Vicroads

Bulla Bypass and Melbourne Airport Link Hydraulic Assessment

5 December 2013

PARSONS BRINCKERHOFF

Document information
Client: Vicroads Title: Bulla Bypass and Melbourne Airport Link Hydraulic Assessment Document No: 2113209A-DMS-RPT-001 RevA Date: 5 December 2013

Rev	Date	Details
A	08/11/2013	First draft
B	14/11/2013	Final
C	05/12/2013	Final

Author, Reviewer and Approver details			
Prepared by:	Aram Manjikian	Date: 05/12/2013	Signature:
Reviewed by:	Eric Lam	Date: 05/12/2013	Signature:
Approved by:		Date: 05/12/2013	Signature:

Distribution
Vicroads, Parsons Brinckerhoff file, Parsons Brinckerhoff Library

Document owner
Parsons Brinckerhoff Australia Pty Limited *ABN 80 078 004 798* Level 15 28 Freshwater Place Southbank VIC 3006 Tel: +61 3 9861 1111 Fax: +61 3 9861 1144 Email: melbourne@pb.com.au www.pbworld.com *Certified to ISO 9001, ISO 14001, AS/NZS 4801* *A GRI Rating: Sustainability Report 2011*

Contents

Glossary

ARI	Average Recurrence Interval, which is the likelihood of a given storm event to occur
Fraction impervious	The percentage of the catchment that has impervious surfaces that will not absorb stormwater
HEC RAS	One dimensional hydraulic modelling software developed by the Hydrologic Engineering Centre for the U.S. Army Corp of Engineers
RORB	A general runoff and streamflow routing model developed by Monash University in conjunction with SKM which calculates flood hydrographs from rainfall and other
Runoff	Volume of water that flows from a catchment after storage and absorption factors are considered.

Executive summary

Parsons Brinckerhoff was commissioned to complete hydraulic assessments for Deep Creek and Moonee Ponds Creek to determine impacts on flooding by the proposed Bulla Bypass and Melbourne Airport Link. The report will provide information for EES and EPBC referrals currently being completed by Vicroads.

Existing information for the catchment was gathered which included:

- Existing 1 in 100 year ARI flood mapping for both creeks
- Flow gauge data for Deep Creek at Bulla in ML/d
- Drainage infrastructure for the township of Bulla

Authority requirements for the creeks in regards to the proposed new roads were sought from the following authorities:

- Melbourne Water
- Port Phillip and Westernport Catchment Management Authority (PPWCMA)
- Hume City Council
- Department of Environment and Primary Industries (DEPI)
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPC)

The main authority requirements were from Melbourne Water;

Moonee Ponds Creek

1. The proposed road should not increase the 100 year ARI flood level.
2. The proposed road should not reduce the volume of existing flood storage.
3. Minimum set back may be required in between top of the bank of creek and the road's embankment.

Deep Creek

4. The proposed road should not increase the 100 year ARI flood level.
5. The bridge underside should be set at 600mm above the applicable flood level.
6. Bridge piers should not be constructed at the centre of the creek.
7. Maintenance envelope 4m x 4m under the bridge should be set for maintenance work of the creek.
8. Bridge abutment should be constructed 5m outside of top of the bank.

A catchment analysis determined the following parameters;

- Catchment areas
- Land use types
- Channel roughness

The findings from the catchment analysis were used as inputs to the hydrology modelling using the RORB software to model the 1 in 20 year, 1 in 50 year and 1 in 100 year ARI storm

events. The flows that were determined for the two creeks from the model are shown in the table below.

Catchment	1 in 20 year ARI peak flow (m^3/s)	1 in 50 year ARI peak flow (m^3/s)	1 in 100 year ARI peak flow (m^3/s)
Deep Creek	292.48	464.44	608.50
Moonee Ponds Creek (top of catchment)	12.98	19.28	24.25
Moonee Ponds Creek (at confluence with a tributary)	27.18	40.39	50.95
Moonee Ponds Creek (halfway along MAL)	27.68	44.18	58.01
Moonee Ponds Creek (adjacent to Melbourne Airport)	34.34	53.83	70.00

The flows were used as in the hydraulic assessment using the one dimensional hydraulic modelling software HEC RAS. The existing case scenario was modelled for the 1 in 20 year, 1 in 50 year and 1 in 100 year ARI storm events and the results plotted on maps shown in Appendix C.

Three options for the proposed Deep Creek crossing were modelled with various pier spans which produced increases in flood levels upstream of the bridge as shown in the following tables.

20 m pier spans

Distance from bridge	Existing 1 in 100 year ARI	Proposed 1 in 100 year ARI	Level difference
5 m upstream	93.41	93.59	0.18
125 m upstream	94.18	94.25	0.07
245 m upstream	94.67	94.71	0.04
365 m upstream	95.22	95.24	0.02
485 m upstream	95.62	95.64	0.02
605 m upstream	95.97	95.98	0.01

25 m pier spans

Distance from bridge	Existing 1 in 100 year ARI	Proposed 1 in 100 year ARI	Level difference
5 m upstream	93.41	94.57	0.16
125 m upstream	94.18	94.24	0.06
245 m upstream	94.67	94.71	0.04
365 m upstream	95.22	95.24	0.02
485 m upstream	95.62	95.63	0.01

30 m pier spans

Distance from bridge	Existing 1 in 100 year ARI	Proposed 1 in 100 year ARI	Level difference
5 m upstream	93.41	93.51	0.10
125 m upstream	94.18	94.22	0.03
245 m upstream	94.67	94.70	0.02
365 m upstream	95.22	95.23	0.01

Vicroads suggested that a mitigation measure that may be looked at would be 80 m span over Deep Creek, which was also assessed.

80 m pier span

Distance from bridge	Existing 1 in 100 year ARI	Proposed 1 in 100 year ARI	Level difference
5 m upstream	93.41	93.41	0
125 m upstream	94.18	94.18	0
245 m upstream	94.67	94.67	0

There is no increase in flood levels due to the span being wider than the floodplain extent. The span can be reduced to 70m for design purposes without impacting on flood levels.

The 1 in 100 year flood extents for Moonee Ponds Creek are clear of the edge of the proposed Melbourne Airport Link road and earthwork embankment edges. Therefore the alignment does not require to be modified.

The third crossing option for standard bridge design with 30 m pier spans is recommended as it provides the best result for keeping flood level increases low. It is also recommended that all piers are designed to be round in order to reduce drag in flood flows. The best option would be for the non-standard 70 m span bridge to be constructed, but will require further assessment and consideration for cost and constructability when the detailed design is undertaken.

Information for EES and EPBC referrals were also prepared for Deep Creek, as there are no impacts on Moonee Ponds Creek.

1. Introduction

This report was prepared for Vicroads to provide information on the hydraulic impacts of the proposed Bulla Bypass and Melbourne Airport Link on Deep Creek and Moonee Ponds Creek. This information will provide input for the EES referral in accordance with the Ministerial Guidelines for Assessing Environmental Effects, as well as an EPBC referral in accordance with the Significant Impact Guidelines, which are currently being completed by Vicroads.

This report outlines the work completed for the hydraulic assessments of Deep Creek and Moonee Ponds Creek, which includes:

- literature review of information gathered for previous flood information
- information from state and local authorities for hydraulic requirements and constraints on road infrastructure
- hydrology assessment to determine peak flows for design storms
- hydraulic assessment to determine peak flood levels for design storms
- discussion of types of creek crossing structures to satisfy hydraulic requirements

2. Preliminary investigations

2.1 Literature review

A literature review and liaison with relevant authorities was required to set the criteria and context for the assessment, and provide inputs for the hydrologic and hydraulic models. Flow and rainfall data, existing drainage infrastructure, and existing flood level information was sought from online resources, Melbourne Water and the Hume City Council.

Flow information was available for Deep Creek at Bulla on the Victorian Water Data Warehouse website which had recorded daily flows for a few days of each year since 1975. This information could be used in a flood frequency analysis to determine design flows, although the information produced would not be reliable due to the data period being incomplete and sporadic. There was no flow gauge data available for the Moonee Ponds Creek.

Existing drainage infrastructure for the town of Bulla was sourced from Hume City Council and Melbourne Water. The small drainage network, and the limited capacity of the main drain that outfalls to Deep Creek, means that the inputs from the drainage network would be negligible compared with the overland flows for large storm events that this study is focussing on. The contribution from the drainage network would be more substantial in smaller storm events that have a less than 1 in 10 year ARI.

Existing 1 in 100 year ARI flood maps with extents and water levels for Deep Creek and Moonee Ponds Creek have previously been provided to VicRoads by Melbourne Water. Discussions with Melbourne Water indicated that the levels were determined using the rational method to determine flows, and HEC RAS modelling of the creek hydraulic capacity. The information provides a good indication of the flood levels for the area, and can be used for calibration purposes for this study.

2.2 Authority requirements

The construction of creek crossings and works within the proximity of watercourses are subject to permits, conditions, and hydraulic criteria that must be adhered to for approval. The relevant authorities that were contacted in order to gain an understanding of their requirements are:

- Melbourne Water
- Port Phillip and Westernport Catchment Management Authority (PPWCMA)
- Hume City Council
- Department of Environment and Primary Industries (DEPI)
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPC)

When the PPWCMA, DEPI, and DSEWPC were contacted, they all responded that they do not have any requirements for hydraulic criteria or provide permit approvals for works on waterways.

Hume City Council responded similarly, with the only requirement being planning approvals, which is outside of the scope for this assessment.

The main authority that has permits and hydraulic requirements relevant to the assessment is Melbourne Water. Through email correspondence and telephone conversations with the relevant members of the flood investigations team, the following preliminary advice was provided by Melbourne Water:

Moonee Ponds Creek

1. The proposed road should not increase the 100 year ARI flood level.
2. The proposed road should not reduce the volume of existing flood storage.
3. Minimum set back may be required in between top of the bank of creek and the road's embankment.

Deep Creek

1. The proposed road should not increase the 100 year ARI flood level.
2. The bridge underside should be set at 600mm above the applicable flood level.
3. Bridge piers should not be constructed at the centre of the creek.
4. Maintenance envelope 4m x 4m under the bridge should be set for maintenance work of the creek.

Bridge abutment should be constructed 5m outside of top of the bank.

Detailed requirements and setback advice will be provided by Melbourne Water upon submission of final alignment and design of the roads and bridge crossing.

3. Hydrology Assessment

3.1 Catchment analysis

The main catchment parameters that need to be determined are:

- Catchment areas
- Land use types
- Channel roughness
- Inputs from cross drainage (if any)

The Moonee Ponds creek catchment area is 33.4 km^2 up to the area adjacent to the south end of the Melbourne Airport Link. The Deep Creek and Emu Creek catchments combined have an area of 857.1 km^2 down to the confluence of the two creeks just upstream of the Bulla township.

The catchment for Moonee Ponds Creek is predominantly in the Woodlands Historic Park, and is covered by the Public Conversation and Resource Zone, and the Green Wedge Zone overlays in the Hume planning scheme. The land use would be classified as rural and the appropriate fraction impervious of 0.1 would be assigned for the catchment in the hydrology model.

The catchment for Deep Creek and Emu Creek are mainly covered by zoning overlays of Farm Zone (FZ), Green Wedge Zone (GWZ), Rural Living Zone (RLZ), and small sections of Residential Zone 1 (RZ1) for the townships of Romsey and Lancefield. The land use FZ and GWZ would be classified as rural and the appropriate fraction impervious of 0.1 would be assigned for the catchment in the hydrology model. The fraction impervious for the RLZ areas would be assigned a value of 0.2, and 0.45 for RZ1 areas.

From site visit observations and inspection of aerial imagery for Moonee Ponds Creek along the proposed Melbourne Airport Link alignment, the channel is natural and unlined with a medium density of vegetation.

From site visit observations and inspection of aerial imagery for Deep Creek between the confluence of Emu Creek and Sunbury Road, the channel is natural and unlined with high density of vegetation.

3.2 Model setup

The RORB runoff and streamflow routing program was used to calculate the flows from each of the creek catchments. The overall catchments of Deep Creek and Moonee Ponds Creek were divided into subcatchments that delineated tributaries and sections of the main branch. Thirty-one subcatchments were determined and represented in the RORB model graphical editor for Deep Creek, and sixteen for Moonee Ponds Creek, along with the corresponding reach lengths. Each subcatchment was assigned the relevant fraction impervious value that was determined in the catchment analysis.

The catchment file created in RORB was used in a run which generated design storms from parameters obtained from Australian Rainfall and Runoff Volume 2 for the Bulla region. The

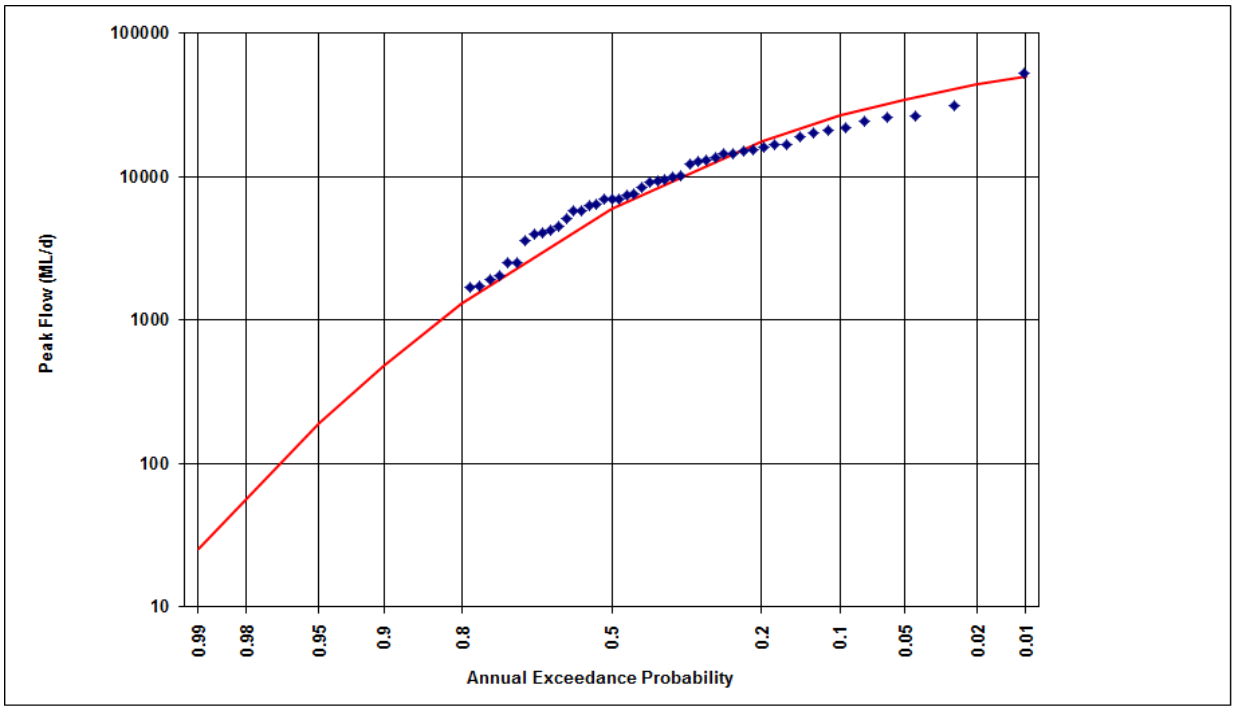
model was run as a runoff coefficient model, with 25 mm initial loss and the following runoff coefficients:

- 0.45 for the 20 year ARI
- 0.55 for the 50 year ARI
- 0.60 for the 100 year ARI

3.3 Calibration

Flood frequency analysis and the rational method were used to calibrate the RORB model for the 100 year ARI design storm event.

Flow information was available for Deep Creek at Bulla, station number 230205 with 59 years of data available. An annual flood frequency analysis selected the largest daily flow from each year of data, and was ranked. A Log Pearson III analysis produced a flood frequency curve to fit the data from its rank and probability, and a peak flow of 607.2 m^3/s was determined for the 1 in 100 year ARI design storm event. The figure below shows the flood frequency curve that was generated from the flow gauge data.



The rational method, as described in Australian Rainfall and Runoff Volume 1, was used for the Moonee Ponds Creek, and as a secondary check of peak flows for Deep Creek. The peak flows for each catchment for the 1 in 100 year ARI design storm event are listed in the table below.

Table 3.1 Rational Method Flows

Catchment	1 in 100 year ARI peak flow (m^3/s)
Deep Creek	642.53
Moonee Ponds Creek	25.63

The flow determined from the flood frequency analysis was used for calibration of the Deep Creek model, as the data is actual recorded flows and is more representative of the catchment.

Although the rational method flow is within an acceptable range of the flood frequency analysis flow.

4. Hydraulic Assessment

4.1 Model setup

Survey information provided by Vicroads was used to create a digital terrain model with which cross sections of the main creek branches in the study area were extracted. 120 m wide cross sections were extracted for Moonee Ponds Creek and 150 m wide cross sections were extracted for Deep Creek.

The HEC RAS one dimensional hydraulic model was used for the assessment. The cross sections for each of the creeks were imported in separate models, and default parameters were assigned for mannings n roughness.

The ford and culvert at the Woodlands Drive crossing on Moonee Ponds Creek was incorporated into the HEC RAS model at the corresponding location between sections.

The bridge at the Bulla road crossing on Deep Creek was incorporated into the HEC RAS model at the corresponding location between sections.

4.2 Calibration

Existing 1 in 100 year ARI flood maps with extents and water levels for Deep Creek and Moonee Ponds Creek have previously been provided to VicRoads by Melbourne Water. These maps were used as an indication of levels to achieve when modelling the 1 in 100 year ARI. The mannings roughness in each of the HEC RAS models were modified to achieve similar flood levels as the existing information.

Once the parameters were set with a good fit of the existing flood level information, the 1 in 20 and 1 in 50 year ARI's were modelled as well.

5. Results

5.1 Hydrology

The Moonee Ponds Creek runs parallel to the proposed Melbourne Airport Link alignment from the top of its catchment. Part of the way along the creek, a tributary which contributes a substantial flow joins the main branch. As this point is within the area that was modelled in HEC RAS, four peak flows were determined from the RORB model at the points of interest within the catchment:

- the peak flow at the start of the HEC RAS model near the top of the catchment
- the peak flow at the confluence with the tributary
- the peak flow halfway along the Melbourne Airport Link alignment
- the peak flow prior to the area adjacent to the Melbourne Airport

The flows determined from the RORB model are listed in the following table, and were used as the inputs for the HEC RAS models of each creek.

Table 5.1 Design Storm Flows

Catchment	1 in 20 year ARI peak flow (m^3/s)	1 in 50 year ARI peak flow (m^3/s)	1 in 100 year ARI peak flow (m^3/s)
Deep Creek	292.48	464.44	608.50
Moonee Ponds Creek (top of catchment)	12.98	19.28	24.25
Moonee Ponds Creek (at confluence)	27.18	40.39	50.95
Moonee Ponds Creek (halfway along MAL)	27.68	44.18	58.01
Moonee Ponds Creek (adjacent to Melbourne Airport)	34.34	53.83	70.00

5.2 Hydraulics

5.2.1 Existing case

The results from the HEC RAS model were mapped as flood extents and are shown in Appendix C for both creek assessments. The flood levels for sections along the creeks are also labelled on the maps.

5.2.2 Developed case

For Deep Creek, the HEC RAS model was modified with various bridge crossing options. The location and width of the crossing was based on the design drawings provided by Vicroads.

The first option looked at bridge piers at 20 m spacing offset from the centre of the creek to avoid having piers in the centre of the channel. When the model was run, the flood level was increased slightly up to 600 m upstream for the 1 in 100 year ARI, and less for the other storm events. The level differences are shown below.

Table 5.2 Option 1 Flood Level Comparisons

Distance from bridge	Existing 1 in 100 year ARI	Proposed 1 in 100 year ARI	Level difference
5 m upstream	93.41	93.59	0.18
125 m upstream	94.18	94.25	0.07
245 m upstream	94.67	94.71	0.04
365 m upstream	95.22	95.24	0.02
485 m upstream	95.62	95.64	0.02
605 m upstream	95.97	95.98	0.01

The second option looked at bridge piers at 25 m spacing offset from the centre of the creek to avoid having piers in the centre of the channel. When the model was run, the flood level was increased slightly up to 500 m upstream for the 1 in 100 year ARI, and less for the other storm events. The level differences are shown below.

Table 5.3 Option 2 Flood Level Comparisons

Distance from bridge	Existing 1 in 100 year ARI	Proposed 1 in 100 year ARI	Level difference
5 m upstream	93.41	94.57	0.16
125 m upstream	94.18	94.24	0.06
245 m upstream	94.67	94.71	0.04
365 m upstream	95.22	95.24	0.02
485 m upstream	95.62	95.63	0.01

The third option looked at bridge piers at 30 m spacing offset from the centre of the creek to avoid having piers in the centre of the channel. When the model was run, the flood level was increased slightly up to 370 m upstream for the 1 in 100 year ARI, and less for the other storm events. The level differences are shown below.

Table 5.4 Option 3 Flood Level Comparisons

Distance from bridge	Existing 1 in 100 year ARI	Proposed 1 in 100 year ARI	Level difference
5 m upstream	93.41	93.51	0.10
125 m upstream	94.18	94.22	0.03
245 m upstream	94.67	94.70	0.02
365 m upstream	95.22	95.23	0.01

A fourth option was also assessed at the request of Vicroads as a potential mitigation option of an 80 m span bridge. The results of the assessment are shown below

Table 5.5 Option 4 Flood Level Comparisons

Distance from bridge	Existing 1 in 100 year ARI	Proposed 1 in 100 year ARI	Level difference
5 m upstream	93.41	93.41	0
125 m upstream	94.18	94.18	0
245 m upstream	94.67	94.67	0

There is no increase in flood levels due to the span being wider than the floodplain extent. The span can be reduced to 70m for design purposes without impacting on flood levels.

6. Discussion

In the assessment of the Bulla bypass crossing over Deep Creek, three options that were looked at resulted in flood impacts. For each of the three options the bridges had a different number of piers that were affecting the flood levels.

- The first option with 20m pier spacing had 3 piers within the 100 year flood extent
- The second option with 25m pier spacing had 2 piers within the 100 year flood extent
- The third option with 30m pier spacing had 1 pier within the 100 year flood extent

As per Melbourne Water requirements, the piers have not been placed at the centre of the creek and are clear of the normal water level. The piers were assumed to be round to reduce drag. The bridge underside is more than 600 mm clear of the flood levels and the bridge abutments are outside of the top of the bank.

All options increased the 1 in 100 year ARI flood level to varying degrees. Discussions held with Melbourne Water indicated that minor increases to the flood levels can be approved as long as it can be demonstrated that the other conditions set by Melbourne Water are met, and that there is no increase in flood levels on private property adjacent to deep creek and the Bulla bypass. All flood extents are maintained within the Deep Creek reserve for all options that were assessed, and do not encroach on any adjoining properties upstream of the proposed bridge crossing. Therefore it would be expected that the crossing be accepted by Melbourne Water with further discussions to be had when the detailed design is being developed.

The 1 in 100 year flood extents for Moonee Ponds Creek are clear of the edge of the proposed Melbourne Airport Link road and earthwork embankment edges. Therefore there is no need to modify the design for the Melbourne Airport Link alignment as the volume of existing flood storage and the flood levels are unaffected. This satisfies Melbourne Water's requirements for Moonee Ponds Creek, although the current setback from the 1 in 100 year ARI flood extent should be agreed with Melbourne Water as being acceptable.

As the Moonee Ponds Creek is unaffected by the proposed works, there are no impacts that are required to be considered for the EES or EPBC referrals.

The changes in the flood levels in Deep Creek do not impact on any of the matters protected by Part 3 of the EPBC Act as listed below:

- World Heritage properties (sections 12 and 15A)
- National Heritage places (sections 15B and 15C)
- Wetlands of international importance (sections 16 and 17B)
- Listed threatened species and communities (sections 18 and 18A)
- Listed migratory species (sections 20 and 20A)
- Protection of the environment from nuclear actions (sections 21 and 22A)
- Commonwealth marine environment (sections 23 and 24A)
- Great Barrier Reef Marine Park (sections 24B and 24C)
- A water resource, in relation to coal seam gas development and large coal mining development (sections 24D and 24E)

- The environment, if the action involves Commonwealth land (sections 26 and 27A), including:
- actions that are likely to have a significant impact on the environment of Commonwealth land (even if taken outside Commonwealth land);
- actions taken on Commonwealth land that may have a significant impact on the environment generally;
- The environment, if the action is taken by the Commonwealth (section 28)
- Commonwealth Heritage places outside the Australian jurisdiction (sections 27B and 27C)

Section 13 of the EES referral relates to water environments, which requires set criteria to be addressed. For the Deep Creek crossing hydraulic impacts, the criteria that need to be addressed are as follows:

Will the project require significant volumes of fresh water (eg. > 1 Gl/yr)?	No
Will the project discharge waste water or runoff to water environments?	Road drainage will be captured and part of it treated by water sensitive road design (WSRD) measures. Part of the drainage will discharge to Deep Creek, but will be a negligible amount compared to the volume of flow from the Deep Creek catchment upstream of the crossing, therefore no significant increases would be observed in flood levels.
Are any waterways, wetlands, estuaries or marine environments likely to be affected?	Deep Creek water levels could be up to 100 mm higher within 600 m upstream of the crossing.
Are any of these water environments likely to support threatened or migratory species?	Migratory species are likely to be present, although the changes in flood levels would not have an impact.
Are any potentially affected wetlands listed under the Ramsar Convention or in 'A Directory of Important Wetlands in Australia'?	No
Could the project affect streamflows?	No
Could regional groundwater resources be affected by the project?	No
Could environmental values (beneficial uses) of water environments be affected?	No
Could aquatic, estuarine or marine ecosystems be affected by the project?	No
Is there a potential for extensive or major effects on the health or biodiversity of aquatic, estuarine or marine ecosystems over the long-term?	No
Is mitigation of potential effects on water environments proposed?	It is proposed that the bridge spans are made wider than the 1 in 100 year ARI flood extents in order to avoid having piers in the floodplain. This would remove any impacts of the bridge on flood levels. A 70m span across Deep Creek would be sufficient.

7. Recommendations

The alignment of the Melbourne Airport Link does not need to be modified as it does not impact on existing flood levels from Moonee Ponds Creek.

Minimising the number of piers that are within the 1 in 100 year ARI flood extents will provide the best outcome possible for approval from Melbourne Water. The third crossing option for standard bridge design with 30 m pier spans is recommended as it provides the best result for keeping flood level increases low. It is also recommended that all piers are designed to be round in order to reduce drag in flood flows.

The best option for the Bulla Bypass would be for the non-standard 70 m span bridge to be constructed, but will require further assessment and consideration for cost and constructability when the detailed design is undertaken.

It is understood that cost implications of having larger spans between piers would be a factor in the bridge design. If it is desirable to keep the spans to a minimum, then discussions will need to be held with Melbourne Water to gain approval for more piers within the flood extents, and may require further conditions set by Melbourne Water.

Appendix A

Assignment Brief

A1. Assignment Brief

This work relates to the hydrology and hydraulic impacts on waterways along the Bulla Bypass 5 and Melbourne Airport Link alignments - refer to plan attached for location of the proposed alignments.

Task 1 Review previous studies

Review of previous hydrology and hydraulic studies relevant to this study area.

Task 2 Liaise with key contacts

Liaise with key contacts including, but not be limited to the Department of Environment and Primary Industries, Department of Sustainability, Environment, Water, population and Communities, Melbourne Water, Port Phillip and Western Port Catchment Management Authority, relevant experts and Hume City Council.

Establish all requirements for both present and future conditions and obtain all relevant information for the study.

Task 3 Site visit

Undertake a site visit of the study area, if required.

Task 4 Determine watercourse catchments

Identify all watercourses within the study area and determine the extent of their associated catchments

Task 5 Establish hydraulic performance criteria

Establish hydraulic performance criteria with key stakeholders including, but not limited to afflux controls, velocity and freeboard as well as any other controls essential for the study.

The Provider shall seek agreement from the relevant water authority to the hydraulic performance criteria before proceeding

Task 6 Assess flood behaviour

Assess flood behaviour (flood levels and velocities) for the 20, 50 and 100 year flood events under the following scenarios:

- Existing bridge and waterway conditions
- Completed developed condition

Task 7 Propose waterway requirements and structure types

Identify the proposed waterway requirements for each watercourse and suggest the most appropriate types of structures.

Task 8 Information for EES referral

Provide sufficient information to enable VicRoads to complete an EES Referral in accordance with the Ministerial Guidelines for Assessing Environmental Effects.

Task 9 Information for EPBC referral

Provide sufficient information to enable VicRoads to complete an EPBC Referral in accordance with the Significant Impact Guidelines.

Task 10 Report

Produce a report covering the outputs from the tasks listed above, including;
- any constraints and major concerns with the proposed route option from an hydrology perspective,
- suggested modifications to the proposed route option from an hydrology perspective, and
- the identification of measures to mitigate the impacts of each proposed route option

The structure and format of the report are further detailed below

NOTE: The report produced for this Assignment shall comply with the Whole of Victorian Government (WoVG) Accessibility Standard. The Provider should ensure that Accessibility requirements are incorporated as documents are being written and not leave this as a separate task to be carried out when finalising documents. Further details are provided in the Deliverables section of this brief.

Task 11 Attendance at meetings

The Provider shall suitably prepare for and then attend all meetings, as instructed by the Superintendent. It is expected the Provider shall be required to prepare for and then attend 1 No. meeting to discuss the draft report. This meeting will be held at VicRoads Camberwell Office.

Further Information

VicRoads will provide the following information to the Provider :

- copies of previous relevant reports,
- plans showing the proposed study area and alignment route BB5 and Melbourne Airport Link,
- relevant VicRoads policies and strategies where relevant.

Report Requirements

Accessibility

VicRoads has adopted the Whole of Victorian Government (WoVG) Accessibility Standard which is based on the Web Content Accessibility Guidelines (WCAG) 2.0. This Standard aims to ensure that information on VicRoads' website will be available to all people without discrimination on the basis of disability and to make finding, using and interacting with the website easier. The Standard is available from the Policies and Standards section of the Victorian Government Department of Treasury and Finance Chief Information Officer's website. The Accessibility Standard is under the "Website Management Framework" tab at the following website address: https://www.dtf.vic.gov.au/CA257310001D7FC4/pages/policies-and-standards-website-management-framework.
As the report produced for this Assignment could be made available for viewing via VicRoads' website, it needs to be prepared to comply with the WoVG Accessibility Standard which involves meeting all Level AA Success Criteria of WCAG 2.0. Further advice on how to meet the WoVG Accessibility Standard can be provided by the Superintendent, if required.

Timing and Format

Step	Timing	Details
1. Provider to submit proposed report structure	two days after award of the contract	The proposed report structure and formatting, together with descriptions of maps and figures proposed to be included in the report will be discussed and agreed with VicRoads before the draft report is prepared
2. Provider to submit draft report	Two weeks after award of the contract	An electronic copy of the complete draft report is to be provided to VicRoads in Microsoft Word (doc) format, along with electronic copies of all maps, drawings and photos in the format agreed with

		VicRoads in Step 1. If the draft report is incomplete or inappropriately structured, VicRoads may request the draft report to be revised before reviewing it.
3. VicRoads to review draft report	One week after receipt of the complete draft report	The Provider may be asked to consider making changes to the report based on the reviewer's comments (and VicRoads' legal advisor's feedback, which will generally be provided after the Provider has considered the reviewer's comments and amended the draft report) before the report is finalised. Where the Provider has concerns about any of the review comments, these are to be discussed with VicRoads Superintendent's Representative prior to finalisation of the report.
4. Provider to submit final report	No more than one week after receipt of VicRoads comments on the draft report	One unbound and one bound copy of the final report (including colour figures, plans and maps) will be provided to VicRoads. An electronic copy of the final report will also be provided to VicRoads in a secured Adobe Portable Document File (PDF) format, along with a digital copy of all figures in the format agreed with VicRoads.
5. VicRoads acceptance of final report		The final report will only be accepted after all changes requested by VicRoads in Step 3 and agreed by the Provider, have been completed.

Report Structure

Subject to any specific modifications required for this Assignment, it is expected that the report will have the following chapter headings:

- Executive summary
- Introduction/background
- Methodology
- Results
- Discussion
- Conclusions
- Recommendations
- Glossary of terms
- References
- A copy of this Assignment brief as Appendix 1
- Other Appendices, as required

It is also expected that the report will contain:

- A Cover Page with the Project name, type of consultancy, author's name and date
- A Table of Contents with a list of maps, drawings, tables and Appendices
- Footers on each page including the date and version number (for both hard copy and electronic files)
- Numbering of all pages, and
- Text that is readable and not less than 10 point Verdana, or agreed equivalent
- Acknowledgements for persons and organisations that have contributed to the report

Maps and Drawings

The report should include maps and drawings showing the study area and alignment option BB5 and MAL. The source of all maps and drawings used in the report needs to be quoted, unless they have been prepared using data collected specifically for this Assignment. Maps need to be prepared to an appropriate scale so that information is clearly legible. Font sizes should be large enough to be able to read legends and text e.g. road names, when produced in

A4.

The Provider shall ensure that roads, features etc. referred to in the report are shown clearly on the relevant maps and drawings.

The Provider shall ensure that maps and drawings comply with the DPCD Communicating Data with Colour Guidelines.

Format of electronic versions of maps, drawings and photos
Maps are to be produced using GIS software. GIS data should be provided in ESRI Shapefile format. GPS locations should be provided on GDA94 Lat/Long datum to at least and accuracy of 1m, or another similar standard agreed with VicRoads prior to the contract being awarded.

Drawings should be provided in a CADD file Microstation Version 8 or dxf or another similar standard agreed with VicRoads prior to the contract being awarded. Specify that MGA zones 54 or 55 shall be used as appropriate, except that Zone 55 should always be used for Melbourne projects, and where projects straddle zone boundaries or are located in the zone overlaps, a decision on the appropriate zone shall be referred to the Superintendent for a decision.

Photos are to be in jpeg format and taken with at least a 5 megapixel camera or another similar standard agreed with VicRoads prior to the contract being awarded.

If alternative software is proposed to be used for presenting maps and drawings, this must be indicated together with any cost implications for the Provider and VicRoads.

Appendix B

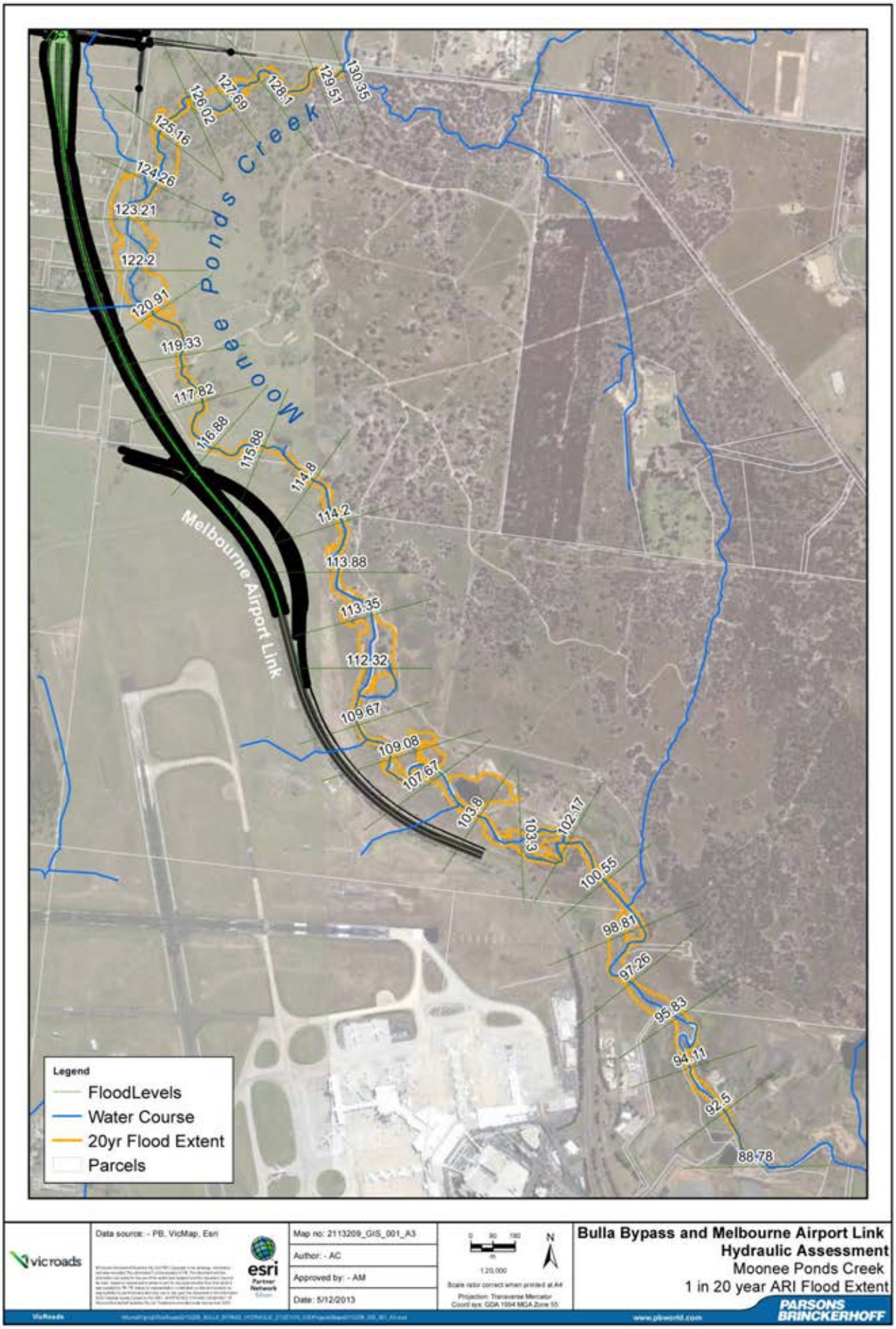
MW flood maps

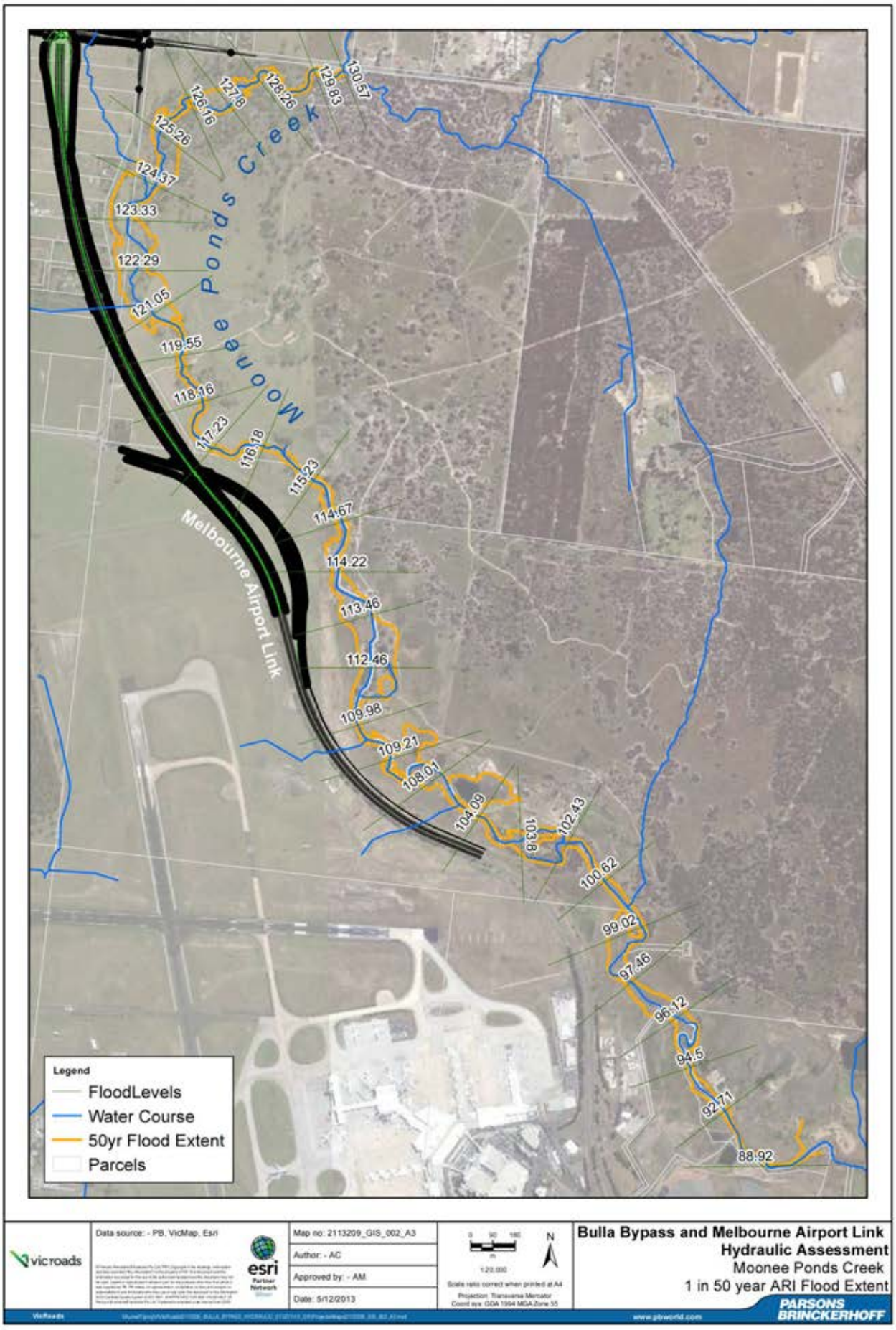

Deep Creek
Natural waterway centreline
Flood Shape
Cross Section
114.32m Flood Level (m) AHD
Map at A3
Scale 1: 5,000
15/02/2012
N
MGA55
Melbourne Water

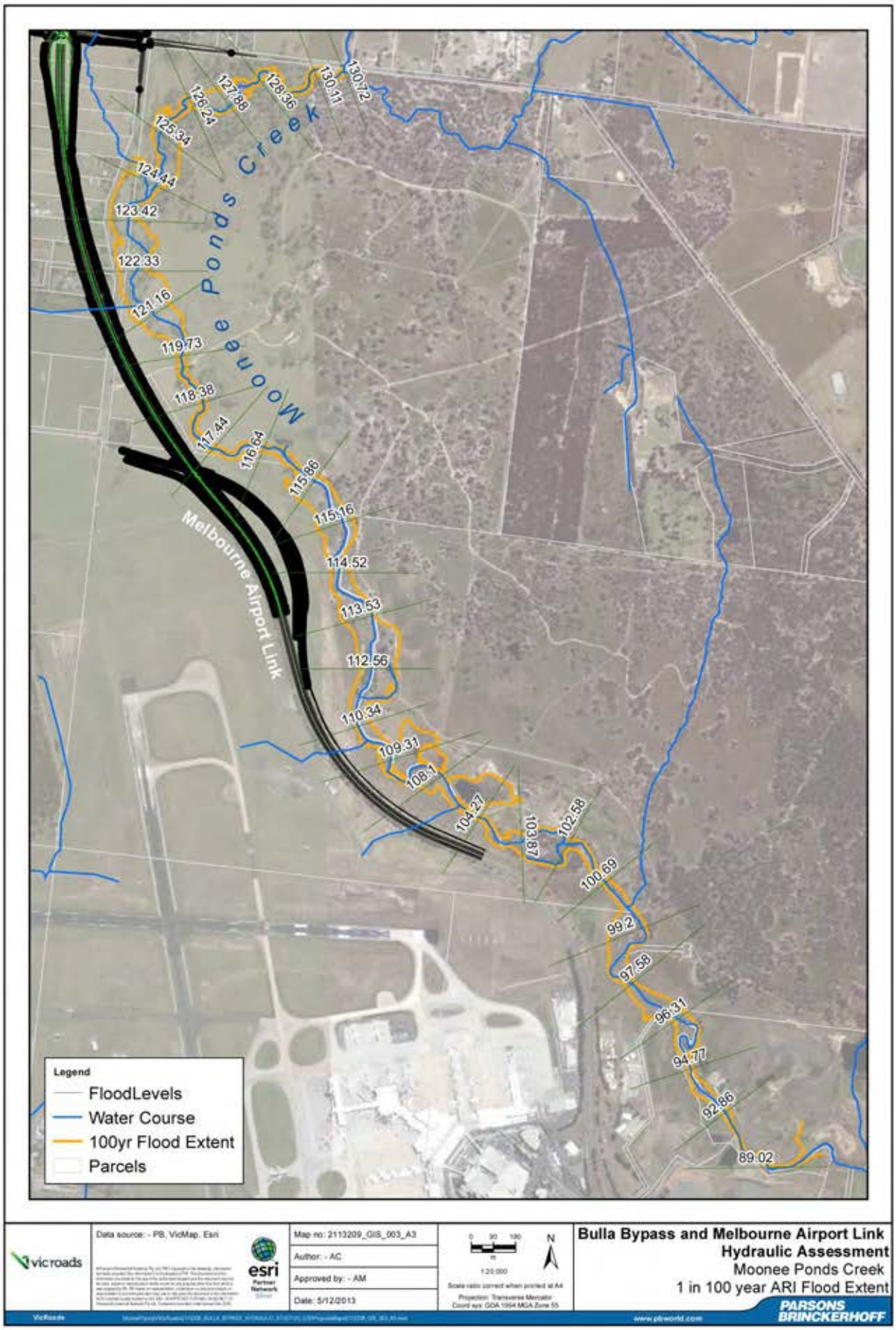

Moonee Ponds Creek
Natural waterway centreline
Flood Shape
Cross Section
114.32m Flood Level (m) AHD
Map at A3
Scale 1: 13,000
15/02/2012
N
MGA55
Melbourne Water

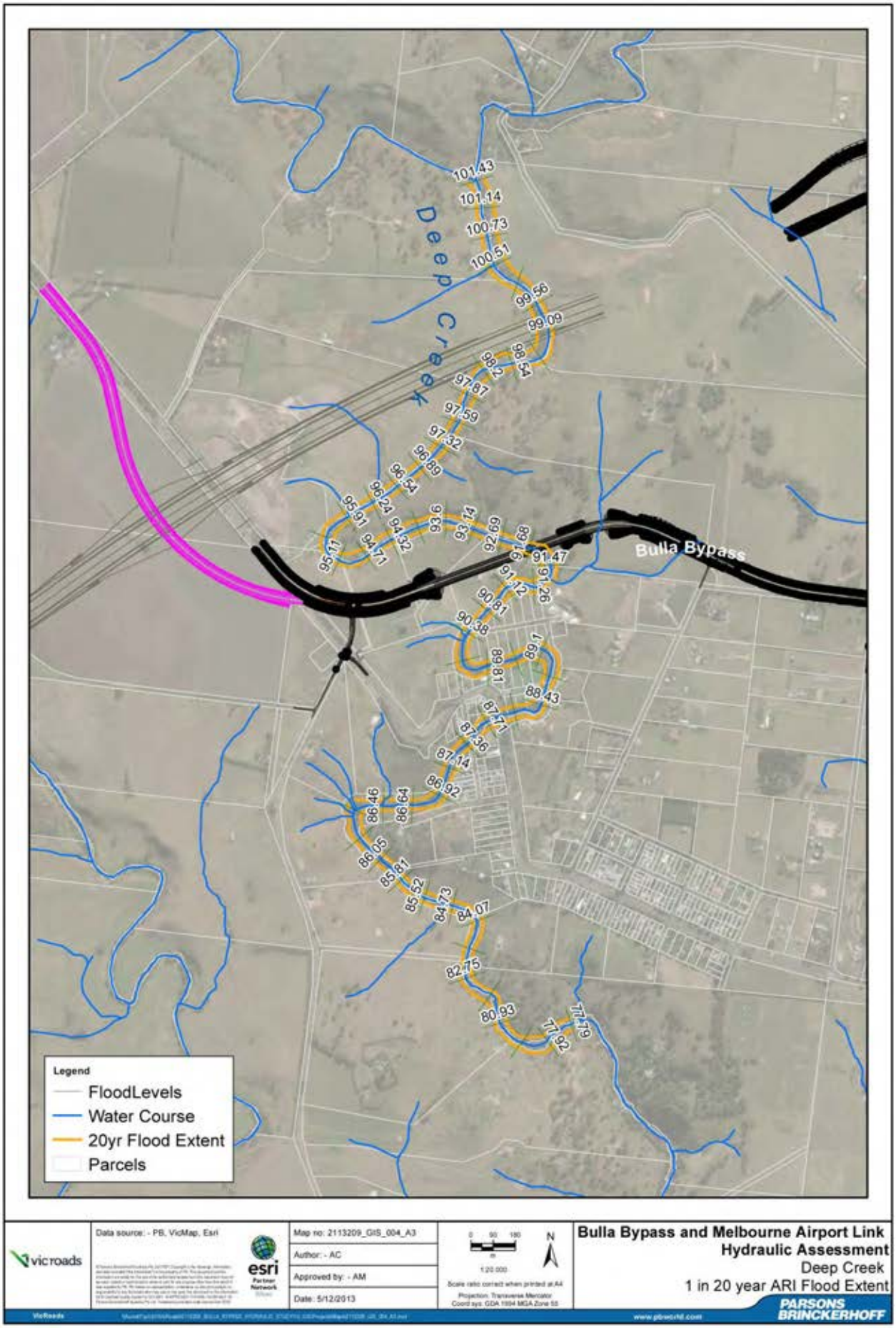
Appendix C

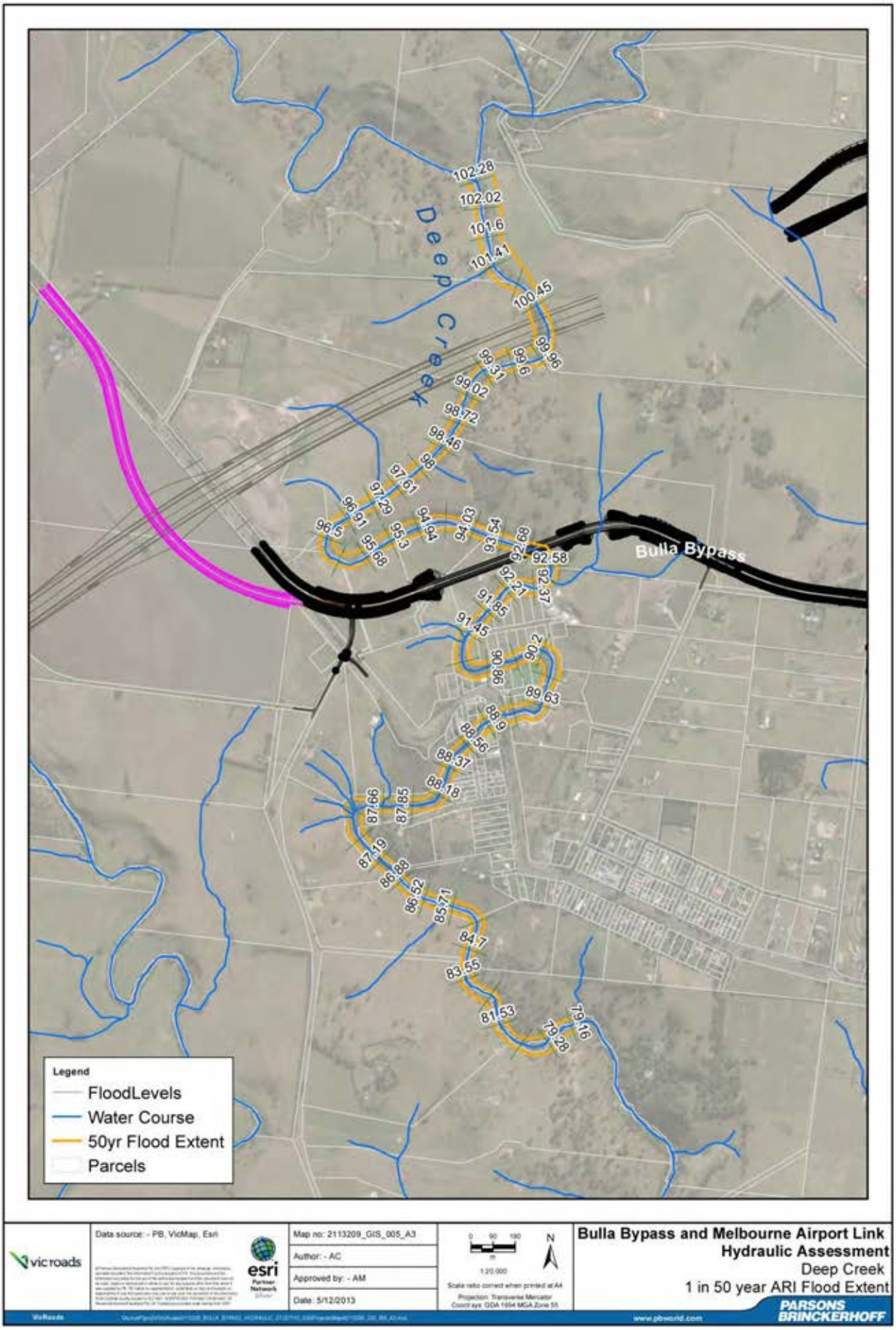
Design Flood Maps

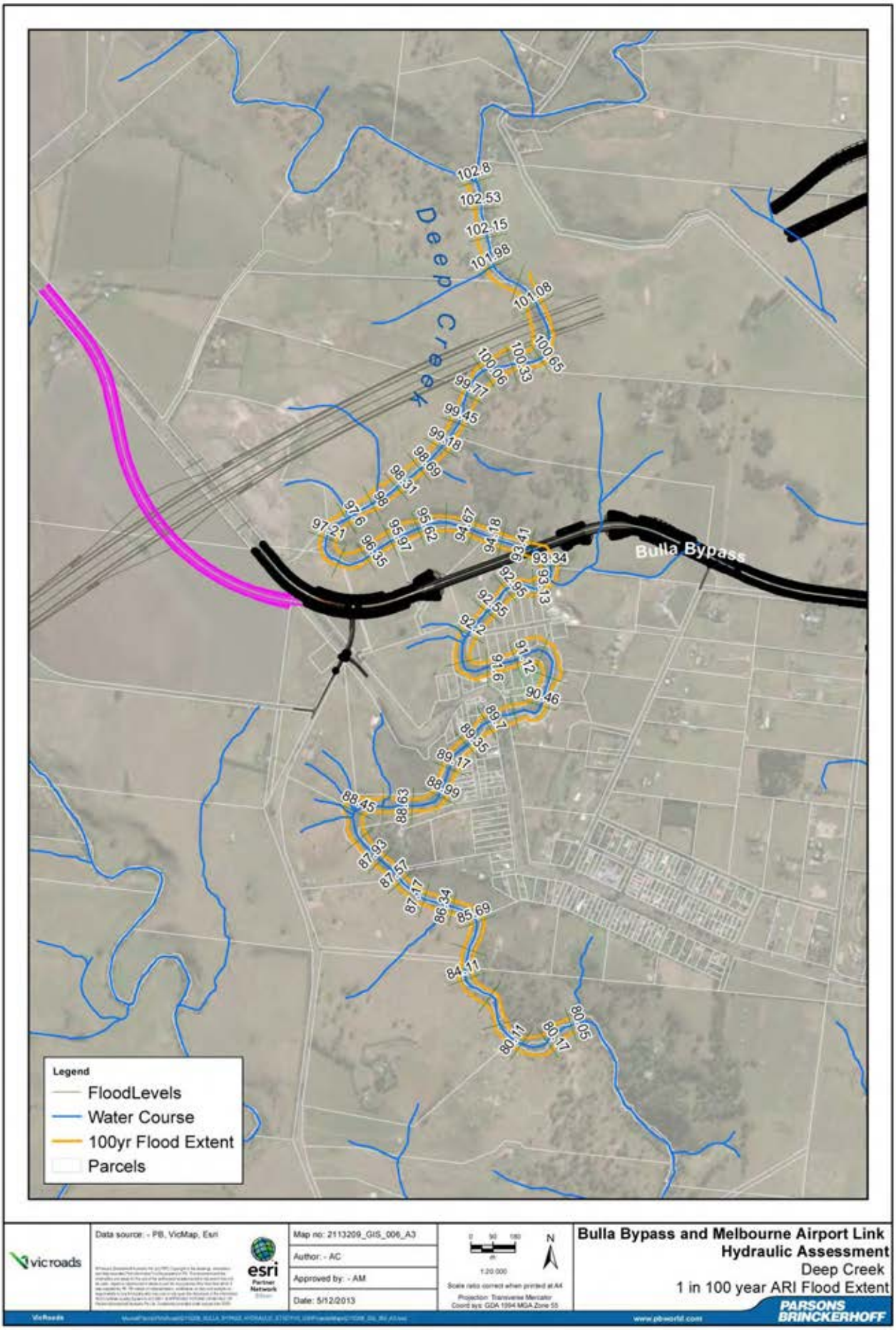

Moonee Ponds Creek
Melbourne Airport Link
130.35
129.51
128.1
127.69
126.02
125.16
124.26
123.21
122.2
120.91
119.33
117.82
116.88
115.88
114.8
114.2
113.88
113.35
112.32
109.67
109.08
107.67
103.8
103.3
102.17
100.55
98.81
97.26
95.83
94.11
92.5
88.78
Legend
FloodLevels
Water Course
20yr Flood Extent
Parcels
Data source: - PB, VicMap, Esri
Map no: 2113209_GIS_001_A3
Author: - AC
Approved by: - AM
Date: 5/12/2013
1:20,000
Scale ratio correct when printed at A4
Projection: Transverse Mercator
Coord sys: GDA 1994 MGA Zone 55
Bulla Bypass and Melbourne Airport Link
Hydraulic Assessment
Moonee Ponds Creek
1 in 20 year ARI Flood Extent
PARSONS BRINCKERHOFF
www.pbworld.com


Moonee Ponds Creek
Melbourne Airport Link
130.57
129.83
128.26
127.8
126.16
125.26
124.37
123.33
122.29
121.05
119.55
118.16
117.23
116.18
115.23
114.67
114.22
113.46
112.46
109.98
109.21
108.01
104.09
103.8
102.43
100.62
99.02
97.46
96.12
94.5
92.71
88.92
Legend
FloodLevels
Water Course
50yr Flood Extent
Parcels
vicroads
Data source: - PB, VicMap, Esri
esri
Partner Network
Map no: 2113209_GIS_002_A3
Author: - AC
Approved by: - AM
Date: 5/12/2013
N
Scale ratio correct when printed at A4
Projection: Transverse Mercator
Coord sys: GDA 1994 MGA Zone 55
Bulla Bypass and Melbourne Airport Link
Hydraulic Assessment
Moonee Ponds Creek
1 in 50 year ARI Flood Extent
PARSONS BRINCKERHOFF
www.pbworld.com


Moonee Ponds Creek
Melbourne Airport Link
130.72
130.11
128.36
127.88
126.24
125.34
124.44
123.42
122.33
121.16
119.73
118.38
117.44
116.64
115.86
115.16
114.52
113.53
112.56
110.34
109.31
108.1
104.27
103.87
102.58
100.69
99.2
97.58
96.31
94.77
92.86
89.02
Legend
FloodLevels
Water Course
100yr Flood Extent
Parcels
vicroads
Data source: - PB, VicMap, Esri
esri
Partner Network
Map no: 2113209_GIS_003_A3
Author: - AC
Approved by: - AM
Date: 5/12/2013
N
Bulla Bypass and Melbourne Airport Link
Hydraulic Assessment
Moonee Ponds Creek
1 in 100 year ARI Flood Extent
PARSONS BRINCKERHOFF


Deep Creek
Bulla Bypass
101.43
101.14
100.73
100.51
99.56
99.09
98.54
98.2
97.87
97.59
97.32
96.89
96.54
96.24
95.91
95.11
94.32
94.71
93.36
93.14
92.69
92.16
91.47
91.26
91.12
90.81
90.38
89.81
89.7
88.43
87.71
87.36
87.14
86.92
86.64
86.46
86.05
85.81
85.52
84.73
84.07
82.75
80.93
77.92
77.79
Legend
FloodLevels
Water Course
20yr Flood Extent
Parcels
vicroads
Data source: - PB, VicMap, Esri
esri
Map no: 2113209_GIS_004_A3
Author: - AC
Approved by: - AM
Date: 5/12/2013
0 90 180
m
1:20,000
Scale ratio correct when printed at A4
Projection: Transverse Mercator
Coord sys: GDA 1994 MGA Zone 55
N
Bulla Bypass and Melbourne Airport Link
Hydraulic Assessment
Deep Creek
1 in 20 year ARI Flood Extent
PARSONS BRINCKERHOFF
VicRoads
www.pbworld.com


Deep Creek
Bulla Bypass
102.28
102.02
101.6
101.41
100.45
99.96
99.6
99.31
99.02
98.72
98.46
98
97.61
97.29
96.91
96.5
96.3
95.68
94.94
94.03
93.54
92.88
92.58
92.37
92.21
91.85
91.45
90.86
90.2
89.63
88.9
88.56
88.37
88.18
87.85
87.66
87.19
86.89
86.52
85.71
84.7
83.55
81.53
79.28
79.16
Legend
FloodLevels
Water Course
50yr Flood Extent
Parcels
vic roads
Data source: - PB, VicMap, Esri
esri Partner Network
Map no: 2113209_GIS_005_A3
Author: - AC
Approved by: - AM
Date: 5/12/2013
0 90 180
m
1:20,000
Scale ratio correct when printed at A4
Projection: Transverse Mercator
Coord sys: GDA 1994 MGA Zone 55
N
Bulla Bypass and Melbourne Airport Link
Hydraulic Assessment
Deep Creek
1 in 50 year ARI Flood Extent
VicRoads
www.pbworld.com
PARSONS BRINCKERHOFF


Deep Creek
Bulla Bypass
102.8
102.53
102.15
101.98
101.08
100.65
100.33
100.06
99.71
99.45
99.18
98.69
98.31
98
97.6
97.21
96.35
95.97
95.62
94.67
94.18
93.41
93.34
93.13
92.95
92.55
92.2
91.6
91.12
90.46
89.7
89.35
89.17
88.99
88.63
88.45
87.93
87.57
87.17
86.34
85.69
84.11
80.11
80.17
80.05
Legend
FloodLevels
Water Course
100yr Flood Extent
Parcels
vicroads
Data source: - PB, VicMap, Esri
esri Partner Network
Map no: 2113209_GIS_006_A3
Author: - AC
Approved by: - AM
Date: 5/12/2013
1:20,000
Scale ratio correct when printed at A4
Projection: Transverse Mercator
Coord sys: GDA 1994 MGA Zone 55
N
Bulla Bypass and Melbourne Airport Link
Hydraulic Assessment
Deep Creek
1 in 100 year ARI Flood Extent
PARSONS BRINCKERHOFF
www.pbworld.com