannot be considered to be definitive. Similarly the NSW Erosion Data has been collected over a period of time leading up to 2004 and so there is uncertainty about the reliability of this data give the period of time since its collection. Finally the River Styles data contained attributes relating to the confidence in the data and this is considered via the Analysis process. The outcome of this process is shown in Figure 5-1.

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Figure 5-1 Priority Management Units from GIS Data Analysis







Further details on the GIS Data Analysis are contained in Attachment A. The following table lists each of the ACWA Management Units and notes their respective categorisations from the GIS Analysis.

Management Unit	Location	Categorisation of erosion risk based on GIS Analysis
Big Badja	NSW	Low
Bredbo	NSW	Moderate
Bridle & Slacks	NSW	Moderate
Cooma Back	NSW	Very High
Gudgenby	ACT	Low
Kybeyan	NSW	Low
Murrumbidgee 1 North	NSW	Low
Murrumbidgee 1 South	NSW	High
Murrumbidgee 2 North (ACT)	ACT	High
Murrumbidgee 2 North (NSW)	NSW	High
Murrumbidgee 2 South	NSW	High
Naas	ACT	Moderate
Numeralla	NSW	Moderate
Paddys	ACT	Low
Rock Flat	NSW	Very High
Strike A Light	NSW	High

Table 5-1 Categorisations of ACWA Management units based on GIS Analysis

Six Management Units were identified as being either a high erosion risk (Murrumbidgee 1 South, Murrumbidgee 2 North (ACT) Murrumbidgee 2 North (NSW) and Murrumbidgee 2 South) or very high erosion risk (Cooma Back and Rock Flat)). These Management Units are highlighted as potentially being a priority in terms of further field based investigations.

5.2 Additional GIS Data

5.2.1 Soil Regolith Stability Data

Soil Regolith Stability Data for the ACWA Plan area has been sourced from the NSW Office of Environment and Heritage. Soil Regolith Stability is a simple scheme based on Soil Landscape Data which classifies soils in terms of both their potential to release sediment and the potential for sediment to move long distances. This classification system is a useful predictor of how likely soil is to cause turbidly in receiving waters.

The Soil Regolith Classification is based on the following matrix giving four regolith classes with each Soil Landscape Component being allocated to a Soil Regolith Stability Class (Table):

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Table5-2: Soil Regolith Classification Matrix

		Potential for Sediment to Move Long Distances	
		LOW (Sediment is Coarse)	HIGH (Sediment is Fine)
	HIGH	R2	R4
Potential for Soil to	(Low Soil Stability)		
Nelease Seument	LOW (High Soil Stability)	R1	R3

All areas of the ACWA Plan area have been assigned to one of the four soil regolith classes and have been allocated a regolith stability classification. A regolith stability classification consists of a dominant class and up to three sub-dominant classes.

In the context of this project Regolith Class R4 is of the greatest interest because soils of this class have a high potential to release fine sediment which could contribute to downstream turbidity.

Of secondary interest are Regolith Class R3 soils (dominant class) that contain sub-dominant R4 soils. Soils of these two types are mapped in Figure 5-2 (below).

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Figure 5-2 Distribution of Regolith Class R4 and R3 (R4) Soils in the ACWA Plan area

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5.2.2 Locations of active erosion from River Styles Data

A key output of the River Styles mapping project was the assessment of the Recovery Potential for each river reach. Seven categories of recovery potential were identified and specific criteria were used to define each. The 'Strategic' category is of relevance because it potentially identifies locations where active erosion may be occurring.

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A review was undertaken of all locations in the ACWA Plan area where the River Styles Recovery Potential category was defined as 'Strategic'. A total of nine of these instances have been extracted from the data and in each instance the sites have been categorised as having 'Strategic' recovery potential because of the presence of an active erosion head within the waterway. These locations are summarised in the following table.

Waterway	Management Unit
Murphy's Creek	Bredbo
Dunns Creek	Murrumbidgee 2 North ACT
Tarpaulin Creek	Murrumbidgee 2 North ACT
Margarets Creek	Murrumbidgee 2 North NSW
Margarets Creek	Murrumbidgee 2 North NSW
Margarets Creek	Murrumbidgee 2 North NSW
Cockatoo Creek	Murrumbidgee 2 North NSW
Naas Creek	Naas
Blue Gum Creek	Paddys

Table 5-3 Locations of all active erosion heads identified via River Styles data

5.3 Anecdotal (Stakeholder provided) Information

In order to gather relevant information from project stakeholders (the Project Advisory Group) a workshop was undertaken on 1 June 2011. All Project Advisory Group members who were invited to attend the workshop were asked to contribute relevant information that they held regarding the current condition of the Upper Murrumbidgee catchment, the trajectory of catchment condition, locations of concern and any other information that might be relevant to the preparation of the ACWA Plan.

Attendees at the workshop were encouraged to mark up plans of the ACWA Plan area to note the locations of particular issues and then to provide contextual information for each. The outcomes of this process are included in Appendix C.

The following locations were identified as being a priority for further investigation (see Table 5-4).





Table 5-4 Locations for further investigation as identified in Project Advisory Group Workshop

Location	Potential issue	ACWA Management Unit
Bredbo River & Catchment	Bredbo River a source of sediment with some deposition in low velocity reaches. Old soil conservation works in place	Bredbo
Bircham's Creek	Major Erosion following rainfall events	Bredbo
Slacks Creek	Riverbank erosion evident	Bridle & Slacks
Gudgenby River	Increased turbidity following willow removal	Gudgenby
Paddys River Catchment	Increased turbidity following storm events	Paddys
Lower Murrumbidgee River (ACT)	Low velocity sections create sediment deposition zones	Murrumbidgee 2 North (ACT)
Billilingra Area	Erosion apparent following cultivation or overgrazing	Murrumbidgee 2 South
Upper Numeralla	Erosion apparent following cultivation	Numeralla
Margaret River (Creek)	Erosion control structures installed on private property	Murrumbidgee 2 North (NSW)
Michelago Creek	Willow control has occurred over the last decade Riparian fencing installed since 2000 and erosion control works (gabions) installed 2005	Murrumbidgee 2 North (NSW)
Bumbalong Valley	Inappropriate areas of rural/residential settlement and poorly constructed waterway crossings Bank slumping in Bumbalong Valley	Murrumbidgee 2 North (NSW)
Numeralla River	Numeralla Valley and Rose Valley both identified as sources of sediment	Numeralla

Subsequent to the project Advisory Group Workshop additional anecdotal information has been provided by members of the Advisory Group regarding a range of issues that may need to be considered via the prioritisation process. This information is summarised in the following table.

Location	Potential issue	ACWA Management Unit
Bush Heritage Property Scottsdale	Significant Erosion head present in Gungoandra Creek potentially generating large amounts of sediment.	Murrumbidgee 2 South
Quarries / Mines are present at multiple locations throughout the ACWA Plan area including: Bredbo (sand) Michelago (sand) Billilingra (sand)	Current management practices should be assessed to determine if they are resulting in generation of turbidity	Bredbo (Bredbo) Murrumbidgee 2 North (NSW) (Michelago) Murrumbidgee 2 South (Billilingra & Colinton) Numeralla (Nimmitabel and Numeralla River)

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Location	Potential issue	ACWA Management Unit
 Colinton (sand) 		
 Nimmitabel (rock) 		
 Numeralla River (sand) 		
Paddys River Catchment	Significant turbidity generation from areas of National Park following 2003 bushfires	Paddys
Gudgenby River	Increased turbidity and sediment generation following 2003 bushfires	Gudgenby
Kybeyan Catchment	Significant source of sediment	Kybeyan
Lanyon Floodplain (Murrumbidgee River)	Floodplain has significant erosion potential with some active gully erosion present	Murrumbidgee 2 North (ACT)
Throughout the Catchment	Impact of sediment generation from unsealed roads	All

5.4 Literature Review

The literature review identified erosion issues across the broader Upper Murrumbidgee catchment. The review was undertaken on a range of literature that has been collated during the early stages of the preparation of the Actions for Clean Water (ACWA) Plan. Many of the reports reviewed considered sites that are outside the nominated area of the ACWA Plan. This information was retained in the review for completeness but was not considered further.

The following locations were identified in the literature review as having the potential to be a priority for further investigation (see Table 6). Further information is contained in Appendix B.

Information Source	Location	ACWA Management Units
Murrumbidgee Geomorphic Investigation for Works Prioritisation (2006)	Murrumbidgee 2 sub-catchment Bredbo sub-catchment Numeralla (west) sub- catchment	Murrumbidgee 2 South Murrumbidgee 2 North (NSW) Murrumbidgee 2 North (ACT) Bredbo Numeralla Cooma Back
Bredbo and the 'Bidgee: Management Strategies for the Murrumbidgee River and its Tributaries in the Bredbo District (1997)	Bredbo District	Bredbo Murrumbidgee 2 South
Budgeting for 'Bidgee Banks (2000)	Yaouk Creek Sam's Creek Murrumbidgee River Billilingra Gorge Buchan's Creek Wangrah Creek	Murrumbidgee 1 North Murrumbidgee 1 South Murrumbidgee 2 South Strike A Light
A Reconnaissance of Trends in the Condition of Streams in the Australian Capital Territory (2000)	Murrumbidgee River Paddys River	Murrumbidgee 2 North (ACT) Paddys

Table 5-6 Locations for further investigation as identified in the Literature Review







Information Source	Location	ACWA Management Units
	Tuggeranong Creek Naas River Gudgenby River	Gudgenby Naas
Soil Erosion, Phosphorus & Dryland Salinity in the Upper Murrumbidgee: Past Change & Current Findings (1999)	Wangrah Creek Michelago Creek Margaret River (Creek) Tea Tree Creek	Strike A Light Murrumbidgee 2 North (NSW)
The State of Streams in the Upper Murrumbidgee Catchment (1993)	Tea Tree Creek Bredbo Gullies	Bredbo
The Numeralla: River of Change (1995)	Numeralla River	Numeralla

6 Review of Information for each Management Unit

The following sections contain a summary of the information that has been collated for each of the Management Units. A preliminary review of aerial photography has been completed for each Management Unit to attempt to validate the information that had been sourced from the literature review, stakeholder input and GIS analysis.

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The aerial photography that has been used for this process was provided by the NSW Office of Environment and Heritage. Eight map sheets of ADS40 data (at 50 cm resolution) were provided. Additional information relating to that data is contained in the following table.

Map Sheet	Date Imagery Flown
Araluen	February 2009
Bombala	January 2011
Brindabella	September 2008
Canberra	September 2008
Cobargo	February 2010
Cooma	March 2011
Michelago	October 2008
Tantangara	October 2008

Table 6-1 Aerial Photography Utilised for Validation Process

Where there was residual uncertainty regarding the information provided, recommendations have been made about the inclusion of specific management units, reaches or sites in the proposed field assessment program.

The exclusion of any Management Unit from the proposed field assessment program does not imply exclusion of them from the formal development of the ACWA Plan. Rather it is an indication that there have not been any specific sites or locations identified during this preliminary prioritisation process that will require additional consideration in plan preparation, particularly in terms of any proposed erosion control works.







6.1 Big Badja

Table 6-2 Management Unit Information Summary

Priority Based on GIS Analysis	Low
Additional Sites Identified from Literature Review	NA
Additional Sites Identified by Stakeholders	NA
Extent of Dispersive Soils (Regolith Classes R4 & R3)	R4 – 0, R3 – 80 km ² (34.3%)
Presence of Active Erosion (from River Styles data)	NA

6.1.1 Management Unit Discussion

This Management Unit is identified as a low priority from the GIS analysis and no locations were noted where active erosion was present. Similarly no specific sites that may require further investigation were identified from the literature review or by the ACWA Advisory Group or Management Committee.

6.1.2 Management Unit Recommendations

It is not recommended that any field based investigations be undertaken in the Big Badja Management Unit.

Regardless, it is anticipated that a range of recommendations for this Management Unit will be developed during the preparation of the ACWA Plan.

6.2 Bredbo

Table 6-3 Management Unit Information Summary

Priority Based on GIS Analysis	Moderate
Additional Sites Identified from Literature Review	Bredbo Sub-Catchment Bredbo Gullies
Additional Sites Identified by Stakeholders	Bredbo River Bredbo River (sand extraction) Bircham's Creek
Extent of Dispersive Soils (Regolith Classes R4 & R3)	R4 – 0, R3 - 296 km ² (59%)
Presence of Active Erosion (from River Styles data)	Murphy's Creek

6.2.1 Management Unit Discussion

This Management Unit is identified as a moderate priority from the GIS analysis and one site on Murphy's Creek was identified as potentially being the location of an active erosion head.





Multiple aspects of this Management Unit were identified through the literature review and stakeholder input as potentially being of concern from a turbidity generation perspective. The Bredbo River (including the specific location of sand extraction), its broader catchment and existing gully networks were highlighted as potentially generating turbidity.

Viewing aerial imagery of the Murrumbidgee River upstream and downstream of the confluence with the Bredbo River, it is clear there is significant sediment entering the Murrumbidgee River from the Bredbo River however the source of this sediment is not clear.

Bircham's Creek is a highly eroded sub-catchment. There are a number of minor gullies present which appear to still be significant sources of mobile sediment coming from this catchment.

6.2.2 Management Unit Recommendations

Field assessments of this Management Unit are recommended to develop a greater understanding of the likely sediment sources and processes present. These assessments should (where possible) include the following specific locations:

- Bircham's Creek catchment;
- Location of erosion head on Murphy's Creek; and
- Location of sand extraction on the Bredbo River.

6.3 Bridle & Slacks

Table 6-4 Management Unit Information Summary

Priority Based on GIS Analysis	Moderate
Additional Sites Identified from Literature Review	NA
Additional Sites Identified by Stakeholders	Slack's Creek
Extent of Dispersive Soils (Regolith Classes R4 & R3)	R4 – 0, R3 – 97 km ² (32%)
Presence of Active Erosion (from River Styles data)	NA

6.3.1 Management Unit Discussion

This Management Unit is identified as a moderate priority from the GIS analysis, while no sites were identified as potentially being the location of active erosion heads.

Slack's Creek was identified via stakeholder input as potentially being of concern from a turbidity generation perspective. Aerial photography indicates that the upper part of the catchment is cleared, and appears to have limited woody vegetation present. Both active gully erosion and isolated bank erosion could be identified along the creek. The lower part of the creek flows through forested gorge, prior to its confluence with the Murrumbidgee River. It is not clear if significant volumes of sediment are transported through the gorge.







6.3.2 Management Unit Recommendations

Field assessments of this Management Unit are recommended to develop a greater understanding of the likely sediment sources and processes present. These assessments should (where possible) focus on Slack's Creek to confirm whether significant volumes of sediment are exported from this catchment.

6.4 Cooma Back

Table 6-5 Management Unit Information Summary

Priority Based on GIS Analysis	Very High
Additional Sites Identified from Literature Review	NA
Additional Sites Identified by Stakeholders	NA
Extent of Dispersive Soils (Regolith Classes R4 & R3)	R4 – 0, R3 49 km ² (19%)
Presence of Active Erosion (from River Styles data)	NA

6.4.1 Management Unit Discussion

This Management Unit is identified as a very high priority from the GIS analysis however no sites were identified as potentially being the location of active erosion heads.

Similarly no specific sites that may require further investigation were identified from the literature review or by the ACWA Advisory Group or Management Committee.

The review of aerial photography for this Management Unit indicated that significant gully networks were present. However the photography also indicated that the gullies appear to be relatively stable and that the gully networks were generally not connected to the waterways in the Management Unit.

An extensive tributary junction plug appears to be present in the Cooma Creek downstream of the confluence with Rock Flat Creek. The presence of this feature possibly indicates that a proportion of sediments supplied from the catchment area are being stored in the channel rather than being exported to the Numeralla River.

6.4.2 Management Unit Recommendations

Field assessments of this Management Unit are recommended to confirm the degree of activity of gully networks in the Management Unit and to establish whether sediment is being stored within the Management Unit or being transported downstream.







6.5 Gudgenby

Table 6-6 Management Unit Information Summary

Priority Based on GIS Analysis	Low
Additional Sites Identified from Literature Review	Gudgenby River
Additional Sites Identified by Stakeholders	Lower Gudgenby River Gudgenby River
Extent of Dispersive Soils (Regolith Classes R4 & R3)	R4 – 0, R3 – 14 km ² (4%)
Presence of Active Erosion (from River Styles data)	NA

6.5.1 Management Unit Discussion

This Management Unit is identified as a low priority from the GIS analysis and no sites within the Management Unit were identified as potentially being the location of active erosion heads.

The Gudgenby River within this Management Unit was highlighted both through the literature review and stakeholder input as potentially being of concern from a turbidity generation perspective.

Parts of the Gudgenby Catchment were impacted upon by the 2003 Canberra bushfires and following this event a significant decrease in water quality became evident.

6.5.2 Management Unit Recommendations

Site visits to this Management Unit are recommended to gain a stronger understanding of this catchment, particularly in terms of types of erosion that may be present and the applicability of potential management actions to mitigate these impacts.







6.6 Kybeyan

Table 6-7 Management Unit Information Summary

Priority Based on GIS Analysis	Low
Additional Sites Identified from Literature Review	NA
Additional Sites Identified by Stakeholders	Kybeyan Catchment
Extent of Dispersive Soils (Regolith Classes R4 & R3)	R4 – <1 (<1%), R3 – 186 km ² (80%)
Presence of Active Erosion (from River Styles data)	NA

6.6.1 Management Unit Discussion

This Management Unit is identified as a low priority from the GIS analysis and no sites within the Management Unit were identified as potentially being the location of active erosion heads.

The catchment of the Kybeyan River within this Management Unit was highlighted through the Stakeholder input as potentially being of concern from a turbidity generation perspective.

This Management Unit is dominated by Regolith Stability Type R4 and R3 with over 80% of the Management Unit Area having these soil types. Given the relative mobility of the vast majority of the topsoil in this Management Unit it has significant potential for the generation of turbidity.

6.6.2 Management Unit Recommendations

Site visits to this Management Unit are recommended to gain a stronger understanding of this catchment, particularly in terms of types of land management practices being undertaken and how they may be impacting on soil stability.

6.7 Murrumbidgee 1 North

Priority Based on GIS Analysis	Low
Additional Sites Identified from Literature Review	Yaouk Creek
	Sam's Creek
	Murrumbidgee River
Additional Sites Identified by Stakeholders	NA
Extent of Dispersive Soils (Regolith Classes R4 & R3)	R4 – 0, R3 – 52 km ² (9%)
Presence of Active Erosion (from River Styles data)	NA

Table 6-8 Management Unit Information Summary







6.7.1 Management Unit Discussion

This Management Unit is identified as a low priority from the GIS analysis and no sites within the Management Unit were identified as potentially being the location of active erosion heads.

Several sites within this Management Unit were highlighted via the Literature Review as potentially being of concern from a turbidity generation perspective. Yaouk Creek and Sam's Creek were identified as potentially being erosion hotspots as were several sections of bank on the Murrumbidgee River itself.

The majority of the Yaouk Creek catchment has been cleared and appears to be grazed. No evidence of the potential erosion noted in 2000 could be seen via the aerial photography. Sam's Creek is a braided upper catchment gully which is a direct tributary of Yaouk Creek. Although the catchment is cleared, there does appear to be a good ground cover through the channel.

The Murrumbidgee River within this Management Unit appears relatively stable. There is isolated bank erosion in highly grazed zones which could be controlled with specific riparian management and revegetation programs.

6.7.2 Management Unit Recommendations

Further field based investigations should be undertaken to determine if Yaouk and Sam's Creeks still represent the erosion risk identified in 2000. Investigations should also occur to determine the potential for riparian zone works (protective fencing, provision of alternate livestock watering points and revegetation) to provide significant reductions in turbidity generation.

6.8 Murrumbidgee 1 South

Table 6-9 Management Unit Information Summary

Priority Based on GIS Analysis	High
Additional Sites Identified from Literature Review	NA
Additional Sites Identified by Stakeholders	NA
Extent of Dispersive Soils (Regolith Classes R4 & R3)	R4 – 0, R3 – 44 km ² (7%)
Presence of Active Erosion (from River Styles data)	NA

6.8.1 Management Unit Discussion

This Management Unit is identified as a high priority from the GIS analysis and no sites within the Management Unit were identified as potentially being the location of active erosion heads.

Similarly no specific sites that require further investigation were identified from the literature review or by the ACWA Advisory Group or Management Committee.

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The review of aerial photography for this reach indicated that whilst gully networks were present, they appeared to be relatively stable. Many of the waterways in this reach were identified through the River Styles process as either having Low or Moderate Recovery Potential. Confirmation is required to determine whether this ranking related to turbidity generation or other factors.

6.8.2 Management Unit Recommendations

Further field based investigations should be undertaken on the tributary streams in this Management Unit (rather than the Murrumbidgee River) to confirm their overall condition and the likelihood of them generating significant amounts of turbidity.

6.9 Murrumbidgee 2 North ACT

Priority Based on GIS Analysis	High
Additional Sites Identified from Literature Review	Murrumbidgee River Tuggeranong Creek
Additional Sites Identified by Stakeholders	Lower Murrumbidgee River Lanyon Floodplain (Murrumbidgee River)
Extent of Dispersive Soils (Regolith Classes R4 & R3)	R4 – 1 km² (<1%), R3 – 223 km² (59%)
Presence of Active Erosion (from River Styles data)	Dunn's Creek Tarpaulin Creek

Table 6-10 Management Unit Information Summary

6.9.1 Management Unit Discussion

This Management Unit is identified as a high priority from the GIS analysis and two sites (Dunn's Creek and Tarpaulin Creek) were identified as potentially being the location of active erosion heads.

The (Lower) Murrumbidgee River, the Lanyon Floodplain and the Tuggeranong Creek were the thee locations in this Management Unit identified through the literature review and Stakeholder input as potentially being of concern from a turbidity generation perspective.

Review of aerial photography highlighted multiple areas of localised bank erosion on the Murrumbidgee River extending 8 km upstream and 6 km downstream of Tharwa. The location and extent of erosion in this reach is likely to be related to the influence of the large in-channel bars that are forming and moving through this reach.

Tuggeranong Creek was also highlighted from the literature review as potentially being a source of turbidity. However any turbidity impact on the Murrumbidgee River from this waterway is likely to be mitigated by Isabella Pond and Tuggeranong Weir which both would be acting as traps for coarse sediment. Similarly Lake Tuggeranong is likely to be acting as a sink for any fine sediment. Downstream of Lake Tuggeranong there are several minor incidences of bank erosion on the





Tuggeranong Creek prior to its confluence with the Murrumbidgee River, however these are considered unlikely to be significant.

This Management Unit is dominated by Regolith Stability Type R4 and R3 with over 59% of the Management Unit Area having these soil types. Given the relative mobility of the vast majority of the topsoil in this Management Unit it has significant potential for the generation of turbidity.

6.9.2 Management Unit Recommendations

Field investigations are recommended to provide additional understanding of the scale and drivers of bank erosion along the section of river noted above (8 km upstream Tharwa – 6 km downstream Tharwa, including the Lanyon area) and the potential to reduce the volume of sediment generated from these areas through bank stabilisation works.

Similarly, field investigations are recommended to (where possible) confirm the location and extent of the erosion heads that have been identified as being present on Dunn's Creek and Tarpaulin Creek.

Site visits to this Management Unit are also recommended to gain a stronger understanding of this catchment, particularly in terms of types of land management practices being undertaken and how they may be impacting on soil stability.

6.10 Murrumbidgee 2 North NSW

Table 6-11 Management Unit Information Summary

Priority Based on GIS Analysis	High
Additional Sites Identified from Literature Review	Michelago Creek
1	Tea Tree Creek
Additional Sites Identified by Stakeholders	Bumbalong Valley
	Margaret River (Creek)
	Michelago Creek
	Michelago Creek (sand extraction)
Extent of Dispersive Soils (Regolith Classes R4 & R3)	R4 – 3 km² (1%), R3 – 154 km² (45%)
Presence of Active Erosion (from River Styles data)	Margarets Creek (3 sites)
	Cockatoo Creek

6.10.1 Management Unit Discussion

This Management Unit is identified as a high priority from the GIS analysis with four sites being identified as potentially being the location of active erosion heads. Three of these locations were on Margarets Creek and the other on Cockatoo Creek.

A large number of sites that may require further investigation were identified from the literature review or by the ACWA Advisory Group or Management Committee.





The review of aerial photography for this reach indicated that the headwaters of many of the tributary streams in this Management Unit are experiencing active gully erosion. Severe gully erosion is evident in the headwaters of tributary streams east of Michelago (Margarets Creek, Michelago Creek, and Tea Tree Creek) and there appears to be a high degree of connectivity of these waterways through to the Murrumbidgee River, potentially allowing significant transfer of sediment.

In addition, active bank erosion was evident in the Michelago Creek and gully erosion in the Michelago Creek catchment. The Michelago Creek flows into a gorge prior to its confluence with the Murrumbidgee River. It could not be determined from aerial photography whether sediment is transported through the gorge and into the Murrumbidgee River.

Margarets Creek has a relatively narrow valley that is cleared, and it appears that bed and bank erosion may be present (as indicated by the River Styles data). Similarly localised gully erosion is evident in several locations along the valley.

Tea Tree Creek is a tributary of the Michelago Creek on the eastern valley margin. There appears to be severe bed and bank erosion present.

Bumbalong Valley runs parallel to the Murrumbidgee River. The forested part of the catchment appears stable in aerial photography and hence, is of little concern. Once into cleared farming country, active gully erosion is evident and the banks of the Bumbalong Creek appear unstable.

6.10.2 Management Unit Recommendations

Further field based investigations are recommended for a large number of issues and locations in this Management Unit. Specifically:

- Margarets Creek, Michelago Creek, and Tea Tree Creek catchments to confirm (where possible) the severity of gully erosion in the headwaters of these catchments and (where possible) to confirm whether sediment is being transported from these catchments to the Murrumbidgee River;
- Michelago Creek to confirm the influence of the gorge upstream of the Murrumbidgee River in terms of sediment transport;
- Margarets Creek and Tea Tree Creek to (where possible) confirm the location and extent of bed and bank erosion identified via aerial photography and GIS data (River Styles);
- Bumbalong Creek to (where possible) confirm the extent of active gully erosion and bank erosion in the downstream reach of this waterway; and
- Cockatoo Creek and Michelago Creeks to (where possible) establish the impact of sand mining on these waterways.





6.11 Murrumbidgee 2 South

Table 6-12 Management Unit Information Summary

Priority Based on GIS Analysis	High
Additional Sites Identified from Literature Review	Billilingra Gorge
Additional Sites Identified by Stakeholders	Billilingra Area Billilingra (sand extraction) Colinton (sand extraction)
Extent of Dispersive Soils (Regolith Classes R4 & R3)	R4 – 0, R3 – 131 km² (35%)
Presence of Active Erosion (from River Styles data)	NA

6.11.1 Management Unit Discussion

This Management Unit is identified as a high priority from the GIS analysis however no sites were identified as potentially being the location of active erosion heads. Several locations were identified for further investigation from the literature review or by the ACWA Advisory Group or Management Committee.

The potential impact of sand extraction was highlighted for sites at Colinton and Billilingra. In addition, land management practices and the presence of active gully erosion in the vicinity of Billilingra were highlighted as potentially contributing to turbidity generation in this Management Unit.

Review of aerial photography noted the presence of a series of active gullies in the Billilingra area upstream of Billilingra Gorge. It cannot be established from the aerial photography whether these gullies are conveying sediment to the Murrumbidgee River.

Several active gullies were identified incising upland areas between Billilingra Gorge and the confluence of the Numeralla River. Again it cannot be established from the aerial photography whether these gullies are conveying sediment to the Murrumbidgee River.

Bank erosion may also be an issue along the Murrumbidgee River in this Management Unit. Two instances were noted from the aerial photography. One site is an 800 m length of right bank running parallel to Bumbalong Road and the other site is 150 m length of bank upstream of Billilingra.

6.11.2 Management Unit Recommendations

Further field based investigations are recommended for the following issues and locations in this Management Unit:

 to determine if the gullies upstream of Billilingra Gorge are contributing sediments to the Murrumbidgee River;

• to determine if the gullies present in upland areas between Billilingra Gorge and the confluence of the Numeralla River are contributing sediments to the Murrumbidgee River;

Catchment Manageme Authority

- to establish the impact of sand mining at Billilingra and Colinton on the Murrumbidgee River; and
- to assess the two instances of bank erosion on the Murrumbidgee River to determine severity and potential remedial works.

6.12 Naas

Table 6-13 Management Unit Information Summary

Priority Based on GIS Analysis	Moderate
Additional Sites Identified from Literature Review	Naas River
Additional Sites Identified by Stakeholders	NA
Extent of Dispersive Soils (Regolith Classes R4 & R3)	R4 – 0, R3 – 25 km² (7%)
Presence of Active Erosion (from River Styles data)	Naas Creek

6.12.1 Management Unit Discussion

This Management Unit is identified as a moderate priority from the GIS analysis and one location was noted on the Naas Creek where active erosion was present.

The Naas River was identified via the literature review as being a location that may require further investigation. The review of aerial photography indicated that the Naas River has undergone significant historical change (specifically channel widening). It cannot be determined from the photography whether these processes are currently active.

6.12.2 Management Unit Recommendations

It is recommended that field investigations be undertaken to confirm whether channel widening is active in the Naas River. Similarly an investigation should be undertaken to confirm the location and severity of the bed erosion identified via the GIS analysis.

6.13 Numeralla

Table 6-14 Management Unit Information Summary

Priority Based on GIS Analysis	Moderate
Additional Sites Identified from Literature Review	Numeralla River
Additional Sites Identified by Stakeholders	Numeralla Valley
	Rose Valley
	Upper Numeralla Area
	Nimmitabel (sand extraction)
	Numeralla River (sand extraction)







Extent of Dispersive Soils (Regolith Classes R4 & R3)R4 - 0, R3 - 358 km² (57%)Presence of Active Erosion (from River Styles data)NA

6.13.1 Management Unit Discussion

This Management Unit is identified as a moderate priority from the GIS analysis however no sites were identified as potentially being the location of active erosion heads. Several locations were identified for further investigation from the literature review or by the ACWA Advisory Group or Management Committee.

The potential impact of sand and gravel extraction was highlighted for sites at Nimmitabel and on the Numeralla River. In addition, the Rose Valley, Numeralla Valley and the upper Numeralla area were all also highlighted as potentially being sources of turbidity.

From the aerial photography it appears that active gully erosion is present in the uplands of the Rose Valley and in the upper parts of the Numeralla valley. Previous field inspections suggest the degree of connectivity between these gullies and the Numeralla River is limited in Rose Valley, however connectivity on the Numeralla Valley is uncertain.

Bank erosion is apparent in the lower Numeralla River as its alignment is impacted upon by the large in-channel bars that are present. It is considered likely that material in these bars would be mobilised during high flow events. In addition there appears to be active sediment remobilisation in the Numeralla River in its upper reaches upstream of Numeralla township.

This Management Unit is dominated by Regolith Stability Type R4 and R3 with over 57% of the Management Unit Area having these soil types. Given the relative mobility of the majority of the topsoil in this Management Unit, it has significant potential for the generation of turbidity.

6.13.2 Management Unit Recommendations

Field investigations are recommended to better understand sources of fine sediments in the Numeralla River system. These should include:

- Investigations of the upper parts of Rose Valley and Numeralla Valley to provide further information on sediment generation and connectivity;
- Investigations into the lower Numeralla to develop a more detailed understanding of in stream erosion processes and rates of sediment mobilisation and transport; and
- Investigations to (where possible) establish the impact of sand and gravel extraction at Nimmitabel and on the Numeralla River.

Site visits to this Management Unit are also recommended to gain a stronger understanding of this catchment, particularly in terms of types of land management practices being undertaken and how they may be impacting on soil stability.







6.14 Paddys

Table 6-15 Management Unit Information Summary

Priority Based on GIS Analysis	Low
Additional Sites Identified from Literature Review	Paddys River
Additional Sites Identified by Stakeholders	Paddys River Paddys River Catchment
Extent of Dispersive Soils (Regolith Classes R4 & R3)	R4 – 0, R3 – 6 km ² (3%)
Presence of Active Erosion (from River Styles data)	Blue Gum Creek

6.14.1 Management Unit Discussion

This Management Unit is identified as a low priority from the GIS analysis and one site on the Blue Gum Creek was identified as potentially being the location of an active erosion head.

The Paddys River and its catchment within this Management Unit were highlighted both through the literature review and stakeholder input as potentially being of concern from a turbidity generation perspective.

Significant parts of the Paddys River Catchment were impacted upon by the 2003 Canberra bushfires and following this event a significant decrease in water quality became evident.

The review of aerial photography indicated the presence of significant gully networks particularly in the lower parts of the catchment. It was not possible to confirm whether these gullies were active and contributing sediment to the Paddys River.

6.14.2 Management Unit Recommendations

Field investigations are recommended for the Management Unit to assess the activity of identified gully networks and to determine if they are contributing sediment to the Paddys River.

Investigations should also be undertaken to confirm the location and assess the severity of the potential erosion head on Blue Gum Creek.

Site visits to this Management Unit are also recommended to gain a stronger understanding of this catchment, particularly in terms of types of erosion that may be present and the applicability of various management actions to mitigate these impacts.

6.15 Rock Flat

Table 6-16 Management Unit Information Summary

Priority Based on GIS Analysis	Very High
Additional Sites Identified from Literature Review	NA







Additional Sites Identified by Stakeholders	NA
Extent of Dispersive Soils (Regolith Classes R4 & R3)	R4 – 0, R3 – 94 km ² (33%)
Presence of Active Erosion (from River Styles data)	NA

6.15.1 Management Unit Discussion

This Management Unit is identified as a very high priority from the GIS analysis however no sites were identified as potentially being the location of active erosion heads.

Similarly no specific sites that may require further investigation were identified from the literature review or by the ACWA Advisory Group or Management Committee.

Rock Flat Creek was noted during the review of aerial photography as appearing to be conveying considerable amount of sediment along its course. Many instances of bank erosion along the length of the tributary were also noted and multiple connected and disconnected eroding gullies were also identified.

6.15.2 Management Unit Recommendations

It is recommended that further field investigations are completed in this Management Unit to determine:

- The activity of bed and bank erosion along the lower reaches of Rock Flat Creek. This should increase understanding of the calibre of material that is being eroded from these areas and whether these sediments are being transferred through to the Cooma Creek; and
- Erosional activity and connectivity of gullies identified via the aerial photography identify appropriate remedial actions.

6.16 Strike A Light

Table 6-17 Management Unit Information Summary

Priority Based on GIS Analysis	High
Additional Sites Identified from Literature Review	Wangrah Creek
Additional Sites Identified by Stakeholders	NA
Extent of Dispersive Soils (Regolith Classes R4 & R3)	R4 – 15 km² (6%), R3 – 177 km² (75%)
Presence of Active Erosion (from River Styles data)	NA

6.16.1 Management Unit Discussion

This Management Unit is identified as a very high priority from the GIS analysis however no sites were identified as potentially being the location of active erosion heads.





The review of aerial imagery does not suggest that this area generates significant sediment. The construction of large numbers of farm dams has occurred on the gully networks and these may be acting to disconnect sediment supply to the river.

One site, Wangrah Creek, was highlighted in the literature review as potentially being of concern from a turbidity generation perspective. The review of aerial imagery noted that Wangrah Creek is a partially forested, partially cleared creek which is a direct tributary of Strike a Light River. Isolated zones of bank erosion were identified from the imagery.

This Management Unit is dominated by Regolith Stability Type R4 and R3 with over 75% of the Management Unit Area having these soil types. Given the relative mobility of the majority of the topsoil in this Management Unit it has significant potential for the generation of turbidity.

6.16.2 Management Unit Recommendations

Field assessments should be undertaken to confirm the activity of gully networks throughout the Management Unit. An assessment should also be made of the rates of bed and bank erosion in the Wangrah Creek.

Site visits to this Management Unit are recommended to gain a stronger understanding of this catchment, particularly in terms of types of land management practices being undertaken and how they may be impacting on soil stability.

Also, given the soil types present a review should be undertaken of the various farm dams present and what risk their failure may have to downstream water quality.

6.17 Tantangara

Table 6-18 Management Unit Information Summary

Priority Based on GIS Analysis	Low
Additional Sites Identified from Literature Review	NA
Additional Sites Identified by Stakeholders	NA
Extent of Dispersive Soils (Regolith Classes R4 & R3)	R4 – 0, R3 – 105 km² (23%)
Presence of Active Erosion (from River Styles data)	NA

6.17.1 Management Unit Discussion

This Management Unit is identified as a low priority from the GIS analysis and no locations were noted where active erosion was present. Similarly no specific sites that may require further investigation were identified from the literature review or by the ACWA Advisory Group or Management Committee.





6.17.2 Management Unit Recommendations

It is not recommended that any field based investigations be undertaken in the Tantangara Management Unit.

Regardless, it is anticipated that a range of recommendations for this Management Unit will be developed during the preparation of the ACWA Plan.