EARTH TECH

Wimmera Catchment Management Authority

Geomorphic Categorisation and Stream Condition Assessment of the Wimmera River Catchment – Appendices

Job 2901049.008 & 2901049.009

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Earth Tech Engineering Pty Ltd
ABN 61 089 482 888
Head Office 71 Queens Road
Melbourne VIC 3004
Tel +61 3 **8517 9200**

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Summary of selected Wimmera River Catchment ISC Assessments in 1999

Table D1: Summary of selected Wimmera River Catchment ISC Assessments in 1999

Region	Reach	Site Number	Name	Stream Order	Stream Style	Overstorey Vegetation Condition	Hydrology	Physical Form Sub-index score	Streamside Zone Sub-index score	Hydrology Sub-index Score
Just South of Jeparit	2	51	Wimmera River	8	Alluvial Continuous 4	20-80%	Hydrologically Affected – Water Removed	4	6	6
West of Gerang Gerung	3	52	Wimmera River	8	Anabranching Fine Grained	20-80%	Hydrologically Affected – Water Removed	6	7	6
Dimboola	4	53	Wimmera River	8	Alluvial Continuous 4	>80%	Hydrologically Affected – Water Removed	4	7	6
Ellis Crossing to East Natimuk	5	54	Unknown	8	Anabranching Fine Grained	Not assessed due to scale of aerial photographs	Hydrologically Affected – Water Removed	4	5	6
Horsham to Vectis South	6	55	Wimmera River	8	Alluvial Continuous 4	20-80%	Hydrologically Affected – Water Removed	6	6	6
Horsham	7	56	Wimmera River	8	Alluvial Continuous 1	<20%	Hydrologically Affected – Water Removed	6	4	7
Marma State Forest	8	57	Mount William Creek	5	Anabranching Fine Grained	20-80%	Hydrologically Affected – Water Removed	5	7	10
Campbells Bridge	9	58	Wimmera River	8	Alluvial Continuous 1	20-80%	Not Hydrologically Affected	4	7	10
Joel Joel	10	59	Wimmera River	8	Alluvial Continuous 1	20-80%	Not Hydrologically Affected	5	7	10
Crowlands	11	60	Wimmera River	7	Partly Confined 3	<20%	Not Hydrologically Affected	4	3	10
Mount Cole	12	61	Wimmera River	5	Intact Valley Fill	<20%	Not Hydrologically Affected	5	3	10
Wonwondah	13	62	Norton Creek	4	Alluvial Continuous 4	20-80%	Not Hydrologically Affected	5	7	10
Laharum	14	63	MacKenzie River	3	Discontinuous Anabranching Chain of Ponds	20-80%	Hydrologically Affected – Water Removed	7	7	2
Wartook	15	64	MacKenzie River	5	Partly Confined 2	20-80%	Hydrologically Affected – Used For Water Transfer	6	6	2
Jung	17	66	Yarriambiak Creek	3	Anabranching Fine Grained	20-80%	Hydrologically Affected – Water Removed	6	5	10
South Warracknabeal	18	67	Yarriambiak Creek	3	Alluvial Continuous 1	>20%	Hydrologically Affected – Water Removed	5	8	10
North of Warracknabeal	19	68	Yarriambiak Creek	3	Alluvial Continuous 1	>20%	Hydrologically Affected – Water Removed	4	7	10
Dadswells Bridge	21	70	Mt William Creek	2	Alluvial Continuous 1	>20%	Hydrologically Affected – Water Removed	5	7	6
Ledcourt (east Lake Lonsdale)	22	71	Mt William Creek	7	Alluvial Continuous 1	<20%	Hydrologically Affected – Water Removed	5	6	5
Lake Fyans	23	72	Mt William Creek	7	Alluvial Continuous 1	>20%	Not Hydrologically Affected	3	5	10
Moyston	24	73	George Creek	4	Incised Alluvial Discontinuous	<20%	Not Hydrologically Affected	3	5	10
Green Lake	25	74	Golton Creek	5	Alluvial Continuous 1	>20%	Not Hydrologically Affected	5	7	10
Halls Gap	27	76	Fyans Yaloog Creek	5	Partly Confined 1	>80%	Hydrologically Affected – Used For Water Transfer	2	5	10
Campbells Bridge	30	79	Sheepwash Creek	4	Alluvial Continuous 1	>20%	Not Hydrologically Affected	5	4	10

Region	Reach	Site Number	Name	Stream Order	Stream Style	Overstorey Vegetation Condition	Hydrology	Physical Form Sub-index score	Streamside Zone Sub-index score	Hydrology Sub-index Score
Concongella	31	80	Concongella Creek	6	Partly Confined 3	>20%	Not Hydrologically Affected	3	5	10
South West Navarre	32	81	Heifer Station Creek	6	Alluvial Continuous 5	>20%	Not Hydrologically Affected	1	4	10
Navarre	33	82	Wattle Creek	6	Alluvial Continuous 5	20-80%	Not Hydrologically Affected	4	4	10
Barkly	34	83	Wattle Creek	6	Cut & Fill	20-80%	Not Hydrologically Affected	3	6	10
Frenchmans	35	84	Watercourse	5	Alluvial Continuous 4	<20%	Not Hydrologically Affected	1	5	10
Bulgana	36	85	Six Mile Creek	5	Incised Alluvial Discontinuous	<20%	Not Hydrologically Affected	3	5	10
Crowlands	37	86	Mount Cole Creek	6	Partly Confined 3	20-80%	Not Hydrologically Affected	4	5	10
Glenlofty	38	87	Glenlofty Creek	6	Chain of Ponds	<20%	Not Hydrologically Affected	4	3	10
Natimuk	41	90	Natimuk Creek	4	Alluvial Continuous 4	<20%	Not Hydrologically Affected	3	5	10
Brimpaen	42	91	Station Creek	3	Alluvial Continuous 5	20-80%	Not Hydrologically Affected	6	7	10
West Laharum	26	125	Golton Creek	2	Confined	>80%	Not Hydrologically Affected	6	4	10
Halls Gap	28	127	Fyans Creek	5	Partly Confined 1	>80%	Hydrologically Affected – Used For Water Transfer	7	7	10
Glenpatrick	40	139	Glenpatrick Creek	5	Partly Confined 2	20-80%	Not Hydrologically Affected	4	5	10

Appendix E:

Summary of Wimmera River Catchment ISC Assessments in 2002 – Location of Sites

Table E1: Summary of ISC Site Locations visited in November 2002

Field Site ID	Site Number	Reach Number	Stream Name	Site Description
FS #1	WIM1.1	1	Dunmunkle Creek	CFA 279 Property #F22
FS #2	WIM1.2	1	Dunmunkle Creek	East from Stawell - Warracknabeal Road. Closest intersection with Glenorchy - Wal Wal Road, Wal Wal.
FS #3	WIM2.1	2	Sheepwash Creek	Wimmera Park Access Road, off Stawell - Donald Road. Adjacent to property E22, CFA315.
FS #4	WIM3.1	3	Unknown 1	Access from unnamed track on Private Property, south from Laharum Road (Grampians Road). Located west from Laharum 'A' Fire Station.
FS #5	WIM2.2	2	Sheepwash Creek	Flood Channel upstream from Horsham - Wal Wal Road. Nearest intersection is Crutes Road.
FS #6	WIM4.1	4	MacKenzie Creek	Three channel system upstream from Golf Road / Three Bridges Road.
FS #7	WIM4.2	4	MacKenzie Creek	Located adjacent to a fire access track that runs along the right bank and crosses in several places. South from Hickeys Road, Wonwondah.
FS #8	WIM5.1	5	Burnt Creek	Upstream from MacInnes Road, west from the intersection with Staehrs Road.
FS #9	WIM6.1	6	Toolando Tributary	Millicent Coast - Stubgate Road, off Black Range Road. Black Range State Park.
FS #10	WIM7.1	7	Mt Talbot Creek	Upstream from unnamed road. South from Wash Tomorrow Road, off Telangatuk East Road. East from Toolondo Reservoir.
FS #11	WIM8.1	8	Boggy Creek	Downstream from Glenisla Road, east from Schmidt's Road.
FS #12	WIM8.2	8	Boggy Creek	Upstream from Asses Ears Road. Near the intersection with Wallaby Rock Road.
FS #13	WIM4.3	4	MacKenzie Creek	Upstream from the Grampians Road, Wartook.
FS #14	WIM4.4	4	MacKenzie Creek	Gorge. Downstream from MacKenzie Falls.
FS #15	WIM4.5	4	MacKenzie Creek	Upstream from MacKenzie Falls.
FS #16	WIM9.1	9	Bovine Creek	West from Grampians Road (Mt Abrupt Road). Near the intersection with Mt William Road. Downstream end of the reach is its confluence with Fyans Creek.
FS #17	WIM10.1	10	Seven Dials Creek	Adjacent to Seven Dials Track. Access upstream from Redman Road, off Grampians Road.
FS #18	WIM11.1	11	Mt William Creek	South from Redman Road, between Shields Road and Neilds Road.
FS #19	WIM12.1	12	Unknown 2	Upstream from Spears Road.
FS #20	WIM13.1	13	Golton Creek	Upstream from Copper Mine Track, Grampians National Park. Across Copper Mine Track from camping ground. Between Flat Rock Road and Polnners Track.
FS #21	WIM13.2	13	Golton Creek	Golton Gorge, access via Golton Gorge Walking Track.
FS #22	WIM14.1	14	Unknown 3	Intact Valley Fill. Downstream from Lake Fyans Tourist Road. Close to the Ararat - Halls Gap Road.
FS #23	WIM15.1	15	Unknown 4	Adjacent to Rulters Lane, off Bellellen Road. Downstream from Reids Bushland Reserve.
FS #24	WIM16.1	16	Basin Creek	Upstream from the corner of Bellellen Road and Lake Fyans Road. Property owned by Sam Young.
FS #25	WIM17.1	17	Seven Mile Creek	Adjacent to Lynleigh Estate, Landsborough - Stawell Road. Downstream from road.
FS #26	WIM17.2	17	Seven Mile Creek	Downstream from Morrl Morrl Road. North from the intersection with Granard Park Road. Near to the Stawell - Avoca Road.
FS #27A	WIM18.1	18	Wimmera River	Marma State Forest. Downstream from the Horsham - Lubeck Road. Adjacent to property A18 (CFA314).
FS #27B	WIM18.2	18	Wimmera River	Marma State Forest, off Lubek Road. Left Channel.
FS #28	WIM19.1	19	Heifer Station Creek	Upstream from Three Chain Road. Near the intersection with McSparrons Road. North from Stawell Avoca Road. Letter given to CFA 316 E11, J. Bibby - Shed.
FS #29	WIM20.1	20	Unknown 5	A. Supple Road, off Barkly, Navarre Road. Upstream from road.
FS #30	WIM21.1	21	Unknown 6	Behind property E10, upstream from Cross Road, near Barkly - Navarre Road. Letter left at E10.
FS #31	WIM22.1	22	Unknown 7	Unknown Road off Stewarts Road. Near property 354 - 21A. East from Treowen Lane. Old gold workings.
FS #32	WIM23.1	23	Unknown 8	Tributary of Heifer Station Creek. Upstream from Frenchmans Track. Off Mashado Track. Off Stawell - Avoca Road.
FS #33	WIM24.1	24	Glenpatrick Creek	Upstream from Elmhurst - Glenpatrick Road. Mined upstream.
FS #34	WIM24.2	24	Glenpatrick Creek	Upstream from North Glenpatrick Road. Near the corner of Emery Track.
FS #35	WIM25.1	25	Spring Creek	Downstream from Spring Creek Road, off Nowhere Creek Road.
FS #36	WIM25.2	25	Nowhere Creek	Access via Property CFA354F5 (N Powell). Upstream from property.
FS #37	WIM25.3	25	Nowhere Creek	Behind property CFA354F5 (N. Powell). Nowhere Creek Road.
FS #38	WIM26.1	26	Glenlofty Creek	Downstream from Boatmans Road. Off Elmhurst - Landsborough Road.
FS #39	WIM26.2	26	Glenlofty Creek	Adjacent to Warrenmang Road, between Croft & Williamson Road.
FS #40	WIM27.1	27	Reservoir Creek	Off Moyston - Dunkeld Road. West from Gumnut Camp.
FS #41	WIM28.1	28	Unknown 9	Downstream from Rocky Point Bushland Reserve. Off Rocky Point Road (off the Halls Gap - Ararat Road). Downstream from Black Cow Road.

Field Site ID	Site Number	Reach Number	Stream Name	Site Description
FS #42	WIM29.1	29	Tributary of Pentland Creek	Downstream from McGuans Road. Between Polas Road & Killough Road.
FS #43	WIM30.1	30	Unknown 10	Downstream from Property CFA392A 25 - AB & E Graham. Off Brewery Road, access via Military Bypass Road.
FS #44	WIM31.1	31	Unknown 11	Upstream from Sinnots Road. Off Allanvale - Dunworthy Common Road.
FS #45	WIM32.1	32	Spring Creek	Access via property 267 Spring Flat Road. Downstream from a fenced stand of exotics.
FS #46	WIM18.3	18	Wimmera River	Downstream from Bulgana Road. Between Woodlands - Ararat Road & Joel Joel - Crowlands Road. Downstream from Ford.
FS #47	WIM33.1	33	Aston's Scour Tributary	Downstream from Landsborough West - Tulkarra Railway Road. Landsborough West. North from Aston's Scour.
FS #48	WIM34.1	34	Unknown 12	South from T.Vances Road. Near the Joel South - Landsborough Road.
FS #49	WIM35.1	35	Unknown 13	Upstream from Ararat - St Arnaud Road. South from Starts Road.
FS #50	WIM36.1	36	Unknown 14	Downstream from the end of Forestry Road, Landsborough.
FS #51	WIM37.1	37	Wattle Creek Tributary	Downstream from Landsborough Road, Landsborough.

Appendix F:

Original Vegetation Cover Data for 52 ISC sites assessed in 2002

Original Vegetation Cover Data

The Wimmera CMA provided Earth Tech with two GIS layers, one being of the Bioregions in the Wimmera River catchment and the other being of the pre-1750 EVC (Ecological Vegetation Class) information. This information was queried using ArcMap 8.1 to determine the Bioregion and pre-1750 EVC for each of the 52 ISC sites visited in 2002.

Table F1 was sent to the Wimmera CMA as a request for EVC information. The Department of Sustainability and Environment provided the Wimmera CMA with the relevant EVC descriptions, which were then passed on to Earth Tech for interpretation.

Each EVC was given a cover score for each of the three structural layers. The layers are the Overstorey, Understorey and Groundlayer. The cover scores are <20% (sparse), 20-80% (patchy) and >80% (continuous). An example of the interpretation is shown in Tables F2 and F3.

Table F1: The pre-1750 EVCs at the 52 ISC sites visited in 2002

EVC_NEW	Field Site ID	EVC	EVC_TYPE
Sand Ridge Woodland / Damp Sands Herb-rich Woodland Mosaic	6	729	mosaic
Plains Riparian Shrubby Woodland	7	659	EVC
Lateritic Woodland	9	704	EVC
Creekline Sedgy Woodland	10	640	EVC
Damp Sands Herb-rich Woodland / Shrubby Woodland Mosaic	11	672	mosaic
Riparian Scrub Complex	14	17	complex
Cool / Warm Temperate Rainforest Overlap	18	33	complex
Hills Herb-rich Woodland	20	71	EVC
Rocky Outcrop Herbland	21	193	EVC
Riparian Forest	33	18	EVC
Grassy Woodland	42	175	EVC
Grassy Dry Forest	49	22	EVC
Herb-rich Foothill Forest	12, 34, 39	23	EVC
Plains Grassy Woodland	13, 23	55	EVC
Heathy Dry Forest	15, 17	20	EVC
Damp Sands Herb-rich Woodland	16, 40	3	EVC
Shrubby Woodland	19, 22	282	EVC
Drainage-line Woodland	3, 2	679	EVC
Low Rises Grassy Woodland / Alluvial Terraces Herb-rich Woodland Mosaic	31, 29	76	mosaic
Valley Grassy Forest	36, 37, 35	47	EVC
Creekline Grassy Woodland	38,45, 48, 51, 30, 26, 24, 25	68	EVC
Plains Woodland	47, 28, 4, 1	803	EVC
Riparian Woodland	5, 8, 46, 27b, 27a	641	EVC
Alluvial Terraces Herb-rich Woodland	50, 32, 44, 43, 41	67	EVC

Example: Extract of an EVC for interpretation

The relevant sections of the Goldfields Bioregion Creekline Grassy Woodland have been reproduced in Tables F2 and F3.

Table F2: Tree Canopy Cover for Example EVC

%cover	Character Species	Common Name	Total Cover
15%	*Eucalyptus camaldulensis*	River Red-gum	
	Eucalyptus microcarpa	Grey Box	
	Eucalyptus melliodora	Yellow Box	15%

All EVCs have a section on the percentage cover of the overstorey vegetation. In this case, it is 15%, which is equivalent to a structural intactness score of sparse (<20%).

Table F3: Understorey Canopy Cover for Example EVC

Life form	%Cover	Total Cover
Immature Canopy Tree	**5%**	
Medium Shrub	**10%**	
Small Shrub	**5%**	20%
Large Herb	**5%**	
Medium Herb	**15%**	
Large Tufted Graminoid	**15%**	
Medium to Small Tufted Graminoid	**25%**	
Medium to Tiny Non-tufted Graminoid	**5%**	
Bryophytes/Lichens	**10%**	75%

The percentages of cover for those life forms that are considered shrubs have been added up, with a result of 20%. This means that the understorey rating is patchy (20-80%). Similarly, the percentages of cover for those life forms that would make up the ground cover add up to 75%. The ground cover rating is therefore continuous (>80%).

This is a rough interpretation of the EVC data for use in the Index of Stream Condition Streamside Zone Sub-index score. It is not a defined method from the original ISC methodology. Rather, it was developed as a way of integrating the extensive EVC information into the ISC method.

Table F4 is a summary of the interpretation of structural intactness for all EVCs relevant to this project. In some cases, the EVC was not available for a particular bioregion. For example, the Dundas Tablelands Plains Grassy Woodland was not available from the DSE. In its place, the Wimmera Plains Grassy Woodland EVC was used to determine the approximate structural intactness.

The Wimmera Drainage-line Woodland EVC was not available. Based on the Plains Woodland, the structural intactness given to the sites was: overstorey (sparse, <20%), understorey (sparse, <20%) and groundcover (continuous, >80%).

The bioregion and pre-1750 EVC for each of the 52 sites visited in 2002 are summarised in Appendix H, *Table H1: Summary of ISC Assessment in 2002*.

Table F4: The interpretation of the structural intactness for the pre-1750s EVC communities.

BIOREGION	EVC code	EVC Description	BioRegion Used	Overstorey	Understorey	Groundcover
Central Victorian Uplands	18	Riparian Forest		patchy (20-80%)	patchy (20-80%)	continuous (>80%)
Central Victorian Uplands	23	Herb-rich Foothill Forest		patchy (20-80%)	patchy (20-80%)	continuous (>80%)
Dundas Tablelands	55	Plains Grassy Woodland	Wimmera	sparse (<20%)	sparse (<20%)	continuous (>80%)
Dundas Tablelands	640	Creekline Sedgy Woodland		sparse (<20%)	patchy (20-80%)	patchy (20-80%)
Dundas Tablelands	672	Damp Sands Herb-rich Woodland / Shrubby Woodland Mosaic		sparse (<20%)	patchy (20-80%)	continuous (>80%)
Goldfields	22	Grassy Dry Forest		patchy (20-80%)	patchy (20-80%)	continuous (>80%)
Goldfields	23	Herb-rich Foothill Forest	Central Vic Uplands	patchy (20-80%)	patchy (20-80%)	continuous (>80%)
Goldfields	47	Valley Grassy Forest		patchy (20-80%)	patchy (20-80%)	continuous (>80%)
Goldfields	55	Plains Grassy Woodland		sparse (<20%)	sparse (<20%)	continuous (>80%)
Goldfields	67	Alluvial Terraces Herb-rich Woodland		sparse (<20%)	patchy (20-80%)	continuous (>80%)
Goldfields	68	Creekline Grassy Woodland		sparse (<20%)	patchy (20-80%)	continuous (>80%)
Goldfields	76	Low Rises Grassy Woodland / Alluvial Terraces Herb-rich Woodland Mosaic		sparse (<20%)	patchy (20-80%)	continuous (>80%)
Goldfields	175	Grassy Woodland		sparse (<20%)	patchy (20-80%)	continuous (>80%)
Goldfields	282	Shrubby Woodland	Central Vic Uplands	sparse (<20%)	patchy (20-80%)	patchy (20-80%)
Goldfields	641	Riparian Woodland	All Bio Regions	sparse (<20%)	patchy (20-80%)	continuous (>80%)
Goldfields	803	Plains Woodland	Wimmera	sparse (<20%)	sparse (<20%)	continuous (>80%)
Greater Grampians	3	Damp Sands Herb-rich Woodland	Wimmera & CVU	sparse (<20%)	patchy (20-80%)	continuous (>80%)
Greater Grampians	17	Riparian Scrub Complex	All Bio Regions	patchy (20-80%)	patchy (20-80%)	patchy (20-80%)
Greater Grampians	20	Heathy Dry Forest		patchy (20-80%)	patchy (20-80%)	continuous (>80%)
Greater Grampians	23	Herb-rich Foothill Forest	Central Vic Uplands	patchy (20-80%)	patchy (20-80%)	continuous (>80%)
Greater Grampians	71	Hills Herb-rich Woodland		sparse (<20%)	patchy (20-80%)	continuous (>80%)
Greater Grampians	193	Rocky Outcrop Herbland		sparse (<20%)	patchy (20-80%)	patchy (20-80%)
Greater Grampians	282	Shrubby Woodland	Central Vic Uplands	sparse (<20%)	patchy (20-80%)	patchy (20-80%)
Greater Grampians	704	Lateritic Woodland		sparse (<20%)	patchy (20-80%)	continuous (>80%)
Wimmera	641	Riparian Woodland		sparse (<20%)	patchy (20-80%)	continuous (>80%)
Wimmera	659	Plains Riparian Shrubby Woodland		sparse (<20%)	patchy (20-80%)	continuous (>80%)
Wimmera	660	Plains Woodland / Plains Grassy Wetland Mosaic		sparse (<20%)	sparse (<20%)	continuous (>80%)
Wimmera	679	Drainage-line Woodland		No Benchmark Available		
Wimmera	729	Sand Ridge Woodland / Damp Sands Herb-rich Woodland Mosaic		sparse (<20%)	patchy (20-80%)	continuous (>80%)
Wimmera	803	Plains Woodland		sparse (<20%)	sparse (<20%)	continuous (>80%)
All Bioregions	17a	Riparian Scrub Complex		patchy (20-80%)	patchy (20-80%)	patchy (20-80%)

Appendix G:

Data Summary Sheets and Field Assessment Photographs for 52 ISC sites assessed in 2002

Appendix H:

Summary of Wimmera River Catchment ISC Assessments in 2002

Table H1: Summary of ISC Assessment in 2002

Stream Name	Unit id	ISC PF Score	ISC SZ Score	Stream Order	Stream Style	Overstorey Vegetation Cover	Hydrology Type	Bioregion	Pre-1750 EVC
Dunmunkle Creek	FS #1	5	4	3	Alluvial Continuous 1	<20% Cover	Not Hydrologically Affected	Wimmera	Plains Woodland
Dunmunkle Creek	FS #2	5	6	3	Alluvial Continuous 1	<20% Cover	Not Hydrologically Affected	Wimmera	Drainage-line Woodland
Sheepwash Creek	FS #3	7	5	3	Alluvial Continuous 1	20-80% Cover	Not Hydrologically Affected	Wimmera	Drainage-line Woodland
Unknown 1	FS #4	3	4	3	Incised Alluvial Discontinuous	20-80% Cover	Not Hydrologically Affected	Wimmera	Plains Woodland
Sheepwash Creek	FS #5	8	6	8	Alluvial Continuous 1	20-80% Cover	Hydrologically Affected - Water Removed	Wimmera	Riparian Woodland
MacKenzie Creek	FS #6	6	8	4	Discontinuous Anabranching Chain of Ponds	20-80% Cover	Hydrologically Affected - Used for Water Transfer	Wimmera	Sand Ridge Woodland / Damp Sands Herb-rich Woodland Mosaic
MacKenzie Creek	FS #7	8	7	3	Discontinuous Anabranching Chain of Ponds	20-80% Cover	Hydrologically Affected - Water Removed	Wimmera	Plains Riparian Shrubby Woodland
Burnt Creek	FS #8	6	6	5	Alluvial Continuous 1	20-80% Cover	Hydrologically Affected - Water Removed	Wimmera	Riparian Woodland
Toolando Tributary	FS #9	6	9	2	Intact Valley Fill	<20% Cover	Not Hydrologically Affected	Greater Grampians	Lateritic Woodland
Mt Talbot Creek	FS #10	2	3	3	Incised Alluvial Discontinuous	<20% Cover	Not Hydrologically Affected	Dundas Tablelands	Creekline Sedgy Woodland
Boggy Creek	FS #11	7	6	1	Partly Confined 1	<20% Cover	Not Hydrologically Affected	Dundas Tablelands	Damp Sands Herb-rich Woodland / Shrubby Woodland Mosaic
Boggy Creek	FS #12	8	8	3	Confined	> 80% Cover	Not Hydrologically Affected	Greater Grampians	Herb-rich Foothill Forest
MacKenzie Creek	FS #13	8	8	5	Partly Confined 2	20-80% Cover	Hydrologically Affected - Used for Water Transfer	Dundas Tablelands	Plains Grassy Woodland
MacKenzie Creek	FS #14	8	9	4	Gorge	> 80% Cover	Hydrologically Affected - Used for Water Transfer	Greater Grampians	Riparian Scrub Complex
MacKenzie Creek	FS #15	8	7	4	Partly Confined 1	> 80% Cover	Hydrologically Affected - Used for Water Transfer	Greater Grampians	Heathy Dry Forest
Bovine Creek	FS #16	8	9	3	Partly Confined 3	> 80% Cover	Not Hydrologically Affected	Greater Grampians	Damp Sands Herb-rich Woodland
Seven Dials Creek	FS #17	7	9	3	Steep Headwater	> 80% Cover	Not Hydrologically Affected	Greater Grampians	Heathy Dry Forest
Mt William Creek	FS #18	6	7	5	Alluvial Continuous 4	20-80% Cover	Not Hydrologically Affected	Goldfields	Creekline Grassy Woodland
Unknown 2	FS #19	4	8	3	Incised Alluvial Discontinuous	> 80% Cover	Not Hydrologically Affected	Greater Grampians	Shrubby Woodland
Golton Creek	FS #20	8	7	1	Steep Headwater	20-80% Cover	Not Hydrologically Affected	Greater Grampians	Hills Herb-rich Woodland
Golton Creek	FS #21	8	7	3	Gorge	> 80% Cover	Not Hydrologically Affected	Greater Grampians	Rocky Outcrop Herbland
Unknown 3	FS #22	4	8	3	Intact Valley Fill	> 80% Cover	Not Hydrologically Affected	Goldfields	Shrubby Woodland
Unknown 4	FS #23	5	5	2	Incised Alluvial Discontinuous	<20% Cover	Not Hydrologically Affected	Goldfields	Plains Grassy Woodland
Basin Creek	FS #24	7	4	3	Incised Alluvial Discontinuous	20-80% Cover	Not Hydrologically Affected	Goldfields	Creekline Grassy Woodland
Seven Mile Creek	FS #25	6	4	4	Alluvial Continuous 4	20-80% Cover	Not Hydrologically Affected	Goldfields	Creekline Grassy Woodland
Seven Mile Creek	FS #26	5	3	5	Alluvial Continuous 1	20-80% Cover	Not Hydrologically Affected	Goldfields	Creekline Grassy Woodland
Wimmera River	FS #27A	7	7	8	Anabranching Fine Grained	20-80% Cover	Hydrologically Affected - Water Removed	Wimmera	Riparian Woodland
Wimmera River	FS #27B	6	8	5	Anabranching Fine Grained	20-80% Cover	Hydrologically Affected - Water Removed	Wimmera	Riparian Woodland
Heifer Station Creek	FS #28	4	4	4	Incised Alluvial Discontinuous	<20% Cover	Not Hydrologically Affected	Goldfields	Plains Woodland
Unknown 5	FS #29	5	3	3	Intact Valley Fill	<20% Cover	Not Hydrologically Affected	Goldfields	Low Rises Grassy Woodland / Alluvial Terraces Herb-rich Woodland Mosaic
Unknown 6	FS #30	0	3	4	Incised Alluvial Discontinuous	<20% Cover	Not Hydrologically Affected	Goldfields	Creekline Grassy Woodland
Unknown 7	FS #31	3	7	3	Cut & Fill	> 80% Cover	Not Hydrologically Affected	Goldfields	Low Rises Grassy Woodland / Alluvial Terraces Herb-rich Woodland Mosaic
Unknown 8	FS #32	5	7	4	Partly Confined 1	> 80% Cover	Not Hydrologically Affected	Goldfields	Alluvial Terraces Herb-rich Woodland
Glenpatrick Creek	FS #33	8	6	5	Partly Confined 2	20-80% Cover	Not Hydrologically Affected	Central Victorian Uplands	Riparian Forest

Stream Name	Unit id	ISC PF Score	ISC SZ Score	Stream Order	Stream Style	Overstorey Vegetation Cover	Hydrology Type	Bioregion	Pre-1750 EVC
Glenpatrick Creek	FS #34	8	9	4	Confined	> 80% Cover	Not Hydrologically Affected	Central Victorian Uplands	Herb-rich Foothill Forest
Spring Creek	FS #35	7	7	5	Partly Confined 1	20-80% Cover	Not Hydrologically Affected	Goldfields	Valley Grassy Forest
Nowhere Creek	FS #36	5	3	6	Partly Confined 3	20-80% Cover	Not Hydrologically Affected	Goldfields	Valley Grassy Forest
Nowhere Creek	FS #37	6	6	6	Partly Confined 3	<20% Cover	Not Hydrologically Affected	Goldfields	Valley Grassy Forest
Glenlofty Creek	FS #38	6	5	6	Chain of Ponds	<20% Cover	Not Hydrologically Affected	Goldfields	Creekline Grassy Woodland
Glenlofty Creek	FS #39	6	5	4	Chain of Ponds	<20% Cover	Not Hydrologically Affected	Goldfields	Herb-rich Foothill Forest
Reservoir Creek	FS #40	6	8	4	Alluvial Continuous 1	<20% Cover	Not Hydrologically Affected	Greater Grampians	Damp Sands Herb-rich Woodland
Unknown 9	FS #41	1	3	3	Incised Alluvial Discontinuous	<20% Cover	Not Hydrologically Affected	Goldfields	Alluvial Terraces Herb-rich Woodland
Tributary of Pentland Creek	FS #42	2	4	3	Incised Alluvial Discontinuous	<20% Cover	Not Hydrologically Affected	Goldfields	Grassy Woodland
Unknown 10	FS #43	4	4	4	Incised Alluvial Discontinuous	<20% Cover	Not Hydrologically Affected	Goldfields	Alluvial Terraces Herb-rich Woodland
Unknown 11	FS #44	2	3	4	Incised Alluvial Discontinuous	<20% Cover	Not Hydrologically Affected	Goldfields	Alluvial Terraces Herb-rich Woodland
Spring Creek	FS #45	2	3	5	Incised Alluvial Discontinuous	<20% Cover	Not Hydrologically Affected	Goldfields	Creekline Grassy Woodland
Wimmera River	FS #46	6	5	8	Partly Confined 3	20-80% Cover	Not Hydrologically Affected	Goldfields	Riparian Woodland
Aston's Scour Tributary	FS #47	3	5	3	Incised Alluvial Discontinuous	<20% Cover	Not Hydrologically Affected	Goldfields	Plains Woodland
Unknown 12	FS #48	1	4	3	Incised Alluvial Discontinuous	<20% Cover	Not Hydrologically Affected	Goldfields	Creekline Grassy Woodland
Unknown 13	FS #49	5	3	4	Floodout	<20% Cover	Not Hydrologically Affected	Goldfields	Grassy Dry Forest
Unknown 14	FS #50	4	5	2	Incised Alluvial Discontinuous	<20% Cover	Not Hydrologically Affected	Goldfields	Alluvial Terraces Herb-rich Woodland
Wattle Creek Tributary	FS #51	1	5	1	Incised Alluvial Discontinuous	<20% Cover	Not Hydrologically Affected	Goldfields	Creekline Grassy Woodland

Appendix I:

Map of Overstorey Vegetation Cover Assessment from Aerial Photograph Interpretation and Location of 89 ISC Sites Assessed in 1999 & 2002

Appendix J:

Hydrologic Analysis (from Wimmera River Geomorphic Assessment 2001) and Map

Contents

An Indication of Hydrologic Change

The hydrologic and hydraulic analysis comprising this appendix indicates the effects of regulation on the volume and frequency of mean daily flows, therefore giving a better understanding of the flow processes now affecting the river channel.

This appendix also indicates the state of the Wimmera River prior to European settlement and the changes that have altered the River.

Hydrologic comparisons were made for locations on the Wimmera River considered to be upstream of the majority of flow regulations and diversions and for a location on the river considered to be downstream of the major regulations and diversions. Flow information was also obtained for an adjacent catchment to determine the natural variations.

For flow data the location upstream of the human changes was taken as Glynwylln station and Concongella Station combined, the location being upstream of Glenorchy, the location of numerous in channel alterations. For flow data from a location downstream of the changes the Horsham Station, downstream of Horsham but upstream of Mackenzie River, was used.

An adjacent catchment, the Avoca River was included in the analysis to ensure the differences in flow indicated are reflecting human alteration to the flow regime rather than natural variations over the periods. The Avoca Basin runs parallel with the Wimmera/Avon Basin with a similar orientation of a general northerly flow direction. There are no major water storages or diversions in the Avoca River (Department of Water Resources Victoria, 1989) which make variations in flows over time periods a result of natural variation as opposed to human interference.

Gauging station information was obtained from Thiess for the following sites, Table J1.

Table J1. Gauging stations used in analysis.

Station no.	Waterway	Location	Data Type	Period of Data
415 206	Wimmera River	Glynwylln – upstream of Glenorchy	Mean daily flow (ML/d)	1946-2001
415 237	Concongella Creek	Stawell – tributary of Wimmera	Mean daily flow (ML/d)	1976-2001
415 200	Wimmera River	Downstream of Horsham – upstream of McKenzie River	Mean daily flow (ML/d)	1889-2001
408 200	Avoca River	Coonooer – upstream of Charlton	Mean daily flow (ML/d)	1889-2001

Historical Waterway Changes in the Wimmera River

The Wimmera River Untouched by European Settlement

In 1836 Major Thomas Mitchell and his party became the first Europeans to pass through the Wimmera Region. While Mitchell's party came across the Wimmera River from the south at a location above Horsham the diaries do not give any descriptive indication to the Wimmera River at this location. The following descriptions of the Wimmera River south of Horsham have been summarised from Mitchell (1839);

- *"At a quarter mile from the camp, we crossed a running stream, which also contained deep, and apparently permanent pools. Several pine or callitris trees grew near its banks, being the first we had seen for some time. I named this mountain stream the Mackenzie."*
- *"Beyond it, were grassy, undulating plains, with clumps of casurina, and box trees (eucalypti). At three miles, we came to a deep stream, running with considerable rapidity, over a bed of sandstone rock…. This I named the Norton."*
- *"At nine miles…we soon came once more upon the Wimmera, flowing in one deep channel nearly as broad as the Murrumbidgee, but in no other respect at all similar. The banks of this newly discovered river were not water-worn, but characterised by verdant slopes, the borders being fringed with bushes of mimosae."*

After this point Mitchell and his party abandoned the pursuit of the Wimmera River and headed south-west.

A History of Alteration

From various stated sources an account of dates pertaining to human alterations of the Wimmera River can be formulated, Table J2. Channel works in the vicinity of Horsham have been abstracted from the works file of the State Rivers and Water Supply Commission (SRWSC) for the period 1966 to 1970. Apart from the construction of weirs and offtakes works have included snag removal, in-channel and floodplain vegetation removal, alignment training, sand extraction and channel enlargement works.

From the historical investigation it was identified that the years between 1935 and 1968 involved the majority of the river diversions and storages constructed with an effect on the flow in the Wimmera River.

Table J2: River Alteration Dates

Date	Flow Alteration	References
1857	First weir on Wimmera River used to divert water into Yarriambiack Creek (used until about 1920)	Pers. Comm. John Martin (WMW)
1878	Weir constructed 5km above Glenorchy to divert water into Dunmunkle and Swedes Creeks	WMW (Wimmera Mallee Water) homepage 2001
1887	Construction of Wartook Reservoir, first storage in Wimmera Catchment – Mackenzie River	Pers. Comm. John Martin (WMW)
Late 1800s	Dooen Weir constructed to supply water via pump to Patterson Swamp channel system (towards Dimboola)	
1903	Construction Lake Lonsdale (65,500 ML) – Mt William Creek. Construction Glenorchy Weir and compensation weirs in mid-lower river (i.e. Drung Drung, Dimboola, Antwerp and Jeparit).	WMW 2001, Department of Water Resources Victoria (DWR) Victoria 1989a, Pers. Comm. John Martin (WMW)
1916	Fyans Lake construction (21,000 ML) – Fyans Creek	WMW 2001
1920's	Huddlestons Weir construction for supply of water to Taylors and Pine Lakes (reconstruction early 1980s)	Pers. Comm. John Martin (WMW)
1923	Taylors Lake effective operation (36,000 ML) and Pine Lake (64,000 ML)	Pers. Comm. John Martin (WMW)
1934/35	Green and Dock Lakes construction	WMW 2001
1960's	Construction of low weir in Wimmera River at Yarriambiack Creek offtake to ensure a share of low flows passed to Creek	Pers. Comm. John Martin (WMW)
1966	Lake Bellfield construction (78,500 ML) – Fyans Creek Removal of snags, scrub and obstructions Glenorchy downstream, cut channels across two bends in River near Company's Bridge.	DWR 1989, State Rivers and Water Supply Commission (SRWSC)1970
1967	Removal of snags and vegetation from silt islands within the Wimmera River from Horsham downstream to Kenny's Ford	SRWSC 1970
1968	Construction of low level weir at Glenorchy	Pers. Comm. John Martin
1969	Removal of snags and cumbungi (using bulldozer) from river channel between highway bridge and Drummond St, removal of soil from river bed (inside of bends) From Glenorchy downstream to Faux Bridge (3 miles) removal of trees from bed of river and 'redefine stream through sand banks'.	SRWSC 1970
1970	Horsham Weir construction – Wimmera River (original weir constructed much earlier) Deepening and Widening of Wimmera River throughout Horsham City Riverbed clearing of instream vegetation through Horsham ceased	SRWSC 1970, Pers. Comm. John Martin (WMW)

Hydrologic Change

Since hydrology and hydraulics of river systems are complex there are several ways of assessing changes. Comparisons of pre and post regulation flow conditions have been made using flow duration and flood frequency analysis. The effective discharge technique has been used to identify the likely change in channel hydraulic capacity resulting from changes in the hydrologic regime.

Hydrologic assessments have been undertaken for the Wimmera River near Horsham and the Avoca River (Coonooer Guage). The Avoca River is considered to have not been impacted by flow regulation and provides a useful comparison for the assessment of regulation versus natural variation in hydrologic regime.

From the historical investigation it was identified that the years between 1935 and 1968 involved the majority of the river diversions and storages constructed with an effect on the flow in the Wimmera River. The flow duration analysis adopted for this investigation requires identical periods of data. For the purpose of pre/post regulation comparisons the periods used for the Wimmera River at Horsham and the Avoca River at Coonooer were 1900-1930 (pre-regulation) and 1970-2000 (post-regulation). The full periods of record outside the period of regulation change (1935 to 1968) were used for flood frequency analysis.

Avoca River – Coonooer Gauging Station (408 200)

The Mean daily flow data for the Avoca River was obtained from Coonooer Gauging Station (408 200), downstream of the Coonooer Bridge and upstream of Charlton. Mean annual streamflow for the Coonooer station is 43,000 ML, compared with 135,000 ML for the Horsham station (Department of Water Resources Victoria, 1989). While there are differences in catchment sizes the stations are worthy comparisons as they are located approximately half way down their respective river systems below most major tributary inputs.

Flow Duration

Flow duration curves indicate the amount of time for which river flows occur within a particular flow range. The duration of time in which flows are within a flow range are indicated by cumulative number of days for which a flow is exceeded over a time period. From the curve the amount of time (number of days) for which mean daily flows are above a particular flow is indicated, for example at the Coonooer gauge post regulation period mean daily flows greater than 15,000 ML/day occurred for 32 days of the 31 year period, Figure J1.

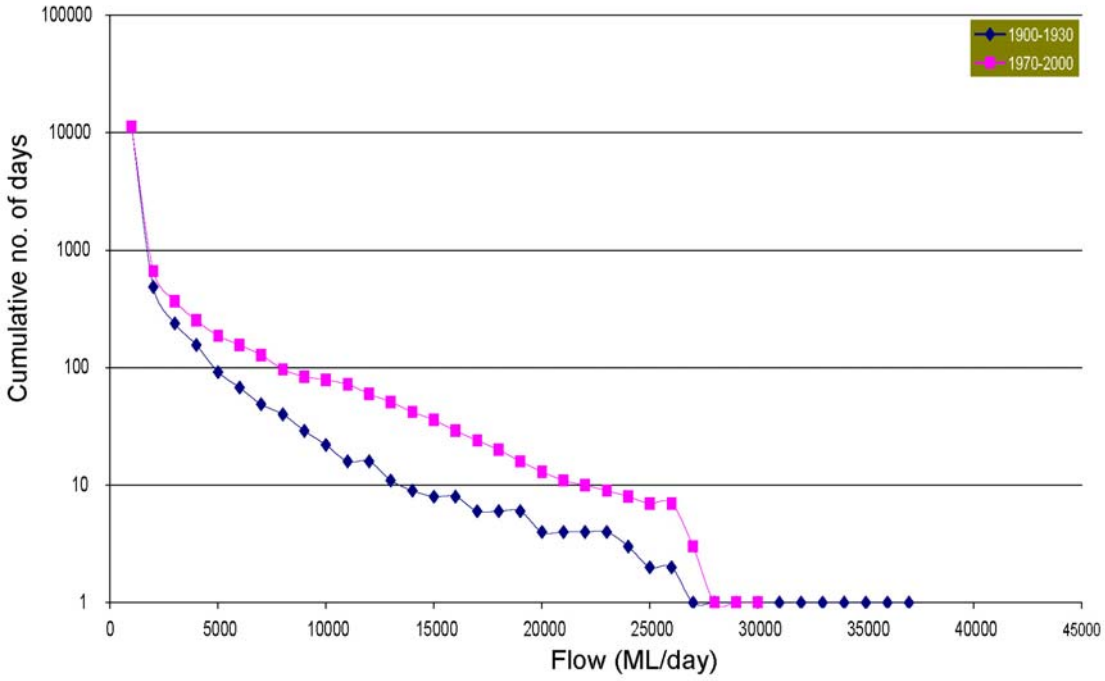


Figure J1 *Flow Duration Curves – Avoca River Coonooer Gauge (408 200)*

Flood Frequency

A flood frequency analysis indicates the return period for a flood of a particular magnitude, this can be represented as an Annual Exceedence Probability (AEP). Annual series Log Pearson Type III analysis has been adopted for the investigation.

The variation in flood frequency for the Avoca River at Coonooer station has been assessed for the same periods (pre and post regulation) as that used for the Wimmera River Horsham gauge, Figures J2 and J3.

The change in flood frequency indicates a general increase in flood frequency magnitude for the equivalent Horsham post regulation period, Table J3.

Table J3 Flood Frequency Summary Avoca River at Coonooer Station.

AEP (%)	Discharge (Ml/d) (1900-1930)	Discharge (Ml/d) (1970-2000)	% Change
50	6585	11070	+68
20	14467	21866	+51
10	20698	26621	+29
5	27312	30011	+10

Note: Results for the 2% and 1% AEP's are not reliable for 30 year data period and have been excluded from the table.

The results for the Avoca River flood frequency analysis indicate that the floods in the 1970 –2000 period were greater than those in the period 1900 -1930. The flow duration analysis indicates that flows were greater in the 1970 –2000 period than that in the 1900-1930 period.

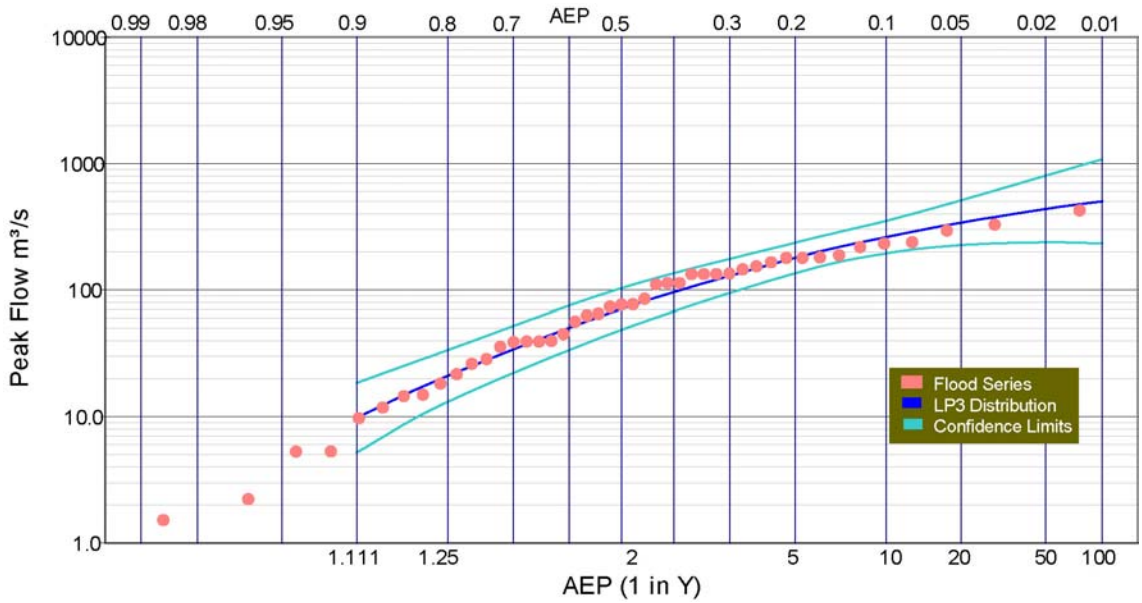


Figure J2 Flood Frequency Curve – Avoca (1900 – 1930)

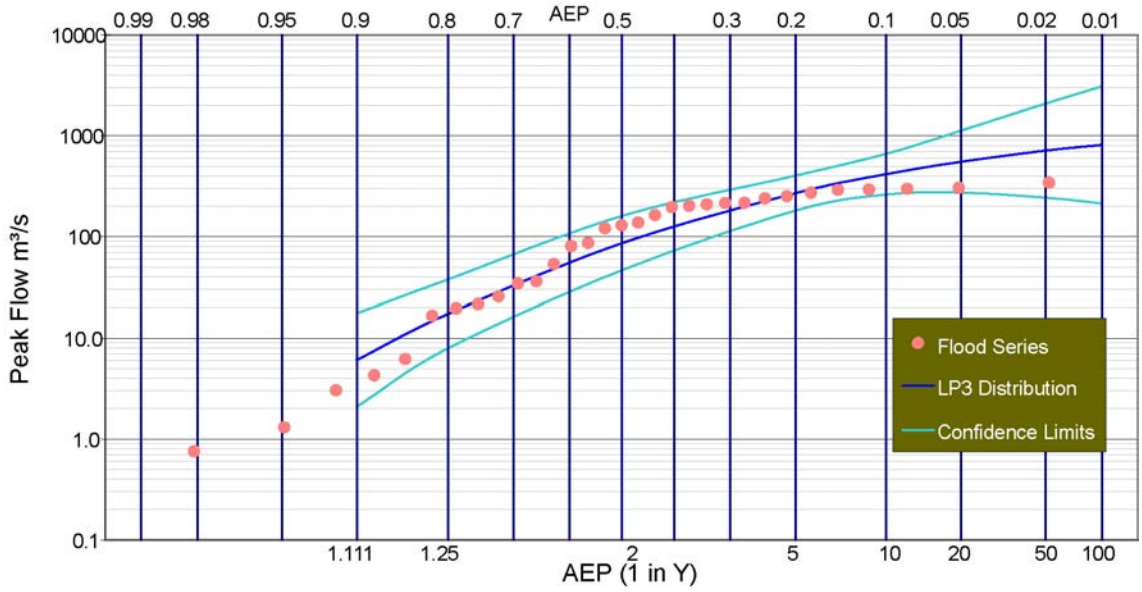


Figure J3 Flood Frequency Curve – Avoca (1970 – 2000)

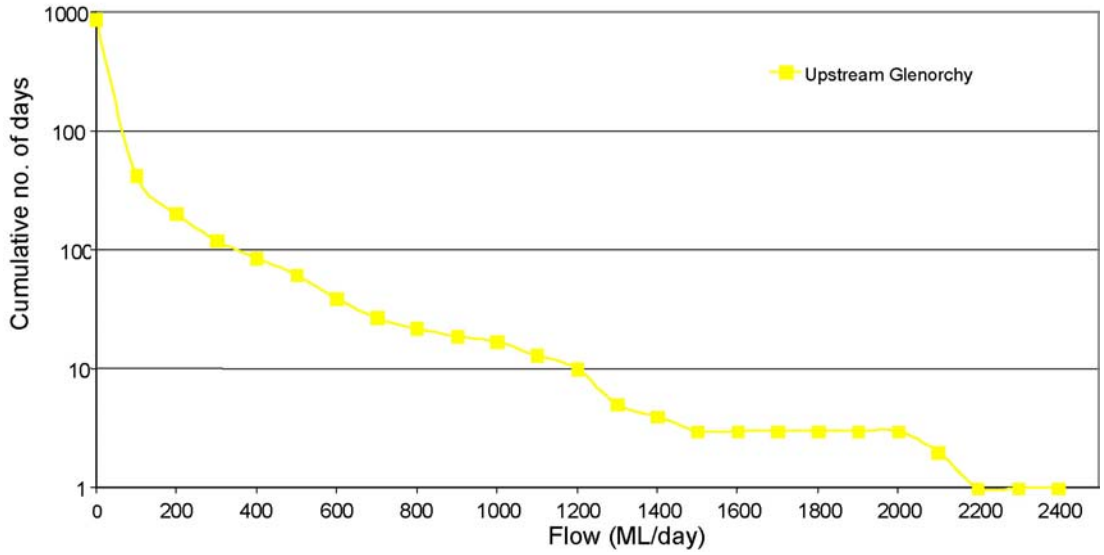
Wimmera River – Glynwylln Station

Flow data for upstream of Glenorchy is obtained from the Glynwylln gauge on the Wimmera River and Concongella gauging station on Concongella Creek (415 237).

Flow Duration

The flow duration curve for the section upstream of the main diversions and regulations was obtained from the mean daily flow data by combining the flows from the Glynwylln station with those for Concongella Creek with a day lag. The period is 24 years from 1977 – 2000 inclusive, the longest period of combined record. No pre regulation dates were considered for Glynwylln.

The period of data is not equal to that chosen for the downstream flow duration curve and as such the curve is not for flow comparison purposes between sites but an indication of the trend in flow duration in the upper catchment, Figure J4. Data has been used for sediment transport investigations



FigureJ4 Flow Duration Curve Wimmera River – Upstream of Glenorchy (415 206 and 415 237)

Wimmera River – Horsham Station

The flow duration curve for the section downstream of the main diversions and storages was taken at the Horsham gauging station (415 200).

Flow Duration

To ensure a relative comparison, periods of equal length were chosen for pre and post conditions. The periods of flow were separated into pre regulation, 1900 – 1930 inclusive and post regulation, 1970 – 2000 inclusive. Both data periods are 31 years, Figure J5.

Flood Frequency

Annual series flood frequency curves were produced for pre and post regulation periods for the Wimmera River. Pre regulation curves were for the period 1889 to 1933 inclusive (45 years), Figure J6, and post regulation 1970 to 2000 inclusive (31 years), Figure J7.

A comparison of discharges for flood frequencies for the Wimmera River upstream and downstream of river alterations reveals a decrease in discharges post regulation, Table J4.

Table J4. Flood Frequency Summary Wimmera River Downstream of Horsham.

AEP (%)	1900-1930 Discharge (m3/s)	1970-2000. Discharge (m3/s)	% Change
50	97	53	-45
20	217	135	-38
10	311	200	-36
5	411	269	-35

Note: Results for the 2% and 1% AEP's are not reliable for 30 year data period and have been excluded from the table.

These results suggest a reduction in flood magnitude in the post regulation period when compared against the pre regulation period. This is in contrast to the results for the Avoca River gauge. The analysis suggests that the reduction in stream flow and flood magnitude in the Wimmera River is likely to be the result of human intervention (flow regulation) alone and not associated with temporal variation in hydrology.

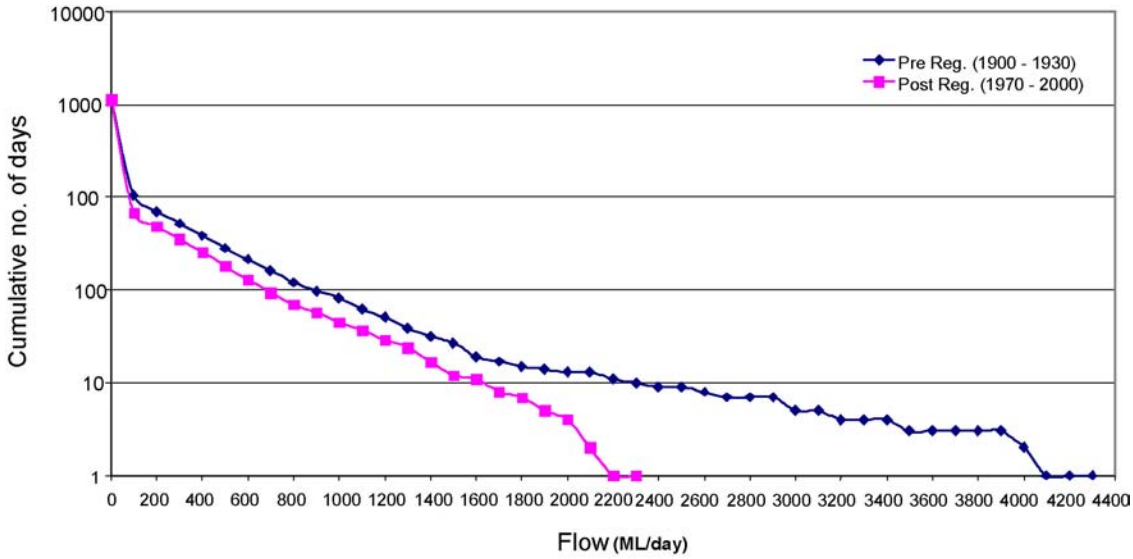


Figure J5 Flow Wimmera River Horsham Gauge (415 200)

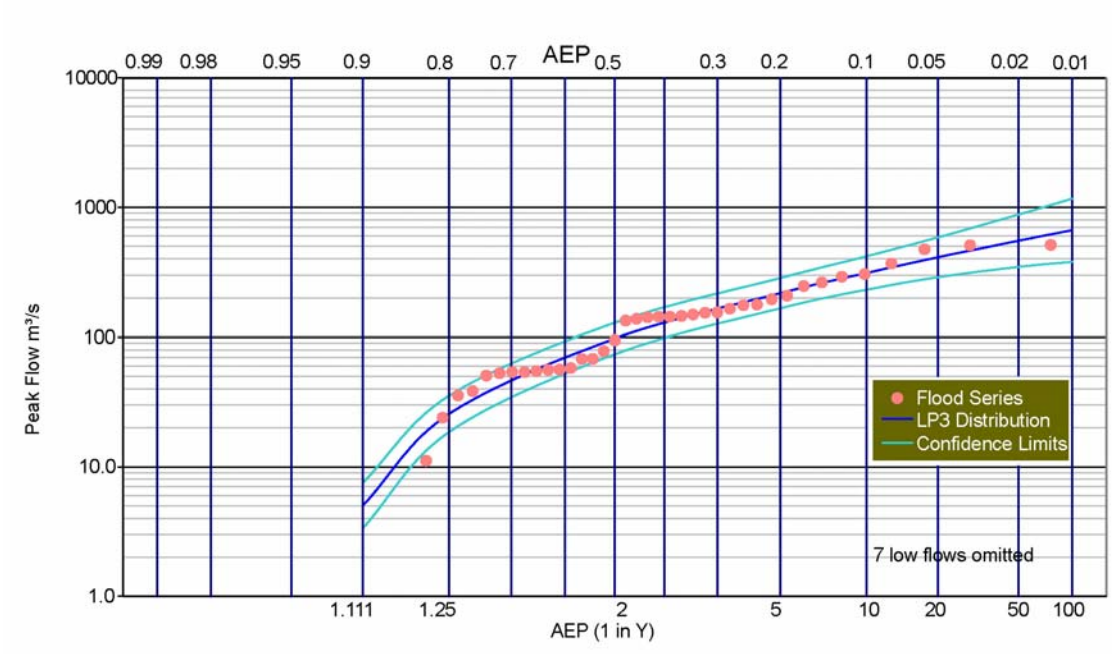


Figure J6 Horsham Pre Regulation 1900 – 1930

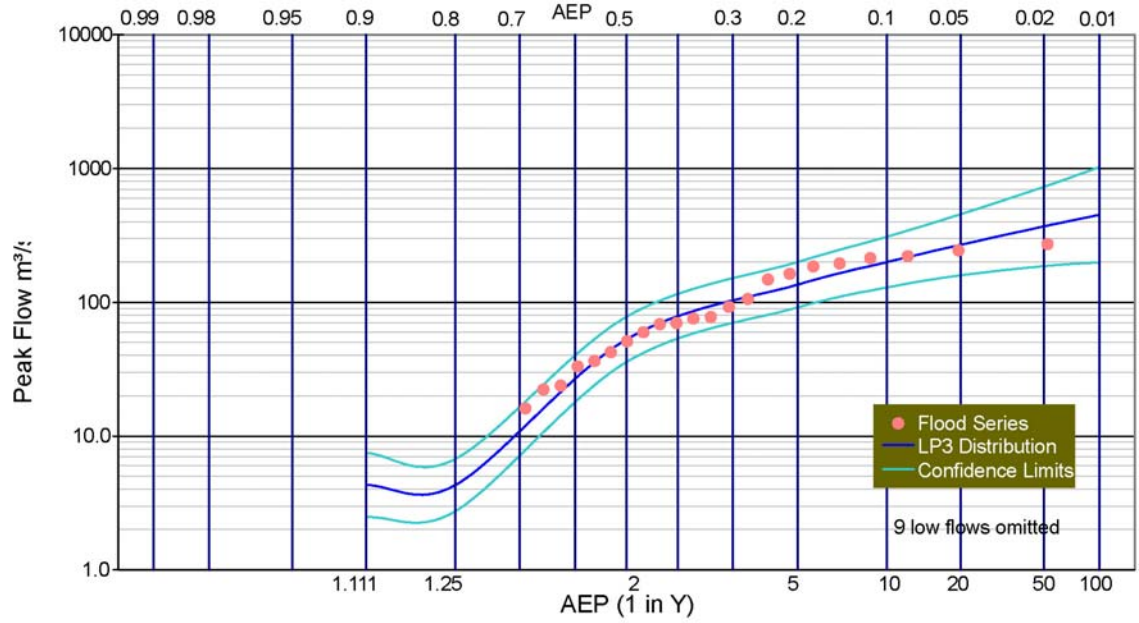


Figure J7 Horsham Post Regulation 1970 – 2000

Effective Discharge Analysis

The effective discharge technique has been used to identify the likely channel capacity resulting from changes in the hydrologic regime. According to Tilleard (1999) a river channel cross section tends to adjust to changes in magnitude, duration or hydraulic characteristics. Tilleard (1999) states that 'Successful river rehabilitation in these situations relies on understanding the direction and magnitude of geomorphic response to hydrologic or hydraulic change'. The 'effective discharge' concept proposes that the size and shape of an alluvial channel will adjust such that the bankfull capacity corresponds to that discharge which, through time, is responsible for moving the most sediment, allowing a prediction of the direction and magnitude of the channel response.

An effective discharge analysis has been undertaken to identify the likely change in capacity of the Wimmera River associated with the flow regulation. Stream power was used as a surrogate for sediment transport for this assessment. Stream powers were determined using the simple normal depth hydraulic modelling package FLOWMASTER, which assists in basic hydraulic analysis. The input for the model includes;

- Cross section profile
- Discharge
- Channel Roughness (Mannings *n*)
- Channel Slope

Flow data was obtained from the Horsham gauging station (415 200), and cross section data was from downstream of Horsham (upstream of McKenzie River), from survey work undertaken during the Horsham flood study of 1979.

From this analysis the stream power for the channel was determined for various flows, Figure J8.

The stream power computations were plotted on and combined with the flow duration curves for the pre and post regulation flow regimes for the Wimmera River gauge near Horsham, (Figure J9). The multiplication of the flow duration in terms of a number of days and the stream power produces an effective discharge curve (Figure J10).

The results of the analysis suggest that the pre regulation bankfull capacity occurred at a flow of around 15,000 ML/d, or about 174 m^3/s. This value corresponds to an Annual Exceedence Probability (AEP) from the flood frequency analysis of between 50 and 20% for the 1900-1930 period, and compares well with the estimated channel capacity for the reach based on historic cross section data and hydraulic analysis. For the post regulation data the effective discharge is estimated to be approximately 13,000 ML/d (150m^3/s).

The results suggest that a reduction in channel capacity is likely to occur as a result of the flow regulation and water extractions.

However, the cross section analysis (refer Wimmera Geomorphic Investigation 2001) reveals limited reduction in channel capacity over the past 20 years. Sediment supply to the subject reach of river is low. This is a result of low transport capacity into the reach and low supply to the reach. Sediment supply has been restricted through the construction of the weirs on the Wimmera Including Glenorchy, Huddlestones and the Horsham Weir.

Because the process of channel adjustment is slow (dependant on sediment supply and transport capacity) and the introduction of regulation relatively rapid, there has been a period of reduced probability of overbank flooding attributable to the flow regulation. The bankfull flow of approximately 175 m3/s has an AEP of 10% on the post regulation flood frequency curve. In essence the large channel is operating within an environment of reduced flow.

Channel contraction should occur (albeit slowly) and as a result it would be expected that the occurrence of overbank flooding is likely to increase. However, review of the flood frequency curve for the post regulation flow regime reveals that the average exceedence probability associated with a flow of 150m^3/s, (the post regulation effective discharge) is approximately 20% (ie a 5 year ARI event). This is the same as the annual exceedence probability of the pre regulation effective discharge. In essence, if the channel capacity of the Wimmera River adjusts to the new effective discharge, the occurrence of overbank flooding will not be significantly different to that which occurred prior to regulation.

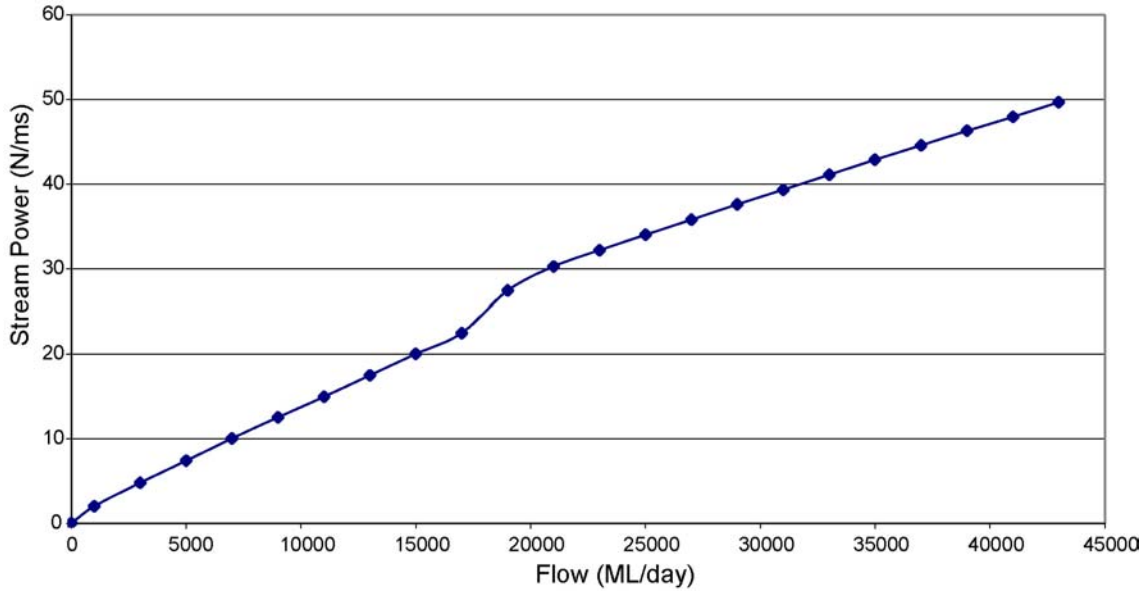


Figure J8 Stream Power – Downstream Horsham

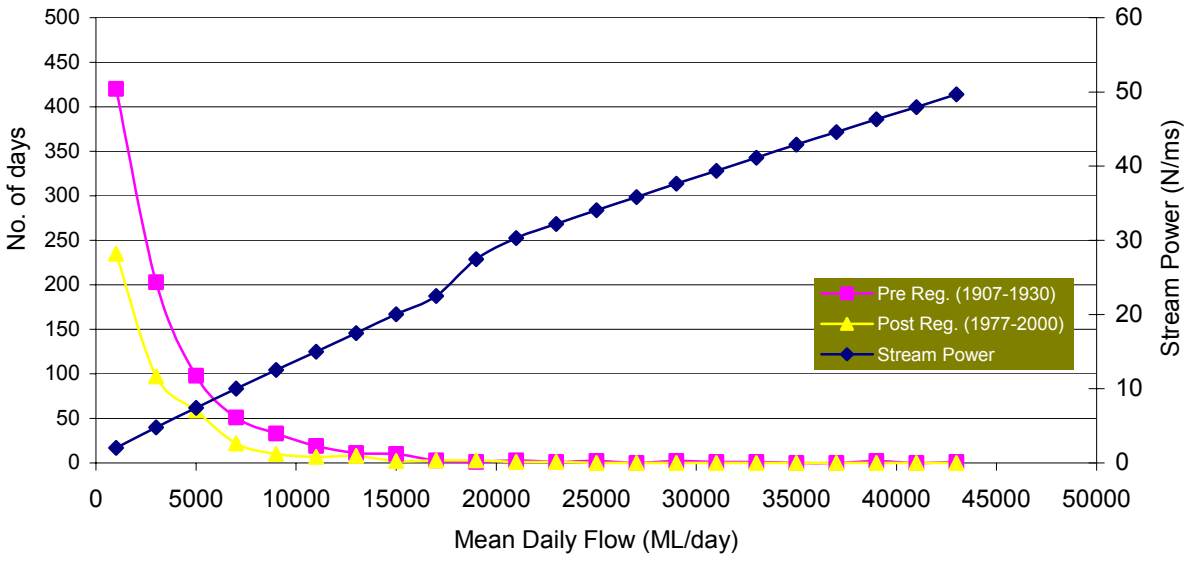


Figure J9 Flow Duration versus Stream Power – Downstream Horsham

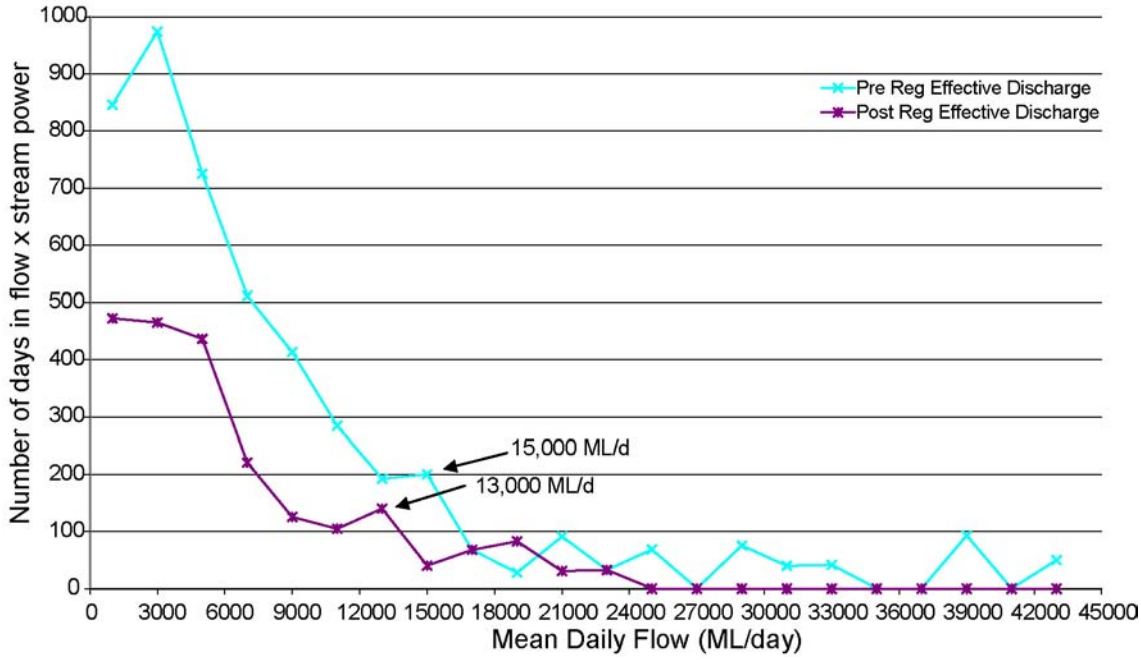


Figure J10 Effective Discharge Analysis – Downstream Horsham

Appendix K

Geomorphic summaries from Field Assessments at 52 sites in the Wimmera River Catchment in 2002

FS#1: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	2.5m	0.5m	>100m
Grade Slope	Very Low		
Sediment Type	Clay		
Stability	Very Stable	Very Stable	
Manning's	Low		
Reach Evolution	Stable		
Erosion	None noted		
Sedimentation	Depositional System		
Cut-offs/Avulsions	None		
Channel Sinuosity	Low		
Number of Channels	1		
Lateral Stability	Very Stable		
Water Present & Depth	No		
Existing Stream Works	None		
Land use	Cropping & Grazing		
Stock Access & Type	Yes – Sheep		
Stream Style Mapped	AC4		
Stream Style Observed	AC1		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: The creek channel has been excavated in a minor way to a depth of about 0.5m with the spoil forming a low levee on one or both of the banks. See photos. There were no features noted on the floodplain.

FS#2: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	2 to 3m	1.5m	>100m
Grade Slope	Very Low		
Sediment Type	Clay and Silt		
Stability	Stable		
Manning's	Very Low		
Reach Evolution	Stable/mature		
Erosion	None		
Sedimentation	Depositional		
Cut-offs/Avulsions	None		
Channel Sinuosity	Low		
Number of Channels	1		
Lateral Stability	Stable		
Water Present & Depth	Yes 0.2m at gauging station retained behind gauging station drop structure, water is currently not flowing		
Existing Stream Works	Yes, drop structure at gauging station		
Land use	Road side reserve changing to grazing and cropping on the floodplain		
Stock Access & Type	No Transect 3, Yes Transects 1&2 (transect from ISC)		
Stream Style Mapped	AC1		
Stream Style Observed	AC1		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: Dunmunkle Creek, has been deepened and may also being used as a irrigation channel or drain from irrigated pastures/paddocks

FS#3: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	12 to 15m	3 to 4m	>100m
Grade Slope	Very Low		
Sediment Type	Cemented Conglomerate changing to sand silt and clay down stream	Silts and clays	
Stability	Very Stable		
Manning's	Low		
Reach Evolution	Stable		
Erosion	Scour in channel bed around Conglomerate and trees	Minor erosion on parts of the bank probably to do with stock access in the past.	
Sedimentation	Loose gravel in the channel bed often associated with conglomerate bars and trees that also occur in the channel bed and banks		
Cut-offs/Avulsions	None		
Channel Sinuosity	Low		
Number of Channels	1		
Lateral Stability	Stable - no evidence of lateral migration		
Water Present & Depth	No flow, pools up to 1m deep?		
Existing Stream Works	None		
Land use	Grazing & Cropping		
Stock Access & Type	Yes - Most likely sheep		
Stream Style Mapped	AC1		
Stream Style Observed	Flood-channel - AC1		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: Sheepwash Creek is a major flood-channel of the Wimmera River. It also acts as a collection points for tributaries draining the northern slopes of the Grampians. The channel is in good condition with regards to geomorphology.

FS#4: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	3m	0.5m	>100m
Grade Slope	Very Low		
Sediment Type	Silt and Clays		
Stability	Low Stability, the channel is currently incising		
Manning's	Very Low, Open Paddock		
Reach Evolution	The system is currently incising		
Erosion	Formation of scour pools in the channel and associated bank erosion		
Sedimentation	None system is eroding		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Very low		
Number of Channels	1		
Lateral Stability	Stable, no evidence of lateral movement or of channel straightening		
Water Present & Depth	None		
Existing Stream Works	None		
Land use	Cropping and Grazing		
Stock Access & Type	Yes, Sheep		
Stream Style Mapped	Intact Valley Fill		
Stream Style Observed	Incised alluvial discontinuous (minor scale)		
Vulnerability (Intact Valley Fills only)	Highly vulnerable to incision		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: The system is currently unstable and may become an active gullying system. The entire system is covered with the pasture of the paddock. A loss of this vegetation would severely destabilise the system. The grassy cover has masked the scouring during the aerial photograph survey.

FS#5: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	14-16m	3-4m	>100m
Grade Slope	Low		
Sediment Type	Clay & silt dominant, with minor sand bars, mid channel	Clay & Silt	
Stability	Very Stable, no evidence of channel incision		
Manning's	Low to moderate		
Reach Evolution	Stable flood channel not undergoing any current geomorphic change.		
Erosion	None noted		
Sedimentation	Transporting system		
Cut-offs/Avulsions	None noted, though scour holes occur at trees bases		
Channel Sinuosity	Low		
Number of Channels	Single channel, however is a subsidiary channel to the Wimmera River		
Lateral Stability	Stable, no evidence of lateral movement		
Water Present & Depth	No		
Existing Stream Works	None		
Land use	Reserve changing to cropping & grazing		
Stock Access & Type	Yes, none present though probably sheep		
Stream Style Mapped	AC1		
Stream Style Observed	Flood-channel - AC1		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: Well preserved channel geomorphically. The channel is predominantly single though splays to a multi-channel in one part with low islands that are well vegetated.

FS#6: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	6-8m	1-2m	>100m
Grade Slope	Low Gradient		
Sediment Type	Sand		
Stability	Moderate		
Manning's	Moderate		
Reach Evolution	Mature reach		
Erosion	None evident		
Sedimentation	Pre dominantly a depositional system		
Cut-offs/Avulsions	Yes - Multi channel system		
Channel Sinuosity	Moderate		
Number of Channels	Approximately 3		
Lateral Stability	Moderately stable		
Water Present & Depth	No		
Existing Stream Works	None noted		
Land use	Reserve		
Stock Access & Type	No		
Stream Style Mapped	AC5		
Stream Style Observed	Discontinuous Anabranching Chain of Ponds		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: The channels consist of scour pools (often associated with channel bends) separated by runs. The channels seem to be fairly stable showing no signs of lateral movement. However there are common scours in the floodplain which may link up with the currently channels in floods allowing the river to evolve.

FS#7: Geomorphic Field Assessment Notes			
Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	3-5m	1-2m	100m
Grade Slope	Very Low		
Sediment Type	Sand & Silt	Silt & Clay	
Stability	Stable		
Manning's	Moderate		
Reach Evolution	Mature - no current geomorphic change		
Erosion	None noted		
Sedimentation	Transporting system		
Cut-offs/Avulsions	None		
Channel Sinuosity	Moderate		
Number of Channels	1		
Lateral Stability	Stable - Minor Point Bars and Meanders		
Water Present & Depth	No		
Existing Stream Works	None noted		
Land use	Reserve		
Stock Access & Type	No		
Stream Style Mapped	AC9		
Stream Style Observed	Discontinuous Anabranching Chain of Ponds		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		
Comments: Low sinuosity channel with minor point bar and bench development on some meander bends. Banks and floodplain thickly vegetated with shrubs.			

FS#8: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	3-4m	0.2m	>100m
Grade Slope	Very Low		
Sediment Type	Clay	Clay	Silt and Clay
Stability	Stable		
Manning's	Moderate		
Reach Evolution	Stable - though may have changed as the creek is currently used as a channel for the transportation of irrigation water		
Erosion	None noted		
Sedimentation	Eroding / transporting system		
Cut-offs/Avulsions	Possible 1 meander cut-off, very old. Occurs as a swamp on the outer side of a meander bend.		
Channel Sinuosity	Very Low		
Number of Channels	1		
Lateral Stability	Stable no movement noted		
Water Present & Depth	Yes, 1m+		
Existing Stream Works	Used as a distribution channel		
Land use	Cropping & grazing		
Stock Access & Type	Yes, sheep		
Stream Style Mapped	AC9		
Stream Style Observed	AC1		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: Burnt Creek is a low sinuosity channel that is used as a channel for the distribution of irrigation water. There are a few very minor scours and possible flood channels on the floodplain, though these are very straight and may be anthropogenic.

FS#9: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	150m	NA	NA
Grade Slope	Low		
Sediment Type	Sand & Silt		
Stability	Very Stable		
Manning's	Moderate - would usually be higher but the vegetation is still recovering form being burnt.		
Reach Evolution	Mature		
Erosion	None Noted		
Sedimentation	Depositional		
Cut-offs/Avulsions	NA		
Channel Sinuosity	NA		
Number of Channels	NA		
Lateral Stability	NA		
Water Present & Depth	None		
Existing Stream Works	None		
Land use	Reserve		
Stock Access & Type	No		
Stream Style Mapped	Intact Valley Fill		
Stream Style Observed	Intact Valley Fill		
Vulnerability (Intact Valley Fills only)	Not vulnerable		
Evolutionary Stage (Incised Systems Only)	NA		
Comments: An intact valley fill system, that looks very stable despite having been recently burnt. No evidence of scour or channel development was noted.			

FS#10: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	2-3m	2-3m	>100m
Grade Slope	Low		
Sediment Type	Clay & Silt		
Stability	Low stability, system is currently incising		
Manning's	Very Low - Open Paddock		
Reach Evolution	Immature, actively evolving		
Erosion	Currently incising in bed eroding banks		
Sedimentation			
Cut-offs/Avulsions	Abandoned meander loop which has now become vegetated with pasture		
Channel Sinuosity	Low		
Number of Channels	1		
Lateral Stability	Stable, no signs of lateral migration or channel straightening		
Water Present & Depth	No		
Existing Stream Works	None noted		
Land use	Grazing		
Stock Access & Type	Yes, sheep		
Stream Style Mapped	Incised alluvial discontinuous		
Stream Style Observed	Incised alluvial discontinuous		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	Immature, just beginning to incise		

Comments: A recently incised Intact Valley Fill. The system is currently unstable with very little vegetation in the channel or on its actively eroding banks.

FS#11: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	1-2m	3-4m	>100m
Grade Slope	Low		
Sediment Type	Sand	Sand & Silt	
Stability	Stable - no active evidence of channel evolution		
Manning's	Moderate		
Reach Evolution	Mature		
Erosion	Very limited – Outer bends of some meanders and scour around fallen trees etc		
Sedimentation	Transporting system		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Low to moderate		
Number of Channels	1		
Lateral Stability	Stable, minor scouring and migration associated with some meander bends		
Water Present & Depth	No		
Existing Stream Works	None noted		
Land use	Reserve		
Stock Access & Type	No		
Stream Style Mapped	Intact Valley Fill		
Stream Style Observed	PC1		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: A moderately sinuous channel that is partially controlled by the foothills of the western Grampians. There is minor development of meander bends and benches in arts of the channel.

FS#12: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	1.5-2m	1.0m	Very Limited to RHB
Grade Slope	Moderate		
Sediment Type	Rock - Cobbles approximately 100-150mm		
Stability	Very stable		
Manning's	High		
Reach Evolution	Mature		
Erosion	None noted		
Sedimentation	Incising system		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Very Low		
Number of Channels	1		
Lateral Stability	Very Stable		
Water Present & Depth	Yes 150mm		
Existing Stream Works	None		
Land use	National Park		
Stock Access & Type	National Park		
Stream Style Mapped	Confined		
Stream Style Observed	Confined		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: A confined stream in the Grampians National park. The system is intact.

FS#13: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	4-5m	3m	~200m
Grade Slope	Low to Moderate		
Sediment Type	Sandy Clay, the clay has a plastic texture		
Stability	Stable		
Manning's	Moderate		
Reach Evolution	Mature		
Erosion	Minor scouring on the outer banks of meander bends		
Sedimentation	Transporting system		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Low to Moderate		
Number of Channels	1 – Occasional very minor abandoned channel relics or flood scours on the floodplain		
Lateral Stability	Stable - no evidence of lateral migration		
Water Present & Depth	Yes – 600mm+		
Existing Stream Works	The creek channel is used to transport water from the Wartook Reservoir		
Land use	Reserve left bank, grazing property right Bank		
Stock Access & Type	Yes on the right bank, most likely sheep or cattle		
Stream Style Mapped	Intact Valley Fill		
Stream Style Observed	PC2		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: Meandering stream that is partly confined by the foothills of the Grampians. Minor scouring is noted on the outer parts of some meander bends. These bends are also usually associated with fallen trees that have been undermined.

FS#14: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	2-14m	0.5m	NA
Grade Slope	Steep		
Sediment Type	Cobbles to boulders to country rock. Minor gravel		
Stability	Very Stable		
Manning's	Moderate to high		
Reach Evolution	Mature		
Erosion	NA		
Sedimentation	Transport /erosion		
Cut-offs/Avulsions	NA		
Channel Sinuosity	Very Low		
Number of Channels	1		
Lateral Stability	Very Stable		
Water Present & Depth	Yes. 100mm to 2m+ in pools		
Existing Stream Works	Wartook Reservoir upstream		
Land use	National Park		
Stock Access & Type	No		
Stream Style Mapped	Confined		
Stream Style Observed	Gorge		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		
Comments: Classic Gorge			

FS#15: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	3-20m	1m	60m in pockets
Grade Slope	Moderate to steep		
Sediment Type	Cobbles, boulders & bed rock		
Stability	Stable		
Manning's	High		
Reach Evolution	Mature		
Erosion	None noted		
Sedimentation	Transporting/eroding system		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Low		
Number of Channels	1		
Lateral Stability	Very stable		
Water Present & Depth	Yes, 600mm^{+} in pools		
Existing Stream Works	Wartook Reservoir upstream		
Land use	National Park		
Stock Access & Type	None noted		
Stream Style Mapped	Confined		
Stream Style Observed	PC1		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: A partly confined stream on an upland plateau above the MacKenzie Falls. The stream seems in good geomorphic condition apart from changed natural flows due to water being released or withheld in the Wartook reservoir upstream.

FS#16: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	1-1.5m	1-1.5m	50-80m
Grade Slope	Moderate		
Sediment Type	Gravels to boulders - 25mm to 500mm		
Stability	Stable		
Manning's	High		
Reach Evolution	Mature		
Erosion	None noted		
Sedimentation	Eroding / Transporting		
Cut-offs/Avulsions	None		
Channel Sinuosity	Low		
Number of Channels	1		
Lateral Stability	Stable with no evidence of lateral migration		
Water Present & Depth	Yes, 100-300mm		
Existing Stream Works	Bridge just upstream		
Land use	National Park		
Stock Access & Type	No		
Stream Style Mapped	Intact Valley Fill		
Stream Style Observed	PC3		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: Minor tributary of Fyans Creek consisting of pools and riffles and logjams. Scour is associated with major logjam and channel bification. There is minor scour/erosion on the outer bank of some meander bends.

FS#17: Geomorphic Field Assessment Notes

Channel Zone	Bed	Banks (Height)	Floodplain
Width	0.5-1.5m	<1.0m	NA
Grade Slope	Steep		
Sediment Type	Gravels to boulders and bedrock - 15mm^{+}		
Stability	The system is stable though the colluvium and alluvial material will be moved and reworked with large flows the channel is controlled by the bedrock bars.		
Manning's	Very High		
Reach Evolution	Mature		
Erosion	Minor unstable banks in the colluvial material		
Sedimentation	Transporting and eroding system		
Cut-offs/Avulsions	NA		
Channel Sinuosity	Very Low		
Number of Channels	1		
Lateral Stability	Very Stable		
Water Present & Depth	Yes - 10mm on riffles and rock bars to 600mm in pools		
Existing Stream Works	None		
Land use	National Park		
Stock Access & Type	NA		
Stream Style Mapped	Confined		
Stream Style Observed	Steep headwater		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: The reach consists of bedrock bars and alluvial material that has a channel cut into it. The bars seem to be 'damming' the alluvial material. Pools are scoured into the colluvial material around LWD or at the base of rock bars. Pools have also been eroded into the bedrock as 'whirl pools' these still contain the grindstones.

FS#18: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	3-8m	2-3m	>100m
Grade Slope	Very Low		
Sediment Type	Sand	Sandy silt	
Stability	Moderately stable		
Manning's	Low to Moderate		
Reach Evolution	Mature		
Erosion	Minor instability on the outer banks on some channel bends.		
Sedimentation	Sand bars occur mid-channel and there is scouring around LWD		
Cut-offs/Avulsions	Yes, minor channel on floodplain		
Channel Sinuosity	Moderate		
Number of Channels	1		
Lateral Stability	Moderate - Abandoned channel on flood plain indicates that the river does evolve laterally though there is no evidence of new movement.		
Water Present & Depth	Yes, up to 1m in pools though not flowing and the pools are isolated		
Existing Stream Works	None		
Land use	Riverside reserve, maybe grazed? Not currently being grazed		
Stock Access & Type	?		
Stream Style Mapped	AC1		
Stream Style Observed	AC4		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: Large amount of leaf litter in the channel. Sand bed channel. Scour holes in channel are often associated with meander bends, though also occurs in straighter sections of the channel and around LWD.

FS#19: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	2-3m	3-4m	>100m
Grade Slope	Very Low		
Sediment Type	Sand	Silty Clay with minor sand	
Stability	The channel currently evolving and therefore is unstable		
Manning's	High		
Reach Evolution	The channel currently seems to be stabilising after a period of incision		
Erosion	The channel is currently eroding on the outer banks of all meander bends.		
Sedimentation	The base of the channel seems to be accreting with lateral and mid-channel bars being deposited. Vegetation is also being to gain a foothold on these new sand bars		
Cut-off/Avulsions	None noted		
Channel Sinuosity	High		
Number of Channels	1		
Laterale Stability	The channel is currently eroding on the outer banks of all meander bends.		
Water Present & Depth	Yes, 100mm max apart from the rare pools		
Existing Stream Works	None noted		
Land use	Reserve?		
Stock Access & Type	No		
Stream Style Mapped	Intact Valley Fill		
Stream Style Observed	Incised Alluvial Discontinuous		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	The system seems to be in a recovery stage with vegetation beginning to gain a foothold in the channel banks and bed.		

Comments: Banks seem to becoming revegetated more so on the inner banks of bends and in straight section of the channel as well as some of the recently deposited sand bars. The area seems to be recovering from past clearing or mining, unsure?

FS#20: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (height)**	**Floodplain**
Width	1m	NA	NA
Grade Slope	Steep		
Sediment Type	Gravels to cobbles	Sand silty soil overlying country rock	
Stability	Stable system		
Manning's	High		
Reach Evolution	Mature		
Erosion	None noted		
Sedimentation	Eroding / transporting system		
Cut-offs/Avulsions	None		
Channel Sinuosity	Low		
Number of Channels	1		
Lateral Stability	Very Stable		
Water Present & Depth	No, dampness in some of the scour/pools of the channel bed, probably from the rain 2 days prior to the survey		
Existing Stream Works	None		
Land use	National Park		
Stock Access & Type	No		
Stream Style Mapped	Steep Headwater, a 1st order stream was assessed		
Stream Style Observed	Steep Headwater		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: Signs of overland flow around the stream, probably during the rain 2 days prior to the survey. Steep headwater stream, which is bedrock, controlled with areas section of gravels, cobbles and boulders occupying the channel. There is a large amount of vegetation in the channel. The area has been burnt previously. Minor duplication of channel at the confluence of a very minor tributary or gully/ or pocket of floodplain all is still very controlled. The area has been cleared and maybe mined (access road s the copper mine track uncertain of the location of the mine).

FS#21: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	1m Base flow 10m high flow	NA	NA
Grade Slope	Very Steep		
Sediment Type	Bedrock & boulders		
Stability	Very Stable		
Manning's	Moderate		
Reach Evolution	Mature		
Erosion	None		
Sedimentation	Eroding/transporting system		
Cut-offs/Avulsions	None		
Channel Sinuosity	Very low		
Number of Channels	1		
Lateral Stability	Very stable		
Water Present & Depth	Yes, 1 mm seeps and 1m+ in pools		
Existing Stream Works	None		
Land use	National Park		
Stock Access & Type	None		
Stream Style Mapped	Confined		
Stream Style Observed	Gorge		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: Classic gorge though very steep access very difficult.

FS#22: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	10-15m	NA	>100m
Grade Slope	Very Flat		
Sediment Type	Silty clays		
Stability	Very stable		
Manning's	Moderate to High		
Reach Evolution	Mature		
Erosion	Minor canalisation with small eroding head <0.5m and a minor scour hole		
Sedimentation	Accreting system, erosion scare also seem to be infilling		
Cut-offs/Avulsions	NA		
Channel Sinuosity	NA		
Number of Channels	NA		
Lateral Stability	NA		
Water Present & Depth	No		
Existing Stream Works	None		
Land use	Reserve		
Stock Access & Type	No - though probably in the past		
Stream Style Mapped	Intact Valley Fill		
Stream Style Observed	Intact Valley Fill		
Vulnerability (Intact Valley Fills only)	System moderately vulnerable to change		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: System seems to be quite stable and the erosion scars seem to be infilling and recovering with vegetation being established on the erosion scar and new growth on clear areas (grassed areas) of the system.

FS#23: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (height)**	**Floodplain**
Width	1-2m	1m	30-40m
Grade Slope	Moderate		
Sediment Type	Sand Bed	Silty Clay	Silty Clay
Stability	Moderate		
Manning's	Low		
Reach Evolution	The reach is infilling and stabilising		
Erosion	Erosion is occurring in some part of the bed	Erosion is occurring on some of the meander bend outer banks	
Sedimentation	The channel is accumulating sand		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Low		
Number of Channels	1		
Lateral Stability	Stable, minor erosion on some bends and banks		
Water Present & Depth	None noted		
Existing Stream Works	None noted		
Land use	Grazing, though the stream has been generally fenced off.		
Stock Access & Type	Yes, though probably only as drought feed. Sheep		
Stream Style Mapped	Incised alluvial discontinuous		
Stream Style Observed	Incised alluvial discontinuous		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	In a stable phase		

Comments: The system seems to be recovering, though not to the original discontinuous system. Stream seems to be very similar to Ian Rutherfurd's study near Euroa with sand beds in eroded old discontinuous systems.

FS#24: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	1.5-2.5m	0.5-1.0m	20m each bank
Grade Slope	Moderate		
Sediment Type	Sand with minor cemented Sandstone	Silty clay with minor sand	
Stability	Moderate		
Manning's	Low		
Reach Evolution	Either a recovering Channelised discontinuous (Most likely) or a PC3.		
Erosion	Minor erosion, (bare banks) on meander bends		
Sedimentation	Minor sand bars in mid channel		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Low		
Number of Channels	1		
Lateral Stability	Stable no evidence of migration		
Water Present & Depth	No		
Existing Stream Works	None noted		
Land use	Grazing		
Stock Access & Type	Yes, Sheep most likely, none present		
Stream Style Mapped	Incised Alluvial Discontinuous		
Stream Style Observed	Incised Alluvial Discontinuous		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	System seems to be recovering		

Comments: The system seems to have evolved into a semi-stable meander sand stream; benches have begun to form on each bank. There is only limited erosion occurring and this is associated with meander bends.

FS#25: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	1.0-1.5m	1m	~500m
Grade Slope	Low		
Sediment Type	Silty sand with minor gravels		
Stability	Stable		
Manning's	Low to moderate		
Reach Evolution	Mature		
Erosion	None noted, in channel some associated with meander bends		
Sedimentation	Fines are infilling scour holes and pools		
Cut-offs/Avulsions	None noted.		
Channel Sinuosity	Moderate		
Number of Channels	1		
Lateral Stability	No sigh of lateral movement		
Water Present & Depth	Yes, No flow, though pool depth varied from 0.1m to 1m+		
Existing Stream Works	None noted		
Land use	Cropping and grazing		
Stock Access & Type	Yes, Sheep		
Stream Style Mapped	AC4		
Stream Style Observed	AC4		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	Systems has reached a stable form		

Comments: Pools silting up according to farmer. Erosion is limited meander bends. The streambed consists of sand and gravel bars. According to the farmer the stream no longer has fish in any of its pools. Benches exist in the channel on both banks and are sparsely vegetated.

FS#26: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	10m	2-2.5m	>100m
Grade Slope	Low		
Sediment Type	Silt and clay bed, banks and floodplain. Minor sand and gravel bars in channel bed		
Stability	Moderate		
Manning's	Low		
Reach Evolution	Mature		
Erosion	Yes, Minor erosion on meander bends and some straight channel sections		
Sedimentation	Sand and gravel bars in stream		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Very Low		
Number of Channels	1 - Seven mile creek is also a flood channel for the Wimmera River		
Laterale Stability	No evidence of lateral movement		
Water Present & Depth	Yes, in pools to an approx depth of 1.5m		
Existing Stream Works	None noted - Bridge 50m upstream of transect 1		
Land use	Grazing		
Stock Access & Type	Yes, sheep		
Stream Style Mapped	AC1		
Stream Style Observed	Flood-channel – AC1		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: All erosion noted is just non-vegetated banks, which do not seem to be actively retreating. Channel consists of pools and benches with minor gravel and sand bars.

FS#27 Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (height)**	**Floodplain**
Width	8-14m	2-3m	>500m
Grade Slope	Very Low		
Sediment Type	Silts and Clays		
Stability	Stable		
Manning's	Moderate		
Reach Evolution	Mature		
Erosion	Very Minor erosion on some banks		
Sedimentation	Minor fine sand bars in the channel bed and Scour holes around LWD, trees and Meander bends		
Cut-offs/Avulsions	Yes, the system is an anabranching system		
Channel Sinuosity	Moderate		
Number of Channels	1 main and multiple minor channels of anabranches and high flow channels		
Laterale Stability	No evidence of current lateral migration though the system is prone to channel changes		
Water Present & Depth	Yes, in pools up to 1m in depth		
Existing Stream Works	None noted		
Land use	Marma State Forest		
Stock Access & Type	No		
Stream Style Mapped	AC9		
Stream Style Observed	AC9 (Anabranching Fine Grained)		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: Single main channel with multiple cut-offs and islands within the major Anabranching system which occurs about 400m west of the current active Wimmera River channel at low flow levels.

FS#27b: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	10-12m	2-3m	>500m
Grade Slope	Low		
Sediment Type	Fines, mainly silts and clays, minor sand in bars in channel		
Stability	Stable		
Manning's	Moderate		
Reach Evolution	Mature		
Erosion	None noted		
Sedimentation	Accumulating fines		
Cut-offs/Avulsions	Yes – the system is an anabranching system with a single main channel with multiple cut-offs and minor anabranches and a major anabranch or flood channel with is on associated cut-offs -see site 27.		
Channel Sinuosity	Moderate		
Number of Channels	2		
Laterale Stability	Currently stable though the ?		
Water Present & Depth	Yes, 1m+		
Existing Stream Works	None noted		
Land use	River reserve - Marma State Forest		
Stock Access & Type	No		
Stream Style Mapped	AC9		
Stream Style Observed	AC9 (Anabranching Fine Grained)		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: The Wimmera River's main channel is a series of reed-fringed pools separated by vegetated bars, which are usually reed, and scrub dominated. The system seems to be in good condition geomorphically. Te pools in the system seem to contain permanent water.

FS#28: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	4-8m	1-1.5m	50m RB, >200m LB
Grade Slope	Low		
Sediment Type	Silty Soils with minor gravel lenses and minor cemented conglomerate exposed in channel bed		
Stability	Low to moderate		
Manning's	Very Low		
Reach Evolution	Stabilising after incision, Channel hasn't changed in 50 years, A Bibby Landholder		
Erosion	Grass in parts of the channel and some bare banks, though there is no evidence of current activity erosion		
Sedimentation	Minor gravel bars forming generally as point bars in the channel		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Low to moderate		
Number of Channels	1		
Laterale Stability	Stable no signs of lateral movement		
Water Present & Depth	None noted		
Existing Stream Works	None noted		
Land use	Cropping and grazing		
Stock Access & Type	Yes, Sheep		
Stream Style Mapped	Incised Alluvial Discontinuous		
Stream Style Observed	Incised Alluvial Discontinuous		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	Current systems seems to be stable		

Comments: Comment form landholder:' Scour hasn't changed since the property was acquired in 1952.' The Current channel seems to be bedrock controlled, with bars forming knick points in the channel. The bedrock is close to the surface according to the landholder. Gravel bars are common in current channel usually on meander bends and there is a series of benches in the channel that may have been formed by a second period of incision. The channel has a tighter meander than the original channel, which contains the benches.

FS#29: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (height)**	**Floodplain**
Width	2-6m		30m in pockets
Grade Slope	Low to moderate		
Sediment Type	Clayey silt with minor coarse sand		
Stability	Stable		
Manning's	Very Low		
Reach Evolution	Mature		
Erosion	Yes, though minor and restricted to the outer part of one bend and a small section of bank/valley side about 5m from the Intact Valley Fill		
Sedimentation	Accreting		
Cut-offs/Avulsions	NA		
Channel Sinuosity	Low		
Number of Channels	NA		
Laterale Stability	NA		
Water Present & Depth	Stable		
Existing Stream Works	Major farm dam across channel		
Land use	Cropping & grazing		
Stock Access & Type	Yes, Sheep		
Stream Style Mapped	Intact Valley Fill		
Stream Style Observed	Intact Valley Fill		
Vulnerability (Intact Valley Fills only)	Moderate		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: Minor bare (vegetation free patches) in the channel but these are usually associated with stock tracks. The system seems to be fairly stable; All bar patches more susceptible to erosion are on the channel sides. The Dam at the upstream end of the reach will help to mitigate large flows and potential scouring events.

FS#30: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	4-8m	2-3.5m	20-30m in pockets
Grade Slope	Moderate		
Sediment Type	Silty clay with minor sand and gravel bars		
Stability	Unstable		
Manning's	Low		
Reach Evolution	Evolving, the reach is still deepening		
Erosion	Both the channel and banks are still actively eroding		
Sedimentation	The system is still eroding though there are gravel bars (point bars) in the channel. The gravel is derived form insitu gravels from the eroded material		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Moderate		
Number of Channels	1		
Laterale Stability	Highly stable		
Water Present & Depth	Yes 0.5m in a single pool		
Existing Stream Works	None noted		
Land use	Cropping and grazing		
Stock Access & Type	Yes, Sheep		
Stream Style Mapped	Incised Alluvial Discontinuous		
Stream Style Observed	Incised Alluvial Discontinuous		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	The system is still eroding and incising and is currently unstable and actively evolving.		
Comments: The system is highly unstable			

FS#31: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	1-3m	0.2-3m	~50m
Grade Slope	Moderate		
Sediment Type	Gravel Bed		
Stability	Moderate		
Manning's	Low to moderate		
Reach Evolution	The system seems to be in recovery phase, though it is still eroding in places		
Erosion	Yes		
Sedimentation	Gravel bars are often associated LWD		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Low		
Number of Channels	Single main channel, there are many subsidiary channel but theses are relics of past mining activity		
Lateral Stability	Stable, no evidence of lateral; migration		
Water Present & Depth	None noted		
Existing Stream Works	None noted		
Land use	Reserve		
Stock Access & Type	No		
Stream Style Mapped	Intact Valley Fill		
Stream Style Observed	Cut & Fill		
Vulnerability (Intact Valley Fills only)	Moderate		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: Area has undergone extensive mining in the past; there are many shafts and trenches cut into the surrounding area/floodplain? these workings show many patches of minor erosion. Both cut sections of the assessed reach have gravel beds. It is unclear if the cut and fill morphology is 'natural' or a response to the past mining activity. The gravel bars/channel bed may also either be due to erosion of the insitu material or may be another relic of the historic mining activity. GEOLOGY: Silty clay material with frequent layers alluvial gravel layers.

FS#32: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	1-2.5m	0.2-3m	NA
Grade Slope	Low to moderate		
Sediment Type	Silty Clay with minor gravel pars in channel bed		
Stability	Moderate		
Manning's	Moderate		
Reach Evolution	Stabilising		
Erosion	Yes, minor erosion on some channel bends and in parts of the channel		
Sedimentation	Minor gravel Bars		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Moderate		
Number of Channels	1		
Lateral Stability	Stable - no signs of lateral migration		
Water Present & Depth	None noted		
Existing Stream Works	None noted		
Land use	Pyrenees State Park		
Stock Access & Type	No		
Stream Style Mapped	Intact Valley Fill		
Stream Style Observed	PC1		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	System is stable, may be returning to Intact Valley Fill		

Comments: The stream is now a PC1, though in the past it may have been an Intact Valley Fill prior to the mining activities that have affected the channel. Parts of the channel are very straight and regular and may have been constructed during the mining period. Also the channel becomes indistinct in some places where the gully floor/floodplain widens and more distinct in more confined parts of the channel.

FS#33: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	6-8m	1-2m	80-120m
Grade Slope	Moderate		
Sediment Type	Gravel to cobble stream bed with cobbles being dominant, 25mm-800mm with average being 200mm. Minor bedrock bars are also exposed in the channel bed. The floodplain and channel banks consist of similar gravels and cobbles but with a silty matrix.		
Stability	Stable		
Manning's	Moderate to high		
Reach Evolution	The channel alignment seems to be mature though it lacks the bed forms of a mature channel.		
Erosion	None noted		
Sedimentation	A slowly incising system, though generally should be considered a transporting system		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Low		
Number of Channels	1		
Laterale Stability	Moderate		
Water Present & Depth	None noted		
Existing Stream Works	None noted		
Land use	Reserve		
Stock Access & Type	No		
Stream Style Mapped	Intact Valley Fill		
Stream Style Observed	PC2		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: The channel is very monotonous with very few bed forms such as scour pools. The channel just seems to be one long riffle. This seems to indicate that the channel is in some stage of evolution and recovery. The current channel generally lacks old LWD, the little that does exist is associated with the only scour in the river channel. There is a large amount of new LWD in channel which may result in more scour and channel features.

FS#34: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (height)**	**Floodplain**
Width	1-3m	0.5-1.5m	Minor pockets
Grade Slope	Moderate		
Sediment Type	Alluvial gravel to cobble streambed with cobbles being dominant. Minor bedrock bars are also exposed in the channel bed. The floodplain pockets and channel banks consist of similar gravels and cobbles but with a silty matrix.		
Stability	Stable		
Manning's	Moderate		
Reach Evolution	Restabilising after past mining activity		
Erosion	Yes though only on banks cutting into valley sides		
Sedimentation	Eroding		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Low		
Number of Channels	1		
Lateral Stability	Stable,		
Water Present & Depth	Yes, single pool which may be associated with a spring for there was a minor over flow of damp channel a few meters down stream of the pool		
Existing Stream Works	None noted		
Land use	Pyrenees State Park		
Stock Access & Type	No		
Stream Style Mapped	Intact Valley Fill		
Stream Style Observed	Confined		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: The channel seems fairly stable though currently seems to be in the later stages of recovery and stabilisation. The channel contains very little in the way of pools and in stream features. The channel may have incised after the mining activity and is now recovering may have originally been and Intact Valley Fill though unlikely considering the gravels in the floodplain.

FS#35: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	1.5-2m	0.5-1.5m	Pockets with a maximum width of 30m
Grade Slope	Moderate		
Sediment Type	The channel bed is dominated in parts by cobbles, though other areas these seem to be being covered with fines. The channel is also thick with vegetation		
Stability	Stable		
Manning's	Moderate to High		
Reach Evolution	Mature?		
Erosion	No		
Sedimentation	Transporting system, minor fines accumulating, may be in response to increasing vegetation in channel		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Low to moderate		
Number of Channels	1		
Lateral Stability	Stable		
Water Present & Depth	Yes, stagnant pools		
Existing Stream Works	Ford, constructed of concrete for light vehicle access, is acting as an artificial knick point and sediment has built up to its level on the upstream side.		
Land use	Recovering cleared land?		
Stock Access & Type	No		
Stream Style Mapped	Intact Valley Fill		
Stream Style Observed	PC1		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: The system seems to be in a recovery phase after a possible period of incision, with vegetation and associated sedimentation occurring in some parts of the channel. There is also no evidence of any active incision or erosion. The area may be recovering from being cleared.

FS#36: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	10-15m	2-3m	100-200m
Grade Slope	Low		
Sediment Type	Cobble bed, banks and floodplain consist of silty clay with gravel and cobble lenses.		
Stability	Stabilising		
Manning's	Low		
Reach Evolution	Stabilising after a period of possible incision.		
Erosion	Minor erosion present on meander bends		
Sedimentation	Gravel bars are forming on channel sides and meander bends		
Cut-offs/Avulsions	Minor cut-offs are present within the incised channel on some of the benches		
Channel Sinuosity	Moderate		
Number of Channels	1		
Lateral Stability	Moderate		
Water Present & Depth	No		
Existing Stream Works	None noted		
Land use	Grazing		
Stock Access & Type	Yes, Sheep		
Stream Style Mapped	Incised Alluvial Discontinuous		
Stream Style Observed	PC3		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: The system seems to be in a recovery phases after a period of incision and active widening of its original channel bed. Bars, point bars and vegetation are establishing themselves in the inset channel, There still seems to be a lack of in channel features though scour pools do exist on some of the meander bends in the reach assessed.

FS#37: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	6-8m	2-3m, though laid back rather than sub vertical	100-150m
Grade Slope	Moderate		
Sediment Type	Cobble bed, banks and floodplain consist of silty clay with gravel and cobble lenses.		
Stability	Stabilising		
Manning's	Moderate		
Reach Evolution	Stabilising		
Erosion	Very minor and is only associated with where the channel comes into contact with valley side.		
Sedimentation	Transporting/eroding system		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Low		
Number of Channels	1		
Lateral Stability	Stable		
Water Present & Depth	None noted		
Existing Stream Works	None noted		
Land use	Former grazing land though now fenced from stock access		
Stock Access & Type	No, though the fenced area is gated so may be used for drought feed.		
Stream Style Mapped	Intact Valley Fill		
Stream Style Observed	PC3		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: The banks of the reach have been revegetated with over storey species within the last 8 to 10years. Also a levee has been constructed to divert flow form meander bend and associated unstable bank. The system and channel seem to be in a recovering phases with the channel minus bars, pools and LWD.

FS#38: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (height)**	**Floodplain**
Width	20-40m	NA	60m in pockets
Grade Slope	Very Low		
Sediment Type	Fine grained		
Stability	Stable		
Manning's	Moderate		
Reach Evolution	Mature		
Erosion	None noted		
Sedimentation	Accreting system		
Cut-offs/Avulsions	NA		
Channel Sinuosity	NA		
Number of Channels	1		
Lateral Stability	NA		
Water Present & Depth	Yes, 2m+ in pools?		
Existing Stream Works	None noted		
Land use	Cropping and grazing		
Stock Access & Type	Yes, Sheep		
Stream Style Mapped	Chain of Ponds		
Stream Style Observed	Chain of Ponds		
Vulnerability (Intact Valley Fills only)	The vegetation of the system is under threat from the stock access though no physical threat such as headward erosion or sediment source was noted. However the ponds maybe receiving excess sediment from the cleared land around the channel.		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: The numbers of ponds in the system seem to be limited, all also seem to be associated with large trees (both living and dead). The channel and ponds are choked with vegetation. Some of the ponds seem to be infilling which ay be due to sediment reaching the ponds from the cleared farmland that surrounds the channel. This infilling doesn't seem to be occurring where the fringing bank vegetation is wider. The ponds are better developed around living trees rather than the dead ones.

FS#39: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (height)**	**Floodplain**
Width	4-12m	Up to 3m	20m in pockets
Grade Slope	Moderate		
Sediment Type	Fines		
Stability	Stable		
Manning's	Moderate		
Reach Evolution	Mature		
Erosion	Some very minor erosion assorted with some of the banks, generally just bar patches		
Sedimentation	Accreting system, very slow		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	NA		
Number of Channels	1		
Lateral Stability	None noted		
Water Present & Depth	No		
Existing Stream Works	None noted		
Land use	Grazing		
Stock Access & Type	Yes Cattle		
Stream Style Mapped	Chain of ponds		
Stream Style Observed	Chain of ponds		
Vulnerability (Intact Valley Fills only)	Minor threats due to excess sediment from the cleared land and the damage to the ponds due to stock access.		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: The chain of bonds system occurs in a channel that is sunk below the floodplain. The ponds usually occur on the upstream parts of bends within the channel. The ponds seem to be quite stable and where dry during assessment. The system seems to be in a fairly robust state and not under any immediate threats.

FS#40: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	8-10m	3-4m	~400m
Grade Slope	Low		
Sediment Type	Sandy bed with silty sand banks and floodplain		
Stability	The bed of the stream seems stable though the banks are sub-vertical and only moderately stable		
Manning's	High		
Reach Evolution	Recovering		
Erosion	The banks of the channel are over steep and susceptible to erosion.		
Sedimentation	Sedimentation is occurring with in the current inset channel		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Moderate		
Number of Channels	1		
Lateral Stability	Stable		
Water Present & Depth	Yes in pools with a depth of ~0.3m		
Existing Stream Works	None noted		
Land use	Scrubland, maybe recovering form being cleared or burnt		
Stock Access & Type	No		
Stream Style Mapped	AC1		
Stream Style Observed	AC1		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: The channel has incised but now seems to recovering with lateral and point bars occurring in the channel and vegetation now becoming very established on incised gully floor and on some of the bars. The bars mainly consist of sand. There is still some minor instability on the outer parts of some bends. The original floodplain above the current channel level may now be to high to be flood easily.

FS#41: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	3-4m	2-3.5m	~15m
Grade Slope	Moderate		
Sediment Type	Sandy silt bed and banks		
Stability	System is still actively eroding.		
Manning's	Low		
Reach Evolution	Immature with active erosion still occurring in channel		
Erosion	Both bed and banks are still eroding		
Sedimentation	No		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Low		
Number of Channels	1		
Lateral Stability	Moderate		
Water Present & Depth	Yes, very minor flows and very limited pools to a depth of 150mm		
Existing Stream Works	Concrete forward at the head of accessed reach which has also acted as a stop on the headward erosion		
Land use	Grazing		
Stock Access & Type	Yes, Sheep		
Stream Style Mapped	Incised Alluvial Discontinuous		
Stream Style Observed	Incised Alluvial Discontinuous		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	Still actively eroding		

Comments: The system is actively eroding bed and banks; scour holes exist in some parts of the channel. There seems also to be some very minor infilling of some scour holes, which might be attributed to low flows?

FS#42: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	4-5m	1-1.5m	30-50m
Grade Slope	Low		
Sediment Type	Gravel bed, with the banks consisting of a silty sand alluvial material with gravel beds and lenses		
Stability	Moderate		
Manning's	Low		
Reach Evolution	Reach stabilising after a period of incision		
Erosion	No active erosion though the banks are unstable in some places		
Sedimentation	Minor accumulation of gravel in stream bed		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Low		
Number of Channels	1		
Lateral Stability	Moderate		
Water Present & Depth	Yes, minor pools to a depth of 0.5m		
Existing Stream Works	Ford acting as a erosion barrier		
Land use	Grazing		
Stock Access & Type	Yes, cattle		
Stream Style Mapped	Incised Alluvial Discontinuous		
Stream Style Observed	Incised Alluvial Discontinuous		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	The system is being to stabilise after a period of incision		

Comments: The channel seems to reaching a point of stabilisation with the formation of some gravel bars and the establishment of some vegetation. The gravel is also being to bury some LWD, which may indicate a change from an erosional system to an accreting system. System is still in an unstable state and would be likely to incise in a large flow event. The source of the gravel is form the erosion of the insitu material.

FS#43: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (height)**	**Floodplain**
Width	1-1.5m	2-3m	~20m
Grade Slope	Moderate		
Sediment Type	A gravel and sand bed stream with banks consisting of sandy silt with gravel lenses		
Stability	Moderate		
Manning's	Moderate		
Reach Evolution	Recovering?		
Erosion	None noted		
Sedimentation	Gravel and sand bars in the channel		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Moderate		
Number of Channels	1		
Lateral Stability	?		
Water Present & Depth	None noted		
Existing Stream Works	Large farm dam upstream, erosion control drop structure.		
Land use	Fenced of grazing land		
Stock Access & Type	None noted		
Stream Style Mapped	AC5		
Stream Style Observed	Incised alluvial discontinuous		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: The system seems to have reached a point of stabilisation, with the channel now being thickly vegetated, though the farm dam and drop structure seems to protect a completely different system of an Intact Valley Fill.

FS#44: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (height)**	**Floodplain**
Width	4-5m	1m	25m
Grade Slope	Low		
Sediment Type	Minor gravel bed system with silty clay banks containing quartz gravels. Minor bedrock out crops in the channel bed		
Stability	Low		
Manning's	Low		
Reach Evolution	Reach is being to recover		
Erosion	Some parts of the channel still seem to be eroding, and sections of bank are still being undercut.		
Sedimentation	Sedimentation is occurring behind the rock bars and in the more highly sinuous parts of the channel		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Low to moderate		
Number of Channels	1		
Lateral Stability	Moderate		
Water Present & Depth	Yes, single pool with a depth of 150mm		
Existing Stream Works	None noted		
Land use	Grazing		
Stock Access & Type	Yes, Sheep		
Stream Style Mapped	Incised Alluvial Discontinuous		
Stream Style Observed	Incised Alluvial Discontinuous		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	System is recovering to a stable position		

Comments: System seems to be in a recovery phase with the channel beginning to infill in the lower reach and benches appearing in the upper parts of the reach. The lower part of the reach channel has also become vegetated. The infill isn't due to the bridge below the reach for the channel has in filled on both sides of the bridge,

FS#45: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (height)**	**Floodplain**
Width	3-4m	2-3m	20m
Grade Slope	Low		
Sediment Type	Gravel bed		
Stability	Moderate		
Manning's	Low		
Reach Evolution	Stream is still recovering though seems to be reaching a stable point		
Erosion	There is some minor erosion on the channel banks		
Sedimentation	Point and lateral gravel bars are developing in the channel and associated pools		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Moderate		
Number of Channels	1		
Lateral Stability	Moderate		
Water Present & Depth	Yes, 25mm flows and pools to ~0.3m		
Existing Stream Works	None noted		
Land use	Grazing		
Stock Access & Type	Yes, Sheep		
Stream Style Mapped	Incised Alluvial Discontinuous		
Stream Style Observed	Incised Alluvial Discontinuous		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	Systems seems to have also most reached a stable form		

Comments: The stream seems to have incised in the past and now seems to be reaching a stable gravel bed form. Vegetation is well established on channel banks and is becoming established on channel bars and in the channel is some places. System will still be susceptible to floods but will more likely act in the way of a gravel bed stream. System may restabilise as a gravel bed stream rather than the probable original form of an Intact Valley Fill.

FS#46: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (height)**	**Floodplain**
Width	5-10m	3m vert, 3-15m horizontally	~200m
Grade Slope	Low		
Sediment Type	A sand and gravel bed stream with a silty clay bank		
Stability	Very Stable		
Manning's	Moderate		
Reach Evolution	Mature		
Erosion	None Noted		
Sedimentation	Yes		
Cut-offs/Avulsions	None Noted		
Channel Sinuosity	Low to moderate		
Number of Channels	1		
Lateral Stability	Very Stable		
Water Present & Depth	Yes, 0.1m to 2m+ in pools		
Existing Stream Works	None Noted		
Land use	Grazing		
Stock Access & Type	Yes, Sheep		
Stream Style Mapped	PC3		
Stream Style Observed	PC3		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: The Wimmera River channel consist of large pools separated by vegetation-choked bars, The system appears to be stable.

FS#47: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (height)**	**Floodplain**
Width	1.5-2m	1.5-0.5m, lessens downstream	~30m
Grade Slope	Low to Moderate		
Sediment Type	Silty sand banks and bed with minor gravel lenses, also minor gravel lenses in the lower part of the reach.		
Stability	Moderate		
Manning's	Low		
Reach Evolution	Recovering		
Erosion	Yes in the upper parts of the reach		
Sedimentation	Yes, gravel bars are forming in the lower pars of the reach.		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Low		
Number of Channels	1		
Lateral Stability	Stable		
Water Present & Depth	None noted		
Existing Stream Works	None noted		
Land use	Grazing, though the scour has been fenced		
Stock Access & Type	None noted		
Stream Style Mapped	Incised Alluvial Discontinuous		
Stream Style Observed	Incised Alluvial Discontinuous		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	System is recovering though is probably still unstable		

Comments: The systems seem to be recovering though still probably unstable and easily effected by large flows. There are some minor benches in the channel but seem to be relics of older channel floor.

FS#48: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (Height)**	**Floodplain**
Width	10m	3m	NA
Grade Slope	Moderate		
Sediment Type	Silty Clay with very minor gravel (<25mm)		
Stability	Low		
Manning's	Low		
Reach Evolution	Still incising		
Erosion	Yes in banks and bed		
Sedimentation	Very minor gravel bars formed of eroded insitu gravel in parts of the channel		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Low		
Number of Channels	1		
Lateral Stability	Moderate		
Water Present & Depth	None noted		
Existing Stream Works	None noted		
Land use	Grazing - though fenced from stock		
Stock Access & Type	No		
Stream Style Mapped	Incised Alluvial Discontinuous		
Stream Style Observed	Incised Alluvial Discontinuous		
Vulnerability (Intact Valley Fills only)			
Evolutionary Stage (Incised Systems Only)	System is still evolving, though has reached bedrock, which is helping to stabilise the channel.		

Comments: The system seems to be still evolving and has not reached a stable form yet, Above the rock bar in the accessed reach the channel seems to gravel bed with a meandering form, though it may still be immature with limited channel features, below the rock bar the gravel has been removed and the channel is occurring bare sediment.

FS#49: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (height)**	**Floodplain**
Width	10-100m	NA	NA
Grade Slope	Moderate to high		
Sediment Type	Fines		
Stability	Stable		
Manning's	Low		
Reach Evolution	Mature		
Erosion	None noted		
Sedimentation	Accreting		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	NA		
Number of Channels	NA		
Lateral Stability	NA		
Water Present & Depth	None noted		
Existing Stream Works	Yes, a series of diversion bars have been but across the floodout and Intact Valley Fill to divert water out of the channel and across the paddock to prevent erosion.		
Land use	Grazing		
Stock Access & Type	Yes, Sheep		
Stream Style Mapped	Floodout		
Stream Style Observed	Floodout		
Vulnerability (Intact Valley Fills only)	Stable, not vulnerable		
Evolutionary Stage (Incised Systems Only)	NA		

Comments: The system is fairly stable and protected form down stream headward erosion by two diversion levees. The floodout is fairly indistinct with a steep lobate front.

FS#50: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (height)**	**Floodplain**
Width	2-10m	0-2m	NA
Grade Slope	Moderate		
Sediment Type	Alluvial gravels with silty matrix		
Stability	Low		
Manning's	Low		
Reach Evolution	Still evolving with headward erosion		
Erosion	Yes – tunnel erosion on banks and headward erosion at gully head		
Sedimentation	None Noted		
Cut-offs/Avulsions	None Noted		
Channel Sinuosity	Low		
Number of Channels	1		
Lateral Stability	Stable		
Water Present & Depth	None Noted		
Existing Stream Works	None Noted		
Land use	Grazing		
Stock Access & Type	Yes, Sheep though none currently in paddock		
Stream Style Mapped	Incised Alluvial Discontinuous		
Stream Style Observed	Incised Alluvial Discontinuous		
Vulnerability (Intact Valley Fills only)			
Evolutionary Stage (Incised Systems Only)	Still evolving with headward erosion, and unstable banks		

Comments: The upper part of the system is still expanding with via headward erosion and the banks are highly unstable and eroding in many places, the lower part of the system the channel is stabilised by some very large over story vegetation though incision is still occurring with there roots very exposed. The channel banks are more stable in the lower reach and there are some minor gravel bars. THE HEADWARD EROSION NEEDS TO BE CONTROLLED.

FS#51: Geomorphic Field Assessment Notes

Channel Zone	**Bed**	**Banks (height)**	**Floodplain**
Width	10m	2-6m	NA
Grade Slope	Mod		
Sediment Type	Silty Clay		
Stability	Very Low		
Manning's	Low		
Reach Evolution	Still evolving		
Erosion	Yes Channel and Banks		
Sedimentation	No		
Cut-offs/Avulsions	None noted		
Channel Sinuosity	Low		
Number of Channels	1		
Lateral Stability	Moderate		
Water Present & Depth	No		
Existing Stream Works	Yes, the CMA has conducted major erosion control works.		
Land use	Wattle Creek Bushland reserve		
Stock Access & Type	No		
Stream Style Mapped	Incised Alluvial Discontinuous		
Stream Style Observed	Incised Alluvial Discontinuous		
Vulnerability (Intact Valley Fills only)	NA		
Evolutionary Stage (Incised Systems Only)	The system is still evolving.		

Comments: The system has under gone extensive rehabilitation works. The banks are still failing in places and there is also some tunnel erosion present in the banks. Would be interesting to monitor to see how successful the work rehabilitation works have been.

Appendix L

Metadata for the Wimmera River Catchment Geomorphic Categorisation and Stream Condition Assessment Database

Dataset Information

Title

WimmeraRCatch2002.mdb

Custodian

Wimmera Catchment Management Authority

Jurisdiction

Wimmera Catchment Management Authority Management Area

Description

Abstract

This dataset contains data primarily representing the waterways in the Wimmera Catchment Management Authority Management Area. All features of the dataset are uniquely identified by ID fields specified in Tables *** to ***. Updates to these datasets are to be determined at the discretion of the Wimmera Catchment Management Authority.

Datasets in the series are listed below:

- Stream Order
- Stream Style
- Stream Condition
- Hydro Type
- Wimmera ISC Field Sites 1999
- ISC Field Sites 2002

Geographic Extent

Wimmera Catchment Management Authority Management Area, Wimmera Region, Victoria, Australia

Coordinate System

GDA 94, AMG Zone 54

Dataset Currency

Beginning Date

Ending Date

Current as of March 2003

Dataset Status

Progress

Complete as of March 2003 data delivery

Maintenance and Update

To be determined at the discretion of Wimmera Catchment Management Authority

Dataset Access

Stored Data Format(s)

CD

Available Format Type(s)

To be determined at the discretion of the Wimmera Catchment Management Authority

Access Constraints

To be determined at the discretion of the Wimmera Catchment Management Authority

Data Quality

Lineage

The 1:25 000 digital hydrology layer was amended by Earth Tech to allow the connection and ordering of streams within the Wimmera River Catchment. The connection process involved removing breaks within the digital layer and joining the discontinuous fluvial systems to the Wimmera River system. Once all the waterways were connected, a complete stream ordering of the catchment was carried out.

Positional Accuracy

A GPS was used to locate the ISC sites in the field in 2002.

Attribute Accuracy

Completeness

Waterways of third order or greater were assigned a Stream Order, Geomorphic Categorisation, an Overstorey Vegetation Cover rating and an Hydrology Rating.

Contact

Contact Organisation

Wimmera Catchment Management Authority

Contact Position

Elyse Riethmuller, Waterway Manager

Address

Horsham, VIC

Phone

(03)

Facsimile

(03)

Email Address

riethmullere@wca.vic.gov.au

Other

Metadata Date

March 11th, 2003, by Earth Tech

Additional Metadata

Additional documents that provide significant data history and descriptive information:

- Wimmera Catchment ISC 1999 data – provided to Earth Tech by the Wimmera CMA in 2002.
- Wimmera River Catchment Geomorphic Categorisation and Stream Condition Assessment Report
- Wimmera River Geology

Name:	Geology of Victoria
Scale:	1:250 000
Spatial Extent:	Victoria (GIS format)
Owner:	Geological Survey of Victoria
	Minerals and Petroleum Victoria
	Department of Primary Industries
	(Department of Natural Resources and Environment)
Access:	General
Abstract:	The dataset contains the line, point & polygon feature delineating the Geology of Victoria.

WimmeraRCatch2002.mdb

Table 1: WimmeraRCatch2002

Code	Description
FID	Each waterway segment has an unique ID
Shape	Polyline / Polygon
Length	Length (metres) of each waterway segment
Object ID	Each waterway segment has an unique ID
Name	Waterway name – where known
Type Code	0-6 and 999 ***
Stream Order	Range 0 – 8, 0 being no order assigned and 1-8 representing stream orders .lyr_Files\WimmeraRCatch_2002_order.lyr
Stream Style	Refer to Table 2 .lyr_Files\WimmeraRCatch_2002_style.lyr
Stream Overstorey Vegetation Cover	Refer to Table 3 .lyr_Files\WimmeraRCatch_2002_cond.lyr
Hydro Type	Refer to Table 4 .lyr_Files\WimmeraRCatch_2002_Hydro.lyr

Table 2: Stream Style Definitions

Code	Description
0	None
1	Intact Valley Fill
2	Cut & Fill
3	Confined
4	Partly Confined 1
5	Partly Confined 2
6	Partly Confined 3
7	Alluvial Continuous 1
10	Alluvial Continuous 4
11	Alluvial Continuous 5
15	Anabranching Fine Grained
18	Chain of Ponds
20	Steep Headwater
21	Gorge
22	Floodout
28	Incised Alluvial Discontinuous
30	Dam
31	Weir
32	Constructed Channel
33	Other
66	Discontinuous Anabranching Chain of Ponds
999	First and second order streams

Table 3: Overstorey Vegetation Cover Definitions

Code	Description
0	No Overstorey Vegetation Cover assigned – likely to be a dam or constructed feature
1	Overstorey Cover >80%
3	Overstorey Cover 20 – 80%
5	Overstorey Cover <20%
77	Anabranching Fine Grained – not assigned an overstorey vegetation cover rating due to lack of detailed aerial photographs at the time of the investigation
999	First and second order streams

Table 4: Hydrology Data

Code	Description
1	Stream not hydrologically affected by the Wimmera Mallee Stock and Domestic Supply System
2	Stream hydrologically affected – water extracted
3	Stream hydrologically affected – used for water transfer

Table 5: ISC Sites 1999 – Wimmera Field Sites 1999 (Reach No.)

Code	Description
FID	Unique ID for ISC site
Shape	Point
Reach	WCMA reach from 1999 ISC Assessments
Region	WCMA region from 1999 ISC Assessments
Easting1	Upstream Easting
Northing 1	Upstream Northing

Table 6: ISC Sites 2002 – ISC Field Sites 2002 (Field Site No.)

Code	Description
FID	Unique ID for ISC site
Shape	Point
MW Unit ID	Field Site Number (FS#)
Stream Name	Waterway Name
Reach Number	2002 ISC Reach Number
Site Number	Site Number grouped by Reach
Start Easting	Upstream Easting
Start Northing	Upstream Northing
End Easting	Downstream Easting
End Northing	Downstream Northing
MW ESMAP	CFA Region 51*** Map Reference
Index PF	ISC Physical Form Score (out of 10)
Index SZ	ISC Streamside Zone Score (out of 10)