APPENDIX C

Spring Creek Flood Impact Assessment

Wyong Areas Coal Joint Venture

Wallarah 2 Coal Project

Spring Creek
Flood Impact Assessment

July 2016
Final Issue

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EXECUTIVE SUMMARY

This Flood Impact Assessment report presents the results of the assessment of potential impacts on flooding in Spring Creek due to the proposed Amendment to the Wallarah 2 Coal Project (the Project). The Amendment involves the construction of a conveyor system, a rail spur and coal loading facilities to enable the transportation of product coal. This infrastructure will replace the previously proposed rail loop and spur. The report is an addendum to the original Flood Impact Assessment prepared in January 2013 as part of the Environmental Impact Statement for the project.

The proposed rail spur will be located on the eastern side of the Main Northern Rail Line between Sydney and Newcastle and north of the Doyalson Link Road (aka Motorway Link Road).

Two new bridges will be constructed to support the proposed rail spur over the two main tributaries of Spring Creek. These bridges will be similar in geometry to the adjacent bridges on the main rail line. Earthworks for the rail spur will encroach on the floodplain of Spring Creek and consequently there may be some afflux caused by reduction in flood storage and constriction of flows.

The northern tributary to Spring Creek flows under the main rail line via a 3.5 metre diameter culvert and twin 1.5m diameter culverts. Both of these crossings will need to be extended eastward under the new rail spur.

The hydrology of Spring Creek catchment upstream of the Doyalson Link Road was modelled using DRAINS software and the hydraulic behaviour was modelled using HEC-RAS software. The models were run for existing conditions and for post development conditions to determine the extent of afflux and any other changes in flow characteristics.

The construction of the rail spur is expected to result in afflux of 0.01m upstream of Bridge 1 over the southern tributary of Spring Creek and 0.03m upstream of Bridge 2 over the main stream of Spring Creek during the 1%AEP (100 year ARI) flood. Mitigation options are available to eliminate this negligible degree of afflux if necessary. There will be no change in flood hazard as a result of the localised, insignificant changes to flow depths and velocities.

The rail line and rail spur would be completely inundated during the PMF with no difference between pre development and post development conditions.

A conveyor is proposed to transport the coal from the stockpile to the loader located about half way along the rail spur. Because much of this conveyor will be constructed along the ridge line beside Tooheys Road and within the rail spur easement, there will be effectively no impacts on flooding caused by the conveyor. Management of water runoff and coal materials, including spillage, within the conveyor and rail spur corridors will be required to avoid potential impacts on water quality. Basic water management methods have also been proposed in this report to address water quality management.

1 INTRODUCTION

1.1 PROJECT OVERVIEW

The Wyong Areas Coal Joint Venture (WACJV) is seeking development consent under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the Wallarah 2 Coal Project (the Project). The key features of the Project include:

- A deep underground longwall mine extracting up to 5 million tonnes per annum (Mtpa) of export quality thermal coal;
- The Tooheys Road Site between the M1 Motorway and the Motorway Link Road, which includes a portal, coal handling facilities and stockpiles, water and gas management facilities, small office buildings, workshop, rail spur, train load out bin and connections to the municipal water and sewerage systems;
- The Buttonderry Site near the intersection of Hue Hue Road and Sparks Road, which includes administration offices, bathhouse, personnel access to the mine, ventilation shafts and water management structures;
- The Western Shaft Site in the Wyong State Forest, which includes a downcast ventilation shaft and water management structures;
- An inclined tunnel (or "drift") from the surface at the Tooheys Road Site to the coal seam beneath the Buttonderry Site;
- Transportation of product coal to the Port of Newcastle by rail; and
- An operational workforce of approximately 300 full time employees.

The Project has been subject to the assessment process under Division 4.1 of Part 4 of the EP&A Act, including a review by the Planning Assessment Commission (PAC). In June 2014, the PAC concluded that *'if the recommendations concerning improved strategies to avoid, mitigate or manage the predicted impacts of the project are adopted, then there is merit in allowing the project to proceed'*.

Following the review by the PAC, the Tooheys Road Site was re-designed to avoid land use conflicts with third parties. The changes to the Project include:

- Removal of the previously proposed rail loop;
- Re-location of the previously proposed rail spur to the eastern side of the Main Northern Rail Line;
- Re-location of the train load out facility to the eastern side of the Main Northern Rail Line;
- A conveyor system to deliver product coal from the stockpile to the new train load out facility; and
- Realignment of the sewer connection.

These proposed changes are referred to as the 'Amendment'. All other aspects of the Project remain identical to the original proposal.

To give effect to the proposed changes to the Project, WACJV is seeking an amendment to the Development Application (DA) under clause 55 of the *Environmental Planning and Assessment Regulation 2000.* This report forms part of the "*Amendment to Development Application SSD-4974*" (Amendment Document) being prepared by Hansen Bailey to support the application to amend the DA.

This report assesses the environmental impacts of the Amendment and where necessary, recommends additional management and mitigation measures to ameliorate these impacts. Aspects of the Project that are unchanged have not been reconsidered. The impacts associated with these aspects of the Project will remain as assessed in the *Wallarah 2 Coal Project Environmental Impact Statement* (Hansen Bailey, 2013).

Key items that may have potential impacts on flooding and water quality include:

- The construction of a new rail spur to the east of the Main Northern Rail Line with earthworks encroaching on the floodplain of Spring Creek;
- The construction of two new bridges over Spring Creek and a major tributary;
- The construction and operation of a conveyor from the coal stockpile to the train load out facility. This conveyor will run alongside Tooheys Road and Doyalson Link Road for much of its length.

The general arrangement of the proposed Tooheys Road site, conveyor, rail spur and train load out facility is shown on ***Figure 1.1***. All other aspects of the Project are unchanged from the original proposal.

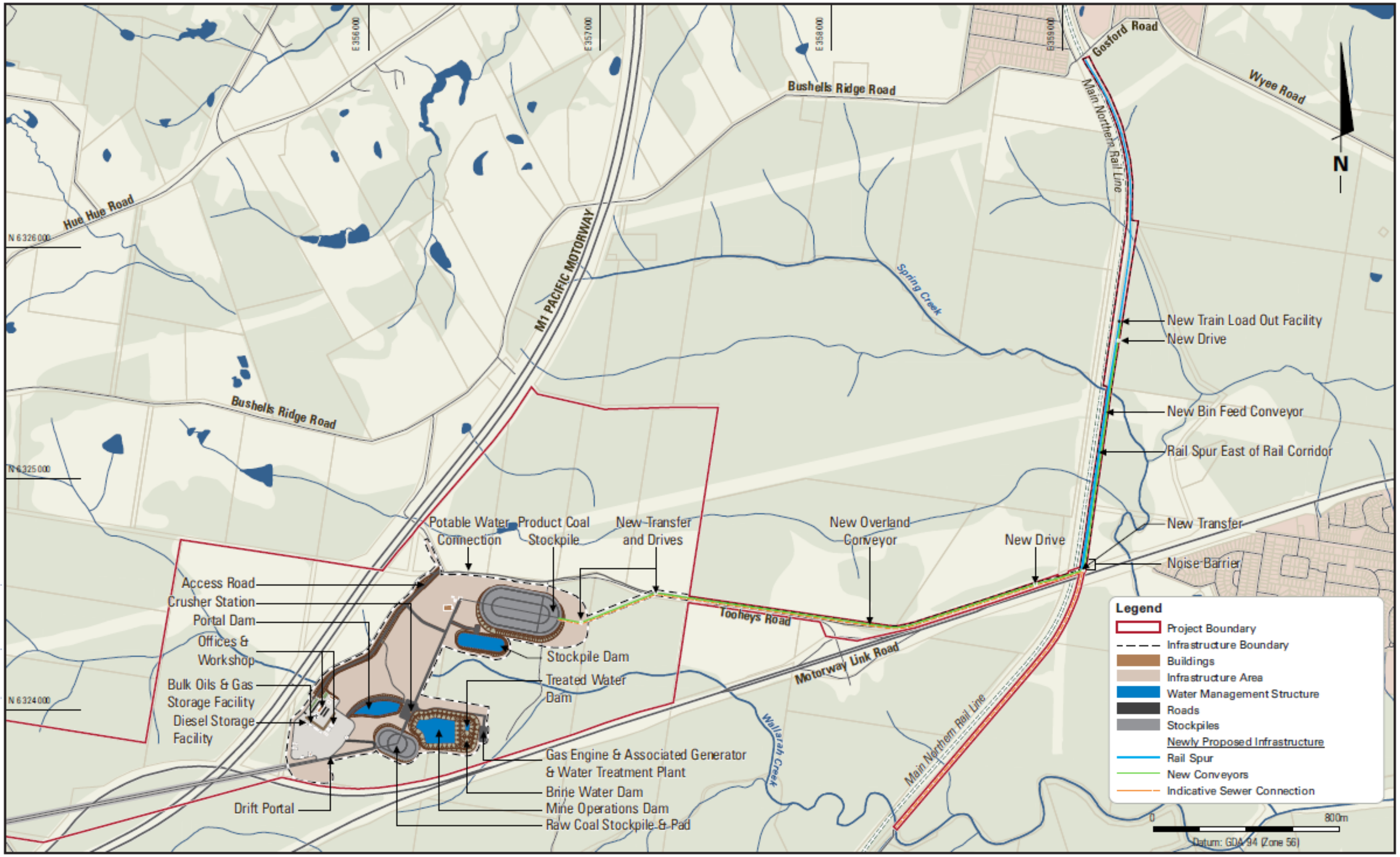

Figure 1.1 Tooheys Road Site, Conveyor, Rail Spur and Train Load Out Facility General Arrangement

1.2 STUDY OVERVIEW

This Flood Impact Assessment forms part of the Amendment Document and looks primarily at the potential changes to flood impacts associated with construction of a rail spur to facilitate loading of coal onto trains for transport to port.

The previous Flood Impact Assessment concentrated on major catchments surrounding the mine subsidence area in the Yarramalong and Dooralong Valleys and the catchment between Buttonderry Creek and Jilliby Jilliby Creek, designated as Hue Hue Creek.

The current study focuses only on Spring Creek and potential impacts on flooding caused by the rail spur and associated infrastructure. The software model DRAINS was used to model the hydrologic behaviour of the Spring Creek catchment and HEC-RAS was used to model the hydraulic behaviour based on flows calculated from the DRAINS model. Flows were determined for the 1% Annual Exceedance Probability (AEP) storm as well as the Probable Maximum Flood (PMF) and hydraulically modelled for Spring Creek and its tributaries upstream of the Doyalson Link Road. The hydraulic model was run for pre and post development conditions to determine afflux (increase in flood water levels).

Note that the terms Annual Exceedance Probability (AEP) and Average Recurrence Interval (ARI) may be used interchangeably. Both terms refer to the likelihood of a particular storm or flood event occurring or being exceeded in any year. The ARI is equivalent to the reciprocal of the AEP i.e. 1% AEP = 100 year ARI, 2% AEP = 50 year ARI etc. The terms "right bank" and "left bank" used throughout this report refer to the right side and left side of a river, stream or channel when facing downstream.

1.3 STUDY OBJECTIVES

The primary purpose of this study is to determine what, if any, impacts may occur to flood flows and to flood levels in the Spring Creek catchment as a result of the proposed coal conveyor and rail spur.

The objectives of this study are to:

- identify all streams and waterways that may be affected;
- determine the extent and quantum of flood impacts resulting from the proposed works; and
- present options to mitigate the flood impacts and to manage the quality of runoff from the works area.

1.4 *THE FLOODPLAIN RISK MANAGEMENT PROCESS*

In New South Wales, the process to assess the impacts of flooding on a community is set out in the New South Wales Government's Floodplain Development Manual (2005) which supersedes the Floodplain Development Manual (2001). The process is based on the New South Wales Government's Flood Prone Land Policy.

The floodplain risk management study forms part of the floodplain risk management process. A process diagram showing the floodplain management process is shown in ***Figure 1.2***.

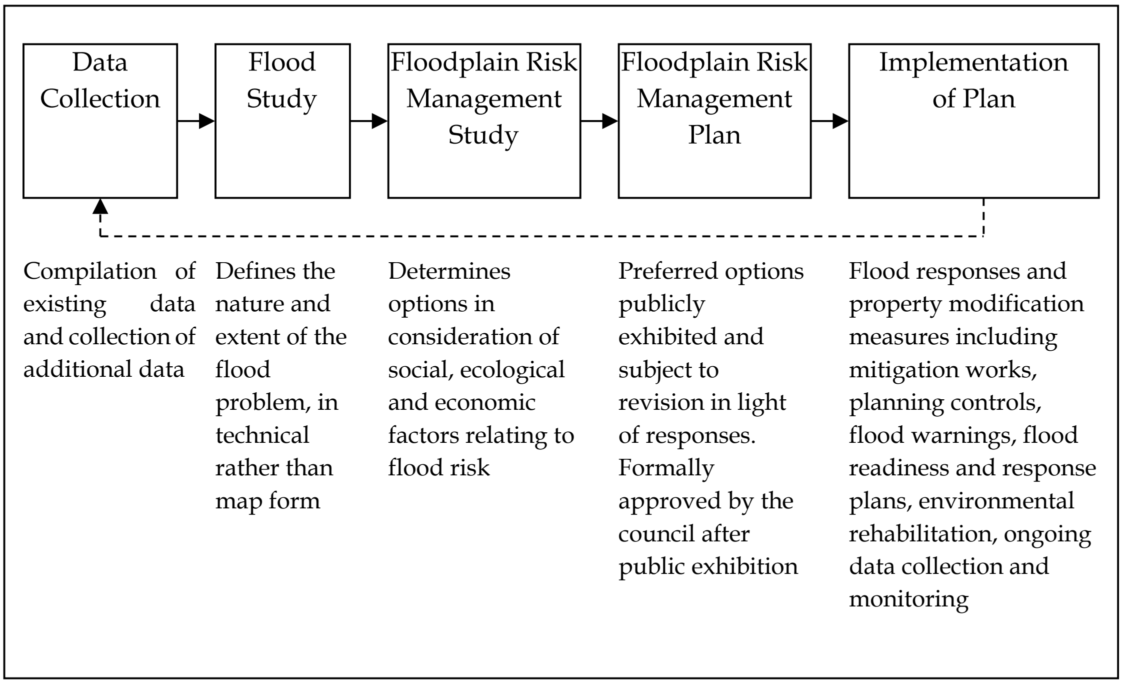

Figure 1.2 The Floodplain Risk Management Process (NSW Govt, 2005)

This study does not include a floodplain risk management study for existing flood impacts. This study does, however, investigate the risks resulting from the change in flood impacts due to the proposed works. The study has been undertaken to assess the changes in flood behaviour as a result of embankments and structures being constructed within existing flood prone areas and the extent of impacts as a result of these changes.

1.5 *REPORT STRUCTURE*

The report is structured in the following format:

- ***Section 1*** provides an introduction to the study and defines the study objectives;
- ***Sections 2*** and ***3*** provide a description of the study area and summarise available data;
- ***Sections 4*** and ***5*** detail the hydrologic and hydraulic modelling that has been undertaken;
- ***Section 6*** presents model results and summarises potential impacts;
- ***Section 7*** discusses mitigation options; and
- ***Section 8*** provides a conclusion to this report.

The revised infrastructure proposal involves no coal extraction and no subsidence related impacts in the study area. Accordingly, the following aspects of subsidence-related environmental hydrology that are beyond the scope of this report include:

- fluvial geomorphology;
- low flow hydrology and river hydraulics;
- sediment transport and deposition; and
- riparian ponding, riffle systems and associated ecological habitat.

2 *STUDY AREA*

2.1 OVERVIEW

The study area catchment and proposed conveyor and rail spur are located near Wyong on the Central Coast of New South Wales (see ***Figure 2.1***).

The study area for this assessment incorporates the Spring Creek catchment upstream of the Doyalson Link Road. Spring Creek flows a further 2.5 km into Wallarah Creek, which flows into Budgewoi Lake; another 1.7 km downstream of the confluence with Spring Creek.

Because all of the proposed rail spur is located to the north of the Doyalson Link Road and the bridge and embankments of this road create a hydraulic control point for Spring Creek there will be no impacts on Spring Creek downstream of this bridge.

The conveyor will be located almost entirely within the Spring Creek catchment with only a short length within the Wallarah Creek catchment. Because the conveyor will have no impacts on runoff quantity, only the Spring Creek catchment will be included in the study area.

The **Study Area** for the flood impact assessment has consequently been defined as the floodplains of Spring Creek upstream of the Doyalson Link Road.

The Study Area is shown in ***Figure 2.2***.

Figure 2.1 Catchment Locality Plan

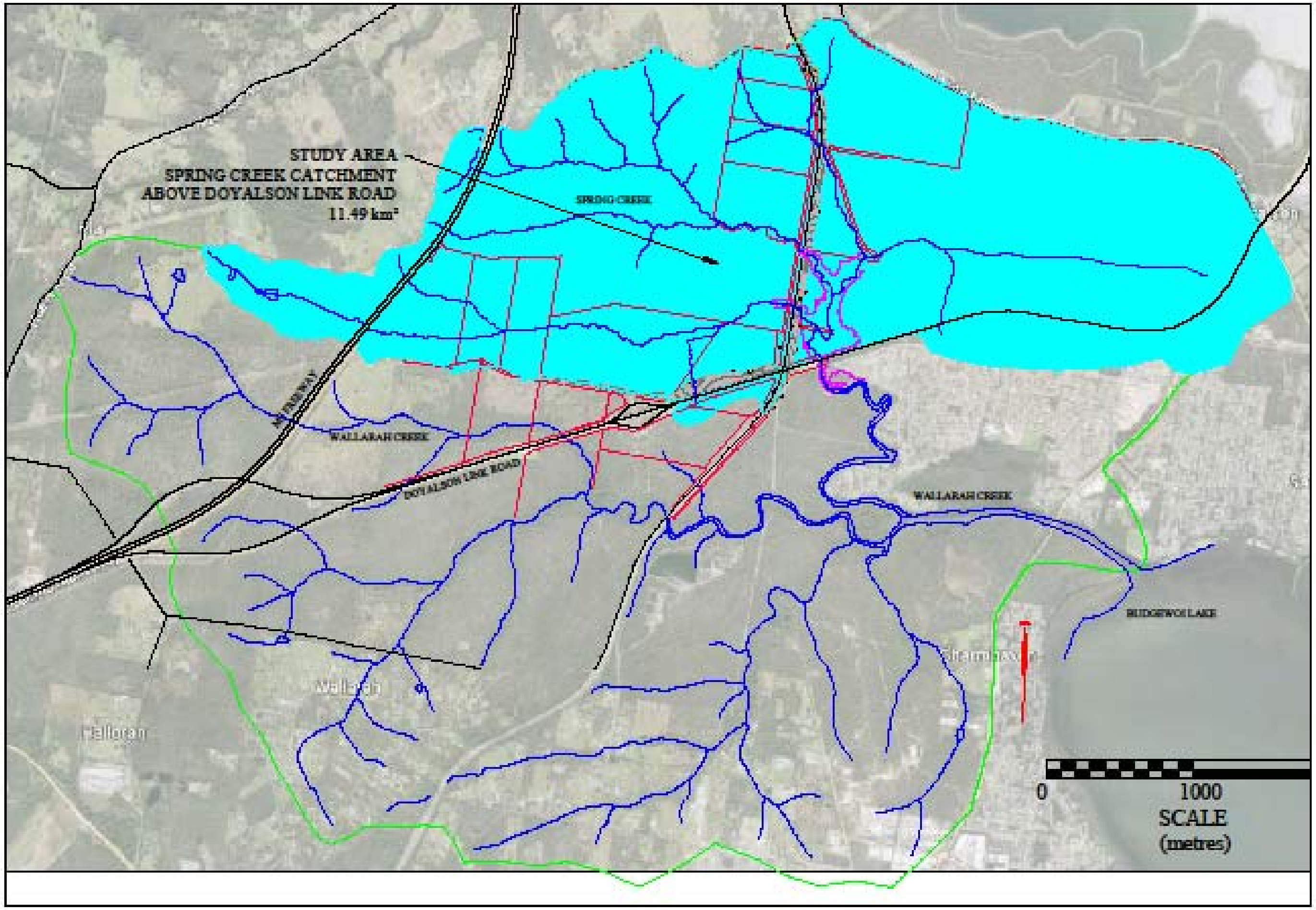

Figure 2.2
STUDY AREA

2.2 *SPRING CREEK CATCHMENT CHARACTERISTICS*

Spring Creek, upstream of the Doyalson Link Road, has a total catchment area of 11.49 km^2. Spring Creek has three main tributaries, designated in this report as the Northern, Southern and Eastern tributaries.

Some of the upper catchment has been cleared for agriculture but most of the catchment is thickly vegetated. Average slopes exceed 1 in 20 (5%) for sub-catchments and between 1 in 500 (0.2%) to 1 in 50 (2%) for waterways.

Most of the waterways in the lower sub-catchments are rough and heavily vegetated.

2.3 *WALLARAH CREEK*

Potential impacts on Wallarah Creek relative to the previously proposed rail loop have been eliminated. However, whilst not affected by hydrological or hydraulic changes due to the proposed conveyor and rail spur, Wallarah Creek is adjacent to the proposed surface facilities and will receive some runoff from a short section of the proposed conveyor. Consequently, it will be necessary to ensure that water quality from these areas meets Environmental Protection Authority (EPA) standards as outlined in the previous EIS.

The extent of the 1% AEP flood in Wallarah Creek is shown in ***Figure 2.3***. The culvert under the Doyalson Link Road acts as a hydraulic control and all potential afflux is fully contained within the Tooheys Road Site boundary.

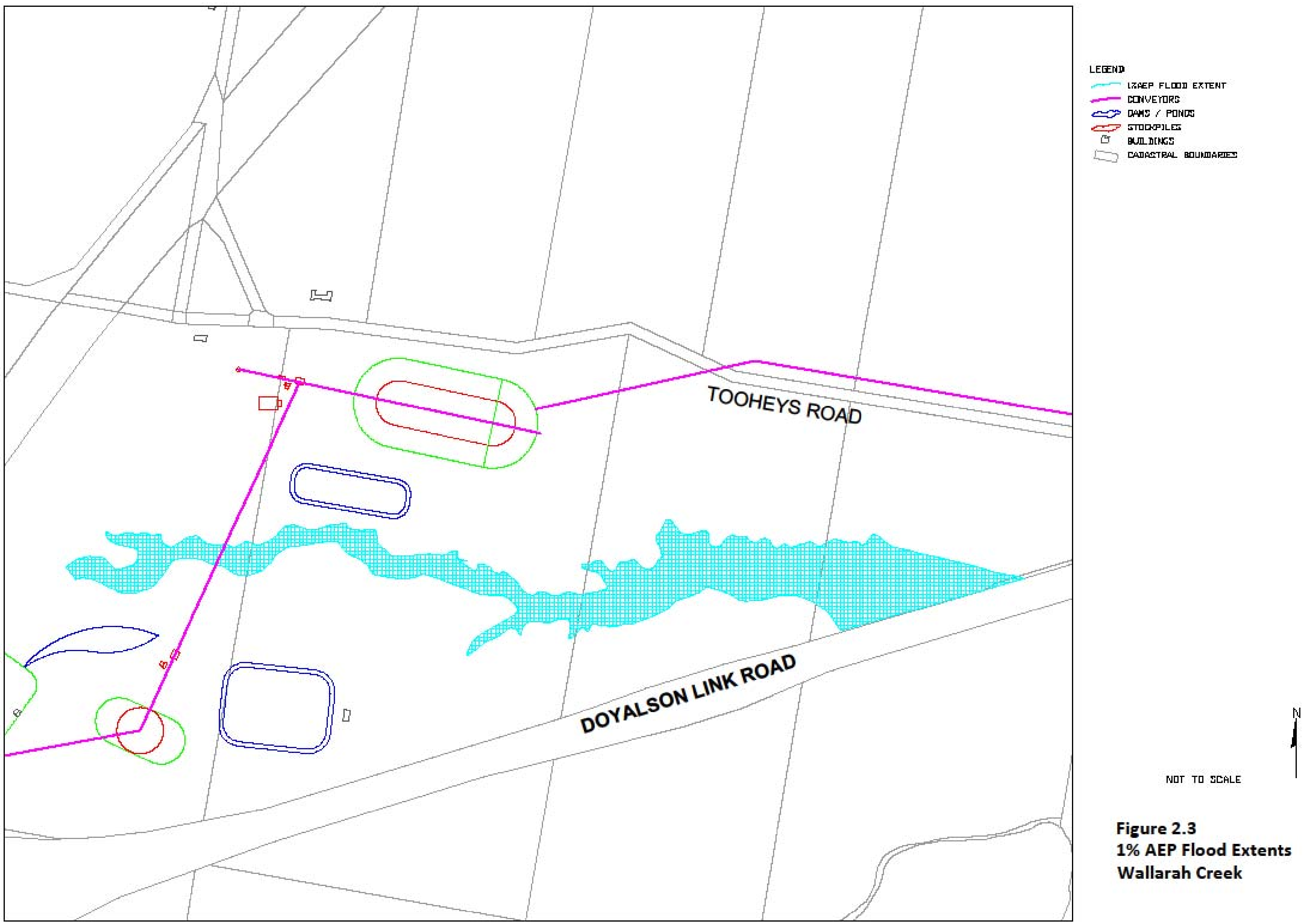

Figure 2.3
1% AEP Flood Extents
Wallarah Creek

3 *DATA REVIEW*

3.1 *TOPOGRAPHIC DATA*

3.1.1 *Digital Terrain Models*

WACJV supplied a Digital Terrain Model (DTM) of most of the Spring Creek catchment. This DTM was derived from a 2006 Aerial Laser Survey (ALS), which produced topographic information with an accuracy of +/- 0.1 m laterally and +/- 0.2 m vertically. This data was used to generate contours for the catchment.

The eastern tributary sub-catchment was not covered by this DTM and contours taken from available orthophoto maps were used to complete the terrain model.

3.1.2 *Detailed Survey*

A detailed survey was undertaken along the proposed conveyor and rail spur alignments. Contours derived from this survey were found to match the ALS data closely and were used to fill in minor details. Bridges were measured by hand.

3.1.3 *Post-Development Topography*

No significant changes are proposed to topography along the conveyor easement. The embankments proposed for the rail spur will be entirely within the 20m easement and no changes to topography outside these areas is proposed.

3.2 *SIGNIFICANT FLOODS OF RECORD*

No flood records were available for the Spring Creek study area. This study is therefore limited to a comparative assessment based on calculated water levels before and after development. Absolute values of flood levels should not be taken as definitive until the sufficient actual flood data is obtained to calibrate the hydraulic model.

3.3 *RAINFALL DATA*

All flood studies require rainfall data for two purposes. The first is to provide information on actual rainfall in the catchment during moderate recorded floods to be entered into a hydrologic model for calibration purposes. This data is referred to as "event" data. The second is to provide information on rare or extreme storms, (usually annual maxima) to compare against design floods. Design storm data requires stations with many years of continuous records.

Since no extreme storms have been recorded in the relatively short period of records available, it is not possible to determine estimates of flood probability using statistical methods. Consequently, the only practical method available for developing flood frequency estimates is to use the procedures outlined in *Australian Rainfall and Runoff* (1987, Revised 2007) (AR&R).

There are a number of rainfall gauges within the Wyong and surrounding Local Government Areas. These gauges are summarised in ***Table 3.1*** and their locations are shown in ***Figure 3.3.***

Due to the lack of streamflow records in Spring Creek, it was not possible to correlate data from the available rain gauge data. However, the temporal patterns were reviewed and found to have good correlation to the temporal patterns used by AR&R.

Table 3.1 Summary of Rain Gauges

Gauge Type	Location	Data Source	Recording Frequency
Pluviograph	Mardi Dam	MHL	2 minutes
Pluviograph	Toukley	MHL	5 minutes
Pluviograph	Wyong	MHL	10 minutes
Pluviograph	Yarramalong	MHL	2 minutes
Rainfall	Wyee Post Office	BOM	Daily
Rainfall	Gosford (Narara Research Station) AWS	BOM	Daily
Rainfall	Ourimbah (Dog Trap Road)	BOM	Daily
Rainfall	Laguna (Kolongba)	BOM	Daily
Rainfall	Kulnura North (Jeavons)	BOM	Daily
Rainfall	Watagan Central	BOM	Daily
Rainfall	Yarramalong (Lewinsbrook)	BOM	Daily
Rainfall	Norah Head Lighthouse	BOM	Daily

Notes:

1. BOM abbreviates Bureau of Meteorology.
2. MHL abbreviates Manly Hydraulics Laboratory.
3. AWS abbreviates Automated Weather Station.

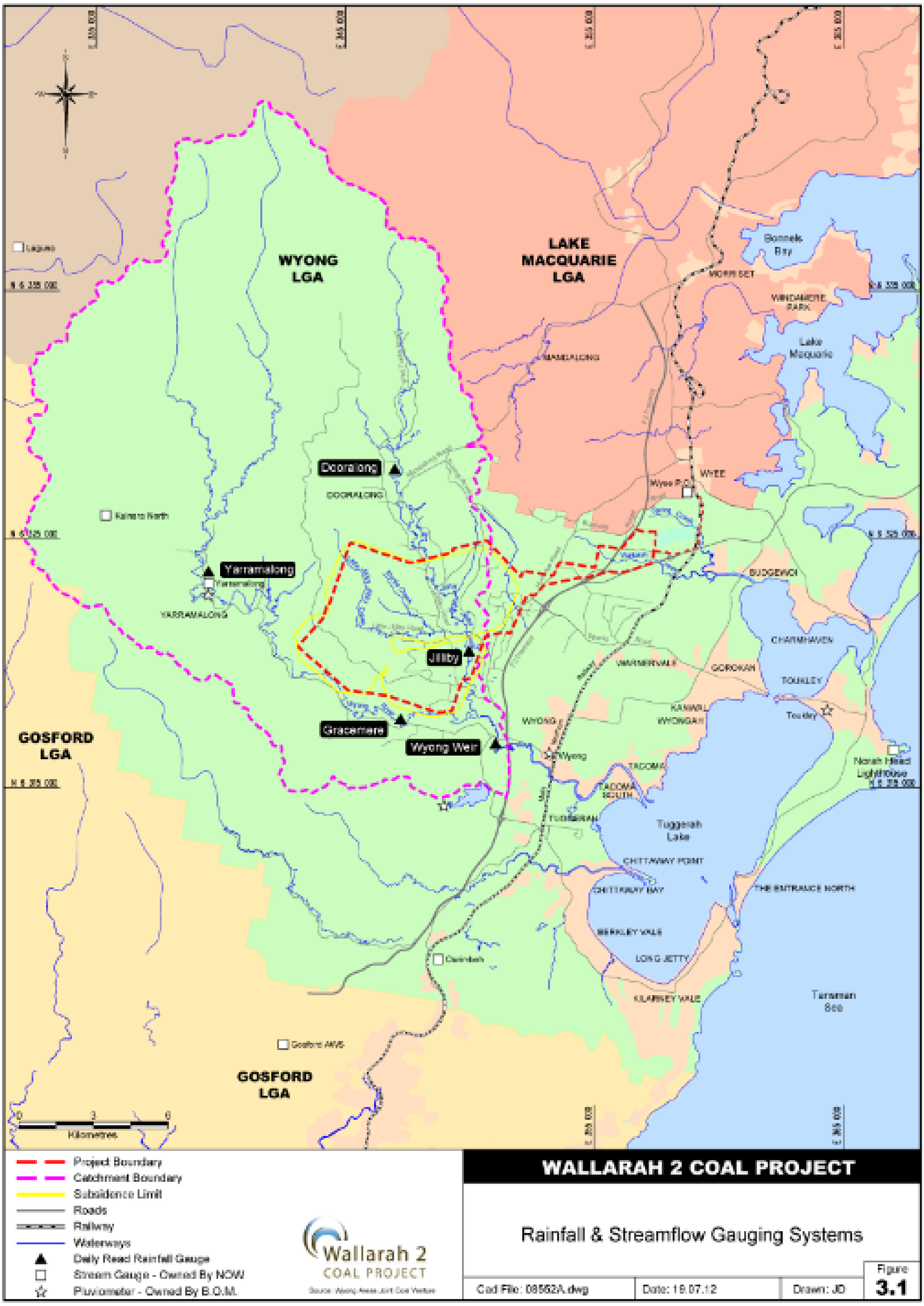

Figure 3.1 Rainfall and Streamflow Gauging Stations

3.3.1 *Design Rainfall*

Design storm data published in AR&R was used in this study. Because the catchment is relatively small, there was no need to allow for spatial variations of rainfall intensity parameters. However, design rainfall was applied to sub-catchments to model a range of intensities for design storms of particular probabilities and to account for routing effects along each stream. A conservative approach was taken in this study by adopting, for the whole of the sub-catchments, the maximum value for each of the rainfall parameters from the relevant AR&R Maps from any point within the catchment.

3.3.2 *Downstream Conditions*

Hydraulic models require the definition of the boundary conditions at the downstream end of the model. The boundary conditions can be entered as:

- a constant water surface level;
- a time varying relationship of water surface levels; or
- a rating curve providing water surface levels for various flow rates.

Due to the lack of recorded flood data it was not possible to use either of the first two approaches. The creek was modelled for a distance of 215m downstream of the Doyalson Link Road to provide a theoretical uniform flow depth rating curve. However, the link road bridge is sufficiently narrow to create a critical flow control point for larger flood flows and flood levels upstream of the bridge are not influenced by conditions downstream.

4 HYDROLOGICAL MODEL

4.1 OVERVIEW

The software package DRAINS was used to model the hydrology of the Spring Creek catchment for the 1% AEP storm and the PMF. As part of the modelling process, each of the 4 sub-catchments were divided into smaller sub-catchments with channel connections between nodes to allow for the effects of channel routing and timing of individual sub-catchment flood peaks.

A number of runs were undertaken to determine the critical storm duration at the two main points of interest (Rail Bridges 1 and 2). The PMF has also been input into the DRAINS model as a peak intensity with similar temporal patterns as the critical 1% AEP storm.

4.2 DESCRIPTION OF DRAINS MODEL

The arrangement of sub-catchments used in the model is shown in ***Figure 4.1***. Values of surface slope, channel slope and channel cross-sections were obtained from the detailed ALS information. Values of surface and channel roughness and other parameters were obtained from site inspections and from aerial photographs. The configuration of the DRAINS model is shown in ***Figure 4.2***. Model input data is summarised in ***Annex A.***

4.3 RAINFALL PARAMETERS

Design storm rainfall was determined for the 1% AEP and for durations between 30 minutes and 3 hours in accordance with the standard procedures described in Chapter 2 of AR&R. Parameters for each rainfall zone were calculated using the maps provided in Volume 2 of AR&R. Hyetographs for each design storm were also developed in accordance with the procedures outlined in AR&R. Parameters used in development of the hydrologic input to the DRAINS model are detailed in ***Annex A***.

4.4 PROBABLE MAXIMUM PRECIPITATION (PMP) CALCULATIONS

Probable Maximum Precipitation (PMP) was calculated using the Generalised Short Duration Method (GSDM) as described in the Bureau of Meteorology's Bulletin 53 (1994). This method is considered suitable only for catchments up to 1000 km^2 in area and for storms up to 6 hours in duration. Bulletin 53 was revised in June 2003, with the moisture adjustment factor (MAF) being changed to reflect updated moisture data that has been used by the Hydrometeorology Section of the Bureau of Meteorology since 2001.

The PMP was applied directly into the DRAINS model for the maximum intensity zone with no special distribution to determine the PMF.

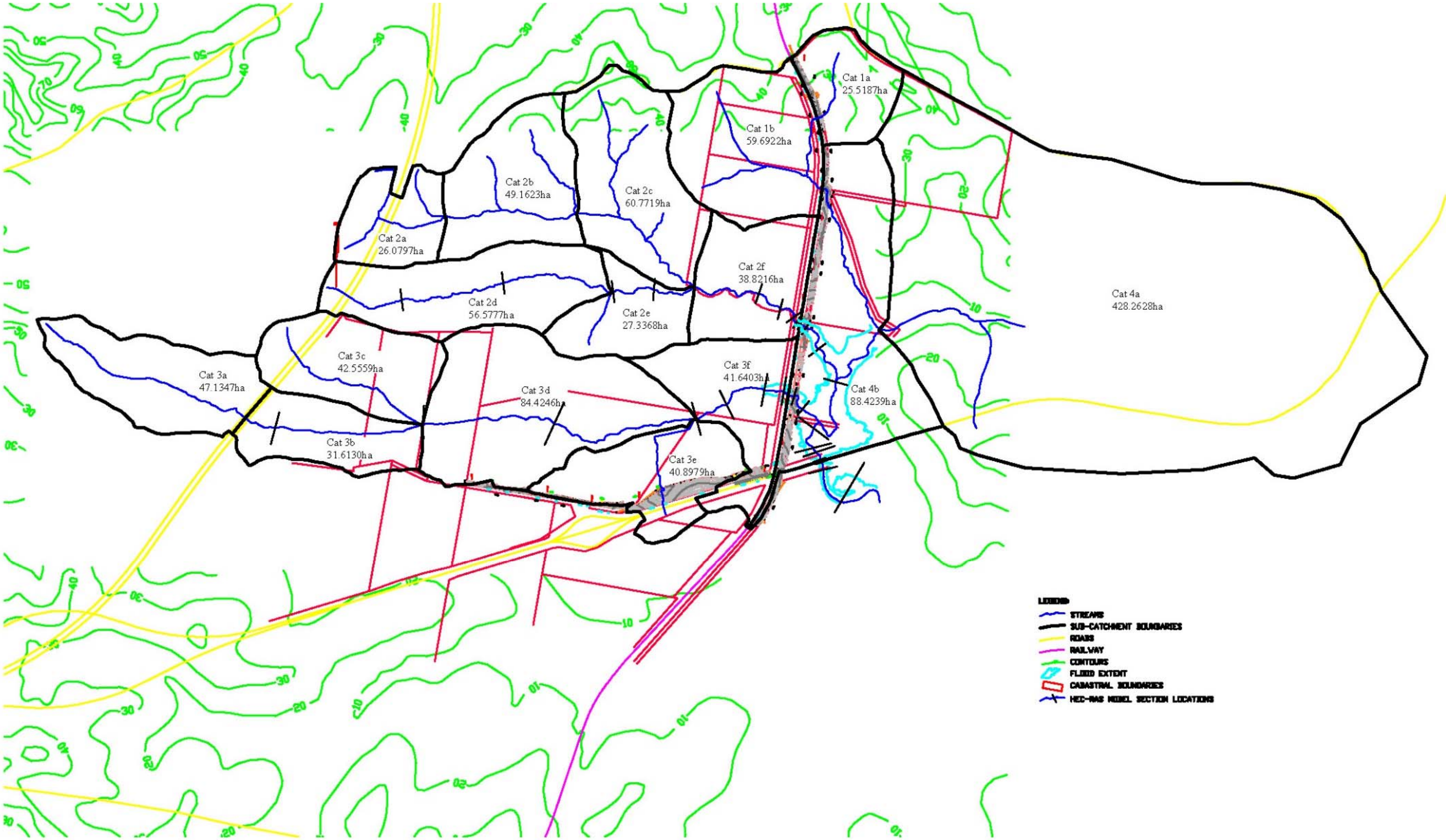

Figure 4.1 Spring Creek Sub-catchments and Hydraulic Model Section Locations

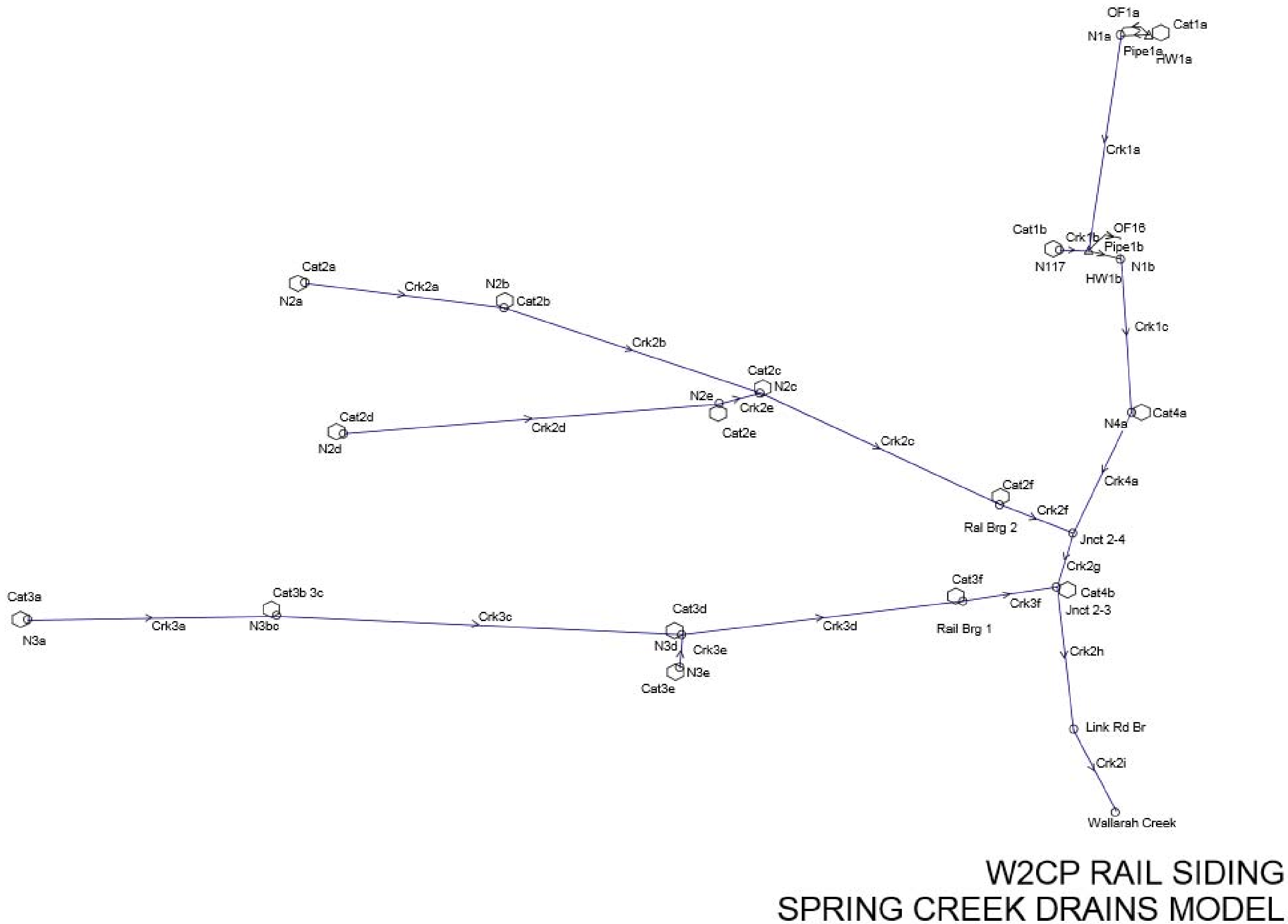

Figure 4.2 DRAINS Model Layout

5 *HYDRAULIC MODELLING*

5.1 *METHODOLOGY*

Estimating flood levels, flows and velocities before and after development is essential to ensure public safety is maintained. It is also necessary so that mitigation measures can be put in place for every structure and property as well as public infrastructure adversely affected as a result of changes to flood behaviour resulting from the development. The HEC-RAS model was used to determine flood levels for this study.

5.2 *MODEL DESCRIPTION*

HEC-RAS is a software package developed by the U.S. Army Corps of Engineers to perform one-dimensional steady and unsteady river hydraulic calculations for a full network of natural and constructed channels. The flow data determined using the DRAINS model provides input to the HEC-RAS model to calculate water surface levels, velocities and water profiles for the critical 1% AEP storm and for the PMF.

The HEC-RAS model topographic input was derived from the ALS data as well as limited site survey. Parameters used in the model were determined from site inspections and from aerial photos. Only the main channel of Spring Creek and its southern tributary needed to be modelled to assess flood levels at the two bridges. The locations of sections used in the HEC-RAS model are shown in Figure 4.1 and a diagrammatic representation of the model indicating the section chainages is given in ***Figure 5.1***.

HEC-RAS model input data is given in ***Annex B***.

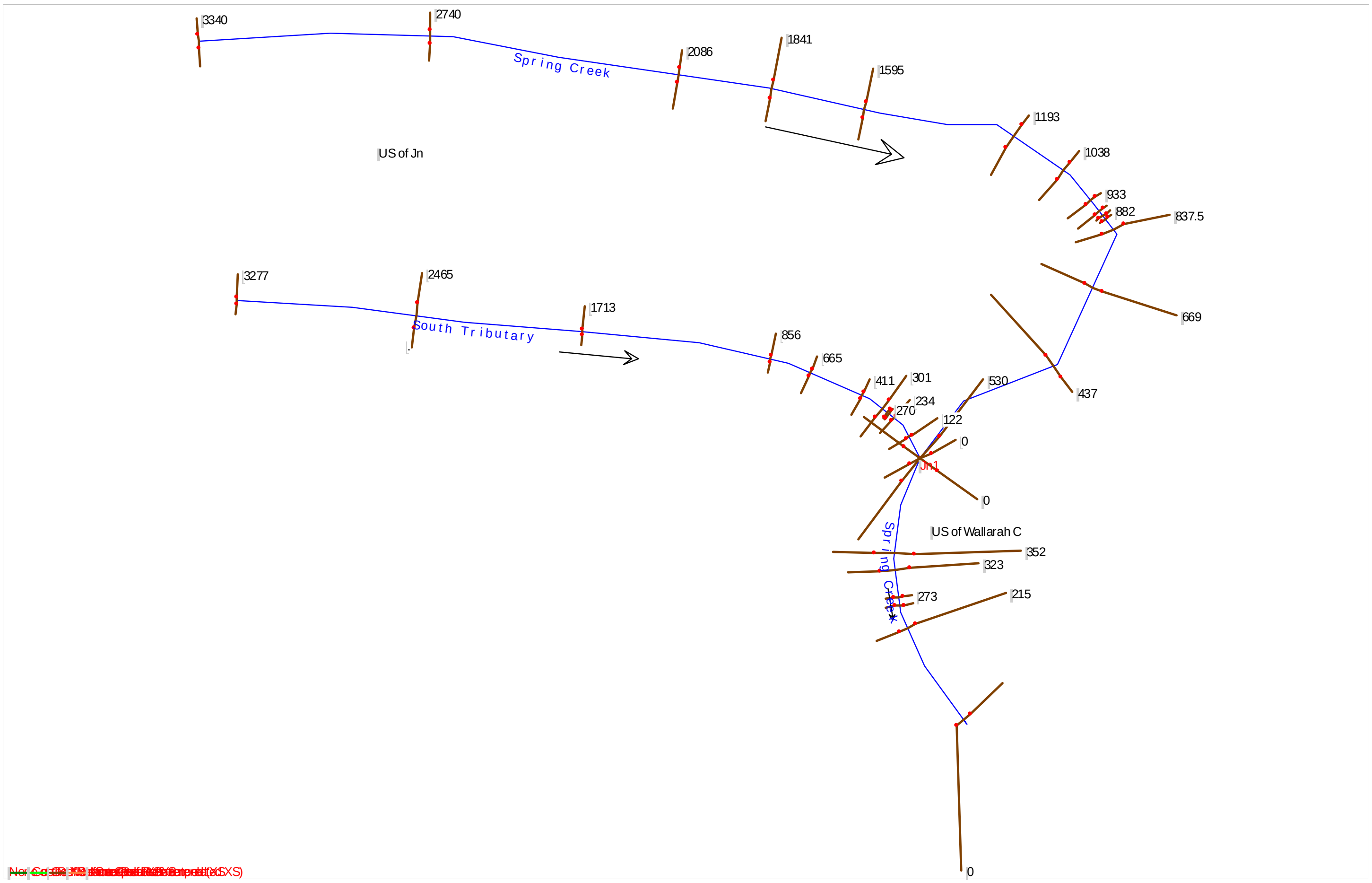

Figure 5.1 HEC-RAS Model Structure

5.4 MODEL PARAMETERS

Roughness Values

Surface roughness is one of the main parameters affecting flood behaviour. In general, for a given flow, water depth is proportional to a function of surface roughness. In the HEC-RAS model, roughness, expressed as Manning's n values, are entered as a tabulated set of material properties for a range of vegetation coverage and surface types across each cross-section.

Roughness values were estimated by comparing the vegetation and topography of the creeks and floodplains with published data (Chow, 1986). These values were varied as part of a sensitivity assessment of the model.

The riparian zones along the main channels are typically heavily vegetated with large trees and dense undergrowth. The majority of the floodplains and surrounding hills are also heavily vegetated with only small areas cleared for agriculture.

Downstream Boundary Conditions

While the hydraulic model extends approximately 250 metres downstream of the Doyalson Link Road bridge, the focus of this study is the creek system upstream of the bridge. No significant variations in flood levels were found to result from changes to downstream boundary conditions. This is due primarily to the bridge acting as a choke for high flows. Uniform flow depth was therefore adopted for the downstream boundary conditions for all floods.

Flow Values

As noted previously, steady state flow values were taken from the DRAINS model. These values were varied along each reach to properly represent the contributions of each sub-catchment and tributary.

6 MODEL RESULTS AND FLOOD IMPACT ASSESSMENT

6.1 DRAINS RESULTS

The results of the DRAINS model are summarised in the following ***Table 6.1***.

Table 6.1 – DRAINS Model Summary

Location	1% AEP Flow (m^3/s)	PMF Flow (m^3/s)
Bridge 1	59.1	310
Bridge 2	61.1	278
Culvert 1	25.8	93.1*
Culvert 2	8.71	30.4*
Link Rd Bridge	204	1228

* Includes flow over rail embankment

The results are also summarised in ***Figures 6.1*** and ***6.2*** and fully tabulated in ***Annex A***. The critical storm duration was found to be 2 hours for all relevant locations within the catchment.

There is no measurable change in hydrology and resultant flows as a consequence of the proposed development.

The model also showed that both culvert crossings have sufficient capacity to carry the 1% AEP with no overtopping of the embankment but would not be capable of conveying the PMF flows.

The 1% AEP model was also run for 10m extensions to the culverts to represent potential extensions required for construction of the rail spur. There were no significant increases in upstream flood levels (afflux) as a result of these extensions.

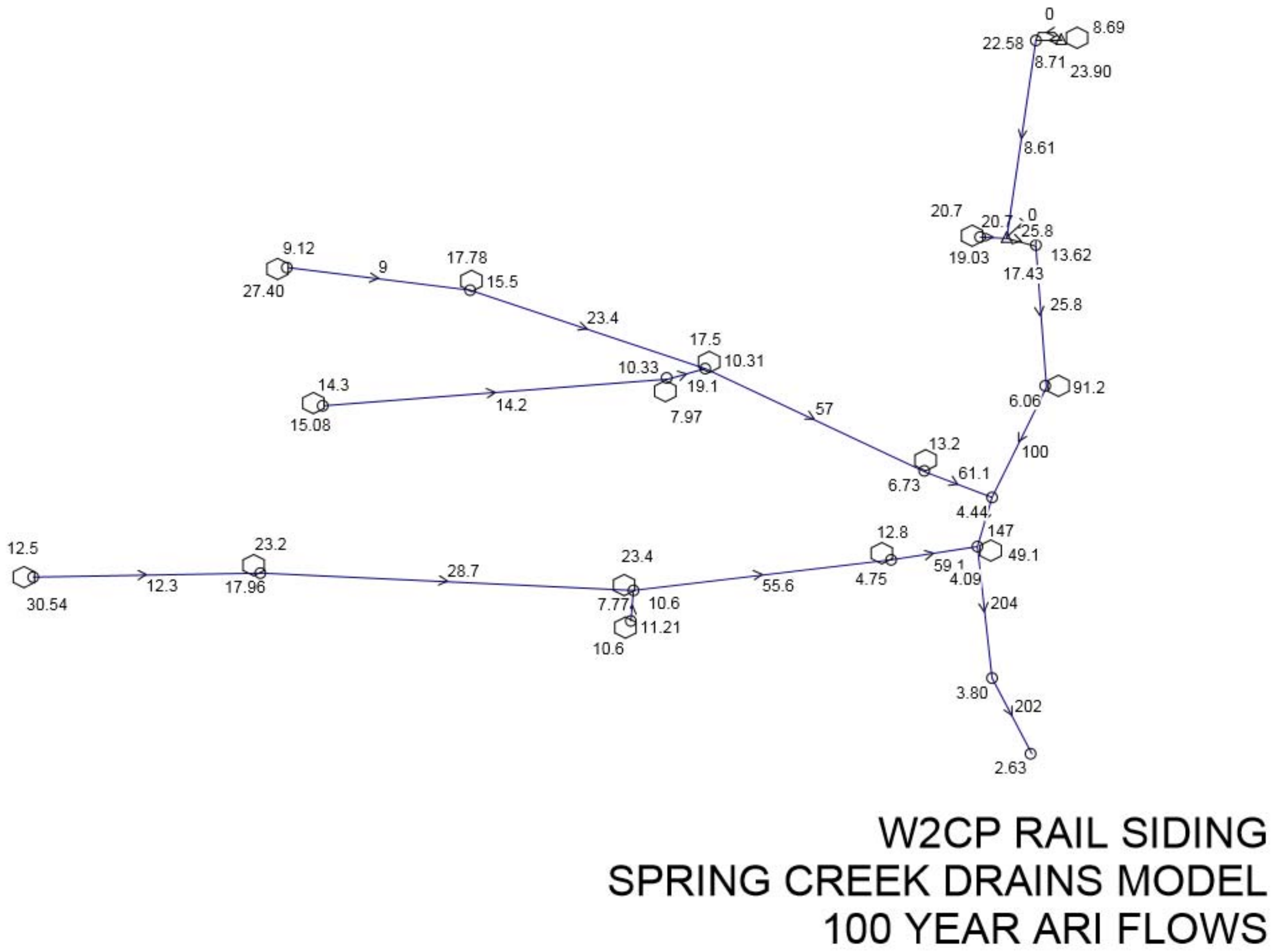

Figure 6.1 1% AEP Flows

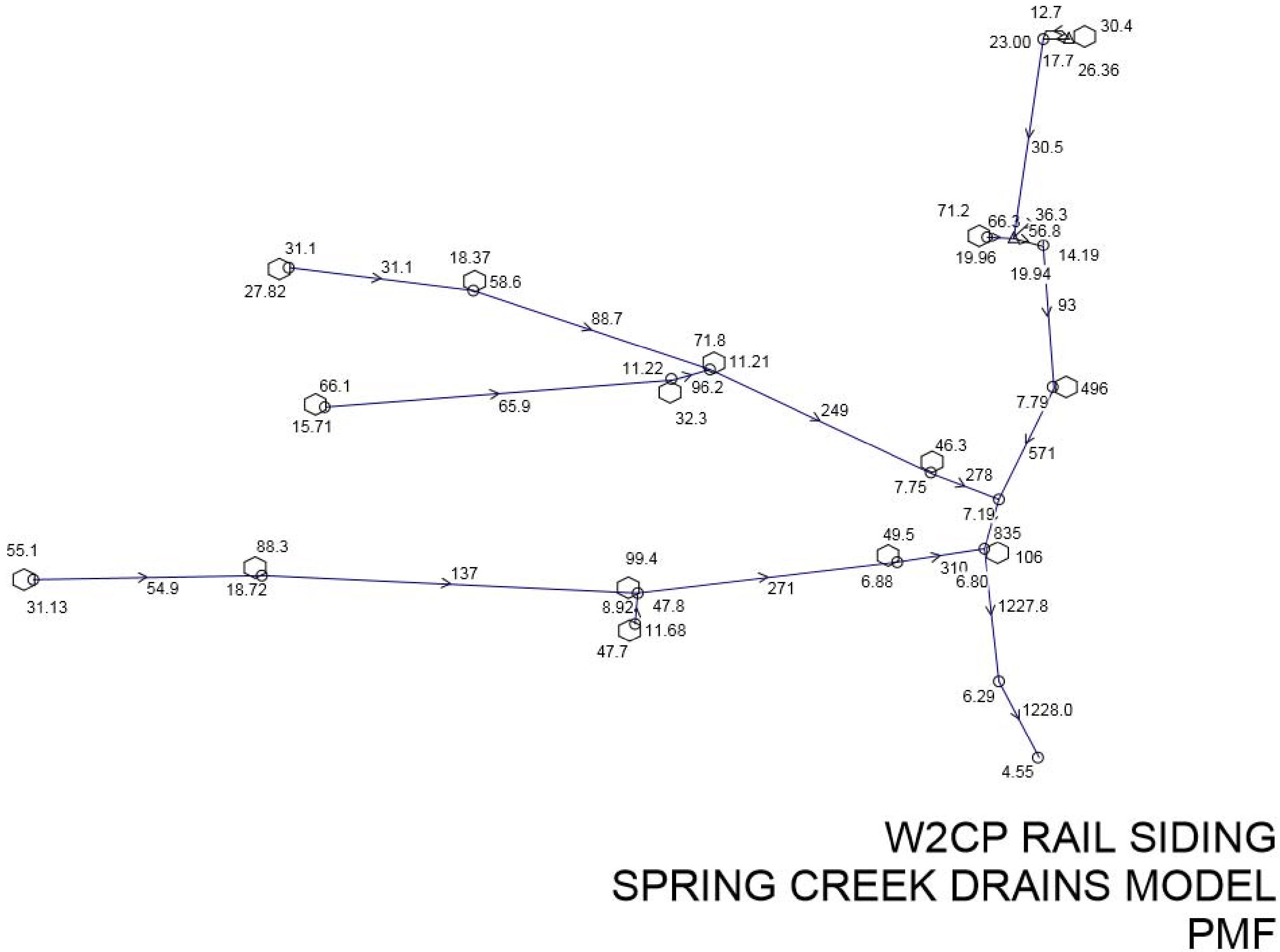

Figure 6.2 PMF Flows

6.2 *HEC-RAS RESULTS*

6.2.1 *1% AEP Flood*

The increase in flood levels – or afflux – caused by development within the floodplain can be caused by an impediment to the flow, which caused a change in energy gradient or by filling of flood volume causing a corresponding increase in levels. For the proposed rail spur, the effects on flood storage volumes are so small as to be undetectable.

Afflux caused by construction of the rail spur and bridges has been determined by comparison of pre and post development HEC-RAS models. These are summarised in the following tables.

Table 6.2 Southern Tributary – 1% AEP Existing Conditions

River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
3277	PF 1	12.3	27.5	28.59	28.29	28.65	0.003045	1.14	10.8	19.06	0.48
2465	PF 1	28.7	19.5	19.95	19.95	20.06	0.026643	1.51	19.04	84.82	1.02
1713	PF 1	39	11.5	13.31		13.39	0.002598	1.29	32.43	47.1	0.41
856	PF 1	55.6	6	7.5	7.5	7.87	0.017861	2.67	20.83	29.17	1.01
665	PF 1	57	4.5	6.19		6.26	0.001787	1.2	51.5	55.9	0.35
411	PF 1	58	4	5.38		5.53	0.005277	1.69	35.59	46.81	0.57
301	PF 1	59	3.4	5.39		5.4	0.000297	0.49	119.54	97.45	0.14
276	PF 1	59	3	5.36	4.05	5.39	0.000346	0.71	87.48	51.8	0.17
266		Bridge									
256	PF 1	59	2.8	5.35		5.37	0.000258	0.65	93.44	50.33	0.14
234	PF 1	59	1.2	5.35		5.37	0.000179	0.64	120.72	86.4	0.12
122	PF 1	59	1.4	5.34		5.35	0.000126	0.56	171.26	205.83	0.11
0	PF 1	59	1	5.34		5.34	0.000006	0.14	535.32	305.55	0.02

Table 6.3 Southern Tributary - 1% AEP Post Development Conditions

River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
3277	PF 1	12.3	27.5	28.59	28.29	28.65	0.003045	1.14	10.8	19.06	0.48
2465	PF 1	28.7	19.5	19.95	19.95	20.06	0.026643	1.51	19.04	84.82	1.02
1713	PF 1	39	11.5	13.31		13.39	0.002598	1.29	32.43	47.11	0.41
856	PF 1	55.6	6	7.5	7.5	7.87	0.017865	2.67	20.83	29.17	1.01
665	PF 1	57	4.5	6.19		6.26	0.00179	1.2	51.47	55.88	0.35
411	PF 1	58	4	5.39		5.53	0.005211	1.68	35.75	46.88	0.57
301	PF 1	59	3.4	5.39		5.4	0.000295	0.49	119.86	97.55	0.14
276	PF 1	59	3	5.37	4.05	5.39	0.000344	0.71	87.65	51.83	0.16
266		Bridge									
256	PF 1	59	2.8	5.36		5.38	0.000257	0.65	93.61	50.36	0.14
244	PF 1	59	1.3	5.35	3.4	5.37	0.000207	0.67	112.68	81.28	0.13
234		Bridge									
224	PF 1	59	1.1	5.35		5.37	0.000154	0.61	129.54	91.68	0.11
122	PF 1	59	1.4	5.34		5.35	0.000126	0.56	171.29	205.84	0.11
0	PF 1	59	1	5.34		5.34	0.000006	0.14	535.32	305.55	0.02

Table 6.4 Spring Creek – 1% AEP Existing Conditions

River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
3340	PF 1	7	33	33.4	33.38	33.48	0.014767	1.24	5.63	28.65	0.9
2740	PF 1	14.2	23	23.51	23.51	23.63	0.01731	1.59	8.96	35.96	1.01
2086	PF 1	19.1	14	15.05	14.78	15.1	0.003742	0.95	20.16	42.52	0.43
1841	PF 1	57	10.5	12.06	12.06	12.35	0.019353	2.39	23.9	42.58	1.01
1595	PF 1	58	8.5	10.04		10.16	0.004696	1.55	37.91	55.28	0.53
1193	PF 1	59	6	8.11		8.2	0.005019	1.3	45.56	73.67	0.52
1038	PF 1	61.1	5.5	7.46		7.55	0.003551	1.34	47.01	61.3	0.46
933	PF 1	61.1	5.1	7.24		7.32	0.001455	1.23	55.76	49.24	0.32
896.5	PF 1	61.1	5	6.77	6.77	7.16	0.016512	2.77	22.58	31.96	0.98
886.5	PF 1	61.1	4.9	6.88	6.23	7.03	0.002652	1.72	37.37	27.86	0.44
876.5		Bridge									
866.5	PF 1	61.1	4.8	6.66		6.79	0.002464	1.62	38.9	29.28	0.42
837.5	PF 1	61.1	4.1	6.66	5.69	6.7	0.001094	0.93	66.02	55.19	0.27
669	PF 1	148	3.8	5.34	5.34	5.85	0.015961	3.17	46.75	46.44	1.01
437	PF 1	148	1.5	5.37		5.39	0.000193	0.7	249.31	183.14	0.13
0	PF 1	205	1	5.33		5.34	0.000073	0.49	531.97	304.78	0.08

Table 6.5 Spring Creek - 1% AEP Post Development Conditions

River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
3340	PF 1	7	33	33.4	33.38	33.48	0.014767	1.24	5.63	28.65	0.9
2740	PF 1	14.2	23	23.51	23.51	23.63	0.01731	1.59	8.96	35.96	1.01
2086	PF 1	19.1	14	15.05	14.78	15.1	0.003742	0.95	20.16	42.52	0.43
1841	PF 1	57	10.5	12.06	12.06	12.35	0.019353	2.39	23.9	42.58	1.01
1595	PF 1	58	8.5	10.04		10.16	0.004704	1.55	37.88	55.27	0.53
1193	PF 1	59	6	8.11		8.2	0.005006	1.3	45.6	73.68	0.52
1038	PF 1	61.1	5.5	7.46		7.55	0.003576	1.34	46.88	61.21	0.46
933	PF 1	61.1	5.1	7.24		7.31	0.001471	1.24	55.55	49.19	0.33
896.5	PF 1	61.1	5	6.79	6.77	7.16	0.014989	2.69	23.32	32.36	0.94
886.5	PF 1	61.1	4.9	6.89	6.23	7.04	0.002553	1.7	37.86	27.95	0.43
876.5		Bridge									
866.5	PF 1	61.1	4.8	6.69		6.82	0.002296	1.58	39.82	29.45	0.41
847.5	PF 1	61.1	4.2	6.7	5.79	6.75	0.001245	0.97	62.78	53.64	0.29
837.5		Bridge									
827.5	PF 1	61.1	4	6.59	5.59	6.63	0.001032	0.9	67.53	55.89	0.26
669	PF 1	148	3.8	5.34	5.34	5.85	0.015961	3.17	46.75	46.44	1.01
437	PF 1	148	1.5	5.37		5.39	0.000193	0.7	249.31	183.14	0.13
0	PF 1	205	1	5.33		5.34	0.000073	0.49	531.97	304.78	0.08

A comparison of these tables indicates an afflux of 0.01m at Bridge 1 over the Southern Tributary and 0.03m at Bridge 2 over Spring Creek (main channel). The maximum increase in velocity at any point near the bridges is 0.04 m/s and the maximum decrease in velocity is 0.07 m/s.

Longitudinal profiles for the 1% AEP flood in the Southern Tributary and Spring Creek are shown in ***Figures 6.3*** and ***6.4*** respectively.

Note that in all figures E G indicates the energy grade line; W S represents the water surface level and Crit represents the critical flow level.

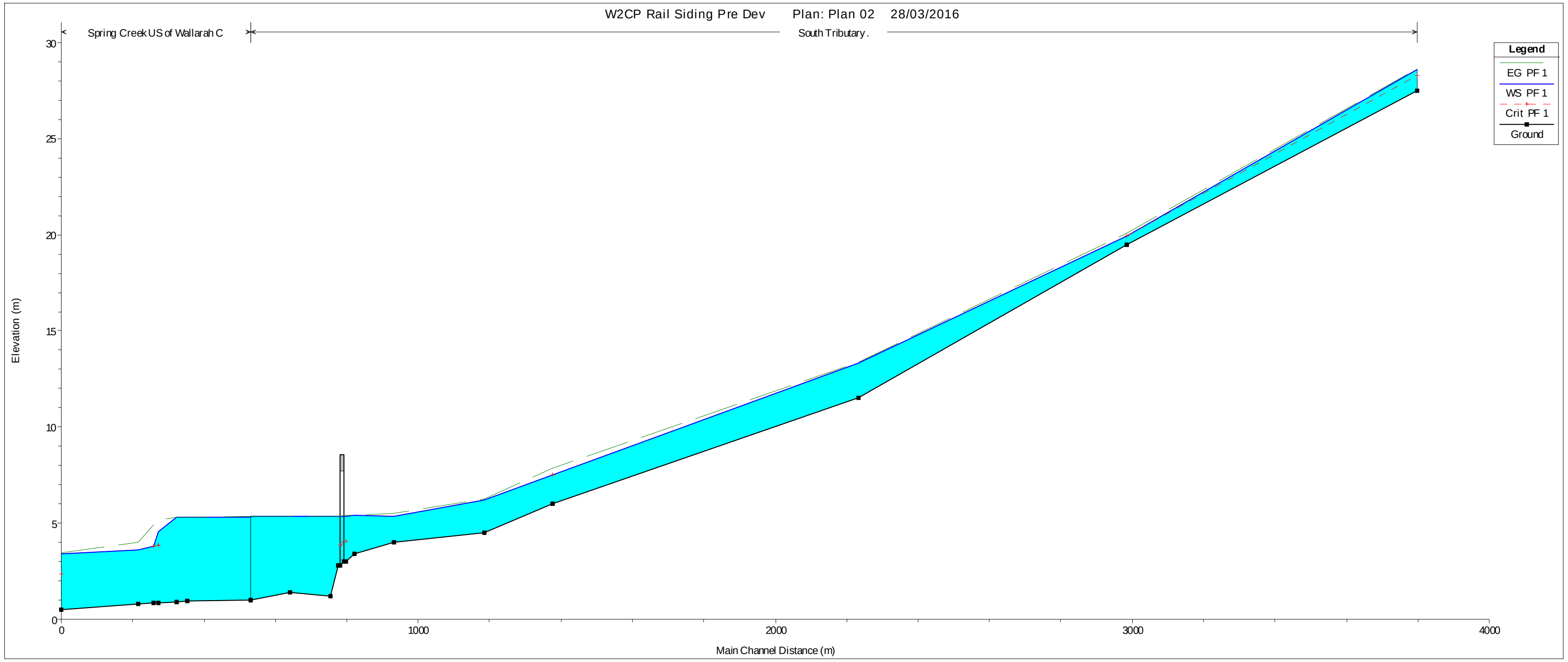

Figure 6.3 1%AEP Flood Profile – Southern Tributary through Bridge 1

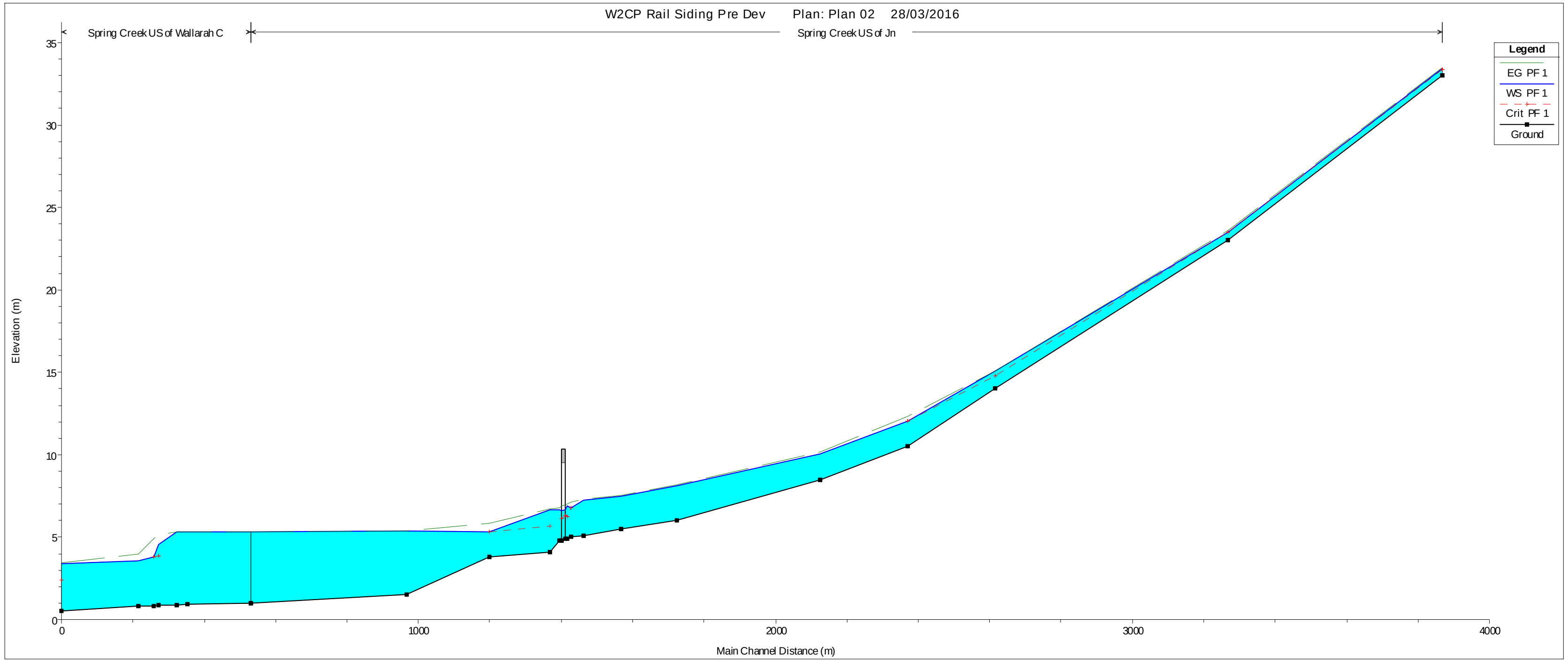

Figure 6.4 1%AEP Flood Profile – Spring Creek through Bridge 2

Figures 6.5 and ***6.6*** show the flood sections through Bridge 1 and Bridge 2 respectively.

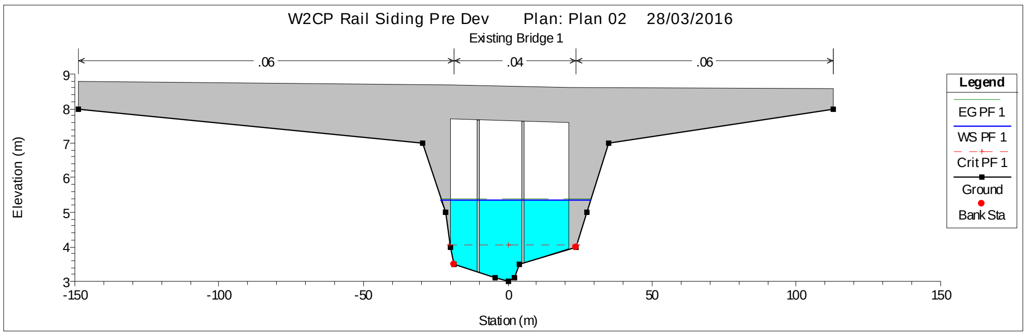

Figure 6.5 Bridge 1 Section – 1% AEP Flood

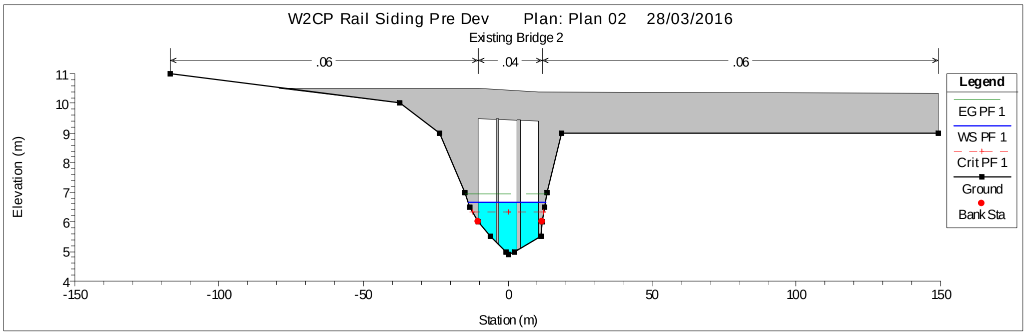

Figure 6.6 Bridge 2 Section – 1% AEP Flood

6.2.2 *PMF*

The PMF flows derived from the DRAINS model were input into the HEC-RAS model for existing conditions. The Doyalson Link Road was not overtopped and the road bridge continued to act as a hydraulic control for the Spring Creek catchment upstream of this point.

However, the rail line would be significantly inundated at all crossing points and, indeed, over most of its length during the PMF. The Doyalson Link Road rail bridge would also form an additional discharge route for the Spring Creek catchment.

PMF flood profiles are shown in ***Figures 6.7*** and ***6.8***. There is not purpose in comparing pre and post development conditions for the PMF as backwater effects would ensure no afflux would be possible.

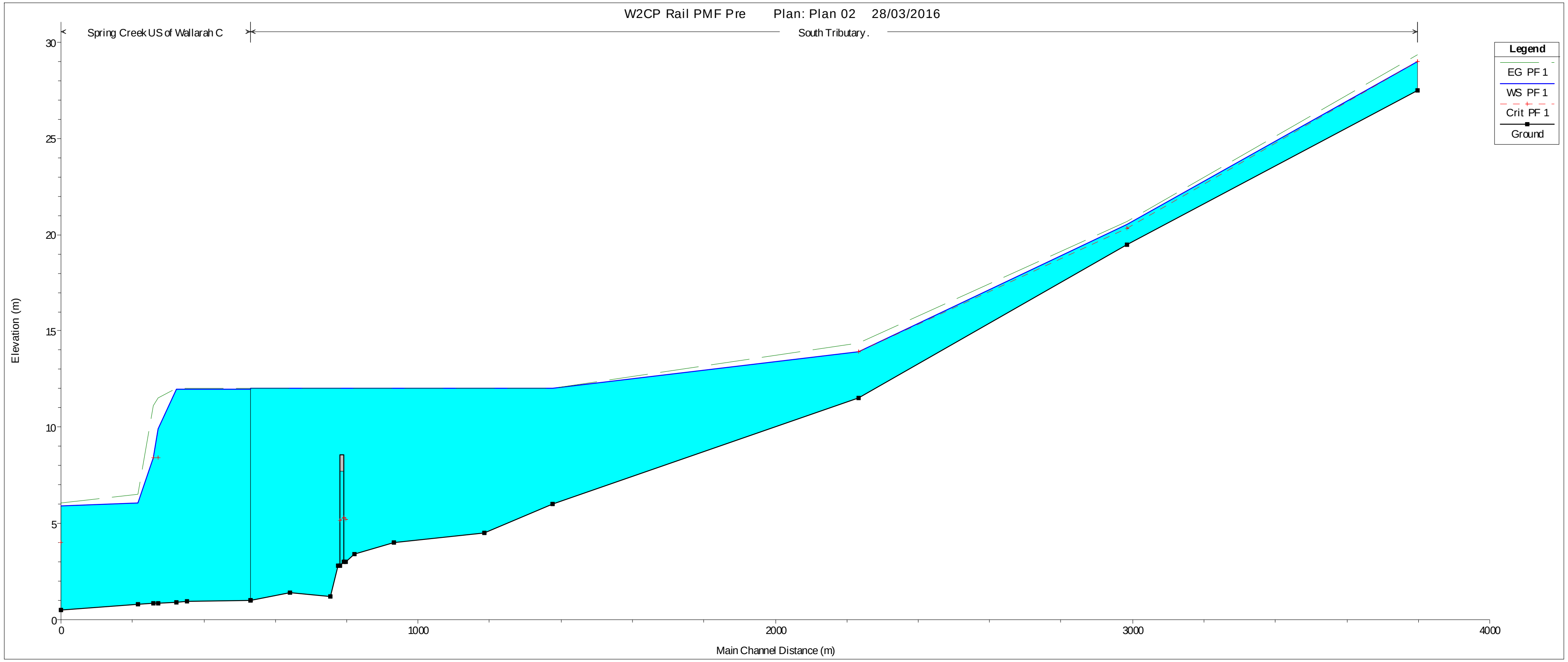

Figure 6.7 PMP Flood Profile – Southern Tributary through Bridge 1

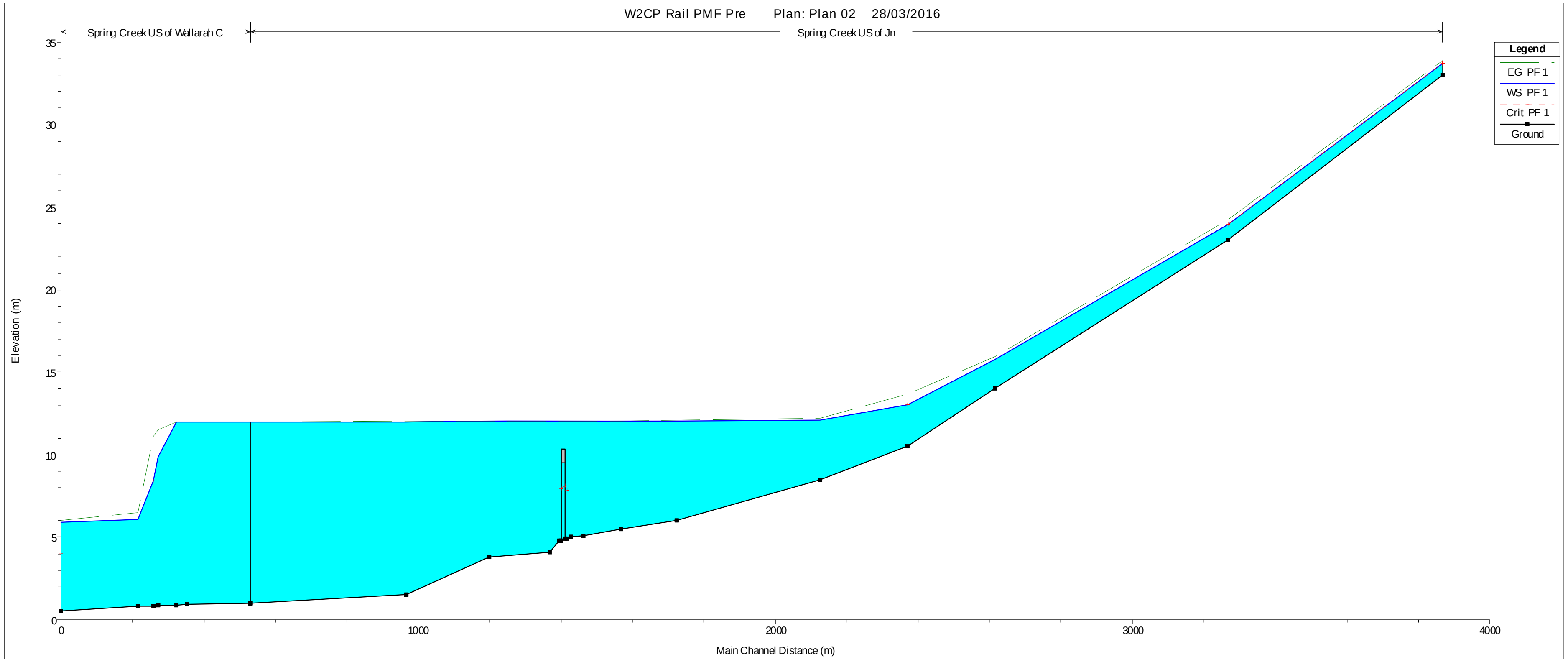

Figure 6.8 PMF Flood Profile – Spring Creek through Bridge 2

6.3 *FLOOD HAZARD ASSESSMENT*

According to the NSW Floodplain Development Manual (2005), floodplain areas can be divided into specific categories that are used to determine appropriate land uses. Categories include:

- Hydraulic categories that represent the impact of development on flood behaviour – floodway, flood storage and flood fringe; and
- Hazard categories (low hazard and high hazard) that show the impact of flooding on structures and people.

Diagrammatic definitions of these categories are provided in ***Figures 6.9*** and ***6.10***.

The food hazard category near the bridges would be classed as high on the basis that velocities are generally greater than 1.4 m/s and depths are generally greater than 1.2 m. Comparison of pre and post development depths and velocities (refer to ***Tables 6.2 to 6.5***) indicates that there will be no change to flood hazard categories at any location in the Study Area. This is a consequence of the insignificant changes to both flow depths and flow velocities.

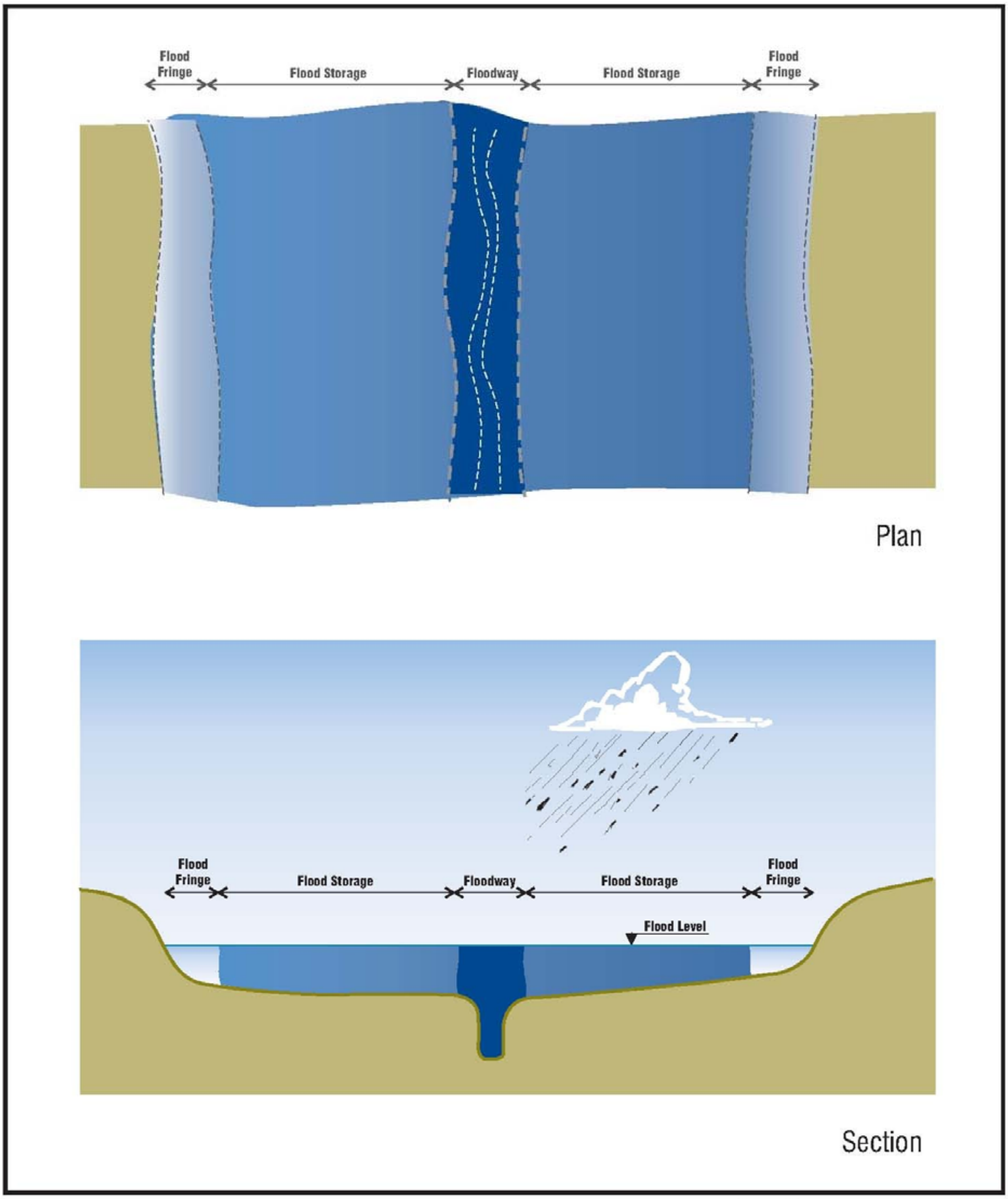

Figure 6.9 Hydraulic Categories

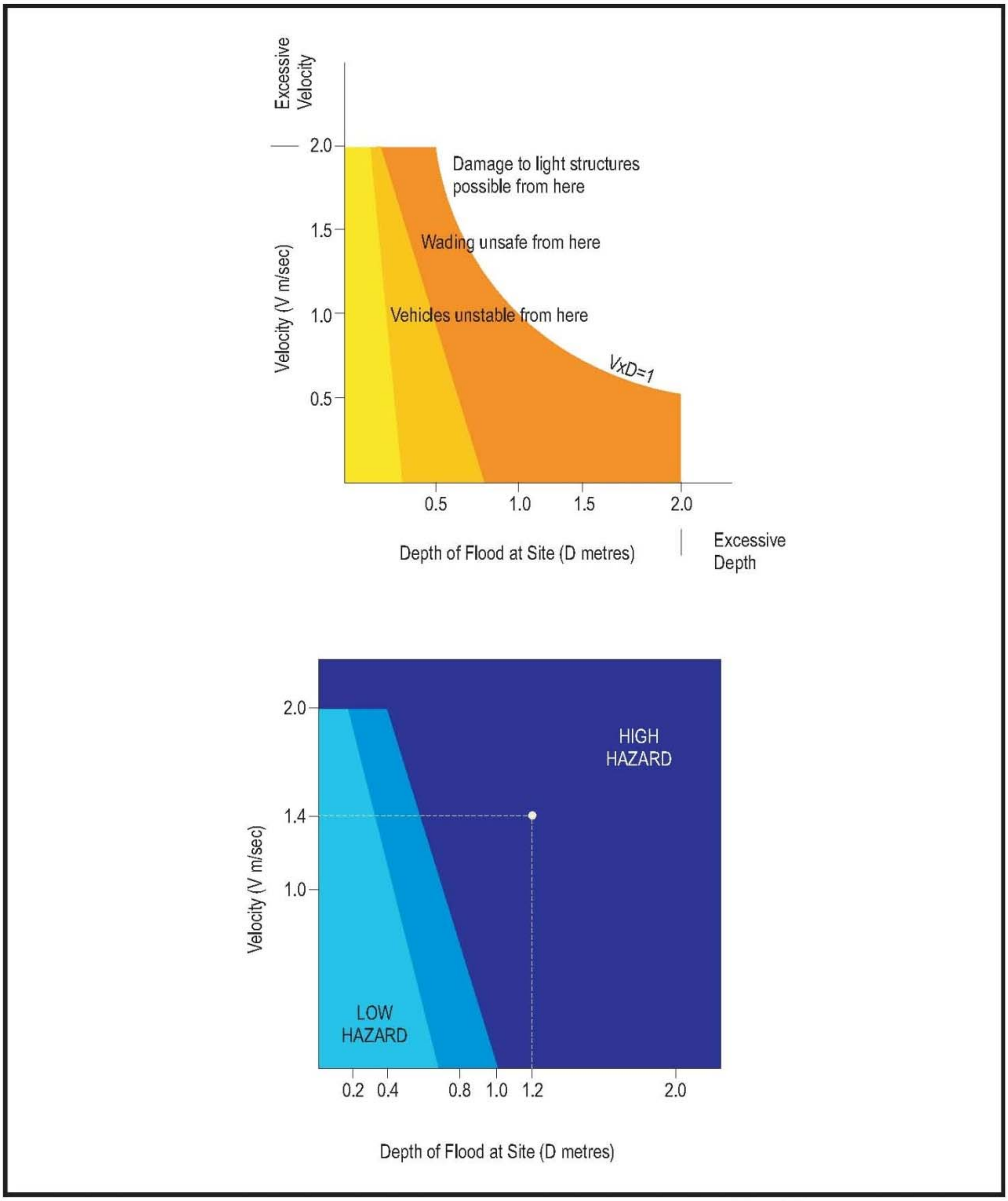

Figure 6.10 Flood Hazard Categories

6.4 *FLOOD EXTENTS*

There will be no significant change to the 1% AEP flood extent other than the reduction in extent corresponding to the rail spur embankment itself.

An indicative flood map is given in ***Figure 6.11***. For the calculated maximum afflux of 30mm there will be no discernible change in flood extent that could be represented on this figure.

It should be noted that without calibration of the model, absolute values of flood levels and associated flood extents cannot be confirmed. As stated in Section 3.2 of this report, no flood data is available for Spring Creek, hence calibration of the model is not possible at this time. For this model the primary aim was to make a comparison between existing and post developed conditions (i.e. afflux) and the model is suitable and sufficiently accurate for that purpose. In addition, conservative values of model parameters were used to give an upper bound estimate of flood levels.

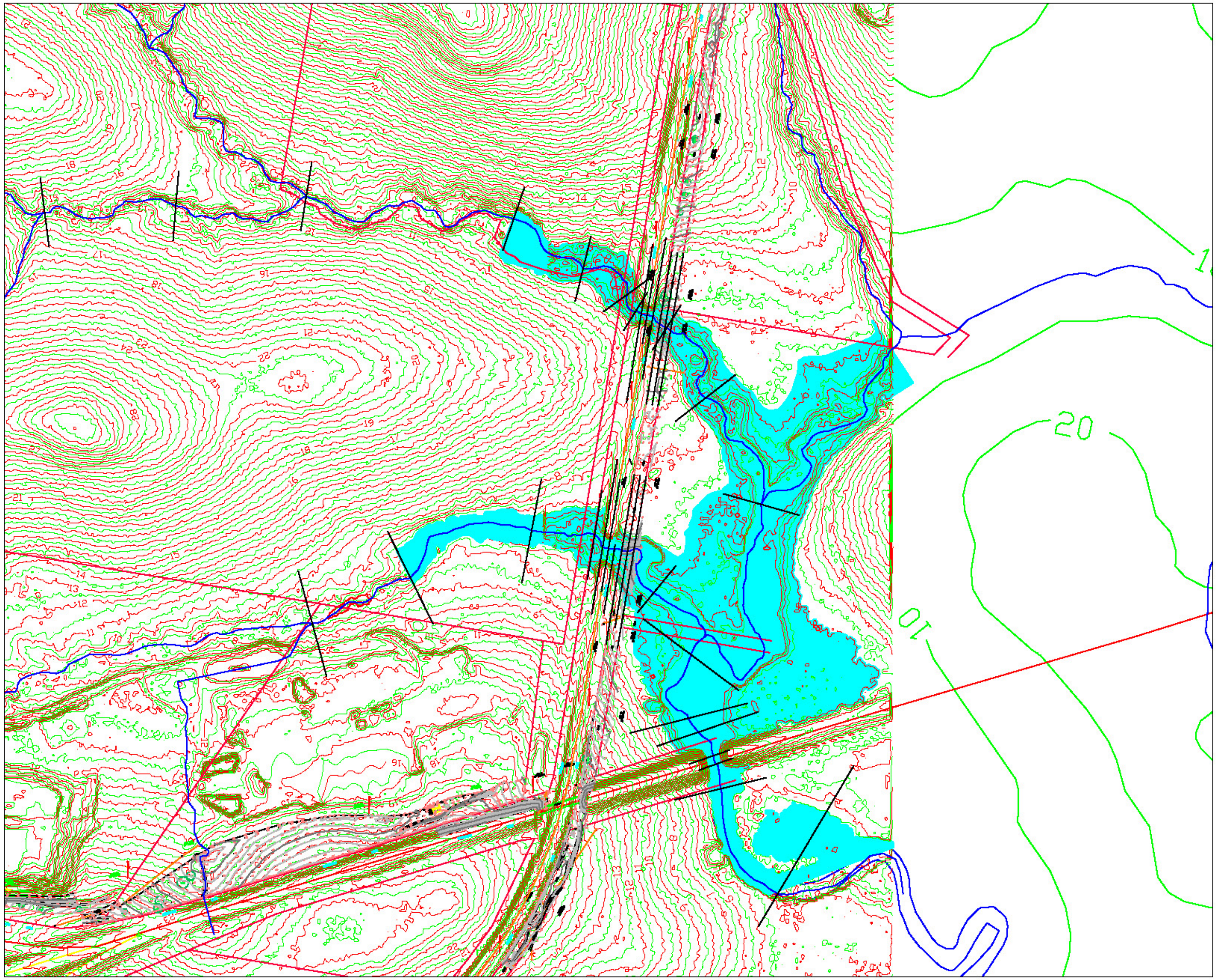

Figure 6.11 1% AEP Flood Extents Spring Creek

7 *MITIGATION MEASURES*

The model demonstrates that there will be negligible afflux caused by the proposed rail spur development. Accordingly, it is expected that mitigation measures to address afflux will not be required and none are proposed. Freeboard to existing rail infrastructure will continue to be adequate.

However, if it is deemed necessary to completely eliminate afflux, this can be achieved by minor improvements to channel geometry and conveyance characteristics as part of detailed design. This may include regrading and lining of the channel under and between bridges and for a nominal distance upstream and downstream.

Management of water quality both during construction and as part of ongoing operational requirements can be achieved easily by bunding the conveyor route and the rail spur with swales to direct all runoff to sediment basins and pollution control devices. This will be a requirement of detailed design with a performance requirement that no uncontrolled flows will occur from any construction or operational area without treatment to ensure runoff water quality meets or exceeds EPA water quality parameters.

8 CONCLUSION

Flood impacts as a result of the proposed rail spur and conveyor are considered to be negligible. There will be no significant change in flood hazards and no discernible change in flow velocities, flood levels or extents as a consequence of the Amendment. Mitigation measures are available to completely eliminate all impacts as part of detailed design of bridges and adjacent infrastructure.

It is recommended that EPA guidelines are followed to ensure no adverse impacts occur to water quality during the construction and operation of the proposed works in and adjacent to all tributaries of Spring Creek and all other waterways.

9 REFERENCES

Pilgrim, DH, (ed)., *Australian Rainfall & Runoff - A Guide to Flood Estimation*, Institution of Engineers, Australia, Barton, ACT, 1987 - Revised 2007

Bureau of Meteorology (1994) *Bulletin 53*

G Herman & Associates (January 2013) *Wallarah 2 Coal Project – Flood Impact Assessment.*

New South Wales Government (2005) *Floodplain Development Manual*

Engineers Australia (November 2012) *Australian Rainfall and Runoff Revision Projects - Project 15, Two Dimensional Modelling in Urban and Rural floodplains*

Annex A – DRAINS Model Input and Output

PIT / NODE DETAILS			Version 10												
Name	Type	Family	Size	Ponding	Pressure	Surface	Max Pond	Base	Blocking	x	y	Bolt-dowr	id	Part Full	Inflow
				Volume	Change	Elev (m)	Depth (m)	Inflow	Factor			lid		Shock Los	Hydrograph
				(cu.m)	Coeff. Ku			(cu.m/s)							
HW1a	Headwall				0.2	26		0		903.044	-147.521		55		
N1a	Node					21.72		0		890.77	-147.683		53		
HW1b	Headwall				0.5	19.55		0		876.83	-241.361		139		
N1b	Node					12.3		0		890.784	-244.989		142		
N4a	Node					4		0		895.417	-311.69		144		
Jnct 2-4	Node					1.5		0		869.965	-364.269		148		
Jnct 2-3	Node					1		0		862.932	-387.712		150		
Link Rd Br	Node					0.5		0		870.132	-449.835		215		
Wallarah	Node					0.4		0		888.465	-485.783		154		
N117	Node					18		0		864.357	-241.047		316		
N2a	Node					26.5		0		536.071	-255.427		586		
N2b	Node					16.5		0		622.475	-266.144		592		
N2c	Node					8.5		0		733.996	-303.317		597		
Ral Brg 2	Node					5		0		838.149	-351.878		602		
N2d	Node					14		0		553.009	-320.949		629		
N2e	Node					9		0		716.079	-307.922		640		
N3a	Node					29.5		0		415.278	-401.968		659		
N3bc	Node					19.5		0		523.495	-400.231		661		
N3d	Node					6.5		0		700	-408.333		662		
Rail Brg 1	Node					3		0		822.106	-393.866		664		
N3e	Node					10.5		0		698.843	-422.801		663		

DETENTION BASIN DETAILS															
Name	Elev	Surf. Ar	Init Vol. (c	Outlet Typ	K	Dia(mm)	Centre RL	Pit Famil	Pit Type	x	y	HED	Crest RL	Crest Leng	id

SUB-CATCHMENT DETAILS																					
Name	Pit or	Total	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp	Lag Time	Gutter	Gutter	Gutter
	Node	Area	Area	Area	Area	Time	Time	Time	Length	Length	Length	Slope(%)	Slope	Slope	Rough	Rough	Rough	or Factor	Length	Slope	FlowFacto
		(ha)	%	%	%	(min)	(min)	(min)	(m)	(m)	(m)	%	%	%					(m)	%	
Cat1a	HW1a	25.519	1	99	0	10	5	0	10	330	1	3	7.7	1	0.017	0.035	0.05	0			
Cat4a	N4a	428.26	1	99	0	5	2	0	10	2100	1	1	8	1	0.015	0.035	0.015	14			
Cat4b	Jnct 2-3	88.424	1	99	0	5	5	0										0			
Cat1b	N117	59.692	1	99	0	5	2	0	10	340	1	1	6.1	1	0.015	0.035	0.15	1			
Cat2a	N2a	26.08	1	99	0	5	2	0	10	370	0	1	8.4	1	0.015	0.035	0.015	3			
Cat2b	N2b	49.162	1	99	0	5	2	0	10	570	1	1	6.8	1	0.015	0.035	0.015	3			
Cat2c	N2c	60.772	1	99	0	5	2	0	10	960	1	1	9.8	1	0.015	0.035	0.015	3			
Cat2f	Ral Brg	38.822	1	99	0	5	2	0	10	510	1	1	9.5	1	0.015	0.035	0.015	3			
Cat2d	N2d	56.578	1	99	0	5	3	0	1	1050	1	1	5	1	0.015	0.032	0.015	10			
Cat2e	N2e	27.337	1	99	0	5	2	0	10	680	1	1	5.4	1	0.015	0.035	0.015	3			
Cat3a	N3a	47.135	1	99	0	5	5	0	10	803	1	1	6.5	1	0.015	0.035	0.015	7			
Cat3b 3c	N3bc	74.169	1	99	0	5	2	0	10	630	1	1	8	1	0.015	0.035	0.015	5			
Cat3d	N3d	84.425	1	99	0	5	2	0	10	980	1	1	8	1	0.015	0.035	0.015	10			
Cat3f	Rail Brg	41.64	1	99	0	5	2	0	10	560	1	1	5.5	1	0.015	0.035	0.015	5			
Cat3e	N3e	40.897	1	99	0	5	5	0	10	600	1	1	3	1	0.015	0.035	0.015	5			

PIPE DETAILS																			
Name	From	To	Length	U/S IL	D/S IL	Slope	Type	Dia	I.D.	Rough	Pipe Is	No. Pipes	Chg From	At Chg	Chg	Rl	Chg	RL	etc
			(m)	(m)	(m)	(%)		(mm)	(mm)						(m)	(m)	(m)	(m)	(m)
Pipe1a	HW1a	N1a	40	22.12	21.72	1	Concrete, u	1500	1524	0.3	Existing	2	HW1a	0					
Pipe1b	HW1b	N1b	40	15	12.3	6.75	Concrete, u	2700	2700	0.3	Existing	2	HW1b	0					

DETAILS of SERVICES CROSSING PIPES										
Pipe	Chg	Bottom	Height of	Chg	Bottom	Height of	Chg	Bottom	Height of S	etc
	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	etc

CHANNEL DETAILS													
Name	From	To	Type	Length	U/S IL	D/S IL	Slope	Base Wid	L.B. Slope	R.B. Slope	Manning	Depth	Roofed
				(m)	(m)	(m)	(%)	(m)	(1:?)	(1:?)	n	(m)	
Crk1a	N1a	HW1b	Irregular	429	21.72	15							
Crk1c	N1b	N4a	Irregular	879	12.3	4							
Crk4a	N4a	Jnct 2-4	Irregular	425	4	1.5							
Crk2g	Jnct 2-4	Jnct 2-3	Irregular	437	1.5	1							
Crk2h	Jnct 2-3	Link Rd	Irregular	266	1	0.5							
Crk2i	Link Rd	Wallara	Irregular	540	0.5	0.4							
Crk1b	N117	HW1b	Irregular	100	18	15							
Crk2a	N2a	N2b	Irregular	756	26.5	16.5							
Crk2b	N2b	N2c	Irregular	854	16.5	8.5							
Crk2c	N2c	Ral Brg 2	Irregular	719	8.5	5							
Crk2f	Ral Brg	Jnct 2-4	Irregular	439	5	1.5							
Crk2d	N2d	N2e	Irregular	480	14	9							
Crk2e	N2e	N2c	Irregular	10	9	8.5							
Crk3a	N3a	N3bc	Irregular	1020	29.5	19.5							
Crk3c	N3bc	N3d	Irregular	1609	16.5	6.5							
Crk3d	N3d	Rail Brg	Irregular	590	6.5	3							
Crk3f	Rail Brg	Jnct 2-3	Irregular	266	3	1							
Crk3e	N3e	N3d	Irregular	60	10.5	6.5							

OVERFLOW ROUTE DETAILS														
Name	From	To	Travel	Spill	Crest	Weir	Cross	Safe Dep	SafeDepth	Safe	Bed	D/S Area		id
			Time	Level	Length	Coeff. C	Section	Major Stc	Minor Stor	DxV	Slope	Contributing		
			(min)	(m)	(m)			(m)	(m)	(sq.m/sec)	(%)	%		
OF1a	HW1a	N1a	1	26	40	1.5	Overflow a	0.05	0	0.6	1	0		56
OF16	HW1b	N1b	1	19.55	100	1.5	Overflow a	0.05	0	0.6	1	0		218

DRAINS results prepared 28 March, 2016 from Version 2011.18							
PIT / NODE DETAILS				Version 8			
Name	Max HGL	Max Pond	Max Surface	Max Pond	Min	Overflow	Constraint
		HGL	Flow Arriving	Volume	Freeboard	(cu.m/s)	
			(cu.m/s)	(cu.m)	(m)		
HW1a	23.9		8.693		2.1	0	None
N1a	22.58		0				
HW1b	17.43		29.115		2.12	0	None
N1b	13.62		0				
N4a	6.06		100.342				
Jnct 2-4	4.42		158.743				
Jnct 2-3	4.07		211.835				
Link Rd Br	3.76		206.104				
Wallarah	2.64		204.974				
N117	19.03		20.746				
N2a	27.4		9.121				
N2b	17.78		24.382				
N2c	10.31		56.813				
Ral Brg 2	6.72		62.622				
N2d	15.08		14.301				
N2e	10.33		19.525				
N3a	30.54		12.524				
N3bc	17.96		31.941				
N3d	7.77		59.699				
Rail Brg 1	4.74		60.261				
N3e	11.21		10.577				
SUB-CATCHMENT DETAILS							
Name	Max	Paved	Grassed	Paved	Grassed	Supp.	Due to Storm
	Flow Q	Max Q	Max Q	Tc	Tc	Tc	
	(cu.m/s)	(cu.m/s)	(cu.m/s)	(min)	(min)	(min)	
Cat1a	8.693	0.119	8.574	11.4	18.28	0.94	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Cat4a	91.242	2.333	90.832	6.81	41.86	0.45	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Cat4b	49.086	0.533	48.552	5	5	0	AR&R 100 year, 1.5 hours storm, average 62 mm/h, Zone 1
Cat1b	20.746	0.325	20.502	6.81	16.5	1.81	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Cat2a	9.121	0.142	9.038	6.81	15.86	0	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Cat2b	15.506	0.268	15.391	6.81	21.14	0.45	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Cat2c	17.536	0.301	17.418	6.56	22.19	0.39	AR&R 100 year, 1 hour storm, average 77 mm/h, Zone 1
Cat2f	13.179	0.211	13.056	6.81	18.19	0.45	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Cat2d	14.301	0.304	14.251	5.39	27.71	0.39	AR&R 100 year, 1 hour storm, average 77 mm/h, Zone 1
Cat2e	7.971	0.135	7.916	6.56	21.63	0.39	AR&R 100 year, 1 hour storm, average 77 mm/h, Zone 1
Cat3a	12.524	0.233	12.461	6.56	25.52	0.39	AR&R 100 year, 1 hour storm, average 77 mm/h, Zone 1
Cat3b 3c	23.249	0.404	23.13	6.81	21.35	0.45	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Cat3d	23.362	0.418	23.259	6.56	23.73	0.39	AR&R 100 year, 1 hour storm, average 77 mm/h, Zone 1
Cat3f	12.783	0.227	12.72	6.81	22.18	0.45	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Cat3e	10.577	0.202	10.52	6.56	26.72	0.39	AR&R 100 year, 1 hour storm, average 77 mm/h, Zone 1

Outflow Volumes for Total Catchment (11.5 impervious + 1137 pervious = 1149 total ha)				
Storm	Total Rainf	Total Runoff	Impervious Ru	Pervious Runoff
	cu.m	cu.m (Runof	cu.m (Runoff %	cu.m (Runoff %)
AR&R 100	643391.56	373607.18 (5	6319.02 (98.2%	367288.16 (57.7%)
AR&R 100	775516.63	471109.25 (6	7640.28 (98.5%	463468.97 (60.4%)
AR&R 100	884663.44	553222.18 (6	8731.74 (98.7%	544490.44 (62.2%)
AR&R 100	1068489.5	691856.70 (6	10570.07 (98.9	681286.63 (64.4%)
AR&R 100	1217848.4	801780.90 (6	12063.59 (99.1	789717.31 (65.5%)
AR&R 100	1440736.4	958263.01 (6	14292.64 (99.2	943970.38 (66.2%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Pipe1a	8.705	4.44	22.927	22.581	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Pipe1b	25.862	11.84	15.663	13.616	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm
Crk1a	8.609	1.96	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Crk1c	25.778	2.29	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Crk4a	100.315	2.86	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Crk2g	147.544	1.64	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Crk2h	206.104	2.05	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Crk2i	204.974	4.66	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Crk1b	20.711	3.23	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Crk2a	8.998	1.89	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Crk2b	23.403	2.22	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Crk2c	57.041	2.64	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Crk2f	61.141	2.83	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Crk2d	14.155	1.98	AR&R 100 year, 1 hour storm, average 77 mm/h, Zone 1
Crk2e	19.063	1.65	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Crk3a	12.289	0	AR&R 100 year, 1 hour storm, average 77 mm/h, Zone 1
Crk3c	28.652	2.73	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Crk3d	55.599	2.12	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Crk3f	59.255	2.67	AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1
Crk3e	10.578	3.64	AR&R 100 year, 1 hour storm, average 77 mm/h, Zone 1

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V
OF1a	0	0	0	0	0	0	0
OF16	0	0	0	0	0	0	0

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level

CONTINUITY CHECK for AR&R 100 year, 2 hours storm, average 53 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Chang (cu.m)	Difference %
HW1a	17897.17	17903.18	0	0
N1a	17903.18	18006.99	0	-0.6
HW1b	59960.63	60418.14	0	-0.8
N1b	60418.14	61199.61	0	-1.3
N4a	358300.41	361320.84	0	-0.8
Jnct 2-4	549542.94	558072.81	0	-1.6
Jnct 2-3	830630	838573.63	0	-1
Link Rd Br	838573.63	844411.88	0	-0.7
Wallarah	844411.88	844411.88	0	0
N117	41899.14	41954.38	0	-0.1
N2a	18311.38	18499.43	0	-1
N2b	52932.36	53793.91	0	-1.6
N2c	155475.88	158412.95	0	-1.9
Ral Brg 2	185640.69	188222.55	0	-1.4
N2d	39433.22	39757.98	0	-0.8
N2e	58872.59	59203.78	0	-0.6
N3a	32895.34	33517.44	0	-1.9
N3bc	85460.81	88261.02	0	-3.3
N3d	175761.3	179166.95	0	-1.9
Rail Brg 1	208316.83	210149.22	0	-0.9
N3e	28524.13	28536.73	0	0

Run Log for 16049 PMF Model.drn run at 20:40:58 on 28/3/2016

Channels Crk1b, Crk4a, Crk1c, Crk1a spilled. Please specify data for higher levels at the representative cross section.

Flows were safe in all overflow routes.

DRAINS results prepared 28 March, 2016 from Version 2011.18							
PIT / NODE DETAILS				Version 8			
Name	Max HGL	Max Pond	Max Surface	Max Pond	Min	Overflow	Constraint
		HGL	Flow Arriving	Volume	Freeboard	(cu.m/s)	
			(cu.m/s)	(cu.m)	(m)		
HW1a	26.36		30.408		-0.36	12.727	Headwall height/system capacity
N1a	23		12.727				
HW1b	19.94		95.698		-0.39	36.283	Headwall height/system capacity
N1b	14.19		36.283				
N4a	7.79		588.474				
Jnct 2-4	7.19		848.51				
Jnct 2-3	6.8		1228.93				
Link Rd Br	6.29		1227.85				
Wallarah	4.55		1227.954				
N117	19.96		71.225				
N2a	27.82		31.117				
N2b	18.37		89.47				
N2c	11.21		247.762				
Ral Brg 2	7.75		291.743				
N2d	15.71		66.061				
N2e	11.22		96.178				
N3a	31.13		55.123				
N3bc	18.72		138.476				
N3d	8.92		277.001				
Rail Brg 1	6.88		314.671				
N3e	11.68		47.748				
SUB-CATCHMENT DETAILS							
Name	Max	Paved	Grassed	Paved	Grassed	Supp.	Due to Storm
	Flow Q	Max Q	Max Q	Tc	Tc	Tc	
	(cu.m/s)	(cu.m/s)	(cu.m/s)	(min)	(min)	(min)	
Cat1a	30.408	0.319	30.089	10.7	11.67	0.47	PMF
Cat4a	495.914	5.353	491.279	5.91	22	0.23	PMF
Cat4b	105.771	1.105	104.665	5	5	0	PMF
Cat1b	71.225	0.746	70.486	5.91	9.28	0.91	PMF
Cat2a	31.117	0.326	30.802	5.91	8.96	0	PMF
Cat2b	58.561	0.615	57.967	5.91	11.6	0.23	PMF
Cat2c	71.765	0.76	71.047	5.91	13.77	0.23	PMF
Cat2f	46.287	0.485	45.818	5.91	10.13	0.23	PMF
Cat2d	66.061	0.707	65.432	5.23	17.4	0.23	PMF
Cat2e	32.324	0.342	31.999	5.91	13.44	0.23	PMF
Cat3a	55.123	0.589	54.573	5.91	16.96	0.23	PMF
Cat3b 3c	88.323	0.927	87.448	5.91	11.71	0.23	PMF
Cat3d	99.36	1.055	98.384	5.91	14.66	0.23	PMF
Cat3f	49.538	0.521	49.047	5.91	12.13	0.23	PMF
Cat3e	47.748	0.511	47.271	5.91	17.66	0.23	PMF

Outflow Volumes for Total Catchment (11.5 impervious + 1137 pervious = 1149 total ha)							
Storm	Total Rainfa	Total Runoff	Impervious Ru	Pervious Runoff			
	cu.m	cu.m (Runof	cu.m (Runoff %	cu.m (Runoff %)			
PMF	6824546	6410329.10 (	68131.60 (99.8	6342197.50 (93.9%)			
PIPE DETAILS							
Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm		
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)			
Pipe1a	17.688	5.26	23.441	23.244	PMF		
Pipe1b	56.773	14.79	15.997	14.193	PMF		
CHANNEL DETAILS							
Name	Max Q	Max V			Due to Storm		
	(cu.m/s)	(m/s)					
Crk1a	30.48	2.88			PMF		
Crk1c	93.045	3.32			PMF		
Crk4a	571.34	3.71			PMF		
Crk2g	834.652	2.77			PMF		
Crk2h	1227.85	3.97			PMF		
Crk2i	1227.954	6.72			PMF		
Crk1b	66.326	2.14			PMF		
Crk2a	31.085	2.73			PMF		
Crk2b	88.665	3.28			PMF		
Crk2c	248.751	3.43			PMF		
Crk2f	278.148	3.63			PMF		
Crk2d	65.915	3.11			PMF		
Crk2e	96.179	2.23			PMF		
Crk3a	54.946	0			PMF		
Crk3c	136.513	3.19			PMF		
Crk3d	270.59	3.41			PMF		
Crk3f	310.107	1.9			PMF		
Crk3e	47.788	5.47			PMF		
OVERFLOW ROUTE DETAILS							
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V
OF1a	12.727	12.727	0.288	0.286	0.67	29.13	2.34
OF16	36.283	36.283	0.288	0.3	1.85	30	6.18
DETENTION BASIN DETAILS							
Name	Max WL	MaxVol	Max Q	Max Q	Max Q		
			Total	Low Level	High Level		
CONTINUITY CHECK for PMF							
Node	Inflow	Outflow	Storage Chang	Difference			
	(cu.m)	(cu.m)	(cu.m)	%			
HW1a	142433.63	142441.88	0	0			
N1a	142441.53	142834.25	0	-0.3			
HW1b	476738.72	480044.88	0	-0.7			
N1b	480045.28	481275.03	0	-0.3			
N4a	2869466	2874057	0	-0.2			
Jnct 2-4	4331589.5	4341072	0	-0.2			
Jnct 2-3	6458325.5	6466707	0	-0.1			
Link Rd Br	6466707	6472684.5	0	-0.1			
Wallarah	6472684.5	6472684.5	0	0			
N117	333244.41	333910.03	0	-0.2			
N2a	145599.61	146145.34	0	-0.4			
N2b	420547	422705.53	0	-0.5			
N2c	1231361.6	1236306.13	0	-0.4			
Ral Brg 2	1453024.8	1457532.38	0	-0.3			
N2d	315631.56	316224.94	0	-0.2			
N2e	468781.72	469517.91	0	-0.2			
N3a	262962.22	264114.69	0	-0.4			
N3bc	678089.31	683100.38	0	-0.7			
N3d	1382377.9	1388122.5	0	-0.4			
Rail Brg 1	1620531.3	1623344.5	0	-0.2			
N3e	228148.38	228176	0	0			
Run Log for 16049 PMF Model.drn run at 20:50:18 on 28/3/2016							
Channels Crk1b, Crk4a, Crk1c, Crk1a spilled. Please specify data for higher levels at the representative cross section.							
The maximum flow exceeded the safe value in the following overflow routes: OF16, OF1a							

Annex B – HEC-RAS Model Input and Output

PREDEVELOPMENT CONDITIONS

```
HEC-RAS Version 4.1.0 Jan 2010
                          U.S. Army Corps of Engineers
                         Hydrologic Engineering Center
                               609 Second Street
                               Davis, California


            X     X  XXXXXX    XXXX        XXXX       XX      XXXX
            X     X  X        X    X       X   X     X  X    X
            X     X  X        X            X   X    X    X   X
            XXXXXXX  XXXX     X      XXX  XXXX     XXXXXX    XXXX
            X     X  X        X            X  X     X    X       X
            X     X  X        X    X       X   X    X    X       X
            X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: W2CP Rail Siding Pre Dev
Project File : W2CPRailSidingPr.prj
Run Date and Time: 28/03/2016 3:44:52 PM

Project in SI units

Project Description:
Flood Impacts Assessment

PLAN DATA

Plan Title: Plan 02
Plan File : e:\G Herman & Associates\Jobs\16049 - Wallarah 2 Coal Project Rail\HEC RAS Model\W2CPRailSidingPr.p02

Geometry Title: Spring Creek
Geometry File : e:\G Herman & Associates\Jobs\16049 - Wallarah 2 Coal Project Rail\HEC RAS Model\W2CPRailSidingPr.g01

Flow Title : 100 year ARI
Flow File : e:\G Herman & Associates\Jobs\16049 - Wallarah 2 Coal Project Rail\HEC RAS Model\W2CPRailSidingPr.f01

```
Plan Summary Information:
Number of:  Cross Sections =   34    Multiple Openings  =    0
            Culverts       =    0    Inline Structures  =    0
            Bridges        =    2    Lateral Structures =    0

Computational Information
    Water surface calculation tolerance  =  0.003
    Critical depth calculation tolerance =  0.003
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.1
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow
```

FLOW DATA

Flow Title: 100 year ARI
Flow File : e:\G Herman & Associates\Jobs\16049 - Wallarah 2 Coal Project Rail\HEC RAS Model\W2CPRailSidingPr.f01

Flow Data (m3/s)

River	Reach	RS	PF 1
South Tributary	.	3277	12.3
South Tributary	.	2465	28.7
South Tributary	.	1713	39
South Tributary	.	856	55.6
South Tributary	.	665	57
South Tributary	.	411	58
South Tributary	.	301	59
South Tributary	.	276	59
South Tributary	.	256	59
South Tributary	.	234	59
South Tributary	.	122	59
South Tributary	.	0	59
Spring Creek	US of Jn	3340	7
Spring Creek	US of Jn	2740	14.2
Spring Creek	US of Jn	2086	19.1
Spring Creek	US of Jn	1841	57
Spring Creek	US of Jn	1595	58
Spring Creek	US of Jn	1193	59
Spring Creek	US of Jn	1038	61.1
Spring Creek	US of Jn	933	61.1
Spring Creek	US of Jn	896.5	61.1
Spring Creek	US of Jn	886.5	61.1
Spring Creek	US of Jn	866.5	61.1
Spring Creek	US of Jn	837.5	61.1
Spring Creek	US of Jn	669	148
Spring Creek	US of Jn	437	148
Spring Creek	US of Jn	0	205
Spring Creek	US of Wallarah C	530	205
Spring Creek	US of Wallarah C	352	205
Spring Creek	US of Wallarah C	323	205
Spring Creek	US of Wallarah C	273	205
Spring Creek	US of Wallarah C	258	205
Spring Creek	US of Wallarah C	215	203
Spring Creek	US of Wallarah C	0	203

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Spring Creek	US of Wallarah C	PF 1		Normal S = 0.001

GEOMETRY DATA

Geometry Title: Spring Creek
Geometry File : e:\G Herman & Associates\Jobs\16049 - Wallarah 2 Coal Project Rail\HEC RAS Model\W2CPRailSidingPr.g01

Reach Connection Table

River	Reach	Upstream Boundary	Downstream Boundary
South Tributary	.		Jn1
Spring Creek	US of Jn		Jn1
Spring Creek	US of Wallarah C	Jn1	

JUNCTION INFORMATION

Name: Jn1
Description:
Energy computation Method

```
    Length across Junction             Tributary
     River           Reach                River           Reach        Length   Angle
Spring Creek    US of Jn         to Spring Creek    US of Wallarah C       0       0
South Tributary .                to Spring Creek    US of Wallarah C       0       0

CROSS SECTION


RIVER: South Tributary
REACH: .                  RS: 3277

INPUT
Description: Top DS of Fwy
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -119      33     -80      31     -57      30     -17      29     -11    28.5
      -6      28       0    27.5       4      28       6    28.5      12      29
      31      30      36      31      59      33

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -119    .035     -17    .033      12    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           -17      12             812     812     812             .1       .3

CROSS SECTION


RIVER: South Tributary
REACH: .                  RS: 2465

INPUT
Description: Jn Trib 3c
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -192      25    -102      23     -85      22     -68      21     -56    20.5
     -48      20       0    19.5    46.5      20      59    20.5      70      21
      89      22     111      23     147      25

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -192     .05     -56     .04      59     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           -56      59             752     752     752             .1       .3

CROSS SECTION


RIVER: South Tributary
REACH: .                  RS: 1713

INPUT
Description: Intermediate
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -119      17     -80      15     -57      14     -17      13     -11    12.5
      -6      12       0    11.5       4      12       6    12.5      12      13
      31      14      36      15      59      17

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -119     .05     -17     .04      12     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           -17      12             857     857     857             .1       .3

CROSS SECTION


RIVER: South Tributary
REACH: .                  RS: 856
```

INPUT
Description: Jn Trib 3e
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-119	11.5	-80	9.5	-57	8.5	-17	7.5	-11	7
-6	6.5	0	6	4	6.5	6	7	12	7.5
31	8.5	36	9.5	59	11.5				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-119	.05	-17	.04	12	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-17	12	191	191	191	.1	.3

CROSS SECTION

RIVER: South Tributary
REACH: . RS: 665

INPUT
Description: Intermediate
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-76	8.5	-57.6	7.5	-47.1	7	-37.6	6.5	-26	6
-16.8	5.5	-7.3	5	0	4.5	12.7	5	20.9	5.5
23.6	6	28.2	6.5	36.6	7	54.4	7.5	103.5	8.5

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-76	.05	-16.8	.04	20.9	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-16.8	20.9	254	254	254	.1	.3

CROSS SECTION

RIVER: South Tributary
REACH: . RS: 411

INPUT
Description: Intermediate
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-76	8	-57.6	7	-47.1	6.5	-37.6	6	-26	5.5
-16.8	5	-7.3	4.5	0	4	12.7	4.5	20.9	5
23.6	5.5	28.2	6	36.6	6.5	54.4	7	103.5	8

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-76	.05	-16.8	.04	20.9	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-16.8	20.9	110	110	110	.1	.3

CROSS SECTION

RIVER: South Tributary
REACH: . RS: 301

INPUT
Description: US of Bridge 1
Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-177	9	-155	8	-127	7	-98.7	6.5	-60.4	6
-42.5	5.5	-31.7	5	-25.9	4.5	-19.6	4	-3.07	3.5
0	3.4	4.37	3.5	27.7	4	47.6	4.5	53.6	5
58.4	5.5	74.1	6	91.4	6.5	103	7	140	8
165	9								

```
Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -177     .05   -42.5     .04    58.4     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         -42.5    58.4              25      25      25             .3       .5

CROSS SECTION


RIVER: South Tributary
REACH: .                  RS: 276

INPUT
Description: West edge Bridge 1
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
  -148.6       8   -29.7       7   -21.6       5     -20       4   -18.8     3.5
   -4.37     3.1       0       3    2.49     3.1     3.8     3.5    23.7       4
    27.3       5    35.1       7   112.7       8

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
  -148.6     .06   -18.8     .04    23.7     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         -18.8    23.7              20      20      20             .3       .5

BRIDGE


RIVER: South Tributary
REACH: .                  RS: 266

INPUT
Description: Existing Bridge 1
Distance from Upstream XS =       5
Deck/Roadway Width        =      10
Weir Coefficient          =     1.7
Upstream  Deck/Roadway Coordinates
    num=       6
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
    -500       9       0     -20     8.7       0     -20     8.7     7.7
      21     8.6     7.6      21     8.6       0     500     8.4       0

Upstream Bridge Cross Section Data
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
  -148.6       8   -29.7       7   -21.6       5     -20       4   -18.8     3.5
   -4.37     3.1       0       3    2.49     3.1     3.8     3.5    23.7       4
    27.3       5    35.1       7   112.7       8

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
  -148.6     .06   -18.8     .04    23.7     .06

Bank Sta: Left   Right    Coeff Contr.   Expan.
         -18.8    23.7             .3       .5

Downstream  Deck/Roadway Coordinates
    num=       6
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
    -500       9       0     -20     8.7       0     -20     8.7     7.7
      21     8.6     7.6      21     8.6       0     500     8.4       0

Downstream Bridge Cross Section Data
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -153       8   -31.2       7   -20.3       5   -17.6       4   -14.1     3.5
   -7.72       3       0     2.8    1.54       3    20.5     3.5      25       4
    27.1       5    32.8       7   107.9       8

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
```

```
    -153     .06   -17.6     .04      25     .06

Bank Sta: Left   Right    Coeff Contr.   Expan.
         -17.6      25             .3       .5

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Piers =  2

Pier Data
Pier Station     Upstream=   -10.1    Downstream=   -10.1
Upstream     num=       2
    Width   Elev    Width   Elev
     .75       0     .75       9
Downstream     num=       2
    Width   Elev    Width   Elev
     .75       0     .75       9

Pier Data
Pier Station     Upstream=     5.1    Downstream=     5.1
Upstream     num=       2
    Width   Elev    Width   Elev
     .75       0     .75       9
Downstream     num=       2
    Width   Elev    Width   Elev
     .75       0     .75       9

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION


RIVER: South Tributary
REACH: .                  RS: 256

INPUT
Description: East edge Bridge 1
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -153       8   -31.2       7   -20.3       5   -17.6       4   -14.1     3.5
   -7.72       3       0     2.8    1.54       3    20.5     3.5      25       4
    27.1       5    32.8       7   107.9       8

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -153     .06   -17.6     .04      25     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         -17.6      25               22      22      22             .3       .5

CROSS SECTION


RIVER: South Tributary
```

REACH: . RS: 234

INPUT
Description: CL New Bridge 1
Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-107	8	-89.4	7	-52.8	6	-29.3	5.5	-19.7	5
-16.2	4.5	-13.3	4	-11.3	3.5	-7.77	3	-4.88	2.5
-3.31	2.4	-2.88	1.3	0	1.2	2.09	1.4	2.83	2.3
4.68	2.5	10.7	3	16.6	3.5	24.3	4	34.4	4.5
48	5	65.1	5.5	72.4	6	82.5	7	95	8

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-107	.05	-11.3	.04	16.6	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-11.3	16.6	112	112	112	.1	.3

CROSS SECTION

RIVER: South Tributary
REACH: . RS: 122

INPUT
Description: Intermediate
Station Elevation Data num= 22

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-154	5	-42.2	4.95	-30.9	4.5	-25.1	4	-17.5	3.5
-11.7	3	-8.82	2.5	-5.04	2	-1.21	1.5	0	1.4
1.25	1.5	3.08	2	5.56	2.5	8.53	3	11.8	3.5
15.4	4	20.5	4.5	34.1	5	60.4	5.5	82.3	6
93	7	99.1	8						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-154	.05	-17.5	.04	11.8	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-17.5	11.8	112	112	112	.1	.3

CROSS SECTION

RIVER: South Tributary
REACH: . RS: 0

INPUT
Description: Jn Spring Creek
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-218	7	-214	6	-199	5	-175	4.5	-111	4.5
-94.1	4	-90.4	3.5	-87.9	3	-84.3	2.5	-75.3	2
-58.4	2	-50	1.5	-46.2	1	-38.8	1.5	-27.8	2
-13	1.5	0	1	5.26	1.5	7.23	2	9.36	2.5
11.5	3	15.5	3.5	30.8	4	57.8	4.5	82.5	5
110	5.5	133	6	138	6.5	141	7	145	8

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-218	.05	-90.4	.04	15.5	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-90.4	15.5	0	0	0	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 3340

INPUT
Description: top

Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-57	36	-32.9	34.5	-15	33.5	-3.5	33.1	0	33
2.8	33.1	20.7	33.5	41.8	34.5	66	36		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-57	.035	-15	.033	20.7	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-15	20.7	600	600	600	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 2740

INPUT
Description: Intermediate
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-57	26	-32.9	24.5	-15	23.5	-3.5	23.1	0	23
2.8	23.1	20.7	23.5	41.8	24.5	66	26		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-57	.035	-15	.033	20.7	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-15	20.7	652	652	652	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 2086

INPUT
Description: Jn Trib 2e
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-70.6	18	-38.3	16	-27.8	15	-7.6	14.5	0	14
7.9	14.5	13.3	15	30.7	16	79.9	18		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-70.6	.05	-27.8	.04	13.3	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-27.8	13.3	245	245	245	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 1841

INPUT
Description: Intermediate
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-124	16	-89.9	15	-61.1	14	-22.2	13.5	-12.3	13
-7.99	12	-3.84	11	0	10.5	3.79	11	8.26	11.5
33.5	12	46.7	13	60.6	14	95.4	16		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-124	.05	-12.3	.04	33.5	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-12.3	33.5	246	246	246	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 1595

INPUT
Description: Jn Nth Trib 2c
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-96.7	14	-81.6	13	-59.1	12	-43.7	11.5	-34.9	11
-21.5	10	-10.7	10	-7.24	9.5	-5.36	9	0	8.5
9.41	9	28	9.5	32.9	10	43.6	11	55.1	12
91.9	14								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-96.7	.05	-10.7	.04	32.9	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-10.7	32.9	402	402	402	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 1193

INPUT
Description: Intermediate
Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-38.6	13	-20.5	11	-17.6	10	-14.2	9	-12.4	8.5
-9.77	8	-6.44	7.5	-4.18	7	-2.36	6.5	0	6
2.4	6.5	3.86	7	10.4	7.5	28.6	7.5	42.8	8
58.2	7.5	62.4	8	70.6	9	84.5	10	104	11
142	13								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-38.6	.05	-9.77	.04	62.4	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-9.77	62.4	155	155	155	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 1038

INPUT
Description: Intermediate
Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-75.8	11	-60.4	10	-52.2	9	-46.3	8	-43.2	7.5
-38.1	7	-31	7.5	-24.7	7	-14.3	7	-7.27	6.5
-5.55	6	0	5.5	8.31	6	11.2	6.5	15.8	7
20	7.5	25	8	33	8.5	51	9	72	10
89	11								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-75.8	.05	-38.1	.04	15.8	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-38.1	15.8	105	105	105	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 933

INPUT

Description: Intermediate
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-30.2	10	-19.6	8	-16.4	7	-14.5	6.5	-12.7	6
-7.83	5.8	-3.55	6	-1.6	5.5	0	5.1	3.6	5.5
7.68	6	14.5	5.8	17.9	6	20.8	6.5	30.3	7
37.5	8	77.6	10						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-30.2	.05	-12.7	.04	17.9	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-12.7	17.9	36.5	36.5	36.5	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 896.5

INPUT
Description: US of Bridge 2
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-26.6	10	-22.8	9	-20.4	8	-19.2	7.5	-18.3	7
-14.2	6.5	-7.14	6	-1.09	5.5	0	5	2.25	5.5
5.09	6	13	6.5	17.7	7	21.4	7.5	26.9	8
44.2	9	68.8	10						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-26.6	.05	-14.2	.04	13	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-14.2	13	10	10	10	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 886.5

INPUT
Description: West side of Bridge 2
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-117	11	-37.3	10	-23.5	9	-14.8	7	-13.2	6.5
-10.1	6	-6.19	5.5	-.729	5	0	4.9	2.48	5
11.3	5.5	12	6	12.7	6.5	13.7	7	18.6	9
149.1	9								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-117	.06	-10.1	.04	12	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-10.1	12	20	20	20	.3	.5

BRIDGE

RIVER: Spring Creek
REACH: US of Jn RS: 876.5

INPUT
Description: Existing Bridge 2
Distance from Upstream XS = 5
Deck/Roadway Width = 10
Weir Coefficient = 1.7
Upstream Deck/Roadway Coordinates
num= 6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-500	10.7	0	-10.2	10.5	0	-10.2	10.5	9.5

10.7	10.4	9.4	10.7	10.4	0	500	10.2	0

Upstream Bridge Cross Section Data
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-117	11	-37.3	10	-23.5	9	-14.8	7	-13.2	6.5
-10.1	6	-6.19	5.5	-.729	5	0	4.9	2.48	5
11.3	5.5	12	6	12.7	6.5	13.7	7	18.6	9
149.1	9								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-117	.06	-10.1	.04	12	.06

Bank Sta: Left	Right	Coeff Contr.	Expan.
-10.1	12	.3	.5

Downstream Deck/Roadway Coordinates
num= 6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-500	10.7	0	-10.2	10.5	0	-10.2	10.5	9.5
10.7	10.4	9.4	10.7	10.4	0	500	10.2	0

Downstream Bridge Cross Section Data
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-133	11	-76	10	-30.1	9	-13.9	7	-12.4	6.5
-9.84	6	-7.39	5.5	-1.06	5	0	4.8	10.8	5
13.7	5.5	15	6	16	6.5	17.2	7	44.7	8
106.3	9								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-133	.06	-9.84	.04	15	.06

Bank Sta: Left	Right	Coeff Contr.	Expan.
-9.84	15	.3	.5

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .98
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Piers = 2

Pier Data
Pier Station Upstream= -3.5 Downstream= -3.5
Upstream num= 2

Width	Elev	Width	Elev
1	0	1	10

Downstream num= 2

Width	Elev	Width	Elev
1	0	1	10

Pier Data
Pier Station Upstream= 3.8 Downstream= 3.8
Upstream num= 2

Width	Elev	Width	Elev
1	0	1	10

Downstream num= 2

Width	Elev	Width	Elev
1	0	1	10

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data
Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
Energy Only

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 866.5

INPUT
Description: East side of Bridge 2
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-133	11	-76	10	-30.1	9	-13.9	7	-12.4	6.5
-9.84	6	-7.39	5.5	-1.06	5	0	4.8	10.8	5
13.7	5.5	15	6	16	6.5	17.2	7	44.7	8
106.3	9								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-133	.06	-9.84	.04	15	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-9.84	15	29	29	29	.3	.5

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 837.5

INPUT
Description: CL new Bridge 2
Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-154	9	-121	8	-102	7.8	-80.6	7.7	-55.7	7.5
-35.3	7	-26.5	6.5	-19.3	6	-12	5.5	-4.61	5
-2	4.9	-.985	4.2	0	4.1	2.81	4.2	3.22	4.6
11.9	5	17.5	5.5	20.8	6	24.5	6.5	28.7	7
37	7.5	56.1	8	69.6	7.7	83.5	8	99.7	9

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-154	.05	-35.3	.04	28.7	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-35.3	28.7	168.5	168.5	168.5	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 669

INPUT
Description: Intermediate
Station Elevation Data num= 18

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-225	8	-160	7	-68.8	6.5	-46.7	6	-23	5.5
-17.3	5	-12.8	4.5	-10	4	0	3.8	11.6	4
16.3	4.5	22.7	5	26.5	5.5	30.2	6	34.9	6.5
118	6.5	135	7	148	8				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-225	.05	-23	.04	26.5	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-23	26.5	232	232	232	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 437

INPUT
Description: Jn East tributary
Station Elevation Data num= 23

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-105	7	-91.3	6	-72	5	-58.4	4	-50.9	3.5
-43.4	3	-35	2.5	-22.4	2	-16.4	1.6	-11.7	2
-4.77	2	0	1.5	5.46	2	6.62	2.5	7.74	3
9	3.5	10.3	4	19.5	4.5	45	5	125	5.5
208	6	220	6.5	223	7				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-105	.05	-58.4	.04	10.3	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-58.4	10.3	437	437	437	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 0

INPUT
Description: Jn Sth Tributary
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-218	7	-214	6	-199	5	-175	4.5	-111	4.5
-94.1	4	-90.4	3.5	-87.9	3	-84.3	2.5	-75.3	2
-58.4	2	-50	1.5	-46.2	1	-38.8	1.5	-27.8	2
-13	1.5	0	1	5.26	1.5	7.23	2	9.36	2.5
11.5	3	15.5	3.5	30.8	4	57.8	4.5	82.5	5
110	5.5	133	6	138	6.5	141	7	145	8

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-218	.05	-90.4	.04	15.5	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-90.4	15.5	0	0	0	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Wallarah C RS: 530

INPUT
Description: Jn Spring Ck and Sth Trib
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-218	7	-214	6	-199	5	-175	4.5	-111	4.5
-94.1	4	-90.4	3.5	-87.9	3	-84.3	2.5	-75.3	2
-58.4	2	-50	1.5	-46.2	1	-38.8	1.5	-27.8	2
-13	1.5	0	1	5.26	1.5	7.23	2	9.36	2.5
11.5	3	15.5	3.5	30.8	4	57.8	4.5	82.5	5
110	5.5	133	6	138	6.5	141	7	145	8

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-218	.05	-90.4	.04	15.5	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-90.4	15.5	178	178	178	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Wallarah C   RS: 352

INPUT
Description: Intermediate
Station Elevation Data   num=   24

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-248	7	-241	6	-234	5	-227	4.5	-149	4.5
-117	5	-87.3	4.5	-70.2	4	-61.3	3	-57.3	2.5
-34.5	2	-30.1	1.5	-27.3	1	-5.75	1	0	.95
5.57	1	8.96	1.5	13.8	2	24	3	34.3	4
41	5	55.9	6	71.7	7	88.9	8		

Manning's n Values   num=   3

Sta	n Val	Sta	n Val	Sta	n Val
-248	.05	-57.3	.04	13.8	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-57.3	13.8	29	29	29	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Wallarah C   RS: 323

INPUT
Description: US of Hwy Link
Station Elevation Data   num=   20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-162	7	-146	6	-131	5	-83.5	4.5	-66.7	4
-55.7	3	-38.9	2.5	-33.2	2	-28.9	1.5	-17.7	1
-7.04	1	0	.9	7.58	1	11.4	1.5	13.8	2
28.8	3	34.8	4	46.1	5	59.9	6	71.1	7

Manning's n Values   num=   3

Sta	n Val	Sta	n Val	Sta	n Val
-162	.05	-38.9	.04	13.8	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-38.9	13.8	50	50	50	.3	.5

CROSS SECTION

RIVER: Spring Creek
REACH: US of Wallarah C   RS: 273

INPUT
Description: Nth edge of Hwy Link
Station Elevation Data   num=   21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-24.9	10	-20.4	8	-17.1	6	-15.3	5	-13.2	4
-11.2	3	-9.96	2.5	-8.2	2	-6.25	1.5	-1.2	1
0	.85	1.2	1	5.8	1.5	7.42	2	9.03	2.5
10.7	3	13.2	4	15.6	5	17.2	6	20.2	8
23.7	10								

Manning's n Values   num=   3

Sta	n Val	Sta	n Val	Sta	n Val
-24.9	.06	-8.2	.04	7.42	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-8.2	7.42	15	15	15	.3	.5

CROSS SECTION

RIVER: Spring Creek
REACH: US of Wallarah C   RS: 258

INPUT
Description: Sth edge of Hwy Link

Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-24.9	10	-20.4	8	-17.1	6	-15.3	5	-13.2	4
-11.2	3	-9.96	2.5	-8.2	2	-6.25	1.5	-2	1
0	.83	2	1	5.8	1.5	7.42	2	9.03	2.5
10.7	3	13.2	4	15.6	5	17.2	6	20.2	8
23.7	10								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-24.9	.06	-8.2	.04	7.42	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-8.2	7.42	43	43	43	.3	.5

CROSS SECTION

RIVER: Spring Creek
REACH: US of Wallarah C RS: 215

INPUT
Description: Sth edge of Hwy Link
Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-194	6	-186	5	-180	4	-178	3.5	-175	4
-154	4.5	-88	4.5	-44.4	4	-39.1	3.5	-35.1	3
-22.7	2.5	-9.16	2	-4.73	1.5	0	.8	5.58	1.5
9.98	2	15.8	3	27.9	4	38.7	5	53.6	6

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-194	.05	-22.7	.04	9.98	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-22.7	9.98	215	215	215	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Wallarah C RS: 0

INPUT
Description: Sth edge of Hwy Link
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-288	6	-281	5	-274	4	-244	4.5	-201	4.5
-172	4	-157	3.5	-154	3	-148	2	-139	1.5
-117	1.5	-84	2	-69	3	-61.4	3.5	-55.6	3.5
-41.2	3	-36.1	2.5	-26	2	-14.7	1.5	-7.9	1
0	.5	4.19	1	5.68	1.5	6.47	2	7.25	2.5
8.9	3.5	12.9	4	42.6	4.5	60.9	5	85.8	6

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-288	.05	-26	.04	6.47	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-26	6.47	215	215	215	.1	.3

SUMMARY OF MANNING'S N VALUES

River:South Tributary

Reach	River Sta.	n1	n2	n3
.	3277	.035	.033	.035
.	2465	.05	.04	.05
.	1713	.05	.04	.05
.	856	.05	.04	.05
.	665	.05	.04	.05

.	411	.05	.04	.05
.	301	.05	.04	.05
.	276	.06	.04	.06
.	266	Bridge		
.	256	.06	.04	.06
.	234	.05	.04	.05
.	122	.05	.04	.05
.	0	.05	.04	.05

River:Spring Creek

Reach	River Sta.	n1	n2	n3
US of Jn	3340	.035	.033	.035
US of Jn	2740	.035	.033	.035
US of Jn	2086	.05	.04	.05
US of Jn	1841	.05	.04	.05
US of Jn	1595	.05	.04	.05
US of Jn	1193	.05	.04	.05
US of Jn	1038	.05	.04	.05
US of Jn	933	.05	.04	.05
US of Jn	896.5	.05	.04	.05
US of Jn	886.5	.06	.04	.06
US of Jn	876.5	Bridge		
US of Jn	866.5	.06	.04	.06
US of Jn	837.5	.05	.04	.05
US of Jn	669	.05	.04	.05
US of Jn	437	.05	.04	.05
US of Jn	0	.05	.04	.05
US of Wallarah C	530	.05	.04	.05
US of Wallarah C	352	.05	.04	.05
US of Wallarah C	323	.05	.04	.05
US of Wallarah C	273	.06	.04	.06
US of Wallarah C	258	.06	.04	.06
US of Wallarah C	215	.05	.04	.05
US of Wallarah C	0	.05	.04	.05

SUMMARY OF REACH LENGTHS

River: South Tributary

Reach	River Sta.	Left	Channel	Right
.	3277	812	812	812
.	2465	752	752	752
.	1713	857	857	857
.	856	191	191	191
.	665	254	254	254
.	411	110	110	110
.	301	25	25	25
.	276	20	20	20
.	266	Bridge		
.	256	22	22	22
.	234	112	112	112
.	122	112	112	112
.	0	0	0	0

River: Spring Creek

Reach	River Sta.	Left	Channel	Right
US of Jn	3340	600	600	600
US of Jn	2740	652	652	652
US of Jn	2086	245	245	245
US of Jn	1841	246	246	246
US of Jn	1595	402	402	402
US of Jn	1193	155	155	155
US of Jn	1038	105	105	105
US of Jn	933	36.5	36.5	36.5

US of Jn	896.5	10	10	10
US of Jn	886.5	20	20	20
US of Jn	876.5	Bridge		
US of Jn	866.5	29	29	29
US of Jn	837.5	168.5	168.5	168.5
US of Jn	669	232	232	232
US of Jn	437	437	437	437
US of Jn	0	0	0	0
US of Wallarah C	530	178	178	178
US of Wallarah C	352	29	29	29
US of Wallarah C	323	50	50	50
US of Wallarah C	273	15	15	15
US of Wallarah C	258	43	43	43
US of Wallarah C	215	215	215	215
US of Wallarah C	0	215	215	215

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: South Tributary

Reach	River Sta.	Contr.	Expan.
.	3277	.1	.3
.	2465	.1	.3
.	1713	.1	.3
.	856	.1	.3
.	665	.1	.3
.	411	.1	.3
.	301	.3	.5
.	276	.3	.5
.	266	Bridge	
.	256	.3	.5
.	234	.1	.3
.	122	.1	.3
.	0	.1	.3

River: Spring Creek

Reach	River Sta.	Contr.	Expan.
US of Jn	3340	.1	.3
US of Jn	2740	.1	.3
US of Jn	2086	.1	.3
US of Jn	1841	.1	.3
US of Jn	1595	.1	.3
US of Jn	1193	.1	.3
US of Jn	1038	.1	.3
US of Jn	933	.1	.3
US of Jn	896.5	.1	.3
US of Jn	886.5	.3	.5
US of Jn	876.5	Bridge	
US of Jn	866.5	.3	.5
US of Jn	837.5	.1	.3
US of Jn	669	.1	.3
US of Jn	437	.1	.3
US of Jn	0	.1	.3
US of Wallarah C	530	.1	.3
US of Wallarah C	352	.1	.3
US of Wallarah C	323	.3	.5
US of Wallarah C	273	.3	.5
US of Wallarah C	258	.3	.5
US of Wallarah C	215	.1	.3
US of Wallarah C	0	.1	.3

POSTDEVELOPMENT CONDITIONS

```
                    HEC-RAS Version 4.1.0 Jan 2010
                   U.S. Army Corps of Engineers
                  Hydrologic Engineering Center
                        609 Second Street
                        Davis, California

      X     X  XXXXXX    XXXX        XXXX       XX      XXXX
      X     X  X        X    X       X   X     X  X    X
      X     X  X        X            X   X    X    X   X
      XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
      X     X  X        X            X  X     X    X        X
      X     X  X        X    X       X   X    X    X        X
      X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: W2CP Rail Siding Post Dev
Project File : W2CPRailSidingPo.prj
Run Date and Time: 28/03/2016 4:22:58 PM

Project in SI units

Project Description:
Flood Impacts Assessment

PLAN DATA

Plan Title: Plan 02
Plan File : e:\G Herman & Associates\Jobs\16049 - Wallarah 2 Coal Project Rail\HEC RAS Model\W2CPRailSidingPo.p02

Geometry Title: Spring Creek
Geometry File : e:\G Herman & Associates\Jobs\16049 - Wallarah 2 Coal Project Rail\HEC RAS Model\W2CPRailSidingPo.g01

Flow Title : 100 year ARI
Flow File : e:\G Herman & Associates\Jobs\16049 - Wallarah 2 Coal Project Rail\HEC RAS Model\W2CPRailSidingPo.f01

```
Plan Summary Information:
Number of:  Cross Sections =   36    Multiple Openings  =    0
            Culverts       =    0    Inline Structures  =    0
            Bridges        =    4    Lateral Structures =    0

Computational Information
    Water surface calculation tolerance  =  0.003
    Critical depth calculation tolerance =  0.003
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.1
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow
```

FLOW DATA

Flow Title: 100 year ARI

Flow File : e:\G Herman & Associates\Jobs\16049 - Wallarah 2 Coal Project Rail\HEC RAS Model\W2CPRailSidingPo.f01

Flow Data (m3/s)

River	Reach	RS	PF 1
South Tributary	.	3277	12.3
South Tributary	.	2465	28.7
South Tributary	.	1713	39
South Tributary	.	856	55.6
South Tributary	.	665	57
South Tributary	.	411	58
South Tributary	.	301	59
South Tributary	.	276	59
South Tributary	.	256	59
South Tributary	.	234	59
South Tributary	.	122	59
South Tributary	.	0	59
Spring Creek	US of Jn	3340	7
Spring Creek	US of Jn	2740	14.2
Spring Creek	US of Jn	2086	19.1
Spring Creek	US of Jn	1841	57
Spring Creek	US of Jn	1595	58
Spring Creek	US of Jn	1193	59
Spring Creek	US of Jn	1038	61.1
Spring Creek	US of Jn	933	61.1
Spring Creek	US of Jn	896.5	61.1
Spring Creek	US of Jn	886.5	61.1
Spring Creek	US of Jn	866.5	61.1
Spring Creek	US of Jn	837.5	61.1
Spring Creek	US of Jn	669	148
Spring Creek	US of Jn	437	148
Spring Creek	US of Jn	0	205
Spring Creek	US of Wallarah C	530	205
Spring Creek	US of Wallarah C	352	205
Spring Creek	US of Wallarah C	323	205
Spring Creek	US of Wallarah C	273	205
Spring Creek	US of Wallarah C	258	205
Spring Creek	US of Wallarah C	215	203
Spring Creek	US of Wallarah C	0	203

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Spring Creek	US of Wallarah C	PF 1		Normal S = 0.001

GEOMETRY DATA

Geometry Title: Spring Creek
Geometry File : e:\G Herman & Associates\Jobs\16049 - Wallarah 2 Coal Project Rail\HEC RAS Model\W2CPRailSidingPo.g01

Reach Connection Table

River	Reach	Upstream Boundary	Downstream Boundary
South Tributary	.		Jn1
Spring Creek	US of Jn		Jn1
Spring Creek	US of Wallarah C	Jn1	

JUNCTION INFORMATION

Name: Jn1
Description:
Energy computation Method

Length across Junction		Tributary			
River	Reach	River	Reach	Length	Angle

```
Spring Creek    US of Jn         to Spring Creek    US of Wallarah C       0       0
South Tributary .                to Spring Creek    US of Wallarah C       0       0

CROSS SECTION


RIVER: South Tributary
REACH: .                  RS: 3277

INPUT
Description: Top DS of Fwy
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -119      33     -80      31     -57      30     -17      29     -11    28.5
      -6      28       0    27.5       4      28       6    28.5      12      29
      31      30      36      31      59      33

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -119    .035     -17    .033      12    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           -17      12             812     812     812             .1       .3

CROSS SECTION


RIVER: South Tributary
REACH: .                  RS: 2465

INPUT
Description: Jn Trib 3c
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -192      25    -102      23     -85      22     -68      21     -56    20.5
     -48      20       0    19.5    46.5      20      59    20.5      70      21
      89      22     111      23     147      25

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -192     .05     -56     .04      59     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           -56      59             752     752     752             .1       .3

CROSS SECTION


RIVER: South Tributary
REACH: .                  RS: 1713

INPUT
Description: Intermediate
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -119      17     -80      15     -57      14     -17      13     -11    12.5
      -6      12       0    11.5       4      12       6    12.5      12      13
      31      14      36      15      59      17

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -119     .05     -17     .04      12     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           -17      12             857     857     857             .1       .3

CROSS SECTION


RIVER: South Tributary
REACH: .                  RS: 856

INPUT
Description: Jn Trib 3e
```

Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-119	11.5	-80	9.5	-57	8.5	-17	7.5	-11	7
-6	6.5	0	6	4	6.5	6	7	12	7.5
31	8.5	36	9.5	59	11.5				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-119	.05	-17	.04	12	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-17	12	191	191	191	.1	.3

CROSS SECTION

RIVER: South Tributary
REACH: . RS: 665

INPUT
Description: Intermediate
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-76	8.5	-57.6	7.5	-47.1	7	-37.6	6.5	-26	6
-16.8	5.5	-7.3	5	0	4.5	12.7	5	20.9	5.5
23.6	6	28.2	6.5	36.6	7	54.4	7.5	103.5	8.5

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-76	.05	-16.8	.04	20.9	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-16.8	20.9	254	254	254	.1	.3

CROSS SECTION

RIVER: South Tributary
REACH: . RS: 411

INPUT
Description: Intermediate
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-76	8	-57.6	7	-47.1	6.5	-37.6	6	-26	5.5
-16.8	5	-7.3	4.5	0	4	12.7	4.5	20.9	5
23.6	5.5	28.2	6	36.6	6.5	54.4	7	103.5	8

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-76	.05	-16.8	.04	20.9	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-16.8	20.9	110	110	110	.1	.3

CROSS SECTION

RIVER: South Tributary
REACH: . RS: 301

INPUT
Description: US of Bridge 1
Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-177	9	-155	8	-127	7	-98.7	6.5	-60.4	6
-42.5	5.5	-31.7	5	-25.9	4.5	-19.6	4	-3.07	3.5
0	3.4	4.37	3.5	27.7	4	47.6	4.5	53.6	5
58.4	5.5	74.1	6	91.4	6.5	103	7	140	8
165	9								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-177	.05	-42.5	.04	58.4	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-42.5	58.4	25	25	25	.3	.5

CROSS SECTION

RIVER: South Tributary
REACH: .   RS: 276

INPUT
Description: West edge Bridge 1
Station Elevation Data   num=   13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-148.6	8	-29.7	7	-21.6	5	-20	4	-18.8	3.5
-4.37	3.1	0	3	2.49	3.1	3.8	3.5	23.7	4
27.3	5	35.1	7	112.7	8				

Manning's n Values   num=   3

Sta	n Val	Sta	n Val	Sta	n Val
-148.6	.06	-18.8	.04	23.7	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-18.8	23.7	20	20	20	.3	.5

BRIDGE

RIVER: South Tributary
REACH: .   RS: 266

INPUT
Description: Existing Bridge 1
Distance from Upstream XS =   5
Deck/Roadway Width   =   10
Weir Coefficient   =   1.7
Upstream Deck/Roadway Coordinates
num=   6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-500	9	0	-20	8.7	0	-20	8.7	7.7
21	8.6	7.6	21	8.6	0	500	8.4	0

Upstream Bridge Cross Section Data
Station Elevation Data   num=   13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-148.6	8	-29.7	7	-21.6	5	-20	4	-18.8	3.5
-4.37	3.1	0	3	2.49	3.1	3.8	3.5	23.7	4
27.3	5	35.1	7	112.7	8				

Manning's n Values   num=   3

Sta	n Val	Sta	n Val	Sta	n Val
-148.6	.06	-18.8	.04	23.7	.06

Bank Sta: Left	Right	Coeff Contr.	Expan.
-18.8	23.7	.3	.5

Downstream Deck/Roadway Coordinates
num=   6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-500	9	0	-20	8.7	0	-20	8.7	7.7
21	8.6	7.6	21	8.6	0	500	8.4	0

Downstream Bridge Cross Section Data
Station Elevation Data   num=   13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-153	8	-31.2	7	-20.3	5	-17.6	4	-14.1	3.5
-7.72	3	0	2.8	1.54	3	20.5	3.5	25	4
27.1	5	32.8	7	107.9	8				

Manning's n Values   num=   3

Sta	n Val	Sta	n Val	Sta	n Val
-153	.06	-17.6	.04	25	.06

Bank Sta: Left   Right   Coeff Contr.   Expan.

```
         -17.6      25              .3       .5

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Piers =  2

Pier Data
Pier Station     Upstream=   -10.1    Downstream=   -10.1
Upstream     num=       2
    Width   Elev    Width   Elev
     .75       0     .75       9
Downstream     num=       2
    Width   Elev    Width   Elev
     .75       0     .75       9

Pier Data
Pier Station     Upstream=     5.1    Downstream=     5.1
Upstream     num=       2
    Width   Elev    Width   Elev
     .75       0     .75       9
Downstream     num=       2
    Width   Elev    Width   Elev
     .75       0     .75       9

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION


RIVER: South Tributary
REACH: .                  RS: 256

INPUT
Description: East edge Bridge 1
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -153       8   -31.2       7   -20.3       5   -17.6       4   -14.1     3.5
   -7.72       3       0     2.8    1.54       3    20.5     3.5      25       4
    27.1       5    32.8       7   107.9       8

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -153     .06   -17.6     .04      25     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         -17.6      25               12      12      12              .3       .5

CROSS SECTION


RIVER: South Tributary
REACH: .                  RS: 244

INPUT
```

Description: CL New Bridge 1
Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-107	8.1	-89.4	7.1	-52.8	6.1	-29.3	5.6	-19.7	5.1
-16.2	4.6	-13.3	4.1	-11.3	3.6	-7.77	3.1	-4.88	2.6
-3.31	2.5	-2.88	1.4	0	1.3	2.09	1.5	2.83	2.4
4.68	2.6	10.7	3.1	16.6	3.6	24.3	4.1	34.4	4.6
48	5.1	65.1	5.6	72.4	6.1	82.5	7.1	95	8.1

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-107	.05	-11.3	.04	16.6	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-11.3	16.6	20	20	20	.1	.3

BRIDGE

RIVER: South Tributary
REACH: . RS: 234

INPUT
Description: Existing Bridge 1
Distance from Upstream XS = 5
Deck/Roadway Width = 10
Weir Coefficient = 1.7
Upstream Deck/Roadway Coordinates
num= 6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-500	9	0	-20	8.7	0	-20	8.7	7.7
21	8.6	7.6	21	8.6	0	500	8.4	0

Upstream Bridge Cross Section Data
Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-107	8.1	-89.4	7.1	-52.8	6.1	-29.3	5.6	-19.7	5.1
-16.2	4.6	-13.3	4.1	-11.3	3.6	-7.77	3.1	-4.88	2.6
-3.31	2.5	-2.88	1.4	0	1.3	2.09	1.5	2.83	2.4
4.68	2.6	10.7	3.1	16.6	3.6	24.3	4.1	34.4	4.6
48	5.1	65.1	5.6	72.4	6.1	82.5	7.1	95	8.1

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-107	.05	-11.3	.04	16.6	.05

Bank Sta: Left	Right	Coeff Contr.	Expan.
-11.3	16.6	.1	.3

Downstream Deck/Roadway Coordinates
num= 6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-500	9	0	-20	8.7	0	-20	8.7	7.7
21	8.6	7.6	21	8.6	0	500	8.4	0

Downstream Bridge Cross Section Data
Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-107	7.9	-89.4	6.9	-52.8	5.9	-29.3	5.4	-19.7	4.9
-16.2	4.4	-13.3	3.9	-11.3	3.4	-7.77	2.9	-4.88	2.4
-3.31	2.3	-2.88	1.2	0	1.1	2.09	1.3	2.83	2.2
4.68	2.4	10.7	2.9	16.6	3.4	24.3	3.9	34.4	4.4
48	4.9	65.1	5.4	72.4	5.9	82.5	6.9	95	7.9

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-107	.05	-11.3	.04	16.6	.05

Bank Sta: Left	Right	Coeff Contr.	Expan.
-11.3	16.6	.1	.3

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .98

Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Piers = 2

Pier Data
Pier Station Upstream= -10.1 Downstream= -10.1
Upstream num= 2

Width	Elev	Width	Elev
.75	0	.75	9

Downstream num= 2

Width	Elev	Width	Elev
.75	0	.75	9

Pier Data
Pier Station Upstream= 5.1 Downstream= 5.1
Upstream num= 2

Width	Elev	Width	Elev
.75	0	.75	9

Downstream num= 2

Width	Elev	Width	Elev
.75	0	.75	9

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data
Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
Energy Only

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: South Tributary
REACH: . RS: 224

INPUT
Description: CL New Bridge 1
Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-107	7.9	-89.4	6.9	-52.8	5.9	-29.3	5.4	-19.7	4.9
-16.2	4.4	-13.3	3.9	-11.3	3.4	-7.77	2.9	-4.88	2.4
-3.31	2.3	-2.88	1.2	0	1.1	2.09	1.3	2.83	2.2
4.68	2.4	10.7	2.9	16.6	3.4	24.3	3.9	34.4	4.4
48	4.9	65.1	5.4	72.4	5.9	82.5	6.9	95	7.9

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-107	.05	-11.3	.04	16.6	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-11.3	16.6	102	102	102	.1	.3

CROSS SECTION

RIVER: South Tributary
REACH: . RS: 122

INPUT
Description: Intermediate
Station Elevation Data num= 22

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

-154	5	-42.2	4.95	-30.9	4.5	-25.1	4	-17.5	3.5
-11.7	3	-8.82	2.5	-5.04	2	-1.21	1.5	0	1.4
1.25	1.5	3.08	2	5.56	2.5	8.53	3	11.8	3.5
15.4	4	20.5	4.5	34.1	5	60.4	5.5	82.3	6
93	7	99.1	8						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-154	.05	-17.5	.04	11.8	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-17.5	11.8	122	122	122	.1	.3

CROSS SECTION

RIVER: South Tributary
REACH: . RS: 0

INPUT
Description: Jn Spring Creek
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-218	7	-214	6	-199	5	-175	4.5	-111	4.5
-94.1	4	-90.4	3.5	-87.9	3	-84.3	2.5	-75.3	2
-58.4	2	-50	1.5	-46.2	1	-38.8	1.5	-27.8	2
-13	1.5	0	1	5.26	1.5	7.23	2	9.36	2.5
11.5	3	15.5	3.5	30.8	4	57.8	4.5	82.5	5
110	5.5	133	6	138	6.5	141	7	145	8

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-218	.05	-90.4	.04	15.5	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-90.4	15.5	0	0	0	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 3340

INPUT
Description: top
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-57	36	-32.9	34.5	-15	33.5	-3.5	33.1	0	33
2.8	33.1	20.7	33.5	41.8	34.5	66	36		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-57	.035	-15	.033	20.7	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-15	20.7	600	600	600	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 2740

INPUT
Description: Intermediate
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-57	26	-32.9	24.5	-15	23.5	-3.5	23.1	0	23
2.8	23.1	20.7	23.5	41.8	24.5	66	26		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-57	.035	-15	.033	20.7	.035

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           -15    20.7              652     652     652             .1       .3

CROSS SECTION


RIVER: Spring Creek
REACH: US of Jn           RS: 2086

INPUT
Description: Jn Trib 2e
Station Elevation Data    num=       9
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
   -70.6      18   -38.3      16   -27.8      15    -7.6    14.5       0      14
     7.9    14.5    13.3      15    30.7      16    79.9      18

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
   -70.6     .05   -27.8     .04    13.3     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         -27.8    13.3              245     245     245             .1       .3

CROSS SECTION


RIVER: Spring Creek
REACH: US of Jn           RS: 1841

INPUT
Description: Intermediate
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -124      16   -89.9      15   -61.1      14   -22.2    13.5   -12.3      13
   -7.99      12   -3.84      11       0    10.5    3.79      11    8.26    11.5
    33.5      12    46.7      13    60.6      14    95.4      16

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -124     .05   -12.3     .04    33.5     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         -12.3    33.5              246     246     246             .1       .3

CROSS SECTION


RIVER: Spring Creek
REACH: US of Jn           RS: 1595

INPUT
Description: Jn Nth Trib 2c
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
   -96.7      14   -81.6      13   -59.1      12   -43.7    11.5   -34.9      11
   -21.5      10   -10.7      10   -7.24     9.5   -5.36       9       0     8.5
    9.41       9      28     9.5    32.9      10    43.6      11    55.1      12
    91.9      14

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
   -96.7     .05   -10.7     .04    32.9     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         -10.7    32.9              402     402     402             .1       .3

CROSS SECTION


RIVER: Spring Creek
REACH: US of Jn           RS: 1193

INPUT
Description: Intermediate
```

Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-38.6	13	-20.5	11	-17.6	10	-14.2	9	-12.4	8.5
-9.77	8	-6.44	7.5	-4.18	7	-2.36	6.5	0	6
2.4	6.5	3.86	7	10.4	7.5	28.6	7.5	42.8	8
58.2	7.5	62.4	8	70.6	9	84.5	10	104	11
142	13								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-38.6	.05	-9.77	.04	62.4	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-9.77	62.4	155	155	155	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 1038

INPUT
Description: Intermediate
Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-75.8	11	-60.4	10	-52.2	9	-46.3	8	-43.2	7.5
-38.1	7	-31	7.5	-24.7	7	-14.3	7	-7.27	6.5
-5.55	6	0	5.5	8.31	6	11.2	6.5	15.8	7
20	7.5	25	8	33	8.5	51	9	72	10
89	11								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-75.8	.05	-38.1	.04	15.8	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-38.1	15.8	105	105	105	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 933

INPUT
Description: Intermediate
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-30.2	10	-19.6	8	-16.4	7	-14.5	6.5	-12.7	6
-7.83	5.8	-3.55	6	-1.6	5.5	0	5.1	3.6	5.5
7.68	6	14.5	5.8	17.9	6	20.8	6.5	30.3	7
37.5	8	77.6	10						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-30.2	.05	-12.7	.04	17.9	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-12.7	17.9	36.5	36.5	36.5	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 896.5

INPUT
Description: US of Bridge 2
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-26.6	10	-22.8	9	-20.4	8	-19.2	7.5	-18.3	7
-14.2	6.5	-7.14	6	-1.09	5.5	0	5	2.25	5.5
5.09	6	13	6.5	17.7	7	21.4	7.5	26.9	8
44.2	9	68.8	10						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-26.6	.05	-14.2	.04	13	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-14.2	13	10	10	10	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 886.5

INPUT
Description: West side of Bridge 2
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-117	11	-37.3	10	-23.5	9	-14.8	7	-13.2	6.5
-10.1	6	-6.19	5.5	-.729	5	0	4.9	2.48	5
11.3	5.5	12	6	12.7	6.5	13.7	7	18.6	9
149.1	9								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-117	.06	-10.1	.04	12	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-10.1	12	20	20	20	.3	.5

BRIDGE

RIVER: Spring Creek
REACH: US of Jn RS: 876.5

INPUT
Description: Existing Bridge 2
Distance from Upstream XS = 5
Deck/Roadway Width = 10
Weir Coefficient = 1.7
Upstream Deck/Roadway Coordinates
num= 6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-500	10.7	0	-10.2	10.5	0	-10.2	10.5	9.5
10.7	10.4	9.4	10.7	10.4	0	500	10.2	0

Upstream Bridge Cross Section Data
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-117	11	-37.3	10	-23.5	9	-14.8	7	-13.2	6.5
-10.1	6	-6.19	5.5	-.729	5	0	4.9	2.48	5
11.3	5.5	12	6	12.7	6.5	13.7	7	18.6	9
149.1	9								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-117	.06	-10.1	.04	12	.06

Bank Sta: Left	Right	Coeff Contr.	Expan.
-10.1	12	.3	.5

Downstream Deck/Roadway Coordinates
num= 6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-500	10.7	0	-10.2	10.5	0	-10.2	10.5	9.5
10.7	10.4	9.4	10.7	10.4	0	500	10.2	0

Downstream Bridge Cross Section Data
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-133	11	-76	10	-30.1	9	-13.9	7	-12.4	6.5
-9.84	6	-7.39	5.5	-1.06	5	0	4.8	10.8	5
13.7	5.5	15	6	16	6.5	17.2	7	44.7	8

106.3 9

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-133	.06	-9.84	.04	15	.06

Bank Sta: Left	Right	Coeff Contr.	Expan.
-9.84	15	.3	.5

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .98
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Piers = 2

Pier Data
Pier Station Upstream= -3.5 Downstream= -3.5
Upstream num= 2

Width	Elev	Width	Elev
1	0	1	10

Downstream num= 2

Width	Elev	Width	Elev
1	0	1	10

Pier Data
Pier Station Upstream= 3.8 Downstream= 3.8
Upstream num= 2

Width	Elev	Width	Elev
1	0	1	10

Downstream num= 2

Width	Elev	Width	Elev
1	0	1	10

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data
Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
Energy Only

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 866.5

INPUT
Description: East side of Bridge 2
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-133	11	-76	10	-30.1	9	-13.9	7	-12.4	6.5
-9.84	6	-7.39	5.5	-1.06	5	0	4.8	10.8	5
13.7	5.5	15	6	16	6.5	17.2	7	44.7	8
106.3	9								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-133	.06	-9.84	.04	15	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-9.84	15	19	19	19	.3	.5

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 847.5

INPUT
Description: CL new Bridge 2
Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-154	9.1	-121	8.1	-102	7.9	-80.6	7.8	-55.7	7.6
-35.3	7.1	-26.5	6.6	-19.3	6.1	-12	5.6	-4.61	5.1
-2	5	-.985	4.3	0	4.2	2.81	4.3	3.22	4.7
11.9	5.1	17.5	5.6	20.8	6.1	24.5	6.6	28.7	7.1
37	7.6	56.1	8.1	69.6	7.8	83.5	8.1	99.7	9.1

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-154	.05	-35.3	.04	28.7	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-35.3	28.7	20	20	20	.1	.3

BRIDGE

RIVER: Spring Creek
REACH: US of Jn RS: 837.5

INPUT
Description: Existing Bridge 2
Distance from Upstream XS = 5
Deck/Roadway Width = 10
Weir Coefficient = 1.7
Upstream Deck/Roadway Coordinates
num= 6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-500	10.7	0	-10.2	10.5	0	-10.2	10.5	9.5
10.7	10.4	9.4	10.7	10.4	0	500	10.2	0

Upstream Bridge Cross Section Data
Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-154	9.1	-121	8.1	-102	7.9	-80.6	7.8	-55.7	7.6
-35.3	7.1	-26.5	6.6	-19.3	6.1	-12	5.6	-4.61	5.1
-2	5	-.985	4.3	0	4.2	2.81	4.3	3.22	4.7
11.9	5.1	17.5	5.6	20.8	6.1	24.5	6.6	28.7	7.1
37	7.6	56.1	8.1	69.6	7.8	83.5	8.1	99.7	9.1

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-154	.05	-35.3	.04	28.7	.05

Bank Sta: Left	Right	Coeff Contr.	Expan.
-35.3	28.7	.1	.3

Downstream Deck/Roadway Coordinates
num= 6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-500	10.7	0	-10.2	10.5	0	-10.2	10.5	9.5
10.7	10.4	9.4	10.7	10.4	0	500	10.2	0

Downstream Bridge Cross Section Data
Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-154	8.9	-121	7.9	-102	7.7	-80.6	7.6	-55.7	7.4
-35.3	6.9	-26.5	6.4	-19.3	5.9	-12	5.4	-4.61	4.9
-2	4.8	-.985	4.1	0	4	2.81	4.1	3.22	4.5
11.9	4.9	17.5	5.4	20.8	5.9	24.5	6.4	28.7	6.9
37	7.4	56.1	7.9	69.6	7.6	83.5	7.9	99.7	8.9

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val

```
    -154     .05   -35.3     .04    28.7     .05

Bank Sta: Left   Right    Coeff Contr.   Expan.
         -35.3    28.7             .1       .3

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Piers =  2

Pier Data
Pier Station     Upstream=    -3.5    Downstream=    -3.5
Upstream     num=       2
    Width   Elev    Width   Elev
       1       0       1      10
Downstream     num=       2
    Width   Elev    Width   Elev
       1       0       1      10

Pier Data
Pier Station     Upstream=     3.8    Downstream=     3.8
Upstream     num=       2
    Width   Elev    Width   Elev
       1       0       1      10
Downstream     num=       2
    Width   Elev    Width   Elev
       1       0       1      10

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION


RIVER: Spring Creek
REACH: US of Jn           RS: 827.5

INPUT
Description: CL new Bridge 2
Station Elevation Data    num=      25
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -154     8.9    -121     7.9    -102     7.7   -80.6     7.6   -55.7     7.4
   -35.3     6.9   -26.5     6.4   -19.3     5.9     -12     5.4   -4.61     4.9
      -2     4.8   -.985     4.1       0       4    2.81     4.1    3.22     4.5
    11.9     4.9    17.5     5.4    20.8     5.9    24.5     6.4    28.7     6.9
      37     7.4    56.1     7.9    69.6     7.6    83.5     7.9    99.7     8.9

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -154     .05   -35.3     .04    28.7     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         -35.3    28.7            158.5   158.5   158.5             .1       .3

CROSS SECTION
```

RIVER: Spring Creek
REACH: US of Jn RS: 669

INPUT
Description: Intermediate
Station Elevation Data num= 18

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-225	8	-160	7	-68.8	6.5	-46.7	6	-23	5.5
-17.3	5	-12.8	4.5	-10	4	0	3.8	11.6	4
16.3	4.5	22.7	5	26.5	5.5	30.2	6	34.9	6.5
118	6.5	135	7	148	8				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-225	.05	-23	.04	26.5	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-23	26.5	232	232	232	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 437

INPUT
Description: Jn East tributary
Station Elevation Data num= 23

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-105	7	-91.3	6	-72	5	-58.4	4	-50.9	3.5
-43.4	3	-35	2.5	-22.4	2	-16.4	1.6	-11.7	2
-4.77	2	0	1.5	5.46	2	6.62	2.5	7.74	3
9	3.5	10.3	4	19.5	4.5	45	5	125	5.5
208	6	220	6.5	223	7				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-105	.05	-58.4	.04	10.3	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-58.4	10.3	437	437	437	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Jn RS: 0

INPUT
Description: Jn Sth Tributary
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-218	7	-214	6	-199	5	-175	4.5	-111	4.5
-94.1	4	-90.4	3.5	-87.9	3	-84.3	2.5	-75.3	2
-58.4	2	-50	1.5	-46.2	1	-38.8	1.5	-27.8	2
-13	1.5	0	1	5.26	1.5	7.23	2	9.36	2.5
11.5	3	15.5	3.5	30.8	4	57.8	4.5	82.5	5
110	5.5	133	6	138	6.5	141	7	145	8

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-218	.05	-90.4	.04	15.5	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-90.4	15.5	0	0	0	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Wallarah C RS: 530

INPUT

Description: Jn Spring Ck and Sth Trib
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-218	7	-214	6	-199	5	-175	4.5	-111	4.5
-94.1	4	-90.4	3.5	-87.9	3	-84.3	2.5	-75.3	2
-58.4	2	-50	1.5	-46.2	1	-38.8	1.5	-27.8	2
-13	1.5	0	1	5.26	1.5	7.23	2	9.36	2.5
11.5	3	15.5	3.5	30.8	4	57.8	4.5	82.5	5
110	5.5	133	6	138	6.5	141	7	145	8

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-218	.05	-90.4	.04	15.5	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-90.4	15.5	178	178	178	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Wallarah C RS: 352

INPUT
Description: Intermediate
Station Elevation Data num= 24

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-248	7	-241	6	-234	5	-227	4.5	-149	4.5
-117	5	-87.3	4.5	-70.2	4	-61.3	3	-57.3	2.5
-34.5	2	-30.1	1.5	-27.3	1	-5.75	1	0	.95
5.57	1	8.96	1.5	13.8	2	24	3	34.3	4
41	5	55.9	6	71.7	7	88.9	8		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-248	.05	-57.3	.04	13.8	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-57.3	13.8	29	29	29	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Wallarah C RS: 323

INPUT
Description: US of Hwy Link
Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-162	7	-146	6	-131	5	-83.5	4.5	-66.7	4
-55.7	3	-38.9	2.5	-33.2	2	-28.9	1.5	-17.7	1
-7.04	1	0	.9	7.58	1	11.4	1.5	13.8	2
28.8	3	34.8	4	46.1	5	59.9	6	71.1	7

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-162	.05	-38.9	.04	13.8	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-38.9	13.8	50	50	50	.3	.5

CROSS SECTION

RIVER: Spring Creek
REACH: US of Wallarah C RS: 273

INPUT
Description: Nth edge of Hwy Link
Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-24.9	10	-20.4	8	-17.1	6	-15.3	5	-13.2	4
-11.2	3	-9.96	2.5	-8.2	2	-6.25	1.5	-1.2	1

0	.85	1.2	1	5.8	1.5	7.42	2	9.03	2.5
10.7	3	13.2	4	15.6	5	17.2	6	20.2	8
23.7	10								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-24.9	.06	-8.2	.04	7.42	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-8.2	7.42	15	15	15	.3	.5

CROSS SECTION

RIVER: Spring Creek
REACH: US of Wallarah C RS: 258

INPUT
Description: Sth edge of Hwy Link
Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-24.9	10	-20.4	8	-17.1	6	-15.3	5	-13.2	4
-11.2	3	-9.96	2.5	-8.2	2	-6.25	1.5	-2	1
0	.83	2	1	5.8	1.5	7.42	2	9.03	2.5
10.7	3	13.2	4	15.6	5	17.2	6	20.2	8
23.7	10								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-24.9	.06	-8.2	.04	7.42	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-8.2	7.42	43	43	43	.3	.5

CROSS SECTION

RIVER: Spring Creek
REACH: US of Wallarah C RS: 215

INPUT
Description: Sth edge of Hwy Link
Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-194	6	-186	5	-180	4	-178	3.5	-175	4
-154	4.5	-88	4.5	-44.4	4	-39.1	3.5	-35.1	3
-22.7	2.5	-9.16	2	-4.73	1.5	0	.8	5.58	1.5
9.98	2	15.8	3	27.9	4	38.7	5	53.6	6

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-194	.05	-22.7	.04	9.98	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-22.7	9.98	215	215	215	.1	.3

CROSS SECTION

RIVER: Spring Creek
REACH: US of Wallarah C RS: 0

INPUT
Description: Sth edge of Hwy Link
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-288	6	-281	5	-274	4	-244	4.5	-201	4.5
-172	4	-157	3.5	-154	3	-148	2	-139	1.5
-117	1.5	-84	2	-69	3	-61.4	3.5	-55.6	3.5
-41.2	3	-36.1	2.5	-26	2	-14.7	1.5	-7.9	1
0	.5	4.19	1	5.68	1.5	6.47	2	7.25	2.5
8.9	3.5	12.9	4	42.6	4.5	60.9	5	85.8	6

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-288	.05	-26	.04	6.47	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-26	6.47	215	215	215	.1	.3

SUMMARY OF MANNING'S N VALUES

River:South Tributary

Reach	River Sta.	n1	n2	n3
.	3277	.035	.033	.035
.	2465	.05	.04	.05
.	1713	.05	.04	.05
.	856	.05	.04	.05
.	665	.05	.04	.05
.	411	.05	.04	.05
.	301	.05	.04	.05
.	276	.06	.04	.06
.	266	Bridge		
.	256	.06	.04	.06
.	244	.05	.04	.05
.	234	Bridge		
.	224	.05	.04	.05
.	122	.05	.04	.05
.	0	.05	.04	.05

River:Spring Creek

Reach	River Sta.	n1	n2	n3
US of Jn	3340	.035	.033	.035
US of Jn	2740	.035	.033	.035
US of Jn	2086	.05	.04	.05
US of Jn	1841	.05	.04	.05
US of Jn	1595	.05	.04	.05
US of Jn	1193	.05	.04	.05
US of Jn	1038	.05	.04	.05
US of Jn	933	.05	.04	.05
US of Jn	896.5	.05	.04	.05
US of Jn	886.5	.06	.04	.06
US of Jn	876.5	Bridge		
US of Jn	866.5	.06	.04	.06
US of Jn	847.5	.05	.04	.05
US of Jn	837.5	Bridge		
US of Jn	827.5	.05	.04	.05
US of Jn	669	.05	.04	.05
US of Jn	437	.05	.04	.05
US of Jn	0	.05	.04	.05
US of Wallarah C	530	.05	.04	.05
US of Wallarah C	352	.05	.04	.05
US of Wallarah C	323	.05	.04	.05
US of Wallarah C	273	.06	.04	.06
US of Wallarah C	258	.06	.04	.06
US of Wallarah C	215	.05	.04	.05
US of Wallarah C	0	.05	.04	.05

SUMMARY OF REACH LENGTHS

River: South Tributary

Reach	River Sta.	Left	Channel	Right
.	3277	812	812	812
.	2465	752	752	752
.	1713	857	857	857
.	856	191	191	191

.	665	254	254	254
.	411	110	110	110
.	301	25	25	25
.	276	20	20	20
.	266	Bridge		
.	256	12	12	12
.	244	20	20	20
.	234	Bridge		
.	224	102	102	102
.	122	122	122	122
.	0	0	0	0

River: Spring Creek

Reach	River Sta.	Left	Channel	Right
US of Jn	3340	600	600	600
US of Jn	2740	652	652	652
US of Jn	2086	245	245	245
US of Jn	1841	246	246	246
US of Jn	1595	402	402	402
US of Jn	1193	155	155	155
US of Jn	1038	105	105	105
US of Jn	933	36.5	36.5	36.5
US of Jn	896.5	10	10	10
US of Jn	886.5	20	20	20
US of Jn	876.5	Bridge		
US of Jn	866.5	19	19	19
US of Jn	847.5	20	20	20
US of Jn	837.5	Bridge		
US of Jn	827.5	158.5	158.5	158.5
US of Jn	669	232	232	232
US of Jn	437	437	437	437
US of Jn	0	0	0	0
US of Wallarah C	530	178	178	178
US of Wallarah C	352	29	29	29
US of Wallarah C	323	50	50	50
US of Wallarah C	273	15	15	15
US of Wallarah C	258	43	43	43
US of Wallarah C	215	215	215	215
US of Wallarah C	0	215	215	215

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: South Tributary

Reach	River Sta.	Contr.	Expan.
.	3277	.1	.3
.	2465	.1	.3
.	1713	.1	.3
.	856	.1	.3
.	665	.1	.3
.	411	.1	.3
.	301	.3	.5
.	276	.3	.5
.	266	Bridge	
.	256	.3	.5
.	244	.1	.3
.	234	Bridge	
.	224	.1	.3
.	122	.1	.3
.	0	.1	.3

River: Spring Creek

Reach	River Sta.	Contr.	Expan.
US of Jn	3340	.1	.3

US of Jn	2740		.1	.3
US of Jn	2086		.1	.3
US of Jn	1841		.1	.3
US of Jn	1595		.1	.3
US of Jn	1193		.1	.3
US of Jn	1038		.1	.3
US of Jn	933		.1	.3
US of Jn	896.5		.1	.3
US of Jn	886.5		.3	.5
US of Jn	876.5	Bridge		
US of Jn	866.5		.3	.5
US of Jn	847.5		.1	.3
US of Jn	837.5	Bridge		
US of Jn	827.5		.1	.3
US of Jn	669		.1	.3
US of Jn	437		.1	.3
US of Jn	0		.1	.3
US of Wallarah C	530		.1	.3
US of Wallarah C	352		.1	.3
US of Wallarah C	323		.3	.5
US of Wallarah C	273		.3	.5
US of Wallarah C	258		.3	.5
US of Wallarah C	215		.1	.3
US of Wallarah C	0		.1	.3