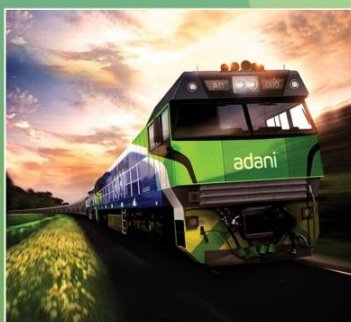




Adani Mining Pty Ltd

NORTH GALILEE BASIN RAIL PROJECT

Environmental Impact Statement

Appendix H2 Hydrology and hydraulics

November 2013



North Galilee Basin Rail (NGBR)



Hydrology & Hydraulics Report

September 2013

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Executive Summary

EXECUTIVE SUMMARY

Introduction

Adani Mining Pty Ltd (Adani) is proposing to develop a greenfield, non-electrified, heavy haul (32.5 tonne axle load), standard gauge railway, referred to as the North Galilee Basin Rail (NGBR) to transport up to 100 Mtpa of coal directly to the Port of Abbot Point. It is anticipated that the coal to be transported will be a combination of coal from Adani's proposed Carmichael Mine and coal from other neighbouring third-party mines, i.e. NGBR is being planned as an 'open access' railway.

Adani lodged an Initial Advice Statement (IAS) with the Queensland Government for NGBR in May 2013 and on 14 June 2013 received a 'Co-ordinated Project' declaration from the Co-ordinator General, on behalf of the Queensland Government.

Adani has engaged Aarvee Associates (Aarvee) to undertake concept level engineering design works for NGBR. This report presents the hydrology and hydraulic investigations undertaken for the NGBR alignment from chainage 10.82 km to chainage 305.63 km (Option 6 Revision 2).

NGBR Overview

The proposed NGBR alignment generally runs north-south, connecting the proposed Carmichael Mine in the Galilee Basin to the Port of Abbott Point via the proposed Carmichael Railway that has previously been submitted separately by Adani to the Co-ordinator General. The Carmichael Railway generally runs east - west from the proposed Carmichael Mine to link with the proposed NGBR alignment near its intersection with the Gregory Developmental Road, as shown in Figure A.



Figure A: Project Location

Hydrology and Hydraulics

The North Galilee Basin Rail (NGBR) traverses a number of major watercourses and a significant extent of floodplains along its length as seen from Figure A.

The hydrological and hydraulic analysis provides recommendations of the cross drainage infrastructure required to minimise impacts to existing flow paths, minimise impacts on existing infrastructure and properties, and to meet the conditions set in the Environmental Impact Statement (EIS) and Project Design Criteria (PDC).

Waterway crossings, 567 numbers, intersecting the NGBR alignment were identified and their catchments delineated. This allowed for classification of waterways based on their catchment sizes and the hydrological analysis method as shown in Table A.

Table A: Catchment Types

CATCHMENT TYPE	CATCHMENT SIZE (KM ²)	Nos	HYDROLOGIC METHOD	ASSESSMENT
Minor	Less than or equal to 25km ²	543	Rational Method	
Moderate	Greater than 25km ² but less than or equal to 100km ²	11	'XPRAFTS' software using the Laurenson runoff-routing method	
Major	Greater than 100km ²	13	'XPRAFTS' software using the Laurenson runoff-routing method	

The waterways are also further classified as either 'watercourses' or 'drainage features' based on their legislative status according to the requirements of the Water Act (2000) and the Fisheries Act (1994). The watercourse mapping has identified that the alignment intersects with 196 watercourses that will require consideration under these acts to determine and minimise the impacts on these watercourses.

A site inspection was undertaken in June, 2013 to visually inspect the alignment and the waterways to confirm the location of major and minor waterway crossings and to conduct a visual assessment of the flow and drainage patterns within the contributing catchments. Information regarding the anecdotal evidence of historic flood levels was identified. The site visit information was used to assist in the analysis and solution development.

Peak discharges and peak flow runoff hydrographs were estimated for the 20, 50 and 100 year Average Recurrence Interval (ARI) events. One dimensional (1D) and preliminary two dimensional (2D) hydraulic modelling was used to determine the existing (pre-development) and future (post-development) behaviour of the waterways in order to establish the impacts of the railway construction.

There were 430 nos 1D hydraulic models and preliminary 10 nos 2D hydraulic models developed at this design stage. Typical drainage solutions for each of the waterway crossing consist of a combination of railway bridge structures, spanning the main waterway channels or a series of cross-drainage structures. The outcomes of the hydraulic modelling is shown in Table B.

Table B: Hydraulic Modelling Outcomes

ITEM	DESCRIPTION	NO
1	Total Waterway Crossings	567
2	Watercourses	196
	Bridge Structures	17
	Drainage Structures (Pipe and Box Culverts)	170
	Diversions	9
3	Drainage Features	371
	Bridge Structures	NIL
	Drainage Structures (Pipe and Box Culverts)	371

Note : The minor drainage features along the alignment with design discharges less than 1 m³/s are proposed to be rerouted locally to the longitudinal drainage. Detailed assessment to be carried out in next design stage.

Bridges structures are proposed at all major waterway crossings to avoid the realignment of channels, ensure required flood flows and immunity is achieved, and maintain required environmental flows in the channels during low flows.

A summary of the major waterway crossings and the proposed structure configuration is shown in Table C.

Table C: Major Waterway Crossings

WATERWAY	CHAINAGE (OPT6 REV2)	CATCHMENT SIZE	PEAK FLOW (Q50 ARI)	STRUCTURAL CONFIGURATION
Name	Km	km ²	m ³ /s	(Bridge / Drainage Str)
Splitters Creek	20.23	76.24	592.68	3x20.2m Span Bridge + Drainage Structures
Elliot River	35.08	128.08	999.44	4x20.2m Span Bridge
Bogie River	61.22	432.51	2732.63	9x20.2m Span Bridge
Sandy Creek	64.78	149.45	663.77	3x20.2m Span Bridge
Strathmore Creek	98.78	155.55	558.71	2x20.2m Span Bridge
Pelican Creek	106.05	563.74	2136.05	8x20.2m Span Bridge
Bowen River	132.20	5806.25	12560.80	20x20.2m Span Bridge + Drainage Structures
Upper Suttor River	172.06	296.42	543.01	2x20.2m Span Bridge
Lily Creek	176.58	40.12	126.05	Drainage Structures
Rockingham Creek	187.00	138.48	301.44	1x20.2m Span Bridge + 1x20.2m Span Bridge
Murray Creek	206.51	100.37	311.27	3x20.2m Span Bridge
Upper Gunn Creek	220.86	39.09	84.13	Drainage Structures
Gunn Creek	231.20	115.39	157.28	Drainage Structures
Verbena Creek	242.53	399.25	526.03	3x20.2m Span Bridge
Serpentine Creek	244.49	101.92	171.30	Drainage Structures
Suttor River	271.06 - 273.37	10541.82	8217.43	30x20.2m Span Bridge + 9x20.2m Span Bridge + 11x20.2m Span Bridge + 5x20.2m Span Bridge + Drainage Structures

With the proposed waterway drainage structures, afflux levels adjacent to the proposed railway generally meet the maximum design criteria of 0.5m. Afflux and velocity results for the post development case meet the nominated design criteria requirements at all critical locations. The modelling has demonstrated that the use of drainage structures along the proposed railway can mitigate its hydraulic impacts to acceptable level.

It is recommended that the following works be undertaken during the next design stage:

- Drainage structures should be further optimised by combining the nearby minor crossings;
- Additional LiDAR data is required for certain areas and should be used in subsequent design to provide inputs for the hydraulic modelling;
- Further refinement of the 2D hydraulic models with proposed bridge and transverse drainage culvert configurations will be conducted to further develop the flood mapping information; and
- A value engineering exercise shall be undertaken to provide the most cost effective drainage solutions within the design constraints and taking into consideration of the third party infrastructure e.g. existing rail/road drainage and others.

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ACRONYMS

ARI – Average Recurrence Interval
AMPL – Adani Mining Propriety Limited
AR&R – Australian Rainfall and Runoff
BoM – Bureau of Meteorology
CGIAR – CSI – Consortium of International Agricultural Centres – Consortium for Spatial Information
DTM – Digital Terrain Model
DTMR - Department of Transport and Main Roads Queensland
EIS – Environmental Impact Statement
Geo-Fabric – Geospatial Fabric
IFD – Intensity-Frequency-Duration
LiDAR – Light Detection and Ranging
NGBR - - North Galilee Basin Rail
PDC – Project Design Criteria
RCP – Reinforced Concrete Pipe
RCBC – Reinforced Concrete Box Culvert
RPEQ – Registered Professional Engineer of Queensland
SRTM – Shuttle Radar Topography Mission
XPRAFTS – Hydrological Modelling Software
XPSWMM+XP2D – 1D and 2D Hydraulic Modelling Software

Section 1

Introduction

1.0 INTRODUCTION

1.1 Project Background

Adani Mining Pty Ltd (Adani) is proposing to develop a greenfield, non-electrified, heavy haul (32.5 tonne axle load), standard gauge railway, referred to as the North Galilee Basin Rail (NGBR) to transport up to 100 Mtpa of coal directly to the Port of Abbot Point. It is anticipated that the coal to be transported will be a combination of coal from Adani's proposed Carmichael Mine and coal from other neighbouring third-party mines, i.e. NGBR is being planned as an 'open access' railway.

Adani lodged an Initial Advice Statement (IAS) with the Queensland Government for NGBR in May 2013 and on 14 June 2013 received a 'Co-ordinated Project' declaration from the Co-ordinator General, on behalf of the Queensland Government.

The proposed NGBR alignment generally runs north - south, connecting the proposed Carmichael Mine in the northern portion of the Galilee Basin to the Port of Abbott Point via the proposed Carmichael Railway that has previously been submitted separately by Adani to the Queensland Government. The Carmichael Railway generally runs east - west from the proposed Carmichael Mine to link with the proposed NGBR alignment near its proposed intersection with the Gregory Developmental Road, as shown in Figure 1.1.

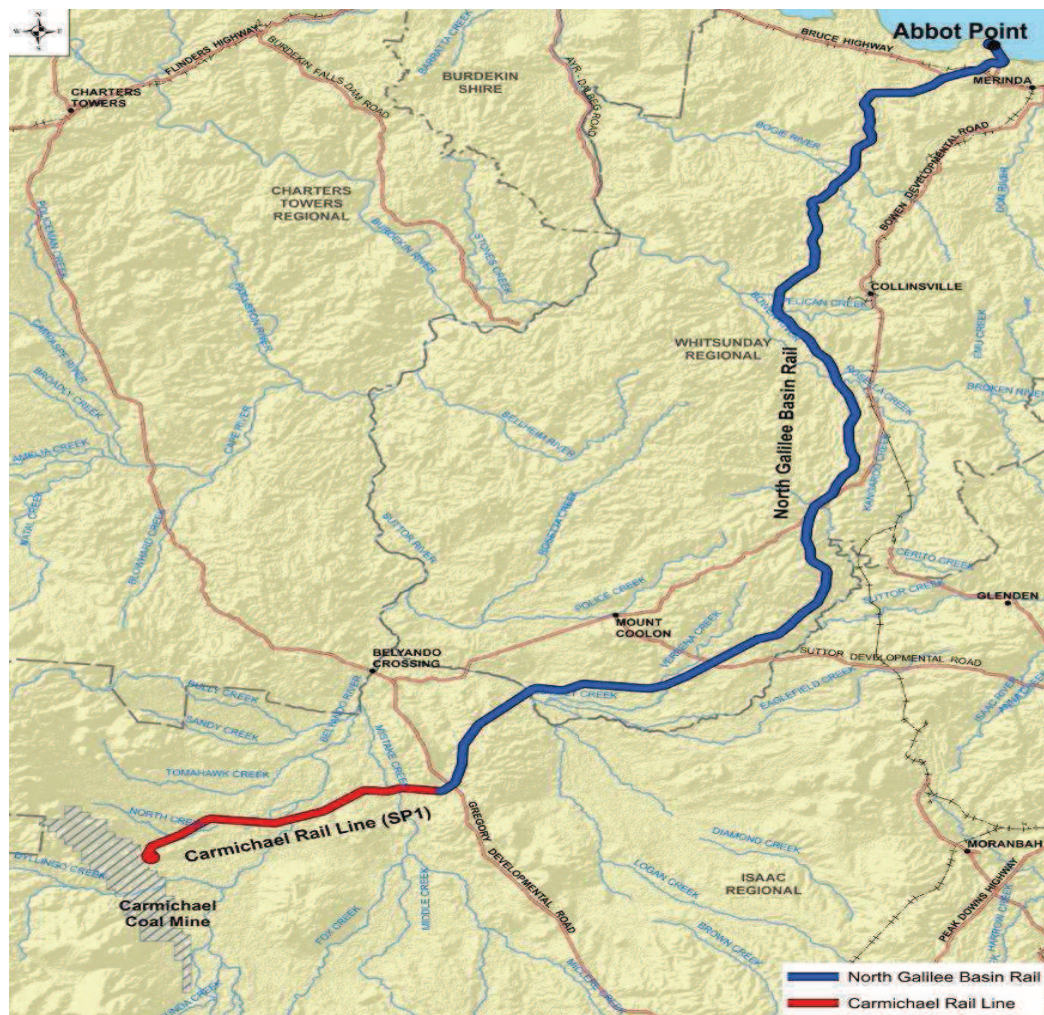


Figure 1.1: Project Location

1.2 Purpose of this Report

The purpose of this report is to analyse and assess the impact of the proposed North Galilee Basin Rail (NGBR) on the existing waterway crossings. The analysis provides recommendations of the cross drainage infrastructure required to minimise impacts to existing flow paths, minimize impacts on existing infrastructure and to meet the conditions set in the Environmental Impact Statement (EIS) and Project Design Criteria (PDC). The design approach was based on best practise principles and experience gained from similar projects within the region. Consideration was given to publicly available requirements from the Coordinator General for these projects, to provide comparable and reasonable design criteria.

This report presents the hydrology and hydraulic investigations undertaken for the NGBR alignment. The following sections outline the methodologies employed for the hydrologic and hydraulic analyses respectively.

1.3 Clients Requirement

The design development for the NGBR is divided into a number of stages with an increasing level of detail provided at each stage. The data requested in support of the EIS application for the NGBR is shown in Table 1.1, with a reference to where it is discussed in this report or other reports. The level of detail provided in response to the information requests is in line with concept level design, and will be further refined and expanded during the next design stage.

Table 1.1: Client Requirements

RFI NO.	ITEM NO.	INFORMATION REQUESTED	REFERENCE SECTION
4	1	Methodology for: a) Develop and run hydrologic models b) Develop and test design criteria for crossings or drainage structures c) Include details of all calculations along with descriptions of base data, any potential for loss of flood plain storage, and triangulated surface meshes produced in terrain modelling software.	2.2
4	2	Description and maps of existing case 20, 50 and 100 year events, with a) flood inundation b) velocity profile c) peak water level d) flood duration	Volume 2 of NGBR Concept Design Report
4	3	Table detailing all crossing locations with, for each location: a) identification number (sequenced north to south) b) rail corridor chainage (or KPs as applicable) c) name of catchment d) name of waterway e) stream order of waterway f) area of catchment upstream of the crossing g) flow rates for the 20, 50 and 100 year events (existing case)	3.0
4	4	Corresponding map showing all crossing locations.	Volume 2 of NGBR Concept Design Report
4	5	For each watercourse that is crossed please provide: a) longitudinal slope b) bed material (boulder, gravel, sand, clay, alluvium)	Appendix -Major Waterway Crossings Summary
4	6	Description and maps of developed case 20, 50 and 100 year events, with: a) flood inundation b) velocity profile c) peak water level d) flood duration d) afflux	Volume 2 of NGBR Concept Design Report
4	7	Estimated change in flood duration at affected homesteads, roads or other potentially sensitive locations, if any	7.0

RFI NO.	ITEM NO.	INFORMATION REQUESTED	REFERENCE SECTION
4	8	Describe any alteration of overland flow path by rail alignment	4.0
4	9	Table of all crossings for the 100 year event (design event) with, for each crossing: a) identification number (sequenced north to south) b) rail corridor chainage c) type of crossing, i.e. culvert or bridge d) estimated length of bridge e) estimated size and required number of culverts f) exit velocity g) recommended scour protection	Appendix C - Waterway Crossings Register
4	10	Design criteria of each crossing, levee, rail line and so on, including a) maximum acceptable velocity b) maximum acceptable afflux c) flood immunity standard (i.e. design event) Demonstrate how flood impacts associated with the Project will be minimised, particularly in consideration of impacts on the following: - Property and infrastructure, including landholders' businesses and private use of properties - Natural waterways - The natural landscape in the floodplain area	2.0 & 4.0
4	11	Details of design of crossings should also be sufficient to determine the level of approval required under the <i>Water Act 2000</i>	2.0
4	12	Descriptions of crossings, drainage structures, levees, including construction material and method for each type.	Section 2.4 and 5.3, Volume 1 of NGBR Concept Design Report
4	13	Evidence that consultation with affected landholders about the flood study data and implications for their properties has been undertaken, and how the landholders views have been accounted for, e.g. a) design solutions b) other commitments	6.0 & Volume 2 of Concept Design Report. Alignment Change Register of Concept Design Report
4	14	Description of in-stream works, e.g. a) area of clearing b) duration of construction c) description of construction activities d) permanent or temporary nature of structure e) recommended decommissioning and rehabilitation method for temporary structures	Section 2.4 and 5.3, Volume 1 of NGBR Concept Design Report
4	15	The following values will be identified in the Hydrologic report and confirmed via mapping, consultation with affected landholders, or subsequent desktop impact assessment e) properties and land use, including cattle grazing land f) structures, including homesteads g) infrastructure, with reference to the EPP (Water) and	-

RFI NO.	ITEM NO.	INFORMATION REQUESTED	REFERENCE SECTION
		the Water Act 2000 h) watercourses and aquatic ecosystems i) the natural landscape in the floodplain area j) roads, farm tracks and stock routes j) dams, levees, weirs j) other assets such as windmills, fences etc.	
4	16	If a major re-alignment of a watercourse is proposed and a licence to interfere with a watercourse is required, then the diversion must be designed, constructed and monitored in accordance with the relevant ACARP reports as advised by the relevant state agency. The state government regional guideline entitled Watercourse Diversions - Central Queensland Mining Industry (15 March 2011) should also be utilised.	5.0
4	17	DEHP blended topographic survey data (Shuttle Radar Topography Mission (SRTM) and combined contour data)	-
4	18	LiDAR data for extent of alignment	-
4	19	DEHP stream-gauge historical data;	Sent Separately
4	20	BoM Intensity-Frequency-Duration regional data.	Appendix
4	21	Culvert design flow and classification, e.g. Major or Minor based on ARI design flows	2.0
4	22	Culvert freeboard, e.g. min. 300mm to the formation surface for design event	2.0
4	23	Culvert headwater, e.g. max. headwater to be 1.5 x culvert diameter	2.0
4	24	Culvert maximum outlet velocity, e.g. 5.0m/sec for design event with appropriate scour protection	2.0
4	25	Culvert scour protection, e.g. based on endurance of ARI design flows	2.0
4	26	Culvert type, e.g. CSP (galvanised corrugated steel pipes)	2.0
4	27	Culvert earthwork cover, e.g. 600mm earthwork cover	
4	28	Culvert size, e.g. 900 mm diameter	2.0
4	29	Cut-off drains, e.g. unlined cut off drains to prevent surface water runoff entering rail cuttings	2.0
4	30	Bridges, e.g. span length, number of spans	4.0
4	31	Bridge freeboard, e.g. 500mm for nominated ARI and 300mm to top of formation (TOF)	2.0
4	32	Bridge max velocity, e.g. 3.8m/s	2.0
4	33	Bridge scour protection, e.g. based on endurance of ARI design flows	2.0
4	34	Maximum afflux, e.g. 1.5m with reduction at sensitive locations.	2.0
4	35	Guide banks, e.g. to be designed in accordance with AUSTROADS Waterway Design, 1994.	2.0
4	36	Levees, e.g. levees to ensure 100mm freeboard above culvert headwater design level	5.0

RFI NO.	ITEM NO.	INFORMATION REQUESTED	REFERENCE SECTION
4	37	Overview on how climate change and/or extreme events have been considered in relation to flood impacts and impacts to rail infrastructure.	4.0
4	38	Consideration of cumulative flood/inundation impacts as a result of other proposed and/or existing infrastructure. How, if at all, can this be addressed? Even if only at a qualitative level based on the outputs of the flood modelling.	4.0
4	39	Information on the proposed location, type and design of waterway barrier works (temporary and permanent structures in both permanent and ephemeral waterways) that would impact on aquatic resources, particularly fish movement with an appropriately scaled map	Section 2.4 and 5.3, Volume 1 of NGBR Concept Design Report
4	40	Location and detail of any of proposed stream diversions, causeway construction and crossing facilities, stockpiled material and other impediments that would restrict free movement of aquatic fauna	5.0
4	41	Are there any farm dams within or near the 1000 m investigation corridor potentially impacted by proposed infrastructure or flooding?	Attachment H - Property Impacts Register of Concept Design Report
4	42	Potential impacts of in-stream works on hydrology and water quality and proposed measures for avoiding or mitigating the impacts and stabilising and rehabilitating any works.	Section 2.4, Volume 1 of NGBR Concept Design Report
4	43	For crossings where a waterway barrier works approval is required, detailed modelling and the following hydrology information is required for each site. Note that this list may not be exhaustive: - flood contours: one in one year, one in five year, one in 50 year events - floodplain extent and floodplain habits over time - historical and current flow regimes including seasonal flow patterns, flow volumes, flow duration curves for a range of flows - historical and existing quantitative hydrological data and details of existing regulatory structures and other barriers.	-
4	45	Any existing surface water hydrology information	-

1.4 Design Approach

The design approach for the bridge and drainage structures at waterway crossings has aimed at the safe passage of flood flows with minimal effects such as ponding, change in flow directions, or increases in flood levels on the surrounding environment and infrastructure. The project design criteria includes the rail- line flood immunity design event, as well as limits on the upstream afflux values and outlet velocities at the structures.

The design inputs and data for the hydrological and hydraulic investigations consisted of the following:

- LiDAR data (vertical accuracy of +/- 0.1m) and orthophotos;
- Information obtained from accessible watercourse crossings during site visits;
- Stream identification and catchment delineation based on the LiDAR and latest SRTM data;
- Intensity-Frequency-Duration (IFD) data from the Bureau of Meteorology (BoM) website for the project area;
- Design event peak discharges and peak discharge hydrographs at the watercourse crossings using hydrological modelling; and
- Peak water depths, peak water levels, afflux and velocities calculated using the 1D and 2D Hydraulic modelling software.

The type of drainage structure was established based on the design event peak discharge values.

Following are some of the peculiarities of the hydrologic and hydraulic investigations, which were addressed by site visits, and adoption of better assessment methods and modelling techniques:

- Varying flow directions of watercourses crossing the rail line;
- Mimicking the complex floodplain flow within major watercourses consisting of multi and braided channels; and
- Un-gauged watercourses i.e. no stream flow data.

Preliminary recommendations and sizing are provided for the cross drainage infrastructure required to satisfy the PDC and the environmental conditions likely to be imposed on the Project.

1.5 References/ Software

The Hydrological calculations for this design have been undertaken with reference to the following manuals and standards.

- Australian Rainfall and Runoff Manual (AR&R) (1987);
- Transport and Main Roads – Road Drainage Manual (2010).
- Topographic maps from Geo science Australia – 55 Series Maps;
- Bureau of Meteorology, Australia – IFD data website;
- Geoscience /Bureau of Meteorology, Australia – Geo-Fabric Data (Version 1.1.3- Nov 2011);
- SRTM Version4 90m data CGIAR-CSI data and
- AMPL LiDAR survey data with an accuracy of +/- 0.1m
- Austroads Waterway Design Manual (1994).
- XPRAFTS – hydrological analysis software
- HEC-RAS – 1D hydraulic modelling software
- XPSWMM+XP2D – 2D hydraulic modelling software

Section 2

Existing Conditions, Design Methodology and Limitations

2.0 EXISTING CONDITIONS, DESIGN METHODOLOGY AND LIMITATIONS

2.1 Existing Conditions

The proposed NGBR traverses undulating terrain consisting of a number of rivers, creeks and drainage paths, which are prone to flood inundation during periods of peak flood events (typically flowing during December to April). The main rivers and creeks that interface with the NGBR are illustrated in Figure 1.1.

The railway alignment passes through catchments that have three distinct terrains.

- At the north end of the alignment, close to the port area, the terrain is flat and the runoff from the catchments drains through the Caley Valley Wetlands or directly into Abbot Bay;
- The landscape of the catchments at the mid-section of the alignment could be described as rolling to hilly terrain with well-defined waterways, predominantly draining into the Burdekin River catchment; and
- The terrain of the catchments at the south end of NGBR could be described as flat. There are a number of floodplains in this locality. The waterways in this section are poorly defined (with the exception of the Suttor River) but generally drain into the Burdekin River catchment.

The aerial views in Photographs 2.1 to 2.6 show typical landscapes along the railway alignment.



Photograph 2.1: Typical Coastal Wetlands – Caley Valley Wetland, at Approx. Ch. 5 km.



Photograph 2.2: Typical Hilly Catchments with Well-Defined Waterways (Clarke Range), at Approx. Ch. 23 km.



Photograph 2.3: Typical Dense Vegetation, at Approx. Ch. 45 km.



Photograph 2.4: Typical Grazing Land and Open Forest, Creek Bed, at Approx. Ch. 62 km.



Photograph 2.5: Typical Flat Catchment with Poorly Defined Water Course, at Approx. Ch. 225 km.



Photograph 2.6 – Typical Wide Floodplain Conditions (Suttor River) Approx. Ch.272 km.

In order to assess the existing conditions and to conduct a visual understanding of the flow and drainage patterns at waterway crossings/within their contributing catchments, a site visit was undertaken in June 2013. The descriptions of accessible major waterway crossings along the NGBR alignment or the nearest accessible waterway crossings along the major roads/railway were recorded during the site visit.

The detailed site investigations are presented in Appendix B.

The summary sheets showing the details of the major waterway crossings are shown in Appendix D.

2.1.1 Hydrological Conditions

The regional climate in the project area is tropical. The average annual rainfall at the Carmichael Mine site is about 530mm while the average annual rainfall at Abbot Point is 1010mm. The design rainfall data was obtained from the Bureau of Metrology (BoM) web site. The majority of the precipitation occurs during the wet season from November to May. Cyclones and seasonal rains can occur during these months.

The mean annual maximum and minimum temperatures at Abbot Point are 31.7°C and 10.8°C respectively while mean annual maximum and minimum temperatures at the Carmichael Mine are 29.7°C and 15°C respectively. The maximum temperatures occur during the warmer half of the year, between the months of October and March.

The rolling terrain areas along the alignment are characterised by defined watercourses with negligible storage potential. This also results in a relatively faster catchment response time when compared to the flatter areas. This faster response time and less catchment storage will result in higher runoff rates.

The predominant land use in the study area is cattle grazing and as such the predominant vegetation is native grazing vegetation. Studies indicated that higher runoff rates are generated from this type of land use compared to catchment areas covered with dense vegetation or sand dunes.

The NGBR alignment crosses tidal creeks as it approaches the port area. The Highest Astronomical Tide (HAT) and Mean High Water Springs (MHWS) are 1.97m and 1.06m AHD for these crossings respectively. HAT level is used as the tail water level boundary when sizing waterway structures in the tidal area.

Regional hydrological conditions were assessed based on site visits; 1:250,000 topographical maps from Geoscience Australia; data obtained from the Bureau of Meteorology; desktop geotechnical assessment; and Queensland Land Use information (Department of Natural Resources and Mines). Hydrological modelling conducted during the concept design stage has considered only the current climate scenario and has not considered any future climate change.

2.2 Methodology

The hydrological and hydraulic investigations undertaken during this study mainly focus on analysis and assessment of the impact of the NGBR as it traverses the various river/creek floodplain systems.

The hydrology assessments and hydraulic modelling were carried out using;

- Option 6 Revision 2 rail alignment for section between chainage 10.82 km to 305.63km; and
- Option 6 Revision 3 rail alignment for section between chainage -9.899 km to 10km (balloon loop section).

The analysis provides recommendations of the optimum drainage infrastructure to meet the conditions set in the design criteria, which are detailed in Appendix A.

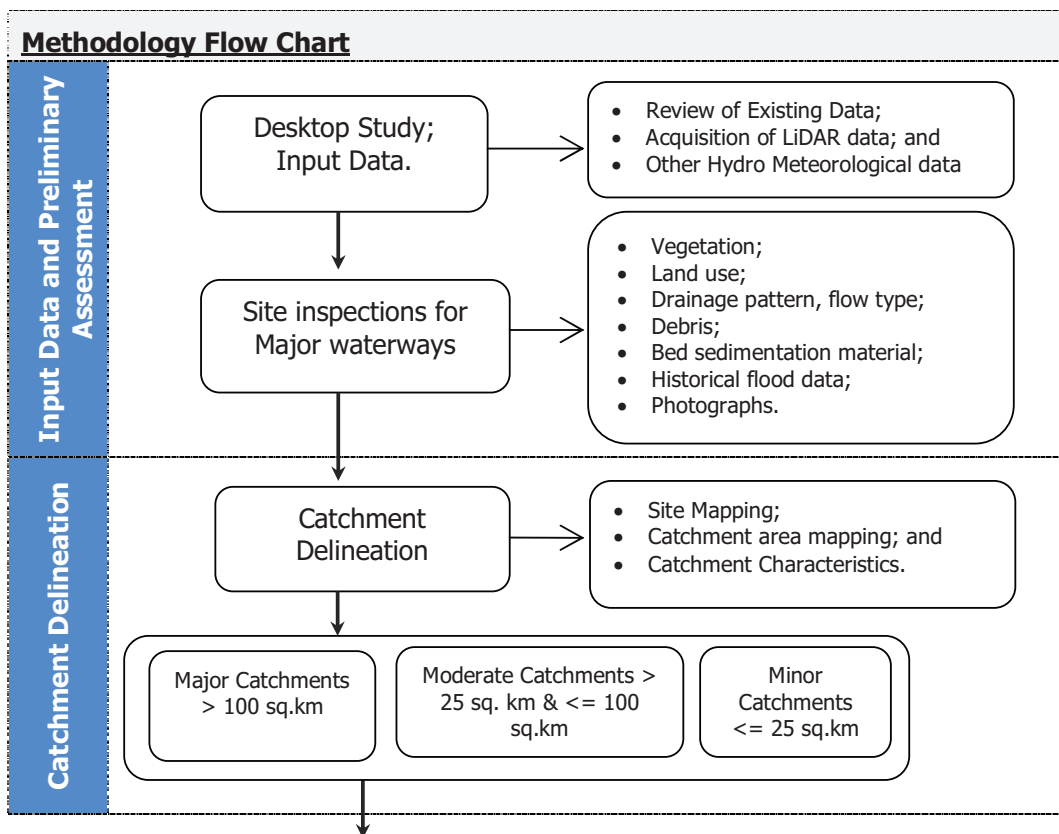
A comprehensive methodology was proposed along with the design criteria for hydrological and hydraulic investigations, which are detailed below.

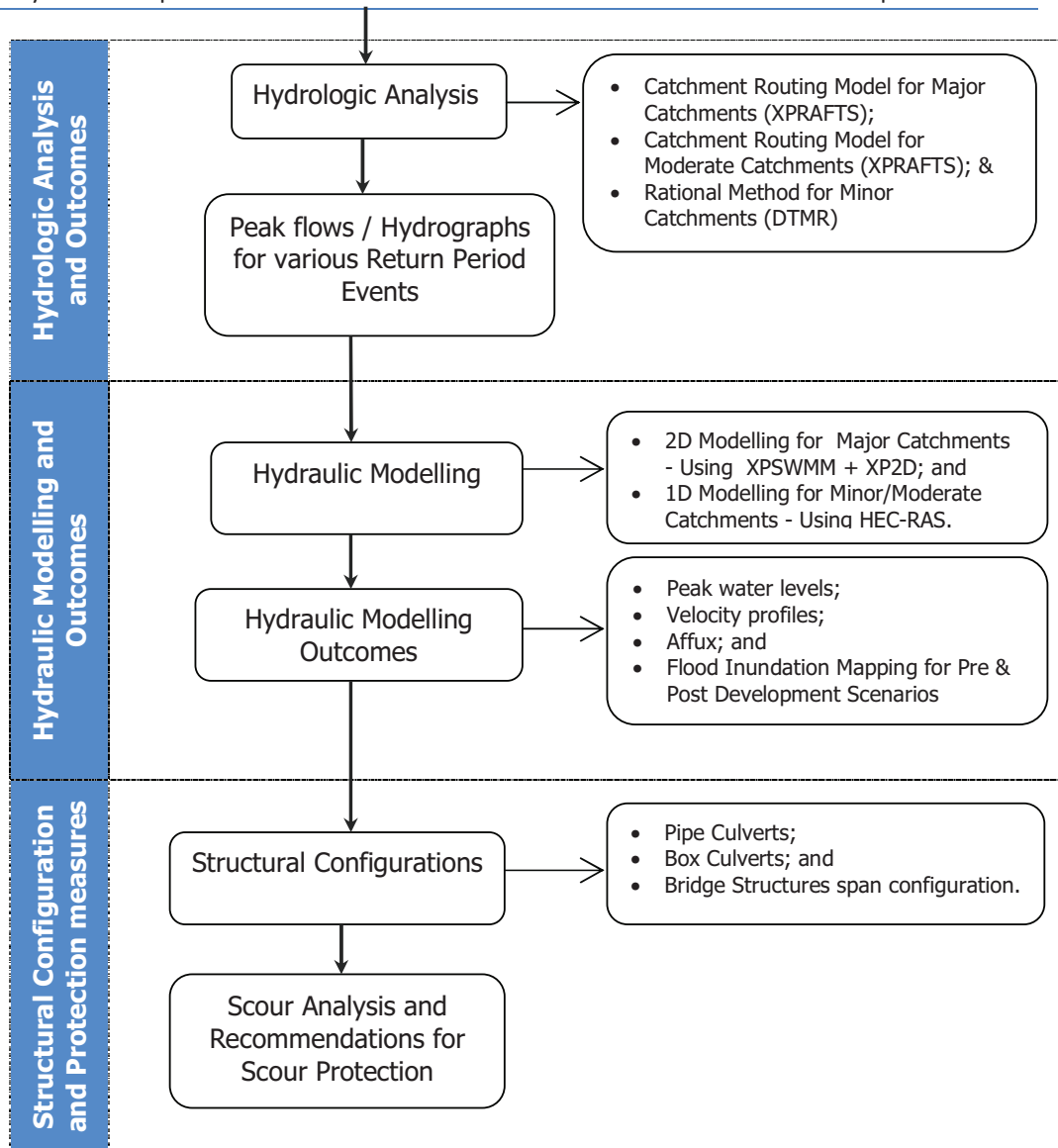
- The investigations began with a desktop review of the existing data, earlier reports and assessment of the further data requirements i.e additional LiDAR data; Hydro-meteorological data (rainfall) and runoff records within the study area.
- Further, the major and minor watercourses were identified and their catchments delineated using topographical maps from Geoscience Australia, aerial photography, LIDAR data, SRTM data and drainage mapping from Australian Geo-fabric 2011.
- Site investigations were undertaken for visual assessment of the flow and drainage patterns and a description of the bed sedimentation material within the accessible major watercourse crossings.
- Hydrologic analysis was undertaken using the Rational Method (DTMR-Road Drainage Manual) for rural catchments smaller than or equal to 25 km² to determine peak flow rates. For rural catchments larger than 25 km², XPRAFTS model implementing the Laurenson runoff-routing method of flood estimation was used to determine peak discharge hydrographs. Where historical stream gauge recorded data was available, Flood frequency analysis as per AR&R was conducted to predict the peak discharges for the design ARI and the runoff-routing models were accordingly calibrated to the predicted peak discharges.
- Hydraulic modelling was undertaken using 1D and 2D modelling software. For ephemeral gullies and well defined creeks, 1D analysis using Hydrologic Engineering Centre's River Analysis System (HEC-RAS) was carried out to

determine the hydraulic impacts and cross drainage infrastructure required. For systems with complex flow patterns and floodplain interaction between multiple streams, preliminary 2D analysis using XPSWMM+XP2D software was carried out to determine the hydraulic impacts and cross drainage infrastructure required. For the 2D systems, preliminary inundation, afflux and velocity maps were produced for pre-development and post-development conditions.

- Reasonable Manning's n values within 1D and 2D hydraulic modelling were considered for the channel and flood plains with inference to site visit data collection.
- A target limit for permissible afflux for a 50 year ARI design flood, based on the similar studies conducted in the study area has been set. The extent of permissible afflux will assist in determining bridge span lengths at major watercourse crossings and type and size of culverts at minor crossings.

A flow chart on the methodology is presented below. Hydrologic and hydraulic investigations are explained further in the subsequent sections.





2.3 Limitations

The following limitations are relevant to the works completed to date:

- Sensitivity testing on input parameters was not completed for both the hydrologic or the hydraulic modelling, however the parametric values are chosen based on the best practice guidelines and site visit observations;
- Structure size and type and embankment heights (for immunity purposes) have been optimised based on the set design criteria, for easy procurement and within the limitations of LiDAR/SRTM data and hydrological predictions. Where no flow data was available for waterway crossings, the hydrology predictions were based on AR&R guidelines;
- Insufficient LiDAR survey data extents have resulted in estimated infrastructure at some locations instead of basing them on hydraulic modelling. These additional LiDAR areas data is required for improvements at next design stage and to be procured.

- It should be noted that 2D maps developed are preliminary only. Further refinement of the models with proposed bridge and transverse drainage/culvert configuration will be conducted during the next design development stage to further refine the flood mapping data.

Section 3

Hydrology

3.0 HYDROLOGY

3.1 Parameters

The following assumptions and substitutions have been made while undertaking the current design.

- Where LiDAR data is insufficient, SRTM DTM has been used for delineation of catchments;
- The coefficient of runoff for the ARI 50 year event (C_{50}) within the Rational Method has been adopted from Table 5.9.1(a) (for rural catchments) of the Department of Transport and Main Roads - Road Drainage Manual 2010. To determine the value of C_y for other ARIs, the C_{50} value is modified using the factors from Table 5.9.1(b);
- For the XP-Rafts models, the sub-catchment Manning's n value has been taken as 0.05 to 0.06 (sub-catchment averaged value) depending on the type of vegetation within the catchment;
- The design loss parameters, median initial loss as 15mm to 30mm depending on the ARI event and median continuing loss as 2.5mm/hour for all ARI design events, have been adopted from Table 3.6(Book II, Section 3) of AR&R for eastern Queensland;
- Additional impact of climate change predictions have not been incorporated into the current design stage; and
- Muskingum Method Coefficient values for modelling reaches within the XP-Rafts model have been adopted as follows:
 - X: 0.3 for the natural channels
 - K: an estimate of the travel time of the flood wave in hours taken by the flood within a particular reach length (channel length divided by the average velocity within natural channels)

3.2 Review of Existing Data and Data Collection

A desktop review of the existing data was undertaken and historical stream gauge recorded data for major watercourses was collected from the water monitoring portal of DERM Queensland.

3.3 Waterway Identification and Catchment Delineation

Waterway crossings were identified and catchment boundaries were delineated based on 1 in 250,000 topographical maps from Geoscience Australia, LIDAR data (collected within 1 km corridor along the proposed rail line and extra coverage areas at major watercourses), available aerial photography, the SRTM data, Google Imagery and drainage mapping layers from Australian Geo-fabric 2011.

The national drainage basins layer (version 1.1.3, Nov 2011) was used for delineation of the catchment extents of major watercourses. ArcGIS's hydrologic analysis tools and the required manual refinement procedures were used to delineate the sub-catchments and determine their characteristics within the major watercourse catchments.

Minor watercourse crossings have been identified and their catchment boundaries delineated using LiDAR data covering a 1 km corridor along the proposed railway, SRTM data for the area outside of the project corridor, and aerial imagery. Some of the minor crossings in the form of drainage features do not have a well formed channel but are located at the lowest point within the terrain to facilitate general cross drainage.

The design work to date has identified a significant number of waterways intersected by the proposed NGBR alignment. For this stage, preliminary waterway identification and assessment has been undertaken in order to establish baseline parameters for bridges and drainage structures, as well as identifying implications for existing waterways in the vicinity of proposed cutting locations.

567 watercourse or drainage feature locations have been identified where either, bridges, transverse drainage structures or longitudinal drainage channels will be required to manage runoff generated during storm events. Waterway crossings have been divided into classifications as watercourses or drainage features, with watercourses being of higher importance. Desktop studies and site investigations have indicated that the alignment crosses 196 identified watercourses that require special consideration under the Queensland Government's Water Act (2000) and the Fisheries Act (1994). Runoff at the remaining identified locations will be managed by the provision of transverse drainage structures, or longitudinal drainage channels where such drainage structures are not feasible due to topographical characteristics and/or proposed railway geometry.

The identified waterway crossings are given in the Waterway Crossings Register in Appendix C, along with the chainages, catchment area and stream order classification. The moderate and major watercourse crossings and the overview of their delineated catchments are shown in Figures 3.1 and 3.2.

3.3.1 Overview of Waterways

The desktop study has identified 567 waterway crossings along the 307 km length of the proposed railway. These waterways have been classified as minor, moderate or major based on their respective upstream catchment areas. This classification assists with the methodology to be adopted for calculation of flows generated from each of the respective catchments. The catchment limits for each classification and the number of crossings in each category are shown in Table 3.1. The table also shows the number of waterways classified as watercourse and drainage features under the Water Act, 2000.

Table 3.1: Waterway Crossing Classification

CATCHMENT SIZE	WATERWAY CLASSIFICATION	WATERWAYS	WATER COURSES	WATER COURSE DIVERSIONS	WATER COURSE DIVERSIONS IN CUTTINGS	DRAINAGE FEATURES
km ²		NO	NO	NO	NO	NO
≤25 km ²	Minor Waterway	543	172	9	6	371
>25 km ² & ≤100 km ²	Moderate Waterway	11	11	Nil	Nil	Nil
>100 km ²	Major Waterway	13	13	Nil	Nil	Nil
Total		567	196	9	6	371

Note : The minor drainage features along the alignment with design discharges less than 1 m³/s are proposed to be rerouted locally to the longitudinal drainage. Detailed assessment to be carried out in next design stage.

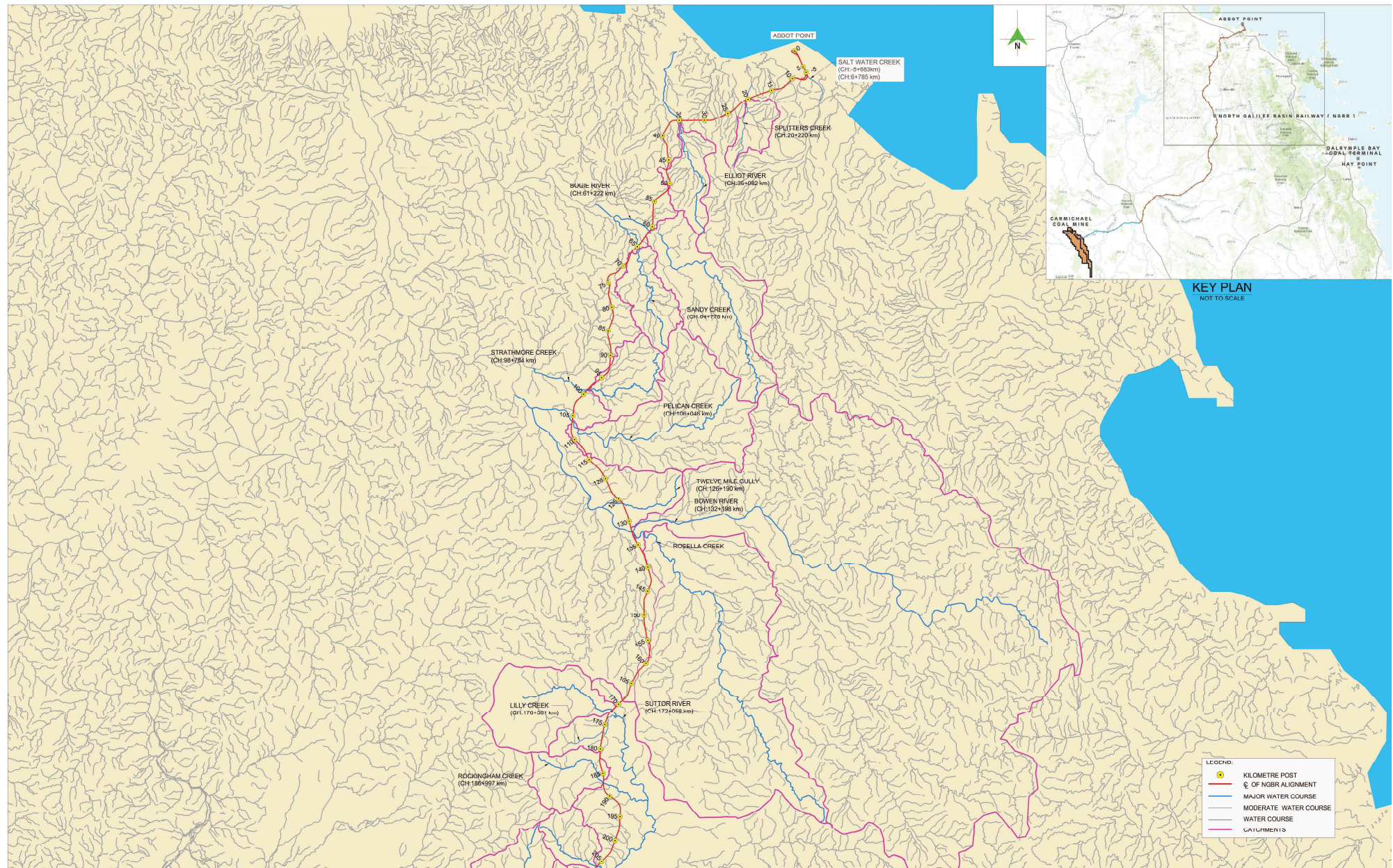


Figure 3.1: Major and Moderate Waterway Catchments – Area 1 of 2

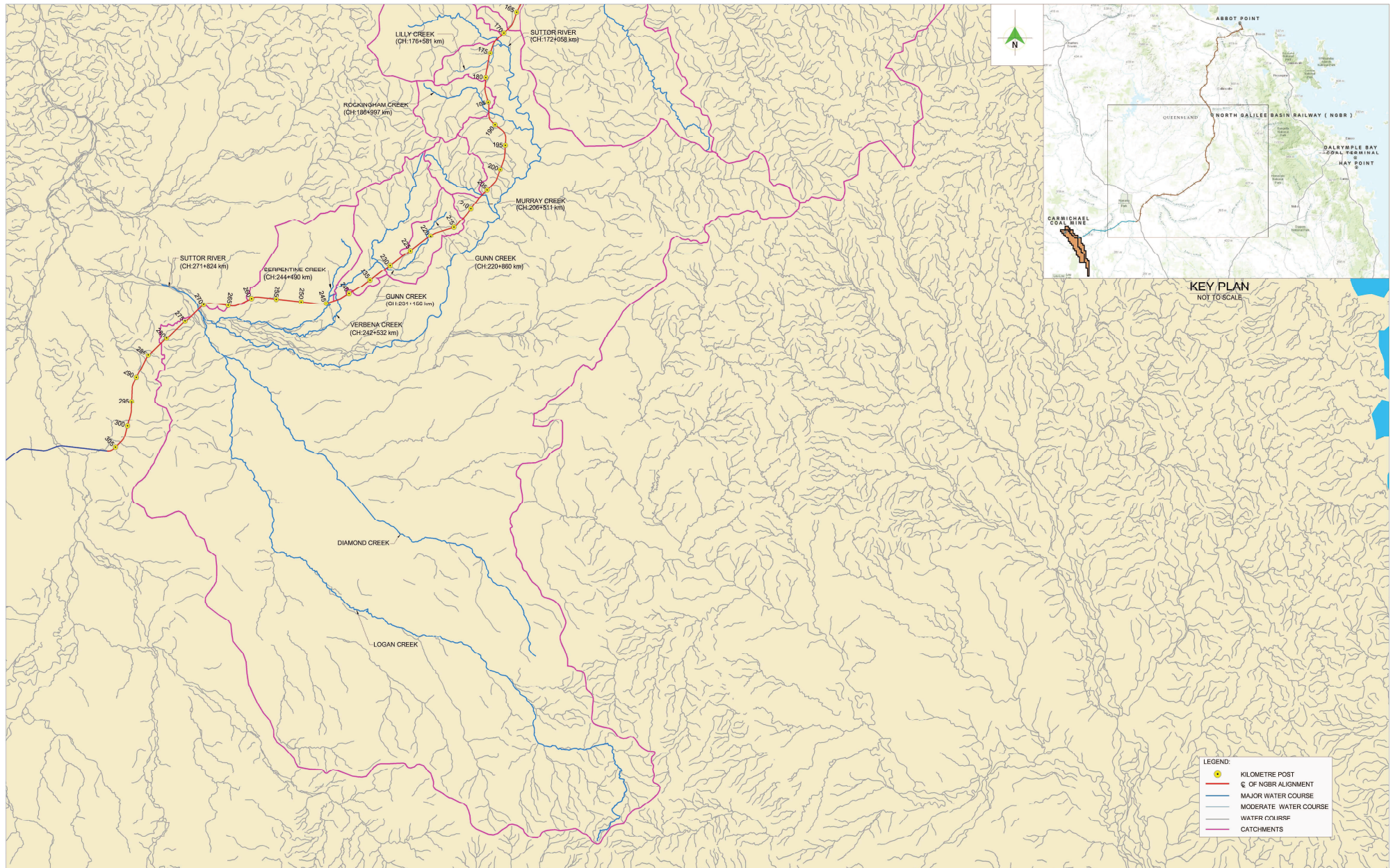


Figure 3.2: Major and Moderate Waterway Catchments – Area 2 of 2

Defined watercourses carry legislative requirements regarding possible construction impacts. The Department of Agriculture Fisheries and Forestry (DAFF) have released a guideline document called the 'Guide for Determination of Waterways Using the Spatial Data Layer Queensland Waterways for Waterway Barrier Works'. The guideline is in response to the broad definition of a waterway under the Fisheries Act, 1994 and a desire to provide greater certainty on what is considered a potential 'Waterway' as defined within the Fisheries Act, 1994.

The guideline maps waterways and codes them based on the risk of impact from waterway barriers works on fish movement. Codes used in the waterway mapping represent the risk of adverse impact on fish movement that is likely from barrier works. The coded risk mapping in combination with the 'Waterway Barrier Works Development Approvals Fish Habitat Management Operational Policy' (FHMP008) and a series of self-assessable codes is used to determine what activities trigger 'waterway barrier works' and what activities are either exempt or can occur in accordance with various self-assessable codes. The risk codes and the assessment requirements are shown in Table 3.2.

Table 3.2: Waterway Zoning and Assessment Requirements

WATERWAY ZONING NUMBER	COLOURS	RISK OF IMPACT	DEVELOPMENT TYPE			
			BED-LEVEL CROSSING	CULVERT CROSSING	LOW IMPACT DAM/WEIR	TEMPORARY WORKS
1	Green	Low	Self-assessable	Self-assessable	Self-assessable	Self-assessable
2	Amber	Moderate	Self-assessable	Self-assessable	Development Approval	Self-assessable
3	Red	High	Self-assessable	Self-assessable	Development Approval	Self-assessable
4	Purple	Major	Self-assessable	Development Approval	Development Approval	Self-assessable
5	Grey	Major	Development Approval	Development Approval	Development Approval	Self-assessable

Typical photos of the watercourses captured during the 'Mapped Watercourses' investigation are shown in Photograph 3.1 to Photograph 3.6.

The zoning numbers of the waterways, classification of the waterways, watercourse and fisheries stream order information are shown in the Waterway Register in Appendix C of this report.



Photograph 3.1: Watercourse, Rockingham Creek (Mount Lookout property)



Photograph 3.2: Watercourse – Unnamed (Disney property)



Photograph 3.3: Watercourse – Unnamed (Figtree property)



Photograph 3.4: Watercourse, Gunn Creek (Gleneva property)



Photograph 3.5: Watercourse, Gunn Creek (Terang property)



Photograph 3.6: Watercourse, Lilly Creek (Cerito property))

Natural drainage features including gullies, drainage depressions or erosion features that convey runoff for a short period of time after a rainfall event, and which do not have enough continuous flow to create riverine environments, are termed 'drainage features'. For the concept design, culverts have been provided at drainage feature crossings where possible and practical. Where the alignment is in cut or in low embankment, drainage features are proposed to be diverted to an adjacent culvert location.

Any construction works in defined watercourses would trigger consideration under the Water Act 2000 and/or the Fisheries Act 1994. The NGBR concept design has identified 9 proposed watercourse diversions where the proposed alignment is in cutting, or

where the depth of the channels is too shallow to feasibly provide effective drainage structures that are able to convey significant flow volumes under the proposed railway. Six of these 9 identified watercourses are in cuttings where longitudinal diversion works is the only option. These Six watercourses are 'first order' streams, which have the lowest number of fish and aquatic habitats and where the risk of damaging aquatic habitats is minimal compared to '3rd order' and lowland streams.

During subsequent design stages, when further watercourse site investigation data becomes available, solutions that satisfy requirements of the Water Act 2000 and Fisheries Act 1994 will be developed for watercourses that are diverted and which are not located in cutting locations.

3.4 Hydrological Analysis

For the purposes of hydrologic analysis, which is described in subsequent sections, the catchments have been categorised as below:

For minor catchments of less than or equal to 25 km², the most commonly used method in Australia for the estimation of design floods is the Rational Method. Using the catchment characteristics, the peak discharges were calculated using the rural catchments method as per DTMR Road Drainage Manual.

For catchment areas greater than 25 km², the runoff-routing method was adopted and XP-RAFTS software has been used to estimate design peak flow hydrographs.

3.4.1 IFD

The Intensity-Frequency-Duration (IFD) rainfall data was extracted from the BoM website for northern and southern extremities of NGBR (Ch 0 km and Ch 305 km) and at intermediate points of 60 km along the proposed rail alignment. The IFD data for the first 120 km of alignment was based on the data at the start of each 60 km section i.e. the data at Abbot Point (Ch 0 km) was used for the section of alignment from 0 km to 60 km and the data at Ch 60 km was used for the section of the alignment from 60 km to 120 km. For subsequent sections of 60kms from Ch 120 km to Ch 305 km, the IFD data was averaged with the values of two ends of the 60km reach, so that a single IFD table could be used for the catchments within that 60km reach.

The IFD data extracted from the BoM website and the averaged values adopted for the current design are shown in Appendix E.

3.4.2 Rational Method

The Rational Method formula is:

$$Q_y = C_y * I_{tc,y} * A / 360$$

Where:

Q_y = flow rate, Q (m³/s) for an ARI of y years;

C_y = runoff coefficient, C (dimensionless) for an ARI of y years;

$I_{tc,y}$ = average rainfall intensity, I (mm/h) for design duration of t_c and ARI of y years; and

A = area of catchment in hectares.

The Bransby-Williams equation as follows was used to calculate the time of concentration.

$$t_c = 58 * L / (A^{0.1} * S_e^{0.2})$$

Where:

t_c = time of concentration (min);

L = length of mainstream (km) from the outlet to the catchment divide;

A = area of catchment in km²;

S_e = equal area slope (m/km)

The average intensity of rainfall for each return period event was calculated from IFD rainfall data for the derived time of concentration of the catchment. The coefficient of runoff for the ARI 50 year event (C_{50}) within the Rational Method has been calculated from Table 5.9.1(a) for rural catchments of the Department of Transport and Main Roads - Road Drainage Manual 2010. To determine the value of C_y , for other ARIs, the C_{50} value was modified using the factors from Table 5.9.1(b). The runoff coefficient C_y is a function of the design ARI (y in years) and depends on the following.

- Rainfall Intensity;
- Relief or Slope of catchment;
- Storage or other detention characteristics; and
- Ground characteristics such as vegetation cover, soil type, and impervious areas.

The above factors were derived using the available IFD data, SRTM/LiDAR data, Orthophotos, Google imagery and Land use data respectively for the project area. It should be noted that the above method can give a C_{50} value greater than 1.0. Where this has occurred the C_{50} values have been rounded down to 1.0.

The peak discharges calculated as per rational method for the minor waterways for the 20 year, 50 year and 100 year ARI events are provided in Appendix F.

3.4.3 XP-RAFTS

XP-RAFTS rainfall-runoff routing model has been used to determine the peak design flows for moderate and major watercourse crossings. Sub-catchment characteristics i.e. area, equal area catchment slope of stream as % are input for each of the sub-catchment. The sub-catchment Manning's n value is taken as 0.05 to 0.06 depending on the type of vegetation within the catchment.

Storm durations from 1 to 72 hours for 20, 50 and 100 year ARI events were run to determine the critical storm duration that generates the peak discharge.

The design loss parameters have been taken from Table 3.6 (Book II, Section 3) of Australian Rainfall and Runoff (AR&R), 1999 for eastern Queensland. Initial and continuing losses were applied as per Table 3.3.

Table 3.3 Design Loss Parameters

ARI FLOOD EVENT	INITIAL LOSS	CONTINUING LOSS
20 year	30mm	2.5mm/hr
50 year	20mm	2.5mm/hr
100 year	15mm	2.5mm/hr

The flow routing within channels has been performed using the Muskingum Method. The routing parameters for the channels are input between the sub-catchments. The field derived values of K and X for the streams are not available. The value of X is taken as 0.3 for the natural channels and the parameter K approximately in hours, represents the travel time taken by the flood, which equals the channel length divided by the average velocity within natural channels.

The rainfall runoff peak flow discharges derived from the XP-RAFTS models are shown in Table 3.4.

Table 3.4 - Rainfall Runoff Method Peak Flow Discharges

ITEM NO	CHAINAGE OPT6 REV2	WATERCOURSE	CATCHMENT AREA	PEAK FLOW (ARI)		
	Km	Name	Km ²	20 YR	50 YR	100 YR
				m ³ /s	m ³ /s	m ³ /s
1	20.23	Splitters Creek	76.244	465.06	592.68	735.98
2	35.08	Elliot River	128.076	818.20	999.44	1200.76
3	61.22	Bogie River	432.507	2284.19	2732.63	3124.67
4	64.78	Sandy Creek	149.455	483.11	663.77	813.18
5	98.78	Strathmore Creek	155.553	380.16	558.71	697.01
6	106.05	Pelican Creek	563.735	1675.31	2136.05	2546.15
7	132.20	Bowen River	5806.250	10205.14	12560.80	14593.34
8	172.06	Upper Suttor River	296.418	403.00	543.01	666.09
9	176.58	Lily Creek	40.119	84.31	126.05	157.06
10	187.00	Rockingham Creek	138.482	197.17	301.44	378.24
11	206.51	Murray Creek	100.372	205.75	311.27	390.12
12	220.86	Upper Gunn Creek	39.086	53.14	84.13	107.65
13	231.20	Gunn Creek	115.396	99.89	157.28	201.50
14	242.53	Verbena Creek	399.254	336.95	526.03	667.05
15	244.49	Serpentine Creek	101.916	108.98	171.30	217.52
16	271.06 - 273.37	Suttor River	10541.819	6111.75	8217.43	9910.07

The rainfall runoff peak flow hydrographs derived for the major watercourses are shown in Figures 1 to 15 of Appendix G.

In the current study the peak flow hydrographs obtained by the runoff-routing method have been considered for hydraulic analysis of watercourses as this method simulates the time varying outflows from the upstream catchments resulting from a design storm event. The peak flow hydrographs derived for various ARI events at the catchment outlet are input as the inflow boundary condition in to the XPSWMM+XP2D models.

Flood frequency analysis was performed for the available DNRM's stream flow gauging stations on major watercourses along the NGBR rail alignment. Data was downloaded from the DNRM website for the full years of gauge operation for the following stations:

- 120304A – Suttor River at Eaglefield
- 120205A - Bowen River at Myuna
- 120002A – Elliot River at Guthalungra
- 120005B - Bogie River at Strathbogie
- 120206A - Pelican Creek at Mt. Jimmy

Annual series analysis assuming a Log Pearson Type III probability distribution was undertaken for each location with gauged data. The fitted Log Pearson Type III distributions for the above stream flow gauging stations are given in Appendix I.

The catchment–area ratio method was used to estimate the flows at the NGBR crossing. This method is based on the assumption that the stream flow for a site of interest can be estimated by multiplying the ratio of the drainage area for the site of interest and the catchment area for a nearby flow gauging station by the flow for the nearby flow gauging station.

Thus the catchment–area ratio method is given by:

$$Q_u = (A_u \div A_g)^a \times Q_g$$

Where:

Q_u is peak flow for the selected flood frequency for the ungauged site;

Q_g is peak flow for the selected flood frequency for the gauged site;

a is exponent for catchment area (taken as 0.644 for this study from similar studies done within the project area);

A_u is catchment area for the ungauged site;

A_g is catchment area for the gauged site.

The estimated design discharges obtained from the Log Pearson type III method were used for the calibration of the XPRAFTS hydrologic models. In general, the design loss parameters for the XP-RAFTS model were based on values described in Table 3.3. These losses have then been adjusted accordingly to match the estimated design discharges from the flood frequency analysis. The model storage coefficient (bx) has also been used to adjust the hydrological model to achieve a suitable fit for validation.

Section 4

Hydraulics

4.0 HYDRAULICS

The choice of hydraulic modelling depends on the complexity of the flow regime, the classification of the waterway and catchment size. 1D modelling was applicable if watercourses have well-defined channels and simple flow regimes; and where watercourses are meandering and complex floodplain flows and interactions occur, the 2D modelling method would be appropriate.

Site visits to the major crossings to assess flow patterns within creeks and rivers assisted in determining the appropriate modelling methodology for each system.

4.1 1D Hydraulic Modelling

1D hydraulic modelling was adopted for the watercourse crossings with well-defined channels and floodplains. HEC-RAS 1D river analysis software was utilised to perform steady state flow calculations. Cross section data, Manning's 'n' values and peak flows were input into the models to compute the existing condition water surface profiles for various return period flood events. The proposed structure type and sizes were incorporated to simulate the developed scenario. Structures were sized to ensure afflux limits, headwater levels and outlet velocities remained within the Project Design Criteria.

4.1.1 HEC-RAS

The HEC-RAS 1D river analysis modelling system was utilised to perform steady flow water surface profile computations. The hydraulic analysis for various types of transverse drainage structures i.e. culverts, battery of culverts, bridges and combinations of multiple structures thereof, can be easily modelled using HEC-RAS. The modelling was conducted in accordance with the software developer's guide.

4.1.2 Roughness Value

Manning's n value has been set at 0.04 for main channels and 0.09 for floodplains. For very shallow main channel flow, a Mannings n value of 0.06 was used. Downstream boundaries were set to normal depth based on downstream channel slope or known water surface elevation for the Tidal levels.

4.1.3 Cross-sections geometry

Cross-sections for the HEC-RAS models were extracted from the LiDAR survey corridor. The cross-sections have been extracted perpendicular to the waterway, for a width that can sufficiently contain the modelled events within each of the cross-sections in order to determine flood levels. Due to the flat terrain, this has not been possible in some cases. Where required, cross-sections have been extended based on interpolation between upstream and downstream cross-sections and the general topography generated from LiDAR data.

4.1.4 Modelling Results

Various modelling methods (energy and momentum) with the highest energy peak water levels were adopted for the bridge structures. Appropriate inlet and outlet losses were used for the analysis of culverts. The cross drainage structure type i.e.

either RCP or RCBC was chosen depending on the allowable depth of the fill for a particular class of pipe.

The minimum size and slope of the engineered culverts were chosen as 900mm and 1 in 300 respectively. In most cases, the culverts were placed such a way that the outlet invert levels matched the existing ground levels with the depressed inlet inverts. The structure configuration was optimised in an iterative way, such that one or more of the design criteria set out in the PDC, such as the limits on outlet velocities, allowable headwater depth and design event afflux reach the design threshold value.

The HEC RAS model simulations have provided peak water levels, velocities and afflux for the 20, 50 and 100-year ARI events for both existing and post-development scenarios for each of the waterway crossing. The developed case results are presented in Appendix C.

Where the channels and adjacent floodplain are well defined with the catchment, the 1D modelling peak water results are reasonably accurate along the length of the waterway. However, when there is floodplain flow entering into the adjacent waterway catchment during the high flood events, a more comprehensive 2D modelling approach as mentioned in the next section becomes necessary to predict the peak water levels.

It can be seen from the 1D modelling results that, with the recommended waterway drainage structures along the proposed NGBR rail line during this design phase, afflux levels adjacent to the railway predominantly meet the 50-year afflux design criteria of 0.5m for Non-critical infrastructure/housing and uninhabited areas. Also it was observed from the longitudinal peak water profiles of various HEC-RAS models, that the afflux gets reduced to around 0.1m within a reasonable distance of 100m to 200m from the proposed rail line.

The scope for combining the minor waterways located within a reasonable proximity to each other shall be examined in detail during the next phase and the modelling for consolidated waterway structures shall be optimised accordingly. Sensitivity analysis of the roughness values has not been undertaken during this phase and shall be included in the next design phases.

4.2 2D Hydraulic Modelling

Based on the site visit assessments, predicted flow regimes and the requirements of the Co-ordinator General from previous study recommendations, preliminary 2D hydraulic modelling was conducted for the major waterway crossings where channels are meandering, braided and complex floodplain flow occurs. The preliminary 2D hydraulic models were set up for the major waterway crossings and detailed in Appendix H. Indicative maps showing peak flood inundation depths, water surface elevations, velocities, inundation extents and afflux are listed in Appendix H and are presented in Volume 2 of the Concept Design Report. Flood inundation maps for 50-year design ARI event for major watercourses are shown in Appendix J.

It should be noted that these maps are preliminary only. Further refinement of the models with proposed bridge and transverse drainage/culvert configuration will be conducted during the next design development stage to further refine the flood mapping data.

The proposed detailed 2D hydraulic modelling will assist in determining the complex flow patterns and floodplain interaction between multiple streams and refine the bridge and culvert waterway areas and configuration. The 2D hydraulic model will also assist in developing the extent of inundation, afflux and flow velocity maps for pre-development and post-development scenarios.

Section 5

Drainage and Scour Protection

5.0 DRAINAGE AND SCOUR PROTECTION

5.1 Cross Drainage

It is proposed to provide bridges at all major waterway crossings to avoid the realignment of channels, ensure required flood flows and immunity is achieved, and maintain required environmental flows in the channels during low flows.

The concept stage design of bridges allows for the bridge soffit level to be located at a minimum of 600 mm above the 50 year ARI design flood level. Further consideration for pier and abutment scour protection and bridge flood loading shall be undertaken as part of the next design stage.

5.2 Longitudinal Drainage

In situations where multiple separate drainage features are intersected by the railway alignment and the drainage features are located within a reasonable proximity to each other and have small contributing catchment areas, it is often pragmatic to link these by means of longitudinal drainage provided on the upstream side of the railway embankment and direct the flows through adjacent and appropriately sized transverse drainage structure / bridge structures. Lining of the channels will be provided where it is required to increase flow capacity or limit erosion potential.

Portions of the NGBR alignment pass through cuttings where diversion drainage channels will be required to convey runoff from the drainage features intersected by the cut to the next viable crossing. Diversion drain flow directions and localities have been identified during the concept design. A detailed hydraulic assessment will be carried out to determine the size of diversion drainage channels in subsequent design stages.

The sizing of longitudinal drainage channels shall be sufficient to accommodate the estimated design peak flow. An additional freeboard of 0.1 m shall be considered for calculating the channel dimensions for the design event. The capacity of the longitudinal drains shall be calculated using the Manning's equation. The velocity of flow shall be calculated based on the same formula, which is limited based on the bed material of the channel.

5.3 Transverse Drainage

It is proposed to provide transverse drainage structures where:

- Railway alignment intersects with a drainage feature that cannot be drained effectively by provision of longitudinal channel;
- Railway alignment vertical geometry results in an embankment depth not feasible for the construction of a bridge; or
- Additional drainage area is required during flood conditions, when the main channel banks are breached, to supplement drainage areas provided by bridge structures.

All engineered culverts are proposed to have a minimum internal opening of 900mm to minimise the potential for blockage. Culverts will be provided in groups with similar dimensions based on the area requirement. Culverts will be skewed if required to

maintain flow connectivity and limit erosion potential. Inlet and outlet scour protection will be provided on all culverts with the exact configuration to be determined during the next design stage. It is also proposed to keep vegetation disturbance downstream of the railway alignment to an absolute minimum to restore natural flow paths as quickly as possible. Minor earthworks to direct flows to these culverts will be undertaken during construction where required.

Portions of the NGBR pass through cuttings. Diversion drainage channels shall be designed instead of cross drainage structures at a few locations along the alignment where the alignment goes through a cutting. The design discharge shall be calculated based on the Rational formula. The sizing of the diversion channel shall be sufficient to accommodate the peak flow calculated by the Rational method with a freeboard of 0.1m. The slope shall be adopted as the natural ground slope for lined channels, and an average slope of 1 in 1000 for unlined channels. The channel design velocity shall be calculated using the Manning's Equation.

5.4 Scour Protection

Design of scour protection at the bridge abutments, for the local scour at the pier locations and embankment protection adjacent to bridges is based on the guidelines provided within the Austroads (1994) Waterway Design Manual.

The design methodology for the scour protection for abutments and piers is based on the average flow velocity equal to 2.5 m/sec in the bridge opening. The class of rock protection required to protect the abutment (without a guide bank) and piers is arrived at by multiplying the average velocity with a factor to allow for the turbulent mixing flow action at the bridge location.

The class of protection to be adopted for the abutments and piers is a ¼ tonne rock with a corresponding thickness in the order of 1m.

The outlet velocity for culverts has been restricted to 2.5 m/s for the design flood event. Riprap protection or similar shall be adopted for culvert outlets with a factored velocity of flow in the range of 2.6 to 2.9 m/s with a Light Class of Rock Protection and 0.75m of thickness. The length of riprap apron shall be set to 6 times the diameter of the culvert (downstream) measured from the edge of the concrete apron.

In subsequent design stages, it is also proposed to provide details of:

- Diversion and longitudinal drainage channels; and
- Culvert inlet and outlet protection details in accordance with Austroads Waterways Guide.

5.5 Environmental Culverts

During waterways mapping it was identified that 196 watercourses will be subject to provisions of the Water Act (2000) and the Fisheries Act (1994). This will necessitate provision of cross drainage structures across the rail alignment. These culverts and bridges can be utilised for fauna connectivity and will be designed to satisfy the requirements of the Department of Agriculture, Fisheries and Forestry Fish Habitat Management Codes and Policies which require the maintenance of aquatic fauna connectivity. The design solutions for these crossings will incorporate features to enhance fauna movement potential.

In addition, there is an opportunity to co-locate other crossing structures (i.e. stock crossings) to provide fauna passage. Should ecological survey identify endangered flora in the rail corridor that would require sheet flow during storm events for their survival, subsequent design will provide additional environmental culverts.

5.6 Waterway Barrier Works

Waterway Barrier Works are regulated under the Fisheries Act, 1994 and the Sustainable Planning Act, 2009 when barriers to fish movement (including partial barriers) are installed across watercourses. Waterway barrier works include construction, raising, replacement and some maintenance works on structures such as culvert crossings, bed level crossings, weirs and dams, both permanent and temporary.

196 watercourses are mapped as intersecting the NGBR alignment. The majority of these (80%) are within the upper limits of mapped watercourses which are colour coded as either 'Green' (Low Risk) or 'Amber' (Moderate Risk). The remaining 20% are mapped as 'Red' (High Risk) and 'Purple' (Major Risk).

Field assessment of these mapped 'Green' and 'Amber' watercourses suggests a number of these locations may be inaccurately mapped or are above the upper limit for fish movement. The DAFF guide for determining watercourses includes a process to contest the accuracy of the spatial data layer. Where mapping is incorrect, information will be supplied which identifies why the design has not catered for fish movement. Where the data layer is correct associated policies will be used to guide the design in relation to aquatic fauna movement. At the concept design level the most efficient design is considered, however it is anticipated that this design will be further refined and reviewed in accordance with DAFF requirements for Waterway Barrier Works in the next design stage.

Section 6

Average Inundation Periods

6.0 AVERAGE INUNDATION PERIODS

The flood inundation duration for the post railway case should not exceed 72 hours or 20 % (whichever is greater) of the existing inundation duration during the 50 yr ARI event, unless under specific circumstance with the landholder agreement.

To provide preliminary estimates of the flood inundation durations for major watercourses, the 2 D hydraulic models for the pre and post railway cases were simulated and the 'water elevation versus time' hydrographs determined at locations along the major watercourse. The inundation duration at each location was determined by drawing a horizontal line on the hydrograph at flood level of 300mm and measured the duration for which the flood level is above this level. Table 6.1 summarises the maximum flood inundation duration for each of the watercourses.

The flood inundation durations were also determined for homesteads situated within the major watercourse catchments and near the NGBR railway corridor. The maximum flood inundation durations on the homesteads are also presented in Table 6.1.

The flood inundations maps for 50 year design ARI event are included in Appendix J.

Table 6.1 - Inundation Times for Major Watercourses and its effect on Homesteads nearer to Railway Corridor

	Major Watercourse	Homestead	Latitude	Longitude	Distance from Railway	Inundation from Major Watercourse for 50 year ARI Design Event	Time of Inundation - Pre Development Scenario (hrs) *	Time of Inundation - Post Development Scenario (hrs) *	Difference in Inundation Time (hrs)
1	Splitters Creek	Salisbury Plains	19°58'36.68"S	148°00'08.28"E	0.7 km	No	36.0	38.0	2.0
2	Finley Creek/Elliot River	Unnamed	20°01'58.84"S	147°49'17.18"E	2.3 km	No	31.0	32.0	1.0
3	Butchers Creek/Elliot River	Unnamed	20°03'15.11"S	147°52'35.63"E	2.6 km	No	29.0	30.0	1.0
4	Bogie River	Eton Vale	20°12'51.85"S	147°46'32.84"E	3.8 km	No	26.0	27.0	1.0
5	Sandy Creek	Unnamed	20°16'25.22"S	147°47'45.27"E	1.9 km	No	20.0	22.0	2.0
6	Pelican Creek	Unnamed	20°35'58.98"S	147°42'38.77"E	5.4 km	No	47.0	49.0	2.0
7	Bowen River	No Homesteads nearer to Railway corridor					67.0	68.0	1.0
8	Rosella Creek	Havilah	20°47'32.63"S	147°49'44.15"E	4.5 km	No	52.0	54.0	2.0
9	Upper Suttor River	No Homesteads nearer to Railway corridor					45.0	48.0	3.0
10	Rockingham Creek	No Homesteads nearer to Railway corridor					18.0	20.0	2.0
11	Murray Creek	No Homesteads nearer to Railway corridor					22.0	24.0	2.0
12	Verbena Creek	No Homesteads nearer to Railway corridor					53.0	55.0	2.0
13	Serpentine Creek	No Homesteads nearer to Railway corridor					52.0	55.0	3.0
14	Suttor River	Gunjulla	21°35'07.27"S	147°11'15.12"E	1.2 km	No	144.0	156.0	12.0
15	Suttor River	Gunjulla 1	21°35'47.64"S	147°12'40.84"E	2.0 km	No	144.0	156.0	12.0

* - For homesteads, the flood inundation times are for nearest location on the watercourse

Section 7 : Summary and Recommendations

7.0 SUMMARY AND RECOMMENDATIONS

Hydrological modelling was completed using runoff routing model (XP-RAFTS) for the 13 major/11 moderate waterways and rational method (rural catchments method of DTMR) for the 552 minor waterways crossing the alignment. HEC-RAS 1D hydraulic modelling was conducted for all the minor waterways excluding diversions. Preliminary XPSWMM-2D modelling for 10 major waterway crossings has also been developed.

Drainage design for NGBR undertaken at this stage was based on the best practice principles and considered appropriate for this level of study. Major bridge structures and major floodplain structures were provided at the major waterway crossings. Bridge structures were also proposed for some moderate waterways. In addition, minor and major drainage structures were also provided at the identified waterway crossings. The waterway crossings register in Appendix C tabulates the location, catchment area, bridge/drainage structure configuration, design discharge, design peak flow level and waterway classification information.

The outcomes of the hydraulic modelling are shown in Table 7.1.

Table 7.1 – NGBR Waterway Crossings

ITEM	DESCRIPTION	NO
1	Total Waterway Crossings	567
2	Watercourses	196
	Bridge Structures	17
	Drainage Structures (Pipe and Box Culverts)	170
	Diversions	9
3	Drainage Features	371
	Bridge Structures	NIL
	Drainage Structures (Pipe and Box Culverts)	371

Note : The very minor drainage features along the alignment with design discharges less than 1 m³/s are proposed to be rerouted locally to the longitudinal drainage. Detailed assessment to be carried out in next design stage.

With the recommended waterway drainage structures, afflux levels adjacent to the proposed railway generally meet the maximum design criteria of 0.5m. Afflux and velocity results for the post development case meet the nominated design criteria requirements at all critical locations. It has been shown that the use of drainage structures along the proposed railway can mitigate its hydraulic impacts to acceptable level.

Indicative existing case and developed case scenario flooding maps have been developed for this stage and are provided in Volume 2 of the Concept Design report. It should be noted that these maps are preliminary only at this stage of the design process and should not be regarded as conclusive.

Based on the modelling conducted so far, results indicate that significant catchment areas and resulting peak flows of Suttor River contributes to multiple waterway crossings and significant areas of inundation. On the other hand Bowen River, Elliot River and Pelican Creek have more contained flood extents with model results predicting deeper and faster flood flows within their channels.

It is recognised that the construction of a new railway will alter the characteristics of floodplains, however, the extent of these changes in the vicinity of existing infrastructure should be minimum. The proposed design at this stage has been developed to reduce the impact of the railway to minimal on waterways and floodplains.

It is recommended that the following works be undertaken during the next design stage:

- Drainage structures should be further optimised by combining the nearby minor crossings;
- Additional LiDAR data in the uncovered areas to provide inputs for the hydraulic modelling;
- Further refinement of the 2D hydraulic models with proposed bridge and transverse drainage culvert configurations will be conducted to further develop the flood mapping information; and
- A value engineering exercise shall be undertaken to provide the most cost effective drainage solutions within the design constraints and taking into consideration of the third party infrastructure e.g. existing rail/road drainage and others.

APPENDICES

APPENDICES

Appendix A : Design Criteria

Appendix B : Site Inspection Details

Appendix C : Waterway Crossings Register

Appendix D : Major Waterway Crossings

Appendix E : IFD Values

Appendix F : Rational Method Calculations

Appendix G : Hydrographs

Appendix H : 2D Hydraulic Modelling

Appendix I : Annual Peak Flow Analysis by LP III Method

Appendix J : Flood Inundation Maps for 50 year Design ARI Event

Appendix A : Design Criteria

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1.2	Cross Drainage Design	2
1.3	Longitudinal Drainage	4
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1.0 DESIGN CRITERIA

The following sections describe the design criteria for the drainage infrastructure along the proposed NGBR.

1.1 Flood Immunity

The following flood immunity criteria as provided in Table 1.1 were adopted for the proposed design:

Table 1.1- Flood Immunity design criteria

DESIGN ASPECT	DESIGN CRITERIA
Lowest edge of formation level	50 year ARI flood immunity plus 300 mm freeboard
Top of rail	100 year ARI flood immunity
Major Road crossings	50 year ARI flood immunity or as specified by appropriate statutory body
Minor Road crossings	10 year ARI flood immunity or as specified by appropriate statutory body

1.2 Cross Drainage Design

The assessment of hydraulic impacts and design of hydraulic structures will be undertaken using 1-dimensional and 2-dimensional hydraulic modelling software. The choice of hydraulic modelling depends on the complexity of the flow regime and the classification of the waterway. Refer to Table 1.2 below for a summary of waterway classification criteria basis.

Table 1.2 Waterway classification criteria basis

CATCHMENT SIZE	WATERWAY CLASSIFICATION
Less than or equal to 25 km ²	Minor Waterway
Greater than 25 km ² and Less than or equal to 100 km ²	Moderate Waterway
Greater than 100 km ²	Major Waterway

The waterway structure classification criteria based on the catchment flow characteristic is given below in Table 1.3.

It should be noted that Major Floodplain Structures will be composed of Bridge Structures and Major Drainage Structures and will be subject to their respective design criteria as outlined below.

Table 1.4 and Table 1.5 below summarise the design criteria for bridge structures and drainage structures. Drainage design will also be subject to additional afflux design criteria, as outlined in Table 1.6.

Table 1.3 Waterway Structure classification criteria basis

CATCHMENT FLOW CHARACTERISTIC	CROSS DRAINAGE STRUCTURE
Identified floodplains	Major Floodplain Structure
Design flow rate $Q_{50} > 250 \text{ m}^3/\text{s}$	Major Bridge Structure
Design flow rate $Q_{50} > 50 \text{ m}^3/\text{s}$ but $\leq 250 \text{ m}^3/\text{s}$	Major Drainage Structure
Design flow rate $Q_{50} \leq 50 \text{ m}^3/\text{s}$	Minor Drainage Structure

Table 1.4 Bridge Structure design criteria

DESIGN ASPECT	DESIGN CRITERIA
Bridge Classification	Locations with a 50 year ARI design flow $> 250 \text{ m}^3/\text{s}$
Design ARI event	Bridge structure must pass the 50 year ARI design flow
Freeboard	Minimum 600 mm to the soffit for the design event
Maximum Velocity	3.8 m/s for the design event with appropriate scour protection
Scour Protection	Rock protection or rock mattress as per Austroads Waterway Design

Table 1.5 – Drainage Structure design criteria

DESIGN ASPECT	DESIGN CRITERIA
Culvert classification	Major culverts: culvert locations with a 50 year ARI design flow $\geq 50 \text{ m}^3/\text{s}$ Minor culverts: culvert locations with a 50 year ARI design flow $< 50 \text{ m}^3/\text{s}$
Design ARI event	Major culverts and isolated minor culverts: 50 year ARI design flow Minor culverts: 20 year ARI design flow
Freeboard	Minimum 300 mm to top of formation level for the design event
Headwater	Maximum headwater to be 1.5 x culvert diameter or box height
Culvert type	Reinforced Concrete Pipes (RCPs) and Reinforced Concrete Box Culverts (RCBCs) depending on location. Minimum diameter for engineered RCP culverts to be 900 mm and minimum culvert slope of 1 in 300.
Cover requirements	Cover design must ensure adequate provision made for train loading
Maximum culvert outlet velocity	2.5 m/s for the design event with appropriate scour protection
Scour protection	Rock Protection as per Austroads Waterway Design

Table 1.6 – Major Floodplain afflux design criteria

DESIGN ASPECT	DESIGN CRITERIA
Critical Infrastructures	0.2 m maximum
Housing Areas	0.1 m maximum
Other Areas	Limited to 0.3 m where practicable
Non-critical infrastructure / housing or uninhabited areas	0.5 m maximum

Note : Afflux is measured as the difference between the peak water levels for pre- and post and development conditions.

1.3 Longitudinal Drainage

The following section describes the design criteria for longitudinal drainage infrastructure along the proposed rail alignment. The design criteria are outlined below in Table 1.7.

Table 1.7 - Longitudinal Drainage design criteria

DESIGN ASPECT	DESIGN CRITERIA
Design ARI event	Longitudinal drainage - 20 year ARI design flow Diversion drainage - 50 year ARI design flow
Scour protection	Rock Protection as per Austroads Waterway Design (if required)

1.4 Inundation Duration

Any increase in duration (modelled) of flooding inundation is not to exceed an average across the modelled extent of 72 hours or 20% (whichever is greater) of existing inundation durations during the 50 year ARI event. This is unless specific circumstances where inundation durations post-development can be tolerated in conjunction with landholder agreement. Inundation durations shall be measured from when the water depth is greater than 300mm on the rising limb of the hydrograph to when the water depth is equal to 300mm on the falling limb of the hydrograph.

Drainage design will be such that no additional permanently ponded areas will be created upstream of the rail formation.

1.5 Environmental Culverts

Environmental culverts shall be 600mm diameter culverts at spacing not less than 250m to allow free drainage in areas inundated by design flood.

Appendix B : Site Inspection Details

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1.0 INTRODUCTION

Site investigations were undertaken in June, 2013 to confirm the location of major and minor watercourse crossings and to conduct a visual assessment of the flow and drainage patterns within the contributing catchments. Information regarding the anecdotal evidence of historic flood levels was identified where visible (such as debris caught within tree branches, on the fencing lines and underside of the existing drainage structures). Floodplain flow has been assessed with consideration to the extent of debris lying within the floodplain.

Most of the major waterways crossing the NGBR are tributaries of the Burdekin River. The catchments of the Bowen River; Pelican Creek; Strathmore Creek; Rosella Creek; Bogie River; and Sandy Creek, drain in a north-westerly direction to join the Burdekin River Basin. Catchments of Serpentine Creek; Verbena Creek; Gunn Creek; Murray Creek; and Rockingham Creek, drain into the Suttor River, which is the largest catchment along NGBR and ultimately drains into the Burdekin River further north of the proposed railway alignment. The Elliot River and some creeks that are closer to the coast drain directly towards the Coral Sea.

The factual data about the features of these waterway crossings is gathered during the site inspection and is described within this report.

2.0 MAJOR WATERWAY CONDITIONS

2.1 Elliot River

The rail alignment crosses the Elliot River at chainage 35.08 km. The Elliot River has a contributing catchment area of approximately 128 km² at the proposed NGBR crossing. The Elliott River drains into the Abbot Bay and there are no major human habitations in the contributing catchment area.



Photograph 2.1: Aerial View of the Elliot River Floodplain around NGBR 35.08 km crossing location

2.2 Bogie River and Sandy Creek

The Bogie River and Sandy Creek cross the proposed NGBR rail alignment at chainages 61.22 km and 64.78 km respectively. These have contributing catchment areas of 433 km² and 150 km² respectively. The Bogie River and Sandy Creek catchments are the most northern catchments of the Burdekin River basin within the study area. The Bogie River catchment is traversed by the Bowen Developmental Road as well as the existing Collinsville-Newlands Branch Railway. No major population centres exist in either of the contributing catchment areas.



Photograph 2.2: Aerial View of the Bogie River Floodplain around NGBR 61.22 km crossing location



Photograph 2.3: Bogie River Channel Looking Upstream at Bowen Developmental Road (upstream of NGBR 61.222km crossing location)



Photograph 2.4: Aerial View of the Sandy Creek Floodplain around NGBR 64.78 km crossing location

2.3 Bowen River, Pelican Creek, Strathmore Creek and Rosella Creek

The Bowen River; Pelican Creek; and Strathmore Creek cross the alignment at chainages 132.2 km, 106.05 km and 98.78 km respectively. Rosella Creek is a major tributary of the Bowen River with a catchment area of 1473 km² and joins the Bowen River just upstream of the proposed NGBR alignment. The catchment size of the Bowen River, Pelican Creek and Strathmore Creek are 5,806 km², 564 km² and 156 km² respectively. Both the Bowen River and Pelican Creek catchments are located within the Burdekin River Basin.

Both catchments are traversed by the Bowen Developmental Road and the existing Collinsville-Newlands Branch Railway. Collinsville is located within the middle reaches of the Pelican Creek catchment.



Photograph 2.5: Aerial View of the Bowen River and Rosella Creek Confluence around NGBR 132.2 km crossing location



Photograph 2.6: Aerial View of the Pelican Creek Deep and Steep Channel at (NGBR 106.05km crossing location)



Photograph 2.7: Aerial View of the Strathmore Creek around NGBR 98.78 km crossing location

2.4 Serpentine Creek, Verbena Creek, Gunn Creek, Murray Creek and Rockingham Creek

Serpentine; Verbena; Gunn; Murray; and Rockingham Creeks cross the proposed alignment at chainages 244.43 km, 242.53 km, 231.20 km, 206.51 km, and 187.0 km respectively. These creeks drain into the Suttor River with contributing catchment areas of 102 km², 400 km², 115 km², 100 km² and 138 km² respectively. Their main channels are deep, well defined and have mild channel bed slopes. The catchments draining to these creeks could be considered as rolling to hilly catchments. No major population centres exist in the contributing catchment areas.



Photograph 2.8: Aerial View of the Serpentine Creek around NGBR 244.43 km crossing location



Photograph 2.9: Aerial View of the Verbena Creek around NGBR 242.53 km crossing location



Photograph 2.10 : Gunn Creek Looking Downstream at Suttor Developmental Road (upstream of NGBR 231.20km crossing location)



Photograph 2.11: Aerial View of the Murray Creek around NGBR 206.51 km crossing location



Photograph 2.12: Aerial View of the Rockingham Creek around NGBR 187.0 km crossing location

2.5 Suttor River

The Suttor River is the largest river crossing along the NGBR alignment. It crosses the proposed railway alignment at multiple locations. The first crossing is in the far upper reaches of the catchment at chainage 172.06 km with the second crossing further downstream between chainage 270.074 km and 273.574 km, some 35 km upstream of the confluence with the Belyando River. Contributing catchment areas to these two crossings are 296 km² and 10,542 km² respectively. The Suttor River catchment lies within the Burdekin River Basin and is traversed by the Bowen Developmental Road and Suttor Developmental Road in the north; and the Peak Downs Highway and the Wotonga Blair Athol Mine Branch Railway in the far south-eastern extents of the catchment.



Photograph 2.5: Suttor River Channel Looking Downstream at Bowen Developmental Road (downstream of NGBR 271.057km crossing location)



Photograph 2.6: Aerial View of the Suttor River Floodplain around NGBR 271.057km crossing location

3.0 HYDROLOGY SURVEY

The descriptions of accessible major waterway crossings along the NGBR alignment or the nearest accessible waterway crossings along the major roads/railway were recorded during the site visit. The summary sheets are presented below. The following are covered in the summary sheets.

- Location;
- GPS Data;
- Vegetation Type;
- Land Use;
- Drainage Pattern;
- Bed Slope Assessment;
- Flow Type;
- Type of Soil;
- Bed Sedimentation Material;
- Bank Stability/Erosion Potential; and
- Debris Accumulation

3.1 Saltwater Creek at Abbot Point Road



Photograph 3.1 – Saltwater Creek at Abbot Point Road

Description

ITEM	DESCRIPTION	REMARKS
1	Location	Saltwater Creek at Abbot Point Road (Near the rail crossing)
2	GPS Data	19°56'48.78"S ; 148°06'20.94"E
3	Vegetation Type	Mangroves/Wooded
4	Land Use	Pasture/Wetlands
5	Drainage Pattern	Meander
6	Bed Slope	Mild Slopes
7	Flow Type	Tranquil/Tidally Influenced
8	Type of Soil	Silty
9	Bed Sedimentation Material	Muddy/Silty
10	Bank Stability/Erosion Potential	Less potential for erosion
11	Debris Accumulation	No Logs Seen

3.2 Splitters Creek at Bruce Highway



Photograph 3.2 – Splitters Creek at Bruce Highway

Description

ITEM	DESCRIPTION	REMARKS
1	Location	Splitters Creek at Bruce Highway (Downstream of rail crossing)
2	GPS Data	19°59'07.47"S ; 147°59'32.17"E
3	Vegetation Type	Grass/Wooded
4	Land Use	Pasture
5	Drainage Pattern	Straight
6	Bed Slope	Mild Slopes
7	Flow Type	Tranquil
8	Type of Soil	Sandy/Silty
9	Bed Sedimentation Material	Sandy/Silty
10	Bank Stability/Erosion Potential	Less potential for erosion
11	Debris Accumulation	No Logs Seen

3.3 Salt Water Creek at Bruce Highway



Photograph 3.3 – Salt Water Creek at Bruce Highway

Description

ITEM	DESCRIPTION	REMARKS
1	Location	Salt Water Creek at Bruce Highway (Downstream of rail crossing)
2	GPS Data	19°56'54.34"S ; 147°55'20.50"E
3	Vegetation Type	Grass/Wooded
4	Land Use	Pasture/Salt Pans
5	Drainage Pattern	Straight
6	Bed Slope	Mild Slopes
7	Flow Type	Tranquil
8	Type of Soil	Sandy/Silty
9	Bed Sedimentation Material	Sandy/Silty
10	Bank Stability/Erosion Potential	Some potential for erosion
11	Debris Accumulation	No Logs Seen

3.4 Elliot River at Bruce Highway



Photograph 3.4 – Elliot River at Bruce Highway

Description

ITEM	DESCRIPTION	REMARKS
1	Location	Elliot River at Bruce Highway (Downstream of rail crossing)
2	GPS Data	19°55'31.89"S ; 147°50'50.39"E
3	Vegetation Type	Grass/Wooded
4	Land Use	Pasture/Agriculture
5	Drainage Pattern	Straight
6	Bed Slope	Mild Slopes
7	Flow Type	Tranquil
8	Type of Soil	Sandy/Gravel
9	Bed Sedimentation Material	Sandy/Pebbles
10	Bank Stability/Erosion Potential	High potential for erosion
11	Debris Accumulation	Some Logs Seen

3.5 Bogie River at Bowen Developmental Road



Photograph 3.5 –Bogie River at Bowen Developmental Road

Description

ITEM	DESCRIPTION	REMARKS
1	Location	Bogie River at Bowen Developmental Road (upstream of rail crossing)
2	GPS Data	20°18'51.63"S; 147°55'33.75"E
3	Vegetation Type	Grass/Wooded
4	Land Use	Pasture
5	Drainage Pattern	Meander
6	Bed Slope	Mild Slopes
7	Flow Type	Tranquil
8	Type of Soil	Sandy
9	Bed Sedimentation Material	Sandy/Silty
10	Bank Stability/Erosion Potential	Less potential for erosion
11	Debris Accumulation	Less potential for debris

3.6 Strathmore Creek at Strathmore Road



Photograph 3.6 – Strathmore Creek at Strathmore Road

Description

ITEM	DESCRIPTION	REMARKS
1	Location	Strathmore Creek at Strathmore Road (downstream of rail crossing)
2	GPS Data	20°30'42.16"S; 147°39'56.04"E
3	Vegetation Type	Grass/Wooded
4	Land Use	Pasture
5	Drainage Pattern	Straight
6	Bed Slope	Mild Slopes
7	Flow Type	Tranquil
8	Type of Soil	Sandy
9	Bed Sedimentation Material	Sandy/Gravel
10	Bank Stability/Erosion Potential	Some potential for erosion
11	Debris Accumulation	Some logs Seen

3.7 Pelican Creek at Myuna Road



Photograph 3.7 – Pelican Creek at Myuna Road

Description

ITEM	DESCRIPTION	REMARKS
1	Location	Pelican Creek at Myuna Road (downstream of rail crossing)
2	GPS Data	20°33'12.43"S; 147°37'9.60"E
3	Vegetation Type	Grass/Wooded
4	Land Use	Pasture
5	Drainage Pattern	Straight
6	Bed Slope	Steeper Slopes
7	Flow Type	Tranquil
8	Type of Soil	Sandy
9	Bed Sedimentation Material	Sandy/Silty
10	Bank Stability/Erosion Potential	Potential for Erosion
11	Debris Accumulation	Logs Not Seen

3.8 Pelican Creek at Bowen Developmental Road



Photograph 3.8 – Pelican Creek at Bowen Developmental Road

Description

ITEM	DESCRIPTION	REMARKS
1	Location	Pelican Creek at Bowen Developmental Road (upstream of rail crossing)
2	GPS Data	20°35'8.45"S; 147°51'03"E
3	Vegetation Type	Grass/Wooded
4	Land Use	Pasture
5	Drainage Pattern	Straight
6	Bed Slope	Steeper
7	Flow Type	Tranquil
8	Type of Soil	Sandy
9	Bed Sedimentation Material	Sandy/Gravel
10	Bank Stability/Erosion Potential	High Potential for Erosion
11	Debris Accumulation	Logs Not Seen

3.9 Bowen River at Bowen Developmental Road



Photograph 3.9 – Bowen River at Bowen Developmental Road

Description

ITEM	DESCRIPTION	REMARKS
1	Location	Bowen River at Bowen Developmental Road (upstream of rail crossing)
2	GPS Data	20°45'11.19"S ; 147°50'55.93"E
3	Vegetation Type	Grass/Wooded
4	Land Use	Pasture
5	Drainage Pattern	Bowen's two branches just join before upstream of crossing
6	Bed Slope	Mild to Steeper Slopes
7	Flow Type	Gushy
8	Type of Soil	Sandy/Gravel
9	Bed Sedimentation Material	Sandy/Pebbles
10	Bank Stability/Erosion Potential	High Potential for Erosion
11	Debris Accumulation	Logs observed. Lot of Debris seen underside of the Road Bridge

3.10 Rosella Creek at Bowen Developmental Road



Photograph 3.10 – Rosella Creek at Bowen Developmental Road

Description

ITEM	DESCRIPTION	REMARKS
1	Location	Rosella Creek at Bowen Developmental Road (upstream of rail crossing)
2	GPS Data	20°49'08.25"S; 147°50'34.59"E
3	Vegetation Type	Grass/Wooded
4	Land Use	Pasture
5	Drainage Pattern	Rosella Creek joins Bowen River just upstream of NGBR crossing
6	Bed Slope	Mild Slopes
7	Flow Type	Tranquil
8	Type of Soil	Sandy/Gravel
9	Bed Sedimentation Material	Sandy/Pebbles
10	Bank Stability/Erosion Potential	Potential for Erosion
11	Debris Accumulation	No logs

3.11 Upper Suttor at Bowen Developmental Road



Photograph 3.11 – Upper Suttor at Bowen Developmental Road

Description

ITEM	DESCRIPTION	REMARKS
1	Location	Upper Suttor at Bowen Developmental Road (Downstream of rail crossing)
2	GPS Data	21°06'13.99"S; 147°44'50.61"E
3	Vegetation Type	Wooded
4	Land Use	Pasture
5	Drainage Pattern	Meander
6	Bed Slope	Steeper
7	Flow Type	Tranquil
8	Type of Soil	Sandy
9	Bed Sedimentation Material	Sandy/Silty
10	Bank Stability/Erosion Potential	Some erosion spots seen
11	Debris Accumulation	Some Logs. Debris at the underside of the Road Bridge

3.12 Lily Creek at Bowen Developmental Road



Photograph 3.12 – Lily Creek at Bowen Developmental Road

Description

ITEM	DESCRIPTION	REMARKS
1	Location	Lily Creek at Bowen Developmental Road (upstream of rail crossing)
2	GPS Data	21°08'46.16"S ; 147°42'20.19"E
3	Vegetation Type	Wooded
4	Land Use	Pasture
5	Drainage Pattern	Straight
6	Bed Slope	Steeper
7	Flow Type	No water flow
8	Type of Soil	Sandy
9	Bed Sedimentation Material	Sandy
10	Bank Stability/Erosion Potential	No erosion spots seen
11	Debris Accumulation	No debris

3.13 Gunn Creek at Suttor Developmental Road



Photograph 3.13 – Gunn Creek at Suttor Developmental Road

Description

ITEM	DESCRIPTION	REMARKS
1	Location	Gunn Creek at Suttor Developmental Road (downstream of rail crossing)
2	GPS Data	21°30'11.64"S ; 147°31'00.51"E
3	Vegetation Type	Wooded
4	Land Use	Pasture
5	Drainage Pattern	Straight
6	Bed Slope	Steeper
7	Flow Type	No water flow/Still water
8	Type of Soil	Silty/Sandy
9	Bed Sedimentation Material	Silty/Weathered Rock
10	Bank Stability/Erosion Potential	Some erosion spots seen
11	Debris Accumulation	No debris

3.14 Verbena Creek at Glenavon Road



Photograph 3.14 – Verbena Creek at Glenavon Road

Description

ITEM	DESCRIPTION	REMARKS
1	Location	Verbena Creek at Glenavon Road (downstream of rail crossing)
2	GPS Data	21°37'29.85"S ; 147°23'32.98"E
3	Vegetation Type	Grass/Wooded
4	Land Use	Pasture
5	Drainage Pattern	Straight
6	Bed Slope	Flat
7	Flow Type	No water flow/Still water
8	Type of Soil	Fine Clayey
9	Bed Sedimentation Material	Clayey/Silty
10	Bank Stability/Erosion Potential	Potential for erosion
11	Debris Accumulation	Some logs

3.15 Serpentine Creek at Glenavon Road



Photograph 3.15 – Serpentine Creek at Glenavon Road

Description

ITEM	DESCRIPTION	REMARKS
1	Location	Serpentine Creek at Glenavon Road (downstream of rail crossing)
2	GPS Data	21°34'57.89"S ; 147°24'52.58"E
3	Vegetation Type	Shrubs/Wooded
4	Land Use	Pasture
5	Drainage Pattern	Meander
6	Bed Slope	Flat
7	Flow Type	No water flow/Still water
8	Type of Soil	Silty/Gravel
9	Bed Sedimentation Material	Silty/Pebbles
10	Bank Stability/Erosion Potential	Some erosion spots seen
11	Debris Accumulation	No debris

3.16 Suttor River at Bowen Developmental Road (Multiple Crossings)



Photograph 3.16 – Suttor River at Bowen Developmental Road (Multiple Crossings)

Description

ITEM	DESCRIPTION	REMARKS
1	Location	Suttor River at Bowen Developmental Road (downstream of rail crossing)
2	GPS Data	21°32'14.58"S ; 147°02'33.57"E
3	Vegetation Type	Grass/Wooded
4	Land Use	Pasture
5	Drainage Pattern	Straight
6	Bed Slope	Mild Slopes
7	Flow Type	Tranquil
8	Type of Soil	Black Clayey
9	Bed Sedimentation Material	Clayey/Silty
10	Bank Stability/Erosion Potential	Less potential for erosion
11	Debris Accumulation	Some logs

4.0 SUMMARY OF OBSERVATIONS

The following conditions were observed during the site visit.

- Most of the Rivers and major creeks are non-perennial, except for Bowen River and most of the minor creeks are of ephemeral nature. There was no flow observed within some of the creek channels due to their seasonal nature. Creek banks were well defined and the channel slopes were steeper for most of the rivers and creeks in the upper and middle sections of NGBR, and shallower for the rivers and creeks within the lower section of NGBR (when compared with Carmichael Rail sections). Hydraulic conditions (velocity, depth and turbulence) during high flows will be dominated by the steep slopes of the channels for the upper and middle sections of NGBR.
- The velocities within the channels can be high due to the steep bed slope. This is evident from the significant channel erosion that was observed, particularly within channels of Pelican Creek, Bowen River and Elliot River;
- The bed resistance for the waterways with steep bed slopes will be higher than normal due to the eroded channels and significant debris lying within the channel beds.
- Cracking clay soils predominate throughout the sub-catchments of Suttor River within the lower sections of NGBR. The sub-catchments of upper sections of NGBR contain of silty and sandy soils.
- High debris accumulation was observed in the channels of Bowen River, Upper Suttor River, where as there was less potential for debris accumulation in the channels of Suttor River, Splitters Creek and Saltwater Creek.
- The fluvial geomorphic processes in the upper NGBR sections include erosion, sand transport and deposition of sediments along the creek systems, contributing to the spontaneous development of new natural channel forms within a relatively stable river banks. Bed sediment mainly comprises coarse sand.

The site visit resulted in the assessment and clarification of the following:

- Input hydraulic parameters i.e. channel roughness, floodplain vegetation, channel bed material etc. ;
- Visualisation of the existing channel conditions and the complex floodplain flow patterns for the simulations using two dimensional hydraulic modelling;
- Suitability of structure types at the crossings based on the site conditions i.e. major bridges, major drainage structures and minor drainage structures.

Appendix C : Waterway Crossings Register

Crossing No.	Chainage (km)		Watercourse Name	Catchment Area (sq. km)	Peak Flow for ARI (m³/sec)			PWL (m)			Velocity (m/sec)			Afflux (m)			Head Water Depth (m)			Culvert Slope	Co-ordinates		Structural Configuration			Type	Soffit Level (m)	Proposed Formation Level (m)	Flow Direction (In the direction of increasing chainage) (for diversions only)	Comments	Government Watercourse Mapping	Stream Order	Fisheries Data Layer	
	Opt. 6 Rev. 2	Opt. 6 Rev. 3			20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs		Northing	Easting	No.	Dia/Span (m)	Height (m)									
1		-1.44																				2	0.9		PIPE									
2		-1.88																				2	0.9		PIPE									
3		2.78 & -4.11																				2	0.9		PIPE									
4		4.80 & -6.14																				2	0.9		PIPE									
5		4.90 & -6.24																				2	0.9		PIPE									
6		5.00 & -6.34																				2	0.9		PIPE									
7		5.67	SALTWATER CREEK	14.728	62.4	83.1	98.6	2.5	2.9	3.4	0.5	0.6	0.7	0.1	0.1	0.1	-	-	-		615865	7793894	7	20.2		BRIDGE	2.50	4.30			Yes	5	4	
8		-6.82		14.728	62.4	83.1	98.6	2.3	2.8	3.4	0.5	0.6	0.7	-	0.0	0.0	-	-	-		615637	7794016	6	20.2		BRIDGE	2.25	4.05			Yes	5	4	
9		-7.05																				2	1.2		PIPE									
10		6.00																				1	1.5	1.5	BOX									
11		7.09		0.089	4.5	5.9	6.5	5.6	5.7	5.7	2.0	2.1	2.2	0.2	0.3	0.4	0.6	0.8	0.8	1 in 300	614931	7793052	4	1.5	1.5	BOX	6.42	6.82						
12		7.30		13.902	77.4	102.3	120.7	5.8	6.1	6.4	1.7	2.3	2.7	0.2	0.3	0.5	2.1	2.4	2.7	1 in 300	614717	7793081	14	1.8	1.8	BOX	5.50	6.40			Yes	1	2	
13		-7.44		14.242	78.5	103.8	122.6	3.7	3.9	4.1	2.0	2.4	2.8	0.1	0.2	0.3	1.6	1.8	2.0	1 in 300	615335	7793495	16	1.8	1.8	BOX	3.86	4.26			Yes	1	2	
14		7.35		8.992	47.8	63.3	74.8	6.0	6.2	6.3	0.9	1.2	1.4	0.1	0.1	0.2	2.0	2.2	2.4	1 in 300	614738	7793206	17	1.8	1.8	BOX	5.74	6.48			Yes	4	4	
15		-8.11		8.992	47.8	63.3	74.8	6.6	6.9	7.1	0.7	1.0	1.2	0.1	0.1	0.1	2.4	2.7	2.9	1 in 300	614671	7793096	20	1.8	1.8	BOX	6.02	7.19			Yes	4	4	
16		7.69 & -8.50		0.112	3.8	4.9	5.6	5.6	5.7	5.8	1.9	2.1	2.3	0.4	0.5	0.5	0.7	0.8	0.9	1 in 300	614349	7793204	6	0.9		PIPE	5.76	6.46						
17		7.84 & -8.65		2.360	13.9	18.3	21.6															2	2.4	2.4	BOX						Structure proposed based on discharge only.	Yes	1	2
18		8.04 & -8.06		0.436	5.6	7.3	8.5															2	1.8	1.8	BOX									
19		8.20 & -9.00		0.644	7.6	9.9	11.5	4.2	4.4	4.5	1.8	2.2	2.4	0.2	0.2	0.3	1.1	1.3	1.4	1 in 300	613875	7793384	3	1.5	1.5	BOX	4.56	4.96			Yes	1	2	
20		8.54 & -9.33		0.461	5.5	7.2	8.4	4.4	4.5	4.6	1.9	2.1	2.2	0.3	0.4	0.4	0.7	0.8	0.9	1 in 300	613556	7793457	9	0.9		PIPE	4.53	5.23						
21		9.09		9.508	58.2	76.7	90.5	5.8	6.1	6.3	2.1	2.5	2.8	0.3	0.4	0.6	1.4	1.7	1.9	1 in 300	612997	7793331	28	1.5		PIPE	5.66	6.36			Yes	3	3	
22		9.62		0.063	2.1	2.7	3.1															3	0.9		PIPE						Structure proposed based on discharge only.			
23		10.00		0.154	3.4	4.3	5.0															5	0.9		PIPE									
24	10.82	10.02		0.153	3.0	3.9	4.6	7.7	7.8	7.9	1.9	2.1	2.2	0.4	0.4	0.5	0.7	0.8	0.9	1 in 300	612303	7792755	5	0.9		PIPE	7.86	8.56						
25	11.68	10.87		0.028	1.2	1.6	1.7	12.7	12.8	12.9	2.0	2.2	2.4	0.4	0.5	0.6	0.7	1.7	2.0	1 in 300	611683	7792141	1	1.5	1.5	BOX	13.46	13.86			Yes	2	2	
26	11.88	11.07		0.018	1.0	1.3	1.4	13.7	13.8	13.8	1.8	1.9	2.0	0.4	0.4	0.5	0.6	0.7	0.8	1 in 300	611541	7792000	2	0.9		PIPE	13.92	14.62			Yes	2	2	
27	12.59	11.79		0.040	1.4	1.9	2.1	18.1	18.4	18.6	1.5	1.7	2.0	0.2	0.3	0.3	2.0	2.3	2.5	1 in 300	611021	7791504	4	2.1	2.1	BOX	18.19	18.69			Yes	2	2	
28	12.75	11.95		0.014	0.9	1.1	1.3	20.3	20.4	20.5	1.9	2.1	2.2	0.3	0.4	0.5	0.7	0.8	0.9	1 in 300	610891	7791417	2	0.9		PIPE	20.49	21.19						
29	12.86	12.06		1.727	21.1	27.3	31.8	19.9	20.3	20.5	1.3	1.6	1.9	0.0	0.1	0.2	1.6	1.9	2.1	1 in 300	610791	7791363	10	1.5		PIPE	19.79	20.56						
30	13.60	12.80		0.845	9.9	12.8	14.9	25.0	25.3	25.5	1.8	2.0	2.2	-0.1	-0.1	0.0	1.4	1.6	1.8	1 in 300	610081	7791202	3	1.5	1.5	BOX	22.12	25.55						
31	14.01	13.21		0.015	0.8	1.1	1.2	32.5	32.7	32.8	2.1	2.4	2.6	0.0	0.2	0.3	0.9	1.0	1.2	1 in 300	609668	7791183	1	0.9		PIPE	32.57	33.27						
32	14.22	13.42		0.224	4.5	5.8	6.8	33.7	33.9	34.0	2.2	2.5	2.7	0.2	0.3	0.5	0.9	1.1	1.2	1 in 300	609459	7791155	5	0.9		PIPE	33.72	34.42						
33	14.59	13.78		1.560	25.0	32.4	37.6	38.7	38.9	39.0	2.5	2.7	2.9	0.1	0.2	0.3	1.1	1.4	1.5	1 in 300	609109	7791061	16	1.2		PIPE	38.69	39.39			Yes	2	2	

Crossing No.	Chainage (km)		Watercourse Name	Catchment Area (sq. km)	Peak Flow for ARI (m³/sec)			PWL (m)			Velocity (m/sec)			Afflux (m)			Head Water Depth (m)			Culvert Slope	Co-ordinates		Structural Configuration		Type	Soffit Level (m)	Proposed Formation Level (m)	Flow Direction (In the direction of increasing chainage) (for diversions only)	Comments	Government Watercourse Mapping	Stream Order	Fisheries Data Layer	
	Opt. 6 Rev. 2	Opt. 6 Rev. 3			20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs		Northing	Easting	No.	Dia/Span (m)									Height (m)
34	15.35	14.54		0.149	5.8	7.5	8.8	40.2	40.4	40.7	2.3	2.6	3.0	0.3	0.4	0.6	1.0	1.2	1.4	1 in 300	608384	7790824	7	0.9		PIPE	40.13	40.83			Yes	1	1
35	15.57	14.77		0.011	0.7	0.9	1.0																			Left to Right	Alignment is in cutting, hence watercourse is diverted	Yes	1	1			
36	15.71	14.91		0.189	4.5	5.8	6.8	40.1	40.5	41.0	2.4	3.0	3.5	0.1	0.4	0.8	1.5	1.9	2.4	1 in 300	608043	7790712	7	1.2		PIPE	39.75	40.83					
37	16.00	15.19		0.381	8.7	11.2	13.1																			Left to Right	Alignment is in cutting, hence watercourse is diverted	Yes	1	0			
38	16.39	15.58		0.109	4.7	6.1	7.1	35.5	35.7	35.9	2.3	2.6	2.8	0.0	0.1	0.3	0.9	1.1	1.3	1 in 300	607396	7790500	6	0.9		PIPE	35.44	36.14		Yes	1	0	
39	16.61	15.80		0.118	3.1	4.0	4.7	35.5	35.7	35.9	2.0	2.4	2.7	-0.5	-0.3	-0.2	1.0	1.2	1.3	1 in 300	607187	7790432	4	0.9		PIPE	35.36	36.06					
40	16.85	16.05		0.061	2.1	2.8	3.1	34.9	35.1	35.3	2.3	2.5	2.8	-0.1	0.1	0.2	0.9	1.1	1.3	1 in 300	606963	7790358	3	0.9		PIPE	34.88	35.58					
41	16.90	16.09		0.154	3.7	4.7	5.5	34.6	35.0	35.3	2.3	2.7	3.2	-0.1	0.2	0.6	1.1	1.5	1.9	1 in 300	606912	7790342	4	0.9		PIPE	34.31	35.25	Yes	1	1		
42	17.24	16.44		0.072	2.6	3.4	3.8	34.6	34.8	34.9	2.2	2.4	2.6	0.3	0.4	0.5	0.9	1.0	1.2	1 in 300	606592	7790237	3	0.9		PIPE	34.63	35.33					
43	17.83	17.03		2.112	28.3	36.7	42.6	27.6	27.6	28.3	2.1	2.7	3.2	0.1	0.4	0.6	1.6	2.0	2.2	1 in 300	606036	7790037	8	1.5	1.5	BOX	27.49	27.94	Yes	2	2		
44	18.06	17.26		0.015	0.8	1.0	1.1	28.4	28.6	28.7	2.1	2.3	2.4	0.1	0.2	0.3	0.8	0.9	1.0	1 in 300	605810	7789948	2	0.9		PIPE	28.53	29.23					
45	18.16	17.36		0.029	1.3	1.6	1.8	30.0	30.2	30.3	2.0	2.2	2.3	0.1	0.2	0.2	0.8	0.9	1.0	1 in 300	605725	7789914	2	0.9		PIPE	30.16	30.86					
46	18.62	17.81		0.225	6.6	8.5	9.9	28.3	28.5	28.6	2.2	2.5	2.7	0.3	0.5	0.6	0.9	1.1	1.3	1 in 300	605294	7789745	7	0.9		PIPE	28.25	28.95					
47	18.84	18.04		0.128	3.3	4.2	4.9	26.4	26.6	26.9	2.4	2.7	3.0	0.2	0.5	0.7	1.0	1.2	1.5	1 in 300	605093	7789666	3	0.9		PIPE	26.28	26.98					
48	19.15	18.34		0.409	7.4	9.5	11.1	21.3	21.6	21.7	2.0	2.6	2.7	0.1	0.4	0.4	1.2	1.5	1.6	1 in 300	604783	7789543	6	0.9		PIPE	20.92	21.87					
49	19.17	18.37																															
50	19.28	18.48		0.057	2.1	2.8	3.1	22.7	22.8	22.9	2.0	2.2	2.4	0.3	0.4	0.5	0.8	0.9	1.0	1 in 300	604685	7789505	3	0.9		PIPE	22.79	23.49					
51	19.66	18.86		0.067	2.7	3.6	4.0	20.1	20.2	20.2	2.0	2.2	2.3	0.2	0.3	0.4	0.8	0.9	0.9	1 in 300	604325	7789363	4	0.9		PIPE	20.18	20.88					
52	20.09	19.29	SPLITTERS CREEK	76.244	465.1	592.7	736.0	16.9	17.4	18.1	1.8	2.0	2.9	0.2	0.3	0.6	4.6	5.2	5.8	1 in 300	603928	7789209	3	3.6	3.6	BOX	15.83	17.70					
53	20.23	19.42									2.7	3.1	3.3								603801	7789158	3	20.2		BRIDGE	17.99	19.79		Yes	4	4	
54	20.29	19.48									1.6	1.9	2.7				2.6	3.1	3.8	1 in 300	603746	7789138	1	2.4	2.4	BOX	16.69	17.09					
55	20.42	19.62		0.310	5.0	6.5	7.5	16.2	16.4	16.4	2.2	2.4	2.5	0.3	0.4	0.4	0.8	1.0	1.1	1 in 300	603620	7789086	3	1.5	1.5	BOX	16.88	17.28					
56	21.51	20.71		3.362	27.4	35.8	42.0	17.2	17.6	17.9	1.8	2.4	2.8	0.1	0.4	0.6	1.7	2.0	2.4	1 in 288	602718	7788501	9	1.5		PIPE	17.05	17.92	Yes	1	0		
57	21.57	20.77		0.066	1.6	2.0	2.4	17.1	17.2	17.3	1.8	2.0	2.1	0.4	0.4	0.3	0.7	0.8	0.8	1 in 288	602671	7788457	3	0.9		PIPE	17.35	18.05					
58	21.63	20.82		0.545	6.1	8.0	9.3															8	0.9		PIPE				Structure proposed based on discharge only.				
59	22.59	21.78		0.394	7.2	9.3	10.9	20.4	20.5	20.6	2.0	2.2	2.4	0.4	0.5	0.6	0.8	0.9	1.0	1 IN 270	601933	7787761	10	0.9		PIPE	20.48	21.18					
60	22.85	22.05		0.043	1.7	2.2	2.4															2	0.9		PIPE				Structure proposed based on discharge only.				
61	23.02	22.21		0.033	1.4	1.8	2.0															2	0.9		PIPE								
62	23.21	22.40		0.049	2.2	2.8	3.1															3	0.9		PIPE								
63	23.43	22.63	PLAIN CREEK	11.854	67.3	88.9	105.0	21.5	22.1	22.5	2.2	2.4	2.5	0.1	0.2	0.3	0.9	1.5	1.9	1 IN 300	601322	7787184	4	2.4	2.4	BOX	20.91	22.36					
64	23.47	22.66									1.9	2.2	2.4				3.0	3.6	4.0		601294	7787158	5	2.4	2.4	BOX	23.01	23.41		Yes	2	2	
65	23.58	22.77		0.015	0.8	1.1	1.2	22.6	22.7	22.8	2.0	2.1	2.2	0.3	0.4	0.5	0.7	0.9	0.9	1 IN 300	601212	7787084	1	1.2		PIPE	22.99	23.69					
66	23.75	22.95		0.041	1.7	2.3	2.5	23.5	23.6	23.6	1.9	2.1	2.1	0.3	0.3	0.4	0.7	0.8	0.8	1 in 300	601073	7786971	3	0.9		PIPE	23.68	24.38					
67	23.93	23.13		5.440	36.7	48.3	56.9	22.2	22.6	22.9	1.9	2.5	2.9	0.2	0.4	0.5	2.3	2.7	3.0	1 IN 300	600858	7786835	6	1.8	1.8	BOX	21.67	22.85		Yes	2	2	
68	24.01	23.21																															
69	24.58	23.78		0.119	6.7	8.7	9.7	25.6	25.9	26.0	2.4	2.8	2.9	0.3	0.5	0.6	1.0	1.3	1.4	1 IN 300	600348	7786584	6	0.9		PIPE	25.46	26.18					

Crossing No.	Chainage (km)		Watercourse Name	Catchment Area (sq. km)	Peak Flow for ARI (m³/sec)			PWL (m)			Velocity (m/sec)			Afflux (m)			Head Water Depth (m)			Culvert Slope	Co-ordinates		Structural Configuration			Type	Soffit Level (m)	Proposed Formation Level (m)	Flow Direction (In the direction of increasing chainage) (for diversions only)	Comments	Government Watercourse Mapping	Stream Order	Fisheries Data Layer
	Opt. 6 Rev. 2	Opt. 6 Rev. 3			20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs		Northing	Easting	No.	Dia/Span (m)	Height (m)								
70	25.73	24.92	KANGAROO CREEK	16.337	100.8	133.2	157.3	29.7	30.1	30.3	2.0	2.3	2.5	0.1	0.2	0.2	2.1	2.5	2.7	1 IN 300	599321	7786089	11	2.4	2.4	BOX	29.98	30.38			Yes	3	3
71	26.12	25.32		0.057	1.9	2.4	2.8	33.1	33.2	33.3	1.9	2.1	2.2	0.3	0.3	0.4	0.7	2.1	2.2	1 IN 300	598963	7785916	3	0.9		PIPE	33.29	33.99					
72	26.36	25.56		0.034	2.0	2.6	2.9															3	0.9		PIPE				Structure proposed based on discharge only.				
73	26.62	25.82		0.264	4.9	6.3	7.4	33.6	33.8	33.9	2.3	2.6	2.8	0.4	0.5	0.6	0.9	1.1	1.3	1 IN 300	598511	7785698	5	0.9		PIPE	33.52	34.22					
74	27.01	26.21		0.115	2.8	3.7	4.3	34.7	34.8	34.9	1.9	2.0	2.2	0.4	0.4	0.5	0.7	0.8	0.9	1 in 300	598166	7785531	5	0.9		PIPE	34.88	35.58					
75	27.28	26.48		1.125	13.2	17.2	20.1	33.3	35.6	35.8	1.8	2.4	2.8	0.3	0.5	0.7	1.2	1.5	1.8	1 IN 300	597910	7785408	12	0.9		PIPE	34.93	35.87		Yes	1	1	
76	27.60	26.80		0.210	5.3	6.8	8.0	36.8	37.0	37.1	2.1	2.4	2.5	0.4	0.5	0.5	0.9	1.0	1.1	1 in 300	597631	7785273	4	0.9		PIPE	36.84	37.54					
77	27.63	26.82									1.9	2.2	2.3				0.7	0.9	1.0		597631	7785273	3	0.9		PIPE	36.98	37.68					
78	27.89	27.09		1.516	26.6	34.4	40.0	36.3	36.7	37.1	2.0	2.6	3.0	0.3	0.5	0.7	2.1	2.5	2.9	1 IN 300	597363	7785144	8	1.5		PIPE	35.61	37.02		Yes	1	1	
79	28.13	27.33		0.035	1.6	2.1	2.3															2	0.9		PIPE				Structure proposed based on discharge only.				
80	28.51	27.71		0.574	13.8	17.8	20.7	38.6	39.0	39.4	1.7	2.2	2.5	0.2	0.4	0.6	1.5	1.9	2.3	1 IN 300	596785	7784941	8	1.2		PIPE	38.26	39.31		Yes	2	2	
81	28.70	27.89		0.291	7.5	9.6	11.2	38.6	38.8	39.0	2.4	2.7	2.9	0.2	0.4	0.5	1.0	1.2	1.4	1 IN 300	596598	7784924	7	0.9		PIPE	38.49	39.19					
82	29.07	28.27		0.079	2.6	3.4	3.8	42.7	42.9	43.2	2.4	2.7	3.0	0.0	0.3	0.5	1.0	1.3	1.5	1 in 300	596223	7784922	3	0.9		PIPE	42.54	43.24					
83	29.17	28.37		0.098	3.3	4.3	4.7	42.6	42.8	43.0	2.4	2.7	2.9	0.1	0.3	0.4	1.0	1.3	1.4	1 in 300	596120	7784921	3	0.9		PIPE	42.47	43.17		Yes	1	1	
84	29.34	28.54		0.055	2.5	3.2	3.6	43.6	43.9	44.1	2.4	2.8	3.0	-0.3	-0.1	0.1	1.0	1.3	1.5	1 in 300	595952	7784920	6	0.9		PIPE	43.47	44.19					
85	29.81	29.01		0.019	1.1	1.4	1.6	46.2	46.3	46.4	2.2	2.3	2.3	-0.5	-0.4	-0.4	0.8	0.9	1.0	1 in 200	595481	7784918	3	0.9		PIPE	46.25	46.95					
86	29.98	29.18		0.028	1.2	1.6	1.8	40.5	40.7	40.8	2.2	2.5	2.6	-0.2	0.0	0.1	0.9	1.1	1.2	1 in 250	595312	7784917	2	0.9		PIPE	40.49	41.19					
87	30.06	29.26		0.242	6.7	8.6	9.8	40.5	40.8	41.1	2.0	2.4	2.8	0.1	0.4	0.7	1.0	1.4	1.7	1 in 300	595232	7784916	6	0.9		PIPE	40.31	41.09		Yes	1	1	
88	30.12	29.31		0.062	1.7	2.2	2.5	40.5	40.7	40.9	1.6	1.8	2.1	-0.2	0.0	0.2	0.9	1.1	1.3	1 in 300	595179	7784916	2	0.9		PIPE	40.49	41.19					
89	30.46	29.65		0.205	3.6	4.7	5.4	41.0	41.2	41.3	2.2	2.5	2.6	0.2	0.3	0.4	0.9	1.1	1.2	1 in 300	594838	7784914	4	0.9		PIPE	40.98	41.68					
90	30.93	30.13		0.880	11.7	15.2	17.7	37.1	37.5	37.8	1.8	2.3	2.7	0.2	0.4	0.6	1.2	1.6	1.9	1 in 300	594361	7784911	11	0.9		PIPE	36.77	37.78		Yes	1	1	
91	31.03	30.23		4.412	39.4	51.6	60.6	35.6	35.8	36.1	2.1	2.3	2.7	0.1	0.1	0.3	1.6	1.9	2.2	1 IN 300	594262	7784911	7	1.8	1.8	BOX	35.71	36.13		Yes	2	2	
92	31.17	30.36		0.057	2.4	3.2	3.5	37.0	37.1	37.2	2.1	2.4	2.5	0.1	0.2	0.3	0.8	1.0	1.1	1 in 300	594127	7784910	3	0.9		PIPE	37.00	37.70					
93	31.66	30.86		0.067	2.6	3.3	3.7	37.8	38.0	38.0	2.1	2.4	2.5	0.2	0.3	0.4	0.9	1.0	1.0	1 in 300	593636	7784907	3	0.9		PIPE	37.84	38.54					
94	31.91	31.11		0.886	8.9	11.6	13.6	35.6	35.9	36.1	2.0	2.4	2.8	0.1	0.3	0.5	1.0	1.3	1.6	1 in 300	593386	7784906	8	0.9		PIPE	35.42	36.16		Yes	1	1	
95	32.07	31.26		0.055	1.9	2.5	2.8	35.0	35.4	35.6	2.0	2.1	2.2	0.4	0.5	0.5	0.9	1.3	1.6	1 IN 300	593228	7784905	2	0.9		PIPE	34.94	35.65					
96	32.12	31.32	SALTWATER CREEK	3.322	45.7	59.4	69.1	35.4	35.8	36.0	2.0	2.3	2.7	0.1	0.2	0.3	1.8	2.1	2.4	1 IN 300	593171	7784904	8	1.8	1.8	BOX	35.45	36.07		Yes	2	2	
97	33.41	32.61		0.726	17.2	22.2	26.0	38.2	38.5	38.8	2.0	2.5	2.9	0.2	0.4	0.6	1.1	1.4	1.6	1 in 300	591883	7784897	15	0.9		PIPE	38.06	38.84		Yes	1	1	
98	34.51	33.71		2.335	19.1	25.0	29.4	42.9	43.2	43.4	1.4	1.9	2.2	0.1	0.3	0.4	1.3	1.6	1.8	1 in 300	590784	7784891	22	0.9		PIPE	42.75	43.46		Yes	1	1	
99	35.08	34.28	ELLIOT RIVER	128.076	818.2	999.4	1200.8	37.1	37.6	39.0	3.2	3.4	3.7	0.2	0.2	1.2					590213	7784888	4	20.2		BRIDGE	38.20	40.00		Yes	4	4	
100	35.30	34.49		15.394	56.1	74.9	89.1	34.8	35.2	35.6	1.9	2.2	2.5	0.1	0.2	0.3	2.7	3.1	3.5	1 in 300	589997	7784887	4	3.0	3.0	BOX	35.06	35.48		Yes	3	3	
101	35.36	34.56		0.025	1.1	1.4	1.6	35.2	35.3	35.6	2.0	2.2	2.3	0.4	0.5	0.5	0.4	0.5	0.8	1 in 300	589929	7784886	2	1.5	1.5	BOX	36.31	36.71					
102	35.50	34.70		0.016	0.9	1.2	1.3	38.5	38.6	38.7	1.9	2.1	2.2	-0.1	0.0	0.0	0.7	0.8	0.9	1 in 300	589792	7784885	2	0.9		PIPE	38.66	39.36					
103	35.72	34.91		0.023	1.2	1.6	1.7	37.4	37.5	37.6	2.1	2.3	2.5	-0.3	-0.2	-0.2	0.8	0.9	1.0	1 in 300	589576	7784884	2	0.9		PIPE	37.43	38.13					
104	35.79	34.99		0.604	10.3	13.3	15.4	37.1	37.4	37.7	1.9	2.4	2.8	0.1	0.3	0.5	1.2	1.5	1.8	1 in 300	589506	7784883	9	0.9		PIPE	36.31	37.74		Yes	1	1	
105	36.42	35.62		0.159	4.4	5.6	6.6	43.3	43.5	43.8	2.4	2.7	3.4	0.3	0.5	0.7	1.0	1.2	1.5	1 in 300	588886	7784804	4	0.9		PIPE	43.18	43.88					
106	36.94	36.14		0.048	2.0	2.6	2.9	42.3	42.5	42.8	2.4	2.7	3.2	0.3	0.5	0.7	1.0	1.2	1.5	1 in 300	588479	7784489	2	0.9		PIPE	42.17	42.87					

Crossing No.	Chainage (km)		Watercourse Name	Catchment Area (sq. km)	Peak Flow for ARI (m³/sec)			PWL (m)			Velocity (m/sec)			Afflux (m)			Head Water Depth (m)			Culvert Slope	Co-ordinates		Structural Configuration			Type	Soffit Level (m)	Proposed Formation Level (m)	Flow Direction (In the direction of increasing chainage) (for diversions only)	Comments	Government Watercourse Mapping	Stream Order	Fisheries Data Layer
	Opt. 6 Rev. 2	Opt. 6 Rev. 3			20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs		Northing	Easting	No.	Dia/Span (m)	Height (m)								
107	37.24	36.43		0.200	4.7	6.1	7.1	39.6	39.8	40.0	2.2	2.5	2.7	0.2	0.3	0.5	0.9	1.1	1.3	1 in 300	588318	7784238	5	0.9		PIPE	39.60	40.30					
108	37.38	36.58		6.597	40.2	53.0	62.5	39.3	39.7	40.0	1.9	2.4	2.8	0.3	0.5	0.7	2.1	2.6	2.8	1 in 300	588243	7784116	5	2.1	2.1	BOX	39.19	39.96		Yes	2	2	
109	37.95	37.14		0.016	0.9	1.1	1.3	42.6	42.8	43.0	2.2	2.5	3.2	0.1	0.3	0.5	0.9	1.1	1.3	1 in 300	587945	7783634	3	0.9		PIPE	42.54	43.24					
110	38.10	37.30		0.149	4.7	6.0	7.1	43.8	44.0	44.2	1.3	1.7	2.0	0.1	0.2	0.3	1.2	1.4	1.6	1 in 300	587861	7783498	10	0.9		PIPE	43.43	44.13					
111	42.94	42.14		0.033	1.9	2.5	2.8	76.1	76.2	76.3	2.3	2.5	2.7	0.0	0.2	0.3	1.0	1.1	1.2	1 in 300	587920	7779138	2	0.9		PIPE	75.96	76.66					
112	43.43	42.62		0.012	0.8	1.0	1.1	80.2	80.3	80.4	2.2	2.4	2.5	-0.5	-0.5	-0.4	0.6	0.8	0.8	1 in 200	587920	7778656	1	1.5	1.5	BOX	81.07	81.47					
113	43.54	42.74		0.031	1.3	1.7	1.9	80.4	80.5	80.6	2.0	2.3	2.4	0.0	0.1	0.1	0.8	0.9	1.0	1 in 300	587922	7778541	2	0.9		PIPE	80.50	81.20					
114	43.59	42.78		0.100	4.0	5.1	5.7	79.1	79.3	79.5	2.4	2.6	2.8	-0.4	-0.3	-0.2	1.0	1.2	1.3	1 in 300	587924	7778496	2	1.5	1.5	BOX	79.67	80.07					
115	43.73	42.92		0.023	1.0	1.3	1.5	84.5	84.7	84.8	2.4	2.7	2.8	0.2	0.4	0.4	1.0	1.1	1.3	1 in 300	587941	7778355	1	1.5	1.5	BOX	85.04	85.44					
116	43.95	43.15		0.025	1.3	1.7	1.9	92.3	92.5	92.5	2.1	2.3	2.4	-0.2	-0.1	0.0	0.8	1.0	1.1	1 in 300	587985	7778132	2	0.9		PIPE	92.36	93.06					
117	44.03	43.22		0.011	0.7	0.9	1.0	91.9	92.1	92.3	2.3	2.6	2.9	-0.1	0.0	0.2	0.9	1.1	1.4	1 in 300	587999	7778061	1	0.9		PIPE	91.72	92.42					
118	44.07	43.27		0.009	0.5	0.7	0.8	91.9	92.0	92.0	2.0	2.2	2.2	-0.5	-0.5	-0.4	0.5	0.6	0.7	1 in 200	588008	7778017	1	1.5	1.5	BOX	92.90	93.30					
119	44.20	43.40		0.013	0.7	1.0	1.1	90.7	90.9	91.1	2.3	2.5	2.8	-0.4	-0.2	0.0	0.9	1.1	1.3	1 in 300	588033	7777893	1	0.9		PIPE	90.64	91.34					
120	44.29	43.48		0.062	2.7	3.5	3.9	89.0	89.2	89.2	2.1	2.3	2.3	-0.3	-0.3	-0.2	0.7	0.8	0.9	1 in 300	588051	7777807	2	1.5	1.5	BOX	89.83	90.23					
121	44.34	43.54		0.030	1.5	1.9	2.1	87.5	87.6	87.7	2.1	2.2	2.3	-0.6	-0.5	-0.5	0.7	0.9	0.9	1 in 300	588061	7777755	1	1.5	1.5	BOX	88.24	88.64					
122	44.44	43.63		0.107	3.8	4.9	5.4	88.8	88.9	89.0	1.5	1.8	2.0	-0.3	-0.2	-0.1	1.0	1.1	1.2	1 in 300	588080	7777661	2	1.5	1.5	BOX	89.27	89.67		Yes	1	1	
123	44.45	43.64		0.073	2.5	3.2	3.6	89.3	89.5	89.6	2.4	2.6	2.7	-0.3	-0.2	-0.2	0.9	1.1	1.3	1 in 300	588084	7777646	2	1.5	1.5	BOX	89.84	90.24					
124	44.94	44.14		0.039	1.8	2.4	2.6	101.1	101.2	101.2	2.1	2.2	2.3	-0.5	-0.5	-0.4	0.5	0.6	0.7	1 in 200	588176	7777166	2	1.5	1.5	BOX	102.05	102.45					
125	45.09	44.28		0.030	1.4	1.8	2.0	100.5	100.7	100.8	2.3	2.5	2.6	0.1	0.2	0.3	0.8	1.0	1.1	1 in 300	588192	7777020	1	1.5	1.5	BOX	101.21	101.61					
126	45.15	44.35		0.012	0.7	0.9	1.0	101.1	101.2	101.9	1.9	2.1	2.2	0.0	0.1	0.1	0.6	0.7	0.8	1 in 300	588196	7776955	1	1.5	1.5	BOX	102.04	102.44					
127	45.46	44.66		0.141	4.7	6.1	6.8	98.5	98.7	98.8	2.5	2.7	2.8	0.1	0.2	0.3	1.0	1.2	1.3	1 in 300	588189	7776581	2	1.5	1.5	BOX	99.00	99.40					
128	45.53	44.72		0.060	2.3	3.0	3.3	98.7	98.9	99.0	2.5	2.7	2.8	0.0	0.2	0.2	1.0	1.2	1.3	1 in 300	588194	7776648	1	1.5	1.5	BOX	99.20	99.60					
129	45.72	44.91		0.060	2.7	3.5	3.9	103.5	103.7	103.8	2.3	2.6	2.6	-0.5	-0.5	-0.4	0.9	1.1	1.2	1 in 300	588164	7776392	4	1.5	1.5	BOX	104.10	104.50					
130	46.49	45.69		0.010	0.6	0.8	0.9	122.1	122.2	122.3	2.3	2.4	2.6	-0.4	-0.3	-0.1	0.9	1.0	1.1	1 in 200	587957	7775643	1	0.9		PIPE	122.08	122.78					
131	46.66	45.85		0.036	1.8	2.3	2.6	121.7	121.9	122.0	2.2	2.4	2.6	0.1	0.3	0.3	0.9	1.1	1.1	1 in 300	587910	7775488	2	0.9		PIPE	121.72	122.42					
132	46.69	45.88		0.179	6.0	7.8	8.6	121.8	122.1	122.2	2.4	2.7	2.9	0.1	0.3	0.5	1.0	1.3	1.4	1 in 300	587902	7775460	6	0.9		PIPE	121.67	122.37		Yes	1	1	
133	47.42	46.62		1.531	18.8	24.3	28.2	126.1	126.3	126.4	2.5	2.7	2.9	-0.2	-0.1	0.0	1.0	1.2	1.3	1 in 300	587712	7774754	8	1.5	1.5	BOX	126.59	126.99		Yes	2	2	
134	47.54	46.74		0.076	3.1	4.0	4.4	128.0	128.3	128.5	2.5	2.9	3.4	-0.2	0.0	0.2	1.0	1.4	1.6	1 in 300	587708	7774630	5	0.9		PIPE	127.81	128.59					
135	47.84	47.03		0.098	4.4	5.7	6.3	125.3	125.6	125.8	2.4	2.8	3.2	-0.2	0.0	0.2	1.0	1.3	1.5	1 in 300	587760	7774343	5	0.9		PIPE	125.10	125.87					
136	48.41	47.61	STOCKYARD CREEK	2.520	36.1	46.8	54.5	122.3	122.6	122.8	2.4	2.7	2.9	0.0	0.1	0.3	1.5	1.8	2.0	1 in 300	587997	7773816	9	1.5	1.5	BOX	122.29	122.85		Yes	2	2	
137	49.06	48.26		0.011	0.6	0.8	0.9	132.1	132.2	132.3	1.7	1.9	2.0	-0.3	-0.2	-0.2	0.5	0.6	0.7	1 in 300	588269	7773224	1	1.5	1.5	BOX	133.09	133.49					
138	49.21	48.40		0.054	2.2	2.9	3.2	130.2	130.4	130.5	2.5	2.7	2.8	0.3	0.4	0.5	1.0	1.2	1.3	1 in 300	588329	7773092	3	1.5	1.5	BOX	130.71	131.11					
139	50.75	49.95		0.110	4.8	6.3	7.0	165.0	165.2	165.3	2.3	2.6	2.7	-0.4	-0.3	-0.2	1.0	1.1	1.3	1 in 300	588385	7771573	6	0.9		PIPE	164.90	165.60		Yes	1	1	
140	51.26	50.46		0.022	1.2	1.5	1.7	172.6	172.8	173.1	2.5	2.9	3.1	-0.3	-0.1	0.1	1.1	1.4	1.6	1 in 300	588172	7771107	2	0.9		PIPE	171.68	173.10					
141	51.31	50.51		0.022	1.3	1.7	1.9	171.7	171.9	172.1	2.3	2.6	2.7	-0.5	-0.3	-0.2	0.9	1.1	1.3	1 in 300	588141	7771071	1	0.9		PIPE	172.41	173.11					
142	52.23	51.43		0.490	6.6	8.6	10.0	180.6	180.9	181.2	1.9	2.4	2.8	0.1	0.3	0.5	1.3	1.7	1.9	1 in 300	587416	7770505	6	1.2		PIPE	180.44	181.24		Yes	1	1	
143	52.26	51.46		0.012	0.6	0.8	0.9	181.4	181.5	181.5	2.1	2.3	2.3	-0.5	-0.4	-0.4	0.7	0.8	0.9	1 in 200	587391	7770487	1	0.9		PIPE	181.51	</					

Crossing No.	Chainage (km)		Watercourse Name	Catchment Area (sq. km)	Peak Flow for ARI (m³/sec)			PWL (m)			Velocity (m/sec)			Afflux (m)			Head Water Depth (m)			Culvert Slope	Co-ordinates		Structural Configuration			Type	Soffit Level (m)	Proposed Formation Level (m)	Flow Direction (In the direction of increasing chainage) (for diversions only)	Comments	Government Watercourse Mapping	Stream Order	Fisheries Data Layer
	Opt. 6 Rev. 2	Opt. 6 Rev. 3			20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs		Northing	Easting	No.	Dia/Span (m)	Height (m)								
147	53.36	52.56		0.413	7.5	9.7	11.3	169.2	169.5	169.6	2.2	2.5	2.6	-0.2	-0.1	0.0	1.3	1.6	1.7	1 in 300	586514	7769833	6	1.5	1.5	BOX	169.83	170.23			Yes	1	1
148	53.52	52.71		0.862	11.7	15.2	17.7																				Right to Left	Waterway crossing is avoided by diverting the watercourse at Ch. 52.793 km (Opt. 6 Rev. 3) to the downstream of watercourse at Ch. 52.714 km (Opt. 6 Rev. 3)	Yes	1	1		
149	53.60	52.79		0.847	12.1	15.7	18.2																			Left to Right	Yes		1	1			
150	54.20	53.40		0.065	3.0	3.9	4.4	171.8	172.0	172.1	2.2	2.5	2.7	-0.1	0.1	0.2	0.9	1.1	1.2	1 in 300	585836	7769324	4	0.9		PIPE	171.79	172.49					
151	54.39	53.59		0.337	7.0	9.0	10.5	171.2	171.5	171.7	2.4	2.7	3.1	0.1	0.3	0.5	1.0	1.2	1.5	1 in 300	585696	7769198	7	0.9		PIPE	171.10	171.80		Yes	1	1	
152	54.85	54.05		0.064	2.9	3.8	4.2	172.1	172.2	172.3	2.4	2.6	2.7	0.1	0.2	0.3	1.0	1.1	1.3	1 in 300	585410	7768840	3	0.9		PIPE	171.94	172.64					
153	55.16	54.35		0.028	1.4	1.8	2.0	165.6	165.8	165.9	2.1	2.4	2.6	-0.4	-0.3	-0.2	0.9	1.0	1.1	1 in 300	585269	7768573	2	0.9		PIPE	165.63	166.33					
154	55.27	54.47		0.421	9.1	11.7	13.6	168.1	168.4	168.5	2.4	2.7	2.9	-0.6	-0.4	-0.4	1.0	1.3	1.4	1 in 300	585228	7768467	4	0.9		PIPE	168.00	168.70		Yes	1	1	
155	55.37	54.56		0.014	0.8	1.0	1.1	164.3	164.6	164.9	2.4	2.8	3.4	0.0	0.1	0.3	1.0	1.3	1.6	1 in 300	585197	7768375	8	0.9		PIPE	164.20	164.92					
156	57.01	56.21		2.929	26.0	34.0	39.9	156.3	156.7	156.9	2.5	2.9	3.2	0.3	0.5	0.6	1.7	2.1	2.3	1 in 300	585072	7766744	7	1.5	1.5	BOX	156.17	156.57		Yes	2	2	
157	57.42	56.62		0.056	2.8	3.7	4.1	156.4	156.6	156.7	2.3	2.5	2.7	0.3	0.4	0.5	1.0	1.1	1.2	1 in 300	585059	7766332	3	0.9		PIPE	156.35	157.05					
158	57.73	56.92		0.040	2.3	3.0	3.4	154.2	154.5	154.7	2.5	2.8	3.2	0.1	0.4	0.5	1.1	1.4	1.6	1 in 300	585049	7766025	2	0.9		PIPE	153.99	154.79					
159	58.08	57.28	SPRING CREEK	10.668	61.9	81.8	96.7	148.1	148.6	149.0	1.8	2.4	2.8	0.2	0.4	0.6	2.6	3.1	3.5	1 in 300	585039	7765674	6	2.4	2.4	BOX	147.95	148.92		Yes	3	3	
160	58.14	57.34		0.027	1.3	1.7	1.9	149.9	150.1	150.2	2.2	2.4	2.5	-0.4	-0.3	-0.2	0.8	0.9	1.0	1 in 300	585037	7765611	1	1.5	1.5	BOX	150.68	151.08					
161	58.52	57.72		0.831	12.0	15.5	18.1	150.9	151.2	151.4	2.0	2.6	3.0	0.2	0.5	0.7	1.2	1.5	1.7	1 in 300	585025	7765235	10	0.9		PIPE	150.57	151.76		Yes	1	1	
162	58.69	57.88		0.052	1.9	2.5	2.7	153.2	153.4	153.6	2.2	2.5	2.7	-0.1	0.1	0.3	0.9	1.1	1.3	1 in 300	585020	7765068	2	0.9		PIPE	153.19	153.89					
163	59.51	58.71		0.544	7.5	9.8	11.4	149.2	149.5	149.7	2.4	2.7	3.1	0.1	0.3	0.5	1.0	1.2	1.5	1 in 300	584994	7764240	7	0.9		PIPE	149.12	149.82		Yes	1	1	
164	60.03	59.22		0.607	11.7	15.1	17.5	148.1	148.5	148.8	2.2	2.8	3.2	0.1	0.4	0.7	1.2	1.6	2.0	1 in 300	584901	7763735	9	0.9		PIPE	147.77	148.80		Yes	1	1	
165	60.91	60.11		0.275	4.8	6.2	7.3	142.1	141.8	142.1	2.3	3.1	3.6	0.0	0.3	0.5	1.1	1.4	1.7	1 in 300	584472	7762971	4	0.9		PIPE	141.30	142.14					
166	61.22	60.42	BOGIE RIVER	432.507	2284.2	2732.6	3124.7	133.6	134.1	135.3	3.1	3.3	3.4	0.2	0.2	0.9					584288	7762717	9	20.2		BRIDGE	134.87	136.67		Yes	5	4	
167	61.52	60.72		0.018	1.0	1.3	1.5	142.0	142.1	142.2	1.9	2.1	2.3	0.2	0.3	0.4	0.7	0.9	0.9	1 in 300	584113	7762472	2	0.9		PIPE	142.13	142.83					
168	63.39	62.58		1.280	21.2	27.5	32.1	147.5	147.7	147.8	2.3	2.5	2.7	0.3	0.5	0.6	1.0	1.2	1.3	1 in 300	583020	7760963	15	1.2		PIPE	147.66	148.36					
169	64.35	63.55		0.856	10.6	13.9	16.2	142.0	142.4	142.7	2.0	2.5	3.0	-0.2	0.1	0.4	1.3	1.7	2.0	1 in 300	582399	7760225	9	0.9		PIPE	141.54	142.68					
170	64.52	63.72		0.323	6.7	8.7	10.1	140.8	141.1	141.4	1.9	2.4	2.8	0.0	0.3	0.5	1.1	1.5	1.7	1 in 300	582278	7760109	6	0.9		PIPE	140.57	141.44					
171	64.78	63.98	SANDY CREEK	149.455	483.1	663.8	813.2	139.6	140.4	141.6	2.8	3.1	3.2	0.1	0.1	0.7					582093	7759931	3	20.2		BRIDGE	141.10	142.90		Yes	4	4	
172	65.19	64.38		1.004	14.2	18.5	21.5	140.9	141.3	141.5	1.0	1.3	1.5	0.4	0.5	0.6	1.9	2.2	2.5	1 in 300	581798	7759648	11	1.8	1.8	BOX	140.84	141.55		Yes	1	1	
173	65.35	64.55		0.293	6.1	8.0	9.3	142.4	142.6	142.7	2.3	2.5	2.7	-0.1	0.0	0.1	0.9	1.1	1.2	1 in 300	581680	7759534	3	1.5	1.5	BOX	142.99	143.69					
174	65.76	64.96		0.080	3.4	4.5	5.0	148.2	148.4	148.6	2.2	2.5	2.9	0.0	0.2	0.2	1.4	1.6	1.8	1 in 300	581387	7759253	4	1.5	1.5	BOX	148.32	148.72					
175	66.49	65.69		0.007	0.4	0.5	0.6	162.1	162.4	162.6	2.4	3.1	3.4	-0.1	0.2	0.3	1.1	1.3	1.5	1 in 200	580859	7758742	3	0.9		PIPE	161.92	162.69					
176	67.41	66.61		0.026	1.2	1.6	1.8	169.9	170.3	170.5	2.5	2.9	3.4	0.0	0.3	0.4	1.1	1.4	1.6	1 in 300	580477	7757914	3	0.9		PIPE	169.75	170.58					
177	67.47	66.67		0.072	3.1	4.1	4.5	167.4	167.7	167.8	2.3	2.7	2.9	0.1	0.3	0.4	1.0	1.2	1.4	1 in 300	580460	7757861	3	0.9		PIPE	167.36	168.06					
178	67.51	66.71		0.047	2.2	2.8	3.2	168.3	168.5	168.7	2.4	2.7	3.3	-0.4	-0.2	-0.1	1.0	1.3	1.4	1 in 200	580447	7757819	2	0.9		PIPE	168.14	168.84					
179	67.86	67.06		0.124	4.1	5.3	6.1	174.4	174.7	174.9	2.4	2.7	2.9	-0.1	0.1	0.4	1.0	1.3	1.4	1 in 300	580343	7757490	7	0.9		PIPE	174.32	175.02		Yes	1	1	
180	68.98	68.18		0.032	1.5	2.0	2.2	182.8	183.0	183.1	2.2	2.4	2.6	-0.4	-0.3	-0.2	0.9	1.0	1.2	1 in 300	579804	7756530	3	0.9		PIPE	182.80	183.50		Yes	1	1	
181	69.29	68.48		0.063	3.1	4.1	4.6	185.3	185.4	185.6	2.4	2.7	3.1	0.0	0.2	0.3	1.1	1.2	1.4	1 in 300	579589	7756309	3	0.9		PIPE	185.10	185.80					
182	69.55	68.75		0.173	5.4	7.0	8.2	183.1	183.2	183.4	2.3	2.5	2.7	-0.2	-0.1	0.0	0.9	1.1	1.2	1 in 200	579406	7756120	6	0.9		PIPE	183.03	183.73					

Crossing No.	Chainage (km)		Watercourse Name	Catchment Area (sq. km)	Peak Flow for ARI (m³/sec)			PWL (m)			Velocity (m/sec)			Afflux (m)			Head Water Depth (m)			Culvert Slope	Co-ordinates		Structural Configuration			Type	Soffit Level (m)	Proposed Formation Level (m)	Flow Direction (In the direction of increasing chainage) (for diversions only)	Comments	Government Watercourse Mapping	Stream Order	Fisheries Data Layer
	Opt. 6 Rev. 2	Opt. 6 Rev. 3			20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs		Northing	Easting	No.	Dia/Span (m)	Height (m)								
183	69.62	68.82		0.011	0.6	0.7	0.8	185.2	185.3	185.4	2.2	2.3	2.4	-0.5	-0.4	-0.4	0.8	0.9	1.0	1 in 200	579357	7756069	1	0.9		PIPE	185.31	186.01					
184	69.98	69.18		0.944	12.3	16.0	18.7	181.6	182.1	182.5	2.1	2.8	3.2	0.0	0.3	0.6	1.5	1.9	2.3	1 in 300	579106	7755811	6	1.2		PIPE	181.33	182.41			Yes	1	1
185	70.22	69.41		0.019	1.0	1.4	1.5	191.4	191.5	191.6	2.2	2.3	2.4	-0.4	-0.3	-0.2	0.8	0.9	1.0	1 in 200	578925	7755625	2	0.9		PIPE	191.48	192.18					
186	70.24	69.44																															
187	70.77	69.97		0.478	9.0	11.7	13.6	181.2	181.4	181.5	2.4	2.6	2.8	-0.2	-0.1	0.0	1.1	1.3	1.4	1 in 300	578558	7755246	4	1.5	1.5	BOX	181.61	182.01			Yes	1	1
188	70.80	70.00		0.011	0.6	0.8	0.9	183.7	183.8	183.9	2.0	2.2	2.3	-0.5	-0.5	-0.4	0.5	0.6	0.7	1 in 200	578535	7755222	1	1.5	1.5	BOX	184.67	185.07					
189	71.04	70.24		0.115	4.4	5.7	6.4	183.9	184.1	184.1	2.4	2.6	2.7	-0.9	-0.9	-0.8	0.8	0.9	1.0	1 in 300	578370	7755053	3	1.5	1.5	BOX	184.66	185.06					
190	71.11	70.31		0.034	1.6	2.1	2.4	186.2	186.4	186.5	2.1	2.3	2.4	-0.5	-0.4	-0.3	0.8	0.9	1.0	1 in 300	578319	7755000	1	1.5	1.5	BOX	186.93	187.33					
191	71.28	70.48		0.012	0.7	0.9	1.0	196.4	196.5	196.6	2.2	2.3	2.4	0.2	0.3	0.3	0.8	0.9	1.1	1 in 200	578201	7754878	3	0.9		PIPE	196.44	197.14					
192	71.60	70.79		0.011	0.6	0.8	0.9	202.8	203.0	203.1	2.5	2.7	2.8	-0.6	-0.5	-0.3	0.9	1.0	1.2	1 in 150	577980	7754653	1	0.9		PIPE	202.80	203.50					
193	71.70	70.89		1.111	17.6	22.8	26.6	189.5	189.8	189.9	2.2	2.5	2.7	-0.1	0.0	0.0	1.3	1.6	1.8	1 in 300	577905	7754589	5	1.5	1.5	BOX	189.69	190.09			Yes	1	1
194	71.74	70.94		0.011	0.6	0.8	0.9	194.0	194.2	194.3	2.3	2.5	2.6	-0.5	-0.4	-0.3	0.8	1.0	1.1	1 in 300	577871	7754563	1	1.5	1.5	BOX	194.65	195.05					
195	71.98	71.18		2.466	35.8	46.5	54.2	191.4	191.7	191.9	1.9	2.2	2.4	-0.1	0.0	0.1	2.0	2.3	2.5	1 in 300	577665	7754441	9	3.0	3.0	BOX	191.47	191.96			Yes	2	2
196	72.74	71.94		0.211	5.0	6.5	7.6	201.9	202.2	202.4	2.3	2.7	3.1	-0.1	0.1	0.3	1.0	1.2	1.4	1 in 300	576934	7754235	7	0.9		PIPE	201.85	202.55					
197	73.16	72.35		3.029	43.0	55.9	65.2	207.8	208.2	208.4	1.7	2.2	2.6	0.1	0.2	0.4	1.2	2.3	2.6	1 in 300	576545	7754083	9	1.8	1.8	BOX	207.61	208.62			Yes	2	2
198	74.42	73.62		0.173	6.6	8.7	10.1	205.7	206.2	206.6	2.1	2.7	3.2	-0.1	0.2	0.5	1.2	1.6	2.0	1 in 300	575967	7753021	7	0.9		PIPE	205.44	206.50					
199	74.82	74.02		0.025	1.2	1.5	1.7	203.2	203.4	203.6	2.4	2.7	2.9	-0.4	-0.3	-0.2	1.1	1.3	1.5	1 in 300	576043	7752634	3	1.2		PIPE	203.29	203.99					
200	75.06	74.25		0.028	1.7	2.2	2.4	197.9	198.1	198.3	2.3	2.6	2.8	-0.2	-0.1	0.1	0.9	1.1	1.4	1 in 300	576142	7752422	2	0.9		PIPE	197.84	198.54					
201	75.21	74.40		0.013	0.7	0.9	1.0	194.7	194.8	194.9	2.0	2.2	2.3	-0.4	-0.3	-0.2	0.8	0.9	1.0	1 in 300	576213	7752286	1	0.9		PIPE	194.83	195.53					
202	75.22	74.42		0.254	5.2	6.7	7.8	193.2	193.4	193.6	2.0	2.3	2.6	0.0	0.1	0.3	1.0	1.2	1.4	1 in 300	576217	7752277	5	0.9		PIPE	193.09	193.79					
203	75.76	74.96		2.623	39.2	51.0	59.4	182.5	182.9	183.2	1.7	2.3	2.6	-0.1	0.2	0.4	1.8	2.2	2.5	1 in 300	576396	7751771	10	1.5	1.5	BOX	182.15	183.17			Yes	2	2
204	75.86	75.06		0.074	3.4	4.4	4.9	183.1	183.3	183.4	2.2	2.5	2.6	-0.3	-0.2	-0.2	0.8	1.0	1.1	1 in 300	576400	7751670	2	1.5	1.5	BOX	183.79	184.19					
205	76.48	75.68		0.017	1.0	1.3	1.5	187.8	187.9	188.0	2.1	2.3	2.5	-0.5	-0.4	-0.4	0.8	0.9	1.0	1 in 300	576283	7751066	2	1.5	1.5	BOX	188.50	188.90					
206	76.60	75.79		0.011	0.6	0.8	0.9	190.3	190.5	190.7	2.3	2.5	2.7	-0.6	-0.5	-0.4	0.9	1.1	1.2	1 in 200	576256	7750952	1	0.9		PIPE	190.32	191.02					
207	77.11	76.31		0.021	1.2	1.6	1.8	170.4	170.5	170.5	2.0	2.2	2.3	0.0	0.1	0.1	0.7	0.8	0.8	1 in 300	576158	7750446	1	1.5	1.5	BOX	171.20	171.60					
208	77.33	76.52		3.056	28.5	37.2	43.6	168.2	168.6	168.8	2.2	2.8	3.2	0.2	0.3	0.4	1.7	2.1	2.3	1 in 300	576174	7750234	7	1.5	1.5	BOX	168.03	168.91			Yes	1	1
209	77.34	76.54		0.321	6.6	8.6	10.0	168.1	168.4	168.6	1.4	1.7	1.9	0.1	0.1	0.2	1.7	2.0	2.2	1 in 300	576177	7750219	2	1.5	1.5	BOX	168.24	168.71					
210	78.51	77.70		0.142	4.5	5.9	6.6																					Left to Right	Alignment is in cutting, hence watercourse is diverted	Yes	1	0	
211	78.88	78.08		0.200	6.8	8.9	9.8	178.5	178.7	178.8	2.5	2.7	2.9	0.0	0.2	0.2	1.1	1.3	1.4	1 in 300	576570	7748730	8	1.2		PIPE	178.61	179.31					
212	79.11	78.31		0.327	7.6	9.8	11.4	176.7	177.0	177.2	2.4	2.7	3.0	-0.2	0.0	0.1	1.0	1.2	1.4	1 in 300	576630	7748509	7	0.9		PIPE	176.63	177.33			Yes	1	1
213	79.26	78.46		0.321	5.8	7.5	8.7	181.1	181.4	181.7	2.4	2.8	3.3	-0.5	-0.2	0.0	1.0	1.3	1.6	1 in 300	576669	7748362	5	0.9		PIPE	180.93	181.69					
214	79.92	79.12		0.162	4.2	5.4	6.3	169.9	170.0	170.1	2.2	2.4	2.6	0.3	0.4	0.5	0.8	1.0	1.1	1 in 300	576839	7747720	4	1.5	1.5	BOX	170.55	170.95					
215	79.98	79.17		0.107	3.5	4.5	5.2	169.8	169.9	170.0	2.0	2.2	2.3	0.2	0.3	0.4	0.7	0.8	0.9	1 in 300	576855	7747662	3	1.5	1.5	BOX	170.66	171.06					
216	80.37	79.57		7.440	84.3	110.0	128.6	164.5	164.9	165.2	2.0	2.4	2.8	0.1	0.2	0.4	2.4	2.8	3.1	1 in 300	576954	7747289	8	2.4	2.4	BOX	164.50	165.19			Yes	2	2
217	80.68	79.87		0.012	0.7	0.9	1.0	171.2	171.5	171.7	2.4	2.7	3.3	-0.1	-0.1	0.0	1.0	1.2	1.4	1 in 200	577032	7746996	2	0.9		PIPE	171.12	171.82					
218	80.85	80.05		0.025	1.2	1.5	1.7	164.1	164.2	164.3	2.4	2.6	2.7	-0.4	-0.4	-0.3	0.7	0.9	1.0	1 in 200	577077	7746828	1	1.5	1.5	BOX	164.88	165.28					
219	80.95	80.15		0.051	1.8	2.3	2.6	163.3	163.5	163.7	2.3	2.5	2.6	-0.5	-0.4	-0.3	0.9	1.0	1.2	1 in 300	577101	7746731	1	1.5	1.5	BOX	163.95	164.35					
220	81.08	80.27		0.060	1.9	2.5	2.9	161.6	161.7	161.7	2.1	2.3	2.4	-0.4	-0.4	-0.3	0.6	0.7	0.7	1 in 200	577129	7746607	2	1.									

Crossing No.	Chainage (km)		Watercourse Name	Catchment Area (sq. km)	Peak Flow for ARI (m³/sec)			PWL (m)			Velocity (m/sec)			Afflux (m)			Head Water Depth (m)			Culvert Slope	Co-ordinates		Structural Configuration			Type	Soffit Level (m)	Proposed Formation Level (m)	Flow Direction (In the direction of increasing chainage) (for diversions only)	Comments	Government Watercourse Mapping	Stream Order	Fisheries Data Layer
	Opt. 6 Rev. 2	Opt. 6 Rev. 3			20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs		Northing	Easting	No.	Dia/Span (m)	Height (m)								
222	81.17	80.37		0.131	3.9	5.1	6.0	161.5	161.7	161.8	2.3	2.5	2.6	-0.1	0.0	0.1	0.8	1.0	1.1	1 in 300	577146	7746510	3	1.5	1.5	BOX	162.16	162.56					
223	82.02	81.22	OAKY CREEK	5.670	50.9	66.5	77.8	157.6	157.9	158.2	1.8	2.3	2.7	0.1	0.3	0.5	2.4	2.7	3.0	1 In 300	577161	7745665	9	1.8	1.8	BOX	157.04	158.23		Yes	2	2	
224	82.13	81.32		0.104	4.1	5.4	6.0	159.2	159.3	159.4	2.1	2.3	2.4	0.2	0.3	0.4	0.6	0.9	1.0	1 in 300	577149	7745576	4	1.5	1.5	BOX	159.95	160.35					
225	82.96	82.16		1.465	20.4	26.5	30.9	152.0	152.2	152.4	2.4	2.7	2.8	0.2	0.3	0.3	1.0	1.2	1.3	1 In 300	576905	7744762	9	1.5	1.5	BOX	157.50	157.90		Yes	1	1	
226	83.13	82.32		0.636	7.7	10.0	11.7	150.5	150.8	151.0	2.1	2.1	2.1	-0.1	0.1	0.2	1.1	1.3	1.5	1 In 300	576841	7744614	3	1.5	1.5	BOX	150.93	151.33		Yes	1	1	
227	83.31	82.50																															
228	83.31	82.51		18.100	103.6	135.7	159.2	151.2	151.6	151.9	1.9	2.2	2.5	0.1	0.2	0.3	2.8	3.2	3.6	1 In 300	576769	7744443	7.0	3.0	3.0	BOX	151.36	151.76		Yes	3	3	
229	83.62	82.82		0.009	0.5	0.7	0.8	156.9	157.1	157.2	2.0	2.3	2.4	-0.1	0.0	0.1	0.8	0.9	1.0	1 in 300	576649	7744161	1	0.9		PIPE	157.04	157.74					
230	84.22	83.42		0.213	6.6	8.5	9.9	159.2	159.4	159.6	2.2	2.5	2.7	0.3	0.4	0.6	0.9	1.1	1.3	1 In 300	576412	7743607	7	0.9		PIPE	159.03	159.73		Yes	1	1	
231	85.11	84.31		0.222	7.1	9.3	10.7	153.1	153.4	153.8	2.5	2.9	3.4	-0.2	0.1	0.5	1.1	1.3	1.7	1 In 300	576094	7742799	6	0.9		PIPE	152.92	153.68					
232	85.33	84.53		0.207	5.6	7.2	8.4	148.2	148.4	148.5	2.3	2.5	2.6	0.2	0.3	0.4	0.9	1.1	1.2	1 In 300	576047	7742562	3	1.5	1.5	BOX	148.81	149.21		Yes	1	1	
233	85.56	84.76		0.062	2.0	2.6	3.0	145.6	145.8	146.0	2.5	2.7	2.8	-0.2	-0.1	0.0	1.0	1.2	1.4	1 in 300	576030	7742330	1	1.8	1.8	BOX	146.39	146.79					
234	85.71	84.91		0.010	0.6	0.7	0.8	147.8	148.0	148.1	2.1	2.3	2.5	0.0	0.0	0.1	0.8	0.9	1.0	1 in 300	576030	7742278	1	0.9		PIPE	147.93	148.63					
235	85.86	85.06		0.355	7.3	9.5	11.0	144.9	145.0	145.2	1.9	2.4	2.7	0.1	0.1	0.3	1.5	1.7	1.8	1 in 300	576048	7742034	2	1.5	1.5	BOX	144.89	145.34		Yes	1	1	
236	86.05	85.25		0.114	4.9	6.4	7.1	145.8	146.0	146.1	2.2	2.4	2.6	0.2	0.3	0.4	0.8	1.0	1.1	1 in 300	576083	7741842	3	1.5	1.5	BOX	146.50	146.90					
237	86.38	85.58		0.189	5.8	7.5	8.8	144.6	144.8	144.9	2.3	2.5	2.7	0.1	0.3	0.3	0.9	1.1	1.2	1 in 300	576160	7741525	3	1.5	1.5	BOX	145.16	145.56					
238	86.80	86.00		1.512	20.1	26.2	30.5	144.9	145.2	145.5	1.8	2.3	2.7	0.2	0.3	0.5	1.9	2.3	2.5	1 In 300	576258	7741119	5	1.5	1.5	BOX	144.48	145.53		Yes	2	2	
239	87.13	86.33		0.680	9.5	12.3	14.4	143.5	143.7	143.8	2.0	2.3	2.5	-0.2	-0.1	0.0	1.0	1.2	1.3	1 In 300	576337	7740794	4	1.5	1.5	BOX	143.95	144.35		Yes	1	1	
240	87.75	86.95		3.318	28.6	37.3	43.6	143.6	143.9	144.1	2.5	2.9	3.1	0.1	0.3	0.4	1.5	1.8	2.0	1 In 300	576483	7740192	7	1.5	1.5	BOX	143.61	144.21		Yes	1	1	
241	88.35	87.55		0.290	5.4	7.0	8.2	149.0	149.2	149.5	2.4	2.7	3.0	-0.5	-0.3	-0.1	1.0	1.2	1.5	1 In 300	576621	7739613	5	0.9		PIPE	148.87	149.57					
242	89.34	88.54		1.282	17.9	23.2	27.1	147.5	147.9	148.2	2.1	2.7	3.1	0.1	0.4	0.6	1.6	2.0	2.3	1 In 300	576626	7738629	15	1.2		PIPE	147.06	148.22		Yes	1	1	
243	89.99	89.19		0.131	3.9	5.1	5.9																				Left to Right	Alignment is in cutting, hence watercourse is diverted	Yes	1	1		
244	90.77	89.97		0.364	7.9	10.3	12.0	141.6	141.9	142.2	2.4	2.8	3.1	0.1	0.3	0.5	1.0	1.3	1.5	1 In 300	576519	7737202	7	0.9		PIPE	141.49	142.22					
245	90.82	90.02		0.164	4.5	5.8	6.8	141.4	141.7	142.0	2.4	2.8	3.0	0.1	0.3	0.5	1.0	1.3	1.5	1 In 300	576516	7737151	4	0.9		PIPE	141.30	142.02		Yes	1	1	
246	91.38	90.58		0.152	4.0	5.1	6.0	139.1	139.3	139.5	2.3	2.6	2.8	-0.4	-0.2	0.0	0.9	1.1	1.3	1 In 300	576474	7736592	4	0.9		PIPE	139.05	139.75					
247	91.54	90.73		0.157	4.5	5.8	6.8	138.6	138.8	138.9	2.3	2.6	2.8	-0.3	-0.2	-0.1	1.0	1.2	1.3	1 In 300	576462	7736437	3	1.2		PIPE	138.71	139.41					
248	95.74	94.93		0.838	11.9	15.5	18.1	125.5	125.7	125.8	2.3	2.5	2.7	0.4	0.5	0.6	1.0	1.2	1.3	1 In 300	574258	7733136	11	1.2		PIPE	125.66	126.36					
249	95.77	94.97		0.399	9.1	11.8	13.8	125.3	125.4	125.7	2.4	2.8	3.0	0.4	0.5	0.6	1.1	1.3	1.5	1 In 300	574231	7733113	7	1.2		PIPE	125.32	126.02					
250	98.24	97.43		0.144	4.4	5.8	6.7	111.4	111.5	111.6	2.0	2.2	2.3	0.4	0.5	0.6	0.7	0.9	0.9	1 In 300	572394	7731476	20	0.9		PIPE	111.53	112.23					
251	98.78	97.98	STRATHMORE CREEK	155.553	380.2	558.7	697.0	107.0	108.3	109.4	2.5	2.8	3.0	0.1	0.1	0.4					572012	7731074	2	20.2		BRIDGE	108.94	110.74		Yes	4	4	
252	99.23	98.43		0.223	6.0	7.8	9.1	107.2	107.4	107.6	2.3	2.6	2.8	0.1	0.3	0.5	0.9	1.1	1.4	1 in 300	571709	7730755	6	0.9		PIPE	107.11	107.81					
253	99.53	98.72		6.989	41.2	54.0	63.3	108.7	109.1	109.4	1.8	2.3	2.8	0.2	0.4	0.5	3.0	3.5	3.8	1 In 300	571506	7730542	4	2.4	2.4	BOX	108.04	109.39		Yes	2	2	
254	99.63	98.83		0.244	8.6	11.2	12.5	109.2	109.4	109.5	2.2	2.4	2.6	0.3	0.5	0.6	0.9	1.0	1.2	1 in 300	571430	7730462	10	0.9		PIPE	109.22	109.92					
255	100.12	99.31		2.382	20.8	27.2	31.8	107.5	107.8	108.1	1.5	2.0	2.3	0.3	0.3	0.5	1.7	2.0	2.2	1 in 300	571097	7730112	13	1.2		PIPE	106.99	108.13		Yes	1	1	
256	100.67	99.87		0.144	5.1	6.6	7.4	110.2	110.6	110.9	2.3	2.8	3.2	-0.3	0.0	0.3	1.1	1.5	1.9	1 in 300	570717	7729711	4	0.9		PIPE	109.93	110.90					
257	100.90	100.10		0.670	14.1	18.3	21.4	112.9	113.2	113.4	2.4	2.4	2.7	0.3	0.5	0.7	1.0	1.3	1.5	1 in 200	570556	7729543	13	0.9		PIPE	112.80	113.50		Yes	1	1	
258	103.29	102.48		0.090	2.5	3.2	3.8	108.0	108.1	108.2	1.9	1.9	1.9	0.3	0.3	0.3	0.7	0.8	0.9	1 In 300	569294	7727589	2	1.5	1.5	BOX	108.82	109.22					
259	103.33	102.53		1.298	19.2	24.9	29.1	108.4	108.7	108.9	2.3	2.7	3.0	0.3	0.4	0.6	1.4	1.7	1.9	1 In 300	569288	7727541	5	1.5	1.5	BOX	108.48	108.96					

Crossing No.	Chainage (km)		Watercourse Name	Catchment Area (sq. km)	Peak Flow for ARI (m³/sec)			PWL (m)			Velocity (m/sec)			Afflux (m)			Head Water Depth (m)			Culvert Slope	Co-ordinates		Structural Configuration			Type	Soffit Level (m)	Proposed Formation Level (m)	Flow Direction (In the direction of increasing chainage) (for diversions only)	Comments	Government Watercourse Mapping	Stream Order	Fisheries Data Layer
	Opt. 6 Rev. 2	Opt. 6 Rev. 3			20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs		Northing	Easting	No.	Dia/Span (m)	Height (m)								
260	103.87	103.07		24.295	89.4	117.6	138.2	104.6	105.1	105.4	1.7	2.2	2.6	0.2	0.3	0.4	3.8	4.2	4.5	1 in 300	569218	7727009	6	3.0	3.0	BOX	103.89	105.39			Yes	3	3
261	104.56	103.75		0.465	7.1	9.2	10.8	107.6	107.7	107.8	2.0	2.2	2.4	0.4	0.5	0.6	0.8	0.9	1.0	1 in 300	569129	7726329	10	0.9		PIPE	107.71	108.41					
262	104.86	104.06		0.881	12.4	16.1	18.8	107.7	107.8	107.9	2.0	2.2	2.3	0.4	0.5	0.6	0.8	0.9	1.0	1 in 300	569089	7726026	18	0.9		PIPE	107.83	108.53					
263	105.42	104.62		0.136	4.7	6.1	6.8	108.6	108.8	108.8	2.0	2.2	2.3	0.4	0.5	0.6	0.8	0.9	1.0	1 in 300	569018	7725474	7	0.9		PIPE	108.75	109.45					
264	106.05	105.24	PELICAN CREEK	563.735	1675.3	2136.0	2546.1	104.2	104.9	105.5	4.3	4.9	5.3	0.3	0.4	0.6					568937	7724852	8	20.2		BRIDGE	107.00	108.80			Yes	5	4
265	106.97	106.17		0.088	3.7	4.8	5.4	115.4	115.5	115.6	2.1	2.3	2.5	0.4	0.5	0.6	0.8	1.0	1.1	1 in 300	568819	7723953	5	0.9		PIPE	115.39	116.09					
266	107.06	106.26		0.324	7.5	9.7	11.3	112.5	112.7	117.9	2.4	2.7	2.9	0.1	0.3	0.3	1.0	1.2	1.4	1 in 200	568806	7723841	7	0.9		PIPE	112.37	113.07					
267	107.14	106.34		0.035	1.3	1.7	1.9	114.1	114.2	114.3	2.1	2.3	2.4	0.1	0.2	0.3	0.8	0.9	1.0	1 in 200	568796	7723768	2	0.9		PIPE	114.17	114.87					
268	107.20	106.40		0.032	1.4	1.8	2.0	116.1	116.2	116.3	2.2	2.4	2.5	0.2	0.3	0.4	0.8	1.0	1.1	1 in 200	568788	7723702	2	0.9		PIPE	116.13	116.83					
269	107.80	107.00		0.170	5.6	7.3	8.4	115.9	116.0	116.2	2.2	2.5	2.7	0.0	0.2	0.3	0.9	1.1	1.2	1 in 300	568721	7723113	6	0.9		PIPE	115.84	116.54					
270	107.86	107.05		0.969	18.6	24.2	28.2	115.5	115.8	116.0	2.3	2.6	2.9	-0.1	0.1	0.2	1.0	1.2	1.4	1 in 300	568719	7723055	18	0.9		PIPE	115.45	116.15		Yes	1	1	
271	108.61	107.80		0.179	5.4	7.0	8.2	124.8	125.1	125.3	2.4	2.7	3.0	0.2	0.4	0.6	1.0	1.3	1.5	1 in 300	568795	7722310	5	0.9		PIPE	124.67	125.38					
272	109.10	108.30		0.340	8.7	11.2	13.1	123.8	123.9	124.1	2.0	2.4	2.7	0.3	0.4	0.6	0.9	1.1	1.3	1 in 300	568943	7721841	9	0.9		PIPE	123.72	124.42		Yes	1	1	
273	109.43	108.63		0.118	4.3	5.6	6.3	126.4	126.6	126.9	2.4	2.8	3.1	0.3	0.5	0.8	1.0	1.3	1.6	1 in 300	569086	7721542	7	0.9		PIPE	126.20	126.93					
274	110.22	109.41		0.247	8.2	10.7	12.2	125.8	126.0	126.3	2.5	2.8	3.1	0.1	0.4	0.6	1.1	1.3	1.6	1 in 300	569549	7720909	7	0.9		PIPE	125.58	126.34					
275	110.39	109.58		0.279	8.0	10.3	12.1	124.2	124.5	124.7	2.3	2.6	2.9	0.0	0.1	0.3	1.0	1.3	1.6	1 in 300	569668	7720791	7	0.9		PIPE	124.05	124.77					
276	111.00	110.19		0.055	2.6	3.3	3.7	126.7	126.9	127.3	2.3	2.6	3.0	0.3	0.5	0.8	0.9	1.1	1.5	1 in 300	570119	7720381	3	0.9		PIPE	126.63	127.33					
277	111.21	110.41		1.645	13.0	17.0	19.9	124.9	125.2	125.4	1.8	2.4	2.8	0.0	0.2	0.4	1.8	2.1	2.4	1 in 300	570281	7720235	15	1.5		PIPE	124.53	125.48		Yes	1	1	
278	111.75	110.95		0.128	3.2	4.2	4.9	129.9	130.1	130.4	2.4	2.7	3.0	0.3	0.5	0.7	1.0	1.2	1.5	1 in 300	570677	7719878	3	0.9		PIPE	129.79	130.49					
279	111.90	111.10		0.115	4.3	5.7	6.3	131.5	131.8	132.0	2.4	2.7	3.0	-0.1	0.2	0.4	1.0	1.3	1.5	1 in 300	570790	7719776	4	0.9		PIPE	131.38	132.08					
280	112.30	111.50		0.026	1.2	1.6	1.8	136.1	136.2	136.3	1.8	1.9	2.0	0.3	0.4	0.4	0.6	0.7	0.8	1 in 300	571055	7719473	3	0.9		PIPE	136.37	137.07					
281	112.47	111.67		0.499	10.4	13.4	15.7	136.1	136.2	136.4	2.2	2.5	2.7	0.3	0.4	0.6	0.9	1.1	1.3	1 in 300	571147	7719333	11	0.9		PIPE	136.04	136.74					
282	112.72	111.92		0.021	1.1	1.4	1.6	138.56	138.7	138.8	2.0	2.2	2.3	-0.4	-0.3	-0.3	0.7	0.9	1.0	1 in 300	571265	7719109	2	0.9		PIPE	138.70	139.40					
283	112.84	112.04		0.235	5.9	7.7	9.0	139.0	139.3	139.6	2.4	2.8	3.2	-0.1	0.1	0.4	1.1	1.4	1.7	1 in 300	571319	7719001	5	0.9		PIPE	138.82	139.60					
284	112.94	112.14		0.260	5.8	7.5	8.8	140.4	140.7	140.9	2.5	2.8	3.1	0.0	0.2	0.4	1.0	1.3	1.6	1 in 300	571362	7718916	5	0.9		PIPE	140.21	140.97		Yes	1	1	
285	114.06	113.26		0.088	3.5	4.5	5.0	152.6	152.9	153.1	2.5	2.9	3.0	0.0	0.3	0.4	1.1	1.4	1.5	1 in 300	571837	7717968	3	0.9		PIPE	152.42	153.24					
286	114.79	113.99		0.726	15.5	20.1	23.4	140.8	141.1	141.3	2.5	2.8	3.0	-0.1	0.1	0.2	1.4	1.7	1.9	1 in 300	572197	7717264	4	1.5	1.5	BOX	140.89	141.38		Yes	1	1	
287	114.91	114.11		0.079	2.7	3.6	4.0	140.8	141.1	141.2	2.1	2.3	2.4	-0.3	-0.2	-0.1	0.7	0.9	0.9	1 in 300	572259	7717172	2	1.5	1.5	BOX	142.29	142.69					
288	115.04	114.24		0.020	1.0	1.4	1.5	144.2	144.4	144.6	2.2	2.5	2.8	-0.3	-0.2	0.0	0.9	1.1	1.3	1 in 300	572338	7717059	3	0.9		PIPE	144.21	144.91					
289	115.85	115.04		0.238	6.3	8.2	9.5	143.0	143.2	143.4	2.4	2.7	3.0	-0.5	-0.4	-0.1	1.0	1.2	1.5	1 in 200	572924	7716504	6	0.9		PIPE	142.84	143.54					
290	116.10	115.29		0.899	13.1	17.1	19.9	140.4	140.6	140.8	2.4	2.7	2.9	-0.1	0.0	0.1	1.1	1.3	1.5	1 in 300	573111	7716341	8	1.2		PIPE	140.48	141.18		Yes	1	1	
291	116.28	115.47		0.035	1.5	2.0	2.2	143.0	143.2	143.4	2.2	2.5	2.8	0.1	0.2	0.4	0.9	1.1	1.3	1 in 300	573246	7716223	3	0.9		PIPE	143.97	144.67					
292	116.88	116.08		2.054	27.1	35.2	41.1	138.2	138.6	138.9	1.6	2.1	2.5	-0.1	0.1	0.3	1.7	2.1	2.4	1 in 300	573703	7715826	16	1.2		PIPE	137.65	138.90		Yes	1	1	
293	117.52	116.72		0.323	8.2	10.6	12.4	144.0	144.3	144.6	2.5	2.7	3.5	-0.3	-0.1	0.2	1.1	1.4	1.7	1 in 300	574182	7715400	7	0.9		PIPE	143.83	144.62					
294	118.90	118.10																															
295	118.97	118.17		2.305	28.7	37.3	43.5	140.1	140.6	140.9	1.8	2.4	2.8	0.1	0.4	0.6	1.9	2.3	2.6	1 IN 300	575069	7714254	7.0	1.5	1.5	BOX	139.74	140.86					
296	119.79	118.98		0.025	1.0	1.3	1.5	133.8	133.9	134.0	1.8	1.9	2.0	0.1																			

Crossing No.	Chainage (km)		Watercourse Name	Catchment Area (sq. km)	Peak Flow for ARI (m³/sec)			PWL (m)			Velocity (m/sec)			Afflux (m)			Head Water Depth (m)			Culvert Slope	Co-ordinates		Structural Configuration			Type	Soffit Level (m)	Proposed Formation Level (m)	Flow Direction (In the direction of increasing chainage) (for diversions only)	Comments	Government Watercourse Mapping	Stream Order	Fisheries Data Layer																								
	Opt. 6 Rev. 2	Opt. 6 Rev. 3			20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs		Northing	Easting	No.	Dia/Span (m)	Height (m)																																
300	121.54	120.73		2.027	22.0	28.6	33.4	140.9	141.3	141.5	1.9	2.4	2.9	0.2	0.4	0.6	1.8	2.2	2.4	1 IN 300	576183	7711954	7	1.5		PIPE	140.54	141.55			Yes	1	1																								
301	121.70	120.90		0.836	10.3	13.4	15.6	140.9	141.2	141.5	2.4	2.9	3.6	0.3	0.5	0.7	1.3	1.6	1.9	1 IN 300	576251	7711799	5	1.2		PIPE	140.80	141.51			Yes	1	1																								
302	123.16	122.35		0.376	10.6	13.7	16.0																					Left to Right	Alignment is in cutting, hence watercourse is diverted	Yes	1	1																									
303	124.82	124.02		1.199	11.6	15.0	17.4	128.4	128.5	128.6	1.9	2.1	2.3	0.4	0.5	0.6	0.7	0.9	0.9	1 IN 300	578055	7709321	29	0.9		PIPE	128.57	129.27			YES	1	1																								
304	125.03	124.23		2.446	21.7	28.0	32.6	128.6	128.8	129.0	2.4	2.6	2.9	0.4	0.5	0.6	1.2	1.3	1.5	1 IN 300	578210	7709171	13	1.2		PIPE	128.65	129.35			YES	1	1																								
305	126.00	125.19		44.912	87.0	133.3	167.6	120.9	121.7	122.2	1.3	2.1	2.6	0.0	0.2	0.3	4.2	5.0	5.5	1 IN 300	578879	7708480	5	3.6	3.6	BOX	120.30	121.97			Yes	3	3																								
306	126.19	125.39		51.561	88.3	130.5	164.4	119.6	120.3	120.9	1.2	1.8	2.3	0.3	0.5	0.7	3.8	4.5	5.1	1 IN 300	579002	7708286	8.0	3.0	3.0	BOX	118.80	120.62																													
307	126.23	125.42	TWELVE MILE GULLY																																																				Yes	3	3
308	126.86	126.05																											2.727	10.8	14.1	16.4	129.6	129.7	129.9	2.1	2.4	2.6	0.4	0.5	0.6	0.8	1.0	1.1	1 IN 300	579257	7707708	13	0.9		PIPE	129.60	130.30				
309	128.82	128.01		5.663	24.4	31.7	37.0	130.1	130.3	130.4	2.0	2.3	2.4	0.4	0.5	0.6	0.8	0.9	1.0	1 IN 300	580001	7705897	33	0.9		PIPE	130.21	130.91																													
310	130.61	129.81		0.903	10.9	14.1	16.3	128.2	128.4	128.6	2.1	2.5	2.8	0.3	0.5	0.6	1.0	1.2	1.4	1 IN 300	580468	7704160	13	0.9		PIPE	128.09	128.79																													
			BOWEN RIVER					121.1	122.3	123.4	-	2.1	1.9	0.3	0.3	0.3	-	1.2	2.3	1 in 300	580750	7703102	15	1.5	1.5	BOX	124.07	124.47																													
311	132.20	131.40		5806.250	10205.	12561	14593	121.1	122.3	123.4	3.6	3.8	4.0	0.3	0.3	0.3	-	-	-		580876	7702630	20	20.2		BRIDGE	124.50	126.30			Yes	6	4																								
312	132.95	132.14		0.092	3.7	4.8	5.3	127.3	127.4	127.5	2.0	2.3	2.4	0.4	0.5	0.5	0.8	0.9	1.0	1 in 300	581071	7701906	5	0.9		pipe	127.40	128.10																													
313	133.24	132.44		0.040	1.6	2.1	2.3	129.5	129.6	129.8	2.1	2.3	2.4	0.4	0.5	0.5	0.8	1.0	1.0	1 in 300	581179	7701633	2	0.9		pipe	130.78	131.48																													
314	133.58	132.78		0.052	1.9	2.5	2.8	130.6	130.7	130.8	1.9	2.1	2.2	0.4	0.5	0.5	0.7	0.8	0.9	1 in 300	581347	7701335	3	0.9		pipe	130.78	131.48																													
315	137.06	136.25		0.117	6.2	8.1	9.1	156.0	156.2	156.3	2.2	2.4	2.6	0.3	0.5	0.6	0.9	1.0	1.1	1 IN 300	583125	7698354	7	0.9		pipe	156.01	156.71																													
316	137.83	137.02		0.082	4.4	5.8	6.5	157.1	157.4	157.5	2.4	2.8	3.0	0.2	0.4	0.6	1.0	1.3	1.5	1 in 300	583399	7697637	4	0.9		pipe	157.20	157.90																													
317	138.25	137.44		0.150	8.0	10.6	11.8	157.2	157.4	157.6	2.3	2.6	2.8	0.2	0.4	0.6	0.9	1.2	1.3	1 IN 300	583521	7697234	8	0.9		PIPE	157.13	157.83																													
318	139.20	138.40		0.056	2.3	3.1	3.4																					Left to Right	Alignment is in cutting, hence watercourse is diverted	Yes	1	1																									
319	139.96	139.15		0.238	5.0	6.5	7.5	156.1	156.3	156.5	2.3	2.6	2.8	0.1	0.2	0.4	0.9	1.2	1.4	1 IN 300	584017	7695598	5	0.9		PIPE	156.00	156.70																													
320	140.13	139.33		0.468	10.2	13.2	15.3	155.5	155.7	156.0	2.5	2.8	3.1	0.1	0.3	0.5	1.0	1.3	1.6	1 IN 300	584068	7695430	9	0.9		PIPE	155.30	156.03		Yes	1	1																									
321	140.68	139.88		0.086	2.6	3.5	4.0	158.0	158.2	158.4	2.2	2.5	2.6	0.4	0.5	0.6	0.9	1.0	1.2	1 in 300	584227	7694905	3	0.9		PIPE	158.17	158.87																													
322	140.74	139.93		0.230	4.5	5.8	6.7	158.1	158.4	158.6	0.4	2.8	3.0	0.2	0.4	0.6	1.0	1.3	1.5	1 in 300	584244	7694851	4	0.9		PIPE	158.15	158.85																													
323	140.95	140.14		0.096	2.1	2.7	3.1	159.1	159.3	159.5	2.3	2.6	2.9	-0.1	0.1	0.3	1.0	1.2	1.4	1 IN 300	584305	7694650	2	0.9		PIPE	159.00	159.70																													
324	141.06	140.26		0.096	1.9	2.5	2.9	159.9	160.1	160.3	2.2	2.5	2.8	0.3	0.5	0.6	0.9	1.1	1.3	1 IN 300	584338	7694538	2	0.9		PIPE	159.87	160.57																													
325	141.25	140.45		0.091	2.2	2.8	3.2	163.0	163.2	163.4	2.4	2.7	2.9	0.1	0.3	0.4	1.0	1.3	1.4	1 in 300	584393	7694359	2	0.9		PIPE	162.87	163.57																													
326	141.53	140.73		0.310	4.5	5.8	6.7	161.9	162.1	162.2	2.2	2.5	2.6	0.2	0.3	0.4	0.9	1.0	1.2	1 in 300	584475	7694087	5	0.9		PIPE	161.96	162.66		Yes	1	1																									
327	141.67	140.87		0.122	4.1	5.3	6.1	163.0	163.0	163.0	2.1	2.4	2.5	0.3	0.4	0.5	0.8	1.0	1.1	1 in 300	584516	7693954	5	0.9		PIPE	163.36	164.06																													
328	142.38	141.58		1.558	17.8	23.0	26.7	160.6	160.8	161.0	2.3	2.6	2.8	0.3	0.4	0.6	0.9	1.1	1.3	1 IN 300	584713	7693247	18	0.9		PIPE	160.55	161.25																													
329	142.41	141.60																																																				Yes	1	1	
330	142.79	141.99		2.130	17.4	22.5	26.1	161.8	162.2	162.5	2.1	2.7	3.1	-0.1	0.2	0.5	1.3	1.7	2.0	1 IN 300	584740	7692864	14	0.9		PIPE	161.35	162.49		Yes	1	1																									
331	143.66	142.85		1.208	9.0	11.6	13.5	166.0	166.4	166.7	2.5	2.8	3.2	0.2	0.4	0.7	1.1	1.5	1.8	1 IN 300	584537	7692031	7	0.9		PIPE	165.76	166.68		Yes	1	1																									
332	144.09	143.28		0.073	1.7	2.3	2.6	163.5	163.7	163.9	1.0	1.1	1.2	0.0	0.0	0.0	1.2	1.4	1.6	1 IN 300	584363	7691639	1	1.5	1.5	BOX	163.80	164.20																													
333	144.10	143.30		4.807	30.5	39.5	46.0	163.6	164.0	164.2	1.6	2.0	2.4	0.2	0.3	0.4	2.3	2.6	2.9	1 IN 300	584356	7691623	6	1.8	1.8	BOX	163.12	164.29		Yes	2	2																									
334	144.34	143.54		0.152	3.5	4.5	5.2	165.0	165.3	165.6	2.5	2.8	3.1	0.2	0.4	0.7	1.1	1.3	1.6	1 IN 300	584259	7691403	3	0.9		PIPE	164.86	165.60																													
335	144.93	144.13		0.748	8.8	11.3	13.2	169.4	169.6	169.7	1.2	1.6	1.8	0.3	0.5	0.6	1.2	1.4	1.5	1 IN 300	583968	7690935	12	0.9		PIPE	169.15	169.90		Yes	1	1																									

Crossing No.	Chainage (km)		Watercourse Name	Catchment Area (sq. km)	Peak Flow for ARI (m³/sec)			PWL (m)			Velocity (m/sec)			Afflux (m)			Head Water Depth (m)			Culvert Slope	Co-ordinates		Structural Configuration			Type	Soffit Level (m)	Proposed Formation Level (m)	Flow Direction (In the direction of increasing chainage) (for diversions only)	Comments	Government Watercourse Mapping	Stream Order	Fisheries Data Layer
	Opt. 6 Rev. 2	Opt. 6 Rev. 3			20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs		Northing	Easting	No.	Dia/Span (m)	Height (m)								
336	145.32	144.52		0.718	10.7	13.9	16.1	173.8	174.1	174.3	2.5	2.9	3.1	0.2	0.4	0.6	1.1	1.4	1.6	1 IN 300	583863	7690508	9	0.9		PIPE	173.70	174.40					
337	146.94	146.14		0.514	9.3	12.0	13.9	186.9	187.1	187.3	2.3	2.6	2.9	0.3	0.4	0.6	1.0	1.2	1.4	1 IN 300	583278	7689003	9	0.9		PIPE	186.79	187.49		Yes	1	1	
338	147.03	146.23		0.217	4.6	5.9	6.9	187.0	187.3	187.5	2.4	2.8	3.1	0.2	0.4	0.6	1.0	1.3	1.6	1 IN 300	583267	7688914	4	0.9		PIPE	186.80	187.55					
339	147.45	146.65		0.336	7.1	9.2	10.7	191.5	191.7	191.9	2.3	2.6	2.8	0.2	0.3	0.5	1.0	1.2	1.3	1 IN 300	583259	7688494	7	0.9		PIPE	191.42	192.12					
340	147.89	147.08		0.091	3.5	4.5	5.0	192.3	192.6	192.8	2.5	2.8	3.0	0.1	0.4	0.6	1.1	1.3	1.5	1 IN 300	583262	7688059	3	0.9		PIPE	192.16	192.89					
341	148.01	147.21	THREE MILE CREEK	1.211	13.1	17.0	19.7	190.0	190.5	190.8	2.1	2.7	3.1	0.0	0.4	0.6	1.4	1.8	2.2	1 IN 300	583260	7687935	6	1.2		PIPE	192.35	193.05		Yes	1	1	
342	148.81	148.00		5.651	37.2	48.1	56.0	190.8	191.0	191.2	1.9	2.4	2.7	0.2	0.4	0.6	1.3	1.6	1.8	1 IN 300	583269	7687139	17	1.2		PIPE	190.62	191.34		Yes	2	2	
343	148.89	148.09									1.9	2.4	2.7				1.6	1.9	2.1	1 IN 300	583270	7687053	2	1.2		PIPE	190.29	190.99					
344	149.07	148.27			0.202	4.0	5.2	6.0	192.6	193.1	193.3	2.2	2.5	2.7	0.3	0.4	0.6	0.6	1.1	1.2	1 IN 300	583271	7686893	8	0.9		PIPE	192.93	193.63				
345	150.72	149.91		0.008	0.4	0.6	0.6	210.4	210.6	210.7	2.2	2.5	2.7	0.2	0.3	0.4	0.9	1.1	1.2	1 IN 300	583284	7685251	4	0.9		PIPE	210.36	211.06					
346	150.83	150.02		0.046	1.7	2.3	2.5	204.0	204.2	204.3	2.5	2.8	2.9	0.1	0.2	0.2	2.2	2.4	2.5	1 IN 300	583285	7685120	1	1.8	1.8	BOX	204.65	205.05					
347	151.16	150.36		0.025	1.0	1.3	1.5	198.4	198.6	198.8	2.1	2.5	2.6	0.2	0.4	0.5	1.6	1.9	2.1	1 IN 300	583315	7684707	5	1.5	1.5	BOX	198.24	198.94					
348	151.24	150.44		2.230	20.4	26.3	30.6																										
349	152.37	151.57		1.192	14.0	18.1	21.0	214.6	214.8	215.0	2.2	2.6	2.9	0.2	0.3	0.4	1.3	1.6	1.7	1 IN 300	583482	7683589	4	1.5	1.5	BOX	214.71	215.11		Yes	1	1	
350	153.80	153.00		0.341	5.2	6.7	7.8	236.9	237.1	237.2	2.2	2.4	2.6	-0.3	-0.3	-0.2	0.9	1.0	1.2	1 IN 300	583694	7682171	6	0.9		PIPE	236.92	237.62		Yes	1	1	
351	154.08	153.28		0.038	1.5	1.9	2.1	236.5	236.6	236.7	2.0	2.2	2.3	-0.3	-0.2	-0.2	0.8	0.9	1.0	1 IN 300	583735	7681896	2	0.9		pipe	236.58	237.28					
352	160.31	159.51		0.481	6.4	8.3	9.6	292.6	292.9	293.1	1.8	2.3	2.6	-0.1	0.1	0.3	1.1	1.2	1.6	1 IN 300	583428	7676099	6.0	0.9		PIPE	292.36	293.16					
353	160.34	159.53																															
354	160.45	159.65		0.282	3.8	4.9	5.7	291.5	291.7	291.8	2.1	2.4	2.6	0.0	0.1	0.2	0.9	1.0	1.2	1 IN 300	583344	7676018	2	1.5	1.5	BOX	291.52	291.98		Yes	1	1	
355	160.51	159.71		0.057	1.2	1.5	1.8	296.8	296.9	296.9	1.9	2.0	2.2	0.2	0.3	0.4	0.7	0.8	0.9	1 IN 300	583299	7675974	2	0.9		PIPE	296.73	297.43					
356	160.58	159.78		0.146	3.7	4.8	5.6	296.5	296.6	296.8	2.2	2.5	2.7	0.3	0.5	0.7	0.9	1.1	1.2	1 IN 300	583248	7675925	4	0.9		PIPE	296.43	297.13					
357	161.32	160.52		0.432	7.2	9.3	10.8	304.7	304.9	305.1	2.3	2.6	2.9	0.0	0.2	0.3	1.0	1.2	1.3	1 IN 300	582720	7675415	7	0.9		PIPE	304.61	305.31		Yes	1	1	
358	161.58	160.78		0.275	6.1	7.9	9.2	304.9	305.1	305.3	2.3	2.6	3.4	0.3	0.5	0.7	1.0	1.2	1.4	1 IN 300	582533	7675234	6	0.9		PIPE	304.84	305.54					
359	162.04	161.24		0.095	4.5	6.0	6.7	314.4	314.6	314.7	2.2	2.5	2.6	0.0	0.1	0.2	0.9	1.1	1.2	1 IN 300	582201	7674913	5	0.9		PIPE	314.37	315.07					
360	162.48	161.68		0.017	0.8	1.1	1.2	316.9	317.1	317.2	2.1	2.4	2.5	0.0	0.2	0.2	0.8	1.0	1.0	1 IN 300	581930	7674571	1	0.9		PIPE	317.01	317.71					
361	162.49	161.69		0.071	2.5	3.2	3.8	317.4	317.6	317.8	2.3	2.5	2.8	-0.1	0.0	0.1	0.9	1.1	1.3	1 IN 300	581923	7674561	4	0.9		PIPE	317.38	318.08		Yes	1	1	
362	163.06	162.26		0.130	4.5	5.9	6.9	314.6	314.8	314.9	2.5	2.7	2.8	-0.5	-0.4	-0.3	1.0	1.2	1.3	1 IN 300	581651	7674060	2	1.5	1.5	BOX	315.11	315.51					
363	163.28	162.47		0.024	1.0	1.3	1.5	314.0	314.2	314.3	2.4	2.5	2.7	-0.4	-0.4	-0.3	1.1	1.3	1.4	1 in 300	581549	7673869	1	1.5	1.5	BOX	314.44	314.84					
364	163.49	162.68		0.025	1.1	1.4	1.6	325.7	325.8	325.9	1.8	2.0	2.1	0.0	0.1	0.2	0.7	0.7	0.9	1 in 300	581450	7673683	2	0.9		PIPE	325.93	326.63					
365	163.62	162.82		0.023	1.0	1.4	1.6	319.8	320.0	320.0	1.9	2.1	2.2	-0.5	-0.3	-0.3	0.6	0.7	0.8	1 in 300	581388	7673567	1	1.5	1.5	BOX	321.17	321.57					
366	163.75	162.95		0.707	12.6	16.3	18.9	313.8	314.0	314.2	2.0	2.4	2.6	-0.1	-0.1	0.0	1.4	1.6	1.8	1 IN 300	581306	7673413	4	1.5	1.5	BOX	313.88	314.32					
367	163.80	162.99		0.030	1.1	1.4	1.7																					Left to Right		Yes	1	1	
368	165.50	164.70		0.170	4.6	6.0	7.0	329.3	329.6	329.7	2.2	2.3	2.4	-0.2	-0.1	-0.1	1.3	1.6	1.7	1 IN 300	580570	7671875	4	1.5	1.5	BOX	329.45	329.85		Yes	1	1	
369	165.93	165.13		0.042	1.6	2.1	2.4	333.6	333.8	333.9	2.4	2.7	2.9	-0.3	0.0	0.1	1.1	1.3	1.4	1 IN 300	580441	7671468	1	1.2		PIPE	333.55	334.25					
370	165.95	165.15						333.0	333.3	333.5	2.4	2.8	3.2	-0.5	-0.2	0.0	1.0	1.3	1.6	1 IN 300	580434	7671447	1	0.9		PIPE	332.88	333.62					
371	166.51	165.71		0.523	7.6	9.8	11.4	318.1	318.3	318.4	2.5	2.8	2.9	-0.1	0.0	0.1	1.1	1.3	1.4	1 IN 300	580265	7670912	3	1.5	1.5	BOX	318.48	318.88		Yes	1	1	
372	166.84	166.03		0.763	9.7	12.5	14.5	319.0	319.2	319.2	2.5	2.7	2.7	0.0	0.1	0.1	1.1	1.2	1.2	1 IN 300	580168	7670603	2	1.5	1.5	BOX	319.43	319.83					
373	166.86	166.06						319.0	319.2	319.2	2.5	2.7	2.7	-0.3	-0.2	-0.2	1.0	1.2	1.2	1 IN 300	580161	7670584	2	1.5	1.5	BOX	319.44	319.84			Yes	1	1
374	167.33	166.53		0.450	5.9	7.7	8.9	320.2	320.4	320.5	2.3	2.7	2.8	-0.5	-0.4	-0.4	1.0	1.2	1.4	1 IN 300	580008	7670133	2	1.8	1.8	BOX	320.92	321.32					
375	167.45	166.64		0.332	4.6	5.9	6.8	322.7	322.9	323.0	2.5	2.7	2.8	0.4	0.5	0.6	1.0	1.2	1.3	1 IN 300	579961	7670031	2	1.5	1.5	BOX	323.20	323.60		Yes	1	1	

Crossing No.	Chainage (km)		Watercourse Name	Catchment Area (sq. km)	Peak Flow for ARI (m³/sec)			PWL (m)			Velocity (m/sec)			Afflux (m)			Head Water Depth (m)			Culvert Slope	Co-ordinates		Structural Configuration			Type	Soffit Level (m)	Proposed Formation Level (m)	Flow Direction (In the direction of increasing chainage) (for diversions only)	Comments	Government Watercourse Mapping	Stream Order	Fisheries Data Layer		
	Opt. 6 Rev. 2	Opt. 6 Rev. 3			20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs		Northing	Easting	No.	Dia/Span (m)	Height (m)										
376	167.75	166.95		0.179	2.8	3.6	4.2	324.6	324.8	324.9	2.2	2.5	2.7	0.0	0.1	0.3	0.9	1.1	1.2	1 IN 300	579792	7669744	3	0.9		PIPE	324.58	325.28							
377	167.78	166.98																																	
378	167.79	166.98																																	
379	168.06	167.26		0.659	12.0	15.5	18.0	327.5	327.7	328.0	2.4	2.7	3.3	0.2	0.4	0.6	1.0	1.3	1.5	1 IN 300	579565	7669490	11	0.9		PIPE	327.36	328.06			Yes	1	1		
380	168.12	167.32																																	
381	168.17	167.36																																	
382	170.09	169.29		16.909	64.1	83.4	97.5	321.7	321.9	322.1	2.0	2.4	2.6	0.2	0.3	0.3	1.4	1.6	1.8	1 IN 300	578148	7668175	18	1.5	1.5	BOX	321.80	322.23			Yes	1	2		
383	171.90	171.10		0.050	1.8	2.4	2.7	315.7	315.8	315.8	1.9	2.1	2.2	0.3	0.3	0.4	0.7	0.8	0.9	1 IN 300	576792	7666916	3	0.9		PIPE	315.84	316.54							
384	172.06	171.26	UPPER SUTTOR RIVER	296.418	403.0	543.0	666.1	317.4	318.0	319.1	2.3	2.8	3.2	0.0	0.0	0.7	-	-	-	-	576680	7666811	2	20.2		BRIDGE	318.59	320.39			Yes	4	4		
385	173.34	172.53		0.943	14.7	18.9	21.9	315.4	315.6	315.8	1.9	2.3	2.6	0.0	0.1	0.3	1.0	1.2	1.4	1 IN 300	575992	7665754	14	0.9		PIPE	315.27	315.97							
386	174.01	173.21		0.356	8.1	10.5	12.2	320.0	320.3	320.5	2.4	2.8	3.1	0.2	0.4	0.6	1.0	1.4	1.6	1 IN 300	575775	7665117	7	0.9		PIPE	319.86	320.63							
387	174.50	173.69		0.498	8.1	10.5	12.2	322.6	322.8	322.9	2.2	2.5	2.7	0.3	0.4	0.5	0.9	1.1	1.2	1 IN 300	575618	7664657	9	0.9		PIPE	322.60	323.30							
388	174.99	174.19		0.220	5.6	7.3	8.5	319.4	319.6	319.8	2.1	2.4	2.7	0.3	0.4	0.6	0.9	1.1	1.3	1 IN 300	575459	7664191	6	0.9		PIPE	319.41	320.11							
389	175.12	174.32		12.346	58.9	76.5	89.3	320.1	320.4	320.7	1.9	2.4	2.8	0.3	0.5	0.7	1.4	1.7	2.0	1 IN 300	575417	7664067	30	1.2		PIPE	319.86	320.72			Yes	3	3		
390	173.54	172.74		0.260	6.1	7.9	9.2	320.7	320.9	321.0	2.2	2.4	2.6	0.4	0.5	0.6	0.9	1.0	1.2	1 IN 300	575281	7663669	7	0.9		PIPE	320.75	321.45							
391	175.83	175.03		0.131	4.0	5.2	6.1	323.6	323.8	323.9	2.1	2.3	2.5	0.2	0.4	0.5	0.8	1.0	1.1	1 IN 300	575206	7663386	5	0.9		PIPE	323.66	324.36			Yes	1	1		
392	176.55	175.75	LILY CREEK	40.119	84.3	126.1	157.1	323.7	324.3	324.8	1.5	2.2	2.7	0.1	0.3	0.5	1.7	2.3	2.7	1 IN 300	575082	7662676	4	1.5		PIPE	323.49	324.59							
393	176.58	175.78									1.5	2.2	2.7				2.1	2.7	3.2	1 IN 300	575078	7662650	15	1.8	1.8	BOX	323.39	323.79			Yes	3	3		
394	177.24	176.43		0.079	3.3	4.3	4.7	324.3	324.4	324.5	1.8	2.0	2.1	0.4	0.5	0.5	0.7	0.8	0.8	1 IN 300	574965	7662004	6	0.9		PIPE	324.55	325.25							
395	177.96	177.15		7.073	41.2	53.3	62.1	326.1	326.2	326.3	2.3	2.5	2.6	0.4	0.5	0.6	1.0	1.1	1.3	1 IN 300	574841	7661295	39	1.2		PIPE	326.25	326.95			Yes	2	2		
396	178.85	178.05		0.482	10.8	14.0	16.3	335.7	336.0	336.1	2.4	2.6	2.8	0.0	0.1	0.2	1.1	1.3	1.4	1 IN 300	574687	7660411	7	1.2		PIPE	335.88	336.58			Yes	1	1		
397	182.09	181.28		0.667	12.1	15.7	18.2	346.9	347.2	347.5	2.5	2.9	3.2	0.2	0.4	0.7	1.1	1.4	1.7	1 IN 300	574418	7657192	10	0.9		PIPE	346.68	347.49							
398	183.06	182.25		0.246	4.6	5.9	6.8	341.0	341.2	341.9	2.3	2.5	2.7	-0.6	-0.5	-0.4	0.9	1.1	1.2	1 in 200	574493	7656232	5	0.9		PIPE	340.97	341.67							
399	183.54	182.74		0.521	9.4	12.1	14.0	328.7	328.9	329.1	2.4	2.6	2.8	-0.3	-0.2	-0.2	1.1	1.3	1.4	1 IN 300	574633	7655770	6	1.2		PIPE	328.88	329.58			Yes	1	1		
400	183.59	182.79		0.685	11.8	15.2	17.6	329.0	329.2	329.3	2.3	2.4	2.6	-0.2	-0.1	-0.1	1.1	1.3	1.5	1 IN 300	574648	7655721	7	1.2		PIPE	329.01	329.71			Yes	1	1		
401	184.22	183.41		0.195	6.4	8.4	9.3	328.6	328.8	329.0	2.4	2.7	2.9	-0.3	-0.2	-0.2	1.0	1.2	1.4	1 IN 300	574830	7655121	6	0.9		PIPE	328.46	329.16							
402	184.56	183.75		1.495	19.4	25.0	29.0	320.3	320.5	320.7	2.2	2.5	2.7	0.1	0.2	0.4	1.5	1.7	1.9	1 IN 300	574929	7654795	5	1.5	1.5	BOX	320.28	320.80			Yes	1	1		
403	185.75	184.95		1.043	15.5	19.9	23.0	319.0	319.4	319.7	1.9	2.3	2.7	0.2	0.4	0.7	1.0	1.4	1.7	1 IN 300	575195	7653638	11	0.9		PIPE	320.66	321.36			Yes	1	1		
404	187.00	186.19	ROCKINGHAM CREEK	138.482	197.2	301.4	378.2	308.8	309.2	309.5	2.7	3.5	4.5	0.1	0.1	0.2	2.7	3.1	3.4		575206	7652348	1	20.2		BRIDGE	309.70	311.50			Yes	4	4		
405	187.04	186.24						308.8	309.2	309.5	2.2	3.2	3.9	0.1	0.1	0.2	3.2	3.6	3.9		575206	7652390	1	20.2		BRIDGE	309.70	311.50							
406	187.38	186.58						309.7	309.9	310.1	2.4	2.6	2.7	0.1	0.2	0.3	0.9	1.1	1.2	1 IN 300	575209	7652006	3	1.5	1.5	BOX	310.33	310.73							
407	188.10	187.30		14.603	59.4	76.7	89.3	314.1	314.4	314.6	1.5	1.8	2.1	0.0	0.0	0.3	1.5	1.9	2.1	1 IN 300	575292	7651222	4	1.5	1.5	BOX	314.02	314.69			Yes	2	2		
408	188.17	187.37		1.361	12.5	16.0	18.5	314.3	314.6	315.0	2.0	2.3	2.7	0.1	0.3	0.4	1.7	2.1	2.4	1 IN 300	575272	7651294	14	1.8	1.8	BOX	314.29	314.94			Yes	1	1		
409	189.16	188.36		0.938	16.3	20.9	24.2	317.8	318.2	318.5	2.3	2.6	3.0	-0.6	-0.3	-0.1	1.3	1.7	2.0	1 IN 300	575791	7650377	9	1.2		PIPE	317.66	318.49			Yes	1	1		
410	190.89	190.09		3.637	28.4	36.4	42.1	309.2	309.6	310.0	2.3	2.7	3.1	0.3	0.5	0.8	1.8	2.2	2.6	1 IN 300	577122	7649278	6	1.5	1.5	BOX	308.88	309.92			Yes	2	2		
411	191.06	190.26		1.638	13.3	17.1	19.8	308.5	308.7	308.8	2.4	2.6	2.8	0.0	0.1	0.2	1.1	1.3	1.5	1 IN 300	577255	7649177	5	1.5	1.5	BOX	308.83	309.23			Yes	1	1		
412	191.23	190.42		0.219	5.5	7.1	8.2	308.7	309.0	309.2	2.3	2.7	3.0	0.2	0.4	0.5	1.0	1.3	1.5	1 IN 300	577427	7649046	5	0.9		PIPE	308.57	309.27							
413	191.28	190.47																																	
414	191.85	191.05		0.132	5.4	7.0	7.8	315.2	315.5	315.6	2.2	2.5	2.8	-0.1	0.0	0.1	1.0	1.2	1.4	1 IN 300	577883	7648693	5	0.9		PIPE	315.12	315.82							

Crossing No.	Chainage (km)		Watercourse Name	Catchment Area (sq. km)	Peak Flow for ARI (m³/sec)			PWL (m)			Velocity (m/sec)			Afflux (m)			Head Water Depth (m)			Culvert Slope	Co-ordinates		Structural Configuration			Type	Soffit Level (m)	Proposed Formation Level (m)	Flow Direction (In the direction of increasing chainage) (for diversions only)	Comments	Government Watercourse Mapping	Stream Order	Fisheries Data Layer
	Opt. 6 Rev. 2	Opt. 6 Rev. 3			20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs		Northing	Easting	No.	Dia/Span (m)	Height (m)								
415	192.41	191.60		1.526	17.1	21.9	25.3	311.5	311.9	312.2	2.2	2.5	2.6	0.0	0.4	0.6	1.4	1.8	2.1	1 IN 300	578246	7648279	7	1.2		PIPE	310.25	312.19					
416	192.47	191.66																		1 IN 300	578278	7648228	5	0.9		PIPE	311.97	312.67			Yes	1	1
417	193.35	192.55																		1 IN 300	578562	7647397	10	0.9		PIPE	313.46	314.16			Yes	1	1
418	194.12	193.32		1.174	15.7	20.0	23.1	311.9	312.0	312.1	2.0	2.2	2.3	0.3	0.4	0.4	0.8	0.9	1.0	1 IN 300	578542	7646630	22	0.9		PIPE	312.19	312.89					
419	195.18	194.38		1.091	12.1	15.4	17.8	308.2	308.3	308.3	1.9	2.0	2.1	0.4	0.5	0.6	0.7	0.8	0.9	1 IN 300	578471	7645568	21	0.9		PIPE	308.34	309.04					
420	195.90	195.09		19.500	63.3	82.1	95.9	298.4	298.8	299.2	1.8	2.3	2.7	0.2	0.4	0.5	2.3	2.7	3.1	1 IN 300	578423	7644857	11	1.8	1.8	BOX	297.92	299.14		Yes	3	3	
421	196.45	195.64		0.311	6.5	8.3	9.6	300.6	300.8	301.0	2.4	2.7	2.9	0.1	0.3	0.5	1.0	1.2	1.4	1 IN 300	578386	7644308	6	0.9		PIPE	300.47	301.17					
422	196.76	195.95		11.852	53.8	69.5	80.8	295.9	296.1	296.4	2.0	2.4	2.8	-0.1	0.0	0.2	1.9	2.1	2.4	1 IN 300	578366	7643998	9	1.8	1.8	BOX	295.80	296.41		Yes	3	3	
423	197.95	197.15		0.126	4.3	5.6	6.3	308.1	308.4	308.5	2.4	2.7	2.9	0.3	0.4	0.6	1.0	1.3	1.4	1 IN 300	578169	7642829	4	0.9		PIPE	307.98	308.68					
424	197.97	197.17		0.335	5.8	7.4	8.5	307.9	308.1	308.3	2.4	2.7	3.0	-0.1	0.1	0.2	1.0	1.3	1.4	1 IN 300	578162	7642809	10	0.9		PIPE	307.72	308.42		Yes	1	1	
425	199.32	198.52		2.161	21.7	27.8	32.1	305.0	305.1	305.3	2.5	2.7	3.0	0.1	0.1	0.2	1.2	1.3	1.5	1 IN 300	577702	7641541	13	1.2		PIPE	304.96	305.66		Yes	1	1	
426	199.72	198.91		0.091	3.3	4.3	4.8	297.2	297.5	297.6	2.4	2.7	2.9	0.0	0.2	0.3	1.0	1.3	1.4	1 IN 300	577566	7641168	3	0.9		PIPE	297.08	297.78					
427	200.00	199.20		0.165	4.0	5.2	6.0	292.3	292.4	292.5	2.1	2.2	2.4	0.3	0.4	0.5	0.7	0.9	0.9	1 IN 300	577468	7640898	3	1.5	1.5	BOX	293.04	293.44		Yes	1	1	
428	200.18	199.38		0.111	2.8	3.6	4.1	297.6	297.8	297.9	1.7	2.0	2.2	0.4	0.5	0.6	0.7	0.8	0.9	1 IN 300	577407	7640729	2	1.5	1.5	BOX	293.44	298.08					
429	200.35	199.54		0.195	3.9	5.0	5.8	297.8	297.9	298.0	2.3	2.5	2.7	-0.5	-0.4	-0.3	1.0	1.1	1.2	1 IN 300	577351	7640575	2	1.5	1.5	BOX	297.93	298.33					
430	200.88	200.08		0.118	2.9	3.7	4.2	299.3	299.4	299.6	2.2	2.5	2.7	0.3	0.4	0.6	0.9	1.1	1.3	1 IN 300	577171	7640076	3	0.9		PIPE	299.24	299.94					
431	201.34	200.54		8.139	49.5	63.5	73.6	289.6	290.0	290.4	1.8	2.3	2.6	-0.1	0.1	0.3	2.0	2.4	2.8	1 IN 300	577013	7639641	9	1.8	1.8	BOX	289.39	290.27		Yes	3	3	
432	201.88	201.08		1.182	13.1	16.8	19.3	296.2	296.4	296.5	2.4	2.7	2.9	0.1	0.2	0.3	1.1	1.3	1.4	1 IN 300	576827	7639130	8	1.2		PIPE	295.97	296.67		Yes	1	1	
433	202.00	201.20		0.019	1.0	1.3	1.4	296.9	297.0	297.0	1.8	1.9	2.0	0.1	0.2	0.2	0.6	0.7	0.8	1 IN 300	576788	7639023	2	0.9		PIPE	297.14	297.84					
434	202.27	201.47		0.088	3.0	3.8	4.4	295.5	295.7	295.9	2.3	2.6	2.8	-0.2	0.0	0.1	0.9	1.1	1.3	1 IN 300	576681	7638772	3	0.9		PIPE	295.47	296.17					
435	202.37	201.57		0.568	8.2	10.5	12.1	295.1	295.3	295.5	2.3	2.6	2.8	0.3	0.4	0.6	1.0	1.2	1.4	1 IN 300	576632	7638683	8	0.9		PIPE	295.00	295.70		Yes	1	1	
436	203.51	202.70		1.534	17.1	21.9	25.3	290.4	290.8	291.0	2.3	2.8	3.0	0.0	0.3	0.5	1.4	1.8	2.0	1 IN 300	575882	7637835	10	1.2		PIPE	290.20	291.12		Yes	1	1	
437	205.82	205.02		3.375	28.2	36.1	41.7	275.3	275.5	275.6	2.5	2.8	3.0	0.1	0.3	0.3	1.2	1.4	1.5	1 IN 300	574245	7636199	10	1.5	1.5	BOX	275.60	276.00			Yes	2	2
438	205.92	205.12																															
439	206.46	205.66	MURRAY CREEK	100.372	205.7	311.3	390.1	274.0	274.4	274.7	2.8	3.5	4.1	0.2	0.2	0.2	2.5	2.9	3.2	-	573758	7635712	3.0	20.2		BRIDGE	274.90	276.70					
440	206.51	205.71																												Yes	4	4	
441	206.53	205.72																															
442	208.02	207.21																															
443	208.22	207.42																															
444	208.33	207.53		8.647	46.4	59.7	69.2	275.7	276.1	276.4	1.9	2.4	2.8	0.1	0.3	0.5	1.6	2.0	2.3	1 IN 300	572582	7634304	15	1.5		PIPE	275.56	276.38					
445	208.36	207.56																											Yes	3	3		
446	208.58	207.78		10.805	58.1	74.8	86.7	276.7	276.9	277.1	2.0	2.4	2.7	0.1	0.2	0.3	1.2	1.4	1.6	1 IN 300	572445	7634121	23	1.5		PIPE	276.99	277.69		Yes	3	3	
447	208.98	208.18		0.909	9.9	12.6	14.6	280.1	280.3	280.5	2.4	2.7	2.9	0.2	0.4	0.6	1.0	1.3	1.4	1 IN 300	572181	7633768	9	0.9		PIPE	279.97	280.67					
448	209.02	208.22																											Yes	1	1		
449	209.80	208.99		0.789	8.6	11.0	12.7	286.4	286.7	286.9	2.2	2.6	2.8	0.2	0.4	0.5	1.0	1.2	1.4	1 IN 300	571716	7633146	8	0.9		PIPE	286.32	287.02		Yes	1	1	
450	210.13	209.33		0.272	5.1	6.5	7.6	291.1	291.2	291.4	2.3	2.6	2.8	0.1	0.3	0.4	1.0	1.2	1.3	1 IN 300	571412	7632739	5	0.9		PIPE	290.97	291.67					
451	210.30	209.50																															
452	210.38	209.58		0.311	5.8	7.4	8.6	290.6	290.9	291.2	2.5	2.8	3.4	0.1	0.4	0.6	1.1	1.3	1.6	1 IN 300	571326	7632625	5	0.9		PIPE	290.45	291.21					
453	210.45	209.65																											Yes	1	1		
454	210.68	209.88		0.179	3.4	4.4	5.1	293.1	293.4	293.6	2.4	2.8	3.0	0.1	0.3	0.5	1.0	1.3	1.5	1 IN 300	571186	7632437	3	0.9		PIPE	292.97	293.70					
455	211.26	210.46		0.146	3.7	4.8	5.6	300.5	300.7	300.8	2.2	2.5	2.7	0.2	0.4	0.5	0.9	1.1	1.2	1 IN 300	570838	7631973	4	0.9		PIPE	300.47	301.17					

Crossing No.	Chainage (km)		Watercourse Name	Catchment Area (sq. km)	Peak Flow for ARI (m³/sec)			PWL (m)			Velocity (m/sec)			Afflux (m)			Head Water Depth (m)			Culvert Slope	Co-ordinates		Structural Configuration			Type	Soffit Level (m)	Proposed Formation Level (m)	Flow Direction (In the direction of increasing chainage) (for diversions only)	Comments	Government Watercourse Mapping	Stream Order	Fisheries Data Layer																										
	Opt. 6 Rev. 2	Opt. 6 Rev. 3			20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs		Northing	Easting	No.	Dia/Span (m)	Height (m)																																		
456	211.29	210.49		0.264	6.8	8.7	10.1	300.3	300.5	300.7	2.3	2.5	2.7	0.3	0.4	0.6	0.9	1.1	1.6	1 IN 300	570820	7631952	7	0.9		PIPE	300.28	300.98																															
457	211.34	210.54																																																									
458	211.93	211.13		0.458	6.9	8.8	10.2	300.6	300.9	301.1	2.4	2.8	3.0	0.1	0.4	0.5	1.0	1.3	1.5	1 IN 300	570385	7631476	6	0.9		PIPE	300.47	301.20			Yes	1	1																										
459	212.19	211.38																																																									
460	213.04	212.23	0.488		9.4	12.0	13.9	306.1	306.4	306.7	2.5	2.8	3.1	0.3	0.5	0.7	1.1	1.3	1.6	1 IN 300	569635	7630668	10	0.9		PIPE	305.97	306.71			Yes	1	1																										
461	213.11	212.31		0.082	2.1	2.7	3.1	306.6	306.8	307.0	2.3	2.6	2.9	0.3	0.5	0.6	1.0	1.2	1.4	1 IN 300	569584	7630613	2	0.9		PIPE	306.47	307.17																															
462	213.95	213.15		0.155	3.9	5.0	5.8	302.3	302.5	302.8	2.4	2.7	3.0	-0.5	-0.4	-0.3	1.0	1.2	1.6	1 IN 300	569013	7629997	8	0.9		PIPE	303.16	303.86																															
463	214.80	213.99		2.691	28.6	36.6	42.3	293.7	293.9	294.1	2.4	2.8	3.0	0.0	0.3	0.4	1.2	1.4	1.6	1 IN 300	568392	7629431	16	1.2		PIPE	293.69	294.39			Yes	2	2																										
464	215.54	214.73		0.696	12.2	15.6	18.0	294.2	294.4	294.5	2.4	2.5	2.5	-0.3	-0.2	-0.2	1.1	1.3	1.4	1 IN 300	567712	7629146	6	1.5		PIPE	294.55	295.25			Yes	1	1																										
465	216.05	215.24		0.272	5.9	7.6	8.8	295.0	295.3	295.6	2.5	2.9	3.5	0.0	0.2	0.5	1.1	1.4	1.7	1 IN 300	567223	7628997	5	0.9		PIPE	294.81	295.60			Yes	1	1																										
466	217.07	216.27		1.716	19.9	25.4	29.4																																																				
467	217.08	216.28																																																									
468	217.12	216.31																																																									
469	217.16	216.35																																																									
470	218.34	217.54		0.585	11.3	14.5	16.8	284.6	284.8	285.0	2.4	2.8	3.0	-0.3	-0.1	0.2	1.0	1.3	1.5	1 IN 300	564932	7628299	10	0.9		PIPE	284.41	285.13			Yes	1	1																										
471	218.44	217.64																																																									
472	220.57	219.76																																																									
473	220.86	220.06	GUNN CREEK	39.086	53.1	84.1	107.6	265.7	266.4	267.0	1.5	2.4	3.1	0.1	0.3	0.6	2.6	3.4	4.0	1 IN 300	562876	7627087	6	2.4	2.4	BOX	265.47	266.73			Yes	4	4																										
474	221.44	220.64		0.637	9.0	11.5	13.2	267.6	267.7	267.8	1.9	2.1	2.2	0.4	0.5	0.5	0.7	0.8	0.9	1 IN 300	562397	7626738	15	0.9		PIPE	267.77	268.47																															
475	225.12	224.32		10.763	41.9	54.2	63.0	254.4	254.7	255.0	2.0	2.5	2.9	0.2	0.4	0.6	1.3	1.6	1.9	1 IN 300	559427	7624572	21	1.2		PIPE	254.25	255.01			Yes	1	1																										
476	225.99	225.19		0.616	6.0	7.7	8.9	253.1	253.2	253.3	2.0	2.2	2.3	0.4	0.5	0.5	0.8	0.9	0.9	1 IN 300	558723	7624059	8	0.9		PIPE	253.22	253.92																															
477	226.47	225.67		1.374	14.7	18.8	21.7	251.7	251.9	252.0	2.2	2.4	2.5	0.4	0.5	0.6	0.9	1.0	1.1	1 IN 300	558337	7623778	15	0.9		PIPE	251.75	252.45																															
478	230.33	229.52	GUNN CREEK	115.396	33.5	50.0	63.0	240.6	241.0	241.4	1.9	2.4	2.8	0.1	0.3	0.6	1.1	1.5	1.9	1 in 300	555220	7621505	20.0	1.2		PIPE	240.66	241.36			Yes	1	2																										
479	230.45	229.64																																																									
480	230.65	229.85																																																									
481	231.20	230.40																																																									
482	231.16	230.35																												99.9	157.3	201.5	239.6	240.2	240.5	1.5	2.4	2.8	0.1	0.4	0.5	2.4	3.0	3.3	1 IN 300	554550	7621016	13	2.1	2.1	BOX	239.32	239.72			Yes	4	4	
483	231.93	231.12		1.808	19.2	24.5	28.3	241.3	241.5	241.7	2.3	2.5	2.7	0.4	0.5	0.6	0.9	1.1	1.3	1 IN 300	553927	7620562	25	0.9		PIPE	241.27	241.97																															
484	235.48	234.68		3.045	24.2	31.1	35.9	242.0	242.2	242.3	2.1	2.3	2.4	0.4	0.5	0.6	0.8	0.9	1.0	1 IN 300	551055	7618468	31	0.9		PIPE	242.08	242.78																															
485	238.22	237.41		3.718	33.7	43.1	49.8	229.3	229.5	229.6	2.2	2.5	2.6	0.4	0.5	0.6	0.9	1.0	1.2	1 IN 300	548790	7616937	37	0.9		PIPE	229.25	229.95																															
486	239.78	238.97		0.818	14.3	18.3	21.2	234.0	234.2	234.4	2.3	2.6	2.8	0.3	0.4	0.6	1.0	1.2	1.3	1 IN 300	547445	7616147	14	0.9		PIPE	233.94	234.64																															
487	242.53	241.73	VERBENA CREEK	399.254	337.0	526.0	667.1	222.1	222.6	223.0	2.5	3.5	4.2	0.1	0.1	0.2	3.0	3.6	3.9	-	545025	7614845	3	20.2		BRIDGE	223.22	225.02			Yes	5	4																										
488	243.78	242.97		0.834	7.7	9.8	11.3	221.2	221.3	221.3	1.8	1.9	2.1	0.4	0.5	0.5	0.6	0.7	0.8	1 IN 300	543841	7614463	15	0.9		PIPE	221.39	222.09																															
489	244.21	243.41		0.078	2.2	2.8	3.3	221.0	221.1	221.1	1.5	1.7	1.7	0.4	0.5	0.5	0.5	0.6	0.6	1 IN 300	543426	7614329	7	0.9		PIPE	221.38	222.08																															
490	244.43	243.62	SERPENTINE CREEK	101.916	109.0	171.3	217.5	222.9	223.7	224.2	1.6	2.5	3.1	0.1	0.3	0.6	2.4	3.2	3.8	1 in 300	543163	7614245	12.0	2.4	2.4	BOX	222.87	223.95																															
491	244.49	243.69																																																									
492	246.39	245.59																												2.121	16.1	20.7	23.9	217.4	217.5	217.6	2.0	2.2	2.4	0.4	0.5	0.6	0.8	0.9	1.0	1 in 300	541210	7614068	34	0.9		PIPE	217.42	218.12					
493	246.61	245.81																												0.748	9.0	11.5	13.4																										
494	247.33	246.53																												0.697	12.8	16.4	19.1	218.8	218.8	219.2	2.3	2.6	2.8	0.3	0.5	0.6	1.0	1.2	1.3	1 IN 300	540369	7614156	18	0.9		PIPE	218.69	219.39					
495	250.00	249.20		32.763	33.4	54.2	70.2	212.8	213.2	213.5	1.8	2.4	3.0	0.2	0.4	0.7	1.1	1.4	1.8	1 IN 300	537650	7614440	23.0	1.2		PIPE	212.90	213.60																															

Crossing No.	Chainage (km)		Watercourse Name	Catchment Area (sq. km)	Peak Flow for ARI (m³/sec)			PWL (m)			Velocity (m/sec)			Afflux (m)			Head Water Depth (m)			Culvert Slope	Co-ordinates		Structural Configuration			Type	Soffit Level (m)	Proposed Formation Level (m)	Flow Direction (In the direction of increasing chainage) (for diversions only)	Comments	Government Watercourse Mapping	Stream Order	Fisheries Data Layer	
	Opt. 6 Rev. 2	Opt. 6 Rev. 3			20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs		Northing	Easting	No.	Dia/Span (m)	Height (m)									
496	250.06	249.26																											Yes	1	2			
497	250.11	249.31																																
498	250.75	249.95		1.340	17.9	23.0	26.6	212.7	212.8	212.9	2.2	2.4	2.5	0.4	0.5	0.6	0.9	1.1	1.2	1 in 300	536967	7614512	15	1.2		PIPE	212.92	213.62						
499	251.48	250.68		0.380	9.7	12.5	14.5	214.0	214.2	214.3	2.0	2.3	2.4	0.4	0.5	0.5	0.8	0.9	1.0	1 in 300	536239	7614589	13	0.9		PIPE	214.13	214.83						
500	253.29	252.49		0.640	13.3	17.1	19.9	208.7	208.8	208.9	2.0	2.1	2.3	0.4	0.5	0.6	0.8	0.9	1.0	1 in 300	534439	7614778	15	1.2		PIPE	209.04	209.74						
501	254.06	253.26		4.722	35.9	46.3	53.7	208.2	208.4	208.5	2.2	2.4	2.6	0.4	0.5	0.6	1.0	1.1	1.2	1 in 300	533670	7614858	28	1.2		PIPE	208.42	209.12						
502	256.57	255.76		61.271	70.4	112.2	143.6	205.3	205.7	205.9	1.7	2.4	2.9	0.1	0.2	0.4	1.6	1.9	2.2	1 in 300	531229	7615115	16	1.8	1.8	BOX	205.51	205.95	Yes	2	2			
503	258.79	257.99		66.842	85.3	134.2	171.0	203.2	203.5	203.9	1.8	2.5	2.9	0.2	0.4	0.7	1.1	1.4	1.8	1 IN 300	528964	7615348	56	1.2		PIPE	203.26	203.96						
504	259.31	258.51		1.878	14.1	18.2	21.1	203.1	203.2	203.3	2.0	2.1	2.2	0.4	0.5	0.5	0.8	0.9	0.9	1 in 300	528447	7615302	17	1.2		PIPE	203.47	204.17						
505	260.14	259.34		0.914	11.7	15.0	17.4	203.5	203.6	203.7	1.9	2.1	2.3	0.4	0.5	0.6	0.7	0.8	0.9	1 in 300	527680	7614992	19	0.9		PIPE	203.52	204.22						
506	262.20	261.40		0.154	5.7	7.4	8.2	203.7	203.8	203.8	1.9	2.0	2.1	0.4	0.5	0.5	0.7	0.8	0.9	1 in 300	525828	7614100	10	0.9		PIPE	203.85	204.55						
507	266.19	265.39		1.304	15.2	19.5	22.6	196.0	196.2	196.4	2.2	2.5	2.7	0.3	0.5	0.6	0.9	1.1	1.3	1 IN 300	521964	7613820	16	0.9		PIPE	195.98	196.68						
508	267.09	266.29		0.655	9.5	12.3	14.2	193.3	193.5	193.7	2.4	2.7	2.9	0.4	0.5	0.8	1.0	1.2	1.4	1 IN 300	521076	7613939	9	0.9		PIPE	193.16	193.86						
509	268.52	267.72		1.033	10.9	14.0	16.2	192.4	192.6	192.7	2.2	2.5	2.6	0.4	0.5	0.6	0.9	1.0	1.2	1 IN 300	519660	7614127	12	0.9		PIPE	192.41	193.11						
510	270.02	269.21		1.313	9.4	12.1	14.0	190.9	191.1	191.2	2.1	2.3	2.5	0.4	0.5	0.6	0.8	0.9	1.0	1 in 300	518230	7613821	12	0.9		PIPE	191.02	191.72						
511	271.06	270.25	SUTTOR RIVER	10541.819	6111.7	8217.4	9910.1	191.2	191.6	191.8	3.0	3.5	4.6	0.2	0.2	0.2					517446	7613137	30	20.2		BRIDGE	192.16	193.96	Yes	1, 1 and 6	1, 2 and 4			
512	271.83	271.02									3.0	3.5	4.5									516879	7612619	9	20.2		BRIDGE	192.16	193.96	Yes	1	1		
513	272.48	271.67									2.7	3.5	3.6									516399	7612181	11	20.2		BRIDGE	192.16	193.96	Yes	6	4		
514	272.87	272.06									1.9	2.1	2.1						2.6	3.0	3.3	1 in 300	516109	7611916	18	2.4	2.4	BOX	190.94	191.34				
515	273.37	272.56									1.8	2.7	2.7										515741	7611580	5	20.2		BRIDGE	190.94	192.74	Yes	1 or 3	1 or 3	
516	274.18	273.37		1.059	11.6	14.9	17.3	192.2	192.3	192.5	2.3	2.5	2.7	0.4	0.5	0.7	0.9	1.1	1.3	1 in 300	515143	7611035	12	0.9		PIPE	192.12	192.82						
517	275.51	274.71		0.083	3.0	3.9	4.3	198.5	198.8	198.9	2.3	2.6	2.8	0.3	0.5	0.6	1.0	1.2	1.3	1 in 300	514157	7610134	3	0.9		PIPE	198.45	199.15						
518	275.55	274.74		0.114	2.3	2.9	3.4	198.7	198.8	198.8	1.9	2.0	2.1	0.4	0.4	0.5	0.7	0.8	0.9	1 in 300	514132	7610110	4	0.9		PIPE	198.86	199.56						
519	275.90	275.10		0.342	5.9	7.6	8.8	199.6	199.7	199.9	2.3	2.6	2.8	0.3	0.4	0.6	0.9	1.1	1.3	1 in 300	513870	7609871	6	0.9		PIPE	199.50	200.20						
520	276.19	275.39		0.105	2.8	3.7	4.3	199.5	199.6	199.7	2.0	2.2	2.4	0.3	0.4	0.5	0.8	0.9	1.0	1 in 300	513654	7609674	4	0.9		PIPE	199.59	200.29						
521	276.40	275.60		0.238	5.1	6.6	7.7	200.2	200.4	200.5	2.1	2.4	2.6	0.2	0.4	0.5	0.9	1.0	1.1	1 in 300	513498	7609532	6	0.9		PIPE	200.22	200.92						
522	276.87	276.07		0.564	8.1	10.4	12.0	202.0	202.1	202.2	1.9	2.1	2.2	0.4	0.4	0.5	0.7	0.8	0.9	1 in 300	513166	7609229	13	0.9		PIPE	202.19	202.89						
523	277.29	276.49		9.803	43.0	55.8	64.9	202.7	203.1	203.3	1.5	1.9	2.2	0.1	0.3	0.9	2.4	2.7	2.9	1 in 300	512841	7608932	9	1.8	1.8	BOX	202.19	203.37	Yes	1	1			
524	277.73	276.93		1.142	15.6	20.1	23.3	205.3	205.5	205.6	2.2	2.7	3.0	0.3	0.5	0.6	1.2	1.4	1.5	1 in 300	512516	7608635	9	1.2		PIPE	205.32	206.02	Yes	1	1			
525	278.25	277.45		0.076	1.8	2.3	2.7	209.5	209.6	209.8	2.3	2.4	2.6	0.3	0.4	0.6	0.9	1.1	1.2	1 in 200	512134	7608286	2	0.9		PIPE	209.47	210.17						
526	278.69	277.89		0.054	2.0	2.6	2.9	216.3	216.5	216.6	2.3	2.6	2.7	0.2	0.4	0.5	1.0	1.2	1.3	1 in 300	511810	7607990	2	0.9		PIPE	216.22	216.92						
527	278.98	278.18		0.055	1.6	2.1	2.4	221.1	221.2	221.3	1.8	2.0	2.1	0.3	0.4	0.4	0.7	0.8	0.8	1 in 300	511594	7607792	3	0.9		PIPE	221.37	222.07						
528	279.12	278.31		0.032	1.1	1.4	1.6	220.8	220.9	220.9	1.8	2.0	2.1	0.2	0.3	0.3	0.6	0.8	0.9	1 in 300	511494	7607702	2	0.9		PIPE	220.99	221.69						
529	279.20	278.40		0.146	3.4	4.4	5.1	219.2	219.4	219.6	2.4	2.8	3.0	0.0	0.3	0.5	1.0	1.3	1.5	1 in 300	511434	7607647	3	0.9		PIPE	220.99	221.69	Yes	1	1			
530	279.42	278.62		0.020	0.8	1.0	1.1	217.6	217.7	217.8	1.9	2.0	2.1	-0.1	0.0	0.0	0.7	0.8	0.8	1 in 300	511147	7607572	2	0.9		PIPE	217.82	218.52						
531	279.83	279.02		0.216	5.6	7.2	8.4	220.4	220.7	220.9	1.6	2.1	2.4	0.2	0.4	0.5	1.2	1.5	1.7	1 IN 300	510971	7607223	6	0.9		PIPE	220.04	220.96	Yes	1	1			
532	280.07	279.26		0.022	1.1	1.4	1.6	225.4	225.7	225.8	2.4	2.7	2.9	-0.1	0.1	0.2	1.0	1.2	1.4	1 IN 300	510793	7607062	1	0.9		PIPE	225.32	226.02						
533	280.11	279.31																																
534	280.44	279.63		0.028	1.3	1.6	1.8	229.1	229.2	229.2	1.9	2.1	2.2	-0.5	-0.4	-0.4	0.7	0.8	0.9	1 IN 300	510521	7606813	2	0.9		PIPE	229.92	230.62						
535	280.56	279.76		0.076	2.9	3.7	4.1	223.4	223.6	223.7	2.2	2.5	2.7	-0.5	-0.4	-0.4	0.9	1.1	1.2	1 IN 300	510429	7606729	3	0.9		PIPE	223.35	224.05						

Crossing No.	Chainage (km)		Watercourse Name	Catchment Area (sq. km)	Peak Flow for ARI (m ³ /sec)			PWL (m)			Velocity (m/sec)			Afflux (m)			Head Water Depth (m)			Culvert Slope	Co-ordinates		Structural Configuration			Type	Soffit Level (m)	Proposed Formation Level (m)	Flow Direction (In the direction of increasing chainage) (for diversions only)	Comments	Government Watercourse Mapping	Stream Order	Fisheries Data Layer
	Opt. 6 Rev. 2	Opt. 6 Rev. 3			20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs	20 yrs	50 yrs	100 yrs		Northing	Easting	No.	Dia/Span (m)	Height (m)								
536	280.73	279.93		0.241	4.8	6.1	7.1	223.1	223.2	223.4	2.5	2.7	2.9	-0.6	-0.5	-0.4	1.0	1.2	1.3	1 IN 300	510304	7606615	2	1.5	1.5	BOX	223.52	223.92					
537	281.03	280.22		0.415	7.0	9.0	10.5	225.4	225.5	225.8	2.3	2.6	3.2	0.2	0.4	0.5	0.9	1.1	1.3	1 IN 300	510085	7606414	7	0.9		PIPE	225.29	225.99					
538	281.30	280.50		0.110	3.7	4.8	5.5	228.5	228.7	228.8	2.2	2.5	2.7	0.4	0.4	0.6	0.9	1.1	1.2	1 IN 300	509883	7606230	4	0.9		PIPE	228.51	229.21					
539	281.61	280.81		0.112	3.2	4.2	4.9	229.1	229.4	229.7	2.4	2.8	3.4	-0.2	0.1	0.3	1.0	1.3	1.6	1 IN 300	509653	7606020	8	0.9		PIPE	228.92	229.67					
540	282.88	282.07		1.292	19.1	24.5	28.4	229.8	229.9	230.1	2.2	2.5	2.6	0.4	0.5	0.6	0.9	1.0	1.2	1 IN 300	508719	7605167	21	0.9		PIPE	229.77	230.47					
541	283.74	282.94		1.009	9.2	11.8	13.7	229.7	229.8	229.9	2.1	2.4	2.5	0.3	0.5	0.5	0.9	1.0	1.1	1 IN 300	508077	7604581	11	0.9		PIPE	229.69	230.39					
542	283.92	283.12		1.751	12.5	16.1	18.7	229.0	229.1	229.3	2.3	2.5	2.7	0.3	0.4	0.6	0.9	1.1	1.3	1 IN 300	507947	7604462	13	0.9		PIPE	228.91	229.61					
543	284.43	283.62		3.884	22.3	28.8	33.5	228.9	229.1	229.4	1.9	2.5	2.9	0.2	0.4	0.6	1.4	1.7	1.9	1 IN 300	507574	7604121	11	1.2		PIPE	228.61	229.43					
544	284.78	283.97		1.010	11.1	14.3	16.6	228.4	228.7	228.9	1.9	2.4	2.7	0.2	0.4	0.6	1.1	1.3	1.5	1 IN 300	507321	7603881	10	0.9		PIPE	228.24	228.97					
545	286.08	285.27		5.547	27.2	35.3	41.0	229.8	230.1	230.3	1.7	2.2	2.6	0.0	0.2	0.3	1.7	1.9	2.1	1 IN 300	506654	7602768	15	1.2		PIPE	229.31	230.39					
546	286.67	285.86		0.281	7.1	9.2	10.7	230.3	230.5	230.7	2.3	2.6	2.8	0.3	0.4	0.5	1.0	1.2	1.3	1 IN 300	506375	7602247	7	0.9		PIPE	230.18	230.88					
547	286.96	286.16		2.798	16.6	21.4	24.9	230.7	231.1	231.4	2.1	2.7	3.2	0.2	0.5	0.7	1.2	1.6	1.9	1 IN 300	506237	7601985	7	0.9		PIPE	230.38	231.37					
548	287.01	286.21						230.7	231.1	231.4	2.1	2.7	3.2	0.2	0.5	0.7	1.2	1.6	1.9	1 IN 300	506214	7601942	6	0.9		PIPE	230.38	231.37					
549	287.66	286.86		0.556	8.7	11.2	13.0	228.5	228.8	229.0	2.0	2.4	2.7	0.3	0.5	0.7	1.0	1.2	1.5	1 IN 300	505908	7601368	8	0.9		PIPE	228.39	229.09			Yes	1	1
550	288.28	287.48		17.313	74.2	96.3	112.1	231.4	231.7	231.9	1.8	2.4	2.8	0.1	0.2	0.4	3.0	3.2	3.4	1 in 210	505617	7600820	7	2.4	2.4	BOX	230.85	231.95			Yes	2	2
551	288.72	287.92		0.482	7.4	9.6	11.1	233.5	233.7	233.8	2.2	2.5	2.7	0.3	0.5	0.6	0.9	1.1	1.2	1 IN 300	505411	7600434	8	0.9		PIPE	233.48	234.18					
552	289.05	288.25		0.138	3.5	4.6	5.3	236.7	236.8	236.9	2.0	2.2	2.3	0.3	0.4	0.5	0.8	0.9	1.0	1 IN 300	505256	7600140	5	0.9		PIPE	237.51	238.21					
553	289.82	289.02		0.229	3.4	4.4	5.1	241.8	242.0	242.0	2.0	2.2	2.3	0.3	0.4	0.5	0.8	0.9	1.0	1 IN 300	504893	7599461	5	0.9		PIPE	241.95	242.65					
554	290.65	289.84		2.096	25.0	32.1	37.2	241.3	241.5	241.7	2.3	2.6	2.9	0.3	0.5	0.6	1.0	1.2	1.4	1 IN 300	504507	7598735	24	0.9		PIPE	241.18	241.88					
555	291.98	291.18		0.283	5.8	7.5	8.7	243.8	244.0	244.1	2.1	2.4	2.5	0.3	0.4	0.5	0.9	1.0	1.1	1 IN 300	504011	7597503	7	0.9		PIPE	243.84	244.54					
556	292.69	291.89		0.310	8.1	10.5	12.1	239.3	239.4	239.5	2.1	2.3	2.5	0.4	0.5	0.6	0.8	1.0	1.1	1 IN 300	503975	7596800	10	0.9		PIPE	239.32	240.02					
557	292.99	292.19		1.509	16.3	20.9	24.3	237.7	237.8	238.0	2.3	2.5	2.7	0.3	0.5	0.6	0.9	1.1	1.3	1 IN 300	503961	7596498	17	0.9		PIPE	237.63	238.33					
558	295.05	294.25		3.159	26.9	34.6	40.2	223.8	224.0	224.1	2.3	2.8	3.0	0.1	0.3	0.4	1.1	1.3	1.5	1 IN 300	503870	7594436	10	1.5	1.5	BOX	223.53	224.28			Yes	1	1
559	295.55	294.75		8.193	33.4	43.4	50.5	223.0	223.3	223.5	1.9	2.5	2.9	0.3	0.5	0.6	1.6	1.9	2.2	1 IN 300	503847	7593938	23	1.2		PIPE	223.22	223.92					
560	296.35	295.54		1.240	20.3	26.1	30.3	224.2	224.3	224.4	2.2	2.4	2.6	0.4	0.5	0.6	0.9	1.0	1.2	1 IN 300	503812	7593147	23	0.9		PIPE	224.15	224.85					
561	297.28	296.47		1.262	13.3	17.1	19.8	224.5	224.6	224.7	2.0	2.2	2.4	0.4	0.5	0.6	0.8	0.9	1.0	1 IN 300	503749	7592219	18	0.9		PIPE	224.55	225.25					
562	298.61	297.81		11.295	44.1	57.3	66.7	216.7	216.8	216.8	2.1	2.5	2.8	-0.2	-0.3	-0.4	1.5	1.7	1.9	1 IN 300	503406	7590931	20	1.8	1.8	BOX	217.12	217.52					
563	298.80	298.00		16.164	48.0	62.5	73.1	216.7	216.8	216.8	1.8	2.1	2.4	-0.2	-0.3	-0.4	0.6	0.8	0.9	1 IN 300	503356	7590744	21	0.9		PIPE	217.13	217.83			Yes	2	2
564	302.30	301.49		29.181	53.0	83.9	105.4	206.0	206.4	206.6	1.4	2.2	2.7	-0.1	0.2	0.4	1.9	2.3	2.6	1 IN 300	502439	7587373	23	1.5		PIPE	205.56	206.66			Yes	2	2
565	303.73	302.93		35.258	53.0	82.1	105.0	201.3	201.8	202.2	1.6	2.5	3.1	0.1	0.4	0.8	1.6	2.1	2.5	1 in 300	501570	7586252	20	1.5		PIPE	201.20	202.10			Yes	2	2
566	305.07	304.26		2.838	15.9	20.5	23.8	199.9	200.1	200.1	2.1	2.2	2.3	0.4	0.5	0.5	0.8	1.0	1.1	1 in 200	500589	7585349	16	1.2		PIPE	200.24	200.94					
567	305.63	304.82		26.763	41.9	64.6	82.6	198.1	198.5	198.9	1.6	2.4	3.1	0.1	0.4	0.7	1.5	1.9	2.3	1 in 300	500174	7584973	16	1.5		PIPE	198.06	198.81			Yes	2	2

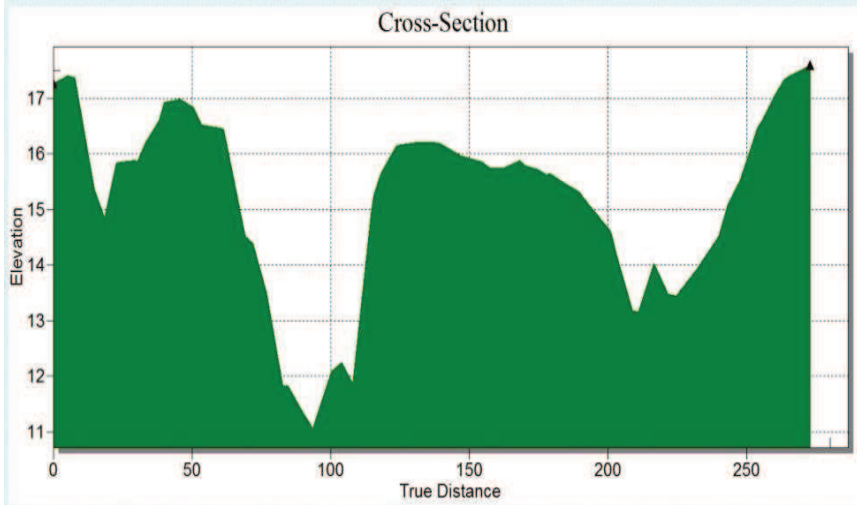
Appendix D : Major Waterway Crossings Details

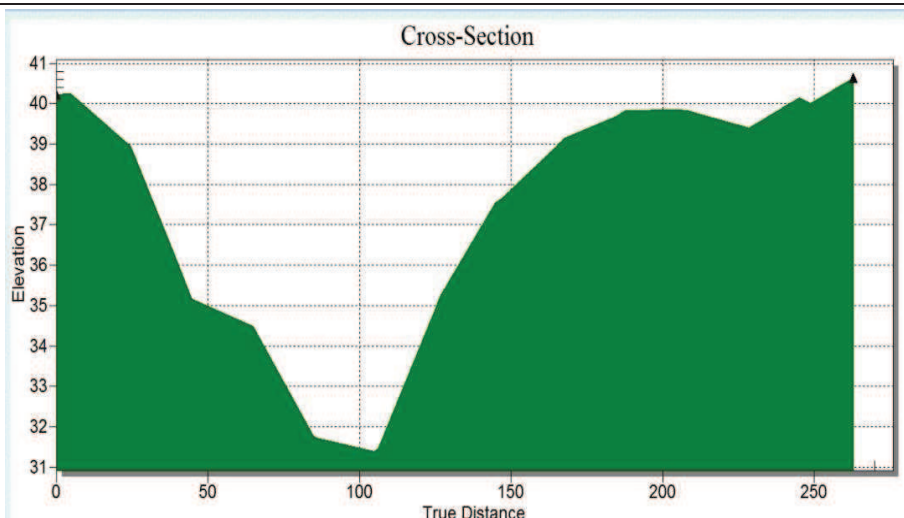
The details for the following list of major waterway crossings are given in the subsequent tables.

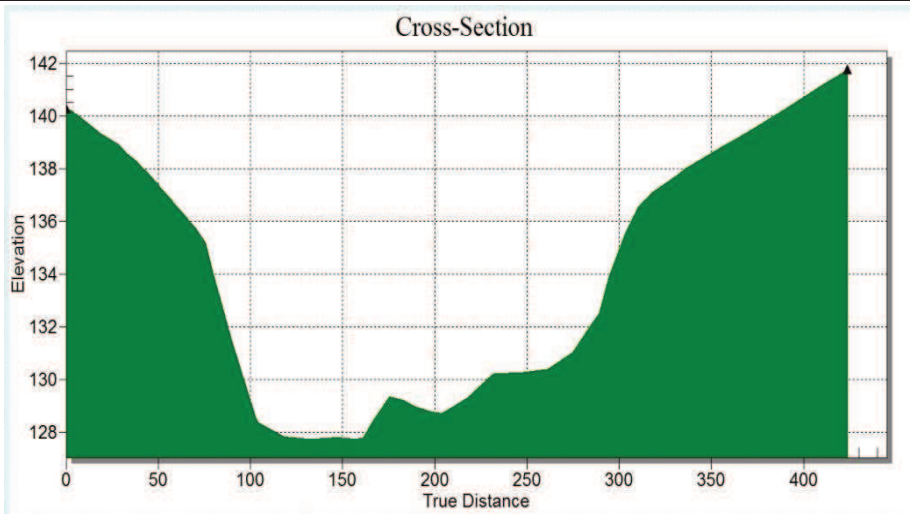
- (1) Splitters Creek
- (2) Elliot River
- (3) Bogie River
- (4) Sandy Creek
- (5) Strathmore Creek
- (6) Pelican Creek
- (7) Bowen River
- (8) Upper Suttor River
- (9) Rockingham Creek
- (10) Murray Creek
- (11) Gunn Creek
- (12) Verbena Creek
- (13) Serpentine Creek
- (14) Suttor River

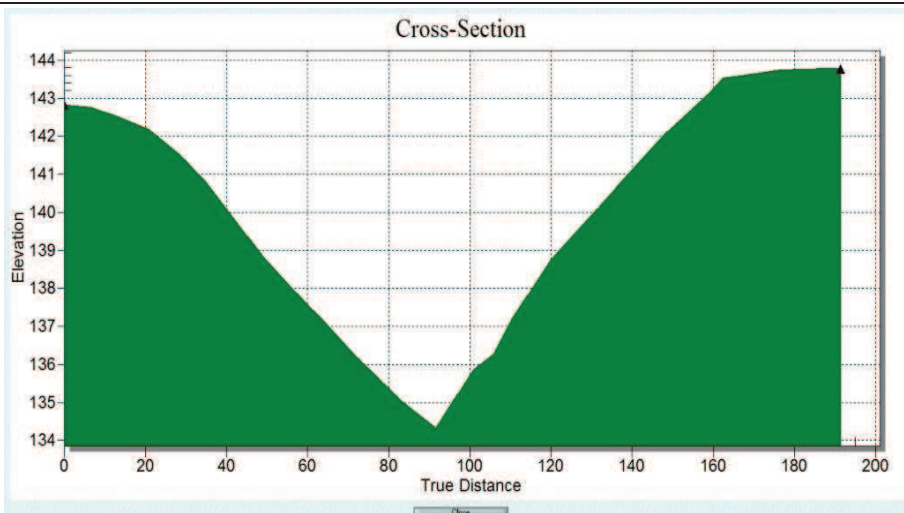
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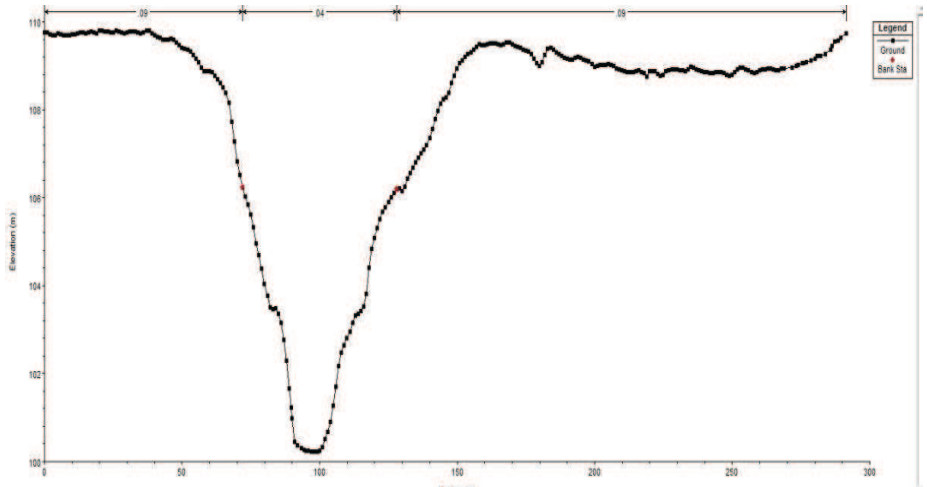
- Location;
- Catchment area;
- Design discharge;
- Design peak water level;
- Aerial view of the waterway crossing; and
- Cross section details of the waterway crossings.

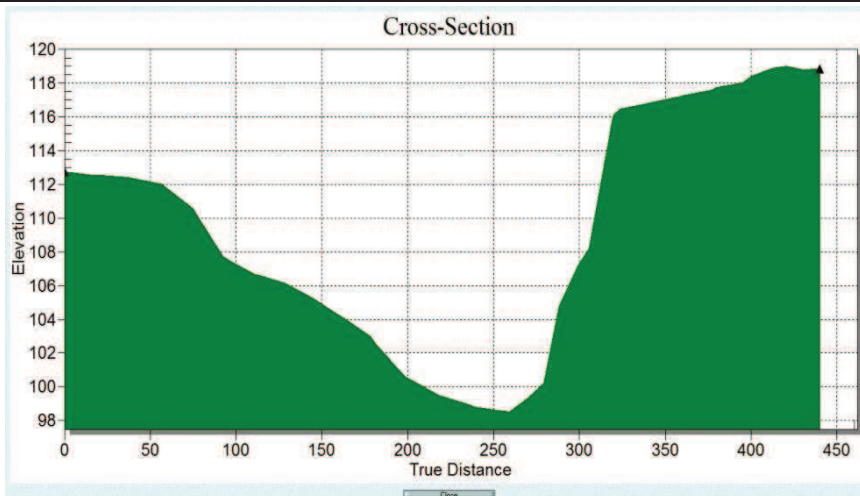
WATERWAY NAME		SPLITTERS CREEK			
Chainage (km) Opt.6 Rev.2	20.22	Design Flow Q50 (m ³ /sec)	592.68	Peak water level (m AHD)	17.40
Chainage (km) Opt.6 Rev.3	19.42				
Catchment area (Sq.Km)	76.24	Proposed Formation Level (m)	19.49	Channel Bottom Level (m)	11.10
General description of river system	The alignment crossing is located in the lower reaches of the river where the river is meandering and the slopes are mild. The average main channel width is approximately 75m. The visual inspection indicates that the bed material at the proposed crossing as sandy/silty.				
Erosion potential	There is bank erosion potential. Some erosion spots seen on the banks.				
Debris accumulation	Less potential for debris accumulation. No logs observed at the alignment crossing and as well at the Bruce Highway bridge crossing.				
Areal View of the waterway Crossing					
Existing waterway cross section					

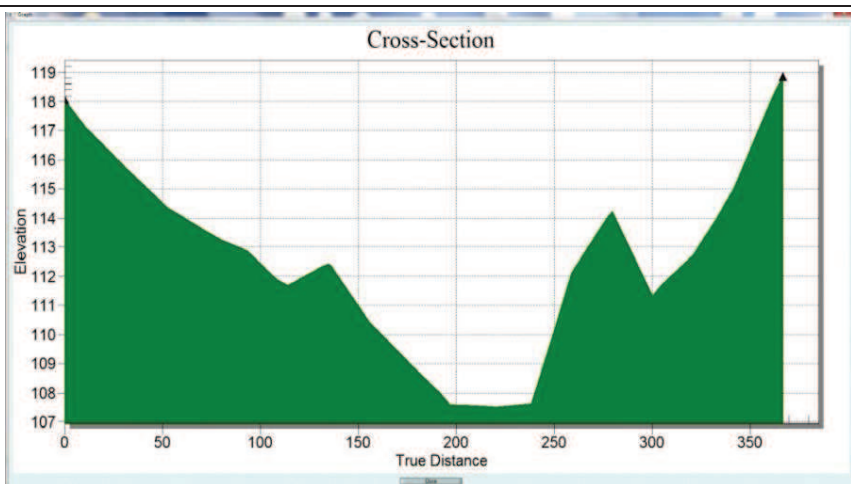
WATERWAY NAME		ELLIOT RIVER			
Chainage (km) Opt.6 Rev.2	35.08	Design Flow Q50 (m ³ /sec)	999.44	Peak water level (m AHD)	37.60
Chainage (km) Opt.6 Rev.3	34.28				
Catchment area (Sq.Km)	128.08	Proposed Formation Level (m)	40.00	Channel Bottom Level (m)	31.50
General description of river system		The alignment crossing is located in the lower reaches of the river where the river is meandering with a well-defined deep channel and the slopes are mild. The average main channel width is approximately 100m. The visual inspection indicates that the bed material at the proposed crossing as sandy/gravel and lot of vegetation growth in the channel.			
Erosion potential		There is a potential for bank erosion. Lot of erosion spots seen on the banks at the Elliot River crossing bridge on Bruce Highway.			
Debris accumulation		There is a potential for debris accumulation. Some logs observed at the alignment crossing and as well at the Bruce Highway bridge crossing.			
Areal View of the waterway Crossing					
Existing waterway cross section					

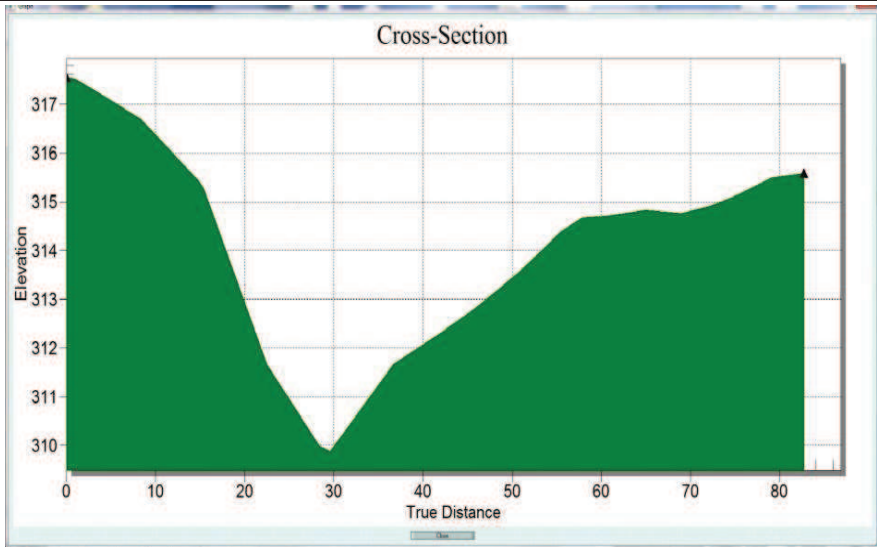
WATERWAY NAME		BOGIE RIVER			
Chainage (km) Opt.6 Rev.2	61.22	Design Flow Q50 (m ³ /sec)	2732.63	Peak water level (m AHD)	134.13
Chainage (km) Opt.6 Rev.3	60.42				
Catchment area (Sq.Km)	432.51	Proposed Formation Level (m)	136.37	Channel Bottom Level (m)	127.90
General description of river system	The alignment crossing is located in the middle reaches of the river where the river is straight with a well-defined deep channel and the slopes are mild. The average main channel width is approximately 200m. The visual inspection indicates that the bed material at the proposed crossing is sandy and lot of vegetation growth in the channel.				
Erosion potential	There is a less potential for bank erosion.				
Debris accumulation	There is a less potential for debris accumulation.				
Ortho photo of the waterway Crossing					
Existing waterway cross section					

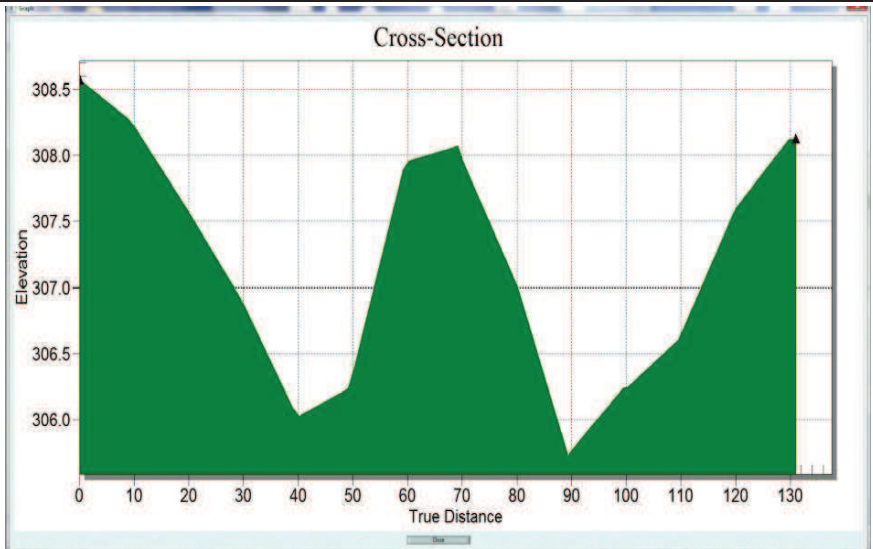
WATERWAY NAME		SANDY CREEK			
Chainage (km) Opt.6 Rev.2	64.78	Design Flow Q50 (m ³ /sec)	663.77	Peak water level (m AHD)	140.44
Chainage (km) Opt.6 Rev.3	63.98				
Catchment area (Sq.Km)	149.46	Proposed Formation Level (m)	142.60	Channel Bottom Level (m)	134.40
General description of river system	The alignment crossing is located in the lower reaches of the river where the river is straight with a well-defined deep channel and the slopes are mild. The average main channel width is approximately 140m. The visual inspection indicates that the main channel is densely vegetated.				
Erosion potential	There is a potential for bank erosion.				
Debris accumulation	There is a potential for debris accumulation. Some logs observed at the alignment crossing.				
Ortho photo of the waterway Crossing					
Existing waterway cross section					

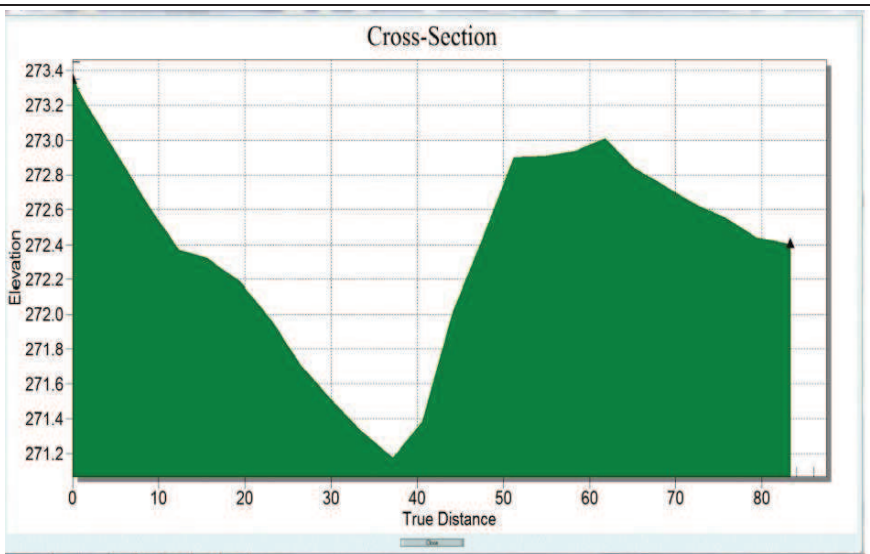
WATERWAY NAME		STRATHMORE CREEK			
Chainage (km) Opt.6 Rev.2	98.78	Design Flow Q50 (m ³ /sec)	558.71	Peak water level (m AHD)	108.30
Chainage (km) Opt.6 Rev.3	97.98				
Catchment area (Sq.Km)	155.55	Proposed Formation Level (m)	110.44	Channel Bottom Level (m)	100.20
General description of river system		The alignment crossing is located in the middle reaches of the river where the river is meandering with a well-defined deep channel and the slopes are mild. The average main channel width is approximately 80m. The visual inspection indicates that the bed material at the proposed crossing as sandy/ gravel and some vegetation growth in the channel.			
Erosion potential		There is a potential for bank erosion. Some erosion spots seen on the banks.			
Debris accumulation		There is a potential for debris accumulation. Some logs observed at the alignment crossing.			
Ortho photo of the waterway Crossing					
Existing waterway cross section					

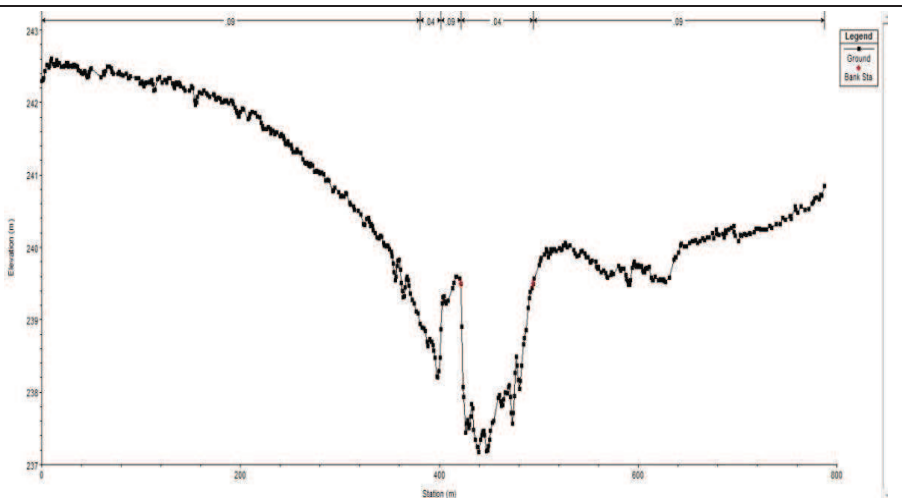
WATERWAY NAME		PELICAN CREEK			
Chainage (km) Opt.6 Rev.2	106.05	Design Flow Q50 (m ³ /sec)	2136.05	Peak water level (m AHD)	104.92
Chainage (km) Opt.6 Rev.3	105.24				
Catchment area (Sq.Km)	563.74	Proposed Formation Level (m)	108.50	Channel Bottom Level (m)	98.50
General description of river system		The alignment crossing is located in the lower reaches of the river where the river is meandering with a well-defined deep channel with a high right bank and the slopes are steeper. The average main channel width is approximately 230m. The visual inspection indicates that the bed material at the proposed crossing is sandy and weathered bed rock. There is some vegetation growth in the channel.			
Erosion potential		There is a potential for right bank erosion. some erosion spots seen on the banks.			
Debris accumulation		There is less potential for debris accumulation.			
Ortho photo of the waterway Crossing					
Existing waterway cross section					

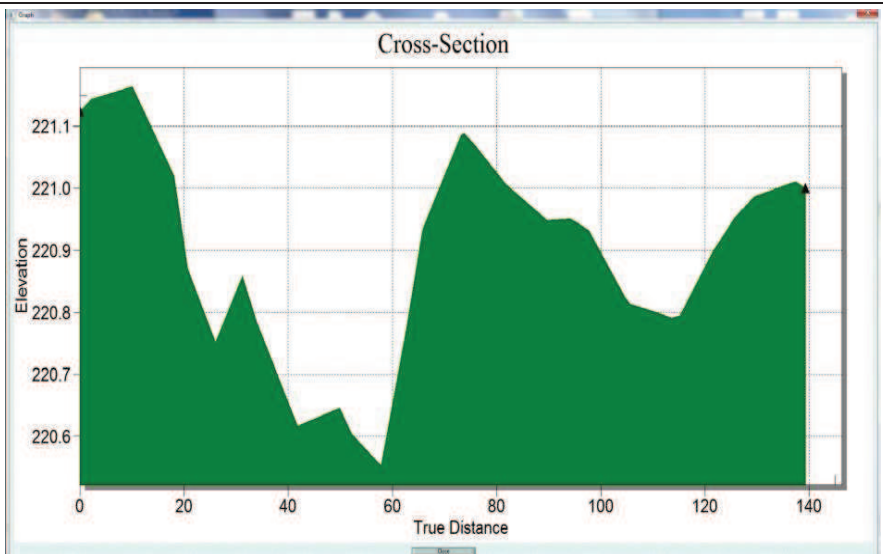
WATERWAY NAME		BOWEN RIVER			
Chainage (km) Opt.6 Rev.2	132.20	Design Flow Q50 (m ³ /sec)	12560.80	Peak water level (m AHD)	122.34
Chainage (km) Opt.6 Rev.3	131.40				
Catchment area (Sq.Km)	5806.25	Proposed Formation Level (m)	126.30	Channel Bottom Level (m)	107.50
General description of river system		The alignment crossing is located in the lower reaches of the river where the river is meandering with a well-defined deep channel and the slopes are mild. The average main channel width is approximately 360m. The visual inspection indicates that the bed material at the proposed crossing as sandy and lot of vegetation growth in the channel. The Rosella Creek and the Bowen River junction is just upstream of the crossing.			
Erosion potential		There is a potential for bank erosion. Lot of erosion spots seen on the banks at the Bowen River crossing bridge on Bowen Developmental Road.			
Debris accumulation		There is a potential for debris accumulation. Lot of logs observed at the alignment crossing and as well at the Bowen Developmental Road bridge crossing. There are debris marks at the soffit of Bowen Developmental Road bridge crossing.			
Ortho photo of the waterway Crossing					
Existing waterway cross section					

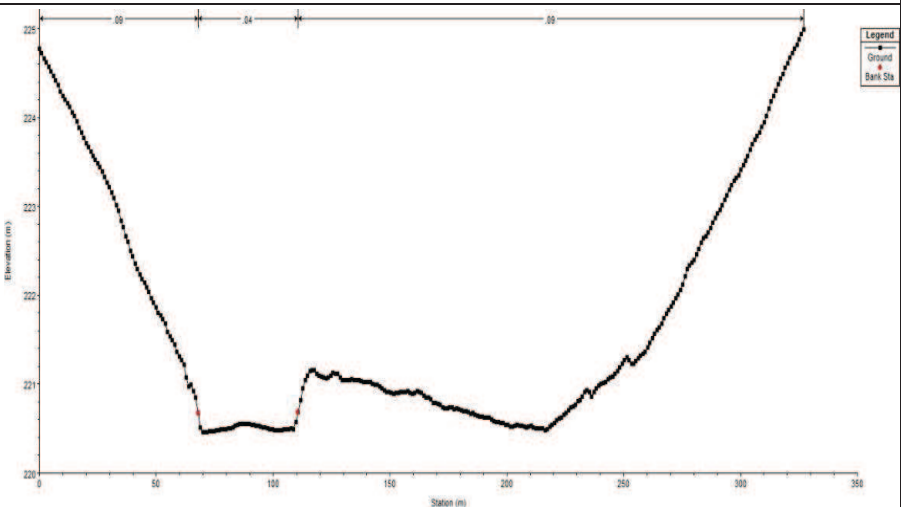
WATERWAY NAME		UPPER SUTOR RIVER			
Chainage (km) Opt.6 Rev.2	172.06	Design Flow Q50 (m ³ /sec)	543.01	Peak water level (m AHD)	317.99
Chainage (km) Opt.6 Rev.3	171.26				
Catchment area (Sq.Km)	296.42	Proposed Formation Level (m)	320.40	Channel Bottom Level (m)	309.90
General description of river system		The alignment crossing is located in the upper reaches of the river where the river is meandering with a well-defined deep channel and the slopes are mild to steep. The average main channel width is approximately 50m. The visual inspection indicates that the bed material at the proposed crossing as silty sand and lot of vegetation growth in the channel.			
Erosion potential		There is a potential for bank erosion. Some of erosion spots seen on the banks at the river crossing bridge on Bowen Developmental Road.			
Debris accumulation		There is lot of potential for debris accumulation. Some logs observed at the alignment crossing and as well at the Bowen Developmental Road bridge crossing.			
Ortho photo of the waterway Crossing					
Existing waterway cross section					

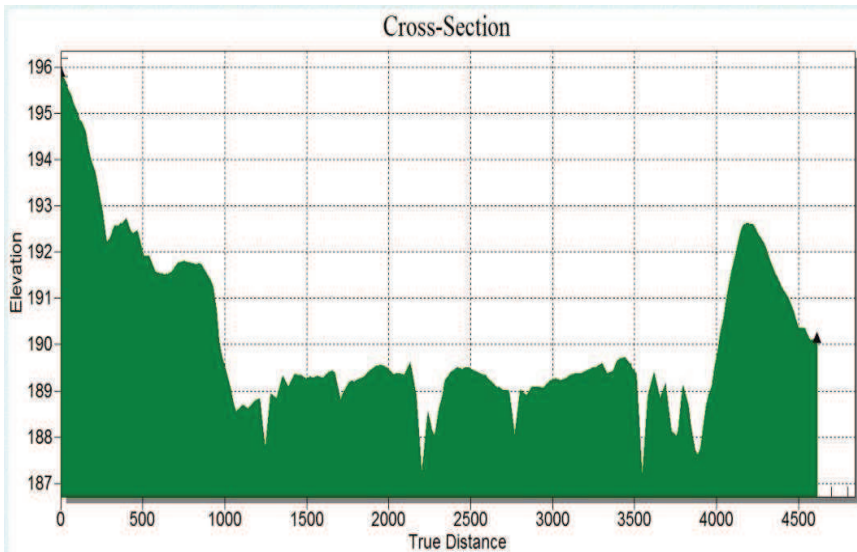
WATERWAY NAME		ROCKINGHAM CREEK			
Chainage (km) Opt.6 Rev.2	187.00	Design Flow Q50 (m ³ /sec)	301.44	Peak water level (m AHD)	309.16
Chainage (km) Opt.6 Rev.3	186.20				
Catchment area (Sq.Km)	138.48	Proposed Formation Level (m)	311.50	Channel Bottom Level (m)	305.60
General description of river system	The alignment crossing is located in the middle reaches of the river where the river is straight with a well-defined channel and the slopes are mild. The average main dual channel width is approximately 100m. The visual inspection indicates that the bed material at the proposed crossing as sandy. The main channel is densely vegetated.				
Erosion potential	There is a potential for bank erosion. Some erosion spots seen on the banks.				
Debris accumulation	There is a potential for debris accumulation. Some logs observed at the alignment crossing.				
Ortho photo of the waterway Crossing					
Existing waterway cross section					

WATERWAY NAME		MURRAY CREEK			
Chainage (km) Opt.6 Rev.2	206.51	Design Flow Q50 (m ³ /sec)	311.27	Peak water level (m AHD)	274.40
Chainage (km) Opt.6 Rev.3	205.71				
Catchment area (Sq.Km)	100.37	Proposed Formation Level (m)	276.70	Channel Bottom Level (m)	271.20
General description of river system		The alignment crossing is located in the middle reaches of the river where the river is straight with a well-defined channel and the slopes are mild. The average main channel width is approximately 50m. The visual inspection indicates that the bed material at the proposed crossing as sandy. The main channel is densely vegetated.			
Erosion potential		There is a potential for bank erosion. Some erosion spots seen on the banks.			
Debris accumulation		There is a potential for debris accumulation.			
Ortho photo of the waterway Crossing					
Existing waterway cross section					

WATERWAY NAME		GUNN CREEK			
Chainage (km) Opt.6 Rev.2	231.20	Design Flow Q50 (m ³ /sec)	157.28	Peak water level (m AHD)	240.18
Chainage (km) Opt.6 Rev.3	230.40				
Catchment area (Sq.Km)	115.40	Proposed Formation Level (m)	240.48	Channel Bottom Level (m)	237.60
General description of river system		The alignment crossing is located in the middle reaches of the river where the river is straight with a well-defined channel and the slopes are mild. The average main channel width is approximately 100m. The visual inspection indicates that the bed material at the proposed crossing is sandy and weathered bed rock. There is some vegetation growth in the channel.			
Erosion potential		There is a potential for bank erosion. Some erosion spots seen on the banks.			
Debris accumulation		There is a potential for debris accumulation.			
Ortho photo of the waterway Crossing					
Existing waterway cross section					

WATERWAY NAME		VERBENA CREEK			
Chainage (km) Opt.6 Rev.2	242.53	Design Flow Q50 (m ³ /sec)	526.03	Peak water level (m AHD)	222.64
Chainage (km) Opt.6 Rev.3	241.72				
Catchment area (Sq.Km)	399.25	Proposed Formation Level (m)	225.02	Channel Bottom Level (m)	220.55
General description of river system		The alignment crossing is located in the lower reaches of the river where the river is straight with a shallow channel and the slopes are mild. The average main channel width is approximately 60m. The visual inspection indicates that the bed material at the proposed crossing as silty clay. Some vegetation is seen in the main channel.			
Erosion potential		There is a potential for bank erosion. Some erosion spots seen on the banks.			
Debris accumulation		There is a potential for debris accumulation. Debris seen within the channel.			
Ortho photo of the waterway Crossing					
Existing waterway cross section					

WATERWAY NAME		SERPENTINE CREEK			
Chainage (km) Opt.6 Rev.2	244.49	Design Flow Q50 (m ³ /sec)	171.30	Peak water level (m AHD)	223.65
Chainage (km) Opt.6 Rev.3	243.69				
Catchment area (Sq.Km)	101.92	Proposed Formation Level (m)	223.95	Channel Bottom Level (m)	220.80
General description of river system		The alignment crossing is located in the lower reaches of the river where the river is meandering with a shallow channel and the slopes are mild. The average main channel width is approximately 230m. The visual inspection indicates that the bed material at the proposed crossing as silty gravel. Some vegetation is seen in the main channel.			
Erosion potential		There is a potential for bank erosion. Some erosion spots seen on the banks.			
Debris accumulation		There is a potential for debris accumulation. Debris seen within the channel.			
Ortho photo of the waterway Crossing					
Existing waterway cross section					

WATERWAY NAME		SUTTOR RIVER			
Chainage (km) Opt.6 Rev.2	271.06- 273.37	Design Flow Q50 (m ³ /sec)	8217.43	Peak water level (m AHD)	191.56
Chainage (km) Opt.6 Rev.3	270.25- 272.56				
Catchment area (Sq.Km)	10541.82	Proposed Formation Level (m)	193.96	Channel Bottom Level (m)	187.00
General description of river system		The alignment crossing is located in the lower reaches of the river. The river is straight with a multi-channel floodplain with the width of 5000m and the slopes are flat. The visual inspection indicates that the bed material at the proposed crossing as silty clay and lot of vegetation growth in the channel.			
Erosion potential		There is a less potential for bank erosion.			
Debris accumulation		There is a potential for debris accumulation. Debris seen within the channel.			
Ortho photo of the waterway Crossing					
Existing waterway cross section					

Appendix E : IFD Values

NGBR IFD Values

DURATION	1 YEAR	2 YEARS	5 YEARS	10 YEARS	20 YEARS	50 YEARS	100 YEARS
NGBR IFD _ Extracted from BoM Website							
Abbot Point Ch 0 km (Lat -19.915650, Lon 148.090493)							
5Mins	117	150	192	216	249	293	326
6Mins	110	141	180	203	234	275	307
10Mins	91.5	118	150	169	194	228	254
20Mins	70.1	89.7	113	127	145	169	188
30Mins	58.4	74.7	93.7	105	120	139	155
1Hr	40.4	51.7	64.9	72.6	83.1	96.8	107
2Hrs	25.9	33.4	42.6	48	55.4	65	72.5
3Hrs	19.5	25.3	32.7	37.2	43.1	51	57.2
6Hrs	11.9	15.6	20.7	23.9	28	33.6	38
12Hrs	7.45	9.82	13.4	15.6	18.5	22.4	25.5
24Hrs	4.89	6.48	8.9	10.4	12.4	15.2	17.4
48Hrs	3.25	4.31	5.95	7	8.36	10.2	11.7
72Hrs	2.44	3.24	4.52	5.34	6.39	7.86	9.03
At Ch 60 km (Lat -20.239026, Lon 147.786063)							
5Mins	110	142	182	207	239	282	315
6Mins	103	133	171	194	225	266	297
10Mins	85.8	111	142	161	186	219	245
20Mins	65.8	84.5	108	121	139	163	181
30Mins	54.7	70.2	89	100	115	134	149
1Hr	37.7	48.4	61.4	69	79.3	92.8	103
2Hrs	24.5	31.5	40.2	45.3	52.1	61.2	68.2
3Hrs	18.7	24	30.8	34.8	40.1	47.2	52.7
6Hrs	11.6	15	19.4	22	25.5	30.2	33.8
12Hrs	7.17	9.35	12.4	14.2	16.7	19.9	22.5
24Hrs	4.42	5.86	8.09	9.51	11.3	13.9	15.9
48Hrs	2.64	3.57	5.25	6.38	7.82	9.85	11.5
72Hrs	1.88	2.58	3.91	4.85	6.04	7.74	9.16
At Ch 120 km (Lat -20.713890, Lon 147.750639)							
5Mins	98.6	128	167	190	221	262	295
6Mins	91.9	119	156	178	207	245	276
10Mins	76.7	99.3	129	146	170	201	225
20Mins	59	75.9	97.1	110	126	149	166
30Mins	49	63	80.1	90.1	104	122	135
1Hr	33.3	42.7	54.1	60.8	69.8	81.7	90.9
2Hrs	20.7	26.6	33.8	38.1	43.8	51.3	57.1
3Hrs	15.3	19.7	25.1	28.3	32.5	38.2	42.6

DURATION	1 YEAR	2 YEARS	5 YEARS	10 YEARS	20 YEARS	50 YEARS	100 YEARS
6Hrs	8.94	11.5	14.8	16.8	19.4	22.9	25.6
12Hrs	5.31	6.89	8.99	10.3	12	14.2	16
24Hrs	3.25	4.27	5.72	6.64	7.82	9.43	10.7
48Hrs	1.98	2.63	3.68	4.36	5.23	6.43	7.39
72Hrs	1.41	1.88	2.7	3.24	3.92	4.89	5.66
At Ch 180 km (Lat -21.210294, Lon 147.719174)							
5Mins	98.2	126	161	181	208	245	273
6Mins	91.6	118	150	169	195	229	255
10Mins	76.4	97.9	124	139	159	186	207
20Mins	58.8	74.9	92.8	103	117	136	150
30Mins	48.9	62.1	76.2	84.3	95.5	110	121
1Hr	33.2	42	51.4	56.7	64.1	73.8	81.1
2Hrs	20.6	26.1	32.2	35.7	40.6	46.9	51.7
3Hrs	15.1	19.3	24	26.7	30.5	35.4	39.2
6Hrs	8.77	11.3	14.3	16.1	18.6	21.8	24.3
12Hrs	5.18	6.71	8.72	9.95	11.6	13.7	15.4
24Hrs	3.17	4.14	5.52	6.37	7.5	9.01	10.2
48Hrs	1.93	2.54	3.5	4.1	4.89	5.97	6.83
72Hrs	1.37	1.81	2.56	3.03	3.64	4.5	5.18
At Ch 240 km (Lat -21.571978, Lon 147.412395)							
5Mins	102	130	164	184	211	246	273
6Mins	94.6	121	153	171	197	230	255
10Mins	78.9	101	126	141	162	188	209
20Mins	61	77.4	95.5	106	120	139	153
30Mins	50.8	64.2	78.7	86.9	98.3	113	125
1Hr	34.2	43.3	52.9	58.3	65.9	75.8	83.3
2Hrs	20.9	26.6	32.8	36.3	41.3	47.7	52.6
3Hrs	15.2	19.4	24.2	26.9	30.7	35.7	39.5
6Hrs	8.62	11.1	14.1	15.9	18.3	21.5	24
12Hrs	4.99	6.47	8.42	9.6	11.2	13.3	14.9
24Hrs	3.01	3.93	5.22	6.01	7.05	8.45	9.55
48Hrs	1.81	2.38	3.23	3.76	4.45	5.4	6.14
72Hrs	1.26	1.68	2.31	2.72	3.24	3.97	4.54
At Ch 305 km (Lat -21.838800, Lon 146.950560)							
5Mins	101	129	165	186	214	251	279
6Mins	93.7	120	154	173	199	234	261
10Mins	78.1	100	127	143	165	193	215
20Mins	60.3	77.1	97.1	109	124	145	161
30Mins	50.1	64	80.3	89.6	102	119	132

DURATION	1 YEAR	2 YEARS	5 YEARS	10 YEARS	20 YEARS	50 YEARS	100 YEARS
1Hr	33.8	43.1	54	60.2	68.8	80	88.5
2Hrs	20.6	26.4	33.2	37.2	42.6	49.7	55.1
3Hrs	15	19.2	24.3	27.3	31.3	36.7	40.7
6Hrs	8.47	10.9	14	15.9	18.3	21.5	24
12Hrs	4.9	6.36	8.28	9.43	11	13	14.6
24Hrs	2.97	3.88	5.13	5.89	6.89	8.23	9.28
48Hrs	1.81	2.38	3.19	3.71	4.37	5.27	5.97
72Hrs	1.28	1.68	2.29	2.68	3.18	3.85	4.39

NGBR IFD _ Adopted for Hydrological Analysis

From Ch 0-60 km

5Mins	117	150	192	216	249	293	326
6Mins	110	141	180	203	234	275	307
10Mins	91.5	118	150	169	194	228	254
20Mins	70.1	89.7	113	127	145	169	188
30Mins	58.4	74.7	93.7	105	120	139	155
1Hr	40.4	51.7	64.9	72.6	83.1	96.8	107
2Hrs	25.9	33.4	42.6	48	55.4	65	72.5
3Hrs	19.5	25.3	32.7	37.2	43.1	51	57.2
6Hrs	11.9	15.6	20.7	23.9	28	33.6	38
12Hrs	7.45	9.82	13.4	15.6	18.5	22.4	25.5
24Hrs	4.89	6.48	8.9	10.4	12.4	15.2	17.4
48Hrs	3.25	4.31	5.95	7	8.36	10.2	11.7
72Hrs	2.44	3.24	4.52	5.34	6.39	7.86	9.03

From Ch 60-120 km

5Mins	110	142	182	207	239	282	315
6Mins	103	133	171	194	225	266	297
10Mins	85.8	111	142	161	186	219	245
20Mins	65.8	84.5	108	121	139	163	181
30Mins	54.7	70.2	89	100	115	134	149
1Hr	37.7	48.4	61.4	69	79.3	92.8	103
2Hrs	24.5	31.5	40.2	45.3	52.1	61.2	68.2
3Hrs	18.7	24	30.8	34.8	40.1	47.2	52.7
6Hrs	11.6	15	19.4	22	25.5	30.2	33.8
12Hrs	7.17	9.35	12.4	14.2	16.7	19.9	22.5
24Hrs	4.42	5.86	8.09	9.51	11.3	13.9	15.9
48Hrs	2.64	3.57	5.25	6.38	7.82	9.85	11.5
72Hrs	1.88	2.58	3.91	4.85	6.04	7.74	9.16

From Ch 120-180 km

5Mins	98.4	127	164	185.5	214.5	253.5	284
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DURATION	1 YEAR	2 YEARS	5 YEARS	10 YEARS	20 YEARS	50 YEARS	100 YEARS
6Mins	91.75	118.5	153	173.5	201	237	265.5
10Mins	76.55	98.6	126.5	142.5	164.5	193.5	216
20Mins	58.9	75.4	94.95	106.5	121.5	142.5	158
30Mins	48.95	62.55	78.15	87.2	99.75	116	128
1Hr	33.25	42.35	52.75	58.75	66.95	77.75	86
2Hrs	20.65	26.35	33	36.9	42.2	49.1	54.4
3Hrs	15.2	19.5	24.55	27.5	31.5	36.8	40.9
6Hrs	8.855	11.4	14.55	16.45	19	22.35	24.95
12Hrs	5.245	6.8	8.855	10.125	11.8	13.95	15.7
24Hrs	3.21	4.205	5.62	6.505	7.66	9.22	10.45
48Hrs	1.955	2.585	3.59	4.23	5.06	6.2	7.11
72Hrs	1.39	1.845	2.63	3.135	3.78	4.695	5.42
From Ch 180-240 km							
5Mins	100.1	128	162.5	182.5	209.5	245.5	273
6Mins	93.1	119.5	151.5	170	196	229.5	255
10Mins	77.65	99.45	125	140	160.5	187	208
20Mins	59.9	76.15	94.15	104.5	118.5	137.5	151.5
30Mins	49.85	63.15	77.45	85.6	96.9	111.5	123
1Hr	33.7	42.65	52.15	57.5	65	74.8	82.2
2Hrs	20.75	26.35	32.5	36	40.95	47.3	52.15
3Hrs	15.15	19.35	24.1	26.8	30.6	35.55	39.35
6Hrs	8.695	11.2	14.2	16	18.45	21.65	24.15
12Hrs	5.085	6.59	8.57	9.775	11.4	13.5	15.15
24Hrs	3.09	4.035	5.37	6.19	7.275	8.73	9.875
48Hrs	1.87	2.46	3.365	3.93	4.67	5.685	6.485
72Hrs	1.315	1.745	2.435	2.875	3.44	4.235	4.86
From Ch 240-305 km							
5Mins	101.5	129.5	164.5	185	212.5	248.5	276
6Mins	94.15	120.5	153.5	172	198	232	258
10Mins	78.5	100.5	126.5	142	163.5	190.5	212
20Mins	60.65	77.25	96.3	107.5	122	142	157
30Mins	50.45	64.1	79.5	88.25	100.15	116	128.5
1Hr	34	43.2	53.45	59.25	67.35	77.9	85.9
2Hrs	20.75	26.5	33	36.75	41.95	48.7	53.85
3Hrs	15.1	19.3	24.25	27.1	31	36.2	40.1
6Hrs	8.545	11	14.05	15.9	18.3	21.5	24
12Hrs	4.945	6.415	8.35	9.515	11.1	13.15	14.75
24Hrs	2.99	3.905	5.175	5.95	6.97	8.34	9.415
48Hrs	1.81	2.38	3.21	3.735	4.41	5.335	6.055
72Hrs	1.27	1.68	2.3	2.7	3.21	3.91	4.465

Appendix F : Rational Method Calculations

														Frequency Factor F _y	0.80	0.90	1.00	1.05			
Sl. No	Chainage (km)		Catchment Area	Catchment Drainage Length	Catchment Equal Area Slope (S _e)	Catchment Equal Area Slope Percentage	Catchment Relief	Catchment Storage	Catchment Characteristics	Time of Concentration (t _c)	Rainfall intensity for duration equal to t _c (I10)	Rainfall intensity for duration equal to t _c (I20)	Rainfall intensity for duration equal to t _c (I50)	Rainfall intensity for duration equal to t _c (I100)	Runoff Coefficient (C10)	Runoff Coefficient (C20)	Runoff Coefficient (C50)	Runoff Coefficient (C100)	20 Year ARI Flow	50 Year ARI Flow	100 Year ARI Flow
	Opt. 6 Rev 2	Opt. 6 Rev 3																	km ²	Km	m/km
1		5.67 & -6.82	14.728	9.03	1.87	0.19	0.00	5.00	40.00	353.11	24.41	28.58	34.27	38.74	0.47	0.53	0.59	0.62	62.38	83.10	98.64
2		7.09	0.089	0.18	7.00	0.70	0.00	5.00	40.00	9.25	175.40	201.53	236.85	263.98	0.96	0.90	1.00	1.00	4.50	5.88	6.55
3		7.30	13.902	1.17	1.00	0.10	0.00	5.00	40.00	73.86	66.92	76.70	89.46	99.03	0.61	0.68	0.76	0.80	77.39	102.25	120.73
4		-7.44	14.242	2.00	1.00	0.10	0.00	5.00	40.00	118.61	48.57	56.04	65.74	73.30	0.55	0.62	0.69	0.72	78.51	103.76	122.56
5		7.35 & -8.11	8.992	0.44	4.17	0.42	0.00	5.00	40.00	28.49	108.32	123.77	143.53	159.98	0.74	0.83	0.92	0.97	47.83	63.29	74.82
6		7.69 & -8.50	0.112	0.40	4.03	0.40	0.00	5.00	40.00	22.05	122.49	139.87	162.84	181.23	0.78	0.88	0.98	1.00	3.82	4.95	5.63
7		7.84 & -8.65	2.360	0.98	3.15	0.32	0.00	5.00	40.00	55.99	76.93	88.03	102.44	113.42	0.64	0.72	0.80	0.84	13.88	18.31	21.60
8		7.97 & -8.77	0.005	0.08	13.84	1.38	0.00	5.00	40.00	4.50	216.00	249.00	293.00	326.00	1.10	0.90	1.00	1.00	0.34	0.44	0.49
9		8.04 & -8.06	0.436	1.87	4.28	0.43	0.00	5.00	40.00	87.90	61.16	70.22	82.01	90.96	0.59	0.66	0.74	0.77	5.63	7.31	8.51
10		8.20 & -9.00	0.644	2.11	3.73	0.37	0.00	5.00	40.00	98.25	56.92	65.44	76.53	85.01	0.58	0.65	0.72	0.76	7.59	9.86	11.50
11		8.54 & -9.33	0.461	2.03	4.06	0.41	0.00	5.00	40.00	96.26	57.73	66.36	77.58	86.15	0.58	0.65	0.72	0.76	5.53	7.19	8.38
12		9.09	9.508	8.88	18.40	1.84	0.00	5.00	40.00	229.66	33.53	38.93	46.20	51.90	0.50	0.57	0.63	0.66	58.17	76.70	90.48
13		9.62	0.063	0.39	4.12	0.41	0.00	5.00	40.00	22.59	121.31	138.54	161.24	179.47	0.78	0.88	0.97	1.00	2.12	2.74	3.13
14		10.00	0.154	0.90	6.14	0.61	0.00	5.00	40.00	44.01	89.86	102.76	119.29	132.58	0.68	0.76	0.85	0.89	3.35	4.32	5.05
15	10.82	10.02	0.153	0.90	3.35	0.33	0.00	5.00	40.00	49.60	83.83	95.89	111.43	123.64	0.66	0.74	0.82	0.87	3.03	3.91	4.55
16	11.68	10.87	0.028	0.24	5.80	0.58	0.00	5.00	40.00	14.24	151.21	173.24	203.01	226.04	0.88	0.90	1.00	1.00	1.20	1.56	1.74
17	11.88	11.07	0.018	0.13	6.62	0.66	0.00	5.00	40.00	7.76	188.08	216.45	254.37	283.74	1.00	0.90	1.00	1.00	0.98	1.28	1.43
18	12.59	11.79	0.040	0.37	6.64	0.66	0.00	5.00	40.00	20.39	126.15	144.03	167.84	186.73	0.79	0.89	0.99	1.00	1.44	1.87	2.09
19	12.75	11.95	0.014	0.11	29.10	2.91	0.00	5.00	40.00	5.12	214.42	247.18	290.82	323.69	1.09	0.90	1.00	1.00	0.87	1.14	1.27
20	12.86	12.06	1.727	3.52	94.84	9.48	5.00	10.00	20.00	77.73	65.33	74.91	87.40	96.80	0.52	0.59	0.65	0.68	21.10	27.35	31.81
21	13.60	12.80	0.845	2.59	38.08	3.81	0.00	10.00	20.00	73.68	66.99	76.78	89.55	99.13	0.49	0.55	0.61	0.64	9.87	12.80	14.87
22	14.01	13.21	0.015	0.16	28.67	2.87	0.00	5.00	20.00	7.11	193.56	222.89	261.95	292.28	0.86	0.90	1.00	1.00	0.84	1.09	1.22
23	14.22	13.42	0.224	1.19	46.37	4.64	5.00	5.00	20.00	37.24	97.19	111.10	128.82	143.42	0.58	0.65	0.73	0.76	4.52	5.82	6.80
24	14.59	13.78	1.560	2.88	169.81	16.98	10.00	10.00	20.00	57.24	75.58	86.49	100.68	111.41	0.59	0.67	0.74	0.78	25.04	32.38	37.63
25	15.35	14.54	0.149	0.55	94.22	9.42	5.00	5.00	20.00	15.53	145.76	166.88	195.35	217.47	0.74	0.83	0.93	0.97	5.78	7.51	8.78
26	15.57	14.77	0.011	0.12	79.86	7.99	5.00	5.00	20.00	4.35	216.00	249.00	293.00	326.00	0.98	0.90	1.00	1.00	0.71	0.92	1.03
27	15.71	14.91	0.189	1.29	188.47	18.85	10.00	5.00	20.00	31.01	103.91	118.76	137.58	153.39	0.64	0.72	0.80	0.84	4.50	5.80	6.79
28	16.00	15.19	0.381	1.57	227.39	22.74	10.00	5.00	20.00	33.91	100.78	115.19	133.50	148.74	0.63	0.71	0.79	0.83	8.67	11.17	13.06
29	16.39	15.58	0.109	0.48	123.98	12.40	5.00	5.00	20.00	13.29	155.19	177.89	208.60	232.30	0.77	0.87	0.97	1.00	4.70	6.12	7.05
30	16.61	15.80	0.118	0.87	85.93	8.59	5.00	5.00	20.00	25.62	114.64	130.95	152.14	169.46	0.64	0.72	0.80	0.84	3.09	3.98	4.66
31	16.85	16.05	0.061	0.68	72.64	7.26	5.00	5.00	40.00	22.28	121.99	139.31	162.17	180.49	0.82	0.90	1.00	1.00	2.13	2.76	3.07
32	16.90	16.09	0.154	1.31	50.25	5.02	5.00	5.00	40.00	41.95	92.10	105.31	122.20	135.89	0.73	0.82	0.91	0.95	3.67	4.73	5.52
33	17.24	16.44	0.072	0.53	36.55	3.66	0.00	5.00	40.00	19.52	129.03	147.37	171.85	191.19	0.80	0.90	1.00	1.00	2.65	3.43	3.81

														Frequency Factor F _y	0.80	0.90	1.00	1.05			
Sl. No	Chainage (km)		Catchment Area	Catchment Drainage Length	Catchment Equal Area Slope (S _e)	Catchment Equal Area Slope Percentage	Catchment Relief	Catchment Storage	Catchment Characteristics	Time of Concentration (t _c)	Rainfall intensity for duration equal to t _c (I10)	Rainfall intensity for duration equal to t _c (I20)	Rainfall intensity for duration equal to t _c (I50)	Rainfall intensity for duration equal to t _c (I100)	Runoff Coefficient (C10)	Runoff Coefficient (C20)	Runoff Coefficient (C50)	Runoff Coefficient (C100)	20 Year ARI Flow	50 Year ARI Flow	100 Year ARI Flow
	Opt. 6 Rev 2	Opt. 6 Rev 3																	km ²	km	m/km
34	17.83	17.03	2.112	2.89	70.32	7.03	5.00	10.00	20.00	66.47	69.95	80.11	93.37	103.28	0.54	0.60	0.67	0.70	28.34	36.70	42.63
35	18.06	17.26	0.015	0.18	30.33	3.03	0.00	5.00	40.00	8.10	185.17	213.02	250.35	279.20	0.99	0.90	1.00	1.00	0.78	1.02	1.14
36	18.16	17.36	0.029	0.32	19.61	1.96	0.00	5.00	40.00	14.48	150.19	172.06	201.58	224.45	0.88	0.90	1.00	1.00	1.26	1.64	1.83
37	18.62	17.81	0.225	0.80	27.84	2.78	0.00	5.00	40.00	27.73	109.99	125.67	145.80	162.48	0.74	0.83	0.93	0.97	6.57	8.47	9.91
38	18.84	18.04	0.128	1.00	37.78	3.78	0.00	5.00	40.00	34.44	100.20	114.53	132.75	147.89	0.71	0.80	0.89	0.93	3.25	4.19	4.90
39	19.17	18.37	0.409	1.58	20.99	2.10	0.00	5.00	40.00	54.65	78.38	89.68	104.33	115.56	0.64	0.72	0.80	0.84	7.36	9.52	11.07
40	19.28	18.48	0.057	0.44	17.94	1.79	0.00	5.00	40.00	19.07	130.91	149.57	174.50	194.15	0.81	0.90	1.00	1.00	2.13	2.76	3.07
41	19.66	18.86	0.067	0.37	16.62	1.66	0.00	5.00	40.00	16.22	142.86	163.51	191.28	212.93	0.85	0.90	1.00	1.00	2.74	3.56	3.96
42	20.42	19.62	0.310	1.13	2.75	0.27	0.00	5.00	40.00	60.41	72.43	82.91	96.58	106.77	0.62	0.70	0.78	0.82	5.01	6.49	7.53
43	21.51	20.71	3.362	3.63	2.89	0.29	0.00	5.00	40.00	150.92	42.43	49.06	57.79	64.62	0.53	0.60	0.66	0.70	27.36	35.80	42.04
44	21.57	20.77	0.066	0.64	3.64	0.36	0.00	5.00	40.00	37.43	96.97	110.86	128.54	143.11	0.70	0.79	0.88	0.92	1.59	2.05	2.40
45	21.63	20.82	0.545	2.09	3.03	0.30	0.00	5.00	40.00	103.33	54.83	63.09	73.83	82.08	0.57	0.64	0.71	0.75	6.12	7.95	9.28
46	22.59	21.78	0.394	1.17	5.19	0.52	0.00	5.00	40.00	53.78	79.32	90.75	105.55	116.95	0.65	0.73	0.81	0.85	7.22	9.33	10.85
47	22.85	22.05	0.043	0.35	8.44	0.84	0.00	5.00	40.00	17.97	135.51	154.93	180.95	201.37	0.83	0.90	1.00	1.00	1.68	2.18	2.42
48	23.02	22.21	0.033	0.29	9.61	0.96	0.00	5.00	40.00	15.09	147.63	169.07	197.98	220.42	0.87	0.90	1.00	1.00	1.41	1.84	2.05
49	23.21	22.40	0.049	0.26	8.61	0.86	0.00	5.00	40.00	13.44	154.55	177.14	207.70	231.29	0.89	0.90	1.00	1.00	2.16	2.82	3.14
50	23.47	22.66	11.854	7.89	5.17	0.52	0.00	5.00	40.00	257.28	31.49	36.62	43.53	48.96	0.50	0.56	0.62	0.65	67.34	88.95	105.04
51	23.58	22.77	0.015	0.14	14.26	1.43	0.00	5.00	40.00	7.45	190.71	219.55	258.02	287.85	1.01	0.90	1.00	1.00	0.83	1.08	1.21
52	23.75	22.95	0.041	0.27	7.82	0.78	0.00	5.00	40.00	14.52	150.00	171.83	201.30	224.14	0.88	0.90	1.00	1.00	1.74	2.27	2.53
53	24.01	23.21	5.440	5.28	4.52	0.45	0.00	5.00	40.00	191.16	36.38	42.16	49.92	56.01	0.51	0.58	0.64	0.67	36.69	48.26	56.85
54	24.58	23.78	0.119	0.15	10.33	1.03	0.00	5.00	40.00	6.92	195.17	224.79	264.17	294.79	1.03	0.90	1.00	1.00	6.67	8.71	9.72
55	25.73	24.92	16.337	9.64	12.49	1.25	0.00	10.00	40.00	255.25	31.64	36.79	43.73	49.17	0.54	0.60	0.67	0.70	100.84	133.18	157.26
56	26.12	25.32	0.057	0.47	8.99	0.90	0.00	5.00	40.00	23.46	119.39	136.35	158.62	176.58	0.77	0.87	0.97	1.00	1.86	2.41	2.78
57	26.36	25.56	0.034	0.13	12.32	1.23	0.00	5.00	40.00	6.44	199.31	229.65	269.89	301.24	1.04	0.90	1.00	1.00	1.97	2.58	2.88
58	26.62	25.82	0.264	0.94	2.29	0.23	0.00	5.00	40.00	52.99	80.18	91.73	106.67	118.22	0.65	0.73	0.81	0.85	4.91	6.34	7.38
59	27.01	26.21	0.115	0.52	1.21	0.12	0.00	5.00	40.00	36.31	98.18	112.23	130.12	144.90	0.70	0.79	0.88	0.92	2.84	3.65	4.27
60	27.28	26.48	1.125	2.60	8.06	0.81	0.00	5.00	40.00	98.31	56.89	65.41	76.49	84.97	0.58	0.65	0.72	0.76	13.23	17.19	20.05
61	27.63	26.82	0.210	0.81	9.85	0.98	0.00	5.00	40.00	34.73	99.89	114.18	132.35	147.43	0.71	0.80	0.89	0.93	5.31	6.84	8.00
62	27.89	27.09	1.516	2.13	32.41	3.24	0.00	10.00	40.00	59.13	73.54	84.17	98.03	108.40	0.67	0.75	0.83	0.88	26.60	34.42	39.96
63	28.13	27.33	0.035	0.29	26.39	2.64	0.00	5.00	40.00	12.20	159.77	183.23	215.03	239.49	0.91	0.90	1.00	1.00	1.60	2.09	2.32
64	28.51	27.71	0.574	1.65	57.08	5.71	5.00	10.00	40.00	44.92	88.89	101.65	118.01	131.13	0.76	0.85	0.94	0.99	13.78	17.78	20.74
65	28.70	27.89	0.291	1.32	44.60	4.46	5.00	10.00	40.00	40.58	93.58	106.99	124.12	138.08	0.77	0.87	0.96	1.00	7.49	9.65	11.15
66	29.17	28.37	0.098	0.84	105.78	10.58	5.00	5.00	40.00	24.29	117.55	134.27	156.12	173.83	0.81	0.90	1.00	1.00	3.30	4.26	4.74
67	29.34	28.54	0.055	0.43	119.26	11.93	5.00	5.00	40.00	12.74	157.49	180.57	211.83	235.92	0.94	0.90	1.00	1.00	2.49	3.24	3.61
68	29.81	29.01	0.019	0.24	280.44	28.04	10.00	5.00	40.00	6.79	196.31	226.13	265.75	296.57	1.11	0.90	1.00	1.00	1.08	1.41	1.58
69	29.98	29.18	0.028	0.38	90.61	9.06	5.00	5.00	40.00	12.87	156.95	179.94	211.07	235.06	0.94	0.90	1.00	1.00	1.25	1.62	1.81
70	30.06	29.26	0.242	1.21	55.77	5.58	5.00	10.00	40.00	36.32	98.17	112.22	130.10	144.88	0.78	0.88	0.98	1.00	6.67	8.59	9.76

															Frequency Factor F _y	0.80	0.90	1.00	1.05			
Sl. No	Chainage (km)		Catchment Area	Catchment Drainage Length	Catchment Equal Area Slope (S _e)	Catchment Equal Area Slope Percentage	Catchment Relief	Catchment Storage	Catchment Characteristics	Time of Concentration (t _c)	Rainfall intensity for duration equal to t _c (I10)	Rainfall intensity for duration equal to t _c (I20)	Rainfall intensity for duration equal to t _c (I50)	Rainfall intensity for duration equal to t _c (I100)	Runoff Coefficient (C10)	Runoff Coefficient (C20)	Runoff Coefficient (C50)	Runoff Coefficient (C100)	20 Year ARI Flow	50 Year ARI Flow	100 Year ARI Flow	
	Opt. 6 Rev 2	Opt. 6 Rev 3																	km ²	km	m/km	%
71	30.12	29.31	0.062	0.76	26.68	2.67	0.00	5.00	40.00	30.21	104.78	119.74	138.71	154.67	0.72	0.82	0.91	0.95	1.68	2.17	2.54	
72	30.46	29.65	0.205	1.37	12.96	1.30	0.00	5.00	40.00	55.91	77.02	88.14	102.56	113.55	0.64	0.72	0.80	0.84	3.60	4.65	5.41	
73	30.93	30.13	0.880	2.88	20.75	2.07	0.00	10.00	40.00	92.22	59.39	68.23	79.72	88.47	0.62	0.70	0.78	0.82	11.69	15.18	17.68	
74	31.03	30.23	4.412	5.00	14.39	1.44	0.00	10.00	40.00	146.69	43.20	49.93	58.77	65.70	0.57	0.64	0.72	0.75	39.45	51.60	60.56	
75	31.17	30.36	0.057	0.33	16.60	1.66	0.00	5.00	40.00	14.46	150.28	172.16	201.71	224.59	0.88	0.90	1.00	1.00	2.44	3.18	3.54	
76	31.66	30.86	0.067	0.40	11.20	1.12	0.00	5.00	40.00	18.57	133.00	152.00	177.43	197.43	0.82	0.90	1.00	1.00	2.55	3.31	3.69	
77	31.91	31.11	0.886	3.10	10.27	1.03	0.00	5.00	40.00	114.09	50.42	58.13	68.13	75.90	0.56	0.62	0.69	0.73	8.94	11.65	13.63	
78	32.07	31.26	0.055	0.46	13.27	1.33	0.00	5.00	40.00	21.08	124.63	142.31	165.77	184.45	0.79	0.89	0.99	1.00	1.94	2.51	2.83	
79	32.12	31.32	3.322	2.93	14.67	1.47	0.00	10.00	40.00	88.16	61.06	70.10	81.88	90.81	0.63	0.71	0.79	0.82	45.74	59.37	69.13	
80	33.41	32.61	0.726	1.09	13.27	1.33	0.00	5.00	40.00	38.78	95.51	109.20	126.64	140.95	0.70	0.78	0.87	0.91	17.25	22.23	25.97	
81	34.51	33.71	2.335	3.67	3.82	0.38	0.00	5.00	40.00	149.75	42.64	49.30	58.06	64.91	0.53	0.60	0.66	0.70	19.12	25.01	29.36	
82	35.30	34.49	15.394	15.00	5.53	0.55	0.00	5.00	40.00	470.19	21.36	25.09	30.17	34.17	0.46	0.52	0.58	0.61	56.06	74.90	89.08	
83	35.36	34.56	0.025	0.35	33.17	3.32	0.00	5.00	40.00	14.52	150.01	171.84	201.32	224.15	0.88	0.90	1.00	1.00	1.09	1.42	1.59	
84	35.50	34.70	0.016	0.17	49.15	4.91	5.00	5.00	40.00	6.93	195.11	224.72	264.10	294.71	1.07	0.90	1.00	1.00	0.90	1.18	1.31	
85	35.72	34.91	0.023	0.23	47.88	4.79	5.00	5.00	40.00	8.88	178.49	205.17	241.12	268.80	1.01	0.90	1.00	1.00	1.20	1.57	1.75	
86	35.79	34.99	0.604	1.44	8.13	0.81	0.00	5.00	40.00	57.60	75.19	86.05	100.17	110.83	0.63	0.71	0.79	0.83	10.27	13.29	15.44	
87	36.42	35.62	0.159	0.67	9.65	0.96	0.00	5.00	40.00	29.76	105.52	120.60	139.71	155.79	0.73	0.82	0.91	0.95	4.36	5.61	6.57	
88	36.94	36.14	0.048	0.31	8.90	0.89	0.00	5.00	40.00	15.76	144.80	165.77	194.01	215.97	0.86	0.90	1.00	1.00	2.00	2.60	2.90	
89	37.24	36.43	0.200	0.87	7.91	0.79	0.00	5.00	40.00	39.02	95.25	108.90	126.31	140.56	0.70	0.78	0.87	0.91	4.72	6.08	7.11	
90	37.38	36.58	6.597	6.62	4.87	0.49	0.00	5.00	40.00	231.58	33.39	38.77	46.01	51.70	0.50	0.57	0.63	0.66	40.16	52.96	62.48	
91	37.95	37.14	0.016	0.19	39.00	3.90	0.00	5.00	40.00	8.19	184.37	212.08	249.25	277.96	0.99	0.90	1.00	1.00	0.87	1.13	1.27	
92	38.10	37.30	0.149	0.64	18.01	1.80	0.00	5.00	40.00	25.15	115.67	132.13	153.55	171.01	0.76	0.86	0.95	1.00	4.68	6.04	7.06	
93	42.94	42.14	0.033	0.17	34.58	3.46	0.00	5.00	40.00	6.65	197.51	227.55	267.42	298.45	1.03	0.90	1.00	1.00	1.90	2.48	2.77	
94	43.43	42.62	0.012	0.11	77.76	7.78	5.00	5.00	40.00	4.14	216.00	249.00	293.00	326.00	1.14	0.90	1.00	1.00	0.77	1.01	1.12	
95	43.54	42.74	0.031	0.39	42.04	4.20	5.00	5.00	40.00	15.31	146.71	168.00	196.69	218.98	0.90	0.90	1.00	1.00	1.30	1.70	1.89	
96	43.59	42.78	0.100	0.52	55.26	5.53	5.00	5.00	40.00	17.12	139.11	159.13	186.02	207.03	0.88	0.90	1.00	1.00	3.96	5.14	5.72	
97	43.73	42.92	0.023	0.41	98.78	9.88	5.00	5.00	40.00	13.74	153.29	175.67	205.93	229.31	0.93	0.90	1.00	1.00	1.03	1.34	1.49	
98	43.95	43.15	0.025	0.28	130.78	13.08	5.00	5.00	40.00	8.91	178.25	204.88	240.78	268.41	1.01	0.90	1.00	1.00	1.27	1.66	1.86	
99	44.03	43.22	0.011	0.16	170.09	17.01	10.00	5.00	40.00	5.36	211.33	243.61	286.53	319.17	1.16	0.90	1.00	1.00	0.68	0.89	0.99	
100	44.07	43.27	0.009	0.14	155.94	15.59	10.00	5.00	40.00	4.74	216.00	249.00	293.00	326.00	1.18	0.90	1.00	1.00	0.53	0.70	0.78	
101	44.20	43.40	0.013	0.23	133.70	13.37	5.00	5.00	40.00	7.61	189.32	217.91	256.09	285.68	1.05	0.90	1.00	1.00	0.73	0.96	1.07	
102	44.29	43.48	0.062	0.43	69.52	6.95	5.00	5.00	40.00	14.02	152.10	174.28	204.26	227.44	0.92	0.90	1.00	1.00	2.71	3.53	3.93	
103	44.34	43.54	0.030	0.27	77.19	7.72	5.00	5.00	40.00	9.48	173.39	199.16	234.07	260.84	0.99	0.90	1.00	1.00	1.47	1.92	2.14	
104	44.44	43.63	0.107	0.70	72.38	7.24	5.00	5.00	40.00	21.59	123.51	141.03	164.23	182.76	0.83	0.90	1.00	1.00	3.76	4.87	5.42	
105	44.45	43.64	0.073	0.74	73.38	7.34	5.00	5.00	40.00	23.57	119.14	136.07	158.28	176.21	0.81	0.90	1.00	1.00	2.49	3.22	3.59	
106	44.94	44.14	0.039	0.41	154.72	15.47	10.00	5.00	40.00	11.86	161.21	184.91	217.05	241.75	0.99	0.90	1.00	1.00	1.81	2.35	2.62	
107	45.09	44.28	0.030	0.39	154.23	15.42	10.00	5.00	40.00	11.85	161.22	184.92	217.07	241.77	0.99	0.90	1.00	1.00	1.39	1.82	2.02	
108	45.15	44.35	0.012	0.17	162.80	16.28	10.00	5.00	40.00	5.43	210.38	242.52	285.22	317.79	1.16	0.90	1.00	1.00	0.70	0.92	1.02	

														Frequency Factor F _y	0.80	0.90	1.00	1.05			
Sl. No	Chainage (km)		Catchment Area	Catchment Drainage Length	Catchment Equal Area Slope (S _e)	Catchment Equal Area Slope Percentage	Catchment Relief	Catchment Storage	Catchment Characteristics	Time of Concentration (t _c)	Rainfall intensity for duration equal to t _c (I10)	Rainfall intensity for duration equal to t _c (I20)	Rainfall intensity for duration equal to t _c (I50)	Rainfall intensity for duration equal to t _c (I100)	Runoff Coefficient (C10)	Runoff Coefficient (C20)	Runoff Coefficient (C50)	Runoff Coefficient (C100)	20 Year ARI Flow	50 Year ARI Flow	100 Year ARI Flow
	Opt. 6 Rev 2	Opt. 6 Rev 3																	km ²	km	m/km
109	45.46	44.66	0.141	0.78	60.10	6.01	5.00	5.00	40.00	24.19	117.77	134.52	156.42	174.16	0.81	0.90	1.00	1.00	4.74	6.13	6.82
110	45.53	44.72	0.060	0.52	55.20	5.52	5.00	5.00	40.00	17.85	136.01	155.51	181.66	202.16	0.87	0.90	1.00	1.00	2.32	3.01	3.35
111	45.72	44.91	0.060	0.39	56.87	5.69	5.00	5.00	40.00	13.33	155.01	177.68	208.35	232.02	0.93	0.90	1.00	1.00	2.67	3.48	3.88
112	46.49	45.69	0.010	0.15	146.64	14.66	5.00	5.00	40.00	5.11	214.57	247.35	291.02	323.90	1.13	0.90	1.00	1.00	0.61	0.79	0.88
113	46.66	45.85	0.036	0.27	37.79	3.78	0.00	5.00	40.00	10.36	167.47	192.21	225.85	251.59	0.93	0.90	1.00	1.00	1.75	2.29	2.55
114	46.49	45.69	0.010	0.15	146.64	14.66	5.00	5.00	40.00	5.11	214.57	247.35	291.02	323.90	1.13	0.90	1.00	1.00	0.61	0.79	0.88
115	46.69	45.88	0.179	0.77	51.29	5.13	5.00	5.00	40.00	24.28	117.58	134.29	156.15	173.87	0.81	0.90	1.00	1.00	6.01	7.76	8.64
116	47.42	46.62	1.531	2.30	23.44	2.34	0.00	10.00	20.00	68.02	69.31	79.40	92.55	102.39	0.49	0.56	0.62	0.65	18.77	24.31	28.24
117	47.54	46.74	0.076	0.56	100.18	10.02	5.00	5.00	40.00	16.67	141.01	161.34	188.67	210.01	0.88	0.90	1.00	1.00	3.05	3.97	4.42
118	47.84	47.03	0.098	0.48	136.85	13.68	5.00	5.00	40.00	13.16	155.74	178.52	209.37	233.16	0.93	0.90	1.00	1.00	4.37	5.69	6.34
119	48.41	47.61	2.520	2.72	14.99	1.50	0.00	10.00	40.00	83.60	62.92	72.20	84.29	93.43	0.63	0.71	0.79	0.83	36.07	46.79	54.45
120	49.06	48.26	0.011	0.17	43.70	4.37	5.00	5.00	40.00	7.25	192.40	221.53	260.34	290.47	1.06	0.90	1.00	1.00	0.60	0.78	0.87
121	49.21	48.40	0.054	0.44	39.03	3.90	0.00	5.00	40.00	16.52	141.63	162.07	189.56	210.99	0.85	0.90	1.00	1.00	2.19	2.85	3.17
122	50.75	49.95	0.110	0.42	50.22	5.02	5.00	5.00	40.00	13.88	152.72	175.01	205.13	228.42	0.92	0.90	1.00	1.00	4.81	6.26	6.98
123	51.26	50.46	0.022	0.22	91.88	9.19	5.00	5.00	40.00	7.50	190.22	218.96	257.33	287.08	1.05	0.90	1.00	1.00	1.18	1.55	1.72
124	51.31	50.51	0.022	0.15	84.67	8.47	5.00	5.00	40.00	5.32	211.90	244.27	287.32	320.00	1.12	0.90	1.00	1.00	1.34	1.75	1.95
125	52.23	51.43	0.490	2.02	8.23	0.82	0.00	5.00	40.00	82.66	63.31	72.64	84.79	93.97	0.60	0.67	0.74	0.78	6.63	8.59	10.00
126	52.26	51.46	0.012	0.21	81.75	8.17	5.00	5.00	40.00	7.76	188.08	216.45	254.38	283.74	1.04	0.90	1.00	1.00	0.64	0.84	0.94
127	52.29	51.49	0.019	0.20	101.76	10.18	5.00	5.00	40.00	6.85	195.81	225.54	265.06	295.79	1.07	0.90	1.00	1.00	1.05	1.37	1.53
128	52.78	51.98	2.056	2.80	6.17	0.62	0.00	10.00	40.00	104.95	54.17	62.35	72.98	81.15	0.61	0.68	0.76	0.80	24.32	31.63	36.93
129	53.14	52.34	0.033	0.25	55.41	5.54	5.00	5.00	40.00	9.29	175.01	201.07	236.31	263.37	1.00	0.90	1.00	1.00	1.66	2.17	2.42
130	53.36	52.56	0.413	1.41	12.58	1.26	0.00	5.00	40.00	54.01	79.07	90.47	105.23	116.59	0.64	0.73	0.81	0.85	7.53	9.73	11.31
131	53.52	52.71	0.862	2.19	9.67	0.97	0.00	5.00	40.00	81.81	63.66	73.03	85.24	94.46	0.60	0.67	0.75	0.78	11.74	15.22	17.71
132	53.60	52.79	0.847	2.03	9.67	0.97	0.00	5.00	40.00	76.05	66.02	75.69	88.30	97.77	0.60	0.68	0.75	0.79	12.10	15.68	18.23
133	54.20	53.40	0.065	0.32	40.14	4.01	5.00	5.00	40.00	11.84	161.29	185.00	217.17	241.88	0.95	0.90	1.00	1.00	3.00	3.91	4.35
134	54.39	53.59	0.337	1.21	13.12	1.31	0.00	5.00	40.00	46.70	86.96	99.46	115.51	128.28	0.67	0.75	0.84	0.88	7.00	9.04	10.54
135	54.85	54.05	0.064	0.35	54.83	5.48	5.00	5.00	40.00	12.13	160.06	183.57	215.44	239.95	0.95	0.90	1.00	1.00	2.92	3.81	4.24
136	55.16	54.35	0.028	0.26	45.91	4.59	5.00	5.00	40.00	10.09	168.63	193.56	227.48	253.41	0.98	0.90	1.00	1.00	1.36	1.78	1.98
137	55.27	54.47	0.421	1.24	16.80	1.68	0.00	5.00	40.00	44.75	89.07	101.86	118.25	131.40	0.68	0.76	0.84	0.89	9.06	11.69	13.64
138	55.37	54.56	0.014	0.20	93.74	9.37	5.00	5.00	40.00	7.33	191.66	220.66	259.32	289.32	1.05	0.90	1.00	1.00	0.75	0.99	1.10
139	57.01	56.21	2.929	3.91	4.92	0.49	0.00	10.00	40.00	148.25	42.92	49.61	58.41	65.30	0.57	0.64	0.72	0.75	25.98	33.99	39.90
140	57.42	56.62	0.056	0.21	20.32	2.03	0.00	5.00	40.00	9.00	177.48	203.98	239.72	267.22	0.97	0.90	1.00	1.00	2.84	3.71	4.13
141	57.73	56.92	0.040	0.19	112.70	11.27	5.00	5.00	40.00	5.96	203.50	234.58	275.69	307.73	1.09	0.90	1.00	1.00	2.33	3.04	3.39
142	58.08	57.28	10.668	7.36	2.63	0.26	0.00	10.00	40.00	277.79	29.97	34.90	41.55	46.77	0.53	0.60	0.66	0.70	61.86	81.83	96.72
143	58.14	57.34	0.027	0.24	27.04	2.70	0.00	5.00	40.00	10.17	168.29	193.17	227.00	252.88	0.94	0.90	1.00	1.00	1.31	1.71	1.90
144	58.52	57.72	0.831	1.75	5.01	0.50	0.00	5.00	40.00	74.82	66.52	76.26	88.95	98.48	0.61	0.68	0.76	0.79	11.99	15.54	18.07
145	58.69	57.88	0.052	0.40	9.35	0.94	0.00	5.00	40.00	19.99	127.04	145.05	169.06	188.06	0.80	0.90	1.00	1.00	1.89	2.45	2.74
146	59.51	58.71	0.544	1.38	1.40	0.14	0.00	5.00	40.00	79.63	64.55	74.04	86.39	95.71	0.60	0.67	0.75	0.79	7.54	9.78	11.37

														Frequency Factor F _y	0.80	0.90	1.00	1.05			
Sl. No	Chainage (km)		Catchment Area	Catchment Drainage Length	Catchment Equal Area Slope (S _e)	Catchment Equal Area Slope Percentage	Catchment Relief	Catchment Storage	Catchment Characteristics	Time of Concentration (t _c)	Rainfall intensity for duration equal to t _c (I10)	Rainfall intensity for duration equal to t _c (I20)	Rainfall intensity for duration equal to t _c (I50)	Rainfall intensity for duration equal to t _c (I100)	Runoff Coefficient (C10)	Runoff Coefficient (C20)	Runoff Coefficient (C50)	Runoff Coefficient (C100)	20 Year ARI Flow	50 Year ARI Flow	100 Year ARI Flow
	Opt. 6 Rev 2	Opt. 6 Rev 3																	km ²	km	m/km
147	60.03	59.22	0.607	1.06	3.22	0.32	0.00	5.00	40.00	51.11	82.20	94.04	109.31	121.23	0.65	0.74	0.82	0.86	11.67	15.07	17.55
148	60.91	60.11	0.275	1.02	2.49	0.25	0.00	5.00	40.00	55.92	77.00	88.12	102.54	113.52	0.64	0.72	0.80	0.84	4.83	6.24	7.25
149	61.52	60.72	0.018	0.11	4.67	0.47	0.00	5.00	40.00	6.97	194.74	224.28	263.58	294.12	1.02	0.90	1.00	1.00	1.01	1.32	1.47
150	63.39	62.58	1.280	1.54	9.41	0.94	0.00	5.00	40.00	55.82	73.32	84.28	98.55	109.42	0.63	0.71	0.79	0.82	21.18	27.52	32.08
151	64.35	63.55	0.856	2.15	7.53	0.75	0.00	5.00	40.00	84.57	59.30	68.16	79.86	88.75	0.58	0.66	0.73	0.77	10.64	13.85	16.16
152	64.52	63.72	0.323	0.91	4.65	0.46	0.00	5.00	40.00	43.26	86.30	99.22	115.79	128.67	0.67	0.75	0.84	0.88	6.71	8.70	10.15
153	65.19	64.38	1.004	1.88	9.49	0.95	0.00	5.00	40.00	69.45	65.27	75.01	87.82	97.52	0.60	0.68	0.75	0.79	14.19	18.46	21.52
154	65.35	64.55	0.293	1.12	14.98	1.50	0.00	5.00	40.00	42.69	86.89	99.90	116.58	129.55	0.67	0.76	0.84	0.88	6.14	7.97	9.29
155	66.49	65.69	0.080	0.37	50.77	5.08	5.00	5.00	40.00	12.74	150.04	173.12	203.66	227.46	0.92	0.90	1.00	1.00	3.44	4.50	5.02
156	67.47	66.67	0.072	0.35	33.16	3.32	0.00	5.00	40.00	12.94	149.25	172.19	202.54	226.19	0.88	0.90	1.00	1.00	3.11	4.07	4.54
157	67.51	66.71	0.047	0.30	59.82	5.98	5.00	5.00	40.00	10.57	158.72	183.32	215.81	241.35	0.95	0.90	1.00	1.00	2.17	2.84	3.17
158	67.86	67.06	0.124	0.62	37.14	3.71	0.00	5.00	40.00	21.58	117.69	135.22	158.43	175.96	0.77	0.87	0.97	1.00	4.06	5.29	6.08
159	68.98	68.18	0.032	0.26	45.16	4.52	5.00	5.00	40.00	9.91	161.71	186.84	220.02	246.13	0.96	0.90	1.00	1.00	1.52	1.98	2.22
160	69.29	68.48	0.063	0.25	50.72	5.07	5.00	5.00	40.00	8.62	172.38	199.45	235.21	262.94	1.00	0.90	1.00	1.00	3.12	4.09	4.57
161	69.55	68.75	0.173	0.64	25.27	2.53	0.00	5.00	40.00	23.29	114.09	131.10	153.46	170.47	0.76	0.86	0.95	1.00	5.39	7.01	8.17
162	69.62	68.82	0.011	0.22	86.89	8.69	5.00	5.00	40.00	8.08	176.84	204.72	241.56	269.96	1.01	0.90	1.00	1.00	0.56	0.73	0.82
163	69.98	69.18	0.944	2.34	9.63	0.96	0.00	10.00	40.00	86.79	58.42	67.15	78.69	87.46	0.62	0.70	0.78	0.81	12.30	16.02	18.69
164	70.24	69.44	0.019	0.18	94.89	9.49	5.00	5.00	40.00	6.26	191.86	222.47	262.95	293.62	1.06	0.90	1.00	1.00	1.04	1.36	1.52
165	70.77	69.97	0.478	1.41	18.58	1.86	0.00	5.00	40.00	48.95	80.42	92.45	107.98	119.95	0.65	0.73	0.81	0.85	8.99	11.66	13.60
166	70.80	70.00	0.011	0.19	106.56	10.66	5.00	5.00	40.00	6.70	188.20	218.15	257.74	287.87	1.05	0.90	1.00	1.00	0.62	0.82	0.91
167	71.04	70.24	0.115	0.54	58.97	5.90	5.00	5.00	40.00	17.10	132.62	152.65	179.27	199.59	0.86	0.90	1.00	1.00	4.40	5.74	6.40
168	71.11	70.31	0.034	0.32	160.46	16.05	10.00	5.00	40.00	9.43	165.73	191.59	225.73	252.45	1.01	0.90	1.00	1.00	1.61	2.10	2.35
169	71.28	70.48	0.012	0.17	324.57	32.46	10.00	5.00	40.00	4.92	207.00	239.00	282.00	315.00	1.15	0.90	1.00	1.00	0.72	0.94	1.05
170	71.60	70.79	0.011	0.18	244.17	24.42	10.00	5.00	40.00	5.36	202.29	233.93	276.20	308.48	1.13	0.90	1.00	1.00	0.63	0.83	0.93
171	71.70	70.89	1.111	2.00	19.53	1.95	0.00	10.00	40.00	63.43	67.64	77.74	90.99	101.01	0.65	0.73	0.81	0.85	17.56	22.83	26.61
172	71.74	70.94	0.011	0.20	152.61	15.26	10.00	5.00	40.00	6.71	188.11	218.03	257.60	287.71	1.09	0.90	1.00	1.00	0.59	0.77	0.86
173	71.98	71.18	2.466	2.44	15.91	1.59	0.00	10.00	40.00	74.20	63.39	72.86	85.32	94.76	0.64	0.72	0.80	0.84	35.75	46.52	54.25
174	72.74	71.94	0.211	0.98	16.02	1.60	0.00	10.00	40.00	38.19	91.54	105.26	122.76	136.45	0.73	0.82	0.91	0.95	5.05	6.54	7.63
175	73.16	72.35	3.029	2.74	22.01	2.20	0.00	10.00	40.00	76.78	62.37	71.69	83.96	93.27	0.63	0.71	0.79	0.83	42.99	55.94	65.25
176	74.42	73.62	0.173	0.55	87.10	8.71	5.00	10.00	20.00	15.44	139.26	160.45	188.56	210.21	0.76	0.86	0.96	1.00	6.63	8.66	10.10
177	74.82	74.02	0.025	0.33	136.98	13.70	5.00	5.00	20.00	10.21	160.15	185.00	217.81	243.64	0.79	0.89	0.99	1.00	1.15	1.50	1.69
178	75.06	74.25	0.028	0.14	122.15	12.22	5.00	5.00	20.00	4.52	207.00	239.00	282.00	315.00	0.95	0.90	1.00	1.00	1.66	2.17	2.43
179	75.21	74.40	0.013	0.19	52.23	5.22	5.00	5.00	20.00	7.62	180.64	209.21	246.98	275.95	0.86	0.90	1.00	1.00	0.71	0.93	1.03
180	75.22	74.42	0.254	1.07	48.39	4.84	5.00	5.00	20.00	32.79	97.12	111.68	130.17	144.72	0.58	0.66	0.73	0.77	5.18	6.71	7.83
181	75.76	74.96	2.623	2.29	14.58	1.46	0.00	10.00	40.00	70.57	64.83	74.51	87.23	96.87	0.64	0.72	0.80	0.84	39.17	50.95	59.41
182	75.86	75.06	0.074	0.37	120.23	12.02	5.00	5.00	40.00	10.65	158.40	182.95	215.37	240.85	0.95	0.90	1.00	1.00	3.37	4.41	4.94
183	76.48	75.68	0.017	0.06	73.28	7.33	5.00	5.00	40.00	2.07	207.00	239.00	282.00	315.00	1.11	0.90	1.00	1.00	1.00	1.32	1.47

															Frequency Factor F _y	0.80	0.90	1.00	1.05			
Sl. No	Chainage (km)		Catchment Area	Catchment Drainage Length	Catchment Equal Area Slope (S _e)	Catchment Equal Area Slope Percentage	Catchment Relief	Catchment Storage	Catchment Characteristics	Time of Concentration (t _c)	Rainfall intensity for duration equal to t _c (I10)	Rainfall intensity for duration equal to t _c (I20)	Rainfall intensity for duration equal to t _c (I50)	Rainfall intensity for duration equal to t _c (I100)	Runoff Coefficient (C10)	Runoff Coefficient (C20)	Runoff Coefficient (C50)	Runoff Coefficient (C100)	20 Year ARI Flow	50 Year ARI Flow	100 Year ARI Flow	
	Opt. 6 Rev 2	Opt. 6 Rev 3																	km ²	km	m/km	%
184	76.60	75.79	0.011	0.14	317.39	31.74	10.00	5.00	40.00	3.92	207.00	239.00	282.00	315.00	1.15	0.90	1.00	1.00	0.64	0.84	0.94	
185	77.11	76.31	0.021	0.12	21.25	2.12	0.00	5.00	40.00	5.42	201.59	233.17	275.34	307.50	1.05	0.90	1.00	1.00	1.24	1.62	1.81	
186	77.33	76.52	3.056	3.89	12.39	1.24	0.00	10.00	40.00	121.94	44.96	51.71	60.75	67.70	0.58	0.65	0.72	0.76	28.53	37.24	43.58	
187	77.34	76.54	0.321	1.38	36.38	3.64	0.00	5.00	40.00	43.67	85.87	98.73	115.23	128.04	0.67	0.75	0.84	0.88	6.61	8.57	10.00	
188	78.51	77.70	0.142	0.77	57.14	5.71	5.00	5.00	40.00	24.16	112.26	129.01	150.93	167.69	0.79	0.89	0.99	1.00	4.53	5.89	6.60	
189	78.88	78.08	0.200	0.71	62.93	6.29	5.00	5.00	40.00	21.10	118.70	136.37	159.82	177.49	0.82	0.90	1.00	1.00	6.80	8.86	9.84	
190	79.11	78.31	0.327	1.17	38.03	3.80	0.00	5.00	40.00	36.71	93.06	107.01	124.78	138.71	0.69	0.78	0.86	0.91	7.56	9.79	11.43	
191	79.26	78.46	0.321	1.29	11.51	1.15	0.00	5.00	40.00	51.56	77.72	89.35	104.39	115.94	0.64	0.72	0.80	0.84	5.77	7.49	8.73	
192	79.92	79.12	0.162	0.81	24.11	2.41	0.00	5.00	40.00	29.97	100.07	115.08	134.10	149.11	0.71	0.80	0.89	0.94	4.16	5.39	6.29	
193	79.98	79.17	0.107	0.55	21.60	2.16	0.00	5.00	40.00	21.63	117.58	135.09	158.27	175.79	0.77	0.87	0.96	1.00	3.48	4.54	5.22	
194	80.37	79.57	7.440	6.98	200.35	20.04	10.00	10.00	40.00	114.72	47.38	54.49	63.98	71.26	0.67	0.75	0.83	0.87	84.32	110.00	128.65	
195	80.68	79.87	0.012	0.18	266.13	26.61	10.00	5.00	40.00	5.42	201.48	233.05	275.20	307.35	1.13	0.90	1.00	1.00	0.69	0.90	1.01	
196	80.85	80.05	0.025	0.32	139.65	13.97	5.00	5.00	40.00	9.85	162.22	187.45	220.74	246.93	0.96	0.90	1.00	1.00	1.17	1.53	1.71	
197	80.95	80.15	0.051	0.47	23.42	2.34	0.00	5.00	40.00	19.46	123.15	141.53	166.01	184.44	0.79	0.89	0.99	1.00	1.79	2.33	2.62	
198	81.08	80.27	0.060	0.54	19.75	1.98	0.00	5.00	40.00	23.05	114.59	131.67	154.15	171.23	0.76	0.86	0.95	1.00	1.88	2.45	2.86	
199	81.11	80.31	0.035	0.41	33.49	3.35	0.00	5.00	40.00	16.36	135.55	156.09	183.37	204.28	0.83	0.90	1.00	1.00	1.37	1.79	2.00	
200	81.17	80.37	0.131	0.68	28.30	2.83	0.00	5.00	40.00	24.72	111.09	127.67	149.31	165.89	0.75	0.84	0.94	0.98	3.93	5.11	5.96	
201	82.02	81.22	5.670	4.65	16.30	1.63	0.00	10.00	40.00	129.85	43.58	50.13	58.90	65.65	0.57	0.65	0.72	0.75	50.93	66.49	77.82	
202	82.13	81.32	0.104	0.48	49.31	4.93	5.00	5.00	40.00	16.04	136.84	157.61	185.18	206.35	0.88	0.90	1.00	1.00	4.10	5.36	5.97	
203	82.96	82.16	1.465	2.44	25.29	2.53	0.00	5.00	40.00	71.33	64.52	74.16	86.83	96.43	0.60	0.68	0.75	0.79	20.39	26.52	30.92	
204	83.13	82.32	0.636	2.72	23.67	2.37	0.00	5.00	40.00	87.64	58.08	66.77	78.24	86.97	0.58	0.65	0.72	0.76	7.70	10.02	11.70	
205	83.31	82.51	18.100	9.02	9.76	0.98	0.00	10.00	40.00	248.16	29.95	34.57	40.76	45.54	0.53	0.60	0.66	0.70	103.61	135.73	159.23	
206	83.62	82.82	0.009	0.10	58.26	5.83	5.00	5.00	40.00	3.93	207.00	239.00	282.00	315.00	1.11	0.90	1.00	1.00	0.54	0.71	0.79	
207	84.22	83.42	0.213	0.65	23.16	2.32	0.00	5.00	40.00	23.65	113.33	130.24	152.41	169.32	0.76	0.85	0.95	0.99	6.56	8.53	9.95	
208	85.11	84.31	0.222	0.65	29.91	2.99	0.00	5.00	40.00	22.22	116.34	133.67	156.57	173.90	0.77	0.86	0.96	1.00	7.13	9.28	10.74	
209	85.33	84.53	0.207	0.80	25.91	2.59	0.00	5.00	40.00	28.41	103.35	118.83	138.62	154.10	0.72	0.82	0.91	0.95	5.56	7.21	8.42	
210	85.56	84.76	0.062	0.58	38.69	3.87	0.00	5.00	40.00	21.50	117.86	135.41	158.66	176.21	0.77	0.87	0.97	1.00	2.02	2.63	3.02	
211	85.71	84.91	0.010	0.14	43.40	4.34	5.00	5.00	40.00	5.90	195.32	226.42	267.63	298.83	1.07	0.90	1.00	1.00	0.57	0.75	0.84	
212	85.86	85.06	0.355	1.26	21.63	2.16	0.00	5.00	40.00	43.85	85.69	98.52	114.98	127.76	0.67	0.75	0.83	0.88	7.30	9.47	11.05	
213	86.05	85.25	0.114	0.58	320.26	32.03	10.00	5.00	40.00	13.26	147.94	170.66	200.72	224.11	0.95	0.90	1.00	1.00	4.86	6.36	7.10	
214	86.38	85.58	0.189	0.62	17.37	1.74	0.00	5.00	40.00	23.93	112.74	129.56	151.60	168.42	0.76	0.85	0.94	0.99	5.79	7.52	8.78	
215	86.80	86.00	1.512	2.23	10.95	1.09	0.00	5.00	40.00	76.74	62.39	71.71	83.98	93.29	0.59	0.67	0.74	0.78	20.11	26.16	30.52	
216	87.13	86.33	0.680	1.95	12.10	1.21	0.00	5.00	40.00	71.31	64.53	74.18	86.85	96.44	0.60	0.68	0.75	0.79	9.47	12.32	14.36	
217	87.75	86.95	3.318	3.61	7.56	0.76	0.00	5.00	40.00	123.82	44.63	51.34	60.31	67.21	0.54	0.60	0.67	0.70	28.57	37.29	43.64	
218	88.35	87.55	0.290	1.18	9.39	0.94	0.00	5.00	40.00	49.33	80.02	92.00	107.45	119.36	0.65	0.73	0.81	0.85	5.42	7.04	8.21	
219	89.34	88.54	1.282	1.96	9.22	0.92	0.00	5.00	40.00	71.24	64.56	74.20	86.88	96.48	0.60	0.68	0.75	0.79	17.86	23.23	27.09	
220	89.99	89.19	0.131	0.58	12.42	1.24	0.00	5.00	40.00	24.72	111.08	127.67	149.31	165.89	0.75	0.84	0.94	0.98	3.92	5.10	5.95	

															Frequency Factor F _y	0.80	0.90	1.00	1.05			
Sl. No	Chainage (km)		Catchment Area	Catchment Drainage Length	Catchment Equal Area Slope (S _e)	Catchment Equal Area Slope Percentage	Catchment Relief	Catchment Storage	Catchment Characteristics	Time of Concentration (t _c)	Rainfall intensity for duration equal to t _c (I10)	Rainfall intensity for duration equal to t _c (I20)	Rainfall intensity for duration equal to t _c (I50)	Rainfall intensity for duration equal to t _c (I100)	Runoff Coefficient (C10)	Runoff Coefficient (C20)	Runoff Coefficient (C50)	Runoff Coefficient (C100)	20 Year ARI Flow	50 Year ARI Flow	100 Year ARI Flow	
	Opt. 6 Rev 2	Opt. 6 Rev 3																	km ²	km	m/km	%
221	90.77	89.97	0.364	1.00	9.95	1.00	0.00	5.00	40.00	40.41	89.24	102.61	119.70	133.04	0.68	0.76	0.85	0.89	7.92	10.27	11.98	
222	90.82	90.02	0.164	0.58	6.47	0.65	0.00	5.00	40.00	27.69	104.84	120.54	140.69	156.38	0.73	0.82	0.91	0.96	4.50	5.83	6.80	
223	91.38	90.58	0.152	0.64	7.82	0.78	0.00	5.00	40.00	29.54	100.98	116.11	135.35	150.49	0.72	0.81	0.90	0.94	3.96	5.12	5.98	
224	91.54	90.73	0.157	0.53	5.54	0.55	0.00	5.00	40.00	26.37	107.62	123.71	144.52	160.61	0.74	0.83	0.92	0.97	4.49	5.83	6.81	
225	95.74	94.93	0.838	1.75	7.58	0.76	0.00	5.00	40.00	68.77	65.54	75.33	88.18	97.92	0.60	0.68	0.75	0.79	11.91	15.50	18.07	
226	95.77	94.97	0.399	0.97	12.08	1.21	0.00	5.00	40.00	37.31	92.45	106.30	123.96	137.79	0.69	0.78	0.86	0.90	9.13	11.83	13.81	
227	98.24	97.43	0.144	0.55	12.08	1.21	0.00	5.00	40.00	23.73	113.16	130.04	152.18	169.06	0.76	0.85	0.95	0.99	4.44	5.77	6.73	
228	99.23	98.43	0.223	0.65	8.63	0.86	0.00	5.00	40.00	28.42	103.32	118.80	138.59	154.06	0.72	0.82	0.91	0.95	6.00	7.77	9.07	
229	99.53	98.72	6.989	5.92	4.67	0.47	0.00	5.00	40.00	207.77	32.83	37.85	44.58	49.78	0.50	0.56	0.62	0.65	41.25	53.98	63.30	
230	99.63	98.83	0.244	0.97	396.59	39.66	10.00	5.00	40.00	19.48	123.08	141.45	165.92	184.34	0.87	0.90	1.00	1.00	8.63	11.25	12.49	
231	100.12	99.31	2.382	3.20	5.54	0.55	0.00	5.00	40.00	120.70	45.18	51.96	61.04	68.02	0.54	0.61	0.67	0.71	20.83	27.18	31.81	
232	100.67	99.87	0.144	0.50	21.08	2.11	0.00	5.00	40.00	19.20	124.22	142.78	167.50	186.15	0.79	0.89	0.99	1.00	5.10	6.65	7.45	
233	100.90	100.10	0.670	1.17	13.00	1.30	0.00	5.00	40.00	42.35	87.24	100.30	117.04	130.07	0.67	0.76	0.84	0.88	14.13	18.32	21.37	
234	103.29	102.48	0.090	0.59	10.39	1.04	0.00	5.00	40.00	27.39	105.48	121.26	141.56	157.35	0.73	0.82	0.91	0.96	2.49	3.23	3.76	
235	103.33	102.53	1.298	1.88	12.68	1.27	0.00	5.00	40.00	63.92	67.45	77.52	90.73	100.72	0.61	0.69	0.76	0.80	19.17	24.93	29.06	
236	103.87	103.07	24.295	11.00	3.29	0.33	0.00	5.00	40.00	365.50	21.88	25.37	30.04	33.63	0.46	0.52	0.58	0.61	89.38	117.62	138.23	
237	104.56	103.75	0.465	1.27	4.15	0.41	0.00	5.00	40.00	59.85	69.16	79.48	93.01	103.24	0.62	0.69	0.77	0.81	7.10	9.23	10.76	
238	104.86	104.06	0.881	1.47	2.82	0.28	0.00	5.00	40.00	70.12	65.00	74.71	87.47	97.13	0.60	0.68	0.75	0.79	12.37	16.10	18.77	
239	105.42	104.62	0.136	0.62	43.60	4.36	5.00	5.00	40.00	20.62	119.69	137.50	161.19	179.00	0.82	0.90	1.00	1.00	4.67	6.08	6.75	
240	106.97	106.17	0.088	0.32	13.57	1.36	0.00	5.00	40.00	14.10	144.59	166.71	196.02	218.74	0.86	0.90	1.00	1.00	3.69	4.81	5.37	
241	107.06	106.26	0.324	1.01	17.60	1.76	0.00	5.00	40.00	36.96	92.81	106.72	124.44	138.33	0.69	0.78	0.86	0.91	7.45	9.66	11.27	
242	107.14	106.34	0.035	0.43	30.86	3.09	0.00	5.00	40.00	17.74	130.05	149.63	175.67	195.48	0.81	0.90	1.00	1.00	1.31	1.71	1.90	
243	107.20	106.40	0.032	0.31	36.70	3.67	0.00	5.00	40.00	12.46	151.16	174.44	205.22	229.26	0.88	0.90	1.00	1.00	1.38	1.81	2.02	
244	107.80	107.00	0.170	0.55	19.77	1.98	0.00	5.00	40.00	20.95	119.00	136.72	160.24	177.96	0.78	0.87	0.97	1.00	5.64	7.34	8.40	
245	107.86	107.05	0.969	1.41	15.14	1.51	0.00	5.00	40.00	47.73	81.68	93.91	109.66	121.82	0.66	0.74	0.82	0.86	18.64	24.18	28.21	
246	108.61	107.80	0.179	0.65	20.73	2.07	0.00	5.00	40.00	24.40	111.77	128.45	150.25	166.93	0.75	0.85	0.94	0.99	5.42	7.04	8.21	
247	109.10	108.30	0.340	0.80	14.40	1.44	0.00	5.00	40.00	30.49	99.50	114.42	133.33	148.25	0.71	0.80	0.89	0.93	8.65	11.20	13.08	
248	109.43	108.63	0.118	0.45	16.45	1.65	0.00	5.00	40.00	18.43	127.30	146.40	171.82	191.08	0.80	0.90	1.00	1.00	4.33	5.65	6.28	
249	110.22	109.41	0.247	0.56	18.73	1.87	0.00	5.00	40.00	20.83	119.26	137.01	160.60	178.35	0.78	0.87	0.97	1.00	8.21	10.69	12.21	
250	110.39	109.58	0.279	0.70	16.59	1.66	0.00	5.00	40.00	26.41	107.54	123.62	144.42	160.49	0.74	0.83	0.92	0.97	7.97	10.35	12.07	
251	111.00	110.19	0.055	0.25	27.04	2.70	0.00	5.00	40.00	10.09	160.63	185.57	218.49	244.41	0.92	0.90	1.00	1.00	2.55	3.34	3.73	
252	111.21	110.41	1.645	3.67	6.27	0.63	0.00	5.00	40.00	140.45	41.72	48.01	56.43	62.92	0.53	0.59	0.66	0.69	13.01	16.99	19.90	
253	111.75	110.95	0.128	0.79	20.53	2.05	0.00	5.00	40.00	30.70	99.28	114.17	133.04	147.92	0.71	0.80	0.89	0.93	3.24	4.19	4.89	
254	111.90	111.10	0.115	0.44	20.36	2.04	0.00	5.00	40.00	17.45	131.20	150.98	177.27	197.31	0.82	0.90	1.00	1.00	4.34	5.66	6.30	
255	112.30	111.50	0.026	0.22	23.81	2.38	0.00	5.00	40.00	9.61	164.22	189.80	223.58	250.07	0.93	0.90	1.00	1.00	1.24	1.63	1.82	
256	112.47	111.67	0.499	1.23	17.44	1.74	0.00	5.00	40.00	43.30	86.26	99.18	115.74	128.61	0.67	0.75	0.84	0.88	10.36	13.43	15.67	
257	112.72	111.92	0.021	0.19	37.09	3.71	0.00	5.00	40.00	7.91	178.27	206.41	243.60	272.22	0.98	0.90	1.00	1.00	1.10	1.44	1.61	

															Frequency Factor F _y	0.80	0.90	1.00	1.05			
Sl. No	Chainage (km)		Catchment Area	Catchment Drainage Length	Catchment Equal Area Slope (S _e)	Catchment Equal Area Slope Percentage	Catchment Relief	Catchment Storage	Catchment Characteristics	Time of Concentration (t _c)	Rainfall intensity for duration equal to t _c (I10)	Rainfall intensity for duration equal to t _c (I20)	Rainfall intensity for duration equal to t _c (I50)	Rainfall intensity for duration equal to t _c (I100)	Runoff Coefficient (C10)	Runoff Coefficient (C20)	Runoff Coefficient (C50)	Runoff Coefficient (C100)	20 Year ARI Flow	50 Year ARI Flow	100 Year ARI Flow	
	Opt. 6 Rev 2	Opt. 6 Rev 3																	km ²	km	m/km	%
258	112.84	112.04	0.235	0.83	18.88	1.89	0.00	5.00	40.00	30.92	99.05	113.90	132.74	147.59	0.71	0.80	0.89	0.93	5.95	7.70	8.99	
259	112.94	112.14	0.260	1.06	19.88	1.99	0.00	5.00	40.00	38.73	90.98	104.61	122.01	135.62	0.68	0.77	0.86	0.90	5.82	7.54	8.80	
260	114.06	113.26	0.088	0.43	27.97	2.80	0.00	5.00	40.00	16.23	136.09	156.73	184.12	205.14	0.83	0.90	1.00	1.00	3.46	4.52	5.04	
261	114.79	113.99	0.726	1.17	13.39	1.34	0.00	5.00	40.00	41.66	87.95	101.12	117.98	131.11	0.68	0.76	0.84	0.89	15.49	20.08	23.43	
262	114.91	114.11	0.079	0.55	39.65	3.97	0.00	5.00	40.00	19.69	122.24	140.45	164.73	182.98	0.79	0.89	0.98	1.00	2.74	3.57	4.02	
263	115.04	114.24	0.020	0.20	61.53	6.15	5.00	5.00	40.00	7.58	180.96	209.59	247.42	276.45	1.03	0.90	1.00	1.00	1.04	1.36	1.52	
264	115.85	115.04	0.238	0.84	27.46	2.75	0.00	5.00	40.00	28.95	102.20	117.51	137.03	152.35	0.72	0.81	0.90	0.95	6.31	8.18	9.55	
265	116.10	115.29	0.899	1.86	12.75	1.27	0.00	5.00	40.00	65.40	66.87	76.85	89.96	99.87	0.61	0.68	0.76	0.80	13.13	17.08	19.90	
266	116.28	115.47	0.035	0.33	44.99	4.50	5.00	5.00	40.00	12.70	150.21	173.33	203.90	227.74	0.92	0.90	1.00	1.00	1.51	1.97	2.20	
267	116.88	116.08	2.054	2.25	9.35	0.93	0.00	5.00	40.00	77.82	61.96	71.22	83.41	92.66	0.59	0.67	0.74	0.78	27.07	35.23	41.10	
268	117.52	116.72	0.323	0.89	23.81	2.38	0.00	5.00	40.00	30.64	99.33	114.23	133.11	148.01	0.71	0.80	0.89	0.93	8.21	10.63	12.41	
269	118.90	118.10	2.305	2.54	10.55	1.05	0.00	5.00	40.00	84.56	59.30	68.17	79.87	88.76	0.58	0.66	0.73	0.77	28.66	37.31	43.53	
270	118.97	118.17																				
271	119.79	118.98	0.025	0.24	4.19	0.42	0.00	5.00	40.00	15.40	139.41	160.64	188.78	210.46	0.85	0.90	1.00	1.00	1.00	1.31	1.46	
272	120.15	119.35	7.926	4.09	7.50	0.75	0.00	5.00	40.00	128.89	43.74	50.32	59.13	65.90	0.53	0.60	0.67	0.70	66.54	86.87	101.67	
273	120.22	119.42																				
274	120.93	120.13	0.261	0.67	18.04	1.80	0.00	5.00	40.00	24.86	110.78	127.33	148.89	165.43	0.75	0.84	0.94	0.98	7.78	10.11	11.80	
275	121.54	120.73	2.027	2.83	8.55	0.85	0.00	5.00	40.00	99.52	53.39	61.39	71.99	80.08	0.56	0.64	0.71	0.74	21.96	28.61	33.42	
276	121.70	120.90	0.836	2.39	11.74	1.17	0.00	5.00	40.00	86.12	58.68	67.46	79.04	87.85	0.58	0.65	0.73	0.76	10.26	13.35	15.58	
277	123.16	122.35	0.376	0.74	16.62	1.66	0.00	5.00	40.00	26.90	106.52	122.45	143.00	158.93	0.74	0.83	0.92	0.96	10.58	13.72	16.01	
278	124.82	124.02	1.199	2.58	15.23	1.52	0.00	5.00	40.00	85.38	49.51	56.48	65.63	72.64	0.55	0.62	0.69	0.72	11.63	15.01	17.44	
279	125.03	124.23	2.446	2.98	13.02	1.30	0.00	5.00	40.00	94.55	46.17	52.70	61.25	67.81	0.54	0.61	0.67	0.71	21.71	28.04	32.59	
280	126.86	126.05	2.727	5.57	2.51	0.25	0.00	5.00	40.00	242.87	23.64	27.13	31.75	35.33	0.47	0.53	0.59	0.61	10.83	14.08	16.45	
281	128.82	128.01	5.663	4.12	0.72	0.07	0.00	5.00	40.00	214.50	25.38	29.10	34.03	37.84	0.47	0.53	0.59	0.62	24.40	31.70	37.01	
282	130.61	129.81	0.903	1.19	2.02	0.20	0.00	5.00	40.00	60.39	58.61	66.79	77.56	85.79	0.58	0.65	0.72	0.76	10.90	14.07	16.34	
283	132.95	132.14	0.092	0.22	6.18	0.62	0.00	5.00	40.00	11.25	137.99	159.11	187.11	208.73	0.84	0.90	1.00	1.00	3.67	4.79	5.34	
284	133.24	132.44	0.040	0.23	13.06	1.31	0.00	5.00	40.00	11.09	138.57	159.80	187.93	209.67	0.84	0.90	1.00	1.00	1.60	2.09	2.33	
285	133.58	132.78	0.052	0.26	8.06	0.81	0.00	5.00	40.00	13.53	129.81	149.34	175.52	195.55	0.81	0.90	1.00	1.00	1.94	2.54	2.83	
286	137.06	136.25	0.117	0.12	12.61	1.26	0.00	5.00	40.00	5.20	183.04	211.74	250.12	280.21	0.99	0.90	1.00	1.00	6.20	8.14	9.12	
287	137.83	137.02	0.082	0.12	21.79	2.18	0.00	5.00	40.00	5.02	185.29	214.26	253.21	283.67	1.00	0.90	1.00	1.00	4.40	5.77	6.47	
288	138.25	137.44	0.150	0.09	17.86	1.79	0.00	5.00	40.00	3.70	185.50	214.50	253.50	284.00	1.00	0.90	1.00	1.00	8.04	10.56	11.83	
289	139.20	138.40	0.056	0.24	25.79	2.58	0.00	5.00	40.00	9.81	143.97	166.23	195.56	218.35	0.86	0.90	1.00	1.00	2.34	3.05	3.41	
290	139.96	139.15	0.238	0.77	16.31	1.63	0.00	5.00	40.00	29.60	87.98	100.62	117.07	129.21	0.67	0.76	0.84	0.88	5.03	6.50	7.54	
291	140.13	139.33	0.468	0.75	11.80	1.18	0.00	5.00	40.00	28.74	89.63	102.49	119.34	131.78	0.68	0.76	0.85	0.89	10.17	13.16	15.25	
292	140.68	139.88	0.086	0.43	17.01	1.70	0.00	5.00	40.00	18.10	113.32	129.65	152.17	168.99	0.76	0.85	0.95	0.99	2.65	3.45	4.03	
293	140.74	139.93	0.230	0.83	11.35	1.14	0.00	5.00	40.00	34.15	83.26	95.21	110.70	122.18	0.66	0.74	0.82	0.86	4.50	5.82	6.74	
294	140.95	140.14	0.096	0.66	13.60	1.36	0.00	5.00	40.00	28.80	89.52	102.36	119.18	131.60	0.68	0.76	0.85	0.89	2.09	2.70	3.13	

														Frequency Factor F _y	0.80	0.90	1.00	1.05			
Sl. No	Chainage (km)		Catchment Area	Catchment Drainage Length	Catchment Equal Area Slope (S _e)	Catchment Equal Area Slope Percentage	Catchment Relief	Catchment Storage	Catchment Characteristics	Time of Concentration (t _c)	Rainfall intensity for duration equal to t _c (I10)	Rainfall intensity for duration equal to t _c (I20)	Rainfall intensity for duration equal to t _c (I50)	Rainfall intensity for duration equal to t _c (I100)	Runoff Coefficient (C10)	Runoff Coefficient (C20)	Runoff Coefficient (C50)	Runoff Coefficient (C100)	20 Year ARI Flow	50 Year ARI Flow	100 Year ARI Flow
	Opt. 6 Rev 2	Opt. 6 Rev 3																	km ²	km	m/km
295	141.06	140.26	0.096	0.73	12.48	1.25	0.00	5.00	40.00	32.35	84.97	97.18	113.01	124.71	0.66	0.75	0.83	0.87	1.93	2.49	2.88
296	141.25	140.45	0.091	0.57	11.45	1.14	0.00	5.00	40.00	25.92	95.07	108.61	126.80	140.23	0.70	0.78	0.87	0.91	2.15	2.79	3.24
297	141.53	140.73	0.310	0.83	1.36	0.14	0.00	5.00	40.00	51.16	67.13	76.61	89.02	98.37	0.61	0.68	0.76	0.79	4.49	5.80	6.73
298	141.67	140.87	0.122	0.38	13.06	1.31	0.00	5.00	40.00	16.45	119.27	136.76	160.59	178.58	0.78	0.87	0.97	1.00	4.06	5.30	6.06
299	142.38	141.58	1.558	1.70	5.69	0.57	0.00	5.00	40.00	66.76	56.29	64.16	74.52	82.44	0.57	0.64	0.71	0.75	17.83	23.02	26.74
300	142.41	141.60																			
301	142.79	141.99	2.130	3.14	11.96	1.20	0.00	5.00	40.00	102.65	43.22	49.36	57.39	63.54	0.53	0.60	0.66	0.70	17.40	22.48	26.13
302	143.66	142.85	1.208	3.05	9.13	0.91	0.00	5.00	40.00	111.55	39.98	45.69	53.14	58.85	0.52	0.58	0.65	0.68	8.96	11.58	13.46
303	144.09	143.28	0.073	0.50	6.76	0.68	0.00	5.00	40.00	25.53	95.84	109.48	127.86	141.42	0.70	0.79	0.87	0.92	1.74	2.26	2.62
304	144.10	143.30	4.807	4.28	11.28	1.13	0.00	5.00	40.00	130.79	35.21	40.28	46.89	51.97	0.50	0.57	0.63	0.66	30.52	39.48	45.95
305	144.34	143.54	0.152	0.67	15.25	1.53	0.00	5.00	40.00	27.08	92.83	106.09	123.73	136.75	0.69	0.78	0.86	0.90	3.48	4.51	5.23
306	144.93	144.13	0.748	1.88	16.84	1.68	0.00	5.00	40.00	63.83	57.36	65.37	75.92	83.98	0.57	0.65	0.72	0.75	8.78	11.32	13.15
307	145.32	144.52	0.718	1.52	20.85	2.09	0.00	5.00	40.00	49.59	68.62	78.33	91.02	100.58	0.61	0.69	0.76	0.80	10.73	13.86	16.08
308	146.94	146.14	0.514	1.31	39.02	3.90	0.00	5.00	40.00	39.06	78.61	89.85	104.45	115.32	0.64	0.72	0.80	0.84	9.27	11.97	13.88
309	147.03	146.23	0.217	1.06	49.52	4.95	5.00	5.00	40.00	32.94	84.42	96.54	112.26	123.89	0.70	0.79	0.88	0.92	4.60	5.94	6.88
310	147.45	146.65	0.336	1.10	47.13	4.71	5.00	5.00	40.00	32.79	84.55	96.70	112.44	124.09	0.70	0.79	0.88	0.92	7.12	9.20	10.66
311	147.89	147.08	0.091	0.32	20.48	2.05	0.00	5.00	40.00	12.98	131.77	151.68	178.29	198.71	0.82	0.90	1.00	1.00	3.46	4.52	5.04
312	148.01	147.21	1.211	2.51	28.55	2.85	0.00	5.00	40.00	72.92	54.04	61.62	71.58	79.19	0.56	0.63	0.70	0.74	13.15	16.97	19.72
313	148.81	148.00	5.651	3.94	8.91	0.89	0.00	5.00	40.00	124.07	36.26	41.47	48.27	53.48	0.51	0.57	0.63	0.67	37.19	48.09	55.96
314	148.89	148.09																			
315	149.07	148.27	0.202	0.87	18.40	1.84	0.00	5.00	40.00	33.09	84.27	96.37	112.06	123.68	0.66	0.74	0.83	0.87	4.03	5.20	6.03
316	150.72	149.91	0.008	0.15	56.88	5.69	5.00	5.00	40.00	6.17	172.16	199.42	235.12	263.36	1.00	0.90	1.00	1.00	0.42	0.55	0.62
317	150.83	150.02	0.046	0.36	56.78	5.68	5.00	5.00	40.00	12.81	132.39	152.43	179.18	199.72	0.86	0.90	1.00	1.00	1.75	2.29	2.55
318	151.16	150.36	0.025	0.27	47.39	4.74	5.00	5.00	40.00	10.33	141.32	163.09	191.83	214.10	0.89	0.90	1.00	1.00	1.00	1.31	1.46
319	151.24	150.44	2.230	2.71	10.00	1.00	0.00	5.00	40.00	91.68	47.21	53.88	62.62	69.32	0.54	0.61	0.68	0.71	20.36	26.29	30.56
320	152.37	151.57	1.192	1.90	14.30	1.43	0.00	5.00	40.00	63.54	57.46	65.49	76.06	84.13	0.57	0.65	0.72	0.75	14.02	18.09	21.01
321	153.80	153.00	0.341	1.07	5.61	0.56	0.00	5.00	40.00	48.84	69.33	79.15	91.98	101.62	0.61	0.69	0.77	0.80	5.17	6.68	7.75
322	154.08	153.28	0.038	0.29	23.53	2.35	0.00	5.00	40.00	12.58	133.22	153.41	180.35	201.04	0.82	0.90	1.00	1.00	1.47	1.92	2.14
323	160.31	159.51	0.481	1.34	39.60	3.96	0.00	5.00	20.00	40.08	77.64	88.72	103.14	113.88	0.48	0.54	0.60	0.63	6.39	8.26	9.57
324	160.34	159.53																			
325	160.45	159.65	0.282	1.23	39.34	3.93	0.00	5.00	20.00	39.00	78.66	89.91	104.52	115.40	0.48	0.54	0.60	0.63	3.83	4.94	5.73
326	160.51	159.71	0.057	0.69	53.04	5.30	5.00	5.00	20.00	23.92	98.93	112.96	132.10	146.23	0.59	0.66	0.74	0.77	1.18	1.54	1.79
327	160.58	159.78	0.146	0.60	63.30	6.33	5.00	5.00	20.00	18.48	111.97	128.03	150.25	166.81	0.63	0.71	0.79	0.83	3.71	4.83	5.63
328	161.32	160.52	0.432	1.05	40.43	4.04	5.00	5.00	20.00	31.60	85.68	98.00	113.96	125.76	0.55	0.61	0.68	0.72	7.21	9.32	10.80
329	161.58	160.78	0.275	0.72	49.41	4.94	5.00	5.00	20.00	21.71	103.20	117.78	137.97	152.87	0.60	0.68	0.75	0.79	6.11	7.95	9.25
330	162.04	161.24	0.095	0.21	53.43	5.34	5.00	5.00	20.00	6.94	166.23	192.44	226.80	253.89	0.82	0.90	1.00	1.00	4.55	5.95	6.67
331	162.48	161.68	0.017	0.19	100.63	10.06	5.00	5.00	20.00	6.48	169.81	196.65	231.82	259.60	0.83	0.90	1.00	1.00	0.82	1.07	1.20

														Frequency Factor F _y	0.80	0.90	1.00	1.05			
Sl. No	Chainage (km)		Catchment Area	Catchment Drainage Length	Catchment Equal Area Slope (S _e)	Catchment Equal Area Slope Percentage	Catchment Relief	Catchment Storage	Catchment Characteristics	Time of Concentration (t _c)	Rainfall intensity for duration equal to t _c (I10)	Rainfall intensity for duration equal to t _c (I20)	Rainfall intensity for duration equal to t _c (I50)	Rainfall intensity for duration equal to t _c (I100)	Runoff Coefficient (C10)	Runoff Coefficient (C20)	Runoff Coefficient (C50)	Runoff Coefficient (C100)	20 Year ARI Flow	50 Year ARI Flow	100 Year ARI Flow
																			Opt. 6 Rev 2	Opt. 6 Rev 3	km ²
332	162.49	161.69	0.071	0.37	82.36	8.24	5.00	5.00	20.00	11.72	136.31	157.10	184.73	206.02	0.72	0.80	0.89	0.94	2.48	3.24	3.80
333	163.06	162.26	0.130	0.40	70.39	7.04	5.00	5.00	20.00	12.11	134.89	155.41	182.72	203.74	0.71	0.80	0.89	0.93	4.48	5.85	6.85
334	163.28	162.47	0.024	0.28	127.61	12.76	5.00	5.00	20.00	8.80	151.83	175.49	206.60	230.91	0.77	0.86	0.96	1.00	1.01	1.32	1.54
335	163.49	162.68	0.025	0.24	78.06	7.81	5.00	5.00	20.00	8.44	154.56	178.70	210.42	235.25	0.78	0.87	0.97	1.00	1.07	1.40	1.61
336	163.62	162.82	0.023	0.23	88.74	8.87	5.00	5.00	20.00	8.07	157.48	182.14	214.52	239.92	0.79	0.89	0.98	1.00	1.05	1.37	1.56
337	163.75	162.95	0.707	1.01	42.01	4.20	5.00	5.00	20.00	28.78	89.55	102.40	119.23	131.65	0.56	0.63	0.70	0.73	12.62	16.33	18.94
338	163.80	162.99	0.030	0.29	52.23	5.22	5.00	5.00	20.00	10.92	139.20	160.55	188.82	210.68	0.73	0.82	0.91	0.95	1.11	1.45	1.69
339	165.50	164.70	0.170	0.57	60.93	6.09	5.00	5.00	20.00	17.24	116.45	133.39	156.60	174.03	0.65	0.73	0.81	0.85	4.59	5.99	6.99
340	165.93	165.13	0.042	0.31	85.40	8.54	5.00	5.00	20.00	10.11	142.10	164.02	192.93	215.35	0.74	0.83	0.92	0.96	1.59	2.08	2.44
341	166.51	165.71	0.523	1.15	34.82	3.48	0.00	5.00	20.00	35.01	82.45	94.27	109.61	120.99	0.50	0.56	0.62	0.65	7.62	9.85	11.41
342	166.84	166.03	0.763	1.38	26.39	2.64	0.00	5.00	20.00	42.71	75.14	85.85	99.79	110.20	0.47	0.53	0.59	0.62	9.66	12.47	14.46
343	166.86	166.06																			
344	167.33	166.53	0.450	1.28	31.24	3.12	0.00	5.00	20.00	40.49	77.25	88.28	102.62	113.31	0.48	0.54	0.60	0.63	5.94	7.68	8.90
345	167.45	166.64	0.332	1.18	32.22	3.22	0.00	5.00	20.00	38.11	79.51	90.89	105.66	116.65	0.49	0.55	0.61	0.64	4.57	5.91	6.85
346	167.75	166.95	0.179	0.92	38.80	3.88	0.00	5.00	20.00	30.50	86.72	99.20	115.36	127.30	0.51	0.57	0.64	0.67	2.82	3.65	4.23
347	167.78	166.98																			
348	167.79	166.98																			
349	168.06	167.26	0.659	0.84	27.87	2.79	0.00	5.00	20.00	26.04	94.85	108.37	126.51	139.89	0.54	0.60	0.67	0.70	11.96	15.51	18.01
350	168.12	167.32																			
351	168.17	167.36																			
352	170.09	169.29																	64.13	83.43	97.49
353	171.90	171.10	0.050	0.24	4.52	0.45	0.00	5.00	40.00	14.00	128.09	147.29	173.09	192.79	0.81	0.90	1.00	1.00	1.83	2.39	2.66
354	173.34	172.53	0.943	1.47	18.95	1.90	0.00	5.00	40.00	47.51	70.60	80.61	93.68	103.49	0.62	0.69	0.77	0.81	14.65	18.92	21.95
355	174.01	173.21	0.356	0.81	25.84	2.58	0.00	5.00	40.00	27.17	92.66	105.90	123.49	136.48	0.69	0.77	0.86	0.90	8.10	10.50	12.18
356	174.50	173.69	0.498	1.16	10.92	1.09	0.00	5.00	40.00	44.74	73.22	83.64	97.21	107.37	0.63	0.70	0.78	0.82	8.14	10.51	12.19
357	174.99	174.19	0.220	0.57	12.66	1.27	0.00	5.00	40.00	23.19	100.34	114.55	134.04	148.42	0.71	0.80	0.89	0.94	5.63	7.32	8.51
358	175.12	174.32	12.346	6.51	12.02	1.20	0.00	5.00	40.00	178.56	27.73	31.76	37.10	41.22	0.48	0.54	0.60	0.63	58.94	76.49	89.26
359	173.54	172.74	0.260	0.59	7.58	0.76	0.00	5.00	40.00	26.20	94.52	108.00	126.06	139.39	0.69	0.78	0.87	0.91	6.09	7.90	9.17
360	175.83	175.03	0.131	0.45	17.74	1.77	0.00	5.00	40.00	18.03	113.60	129.97	152.55	169.43	0.76	0.85	0.95	1.00	4.02	5.25	6.12
361	177.24	176.43	0.079	0.27	32.27	3.23	0.00	5.00	40.00	10.08	142.21	164.16	193.09	215.54	0.86	0.90	1.00	1.00	3.25	4.25	4.75
362	177.96	177.15	7.073	4.44	6.33	0.63	0.00	5.00	40.00	146.38	32.77	37.50	43.69	48.47	0.50	0.56	0.62	0.65	41.18	53.32	62.10
363	178.85	178.05	0.482	0.76	15.05	1.50	0.00	5.00	40.00	27.59	91.85	104.99	122.39	135.23	0.69	0.77	0.86	0.90	10.85	14.05	16.30
364	182.09	181.28	0.667	1.19	22.01	2.20	0.00	5.00	40.00	38.59	79.06	90.36	105.05	115.98	0.64	0.72	0.81	0.85	12.13	15.67	18.17
365	183.06	182.25	0.246	1.12	30.56	3.06	0.00	5.00	40.00	37.56	80.03	91.49	106.37	117.42	0.65	0.73	0.81	0.85	4.56	5.89	6.82
366	183.54	182.74	0.521	1.28	33.42	3.34	0.00	5.00	40.00	39.16	78.51	89.74	104.32	115.18	0.64	0.72	0.80	0.84	9.38	12.11	14.04
367	183.59	182.79	0.685	1.37	29.84	2.98	0.00	5.00	40.00	41.84	75.97	86.80	100.90	111.42	0.63	0.71	0.79	0.83	11.78	15.22	17.64
368	184.22	183.41	0.195	0.55	44.85	4.49	5.00	5.00	40.00	17.68	114.86	131.49	154.34	171.47	0.80	0.90	1.00	1.00	6.42	8.37	9.30

														Frequency Factor F_y	0.80	0.90	1.00	1.05			
Sl. No	Chainage (km)		Catchment Area	Catchment Drainage Length	Catchment Equal Area Slope (S_e)	Catchment Equal Area Slope Percentage	Catchment Relief	Catchment Storage	Catchment Characteristics	Time of Concentration (t_c)	Rainfall intensity for duration equal to t_c (I10)	Rainfall intensity for duration equal to t_c (I20)	Rainfall intensity for duration equal to t_c (I50)	Rainfall intensity for duration equal to t_c (I100)	Runoff Coefficient (C10)	Runoff Coefficient (C20)	Runoff Coefficient (C50)	Runoff Coefficient (C100)	20 Year ARI Flow	50 Year ARI Flow	100 Year ARI Flow
	Opt. 6 Rev 2	Opt. 6 Rev 3																	km ²	km	m/km
369	184.56	183.75	1.495	1.89	22.16	2.22	0.00	5.00	40.00	56.79	61.79	70.46	81.84	90.49	0.59	0.66	0.74	0.77	19.37	25.00	29.02
370	185.75	184.95	1.043	1.58	26.43	2.64	0.00	5.00	40.00	47.43	69.27	78.36	90.18	99.29	0.61	0.68	0.76	0.80	15.53	19.86	22.96
371	187.38	186.58	0.269	0.74	27.27	2.73	0.00	5.00	40.00	25.16	94.74	107.35	124.08	136.79	0.69	0.78	0.86	0.91	6.22	7.99	9.25
372	188.10	187.30	14.603	7.56	7.74	0.77	0.00	5.00	40.00	222.80	24.23	27.71	32.25	35.74	0.47	0.53	0.59	0.62	59.36	76.75	89.31
373	188.17	187.37	1.361	2.81	19.77	1.98	0.00	5.00	40.00	87.07	47.80	54.15	62.39	68.64	0.54	0.61	0.68	0.71	12.48	15.98	18.45
374	189.16	188.36	0.938	1.30	29.72	2.97	0.00	5.00	40.00	38.54	77.60	87.82	101.05	111.38	0.63	0.71	0.79	0.83	16.34	20.89	24.18
375	190.89	190.09	3.637	3.57	16.98	1.70	0.00	5.00	40.00	103.27	41.99	47.66	54.97	60.53	0.52	0.59	0.65	0.69	28.38	36.37	42.05
376	191.06	190.26	1.638	3.24	18.99	1.90	0.00	5.00	40.00	99.14	43.48	49.31	56.86	62.60	0.53	0.59	0.66	0.69	13.34	17.09	19.75
377	191.23	190.42	0.219	0.64	27.56	2.76	0.00	5.00	40.00	22.42	99.92	113.27	131.20	144.60	0.71	0.80	0.88	0.93	5.49	7.07	8.18
378	191.28	190.47																			
379	191.85	191.05	0.132	0.26	24.55	2.46	0.00	5.00	40.00	9.66	142.57	163.54	190.64	212.03	0.85	0.90	1.00	1.00	5.38	6.97	7.76
380	192.41	191.60	1.526	1.91	12.50	1.25	0.00	5.00	40.00	64.15	56.01	63.34	72.90	80.12	0.57	0.64	0.71	0.74	17.13	21.90	25.28
381	192.47	191.66																			
382	193.35	192.55	0.380	0.70	10.50	1.05	0.00	5.00	40.00	28.05	89.29	101.11	116.57	128.56	0.67	0.76	0.84	0.88	8.06	10.33	11.96
383	194.12	193.32	1.174	1.49	10.50	1.05	0.00	5.00	40.00	53.25	63.83	72.18	83.06	91.39	0.59	0.67	0.74	0.78	15.66	20.03	23.13
384	195.18	194.38	1.091	1.60	5.35	0.54	0.00	5.00	40.00	65.87	55.40	62.65	72.11	79.26	0.57	0.64	0.71	0.74	12.07	15.44	17.82
385	191.85	191.05	0.131	0.26	1.40	0.14	0.00	5.00	40.00	17.28	114.17	129.94	150.98	166.89	0.75	0.85	0.94	0.99	4.01	5.18	6.01
386	195.90	195.09	19.500	10.43	8.13	0.81	0.00	5.00	40.00	295.73	19.86	22.79	26.61	29.58	0.46	0.51	0.57	0.60	63.31	82.15	95.86
387	196.45	195.64	0.311	0.80	19.85	1.99	0.00	5.00	40.00	28.51	88.41	100.12	115.37	127.24	0.67	0.75	0.84	0.88	6.50	8.33	9.64
388	196.76	195.95	11.852	6.53	11.43	1.14	0.00	5.00	40.00	181.78	26.69	30.48	35.41	39.20	0.48	0.54	0.60	0.63	53.85	69.51	80.79
389	197.95	197.15	0.126	0.40	27.35	2.74	0.00	5.00	40.00	14.71	123.29	140.73	163.70	181.41	0.78	0.88	0.98	1.00	4.33	5.60	6.33
390	197.97	197.17	0.335	1.15	24.87	2.49	0.00	5.00	40.00	39.17	77.01	87.14	100.28	110.52	0.63	0.71	0.79	0.83	5.77	7.38	8.54
391	199.32	198.52	2.161	2.49	15.68	1.57	0.00	5.00	40.00	77.08	51.38	58.16	66.97	73.65	0.55	0.62	0.69	0.73	21.70	27.77	32.07
392	199.72	198.91	0.091	0.40	44.94	4.49	5.00	5.00	40.00	13.61	127.19	145.35	169.14	187.62	0.84	0.90	1.00	1.00	3.31	4.28	4.75
393	200.00	199.20	0.165	0.64	23.91	2.39	0.00	5.00	40.00	23.52	97.85	110.90	128.36	141.48	0.70	0.79	0.88	0.92	4.01	5.16	5.97
394	200.18	199.38	0.111	0.36	1.92	0.19	0.00	5.00	40.00	22.66	99.47	112.76	130.59	143.92	0.71	0.79	0.88	0.93	2.76	3.55	4.11
395	200.35	199.54	0.195	0.85	27.08	2.71	0.00	5.00	40.00	30.15	85.46	96.74	111.32	122.79	0.66	0.74	0.82	0.87	3.88	4.97	5.75
396	200.88	200.08	0.118	0.56	14.20	1.42	0.00	5.00	40.00	23.67	97.56	110.57	127.95	141.03	0.70	0.79	0.87	0.92	2.85	3.67	4.24
397	201.34	200.54	8.139	4.79	14.50	1.45	0.00	5.00	40.00	131.88	34.18	38.90	44.97	49.61	0.50	0.56	0.62	0.66	49.46	63.54	73.60
398	201.88	201.08	1.182	2.10	20.50	2.05	0.00	5.00	40.00	65.53	55.52	62.78	72.26	79.43	0.57	0.64	0.71	0.74	13.11	16.77	19.35
399	202.00	201.20	0.019	0.12	21.30	2.13	0.00	5.00	40.00	5.55	175.63	202.09	236.71	263.11	0.96	0.90	1.00	1.00	0.97	1.26	1.40
400	202.27	201.47	0.088	0.40	27.87	2.79	0.00	5.00	40.00	15.17	121.65	138.80	161.42	178.80	0.78	0.88	0.97	1.00	2.96	3.83	4.35
401	202.37	201.57	0.568	1.45	19.25	1.93	0.00	5.00	40.00	49.24	67.58	76.44	87.96	96.83	0.60	0.68	0.75	0.79	8.18	10.46	12.09
402	203.51	202.70	1.534	2.08	17.92	1.79	0.00	5.00	40.00	64.88	55.75	63.04	72.56	79.76	0.57	0.64	0.71	0.74	17.11	21.88	25.25
403	205.82	205.02	3.375	3.00	10.24	1.02	0.00	5.00	40.00	96.73	44.34	50.28	57.97	63.81	0.53	0.60	0.66	0.70	28.16	36.07	41.69
404	205.92	205.12																			
405	208.22	207.42	8.647	4.40	4.21	0.42	0.00	5.00	40.00	154.24	30.75	35.04	40.59	44.85	0.49	0.55	0.61	0.64	46.35	59.66	69.20

														Frequency Factor F _y	0.80	0.90	1.00	1.05			
Sl. No	Chainage (km)		Catchment Area	Catchment Drainage Length	Catchment Equal Area Slope (S _e)	Catchment Equal Area Slope Percentage	Catchment Relief	Catchment Storage	Catchment Characteristics	Time of Concentration (t _c)	Rainfall intensity for duration equal to t _c (I10)	Rainfall intensity for duration equal to t _c (I20)	Rainfall intensity for duration equal to t _c (I50)	Rainfall intensity for duration equal to t _c (I100)	Runoff Coefficient (C10)	Runoff Coefficient (C20)	Runoff Coefficient (C50)	Runoff Coefficient (C100)	20 Year ARI Flow	50 Year ARI Flow	100 Year ARI Flow
	Opt. 6 Rev 2	Opt. 6 Rev 3																	km ²	km	m/km
406	208.33	207.53																			
407	208.36	207.56																			
408	208.58	207.78	10.805	5.00	7.25	0.73	0.00	5.00	40.00	153.73	30.83	35.13	40.69	44.95	0.49	0.55	0.61	0.64	58.09	74.76	86.72
409	208.98	208.18	0.909	1.97	14.01	1.40	0.00	5.00	40.00	67.99	54.64	61.80	71.14	78.20	0.56	0.63	0.70	0.74	9.87	12.63	14.58
410	209.02	208.22																			
411	209.80	208.99	0.789	2.00	16.18	1.62	0.00	5.00	40.00	67.98	54.64	61.80	71.14	78.21	0.56	0.63	0.70	0.74	8.57	10.96	12.65
412	210.13	209.33	0.272	0.96	22.86	2.29	0.00	5.00	40.00	33.82	82.02	92.84	106.83	117.81	0.65	0.73	0.81	0.85	5.11	6.54	7.57
413	210.30	209.50																			
414	210.38	209.58	0.311	0.98	22.23	2.22	0.00	5.00	40.00	34.36	81.52	92.27	106.17	117.07	0.65	0.73	0.81	0.85	5.80	7.42	8.59
415	210.45	209.65																			
416	210.68	209.88	0.179	0.93	29.40	2.94	0.00	5.00	40.00	32.53	83.23	94.21	108.40	119.56	0.65	0.73	0.82	0.86	3.44	4.40	5.10
417	211.26	210.46	0.146	0.61	31.70	3.17	0.00	5.00	40.00	21.62	101.44	115.01	133.30	146.89	0.71	0.80	0.89	0.93	3.75	4.83	5.58
418	211.29	210.49	0.264	0.61	22.72	2.27	0.00	5.00	40.00	21.69	101.30	114.84	133.10	146.67	0.71	0.80	0.89	0.93	6.75	8.69	10.06
419	211.93	211.13	0.458	1.19	10.27	1.03	0.00	5.00	40.00	47.01	69.66	78.81	90.69	99.86	0.61	0.69	0.76	0.80	6.87	8.79	10.16
420	212.19	211.38																			
421	213.04	212.23	0.488	0.88	13.61	1.36	0.00	5.00	40.00	32.42	83.34	94.33	108.54	119.71	0.65	0.73	0.82	0.86	9.39	12.01	13.90
422	213.11	212.31	0.082	0.52	18.31	1.83	0.00	5.00	40.00	21.56	101.55	115.13	133.45	147.06	0.71	0.80	0.89	0.93	2.09	2.69	3.11
423	213.95	213.15	0.155	0.65	34.11	3.41	0.00	5.00	40.00	22.50	99.77	113.10	131.00	144.37	0.71	0.79	0.88	0.93	3.87	4.98	5.77
424	214.80	213.99	2.691	2.14	10.30	1.03	0.00	5.00	40.00	70.42	53.77	60.82	70.02	76.98	0.56	0.63	0.70	0.74	28.65	36.64	42.30
425	215.54	214.73	0.696	1.28	33.46	3.35	0.00	5.00	40.00	38.17	77.95	88.21	101.51	111.89	0.64	0.72	0.79	0.83	12.19	15.59	18.04
426	216.05	215.24	0.272	0.81	30.09	3.01	0.00	5.00	40.00	27.18	90.93	102.99	118.83	131.04	0.68	0.76	0.85	0.89	5.93	7.60	8.80
427	217.07	216.27	1.716	2.00	20.38	2.04	0.00	5.00	40.00	60.17	57.44	64.93	74.72	82.12	0.57	0.64	0.71	0.75	19.89	25.44	29.35
428	217.08	216.28																			
429	217.12	216.31																			
430	217.16	216.35																			
431	218.34	217.54	0.585	1.02	29.24	2.92	0.00	5.00	40.00	31.90	83.82	94.88	109.18	120.42	0.65	0.74	0.82	0.86	11.34	14.50	16.79
432	218.44	217.64																			
433	221.44	220.64	0.637	1.25	7.71	0.77	0.00	5.00	40.00	50.47	66.43	75.14	86.46	95.16	0.60	0.67	0.75	0.79	8.96	11.46	13.24
434	225.12	224.32	10.763	7.05	4.54	0.45	0.00	5.00	40.00	238.14	23.31	26.68	31.06	34.44	0.47	0.52	0.58	0.61	41.86	54.15	63.05
435	220.57	219.76	0.715	1.37	6.32	0.63	0.00	5.00	40.00	56.98	60.32	68.21	78.49	86.30	0.58	0.65	0.73	0.76	8.85	11.31	13.06
436	225.99	225.19	0.616	1.49	1.91	0.19	0.00	5.00	40.00	79.82	50.40	57.06	65.72	72.28	0.55	0.62	0.69	0.72	6.04	7.73	8.92
437	226.47	225.67	1.374	1.27	1.12	0.11	0.00	5.00	40.00	70.01	53.91	60.99	70.21	77.19	0.56	0.63	0.70	0.74	14.68	18.78	21.67
438	231.93	231.12	1.808	1.14	0.53	0.05	0.00	5.00	40.00	70.94	53.58	60.61	69.78	76.72	0.56	0.63	0.70	0.73	19.16	24.51	28.29
439	235.48	234.68	3.045	1.82	0.70	0.07	0.00	5.00	40.00	101.34	42.68	48.43	55.85	61.49	0.53	0.59	0.66	0.69	24.24	31.07	35.92
440	238.22	237.41	3.718	1.72	0.95	0.10	0.00	5.00	40.00	88.26	47.37	53.67	61.85	68.05	0.54	0.61	0.68	0.71	33.70	43.15	49.85
441	239.78	238.97	0.818	0.57	0.55	0.06	0.00	5.00	40.00	38.16	77.95	88.22	101.51	111.90	0.64	0.72	0.79	0.83	14.34	18.34	21.22
442	243.78	242.97	0.834	1.38	1.18	0.12	0.00	0.00	40.00	78.78	50.77	57.47	66.19	72.79	0.51	0.57	0.64	0.67	7.66	9.80	11.31

															Frequency Factor F _y	0.80	0.90	1.00	1.05			
Sl. No	Chainage (km)		Catchment Area	Catchment Drainage Length	Catchment Equal Area Slope (S _e)	Catchment Equal Area Slope Percentage	Catchment Relief	Catchment Storage	Catchment Characteristics	Time of Concentration (t _c)	Rainfall intensity for duration equal to t _c (I10)	Rainfall intensity for duration equal to t _c (I20)	Rainfall intensity for duration equal to t _c (I50)	Rainfall intensity for duration equal to t _c (I100)	Runoff Coefficient (C10)	Runoff Coefficient (C20)	Runoff Coefficient (C50)	Runoff Coefficient (C100)	20 Year ARI Flow	50 Year ARI Flow	100 Year ARI Flow	
	Opt. 6 Rev 2	Opt. 6 Rev 3																	km ²	km	m/km	%
443	244.21	243.41	0.078	0.31	3.50	0.35	0.00	0.00	40.00	17.99	111.64	126.95	147.45	162.86	0.71	0.79	0.88	0.93	2.18	2.81	3.26	
444	246.39	245.59	2.121	2.60	4.08	0.41	0.00	5.00	40.00	105.75	41.11	46.66	53.83	59.29	0.52	0.59	0.65	0.68	16.12	20.66	23.90	
445	246.61	245.81	0.748	1.42	4.80	0.48	0.00	5.00	40.00	61.94	58.52	66.53	76.95	84.86	0.58	0.65	0.72	0.76	8.97	11.53	13.35	
446	247.33	246.53	0.697	0.81	3.16	0.32	0.00	5.00	40.00	38.48	80.06	90.88	105.23	116.46	0.64	0.73	0.81	0.85	12.76	16.42	19.08	
447	250.75	249.95	1.340	1.27	3.47	0.35	0.00	5.00	40.00	55.64	63.47	72.12	83.44	92.10	0.59	0.67	0.74	0.78	17.88	22.99	26.64	
448	251.48	250.68	0.380	0.49	4.23	0.42	0.00	5.00	40.00	23.34	101.08	114.71	133.33	147.49	0.71	0.80	0.89	0.93	9.70	12.52	14.55	
449	253.29	252.49	0.640	0.72	5.81	0.58	0.00	5.00	40.00	30.53	87.74	99.57	115.32	127.74	0.67	0.75	0.84	0.88	13.31	17.13	19.92	
450	254.06	253.26	4.722	2.77	3.21	0.32	0.00	5.00	40.00	108.87	40.92	46.66	54.12	59.80	0.52	0.59	0.65	0.68	35.94	46.31	53.73	
451	259.31	258.51	1.878	2.18	1.46	0.15	0.00	5.00	40.00	109.96	40.52	46.20	53.59	59.21	0.52	0.59	0.65	0.68	14.11	18.19	21.11	
452	260.14	259.34	0.914	1.20	2.66	0.27	0.00	5.00	40.00	57.85	61.33	69.70	80.64	88.96	0.59	0.66	0.73	0.77	11.66	14.98	17.35	
453	262.20	261.40	0.154	0.24	2.77	0.28	0.00	5.00	40.00	13.76	129.04	147.91	172.28	191.34	0.81	0.90	1.00	1.00	5.71	7.39	8.21	
454	266.19	265.39	1.304	1.39	2.46	0.25	0.00	5.00	40.00	65.61	57.15	64.97	75.17	82.90	0.57	0.64	0.72	0.75	15.16	19.49	22.57	
455	267.09	266.29	0.655	1.17	5.07	0.51	0.00	5.00	40.00	51.18	67.78	77.00	89.10	98.43	0.61	0.68	0.76	0.80	9.55	12.27	14.24	
456	268.52	267.72	1.033	1.49	3.07	0.31	0.00	0.00	40.00	68.75	55.97	63.64	73.64	81.22	0.53	0.59	0.66	0.69	10.87	13.97	16.18	
457	270.02	269.21	1.313	2.20	2.03	0.20	0.00	0.00	40.00	107.65	41.38	47.18	54.71	60.45	0.48	0.54	0.60	0.63	9.35	12.05	13.98	
458	274.18	273.37	1.059	1.80	6.06	0.61	0.00	5.00	40.00	72.48	54.57	62.07	71.83	79.24	0.56	0.63	0.71	0.74	11.59	14.90	17.26	
459	275.51	274.71	0.083	0.30	9.58	0.96	0.00	5.00	40.00	14.35	126.98	145.43	169.38	188.05	0.80	0.90	1.00	1.00	3.02	3.91	4.35	
460	275.55	274.74	0.114	0.74	9.80	0.98	0.00	5.00	40.00	33.95	84.43	95.83	110.99	122.89	0.66	0.74	0.82	0.86	2.25	2.90	3.37	
461	275.90	275.10	0.342	0.98	7.86	0.79	0.00	5.00	40.00	41.98	76.67	87.06	100.79	111.49	0.63	0.71	0.79	0.83	5.89	7.58	8.80	
462	276.19	275.39	0.105	0.48	11.64	1.16	0.00	5.00	40.00	21.15	105.28	119.48	139.00	153.72	0.73	0.82	0.91	0.95	2.83	3.66	4.25	
463	276.40	275.60	0.238	0.76	16.45	1.65	0.00	5.00	40.00	29.24	89.72	101.82	117.99	130.68	0.68	0.76	0.84	0.89	5.12	6.59	7.66	
464	276.87	276.07	0.564	1.27	7.47	0.75	0.00	5.00	40.00	52.20	66.79	75.88	87.81	96.98	0.60	0.68	0.75	0.79	8.07	10.37	12.03	
465	277.29	276.49	9.803	5.68	3.79	0.38	0.00	5.00	40.00	200.75	25.81	29.54	34.51	38.24	0.47	0.53	0.59	0.62	42.96	55.77	64.90	
466	277.73	276.93	1.142	1.66	16.25	1.63	0.00	5.00	40.00	54.39	64.67	73.48	85.02	93.86	0.60	0.67	0.75	0.78	15.63	20.09	23.29	
467	278.25	277.45	0.076	0.62	17.27	1.73	0.00	5.00	40.00	26.29	95.40	108.26	125.66	139.08	0.69	0.78	0.87	0.91	1.79	2.30	2.68	
468	278.69	277.89	0.054	0.32	18.28	1.83	0.00	5.00	40.00	13.78	128.98	147.83	172.19	191.24	0.81	0.90	1.00	1.00	2.01	2.60	2.88	
469	278.98	278.18	0.055	0.48	25.36	2.54	0.00	5.00	40.00	19.39	109.60	124.53	144.96	160.35	0.74	0.83	0.92	0.97	1.60	2.06	2.40	
470	279.12	278.31	0.032	0.39	30.88	3.09	0.00	5.00	40.00	16.16	120.74	137.93	160.61	178.11	0.78	0.87	0.97	1.00	1.08	1.40	1.60	
471	279.20	278.40	0.146	0.64	13.44	1.34	0.00	5.00	40.00	26.84	94.34	107.06	124.22	137.51	0.69	0.78	0.86	0.91	3.38	4.36	5.07	
472	279.42	278.62	0.020	0.26	38.22	3.82	0.00	5.00	40.00	10.76	139.37	160.33	186.80	207.80	0.84	0.90	1.00	1.00	0.79	1.03	1.14	
473	279.83	279.02	0.216	0.65	25.41	2.54	0.00	5.00	40.00	22.90	101.93	115.67	134.47	148.75	0.71	0.80	0.89	0.94	5.59	7.22	8.38	
474	280.07	279.26	0.022	0.20	104.88	10.49	5.00	5.00	40.00	6.54	167.97	193.36	226.42	251.82	0.98	0.90	1.00	1.00	1.09	1.41	1.57	
475	280.11	279.31																				
476	280.44	279.63																				
477	280.56	279.76	0.028	0.24	85.51	8.55	5.00	5.00	40.00	8.05	156.62	180.31	210.73	234.42	0.94	0.90	1.00	1.00	1.25	1.63	1.81	
478	280.73	279.93	0.076	0.39	57.92	5.79	5.00	5.00	40.00	13.12	131.22	150.54	175.35	194.82	0.85	0.90	1.00	1.00	2.86	3.70	4.11	
478	280.73	279.93	0.241	0.91	18.94	1.89	0.00	5.00	40.00	33.77	84.61	96.03	111.21	123.15	0.66	0.74	0.82	0.86	4.76	6.12	7.12	
479	281.03	280.22	0.415	1.15	13.93	1.39	0.00	5.00	40.00	43.17	75.52	85.75	99.27	109.80	0.63	0.71	0.79	0.83	7.00	9.01	10.46	

															Frequency Factor F _y	0.80	0.90	1.00	1.05			
Sl. No	Chainage (km)		Catchment Area	Catchment Drainage Length	Catchment Equal Area Slope (S _a)	Catchment Equal Area Slope Percentage	Catchment Relief	Catchment Storage	Catchment Characteristics	Time of Concentration (t _c)	Rainfall intensity for duration equal to t _c (I10)	Rainfall intensity for duration equal to t _c (I20)	Rainfall intensity for duration equal to t _c (I50)	Rainfall intensity for duration equal to t _c (I100)	Runoff Coefficient (C10)	Runoff Coefficient (C20)	Runoff Coefficient (C50)	Runoff Coefficient (C100)	20 Year ARI Flow	50 Year ARI Flow	100 Year ARI Flow	
	Opt. 6 Rev 2	Opt. 6 Rev 3																	km ²	km	m/km	%
480	281.30	280.50	0.110	0.43	27.53	2.75	0.00	5.00	40.00	16.15	120.77	137.97	160.66	178.16	0.78	0.87	0.97	1.00	3.70	4.79	5.47	
481	281.61	280.81	0.112	0.54	33.45	3.35	0.00	5.00	40.00	19.25	110.07	125.09	145.62	161.10	0.74	0.83	0.93	0.97	3.25	4.20	4.88	
482	282.88	282.07	1.292	1.36	8.16	0.82	0.00	5.00	40.00	50.57	68.36	77.66	89.87	99.29	0.61	0.68	0.76	0.80	19.05	24.50	28.42	
483	283.74	282.94	1.009	2.56	10.79	1.08	0.00	5.00	40.00	92.02	47.24	53.79	62.32	68.79	0.54	0.61	0.68	0.71	9.19	11.82	13.71	
484	283.92	283.12	1.751	3.18	8.18	0.82	0.00	5.00	40.00	114.38	38.86	44.33	51.43	56.85	0.52	0.58	0.64	0.68	12.51	16.12	18.71	
485	284.43	283.62	3.884	4.51	9.18	0.92	0.00	5.00	40.00	146.74	32.45	37.07	43.13	47.72	0.50	0.56	0.62	0.65	22.29	28.82	33.48	
486	284.78	283.97	1.010	1.90	8.33	0.83	0.00	5.00	40.00	71.87	54.80	62.32	72.12	79.56	0.57	0.64	0.71	0.74	11.12	14.30	16.56	
487	286.08	285.27	5.547	5.18	6.94	0.69	0.00	5.00	40.00	171.71	28.43	32.51	37.93	42.00	0.48	0.54	0.60	0.63	27.22	35.28	41.03	
488	286.67	285.86	0.281	0.63	17.50	1.75	0.00	5.00	40.00	23.52	100.72	114.30	132.84	146.96	0.71	0.80	0.89	0.93	7.14	9.23	10.72	
489	286.96	286.16	2.798	4.35	10.83	1.08	0.00	5.00	40.00	141.26	33.33	38.07	44.27	48.98	0.50	0.56	0.62	0.65	16.59	21.43	24.89	
490	287.01	286.21																				
491	287.66	286.86	0.556	1.22	10.01	1.00	0.00	5.00	40.00	47.37	71.46	81.16	93.94	103.84	0.62	0.69	0.77	0.81	8.71	11.20	12.99	
492	288.28	287.48	17.313	7.08	7.08	0.71	0.00	5.00	40.00	208.64	25.32	28.98	33.86	37.54	0.47	0.53	0.59	0.62	74.20	96.34	112.14	
493	288.72	287.92	0.482	1.27	11.91	1.19	0.00	5.00	40.00	48.26	70.60	80.19	92.81	102.57	0.61	0.69	0.77	0.81	7.43	9.56	11.09	
494	289.05	288.25	0.138	0.59	18.04	1.80	0.00	5.00	40.00	23.25	101.24	114.90	133.55	147.73	0.71	0.80	0.89	0.94	3.53	4.56	5.29	
495	289.82	289.02	0.229	0.64	0.46	0.05	0.00	5.00	40.00	49.85	69.07	78.45	90.80	100.32	0.61	0.69	0.76	0.80	3.43	4.41	5.12	
496	290.65	289.84	2.096	1.81	9.21	0.92	0.00	5.00	40.00	62.62	58.27	66.24	76.63	84.50	0.58	0.65	0.72	0.76	24.99	32.12	37.19	
497	291.98	291.18	0.283	0.82	16.00	1.60	0.00	5.00	40.00	31.06	87.23	98.99	114.66	127.00	0.67	0.75	0.83	0.88	5.84	7.51	8.73	
498	292.69	291.89	0.310	0.64	22.32	2.23	0.00	5.00	40.00	22.58	102.54	116.37	135.30	149.66	0.72	0.81	0.90	0.94	8.09	10.45	12.14	
499	292.99	292.19	1.509	2.14	10.68	1.07	0.00	5.00	40.00	74.09	53.97	61.39	71.04	78.37	0.56	0.63	0.70	0.74	16.28	20.94	24.25	
500	295.05	294.25	3.159	2.99	9.53	0.95	0.00	5.00	40.00	98.55	44.79	51.03	59.14	65.31	0.53	0.60	0.67	0.70	26.90	34.64	40.17	
501	295.55	294.75	8.193	6.44	4.33	0.43	0.00	5.00	40.00	225.82	24.25	27.77	32.46	36.00	0.47	0.53	0.59	0.62	33.41	43.39	50.53	
502	296.35	295.54	1.240	1.24	9.33	0.93	0.00	5.00	40.00	45.01	73.74	83.74	96.94	107.19	0.62	0.70	0.78	0.82	20.27	26.07	30.27	
503	297.28	296.47	1.262	1.97	6.49	0.65	0.00	5.00	40.00	76.69	52.99	60.29	69.78	76.99	0.56	0.63	0.70	0.73	13.30	17.10	19.81	
504	298.61	297.81	11.295	7.79	6.96	0.70	0.00	5.00	40.00	240.43	23.34	26.74	31.26	34.69	0.47	0.53	0.58	0.61	44.07	57.27	66.73	
505	298.80	298.00	16.164	9.95	4.68	0.47	0.00	5.00	40.00	320.96	18.33	21.05	24.69	27.49	0.45	0.51	0.56	0.59	47.99	62.53	73.11	
506	305.07	304.26	2.838	3.82	4.00	0.40	0.00	5.00	40.00	151.13	31.74	36.27	42.21	46.72	0.49	0.55	0.62	0.65	15.87	20.52	23.84	

Appendix G : Hydrographs

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1.0 PEAK FLOW HYDROGRAPHS - SPLITTERS CREEK

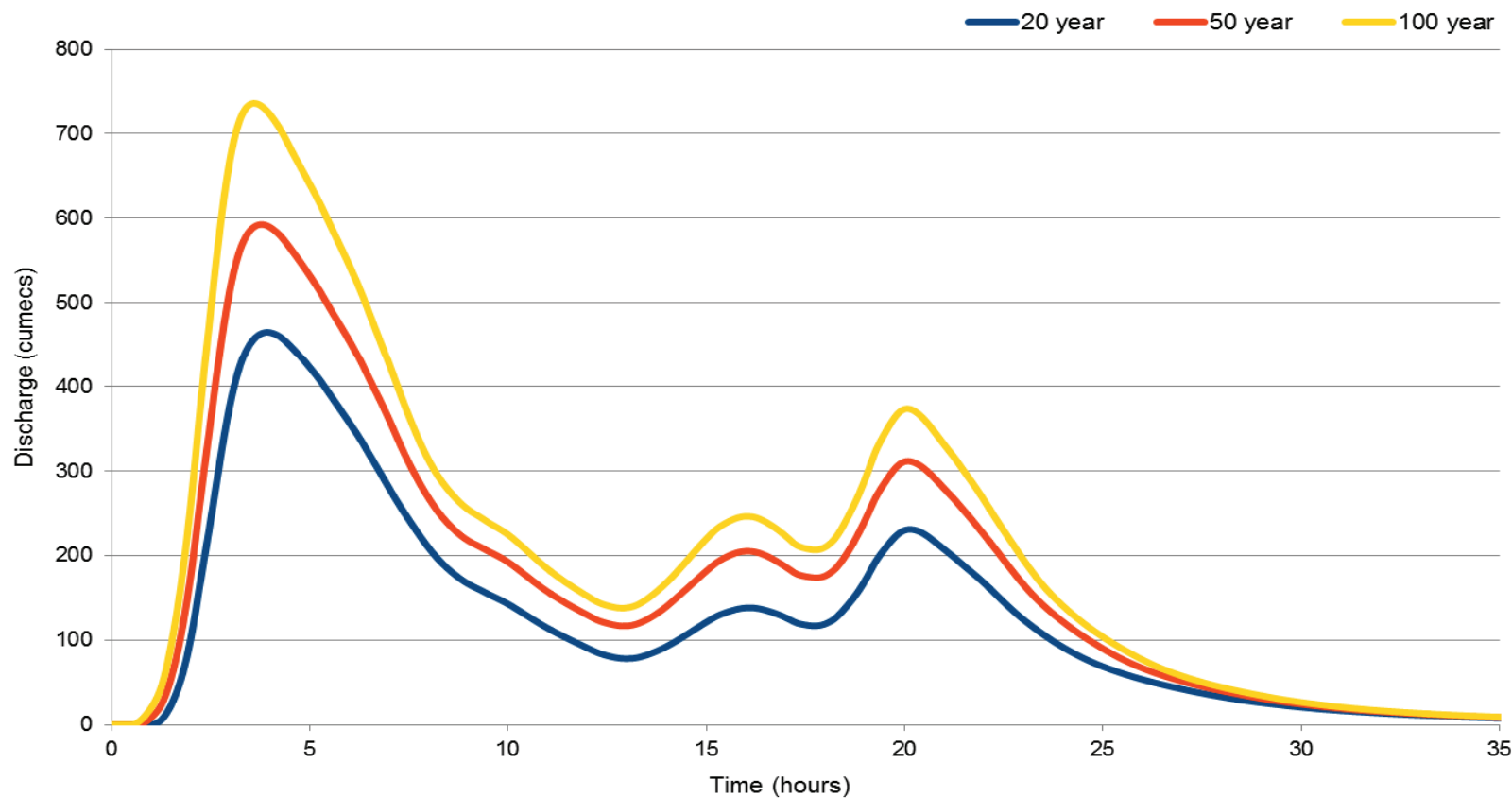


Figure 1: Peak flow hydrographs of Splitters Creek for ARI 20, 50 and 100 years

2.0 PEAK FLOW HYDROGRAPHS - ELLIOT RIVER

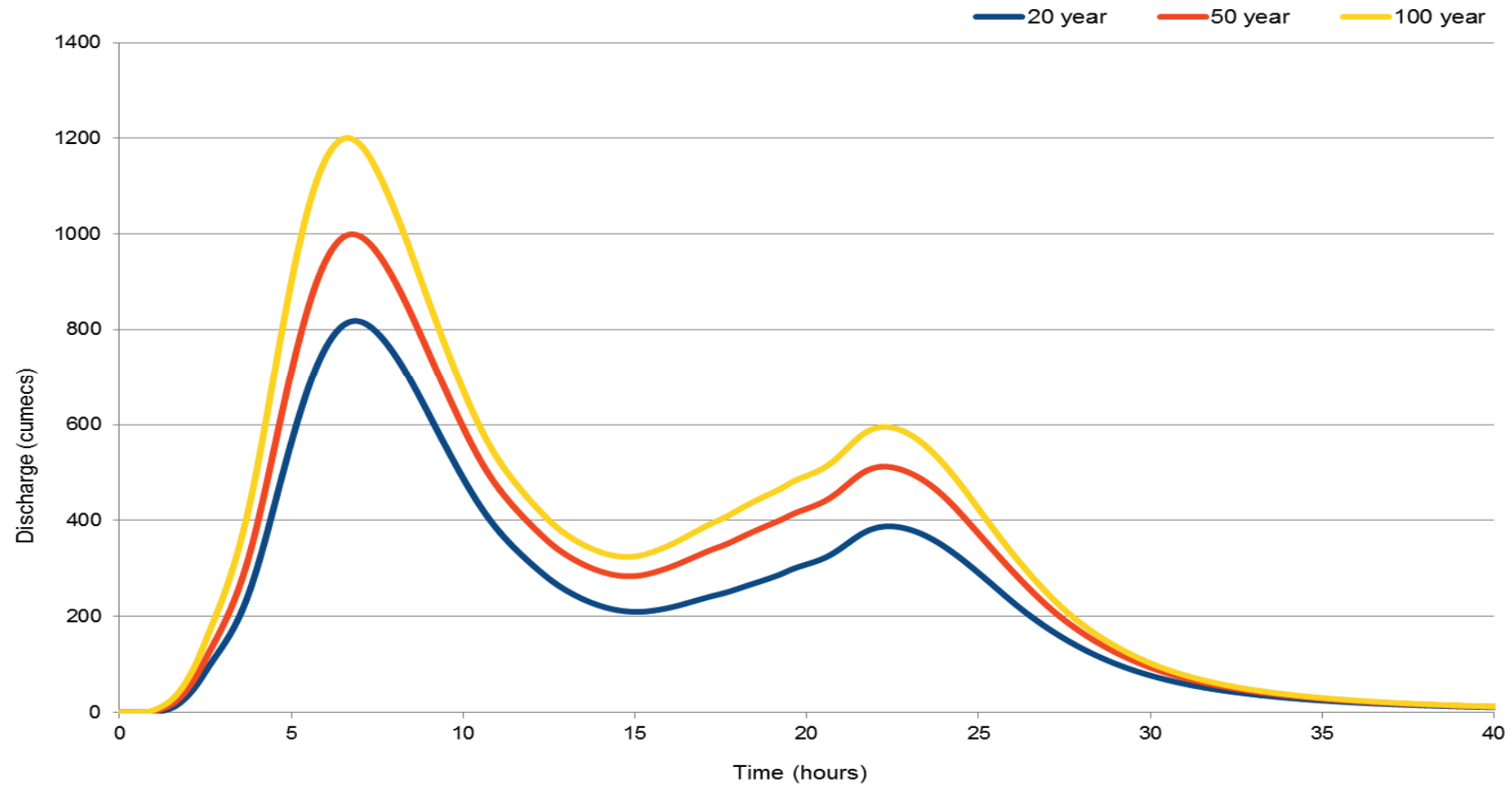


Figure 2: Peak flow hydrographs of Elliot River for ARI 20, 50 and 100 years

3.0 PEAK FLOW HYDROGRAPHS - BOGIE RIVER

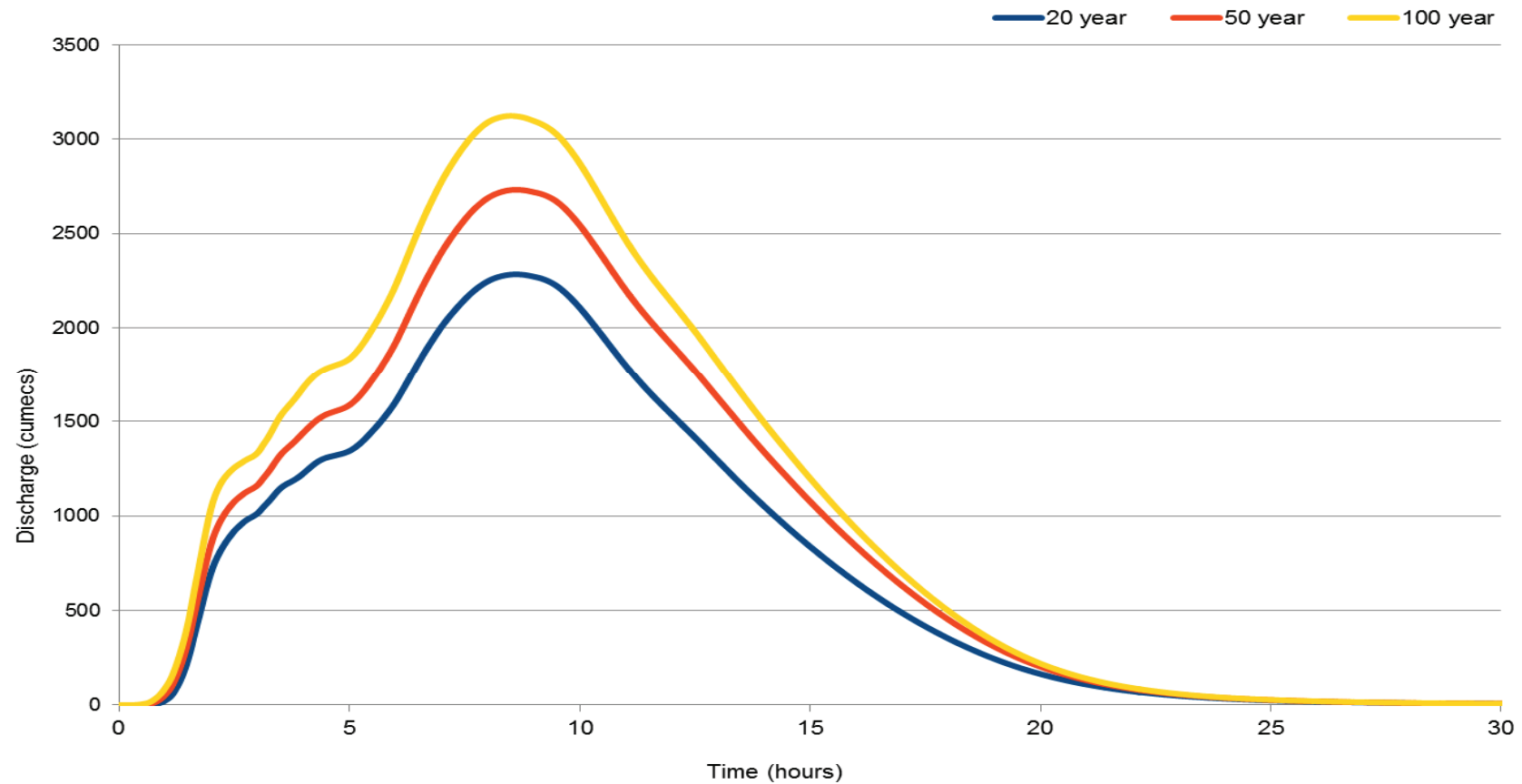


Figure 3: Peak flow hydrographs of Bogie River for ARI 20, 50 and 100 years

4.0 PEAK FLOW HYDROGRAPHS - SANDY CREEK

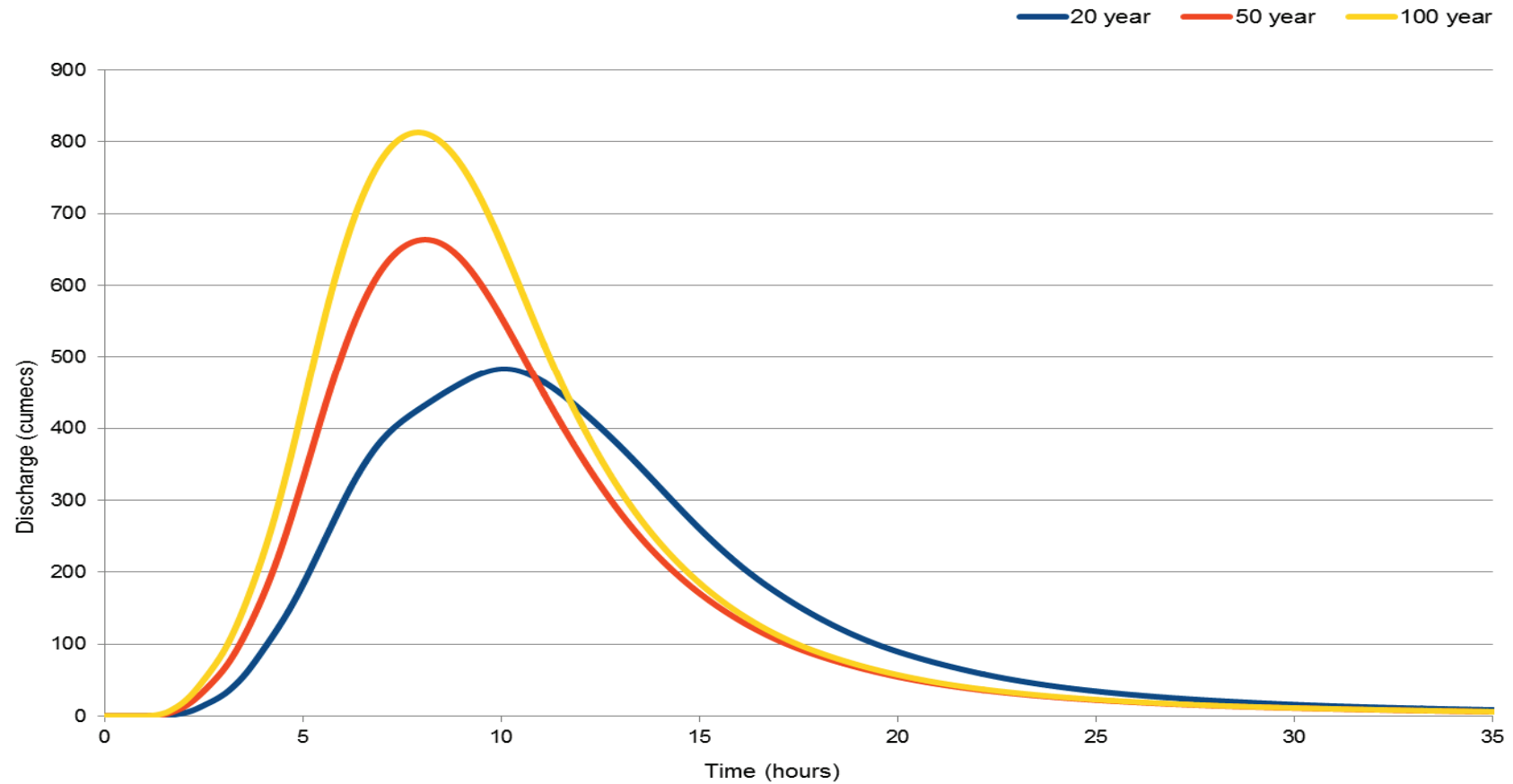


Figure 4: Peak flow hydrographs of Sandy Creek for ARI 20, 50 and 100 years

5.0 PEAK FLOW HYDROGRAPHS - STRATHMORE CREEK

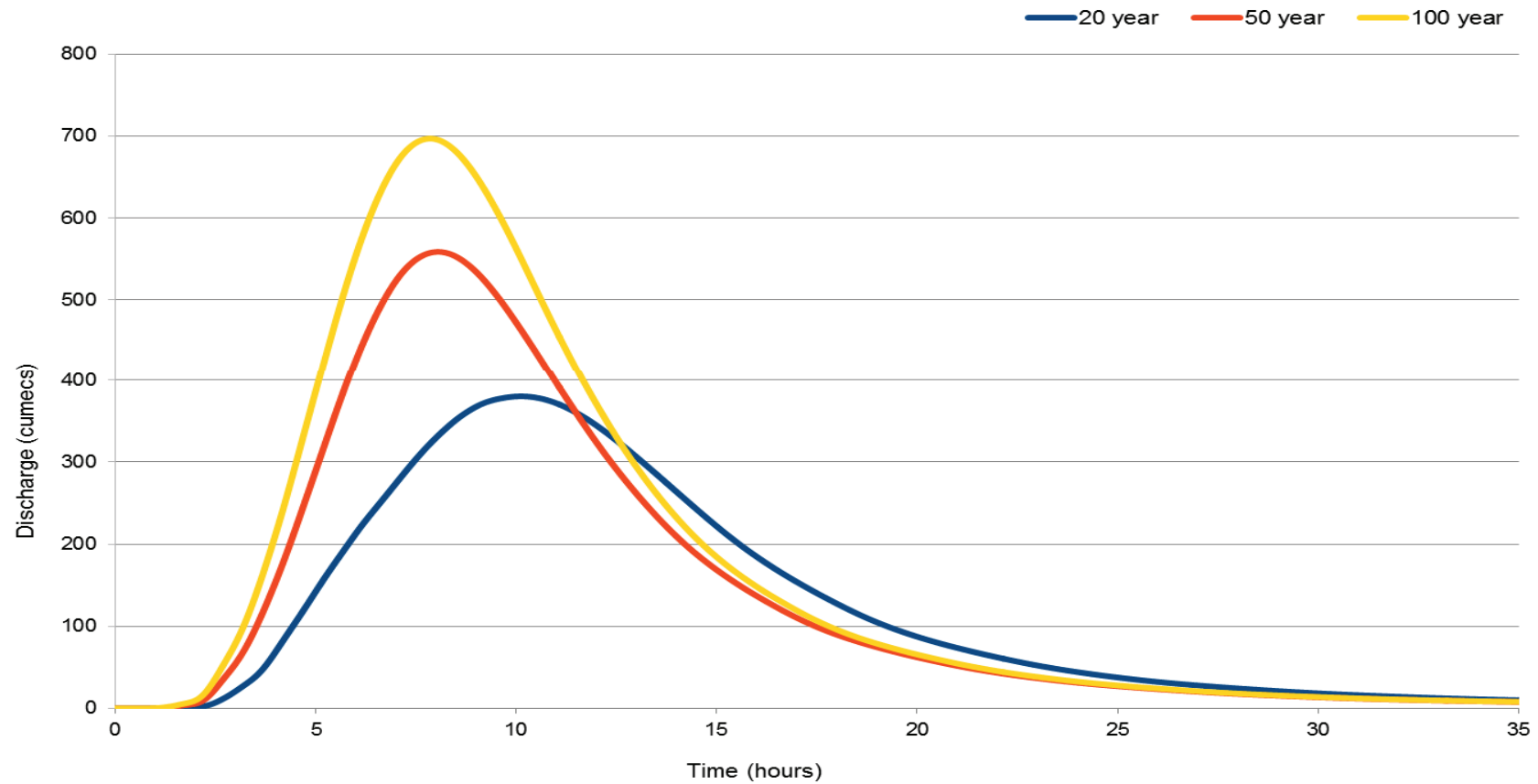


Figure 5: Peak flow hydrographs of Strathmore Creek for ARI 20, 50 and 100 years

6.0 PEAK FLOW HYDROGRAPHS - PELICAN CREEK

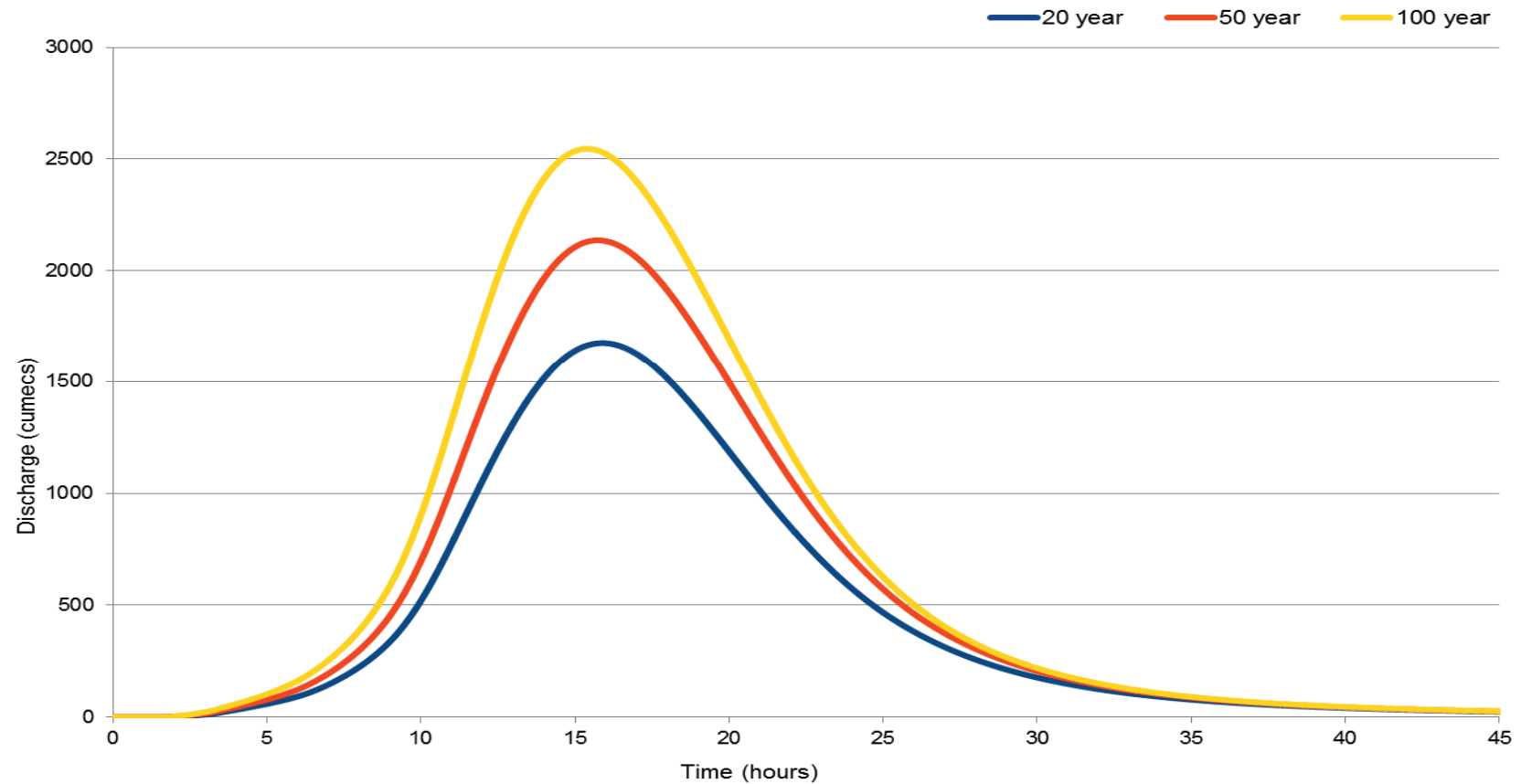


Figure 6: Peak flow hydrographs of Pelican Creek for ARI 20, 50 and 100 years

7.0 PEAK FLOW HYDROGRAPHS - BOWEN RIVER

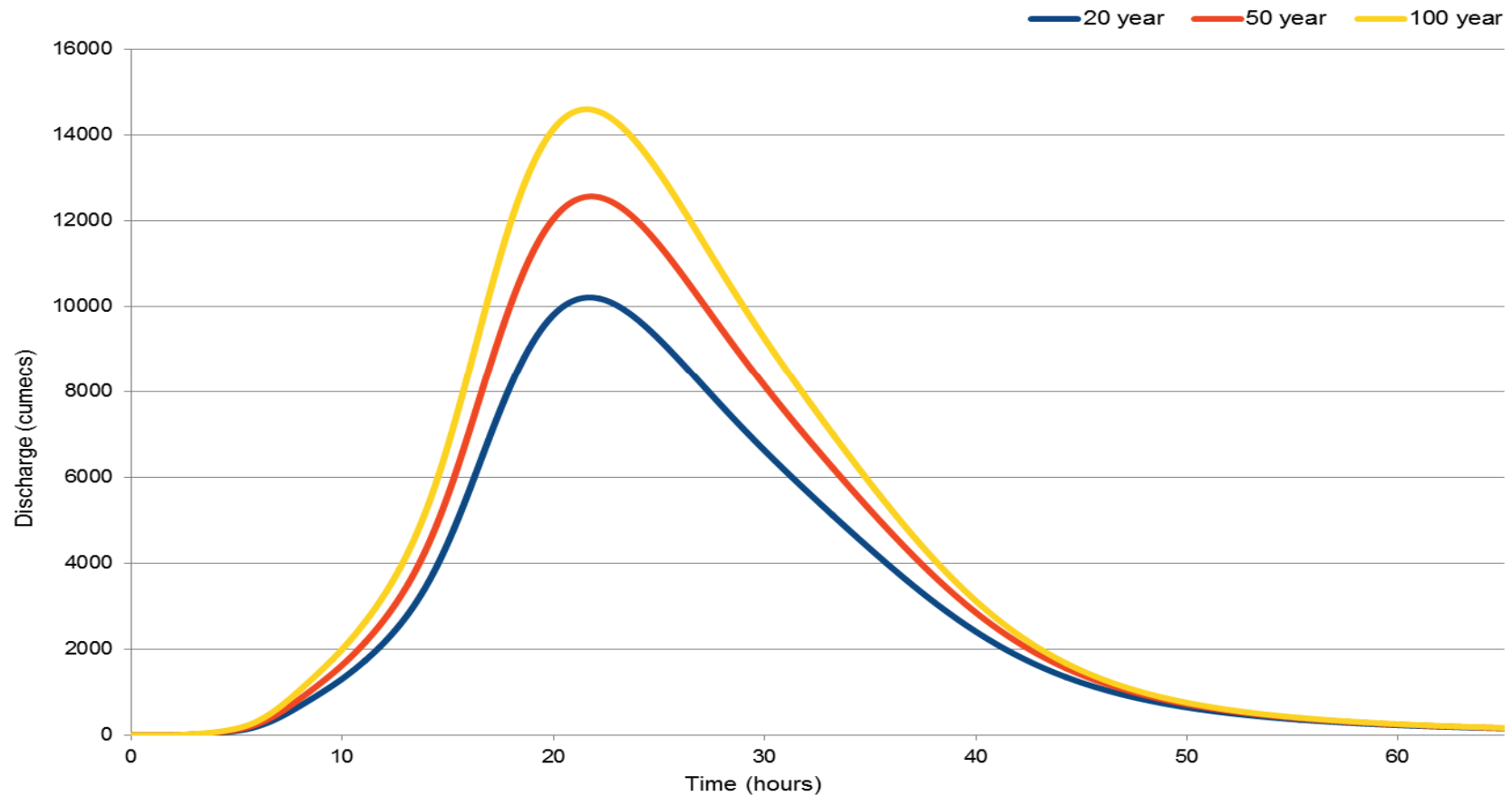


Figure 7: Peak flow hydrographs of Bowen River for ARI 20, 50 and 100 years

8.0 PEAK FLOW HYDROGRAPHS - UPPER SUTTOR RIVER

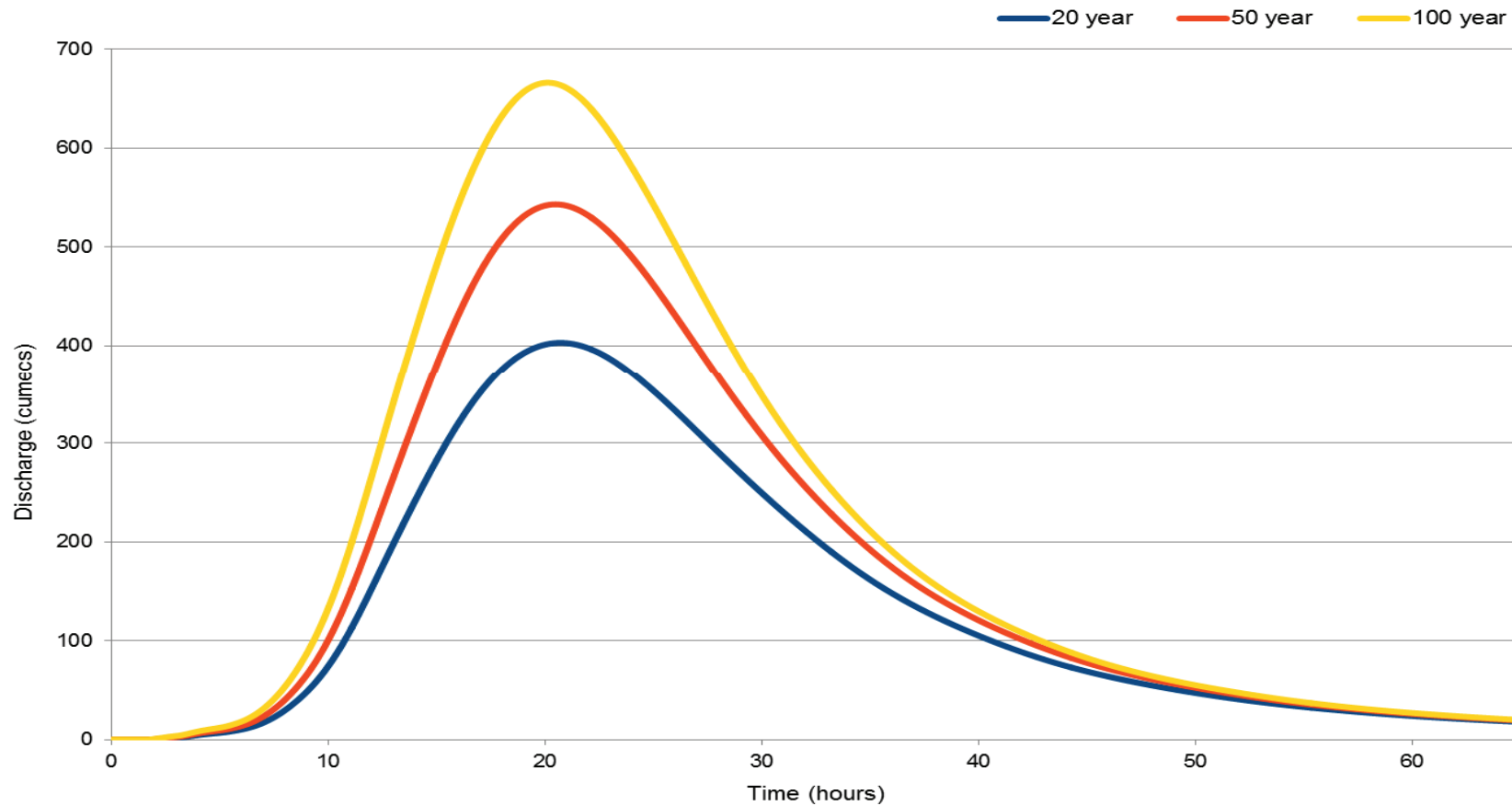


Figure 8: Peak flow hydrographs of Upper Suttor River for ARI 20, 50 and 100 years

9.0 PEAK FLOW HYDROGRAPHS - LILY CREEK

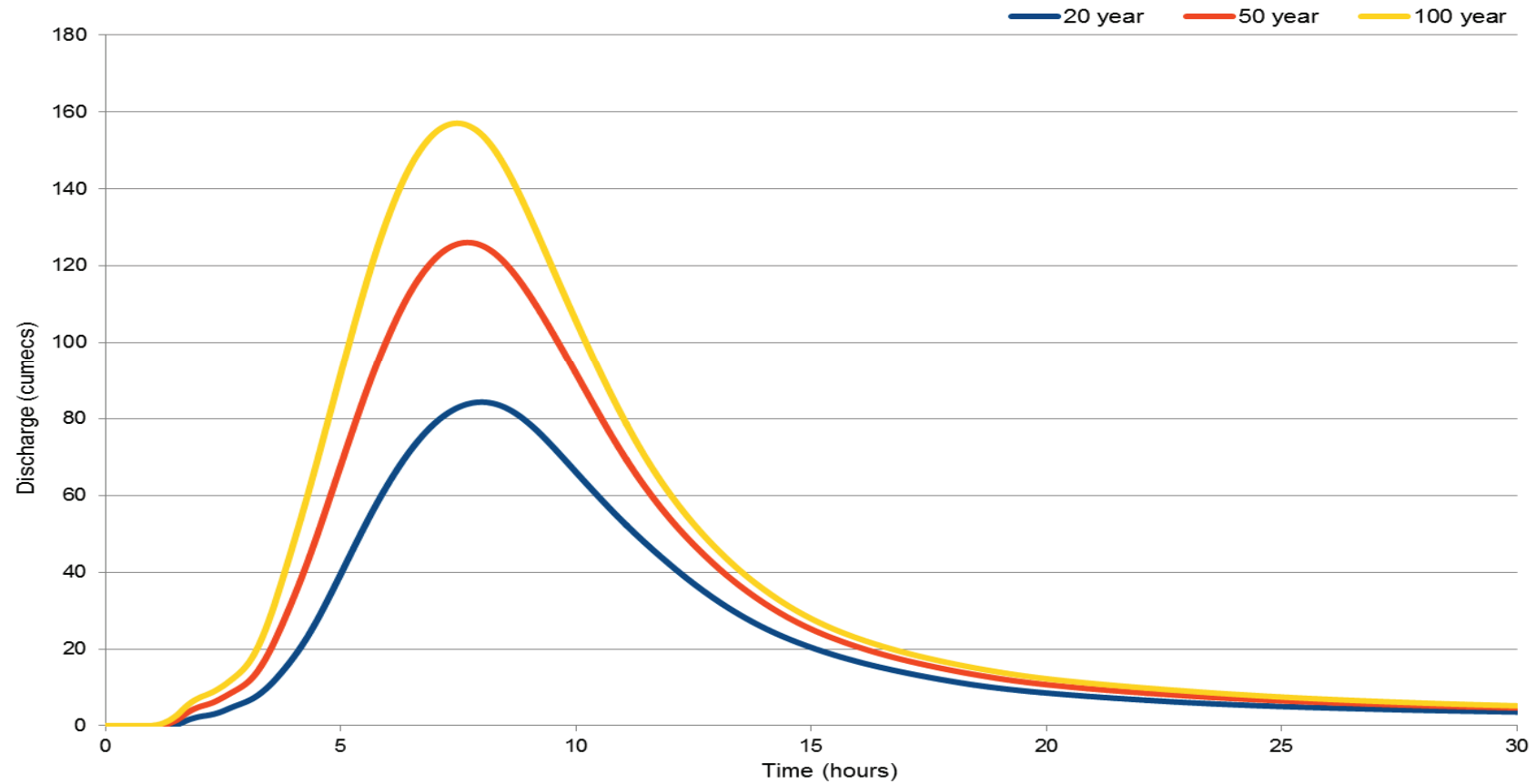


Figure 9: Peak flow hydrographs of Lily Creek for ARI 20, 50 and 100 years

10.0 PEAK FLOW HYDROGRAPHS - ROCKINGHAM CREEK

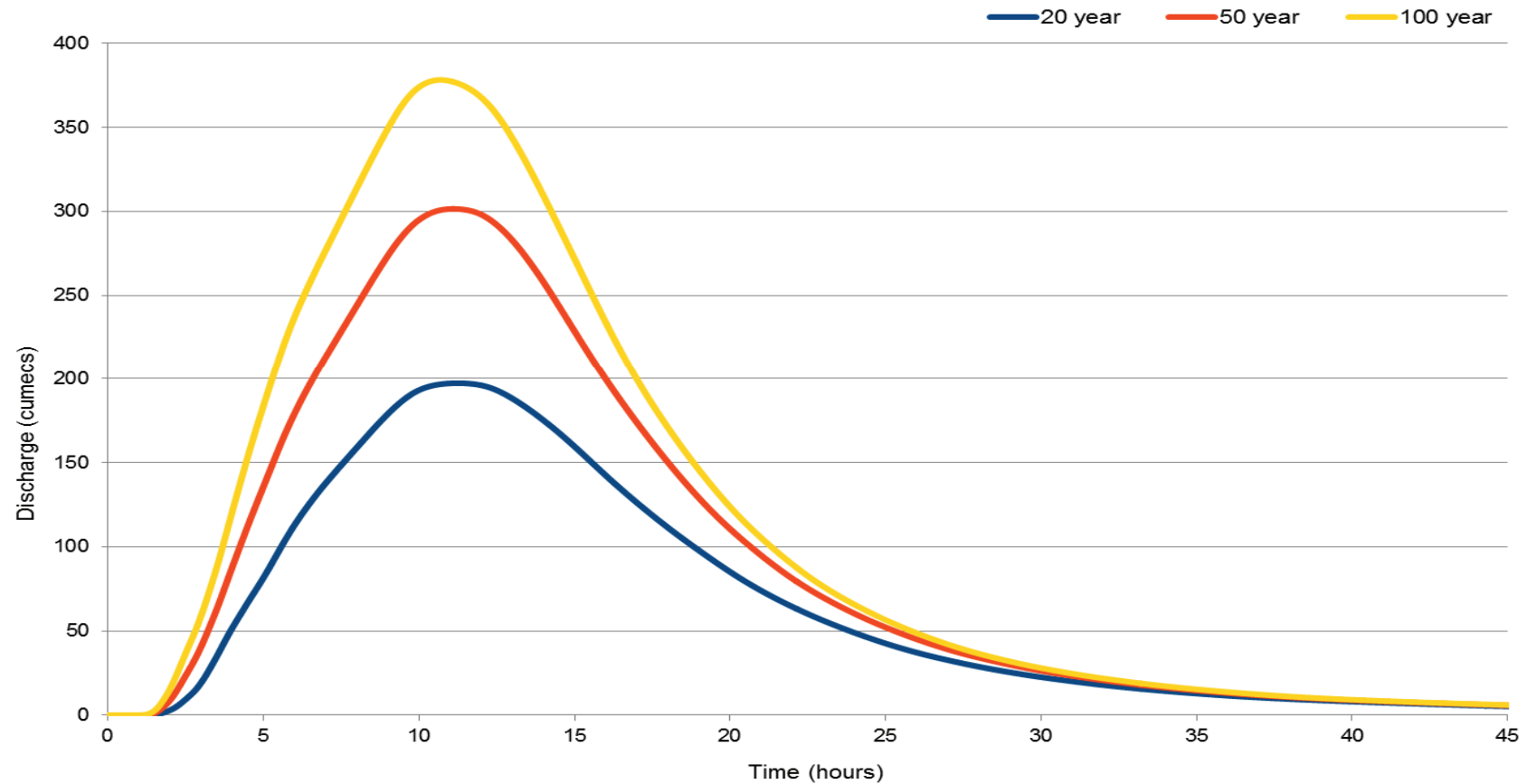


Figure 10: Peak flow hydrographs of Rockingham Creek for ARI 20, 50 and 100 years

11.0 PEAK FLOW HYDROGRAPHS - MURRAY CREEK

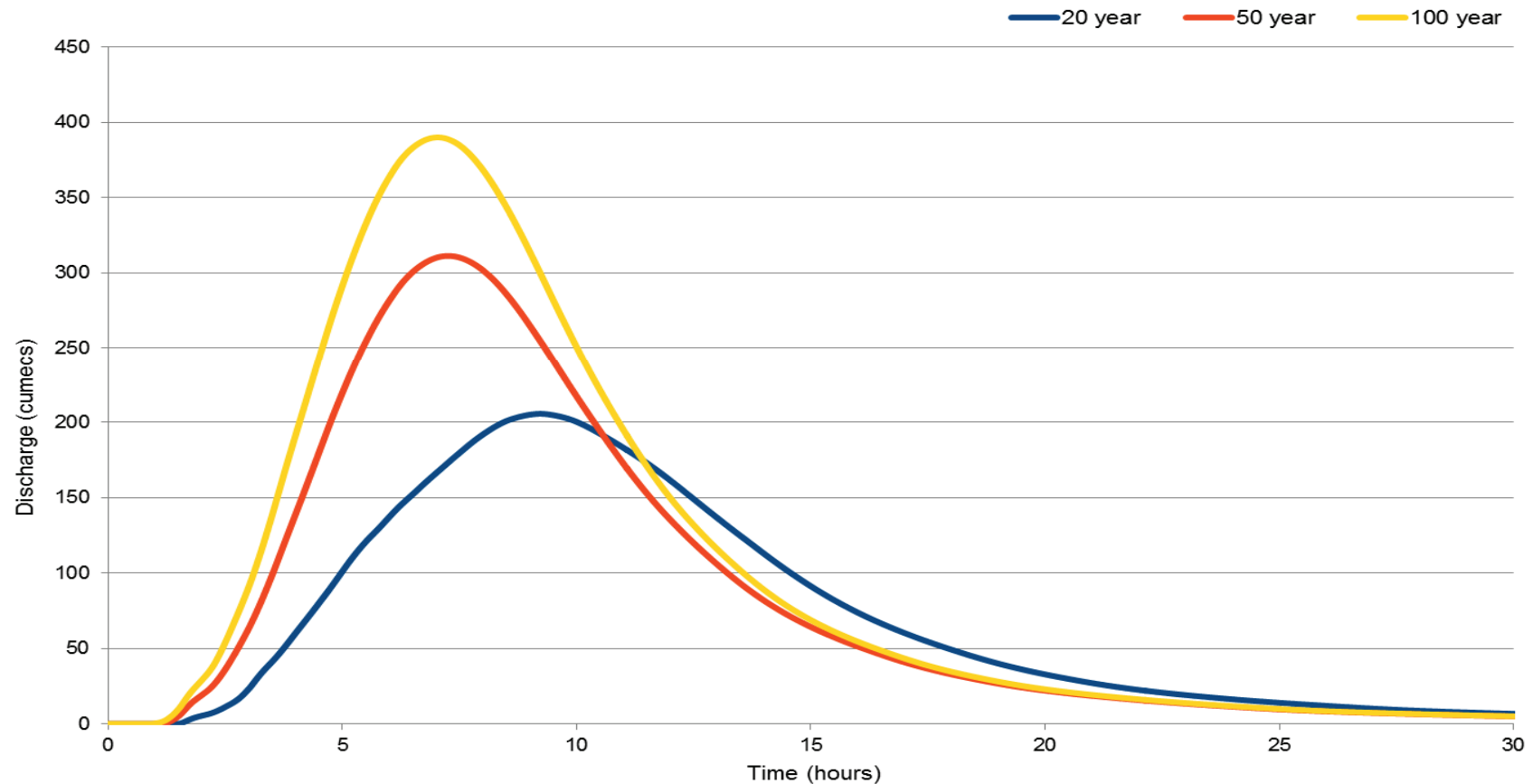


Figure 11: Peak flow hydrographs of Murray Creek for ARI 20, 50 and 100 years

12.0 PEAK FLOW HYDROGRAPHS - GUNN CREEK

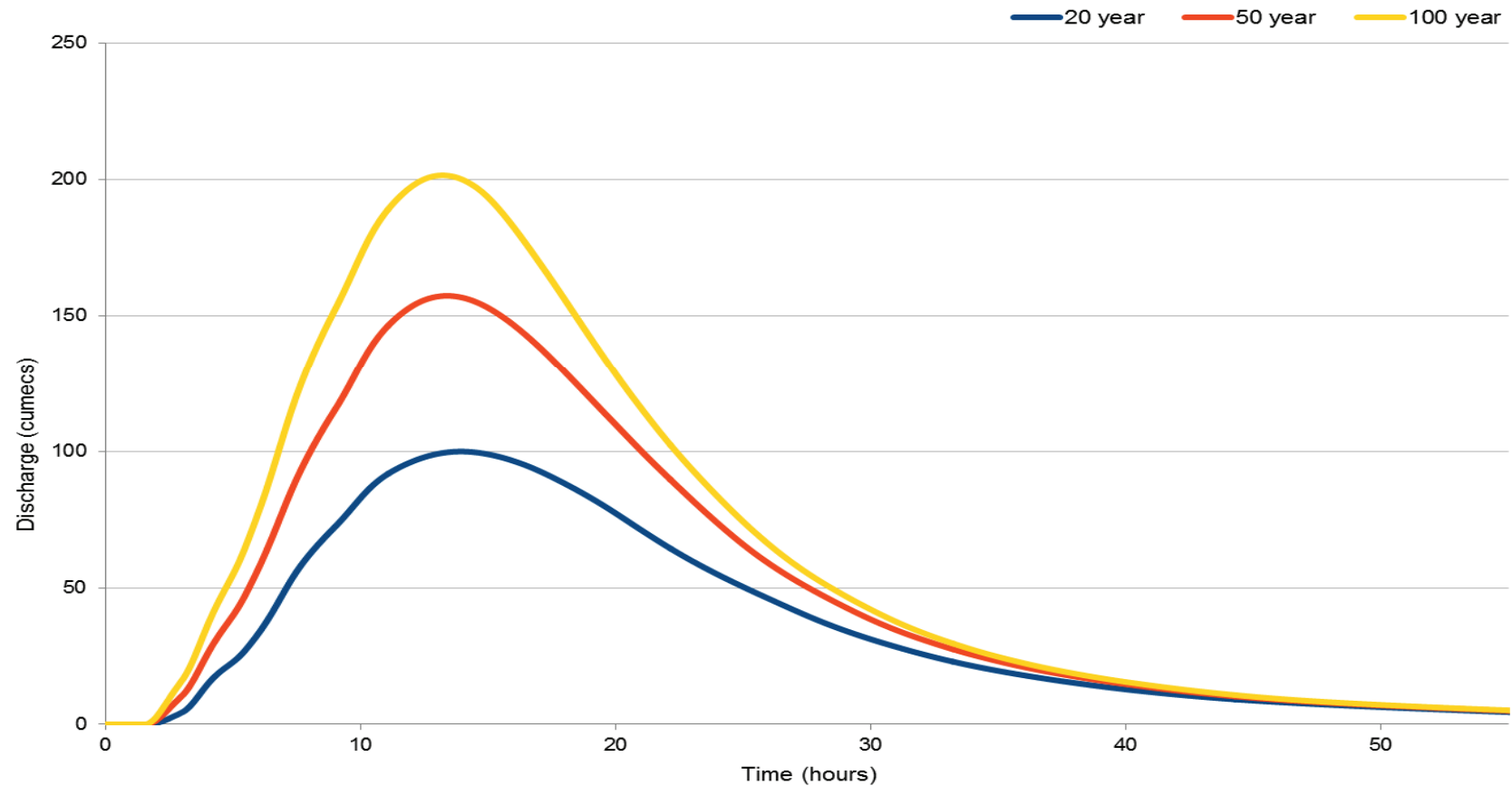


Figure 12: Peak flow hydrographs of Gunn Creek for ARI 20, 50 and 100 years

13.0 PEAK FLOW HYDROGRAPHS - VERBENA CREEK

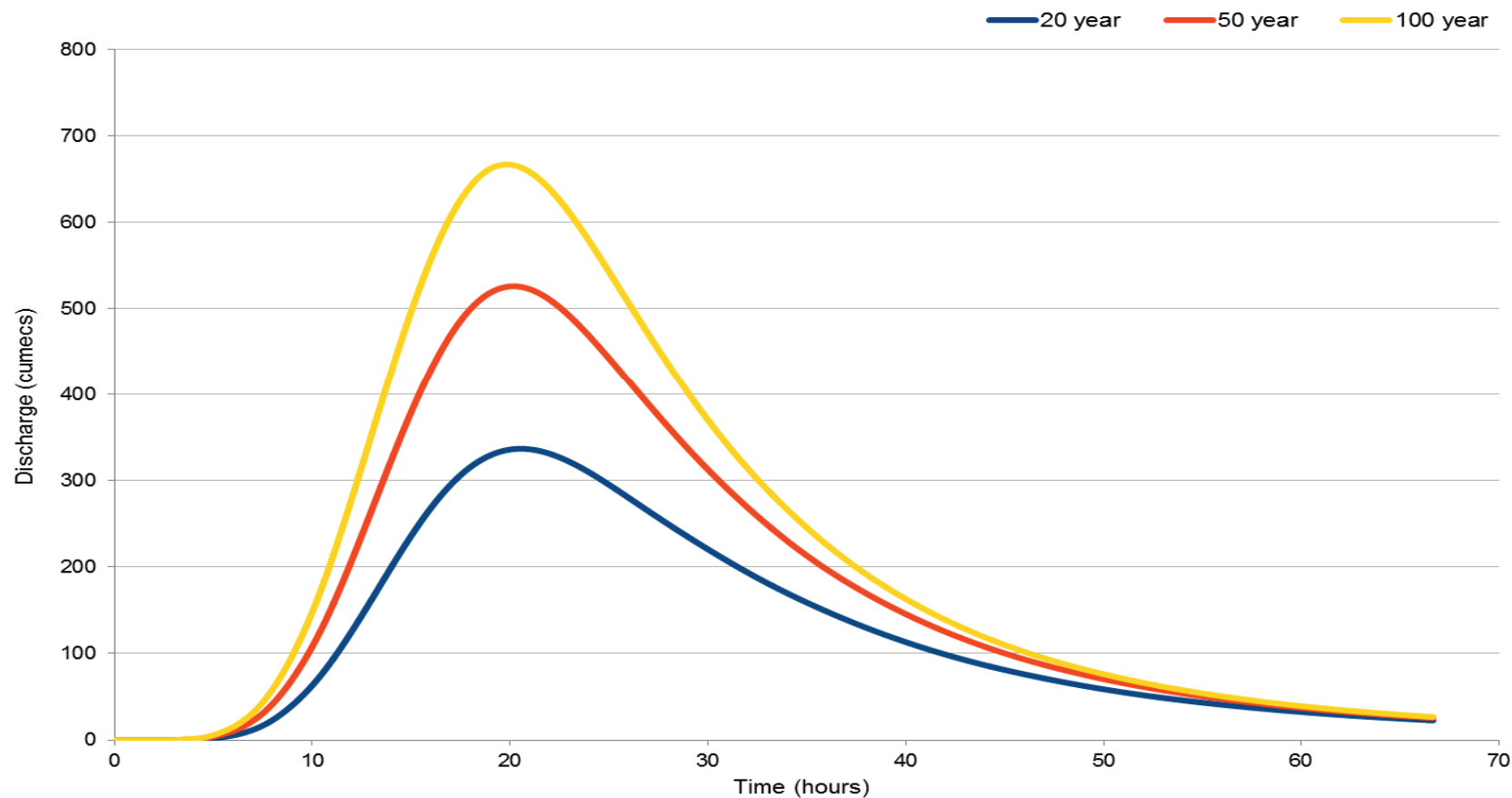


Figure 13: Peak flow hydrographs of Verbena Creek for ARI 20, 50 and 100 years

14.0 PEAK FLOW HYDROGRAPHS- SERPENTINE CREEK

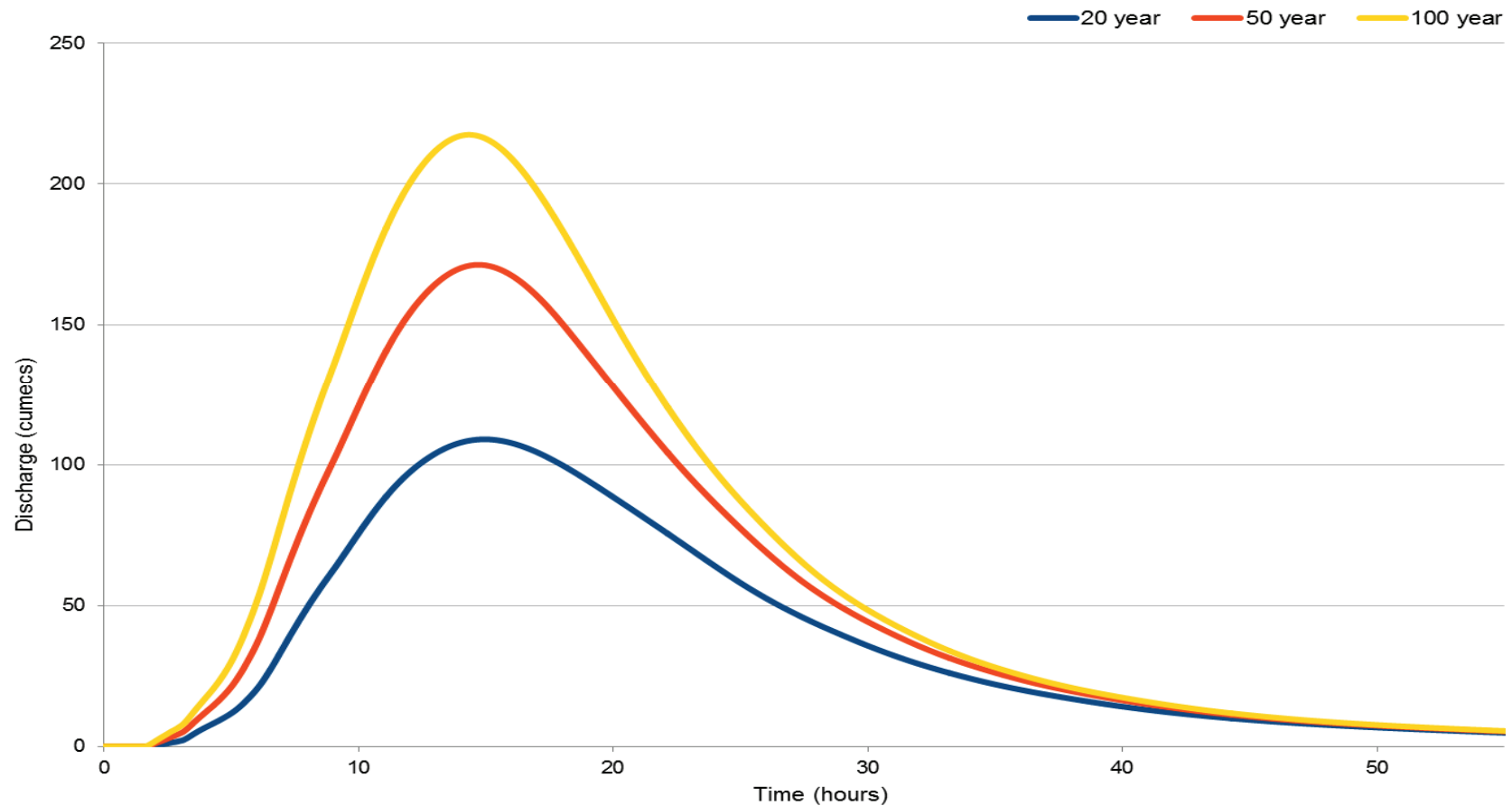


Figure 14: Peak flow hydrographs of Serpentine Creek for ARI 20, 50 and 100 years

15.0 PEAK FLOW HYDROGRAPHS - SUTTOR RIVER

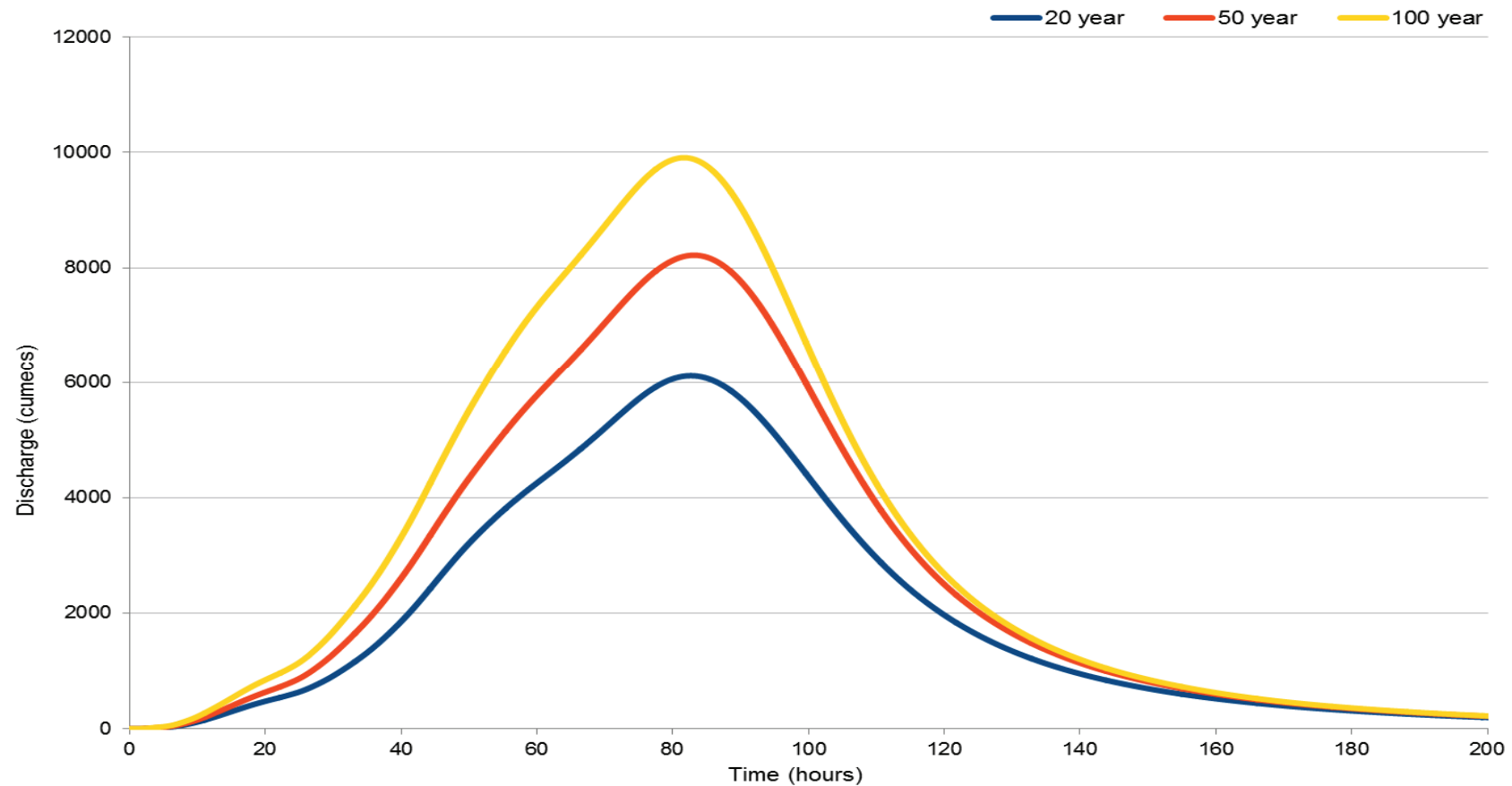


Figure 15: Peak flow hydrographs of Suttor Creek for ARI 20, 50 and 100 years

Appendix H : Preliminary 2D Hydraulic Modelling

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1.0 XP-2D MODEL

In order to accurately assess the complex floodplain interaction, a full hydrodynamic 2D model for each system was generated using XP-SWMM+XP2D. The model had the ability to simulate features such as complex floodplains while also allowing sub grid-scale features such as culverts and bridges to be modelled.

2.0 ROUGHNESS COEFFICIENTS

A Manning's n of 0.04 has been adopted for main channels and 0.09 for floodplains.

3.0 DESCRIPTION/PROCESS

A Digital Terrain Model (DTM) was generated from the LiDAR survey data for each floodplain system. The DTM for each system is replicated within the 2-d model domain by square grids (topography), where each grid cell represents the average height data from the DTM. Grid sizes vary from 10m up to 50m in width. These grid cell sizes are considered reasonable for the significant areas covered in each model and allow reasonable model run times without compromising loss of survey detail.

For a 2D modelling scheme, the Courant Number generally needs to be less than ten and is typically around five for stabilising the models. The computation time step was set in accordance with this criterion. A time step, typically half the cell size or less, was adopted to keep the Courant Number within limits. A summary of the grid size and time step selected for each system is shown below in Table 3.1.

Table 3.1 - 2D Modelling Parameter Summary

ITEM	SYSTEM NAME	CHAINAGE (KM)	GRID CELL SIZE	TIME STEP (SECONDS)
1	Splitters Creek	20.23	10 m x 10 m	10
2	Elliot River	35.08	20 m x 20 m	2
3	Bogie River	61.22	20 m x 20 m	5
4	Pelican Creek	106.05	20 m x 20 m	5
5	Bowen River	132.20	20 m x 20 m	3
6	Upper Suttor River	172.06	10 m x 10 m	5
7	Rockingham Creek	187.00	10 m x 10 m	3
8	Murray Creek	206.51	10 m x 10 m	5
9	Verbena Creek	242.53	20 m x 20 m	4
10	Suttor River	271.06 - 273.37	50 m x 50 m	15

The bed resistance to flow within the catchment depends on the Manning's n values, which can be varied over the 2D model domain. The Manning's n values for channels and floodplains was created for considering appropriate Manning's n values of 0.04 for channels and 0.09 for floodplains for hydraulic computations.

The inflow boundaries into the 2D model domain are hydrographs extracted from the hydrological modelling of catchments for various ARI events. The downstream boundary condition has been set as a normal depth .

The existing condition was represented and the boundary conditions are set up in the 2D model, the various design flow events were run through the model to get the modelling results of velocities, water depth, water surface elevation and inundation extent within the 2D domain of the watercourse for the existing case.

For the developed case, the rail line embankment was simulated by using the area shapes utility within the XP-SWMM+XP2D software. For the preliminary indicative flood mapping purposes, the bridge spans are modelled as clear openings. The proposed culverts were also modelled as equivalent openings.

The structure openings and rail line embankment were modelled as above and the same boundary conditions were set up in the 2D model for the post-development case. The various design flow events were run through the model to get the modelling results of velocities, water depth, water surface elevation and inundation extent within the 2D domain of the watercourse for the post-development case.

Preliminary pre-developed and post-developed scenario two-dimensional (2D) flood modelling was conducted at the major crossing NGBR localities using XPSWMM+XP2D program to understand the behaviour of flow adjacent the railway infrastructure. Indicative pre-developed and post-developed scenario flooding maps were developed for the concept stage and are shown in Volume 2 of the Concept Design report.

4.0 SPLITTERS CREEK 2D HYDRAULIC MODEL

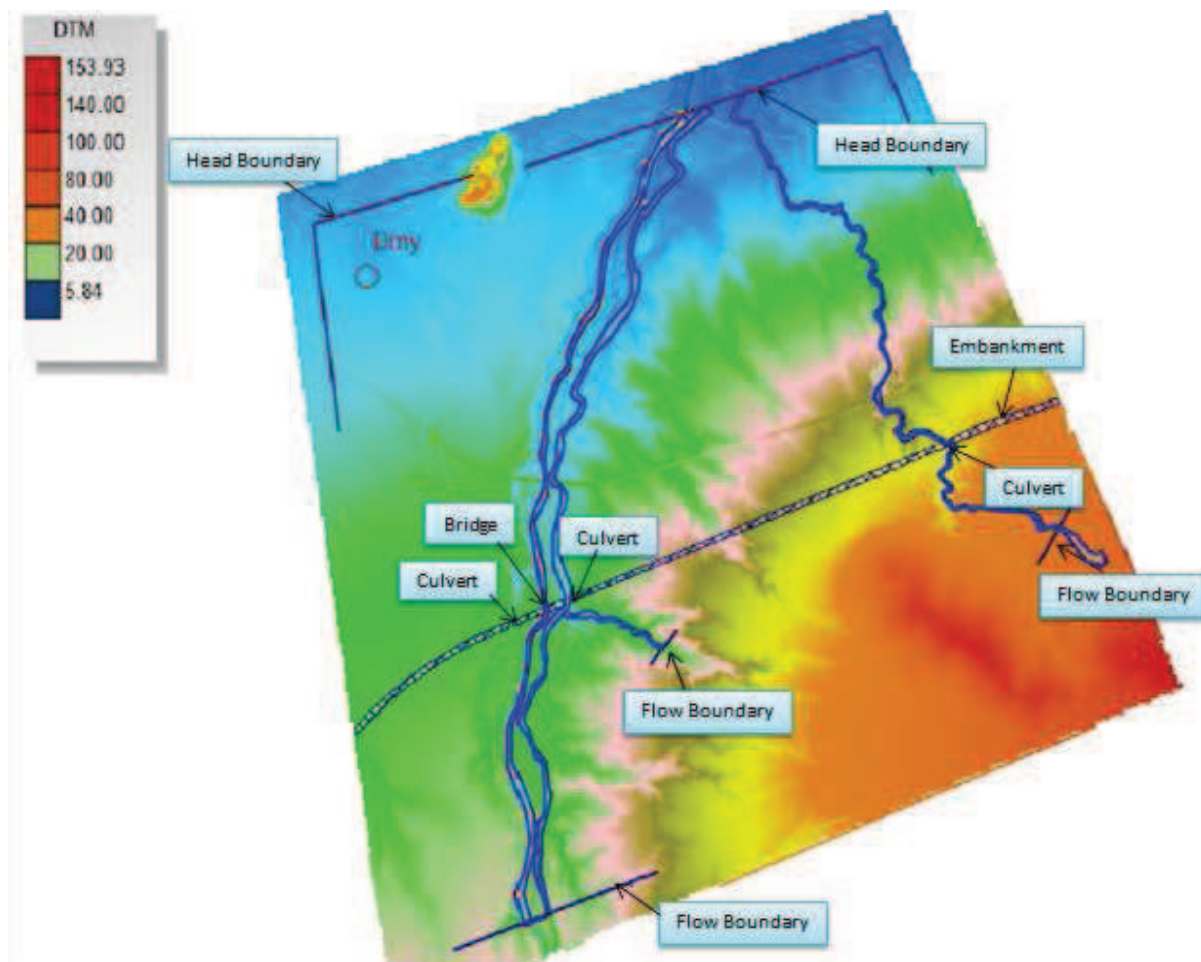


Figure 4.1: Screen Capture of the XPSWMM Splitters Creek 2D Model

Table 4.1 Splitters Creek Flood Inundation Drawing Reference

DRAWING DESCRIPTION	DRAWING NUMBER
Splitters Creek – Flood Inundation (Q20)	NGBR1551-C-DWG-H-201
Splitters Creek – Flood Inundation (Q50)	NGBR1551-C-DWG-H-202
Splitters Creek – Flood Inundation (Q100)	NGBR1551-C-DWG-H-203
Splitters Creek – Afflux (Q50)	NGBR1551-C-DWG-H-204
Splitters Creek – Pre Water Depth (Q50)	NGBR1551-C-DWG-H-205
Splitters Creek – Pre Water Surface (Q50)	NGBR1551-C-DWG-H-206
Splitters Creek – Pre Velocity (Q50)	NGBR1551-C-DWG-H-207
Splitters Creek – Post Water Depth (Q50)	NGBR1551-C-DWG-H-208
Splitters Creek – Post Water Surface (Q50)	NGBR1551-C-DWG-H-209
Splitters Creek – Post Velocity (Q50)	NGBR1551-C-DWG-H-210

5.0 ELLIOT RIVER 2D HYDRAULIC MODEL

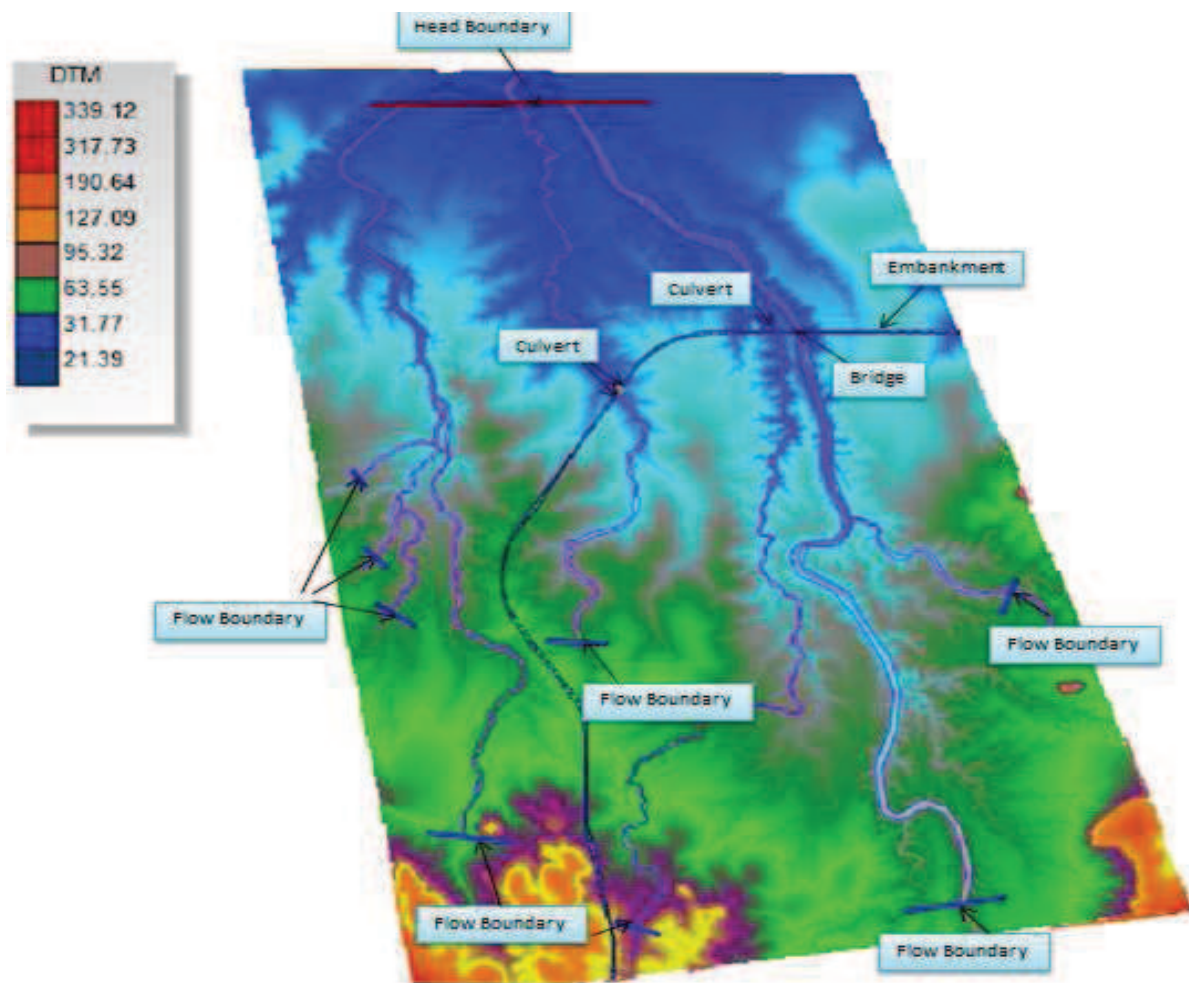


Figure 5.1: Screen Capture of the XPSWMM Elliot River 2D Model

Table 5.1: Elliot River Flood Inundation Drawing Reference

DRAWING DESCRIPTION	DRAWING NUMBER
Elliot River – Flood Inundation (Q20)	NGBR1551-C-DWG-H-211
Elliot River – Flood Inundation (Q50)	NGBR1551-C-DWG-H-212
Elliot River – Flood Inundation (Q100)	NGBR1551-C-DWG-H-213
Elliot River – Afflux (Q50)	NGBR1551-C-DWG-H-214
Elliot River – Pre Water Depth (Q50)	NGBR1551-C-DWG-H-215
Elliot River – Pre Water Surface (Q50)	NGBR1551-C-DWG-H-216
Elliot River – Pre Velocity (Q50)	NGBR1551-C-DWG-H-217
Elliot River – Post Water Depth (Q50)	NGBR1551-C-DWG-H-218
Elliot River – Post Water Surface (Q50)	NGBR1551-C-DWG-H-219
Elliot River – Post Velocity (Q50)	NGBR1551-C-DWG-H-220

6.0 BOGIE RIVER – SANDY CREEK 2D HYDRAULIC MODEL

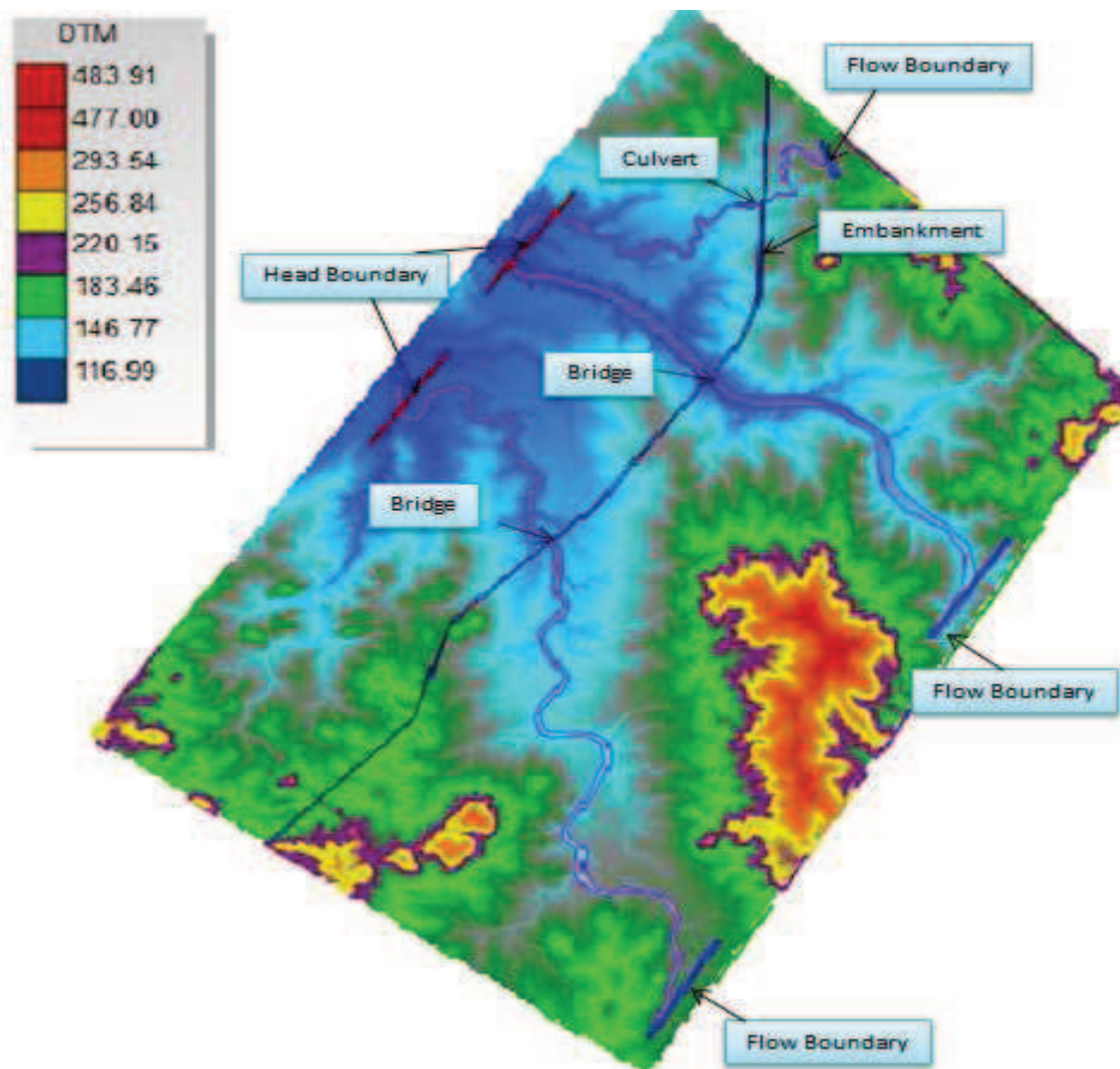


Figure 6.1: Screen Capture of the XPSWMM Bogie River 2D Model

Table 6.1 : Bogie River-Sandy Creek Flood Inundation Drawing Reference

DRAWING DESCRIPTION	DRAWING NUMBER
Bogie River – Flood Inundation (Q20)	NGBR1551-C-DWG-H-221
Bogie River – Flood Inundation (Q50)	NGBR1551-C-DWG-H-222
Bogie River – Flood Inundation (Q100)	NGBR1551-C-DWG-H-223
Bogie River – Afflux (Q50)	NGBR1551-C-DWG-H-224
Bogie River – Pre Water Depth (Q50)	NGBR1551-C-DWG-H-225
Bogie River – Pre Water Surface (Q50)	NGBR1551-C-DWG-H-226
Bogie River – Pre Velocity (Q50)	NGBR1551-C-DWG-H-227
Bogie River – Post Water Depth (Q50)	NGBR1551-C-DWG-H-228
Bogie River – Post Water Surface (Q50)	NGBR1551-C-DWG-H-229
Bogie River – Post Velocity (Q50)	NGBR1551-C-DWG-H-230

7.0 PELICAN CREEK 2D HYDRAULIC MODEL

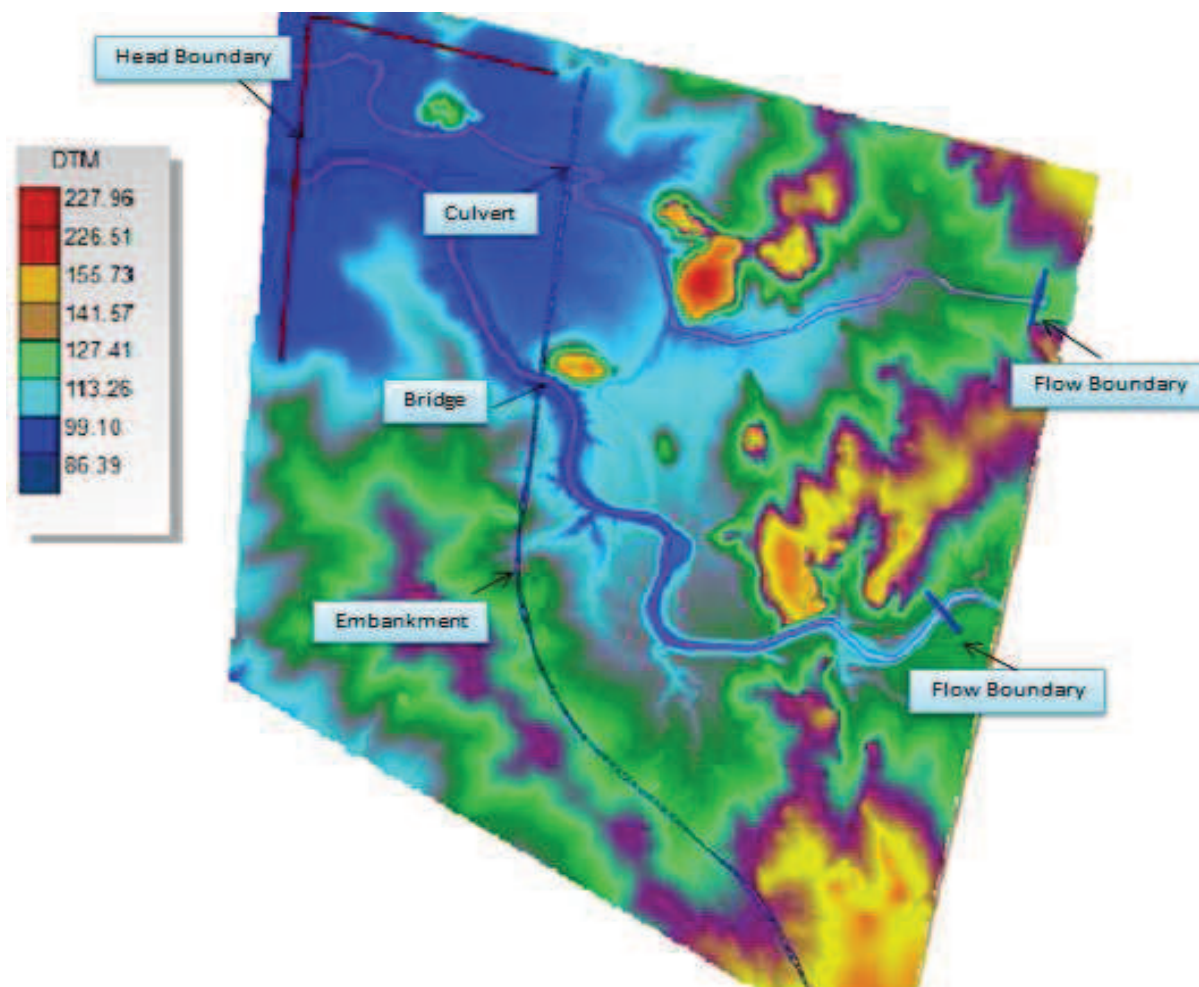


Figure 7.1 : Screen Capture of the XPSWMM Pelican Creek 2D Model

Table 7.1 : Pelican Creek Flood Inundation Drawing Reference

DRAWING DESCRIPTION	DRAWING NUMBER
Pelican Creek – Flood Inundation (Q20)	NGBR1551-C-DWG-H-231
Pelican Creek – Flood Inundation (Q50)	NGBR1551-C-DWG-H-232
Pelican Creek – Flood Inundation (Q100)	NGBR1551-C-DWG-H-233
Pelican Creek – Afflux (Q50)	NGBR1551-C-DWG-H-234
Pelican Creek – Pre Water Depth (Q50)	NGBR1551-C-DWG-H-235
Pelican Creek – Pre Water Surface (Q50)	NGBR1551-C-DWG-H-236
Pelican Creek – Pre Velocity (Q50)	NGBR1551-C-DWG-H-237
Pelican Creek – Post Water Depth (Q50)	NGBR1551-C-DWG-H-238
Pelican Creek – Post Water Surface (Q50)	NGBR1551-C-DWG-H-239
Pelican Creek – Post Velocity (Q50)	NGBR1551-C-DWG-H-240

8.0 BOWEN RIVER – ROSELLA CREEK 2D HYDRAULIC MODEL

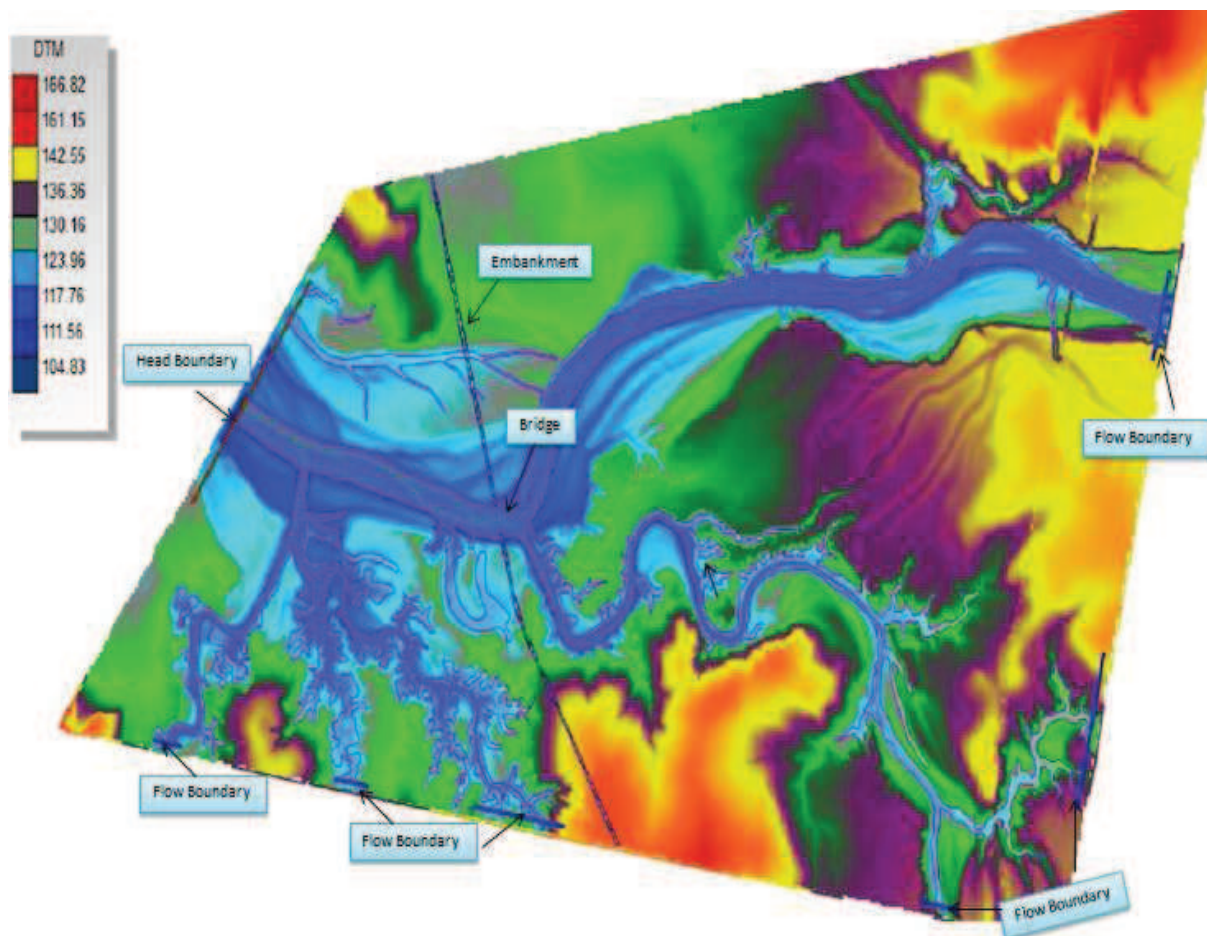


Figure 8.1 : Screen Capture of the XPSWMM Bowen River 2D Model

Table 8.1 : Bowen River- Rosella Creek Flood Inundation Drawing Reference

DRAWING DESCRIPTION	DRAWING NUMBER
Bowen River – Flood Inundation (Q20)	NGBR1551-C-DWG-H-241
Bowen River – Flood Inundation (Q50)	NGBR1551-C-DWG-H-242
Bowen River – Flood Inundation (Q100)	NGBR1551-C-DWG-H-243
Bowen River – Afflux (Q50)	NGBR1551-C-DWG-H-244
Bowen River – Pre Water Depth (Q50)	NGBR1551-C-DWG-H-245
Bowen River – Pre Water Surface (Q50)	NGBR1551-C-DWG-H-246
Bowen River – Pre Velocity (Q50)	NGBR1551-C-DWG-H-247
Bowen River – Post Water Depth (Q50)	NGBR1551-C-DWG-H-248
Bowen River – Post Water Surface (Q50)	NGBR1551-C-DWG-H-249
Bowen River – Post Velocity (Q50)	NGBR1551-C-DWG-H-250

9.0 UPPER SUTTOR RIVER 2D HYDRAULIC MODEL

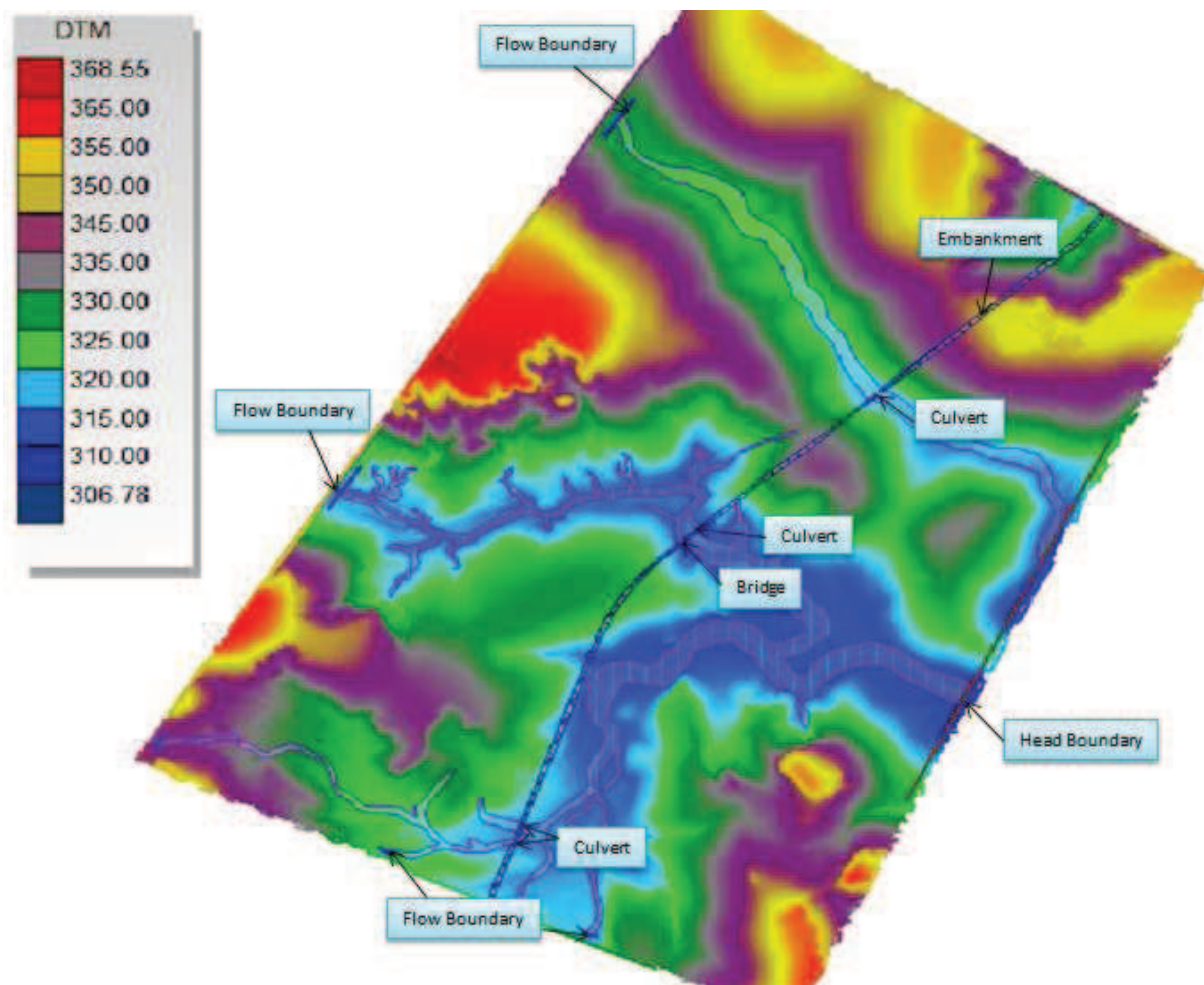


Figure 9.1 : Screen Capture of the XPSWMM Upper Suttor River 2D Model

Table 9.1 : Upper Suttor River Flood Inundation Drawing Reference

DRAWING DESCRIPTION	DRAWING NUMBER
Upper Suttor River – Flood Inundation (Q20)	NGBR1551-C-DWG-H-251
Upper Suttor River – Flood Inundation (Q50)	NGBR1551-C-DWG-H-252
Upper Suttor River – Flood Inundation (Q100)	NGBR1551-C-DWG-H-253
Upper Suttor River – Afflux (Q50)	NGBR1551-C-DWG-H-254
Upper Suttor River – Pre Water Depth (Q50)	NGBR1551-C-DWG-H-255
Upper Suttor River – Pre Water Surface (Q50)	NGBR1551-C-DWG-H-256
Upper Suttor River – Pre Velocity (Q50)	NGBR1551-C-DWG-H-257
Upper Suttor River – Post Water Depth (Q50)	NGBR1551-C-DWG-H-258
Upper Suttor River–Post Water Surface (Q50)	NGBR1551-C-DWG-H-259
Upper Suttor River – Post Velocity (Q50)	NGBR1551-C-DWG-H-260

10.0 ROCKINGHAM CREEK 2D HYDRAULIC MODEL

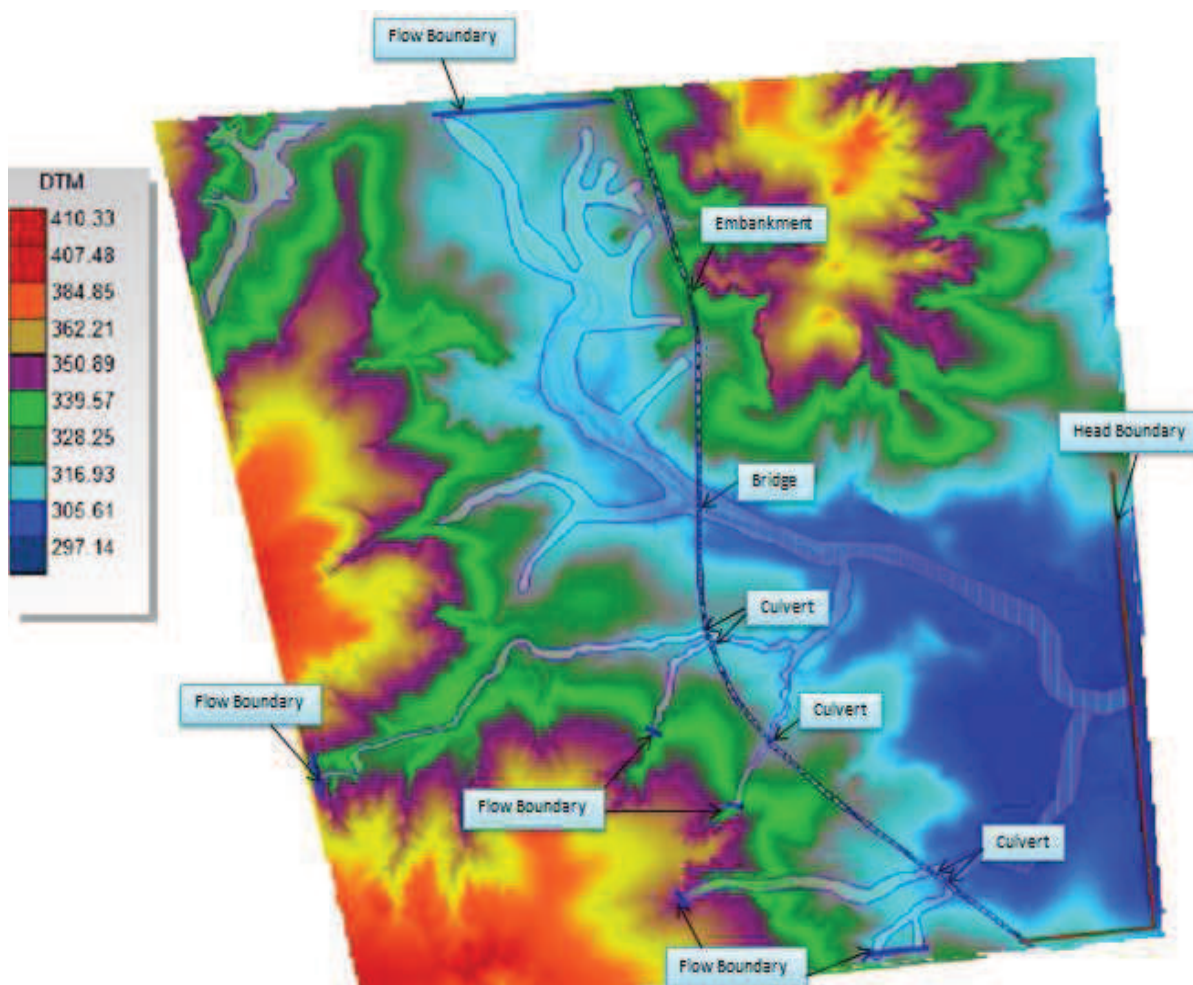


Figure 10.1 : Screen Capture of the XPSWMM Rockingham Creek 2D Model

Table 10.1 : Rockingham Creek Flood Inundation Drawing Reference

DRAWING DESCRIPTION	DRAWING NUMBER
Rockingham Creek – Flood Inundation (Q20)	NGBR1551-C-DWG-H-261
Rockingham Creek – Flood Inundation (Q50)	NGBR1551-C-DWG-H-262
Rockingham Creek – Flood Inundation (Q100)	NGBR1551-C-DWG-H-263
Rockingham Creek – Afflux (Q50)	NGBR1551-C-DWG-H-264
Rockingham Creek – Pre Water Depth (Q50)	NGBR1551-C-DWG-H-265
Rockingham Creek – Pre Water Surface (Q50)	NGBR1551-C-DWG-H-266
Rockingham Creek – Pre Velocity (Q50)	NGBR1551-C-DWG-H-267
Rockingham Creek – Post Water Depth (Q50)	NGBR1551-C-DWG-H-268
Rockingham Creek – Post Water Surface (Q50)	NGBR1551-C-DWG-H-269
Rockingham Creek – Post Velocity (Q50)	NGBR1551-C-DWG-H-270

11.0 MURRAY CREEK 2D HYDRAULIC MODEL

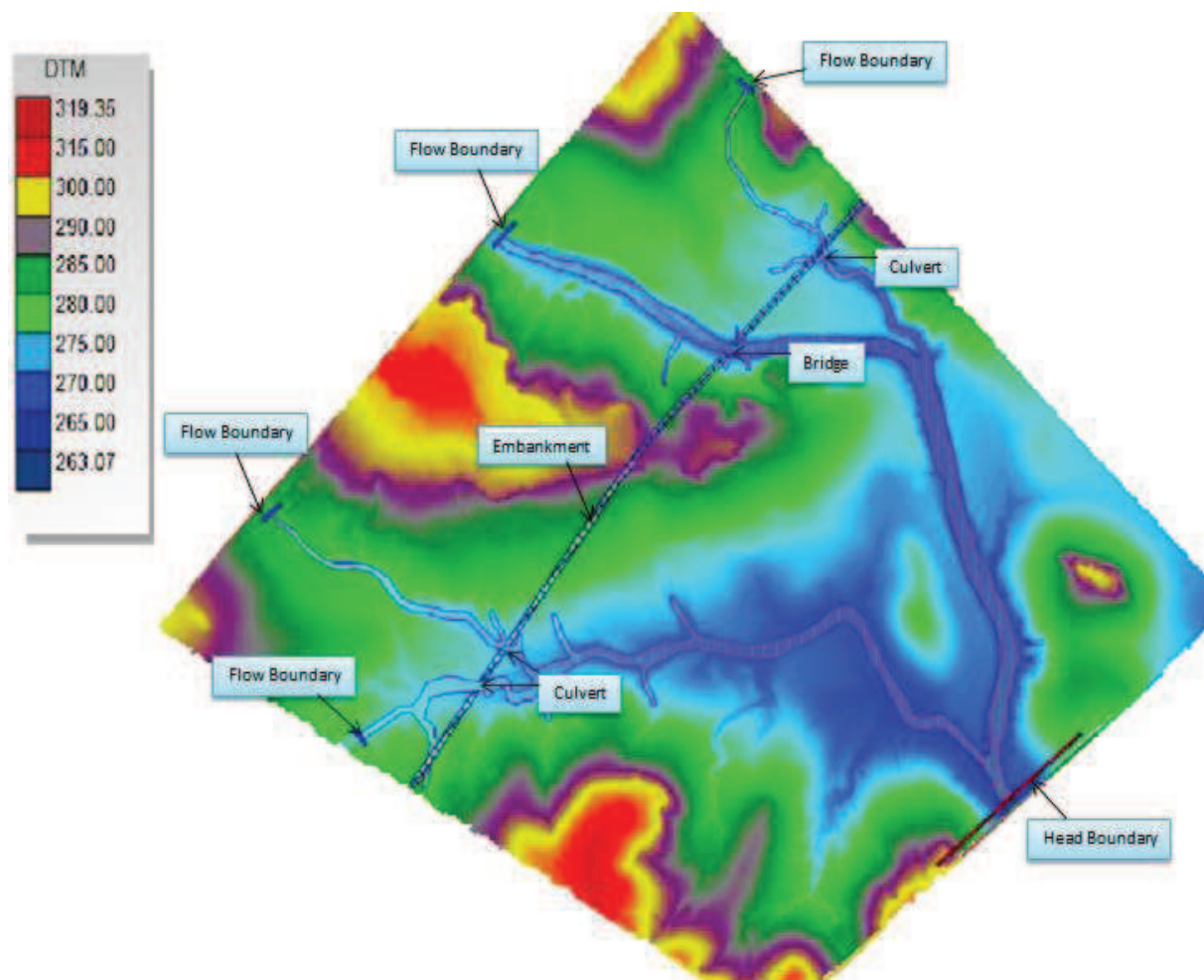


Figure 11.1 : Screen Capture of the XPSWMM Murray Creek 2D Model

Table 11.1 : Murray Creek Flood Inundation Drawing Reference

DRAWING DESCRIPTION	DRAWING NUMBER
Murray Creek – Flood Inundation (Q20)	NGBR1551-C-DWG-H-271
Murray Creek – Flood Inundation (Q50)	NGBR1551-C-DWG-H-272
Murray Creek– Flood Inundation (Q100)	NGBR1551-C-DWG-H-273
Murray Creek – Afflux (Q50)	NGBR1551-C-DWG-H-274
Murray Creek – Pre Water Depth (Q50)	NGBR1551-C-DWG-H-275
Murray Creek – Pre Water Surface (Q50)	NGBR1551-C-DWG-H-276
Murray Creek – Pre Velocity (Q50)	NGBR1551-C-DWG-H-277
Murray Creek – Post Water Depth (Q50)	NGBR1551-C-DWG-H-278
Murray Creek–Post Water Surface (Q50)	NGBR1551-C-DWG-H-279
Murray Creek – Post Velocity (Q50)	NGBR1551-C-DWG-H-280

12.0 VERBENA CREEK 2D HYDRAULIC MODEL

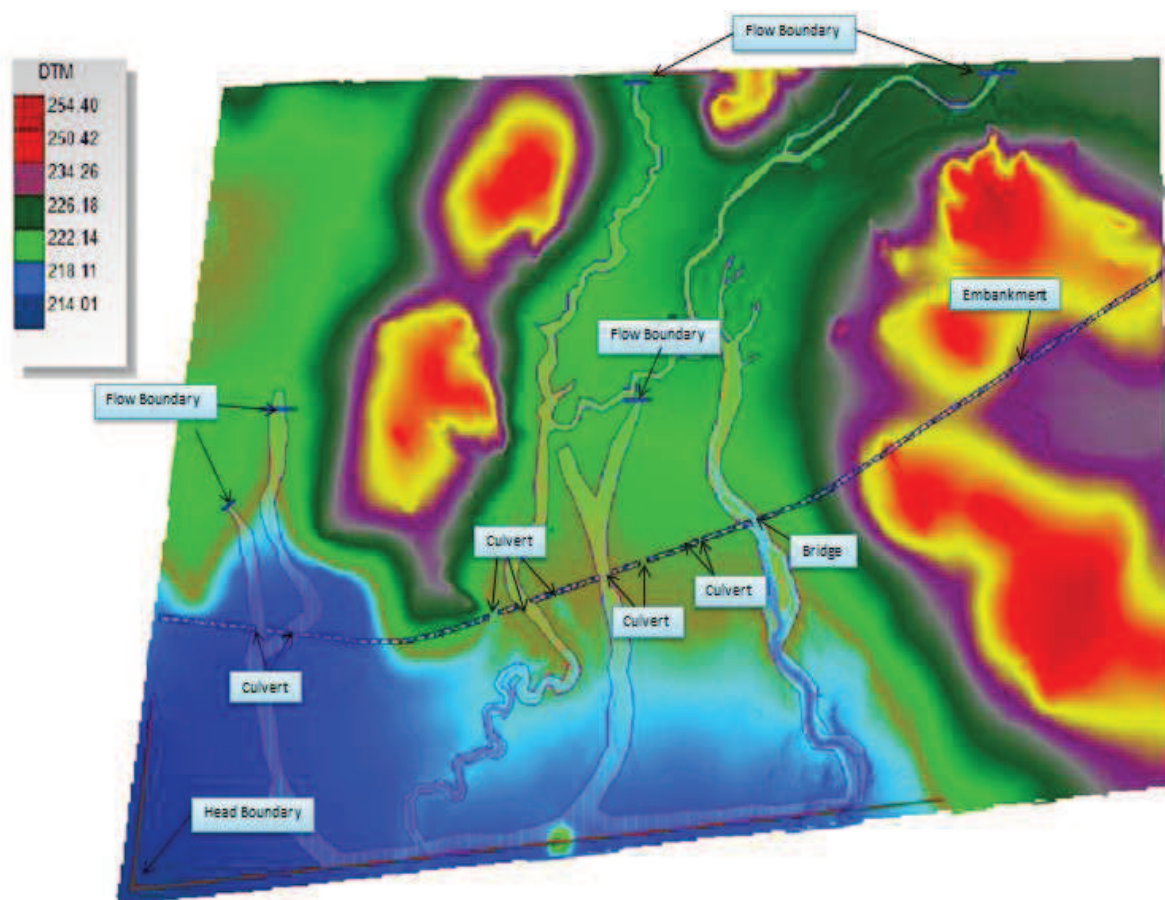


Figure 12.1 : Screen Capture of the XPSWMM Verbena Creek 2D Model

Table 12.1 : Verbena Creek Flood Inundation Drawing Reference

DRAWING DESCRIPTION	DRAWING NUMBER
Verbena Creek – Flood Inundation (Q20)	NGBR1551-C-DWG-H-281
Verbena Creek – Flood Inundation (Q50)	NGBR1551-C-DWG-H-282
Verbena Creek – Flood Inundation (Q100)	NGBR1551-C-DWG-H-283
Verbena Creek – Afflux (Q50)	NGBR1551-C-DWG-H-284
Verbena Creek – Pre Water Depth (Q50)	NGBR1551-C-DWG-H-285
Verbena Creek – Pre Water Surface (Q50)	NGBR1551-C-DWG-H-286
Verbena Creek – Pre Velocity (Q50)	NGBR1551-C-DWG-H-287
Verbena Creek – Post Water Depth (Q50)	NGBR1551-C-DWG-H-288
Verbena Creek – Post Water Surface (Q50)	NGBR1551-C-DWG-H-289
Verbena Creek – Post Velocity (Q50)	NGBR1551-C-DWG-H-290

13.0 SUTTOR RIVER 2D HYDRAULIC MODEL

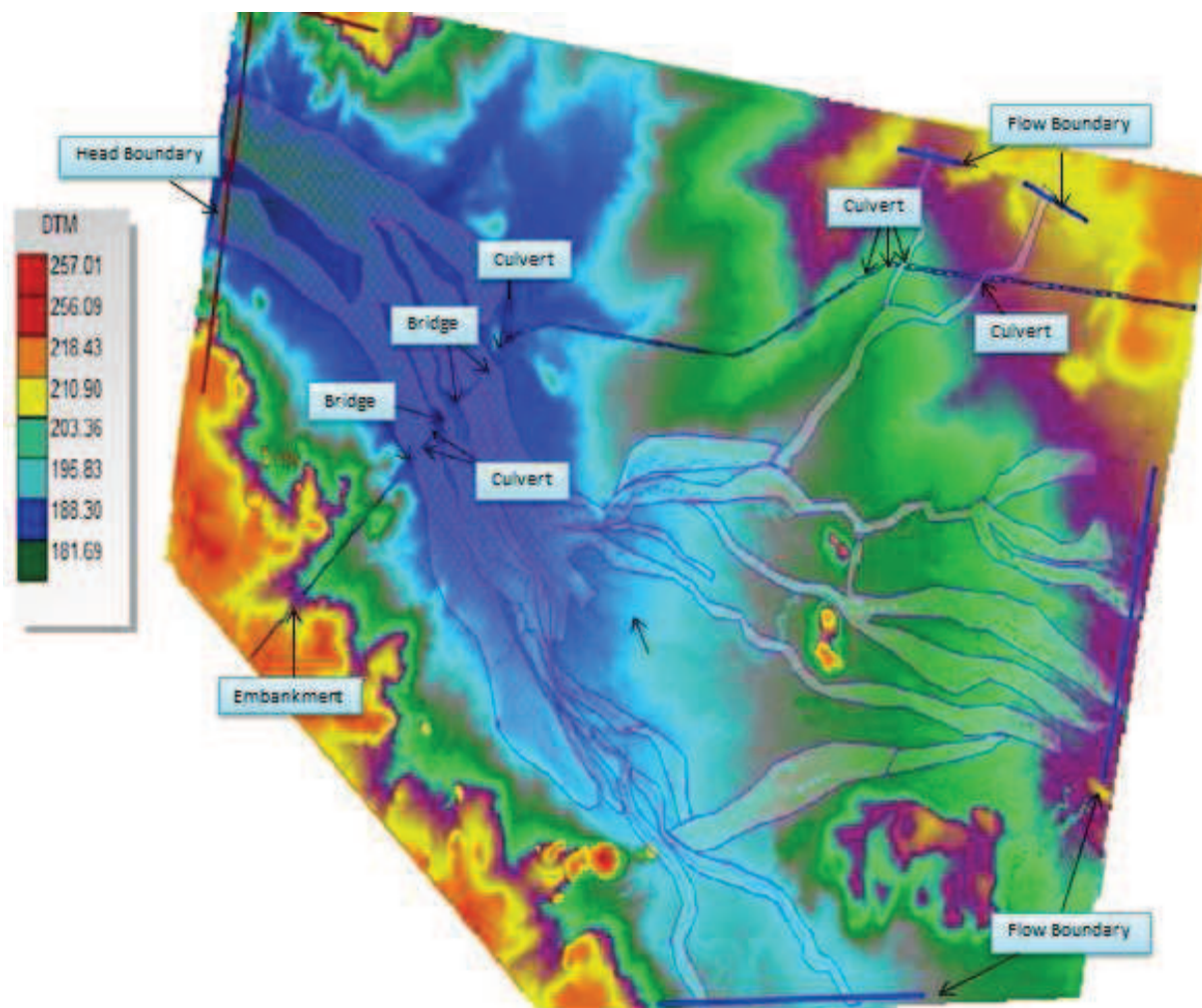


Figure 13.1: Screen Capture of the XPSWMM Suttor River 2D Model

Table 13.1 : Suttor River Flood Inundation Drawing Reference

DRAWING DESCRIPTION	DRAWING NUMBER
Suttor River – Flood Inundation (Q20)	NGBR1551-C-DWG-H-291
Suttor River – Flood Inundation (Q50)	NGBR1551-C-DWG-H-292
Suttor River – Flood Inundation (Q100)	NGBR1551-C-DWG-H-293
Suttor River – Afflux (Q50)	NGBR1551-C-DWG-H-294
Suttor River – Pre Water Depth (Q50)	NGBR1551-C-DWG-H-295
Suttor River – Pre Water Surface (Q50)	NGBR1551-C-DWG-H-296
Suttor River – Pre Velocity (Q50)	NGBR1551-C-DWG-H-297
Suttor River – Post Water Depth (Q50)	NGBR1551-C-DWG-H-298
Suttor River – Post Water Surface (Q50)	NGBR1551-C-DWG-H-299
Suttor River – Post Velocity (Q50)	NGBR1551-C-DWG-H-300

Appendix I :
Annual Peak Flow Analysis by LP III Method

CONTENTS

1.0	ELLIOT RIVER AT GUTHALUNGRA.....	2
2.0	BOGIE RIVER AT STRATHBOGIE	3
3.0	BOWEN RIVER AT MYUNA	4
4.0	PELICAN CREEK AT MT. JIMMY	5
5.0	SUTTOR RIVER AT EAGLEFIELD.....	6

1.0 ELLIOT RIVER AT GUTHALUNGRA

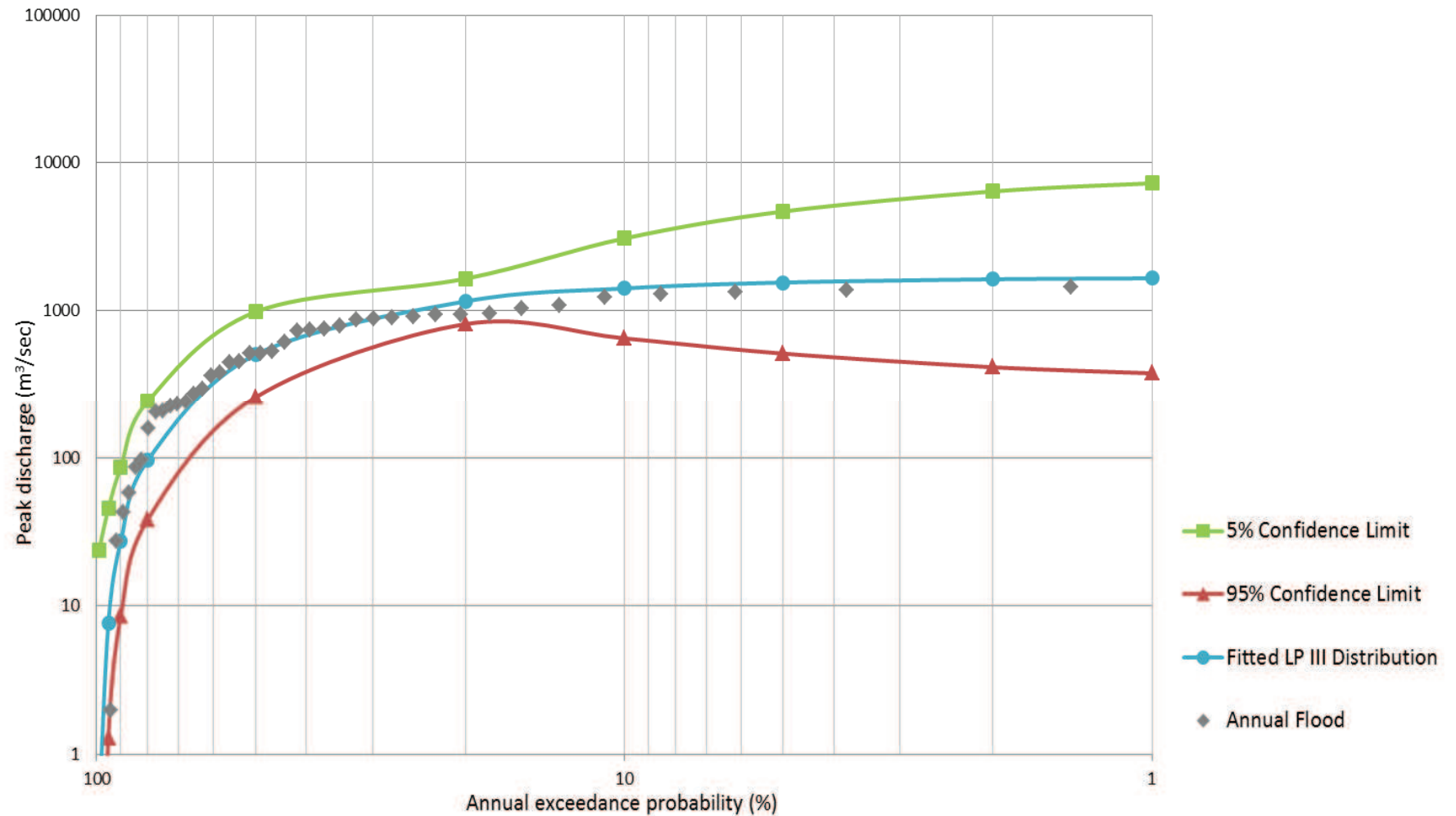


Figure 1: Frequency curve of annual floods using Log Pearson Type III Method for Elliot River at Guthalungra (120002A)

2.0 BOGIE RIVER AT STRATHBOGIE

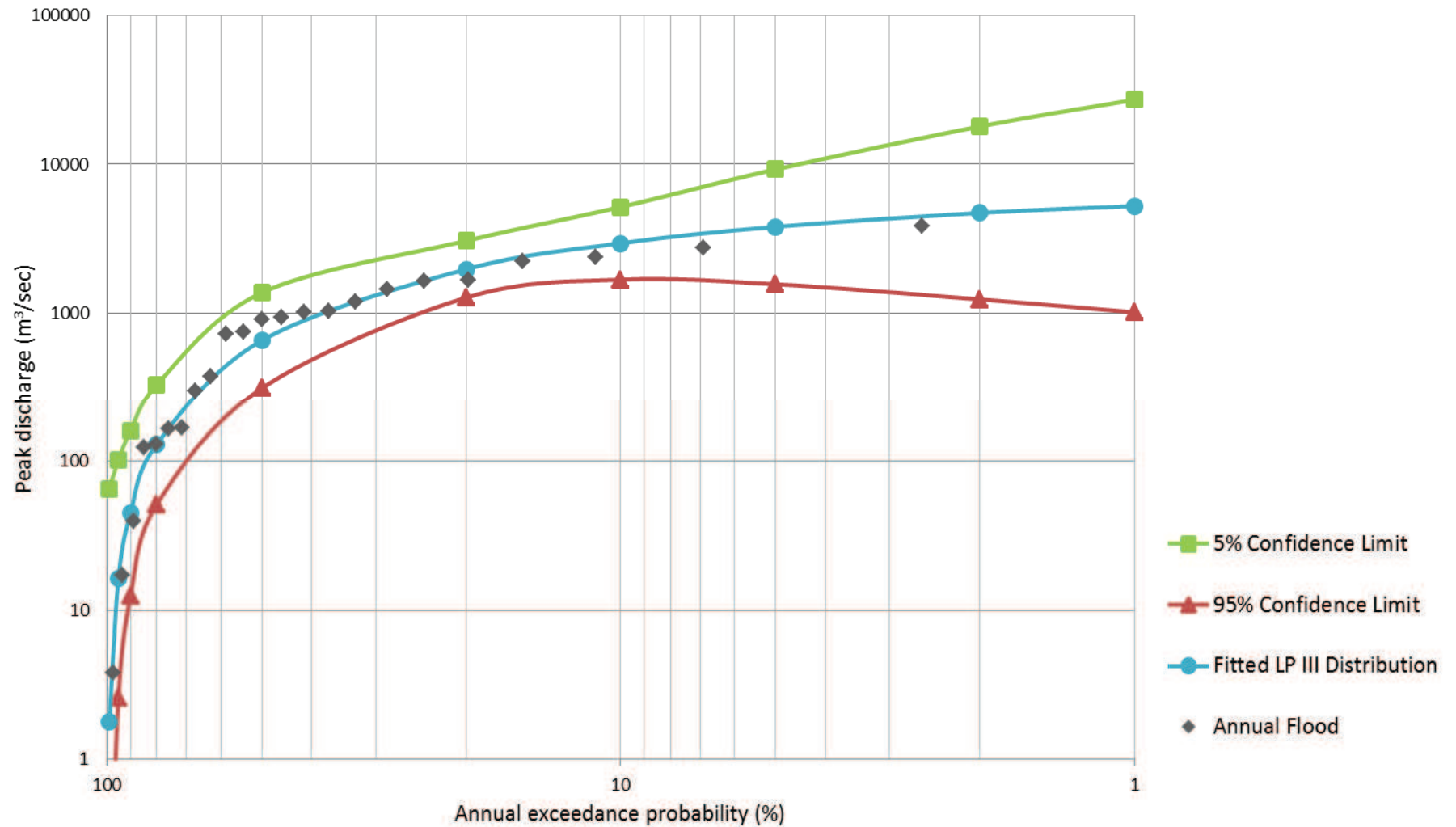


Figure 2: Frequency curve of annual floods using Log Pearson Type III Method for Bogie River at Strathbogrie (120005B)

3.0 BOWEN RIVER AT MYUNA

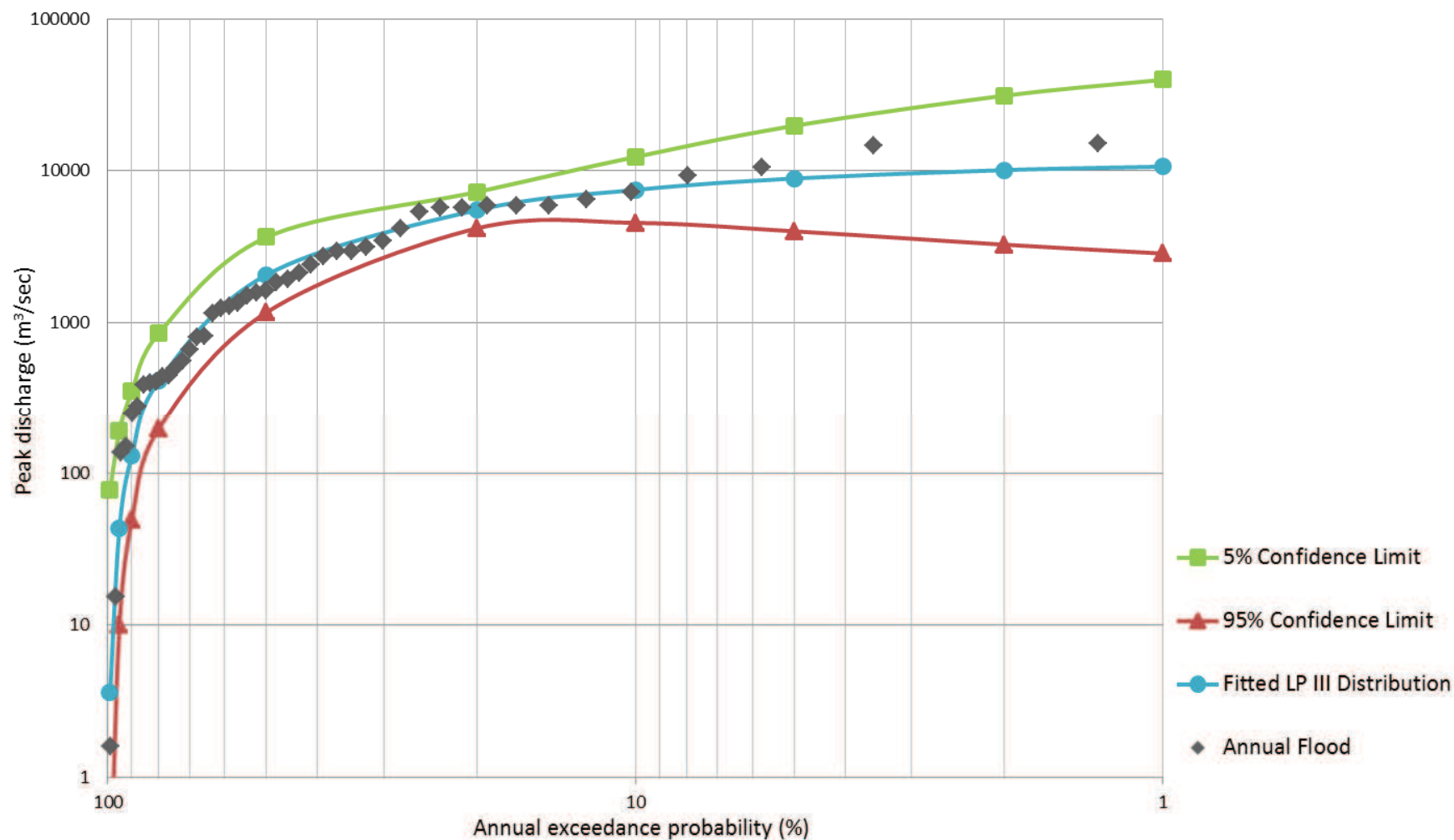


Figure 3: Frequency curve of annual floods using Log Pearson Type III Method for Bowen River at Myuna (120205A)

4.0 PELICAN CREEK AT MT. JIMMY

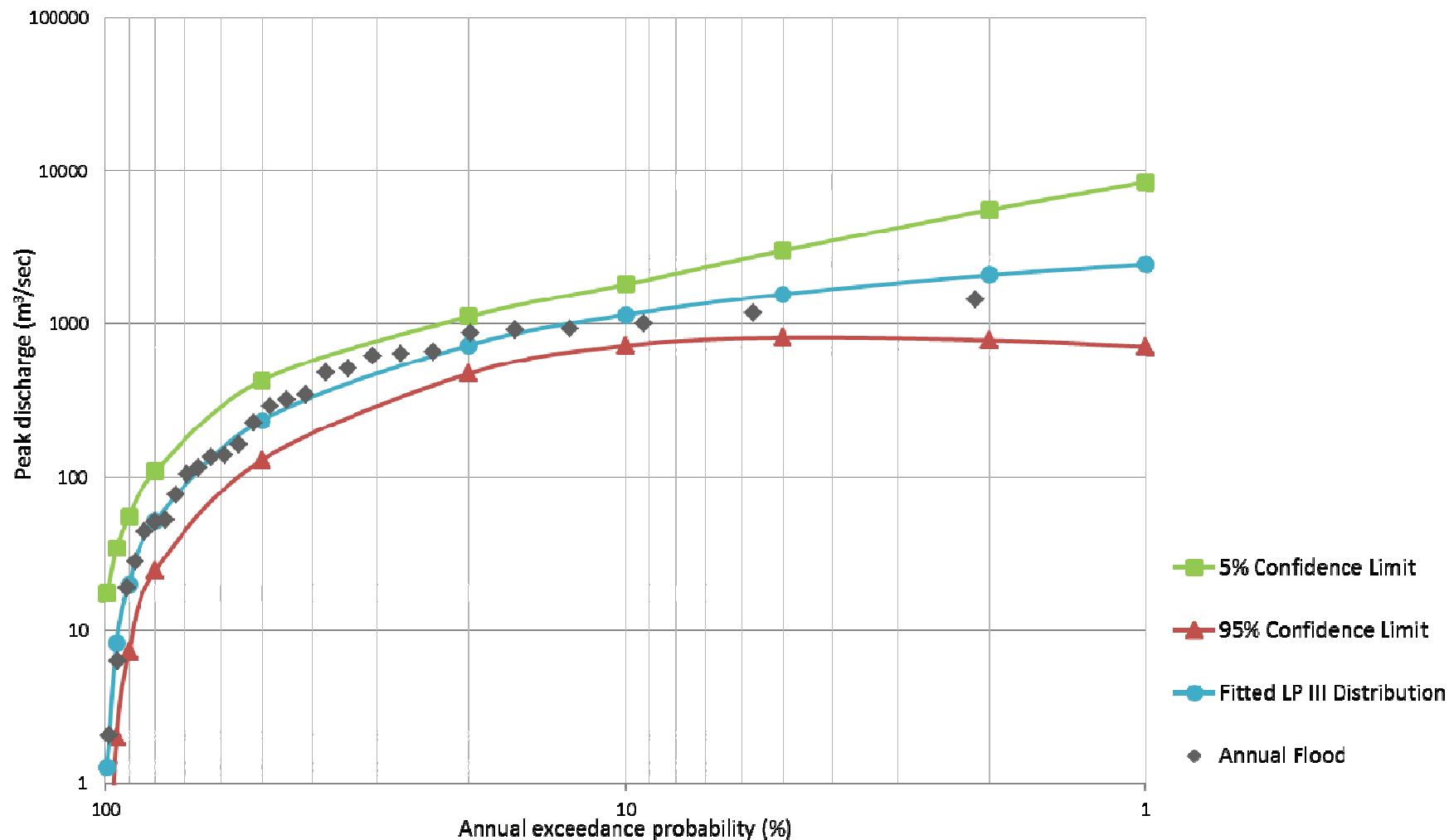


Figure 4: Frequency curve of annual floods using Log Pearson Type III Method for Pelican Creek at Mt. Jimmy (120206A)

5.0 SUTTOR RIVER AT EAGLEFIELD

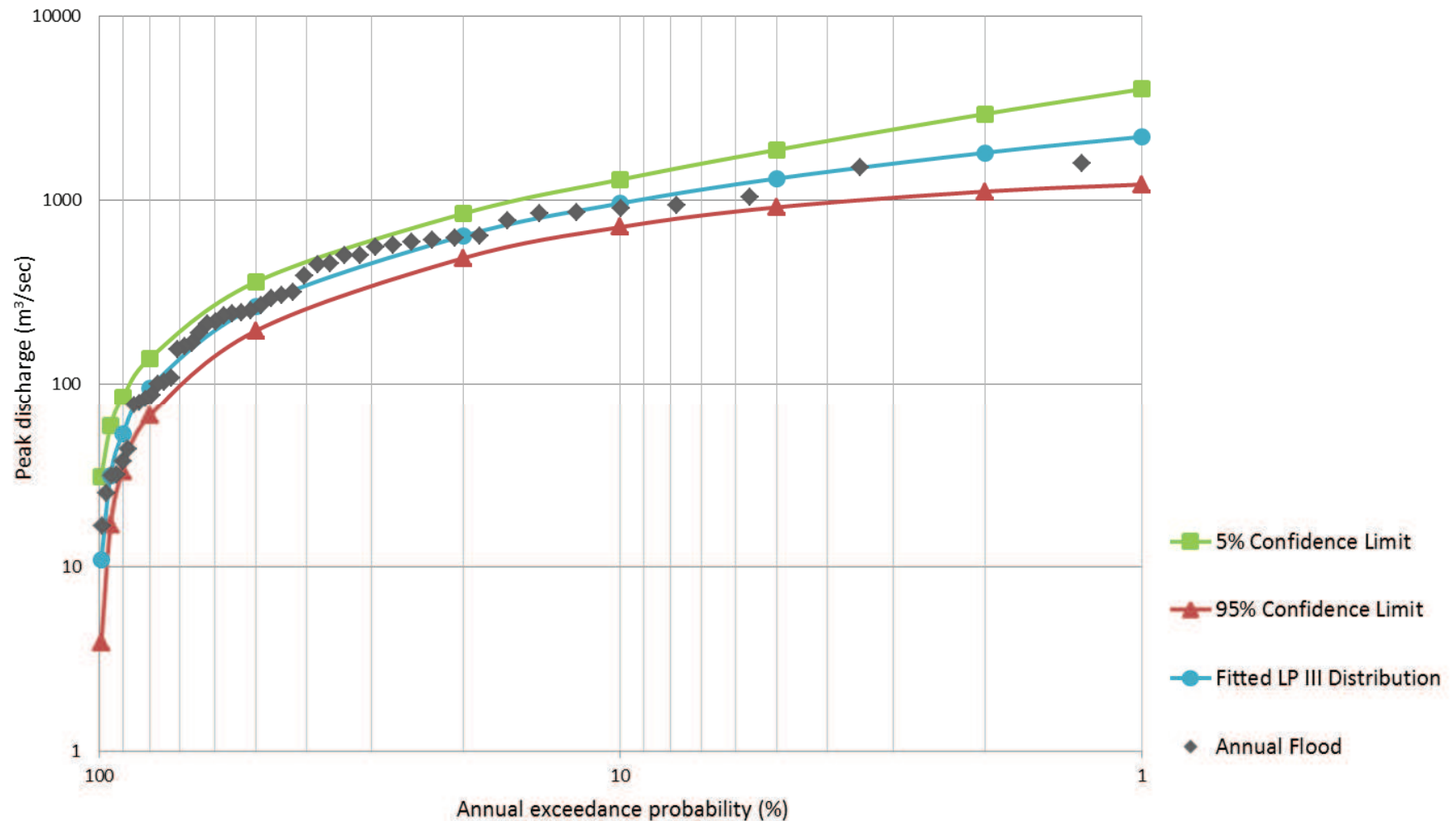
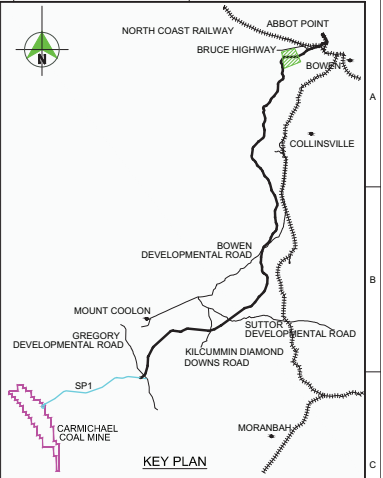
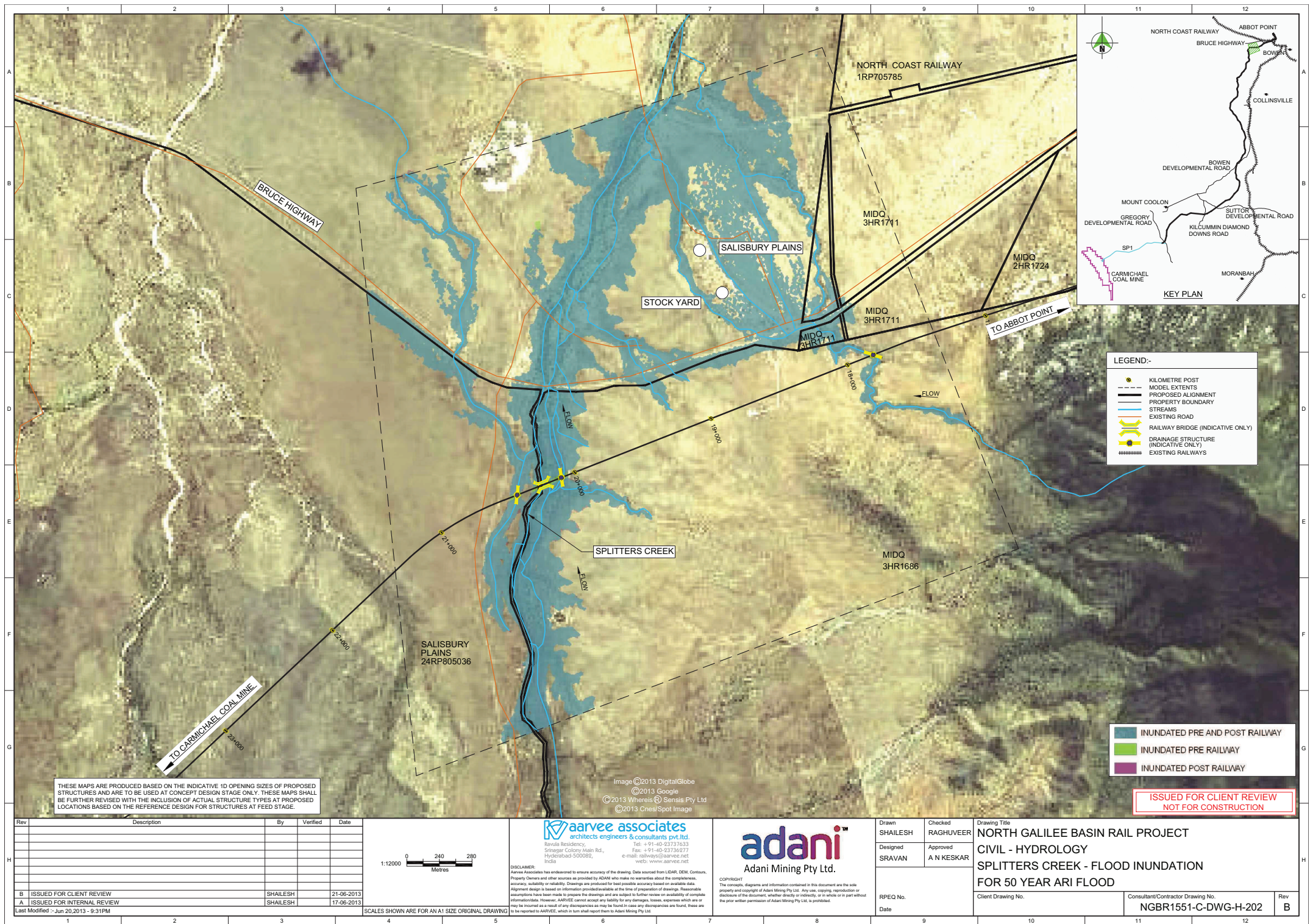


Figure 5: Frequency curve of annual floods using Log Pearson Type III Method for Suttor River at Eaglefield (120304A)

Appendix J : Flood Inundation Maps for 50 year Design ARI Event



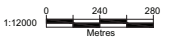
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- KILOMETRE POST
 - MODEL EXTENTS
 - PROPOSED ALIGNMENT
 - PROPERTY BOUNDARY
 - STREAMS
 - EXISTING ROAD
 - RAILWAY BRIDGE (INDICATIVE ONLY)
 - DRAINAGE STRUCTURE (INDICATIVE ONLY)
 - EXISTING RAILWAYS

- INUNDATED PRE AND POST RAILWAY
- INUNDATED PRE RAILWAY
- INUNDATED POST RAILWAY

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B	ISSUED FOR CLIENT REVIEW	SHAILESH		21-06-2013
A	ISSUED FOR INTERNAL REVIEW	SHAILESH		17-06-2013
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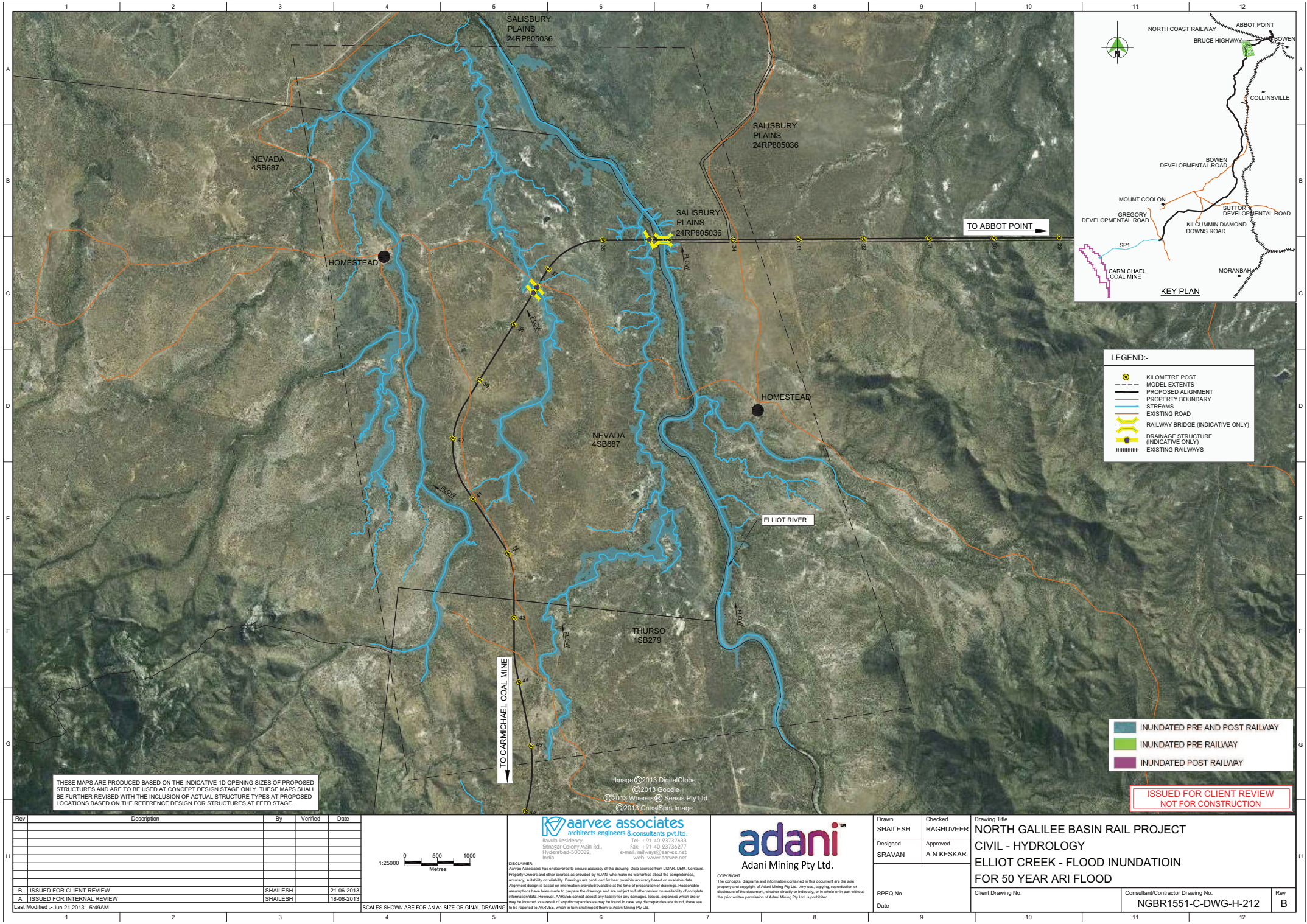
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Designed SRAVAN	Approved A N KESKAR
RPEQ No.	
Date	

Drawing Title NORTH GALILEE BASIN RAIL PROJECT CIVIL - HYDROLOGY SPLITTERS CREEK - FLOOD INUNDATION FOR 50 YEAR ARI FLOOD	
Client Drawing No.	Consultant/Contractor Drawing No.
	NGBR1551-C-DWG-H-202
	Rev B



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web: www.aarvee.net

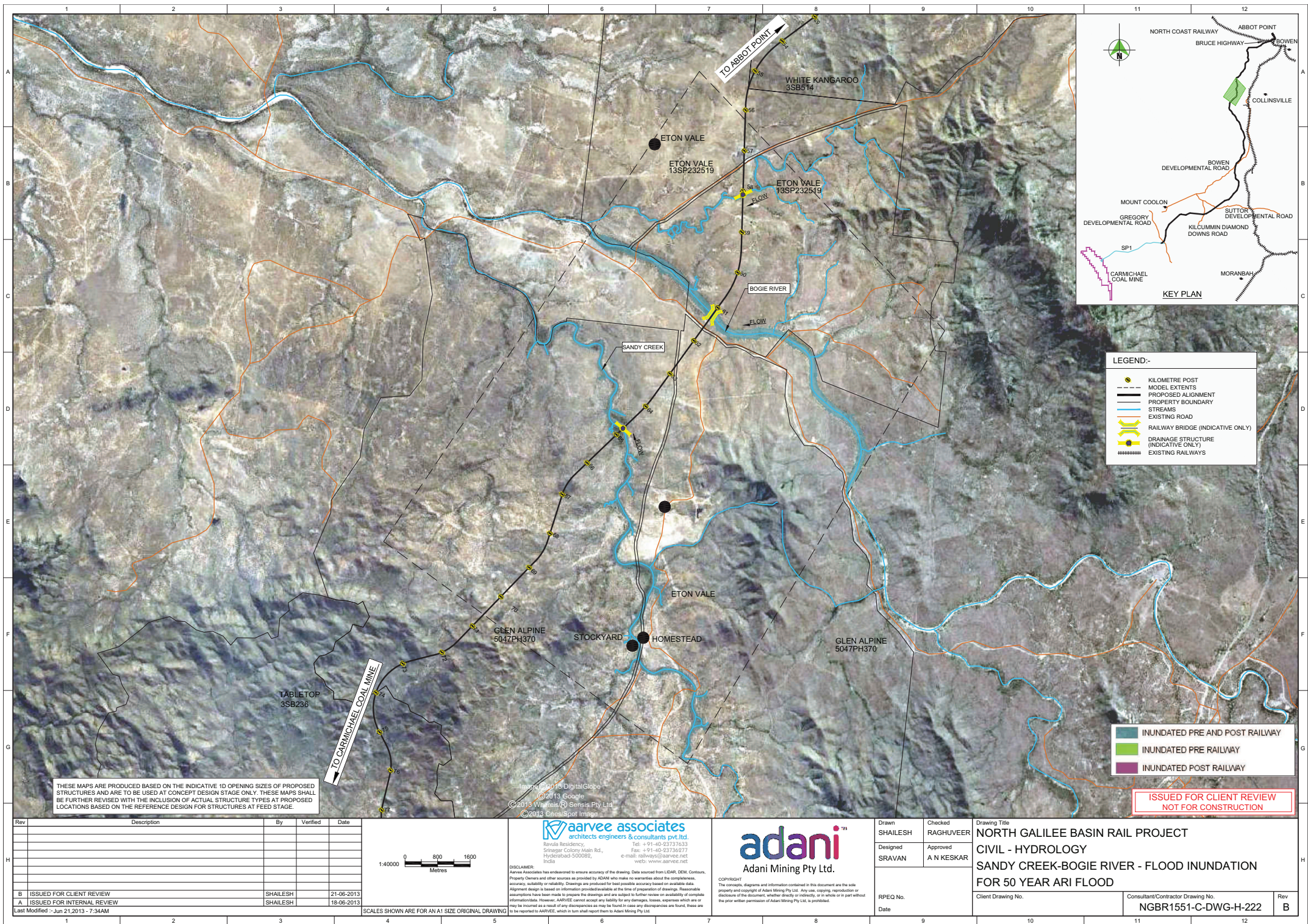
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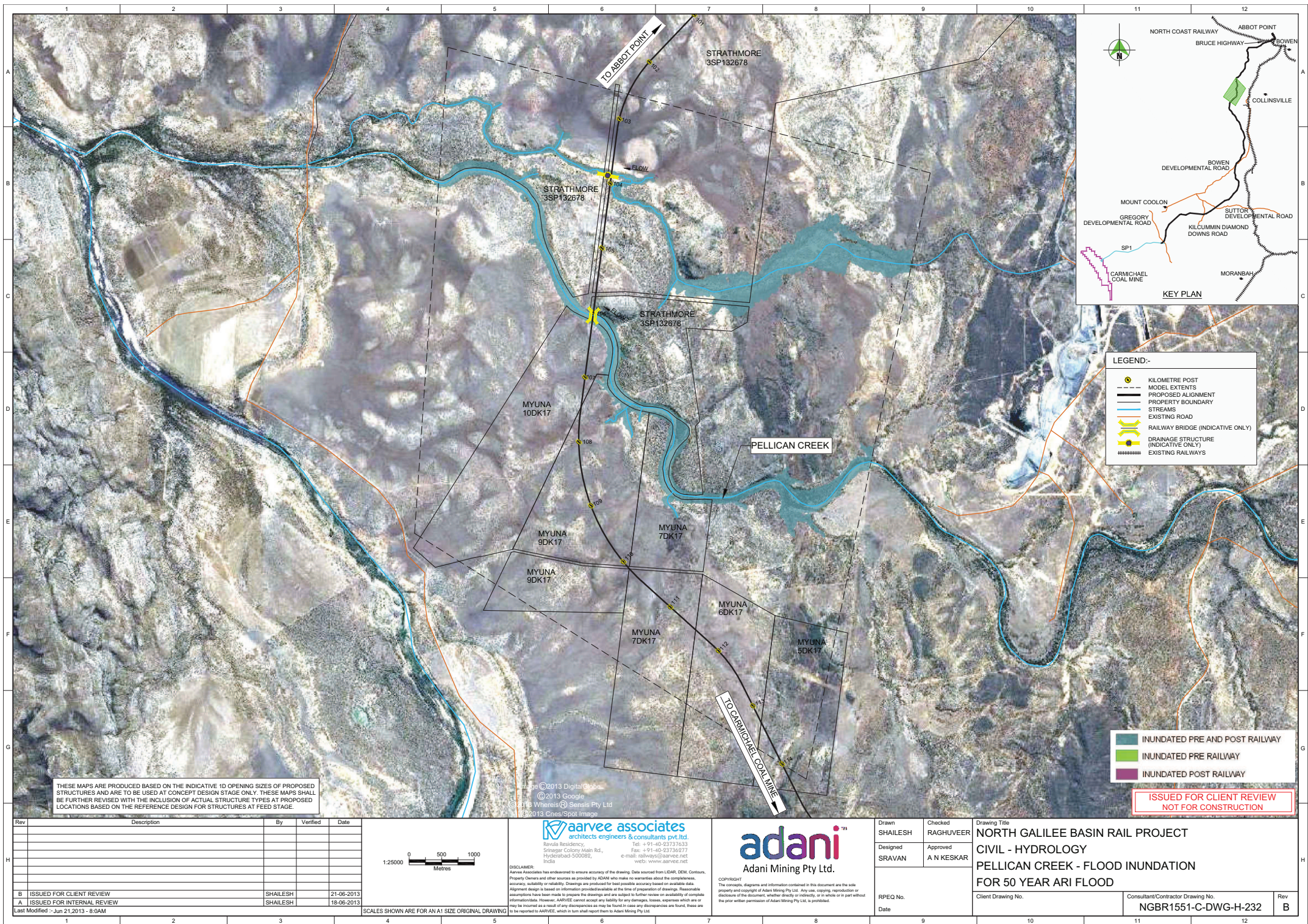
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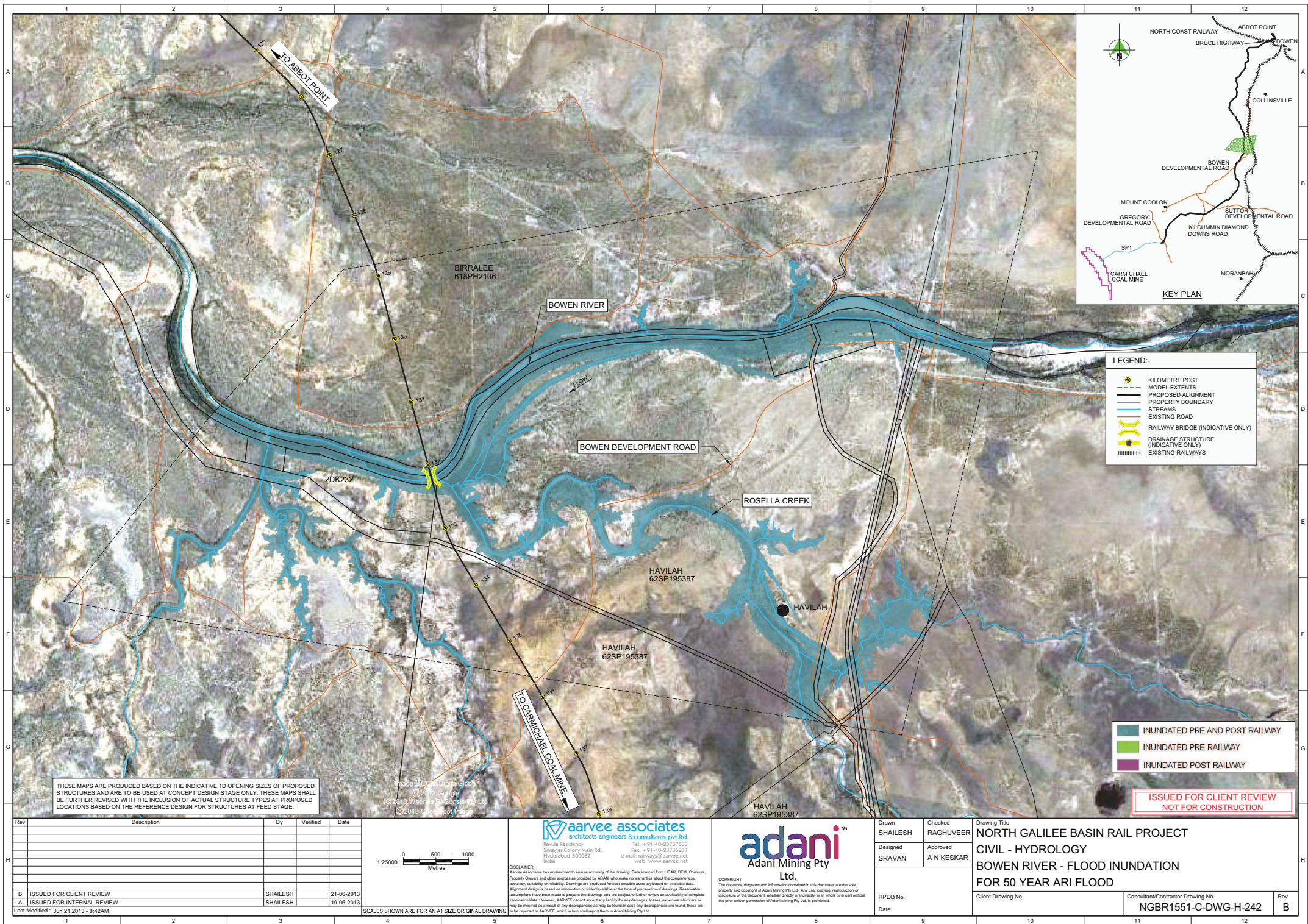
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Date	

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- STREAMS
- EXISTING ROAD
- RAILWAY BRIDGE (INDICATIVE ONLY)
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- INUNDATED PRE AND POST RAILWAY
- INUNDATED PRE RAILWAY
- INUNDATED POST RAILWAY

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A	ISSUED FOR INTERNAL REVIEW	SHAILESH		19-06-2013
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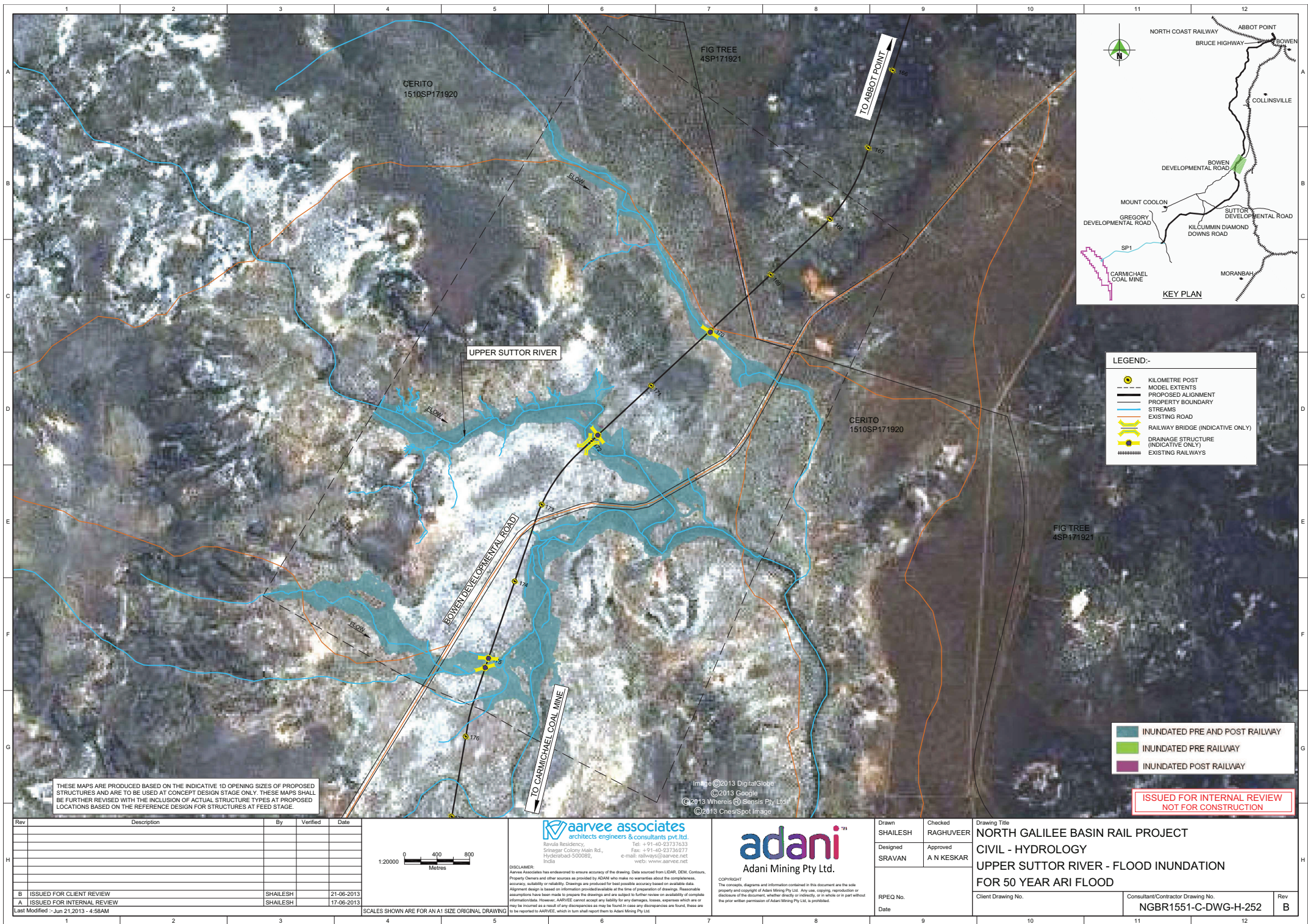
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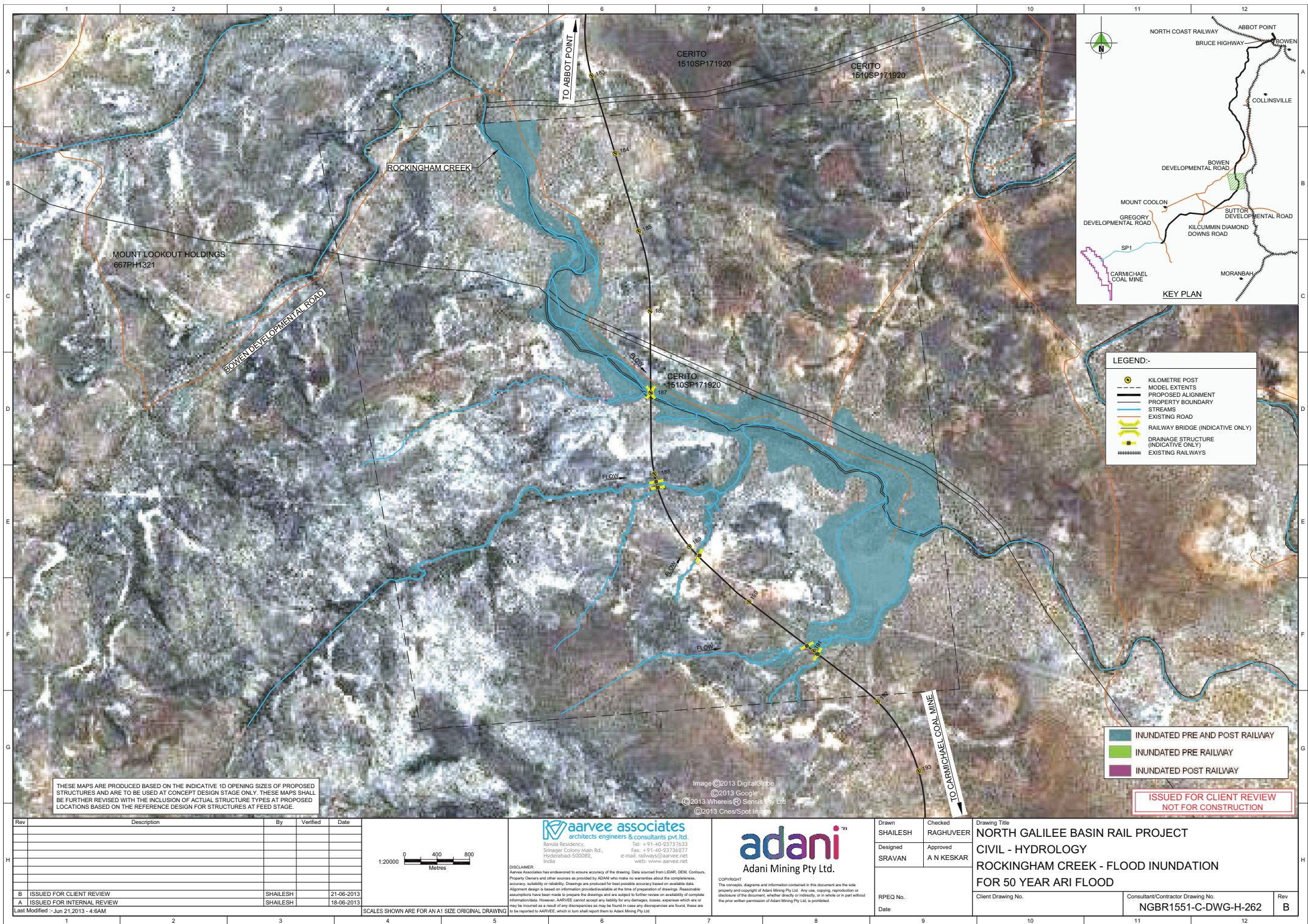
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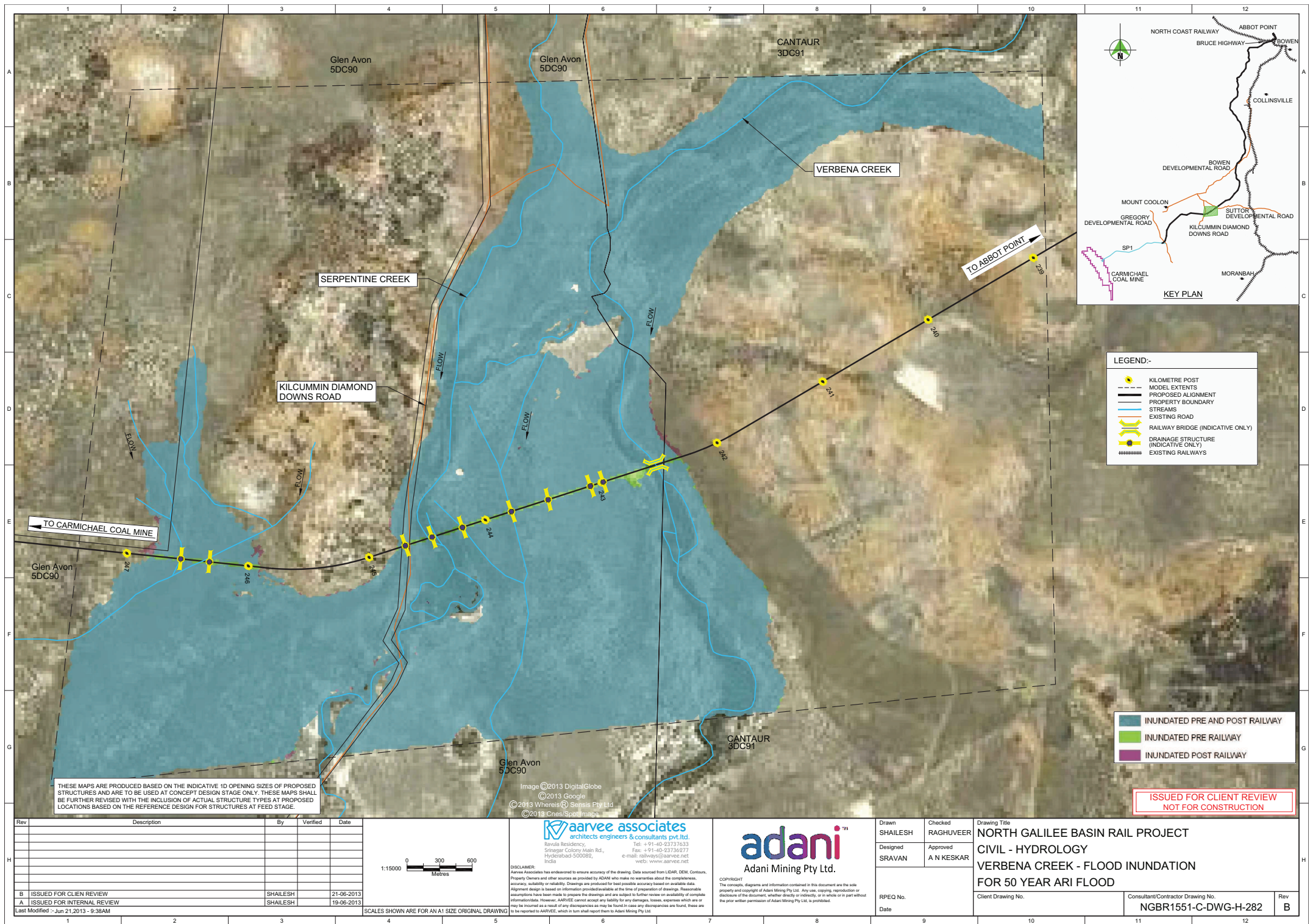
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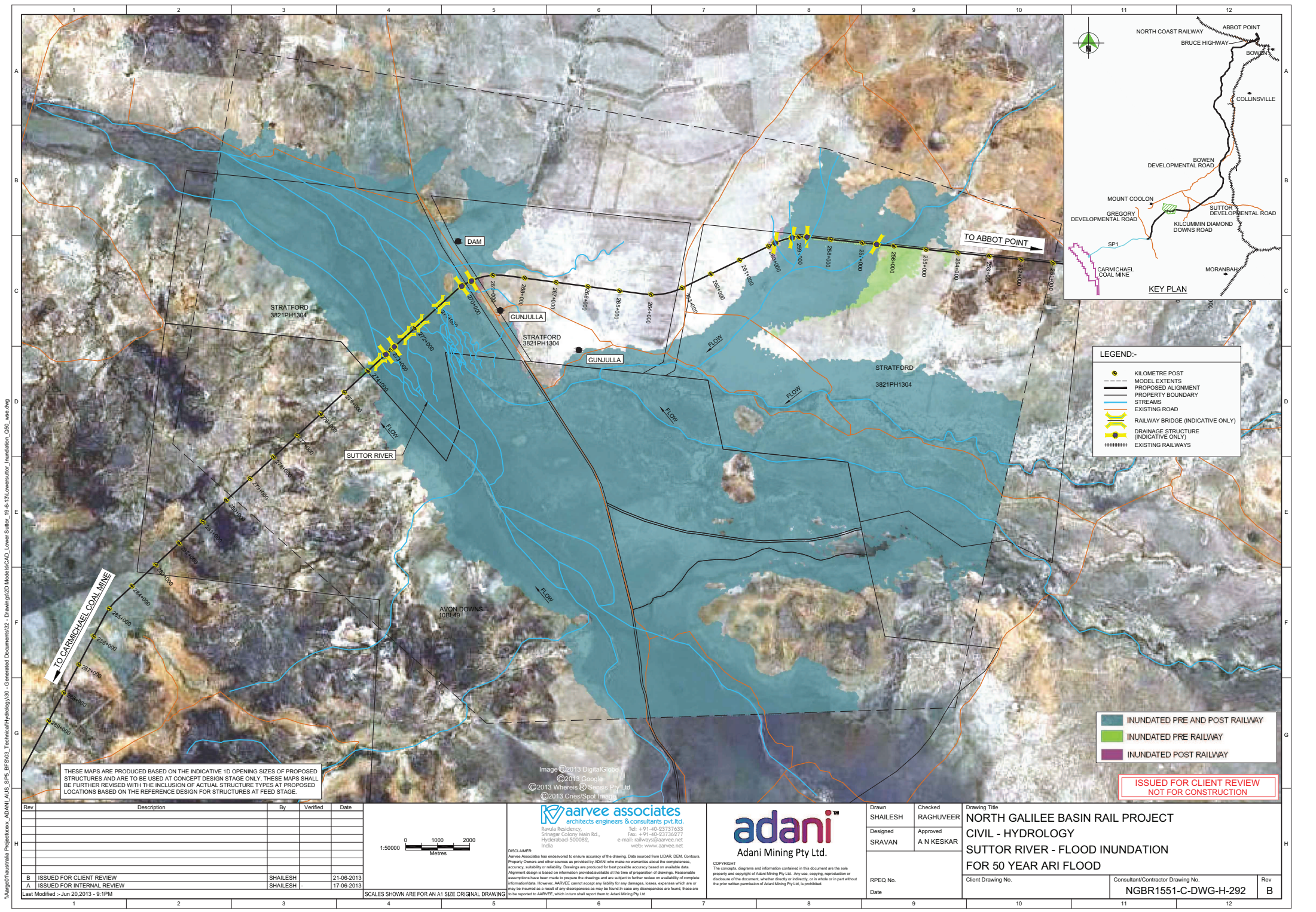
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Client Drawing No.	Consultant/Contractor Drawing No.
	NGBR1551-C-DWG-H-242
	Rev B







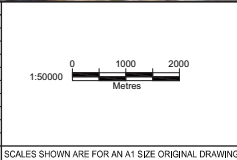




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Rev	Description	By	Verified	Date
B	ISSUED FOR CLIENT REVIEW			21-06-2013
A	ISSUED FOR INTERNAL REVIEW	SHAILESH		17-06-2013
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