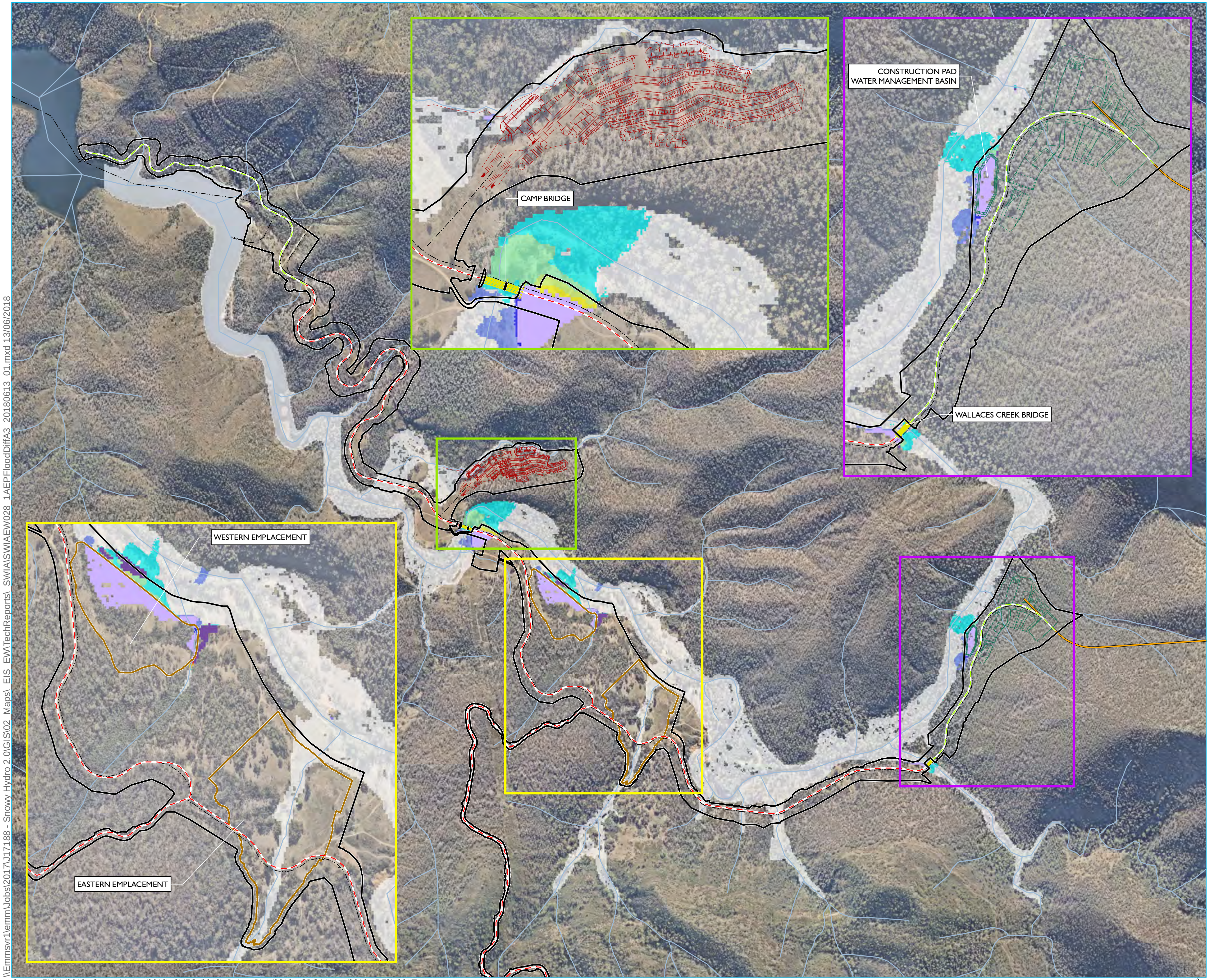


KEY

- Access road upgrade
- Access road extension
- Permanent bridge
- Accommodation camp conceptual layout
- Portal construction pad conceptual layout
- Exploratory tunnel
- Communications cable and water services pipeline location
- On land rock emplacement area
- Disturbance footprint
- Watercourse / drainage line

Changes in flood level (m)

- < -0.1
- -0.1 to -0.01
- No change
- 0.01 to 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 0.7
- 0.7 - 0.9
- > 0.9
- No longer flooded
- Newly flooded

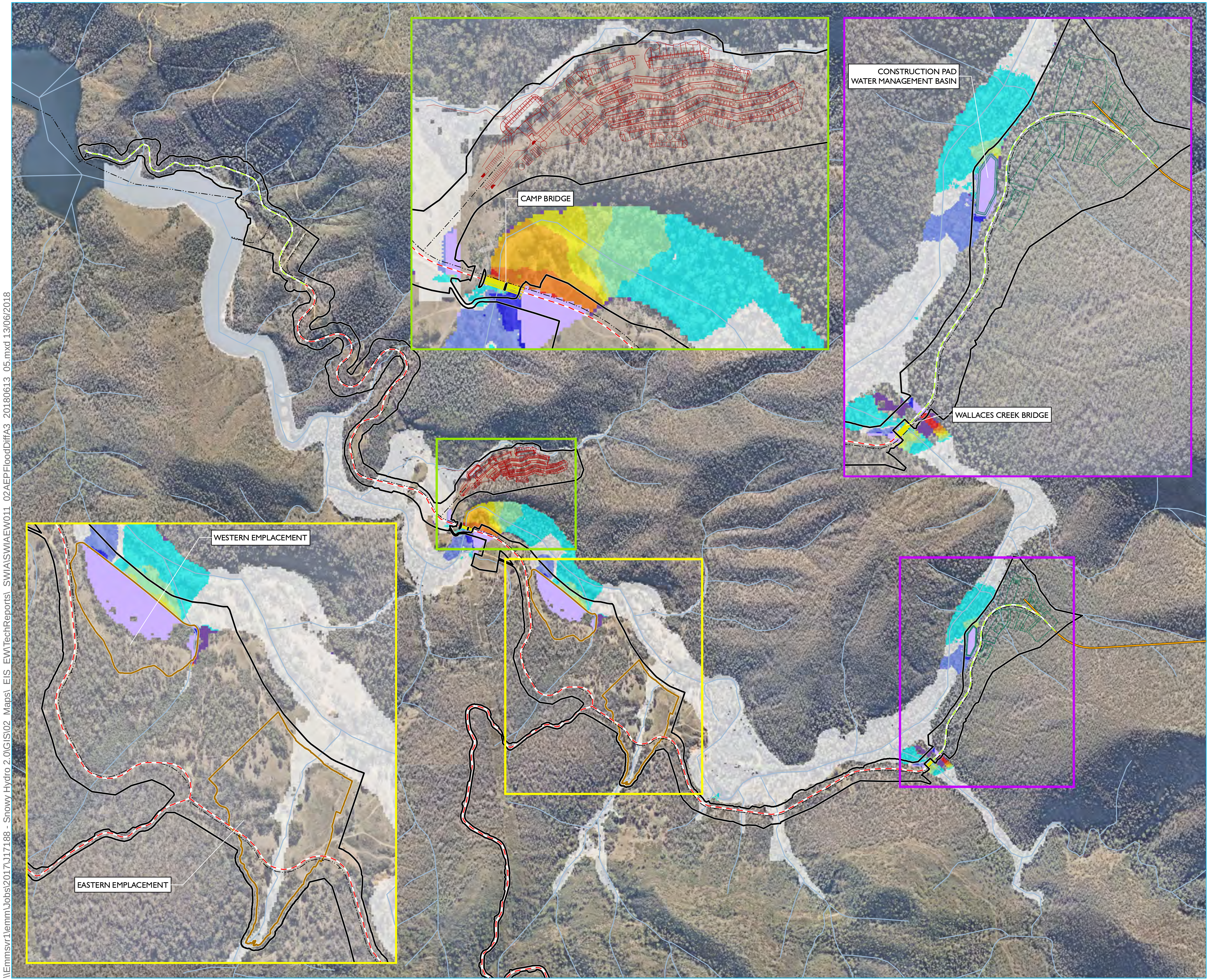
1% AEP event - Changes to peak flood levels

Snowy 2.0
Surface Water Assessment
Exploratory Works
Figure C15

snowy2.0 EMM

Source: EMM (2018); Snowy Hydro (2018); SMEC (2018); Robert Bird (2018); GRC Hydro (2018); DFSI (2017)

\\Emmsvr1\emm\Jobs\2017\J17188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EW\TechReports_SWIA\SWIAEW028_1AEPFloodDiffA3_20180613_01.mxd 13/06/2018



Source: EMM (2018); Snowy Hydro (2018); SMEC (2018); Robert Bird (2018); GRC Hydro (2018); DFSI (2017)

0 0.5 1 km

1:15,000 @ A3

GDA 1994 MGA Zone 55

N

KEY

- Access road upgrade
- Access road extension
- Permanent bridge
- Accommodation camp conceptual layout
- Portal construction pad conceptual layout
- Exploratory tunnel
- Communications cable and water services pipeline location
- On land rock emplacement area
- Disturbance footprint
- Watercourse / drainage line

Changes in flood level (m)

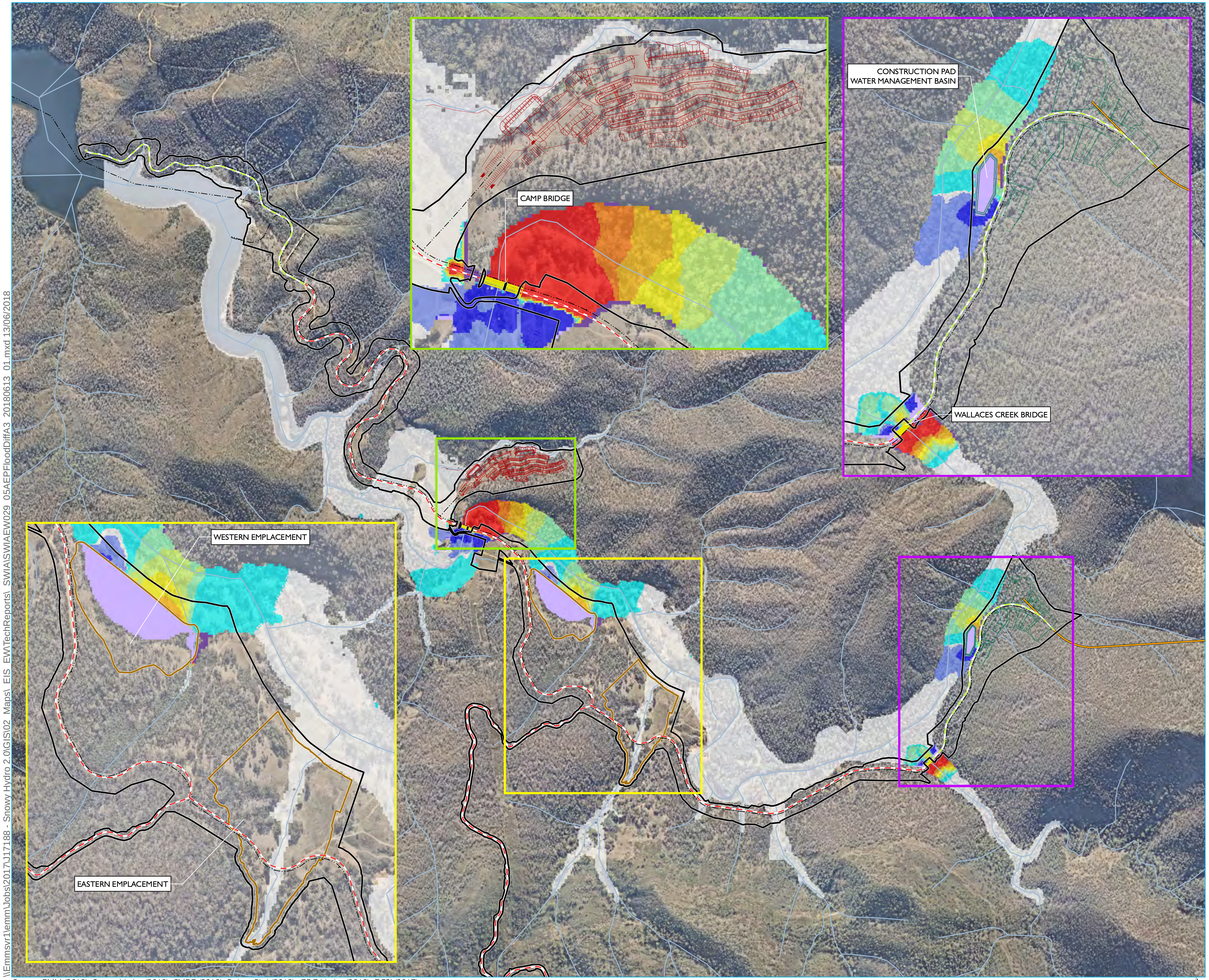
- < -0.1
- -0.1 to -0.01
- No change
- 0.01 to 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 0.7
- 0.7 - 0.9
- > 0.9
- No longer flooded
- Newly flooded

0.2% AEP event - Changes to peak flood levels

Snowy 2.0
Surface Water Assessment
Exploratory Works
Figure C16

snowy 2.0 EMM

\\Emmsvr1\emm\Jobs\2017\J17188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EMTechReports_SW\A\SW\AEW011_02AEPFloodDiffA3_20180613_05.mxd 13/06/2018



Source: EMM (2018); Snowy Hydro (2018); SMEC (2018); Robert Bird (2018); GRC Hydro (2018); DFSI (2017)

0 0.5 1 km
1:15,000 @ A3
GDA 1994 MGA Zone 55
N

KEY

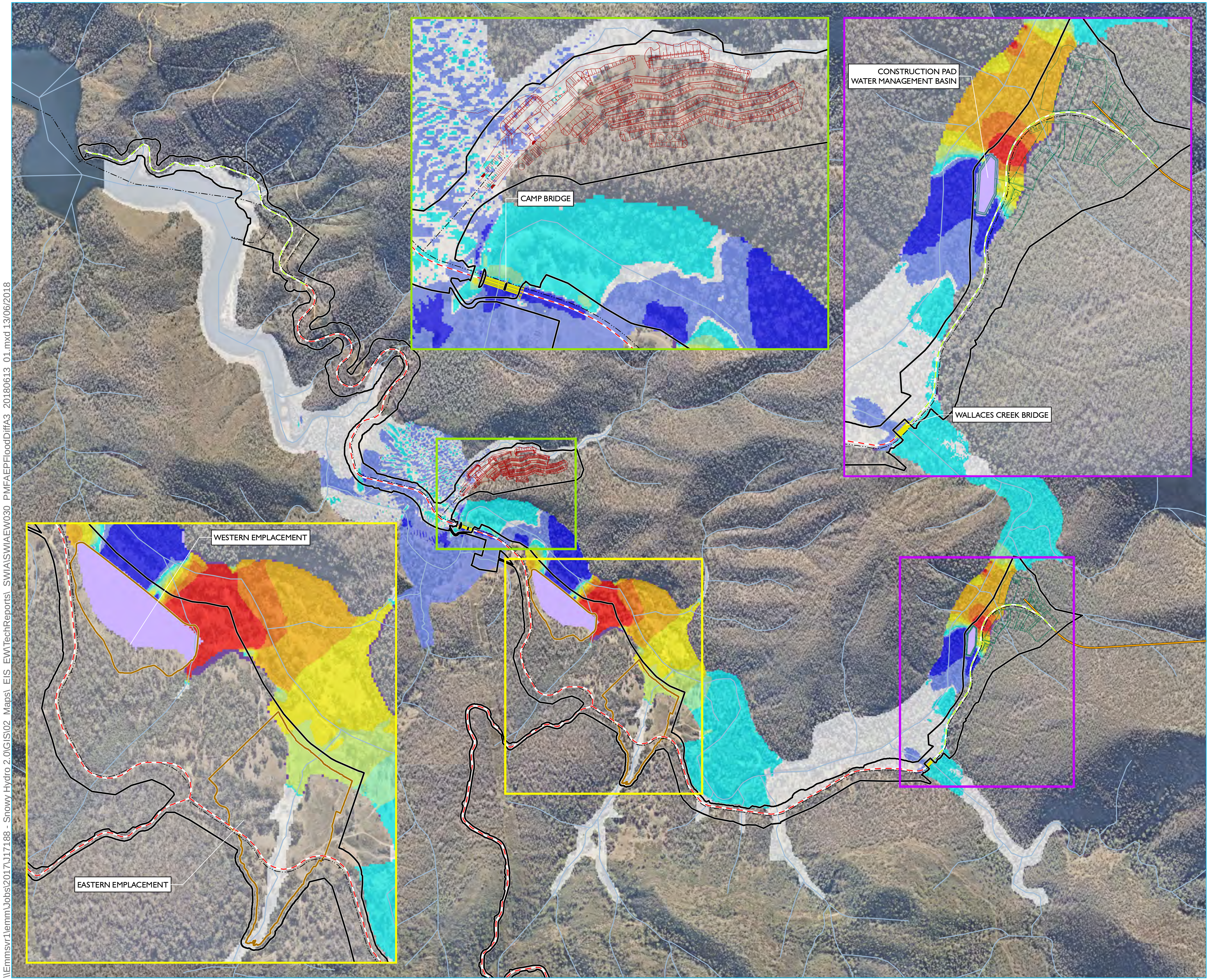
- Access road upgrade
- Access road extension
- Permanent bridge
- Accommodation camp conceptual layout
- Portal construction pad conceptual layout
- Exploratory tunnel
- Communications cable and water services pipeline location
- On land rock emplacement area
- Disturbance footprint
- Watercourse / drainage line

Changes in flood level (m)

- < -0.1
- -0.1 to -0.01
- No change
- 0.01 to 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 0.7
- 0.7 - 0.9
- > 0.9
- No longer flooded
- Newly flooded

0.05% AEP event - Changes to peak flood levels

Snowy 2.0
Surface Water Assessment
Exploratory Works
Figure C17



KEY

- Access road upgrade
- Access road extension
- Permanent bridge
- Accommodation camp conceptual layout
- Portal construction pad conceptual layout
- Exploratory tunnel
- Communications cable and water services pipeline location
- On land rock emplacement area
- Disturbance footprint
- Watercourse / drainage line

Changes in flood level (m)

- < -0.1
- -0.1 to -0.01
- No change
- 0.01 to 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 0.7
- 0.7 - 0.9
- > 0.9
- No longer flooded
- Newly flooded

Source: EMM (2018); Snowy Hydro (2018); SMEC (2018); Robert Bird (2018); GRC Hydro (2018); DFSI (2017)

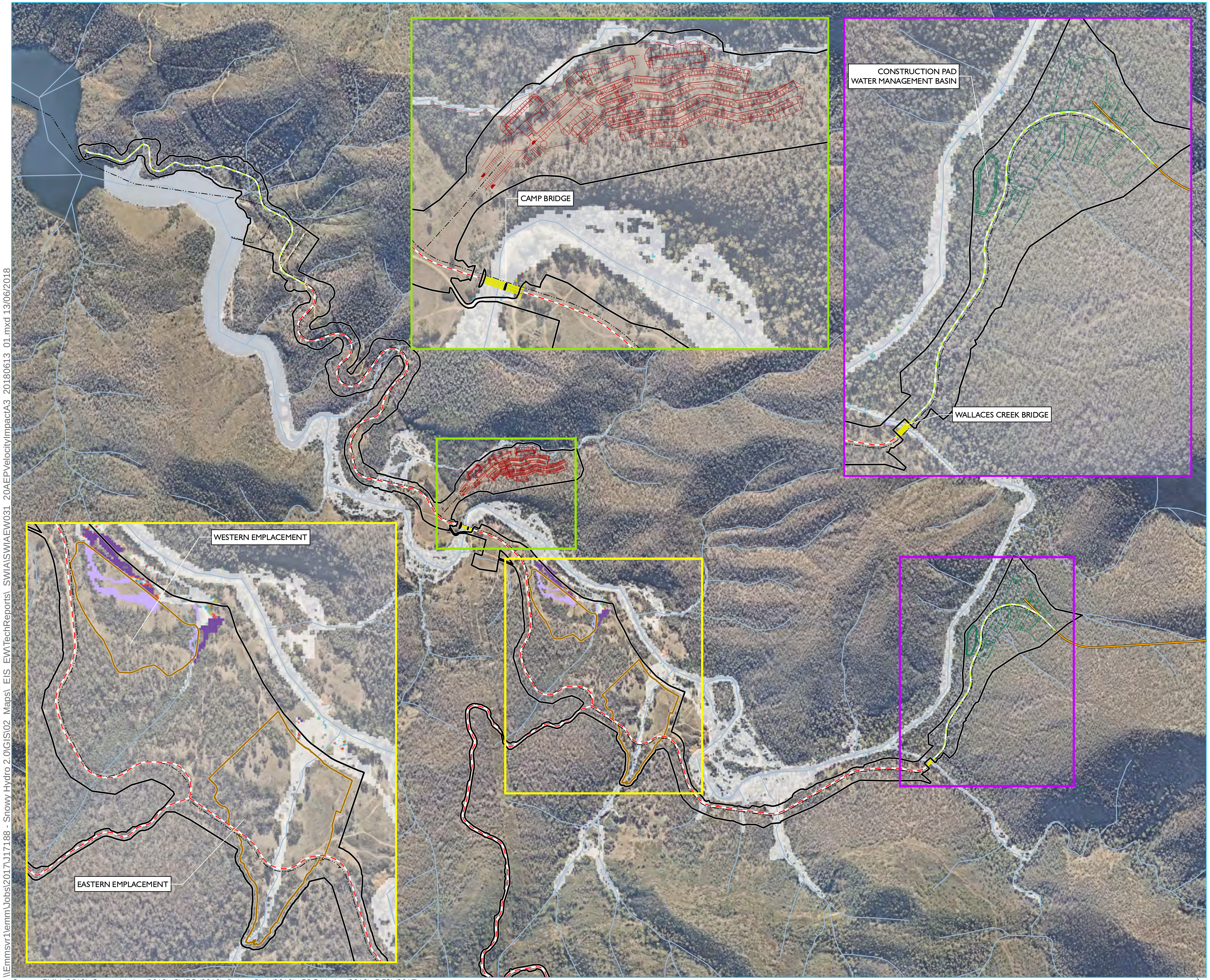
0 0.5 1 km
1:15,000 @ A3
GDA 1994 MGA Zone 55
N

Probable Maximum Flood event - Changes to peak flood levels

Snowy 2.0
Surface Water Assessment
Exploratory Works
Figure C18

snowy 2.0
EMM

\\Emmsvr1\emm\Jobs\2017\J17188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EW\TechReports_SWIA\SWIAEW030_PMFAEPFloodDiffA3_20180613_01.mxd 13/06/2018



Source: EMM (2018); Snowy Hydro (2018); SMEC (2018); Robert Bird (2018); GRC Hydro (2018); DFSI (2017)

\\Emmsvr1\emm\Jobs\2017\J17188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EWTechReports_SWIA\SWIAEW031_20AEPVelocityImpactA3_20180613_01.mxd 13/06/2018

KEY

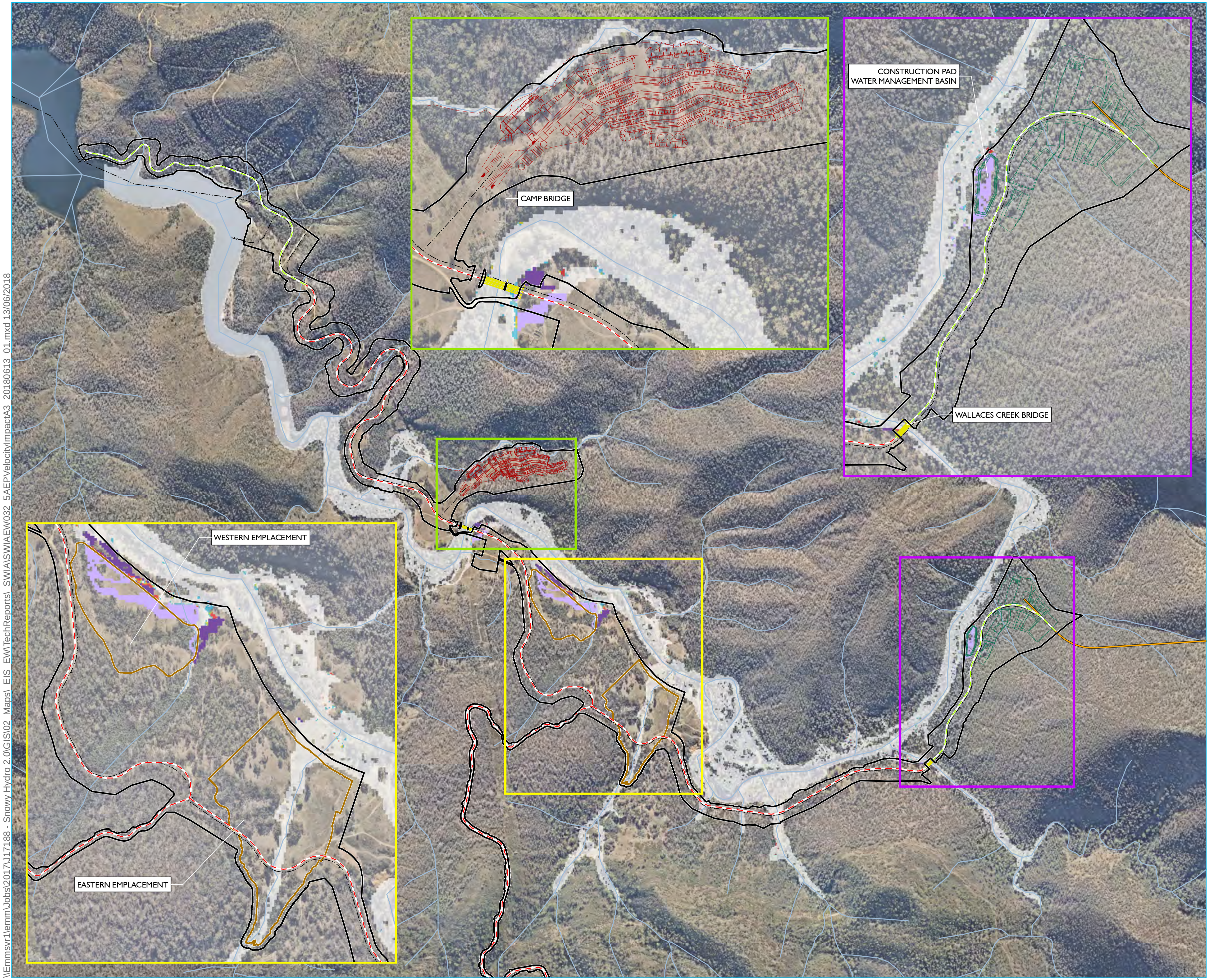
- Access road upgrade
- Access road extension
- Permanent bridge
- Accommodation camp conceptual layout
- Portal construction pad conceptual layout
- Exploratory tunnel
- Communications cable and water services pipeline location
- On land rock emplacement area
- Disturbance footprint
- Watercourse / drainage line

Changes in velocity

- 0 to10
- 10 to 20
- 20 to 30
- 30 to 40
- 40 to 50
- 50 to 60
- 60 to 70
- 70 to 80
- 80 to 90
- 90 t0 100
- No longer flooded
- Newly flooded

20% AEP event - Changes to peak velocity

Snowy 2.0
Surface Water Assessment
Exploratory Works
Figure C19



Source: EMM (2018); Snowy Hydro (2018); SMEC (2018); Robert Bird (2018); GRC Hydro (2018); DFSI (2017)

\\Emmsvr1\emm\Jobs\2017\J17188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EWTechReports_SWIA\SWIAEW032_5AEPVelocityImpactA3_20180613_01.mxd 13/06/2018

KEY

- Access road upgrade
- Access road extension
- Permanent bridge
- Accommodation camp conceptual layout
- Portal construction pad conceptual layout
- Exploratory tunnel
- Communications cable and water services pipeline location
- On land rock emplacement area
- Disturbance footprint
- Watercourse / drainage line

Changes in velocity

- 0 to10
- 10 to 20
- 20 to 30
- 30 to 40
- 40 to 50
- 50 to 60
- 60 to 70
- 70 to 80
- 80 to 90
- 90 t0 100
- No longer flooded
- Newly flooded

0 0.5 1 km

1:15,000 @ A3

GDA 1994 MGA Zone 55

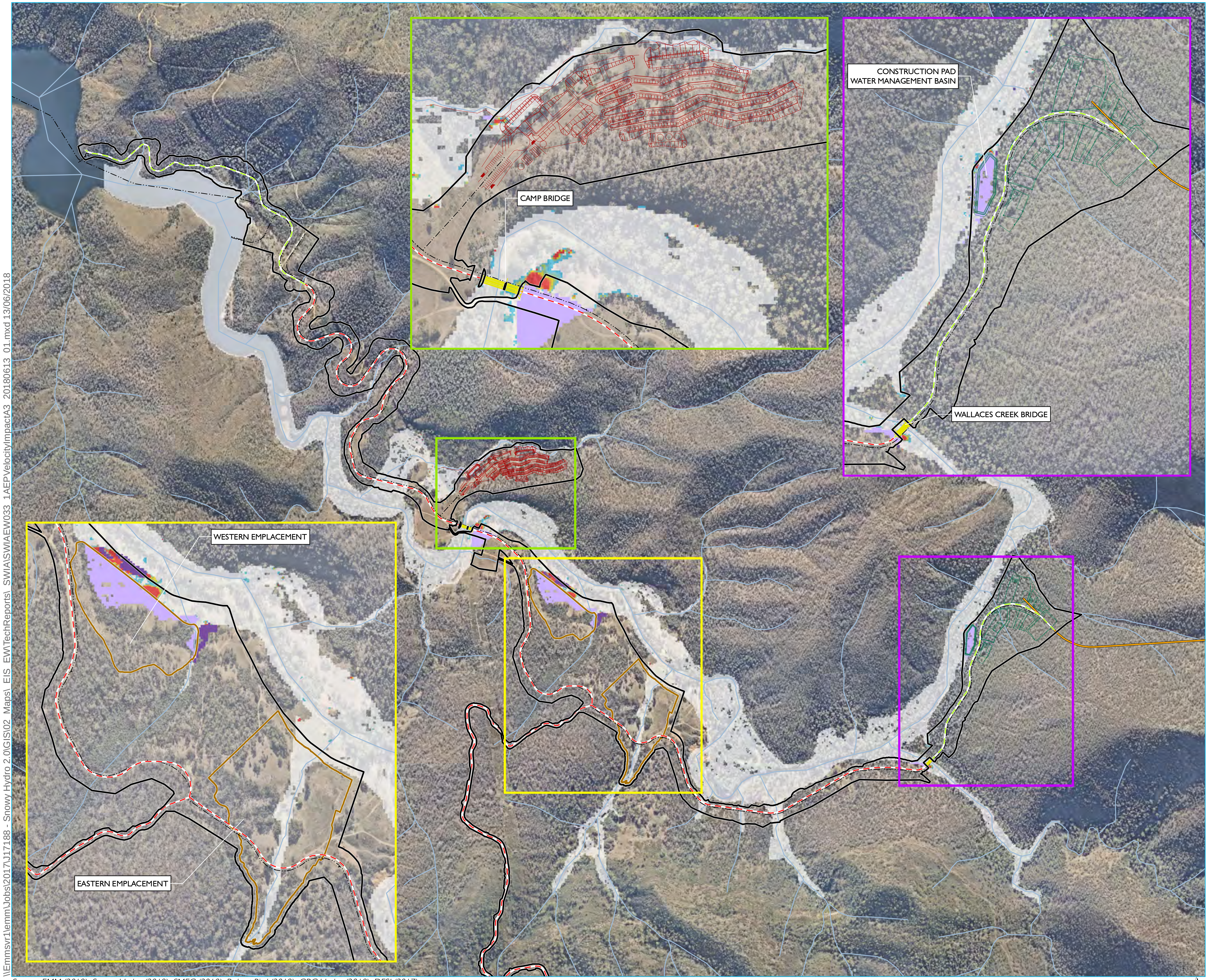
N

5% AEP event - Changes to peak velocity

Snowy 2.0
Surface Water Assessment
Exploratory Works
Figure C20

snowy 2.0

EMM



KEY

- Access road upgrade
- Access road extension
- Permanent bridge
- Accommodation camp conceptual layout
- Portal construction pad conceptual layout
- Exploratory tunnel
- Communications cable and water services pipeline location
- On land rock emplacement area
- Disturbance footprint
- Watercourse / drainage line

Changes in velocity

- 0 to10
- 10 to 20
- 20 to 30
- 30 to 40
- 40 to 50
- 50 to 60
- 60 to 70
- 70 to 80
- 80 to 90
- 90 t0 100
- No longer flooded
- Newly flooded

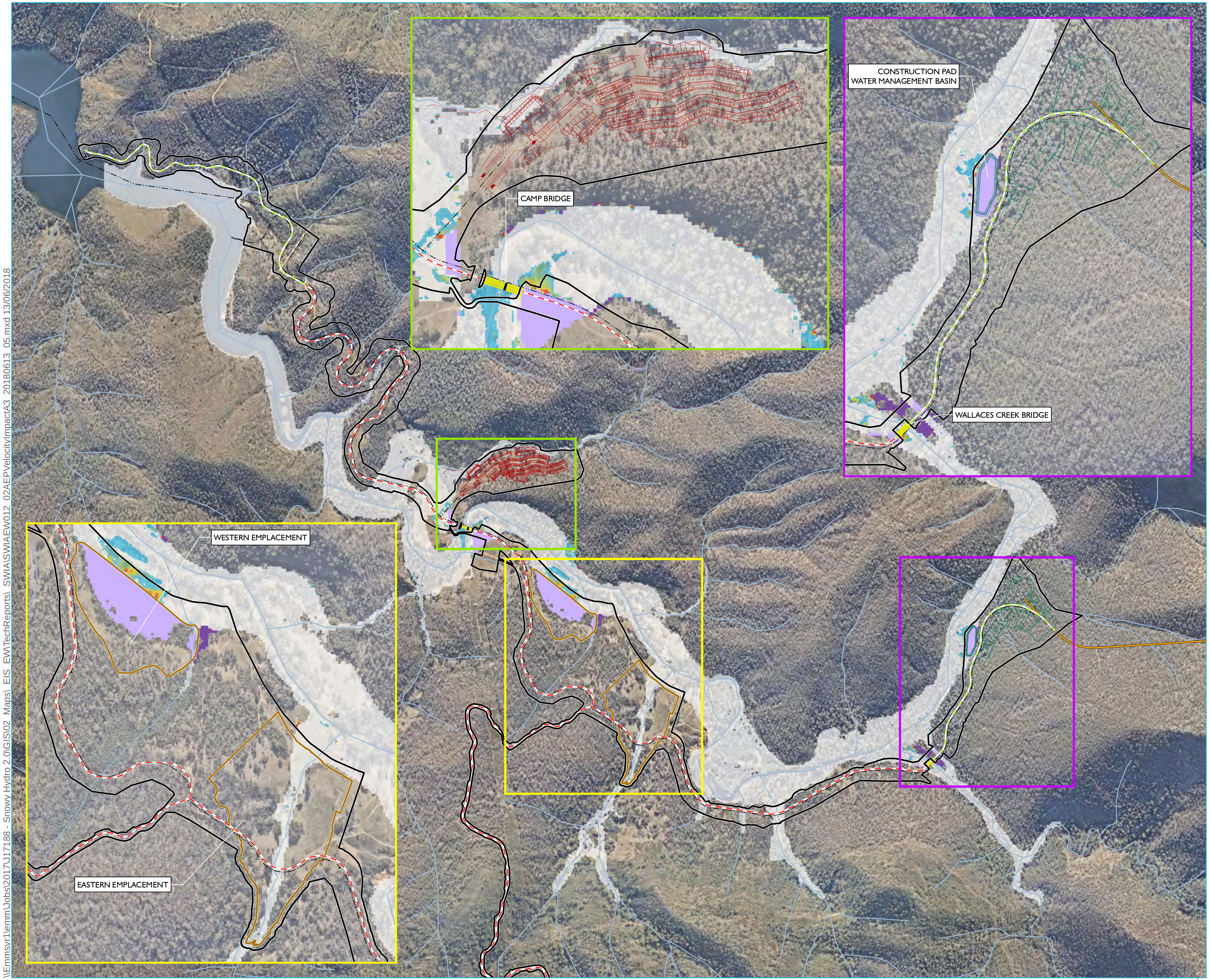
Source: EMM (2018); Snowy Hydro (2018); SMEC (2018); Robert Bird (2018); GRC Hydro (2018); DFSI (2017)

0 0.5 1 km
1:15,000 @ A3
GDA 1994 MGA Zone 55
N

\\Emmsvr1\emm\Jobs\2017\J17188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EWTechReports_SWIA\SWIAEW033_1AEPVelocityImpactA3_20180613_01.mxd 13/06/2018

1% AEP event - Changes to peak velocity

Snowy 2.0
Surface Water Assessment
Exploratory Works
Figure C21



\\Emmsvr1\emm\Jobs\2017\J17188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EW\TechReports_SWIA\SWIAEW012_02AEPVelocityImpactA3_20180613_05.mxd 13/06/2018

Source: EMM (2018); Snowy Hydro (2018); SMEC (2018); Robert Bird (2018); GRC Hydro (2018); DFSI (2017)

0 0.5 1 km
1:15,000 @ A3
GDA 1994 MGA Zone 55
N

KEY

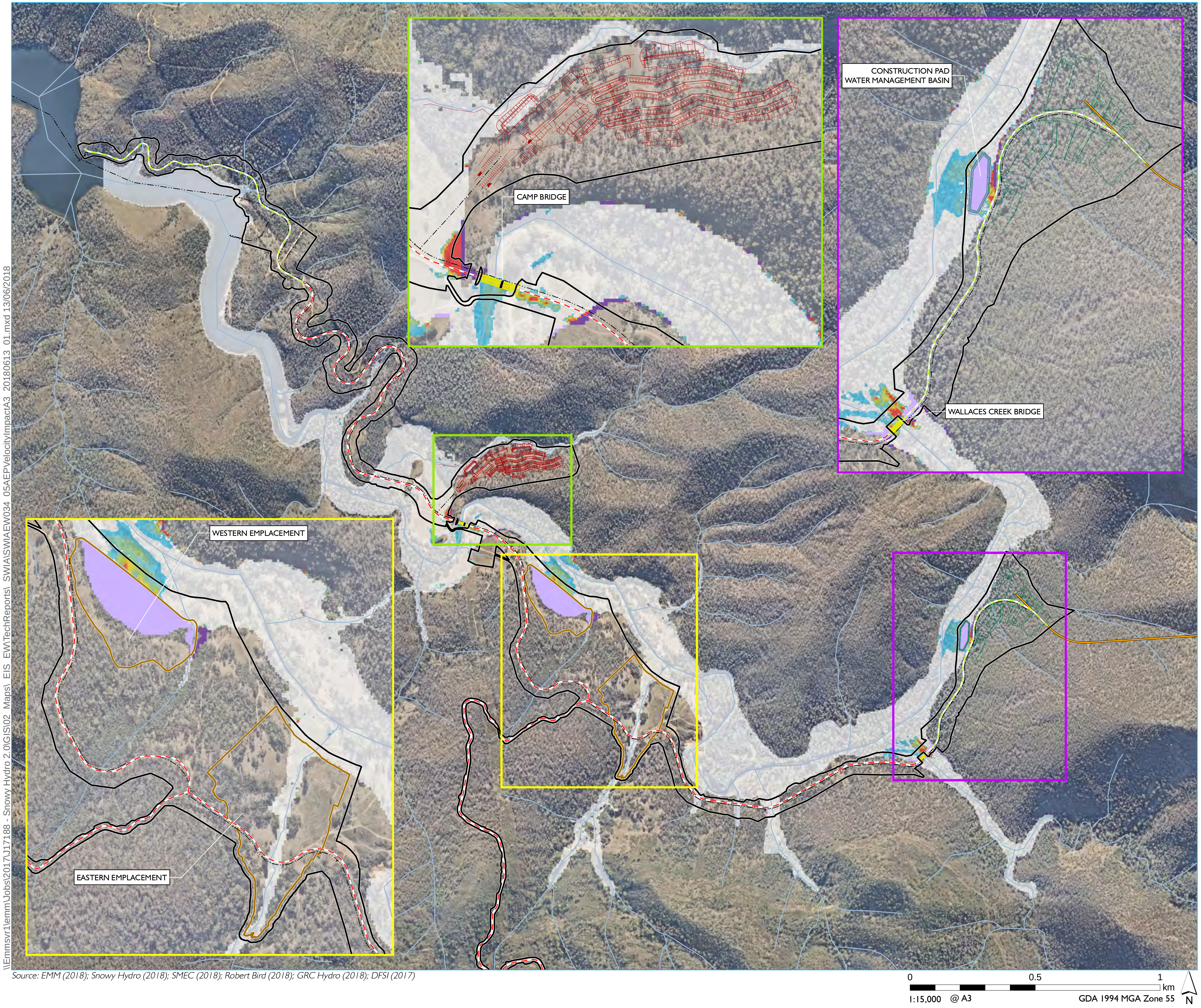
- Access road upgrade
- Access road extension
- Permanent bridge
- Accommodation camp conceptual layout
- Portal construction pad conceptual layout
- Exploratory tunnel
- Communications cable and water services pipeline location
- On land rock emplacement area
- Disturbance footprint
- Watercourse / drainage line

Changes in velocity

- 0 to10
- 10 to 20
- 20 to 30
- 30 to 40
- 40 to 50
- 50 to 60
- 60 to 70
- 70 to 80
- 80 to 90
- 90 t0 100
- No longer flooded
- Newly flooded

0.2% AEP event - Changes to peak velocity

Snowy 2.0
Surface Water Assessment
Exploratory Works
Figure C22



Source: EMM (2018); Snowy Hydro (2018); SMEC (2018); Robert Bird (2018); GRC Hydro (2018); DFSI (2017)

\\Emmsvr1\emm\Jobs\2017\J17188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EWTechReports_SWIA\SWIAEW034_05AEPVelocityImpactA3_20180613_01.mxd 13/06/2018

KEY

- Access road upgrade
- Access road extension
- Permanent bridge
- Accommodation camp conceptual layout
- Portal construction pad conceptual layout
- Exploratory tunnel
- Communications cable and water services pipeline location
- On land rock emplacement area
- Disturbance footprint
- Watercourse / drainage line

Changes in velocity

- 0 to10
- 10 to 20
- 20 to 30
- 30 to 40
- 40 to 50
- 50 to 60
- 60 to 70
- 70 to 80
- 80 to 90
- 90 t0 100
- No longer flooded
- Newly flooded

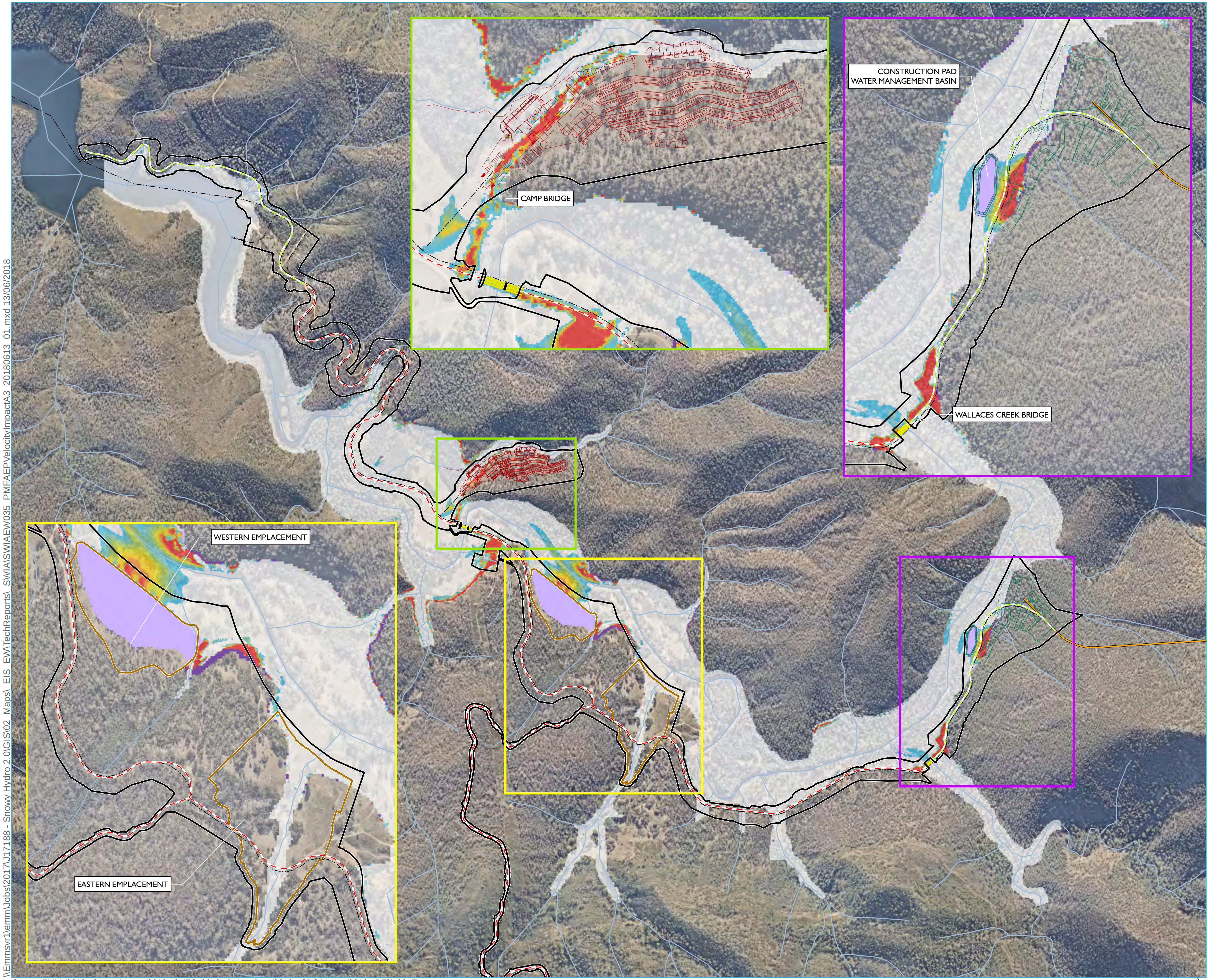
0.05% AEP event - Changes to peak velocity

Snowy 2.0
Surface Water Assessment
Exploratory Works
Figure C23

snowy 2.0

EMM

\\Emmsvr1\emm\Jobs\2017\J17188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EW\TechReports_SW\A\SWIAEW035_PMFAEPVelocityImpactA3_20180613_01.mxd 13/06/2018



Source: EMM (2018); Snowy Hydro (2018); SMEC (2018); Robert Bird (2018); GRC Hydro (2018); DFSI (2017)

0 0.5 1 km
1:15,000 @ A3
GDA 1994 MGA Zone 55
N

KEY

- Access road upgrade
- Access road extension
- Permanent bridge
- Accommodation camp conceptual layout
- Portal construction pad conceptual layout
- Exploratory tunnel
- Communications cable and water services pipeline location
- On land rock emplacement area
- Disturbance footprint
- Watercourse / drainage line

Changes in velocity

- 0 to10
- 10 to 20
- 20 to 30
- 30 to 40
- 40 to 50
- 50 to 60
- 60 to 70
- 70 to 80
- 80 to 90
- 90 t0 100
- No longer flooded
- Newly flooded

Probable Maximum Flood event - Changes to peak velocity

Snowy 2.0
Surface Water Assessment
Exploratory Works
Figure C24

Appendix D

Water Balance Method Statement

D.1 Introduction

A site water balance was developed for the process water management system that is described in Section 6.7. The appendix is a method statement that describes the modelling approach, assumptions and results.

D.2 Model objectives

The objectives of the water balance modelling process are to:

- demonstrate the functionality of the process water system over the 26 month tunnel construction period;
- estimate the probable range in water transfer volumes over the above period, having regard to variable weather conditions; and
- assist in the determination of water licensing requirements.

D.3 Overview of the process water system

The process water system will be designed to:

- manage potentially contaminated water produced from construction activities; and
- supply water to construction activities.

The system will be designed to prevent (where possible) the ingress of stormwater into the process water system. Captured process water will be treated in a water treatment plant. Treated process water will be used for:

- use in the tunnel construction;
- concrete production;
- equipment wash down; and
- access road dust suppression.

The process water system will source additional water from the construction pad's water management basin and Talbingo Reservoir as required to meet demand. Any surplus treated process water will be discharged to Talbingo Reservoir. This arrangement will avoid either discharge to or extraction from the Yarrangobilly River.

Figure D1 describes the proposed process water management system.

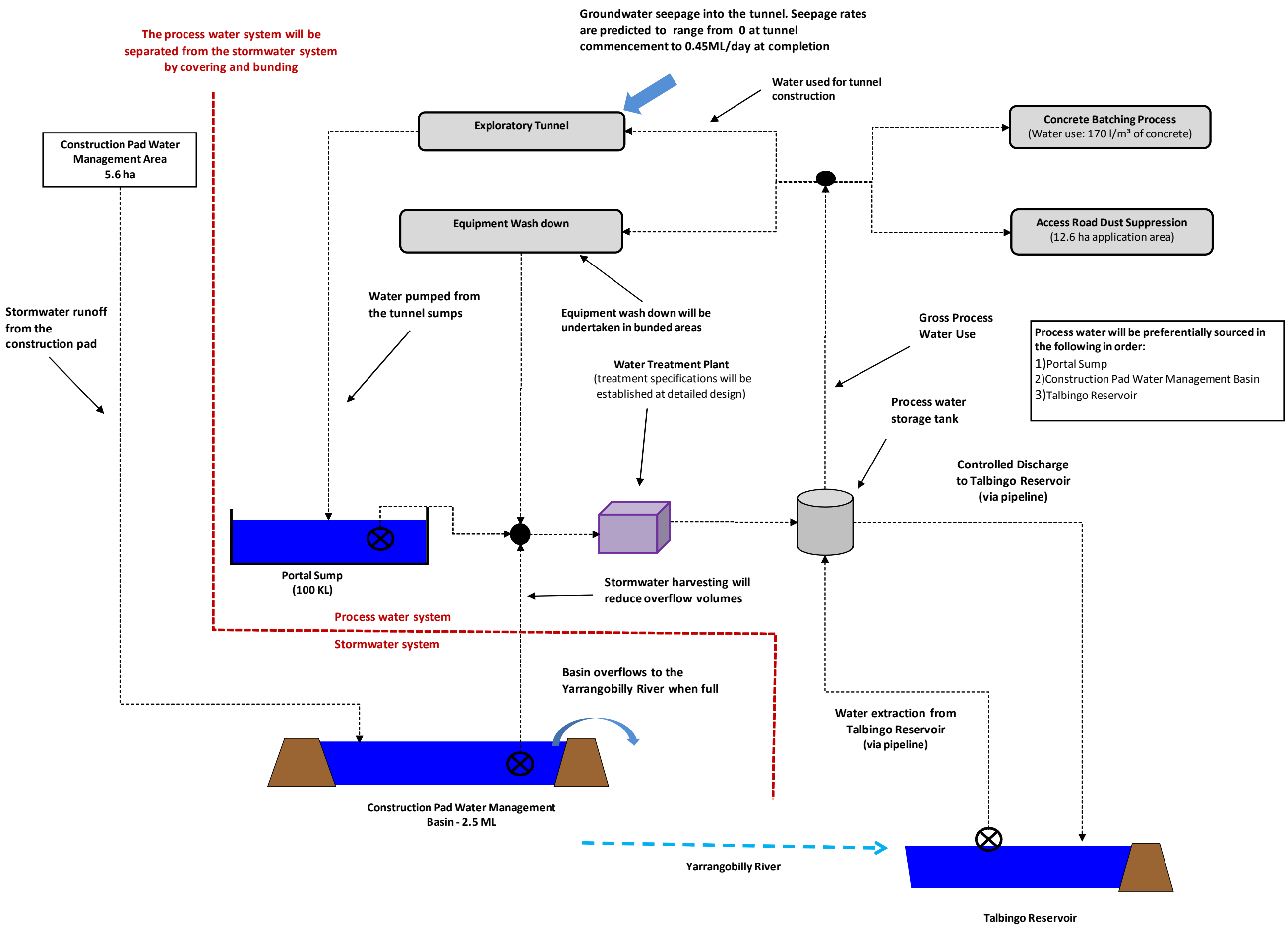


Figure D1 Process water system

D.4 Modelling Assumptions

D.4.1 Rainfall Data

Daily rainfall data from the Talbingo (72131) rainfall gauge over the January 1997 to December 2017 period was applied to the model.

D.4.2 Evaporation

Average monthly evaporation and evapotranspiration rates that are reported in Table 4.4 were applied to the model. Evaporation losses were calculated as a function of the evaporation rate and the surface area of the storage. A pan factor of 0.7 was applied to the calculation of evaporation losses from surface water storages.

Evapotranspiration factors were applied in the hydrologic model to simulate evapotranspiration losses from catchments.

D.4.3 Process water system configuration

a. Process Water Demands

Process water is required for as dust suppression of access roads, concrete production, tunnel construction activities and vehicle wash down.

Dust suppression application rates were calculated by applying the following equation:

Dust Suppression (t) = [(Shading Multiplier x ET (t)) – Rainfall (t) + Loss Factor] x Area

Where:

Shading Multiplier = 0.8

ET (t) = Daily Evapotranspiration Rate (mm/day)

Rainfall (t) = Rainfall Rate (mm/day)

Loss Factor = Dust Suppression Loss Factor 3mm/day

Area = 12.6 (ha)

The other water demands included:

- Concrete production – average daily use rate of 12 KL/day.
- Water use in the tunnel construction - average daily use rate of 10 KL/day.
- Equipment wash down was assumed to have a minimal net demand compared to other process water uses and was therefore not modelled in the water balance.

b. Groundwater Inflows

Estimates of groundwater flows into the exploratory tunnel were established by the Groundwater Assessment (EMM, 2018b) and are presented in Figure D2.

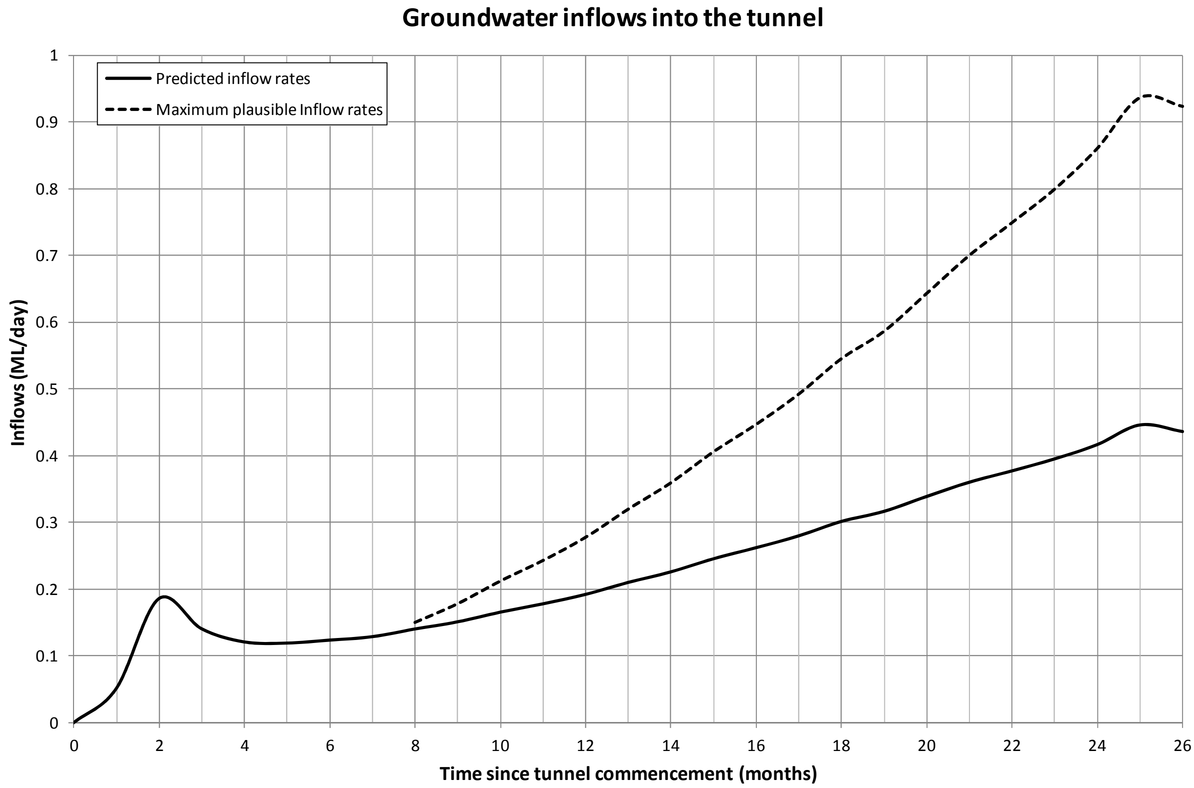


Figure D2 Estimated Groundwater Inflows into Exploratory Tunnel (EMM, 2018)b

c. Portal Sump

A portal sump will receive water dewatered from the tunnel. The sump is assumed to have a 0.1ML capacity and be a turkeys nest style dam. A turkeys nest style dam receives direct rainfall but no runoff from adjoining catchment areas.

d. Water Management Basin

The construction pad water management basin will receive runoff from the 5.6 ha construction pad water management area. The basin is assumed to have a 2.5 ML capacity. Water can be extracted from the basin to supply process water as required. When the basin is full, it will overflow into the Yarrangobilly River.

e. Water Treatment Plant

A water treatment plant will treat water from the portal sump and the water management basin. The treatment process will have no influence on volumetric flows and is not included in the water balance model.

f. Process Water Tank

A process water tank will supply treated process water to all process water use points. The process water tank will be toped up with clean water extracted from the Talbingo Reservoir as required. If process water supply exceeds use, the excess treated process water will be discharge to Talbingo Reservoir via a controlled discharge arrangement.

g. Order of use

Process water is preferentially sourced by the water balance model in the following order:

- Portal sump;
- Construction pad water management basin; and
- Talbingo Reservoir.

Controlled discharge to Talbingo Reservoir will only occur when dewatering requirements from the portal sump exceed the net process water demand.

D.5 Modelling Representation

D.5.1 Modelling Approach

The water balance model was developed in GoldSim version 12.0. The model applied a continuous simulation methodology that simulated the performance of the system under a range of climatic conditions.

D.5.2 Time Steps and Simulation Time

The model simulated the water management system for the 26 month tunnel construction timeline with hourly time steps. The primary change to the water management system over the project timeline is the change in groundwater inflows (as shown in Figure D2).

D.5.3 Runoff

Runoff from the construction pad's water management area was estimated using the Australian Water Balance Model (AWBM). The AWBM model was developed by Boughton (2003) and is widely used across Australia to estimate stream flow and runoff. The hydrological model calculates runoff from rainfall after allowing for relevant losses and storage. Parameters in the AWBM model were adjusted to reflect the expected hydrologic response of the construction pad's water management area.

D.5.4 Probabilistic Modelling

To assess the impact of rainfall variation on the system, 100 different rainfall patterns (referred to as 'realisations') were applied to the 26 month simulation period. Each of the rainfall patterns was obtained randomly from the Talbingo (72131) rainfall record that is described in Section D.4.1. The 100 realisations enabled statistical assessment of the system and were used to determine statistics for monthly and annual water transfer volumes over 26 month tunnel construction timeline.

Probabilistic model results are presented as minimum, 10th Percentile, 50th Percentile, 90th percentile and maximum monthly values.

D.5.5 Scenarios

Scenario model simulations were undertaken to provide a representative 'snap shot' of the functionality of the water management system at months 1, 12 and 26. Scenario simulations were run for 10th, 50th and 90th percentile rainfall years. The results from each scenario are presented in flow chart format as annualised monthly average (ie the annual value divided by 12). This was done to avoid seasonal influences in the results.

D.6 Model Results

D.6.1 Probabilistic modelling results

Table 6.12 presents the minimum, 10th Percentile, 50th Percentile, 90th percentile and maximum monthly values and annual values for extraction from and discharge to Talbingo Reservoir. Results are presented for Months 1, 12 and 26 and are discussed in Section 6.7.4.

D.6.2 Scenarios

Scenario model simulations were undertaken to provide a representative 'snap shot' of the functionality of the water management system at months 1, 12 and 26. Results are provided in flow chart format for 10th, 50th and 90th percentile rainfall years in Figure D3 to D12. The 50th percentile rainfall year results are also provided in Section 6.7.4.

D.6.3 Results discussion

Results are discussed in Section 6.7.4.

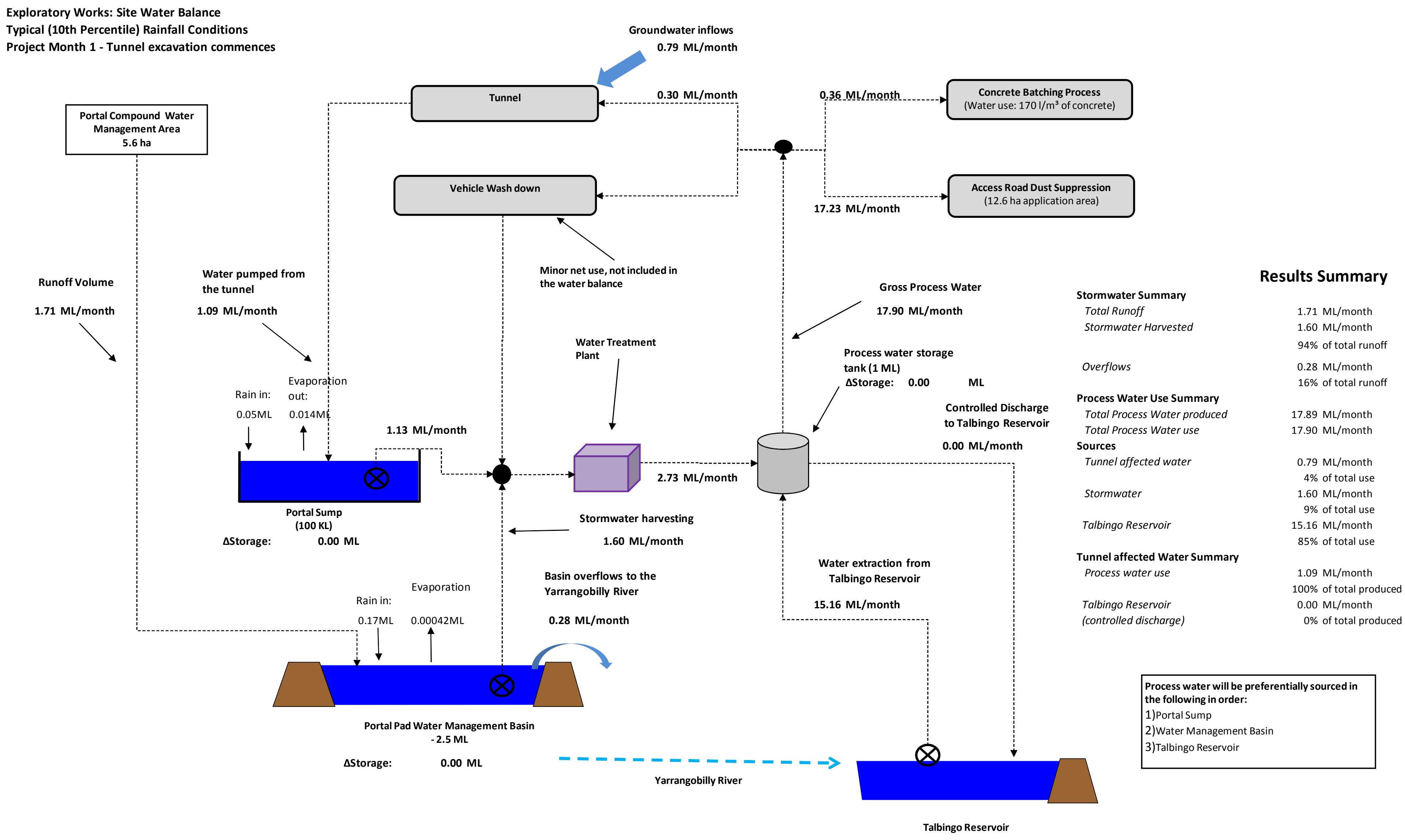


Figure D3 Water balance results: Tunnel Month 1 – dry conditions

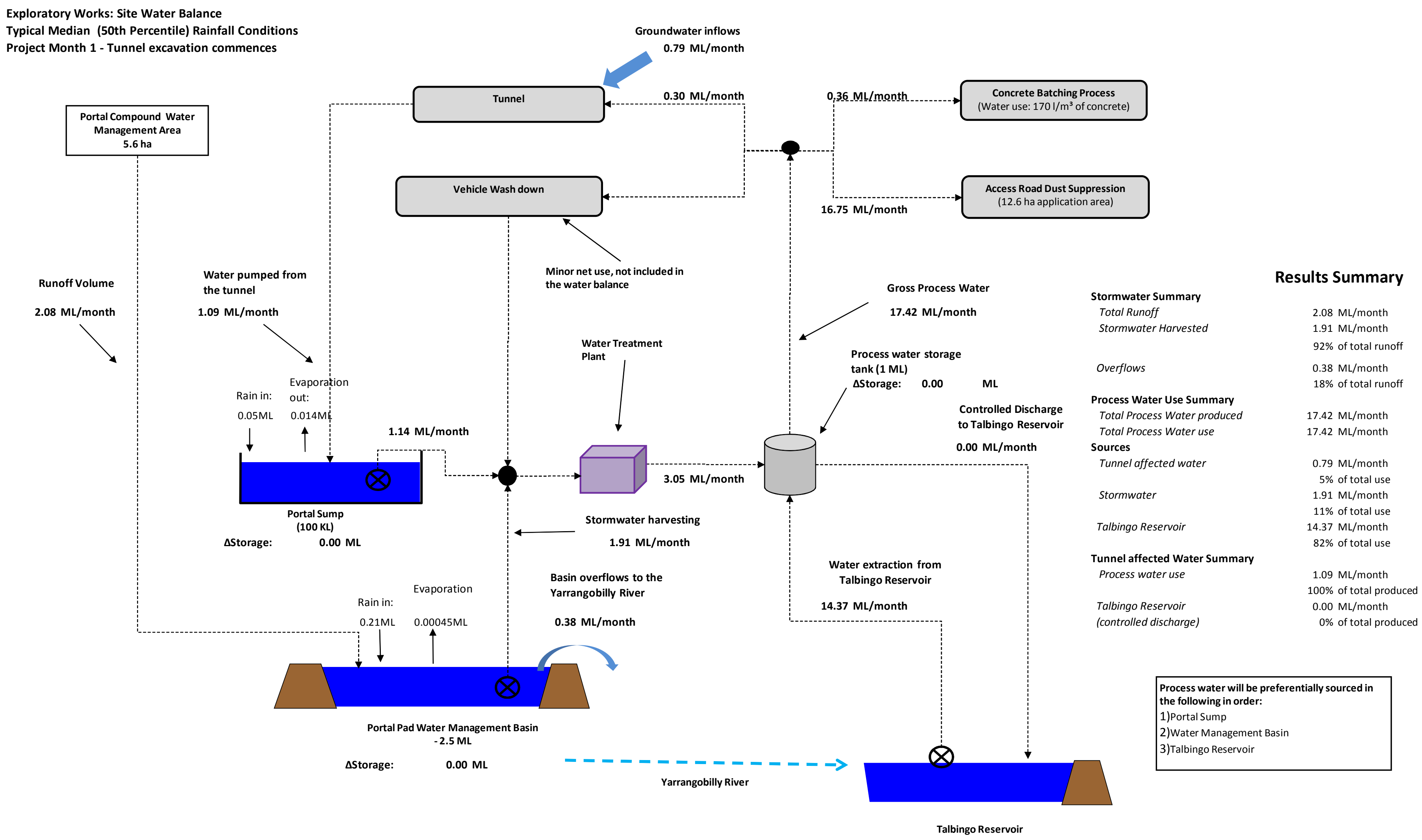


Figure D4 Water balance results: Tunnel Month 1 – median conditions

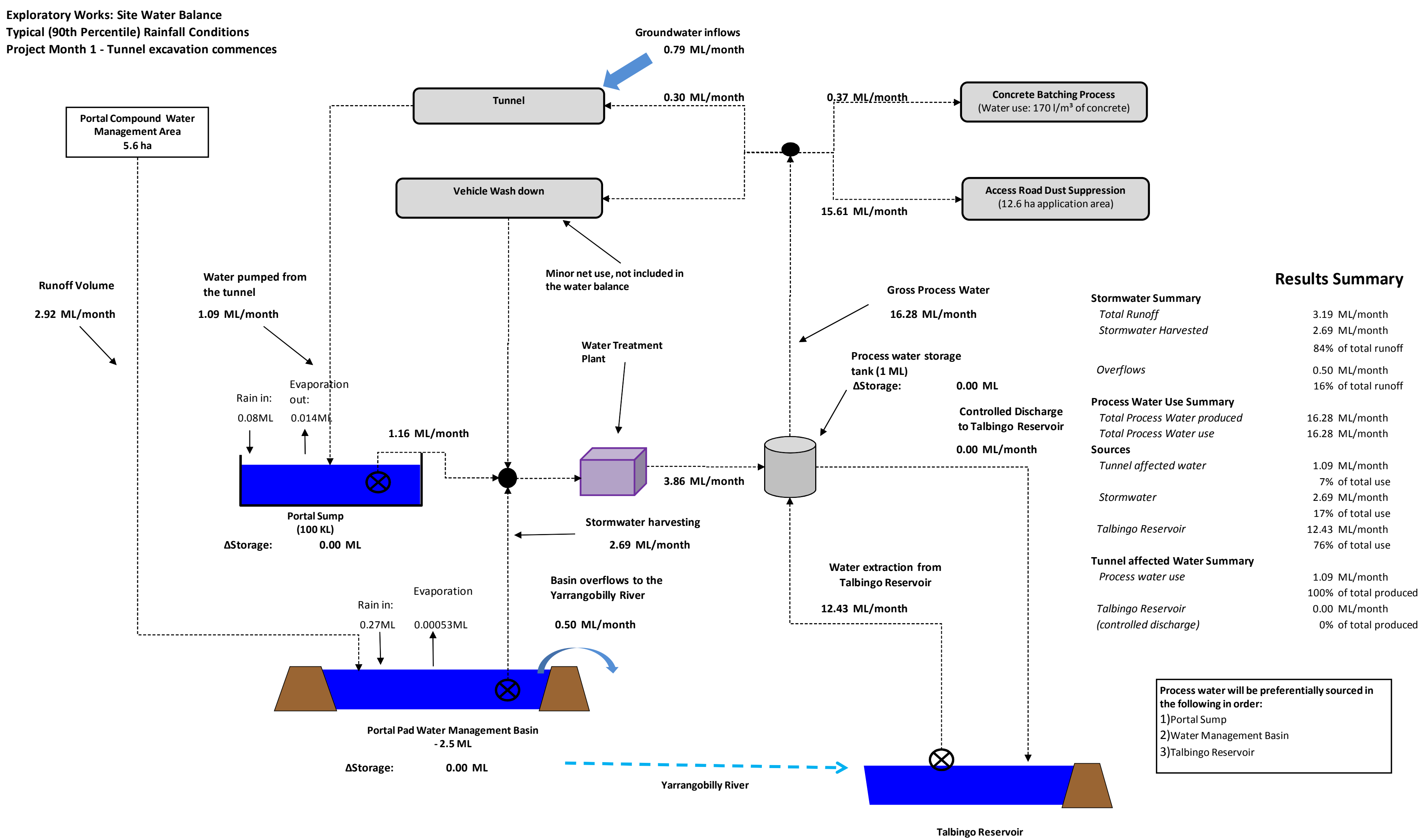


Figure D5 Water balance results: Tunnel Month 1 – wet conditions

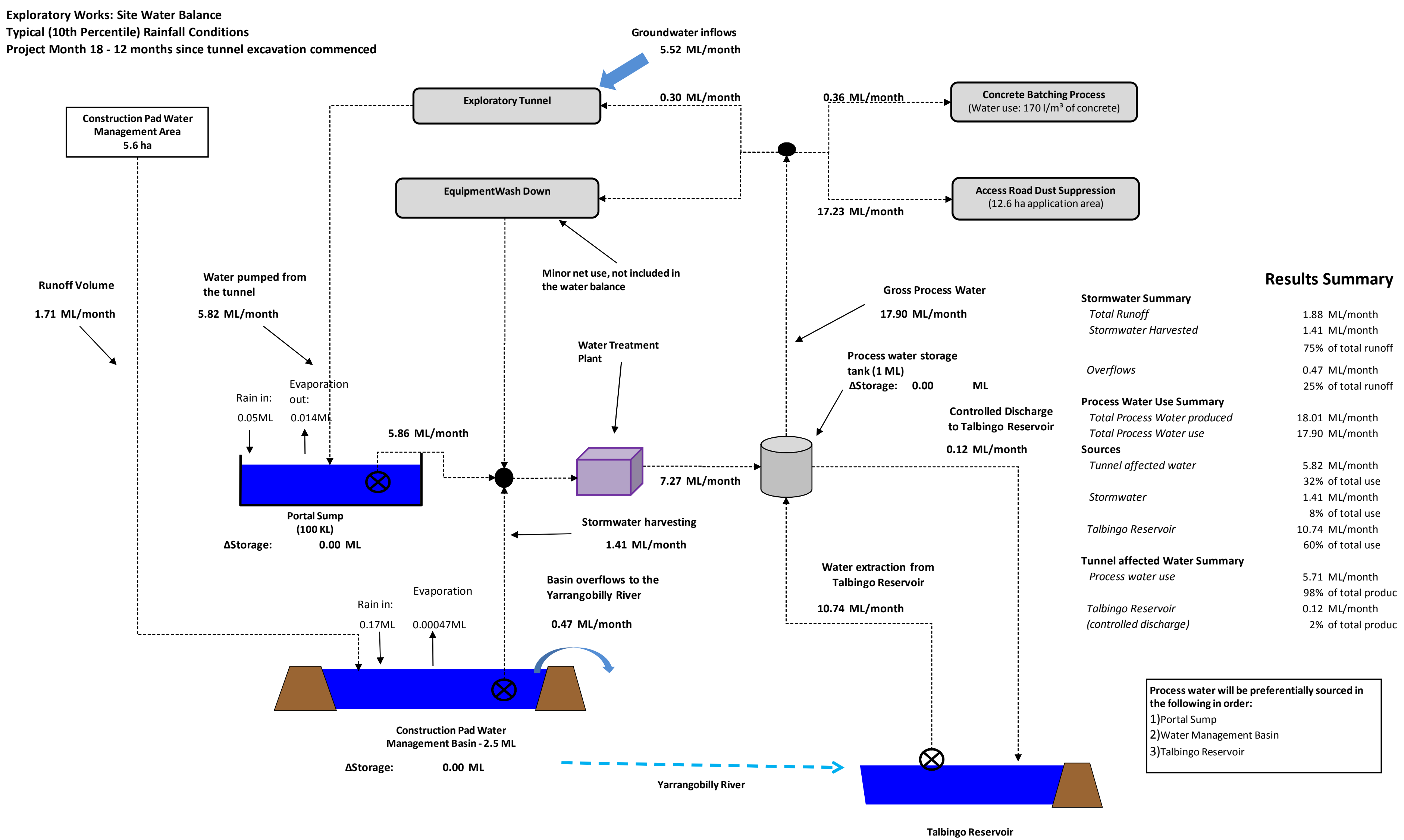


Figure D6 Water balance results: Tunnel Month 12 – dry conditions

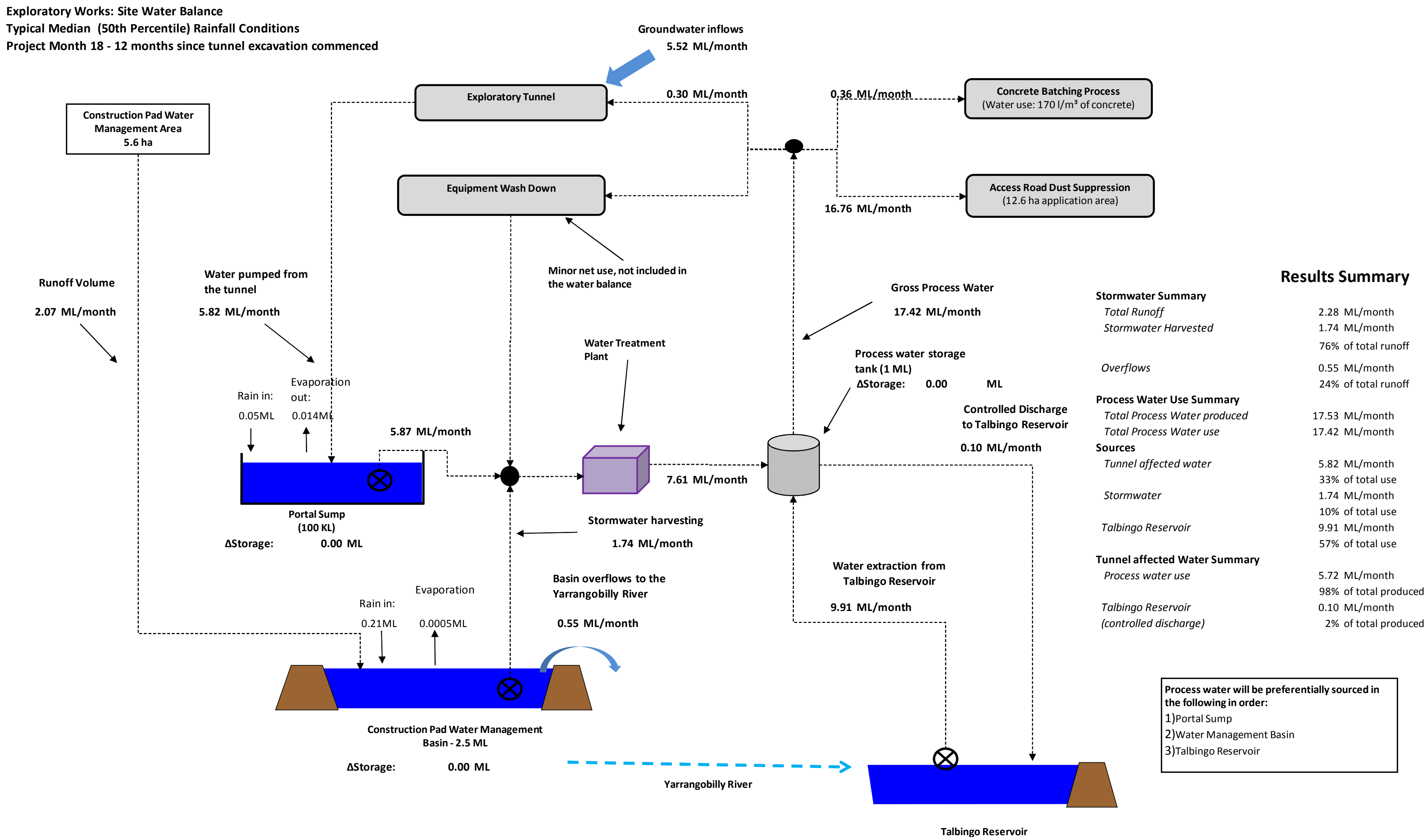


Figure D7 Water balance results: Tunnel Month 12 – median conditions

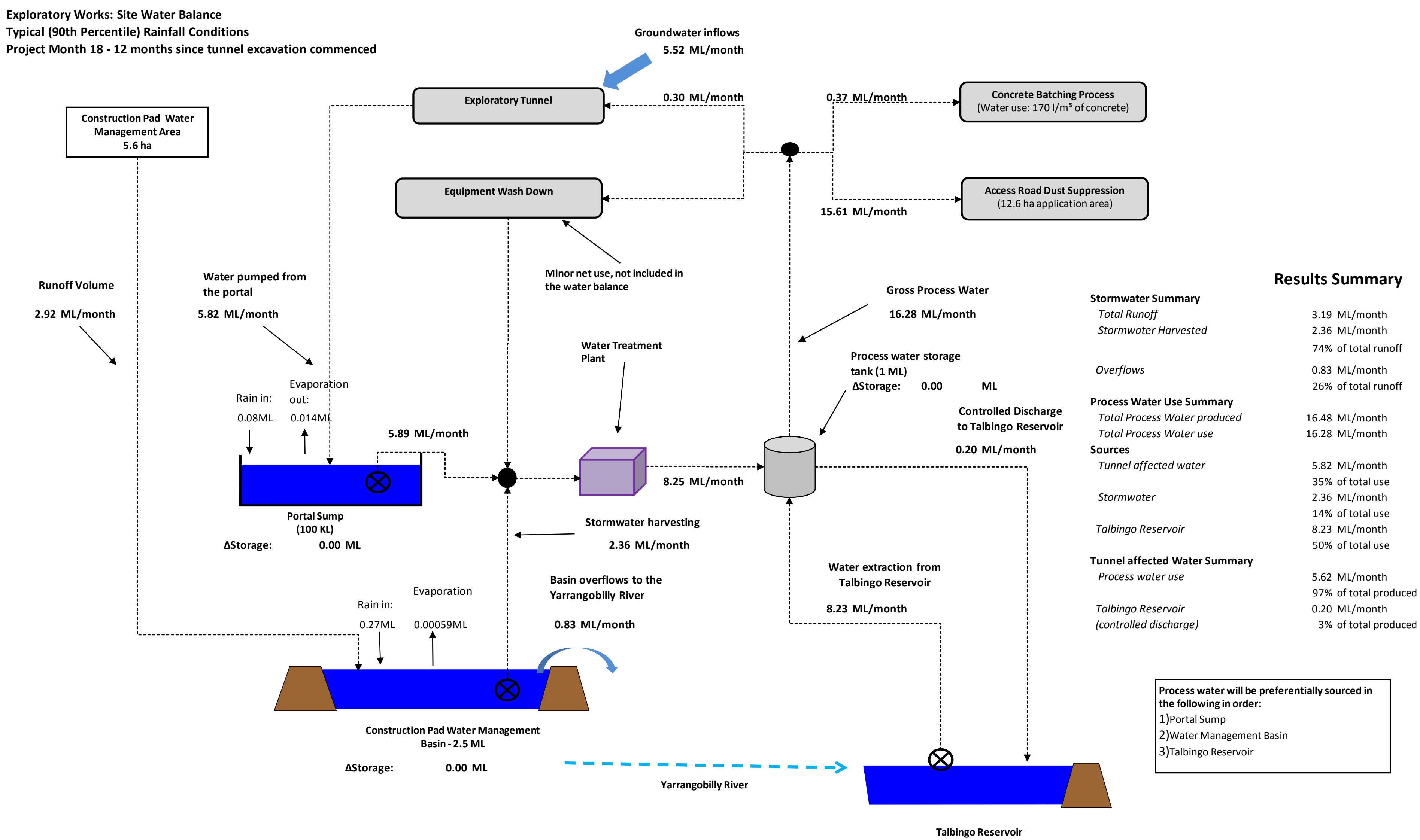


Figure D8 Water balance results: Tunnel Month 12 – wet conditions

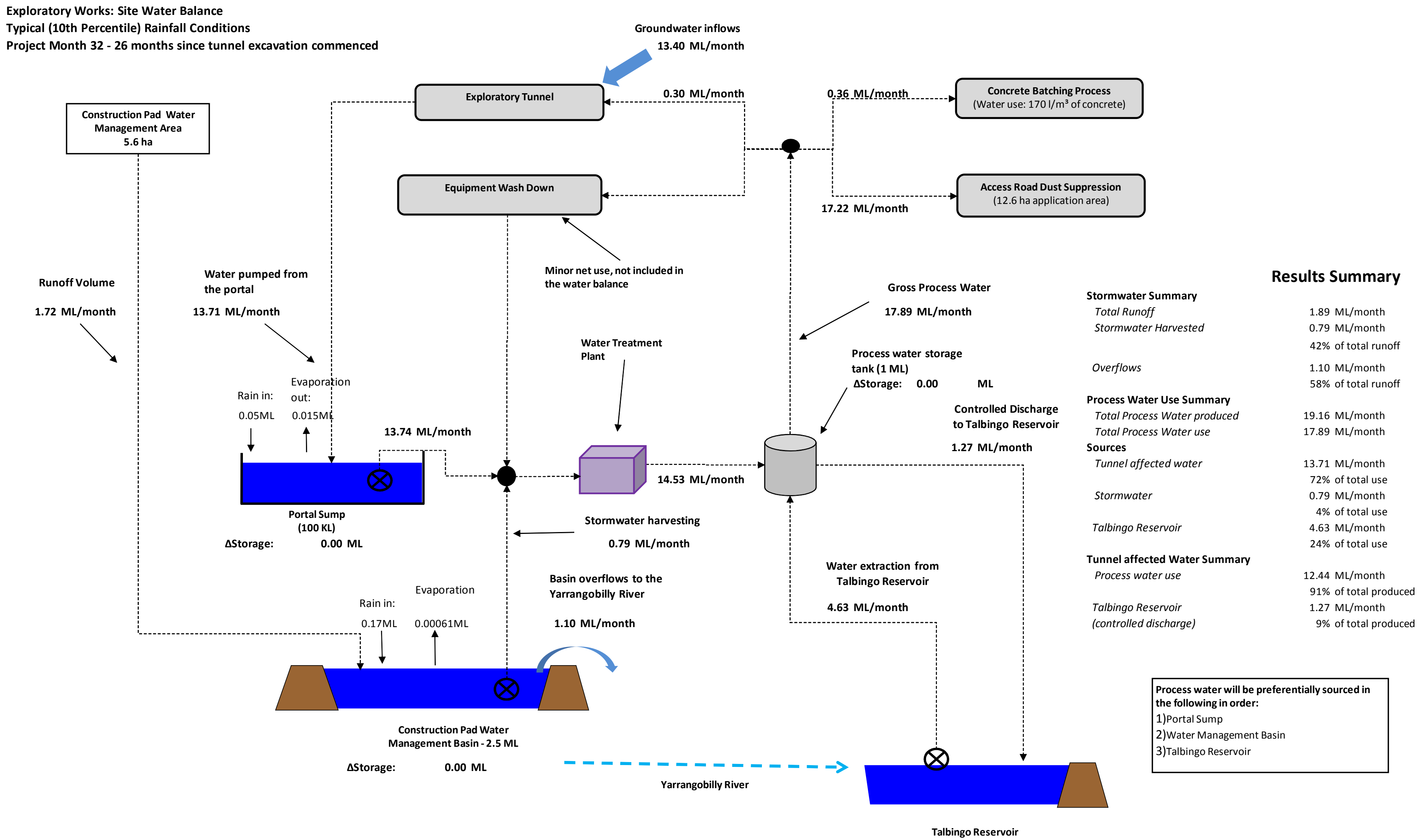


Figure D9 Water balance results: Tunnel Month 26 – dry conditions

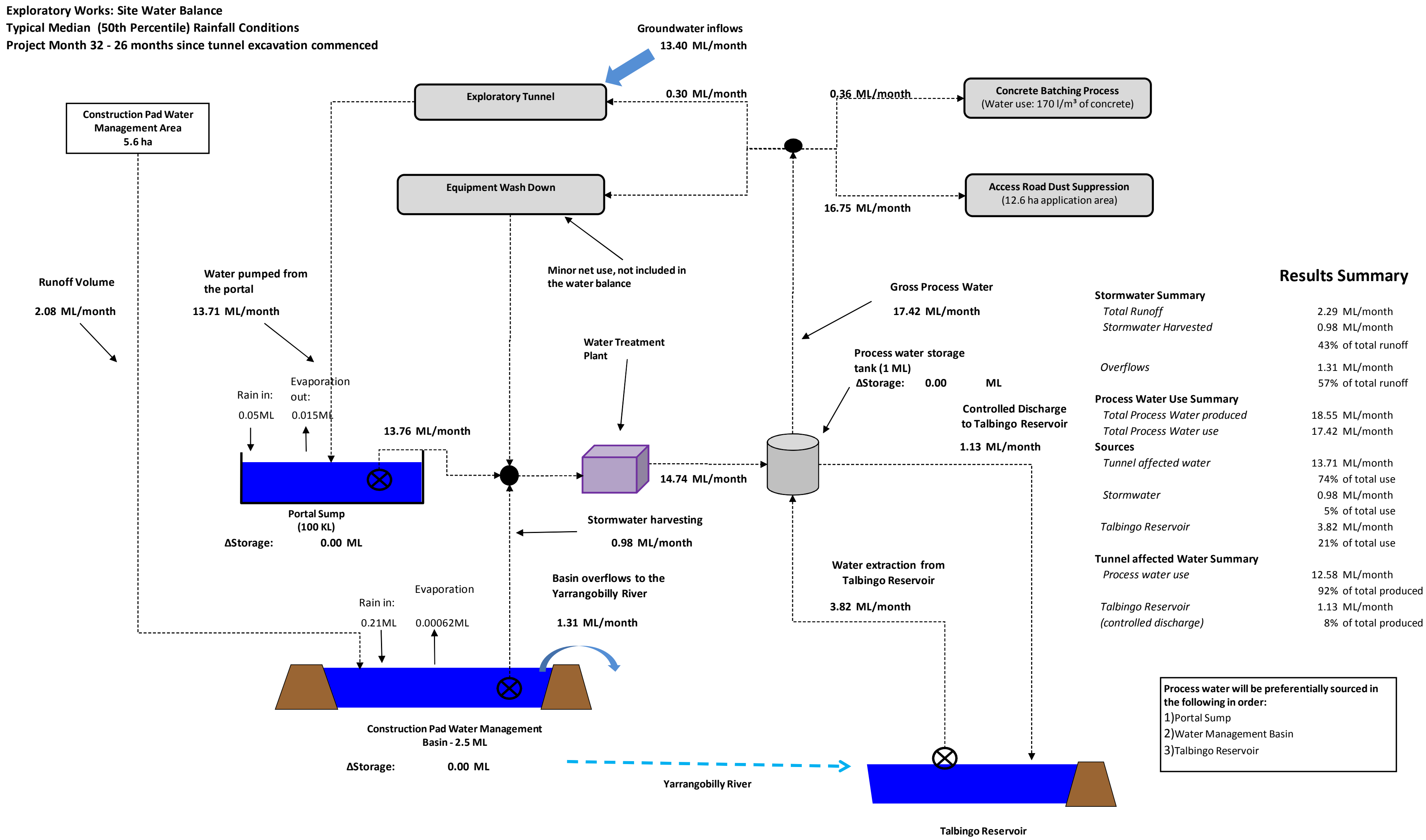


Figure D10 Water balance results: Tunnel Month 26 – median conditions

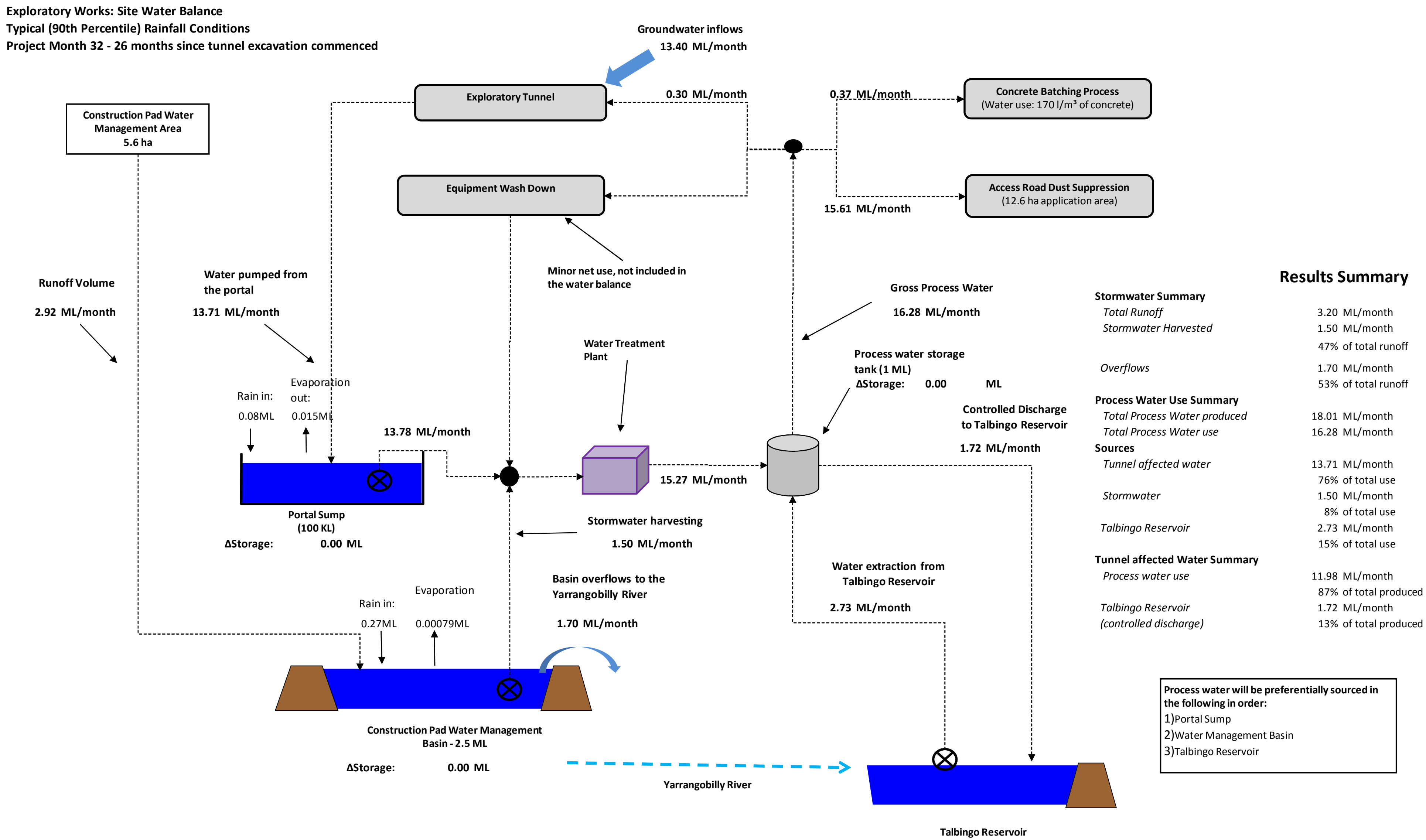


Figure D11 Water balance results: Tunnel Month 26 – wet conditions

Appendix E

Sedimentation Dam Sizing Methodology

E.1 Introduction

This appendix establishes methods for calculating sedimentation dam volumes for the Exploratory Works. The applied methods are recommended in the following NSW government guidelines:

- Managing Urban Stormwater: Soils and Construction – Volume 1 (Landcom, 2004); and
- Managing Urban Stormwater: Soils and Construction – Volume 2D – Main road construction (DECC, 2008).

E.2 Design criteria

All sedimentation basins will be designed as Type F or D sediment retention basins. Table 6.1 from Volume 2D (DECC, 2008) establishes design criteria for sedimentation basins based on the sensitivity of the receiving environment and duration of disturbance. Table E.1 summarises the recommended design criteria.

Table E.1 Sedimentation basin design criteria

	Duration of disturbance			
	< 6 months	**6 – 12 months**	**1– 3 years**	**>3 years**
Design treatment event[1] (five-day duration event)	80^{th} percentile	85^{th} percentile	85^{th} percentile	95^{th} percentile
Embankment and spillway design capacity[1]	20 year event	50 year event	100 year event	100 year event

Notes: 1.design criteria for a sensitive receiving environment adopted.

E.3 Runoff volume calculations

Volume 1 (Landcom, 2004) recommends that sedimentation treatment volumes for Type F and D basins are calculated as a function of the rainfall depth and runoff coefficient for the design treatment event.

E.3.1 Rainfall

Table E2 presents rainfall depths for 2, 5, 10 and 20 day rainfall events. This information was calculated from the Talbingo (72131) rainfall record.

Table E.2 Design rainfall depths for frequent events

	Rainfall Duration			
	2 day	**5 day**	**10 day**	**20 day**
80^{th} Percentile event	7.5 mm	24.2 mm	47.4 mm	86.9 mm
85^{th} Percentile event	11.4 mm	30.6 mm	56.0 mm	99.0 mm
90^{th} Percentile event	18.4 mm	41.6 mm	68.1 mm	116.0 mm
95^{th} Percentile event	30.0 mm	56.8 mm	85.0 mm	138.0 mm

Notes: Rainfall depths have been calculated from the Talbingo (72131) gauge record

E.3.2 Runoff volumes

Appendix F from Volume 1 (Landcom, 2004) provides volumetric runoff coefficients for a range of soil hydrologic groups. Table E.3 describes the soil hydrologic groups that have been identified or may be created following disturbance.

Table E.3 Soil hydrologic groups

	Description	Relevance to Exploratory Works
Soil hydrologic Group B	Low to moderate runoff potential	Tensols soils are considered to be soil hydrologic group B. The accommodation camp, construction pad and some access roads will be established in Tensols soils.
Soil hydrologic Group C	Moderate to high runoff potential	Kandosols soils are considered to be soil hydrologic group B. The accommodation camp, construction pad and some access roads will be established in Tensols soils.
Soil hydrologic Group D	Very high runoff potential	Soil hydrologic Group D conditions may occur at: • construction areas that have shallow soils and/or compacted areas; and • access roads.

Table E.4 provides the runoff coefficients (Cv) from Table F2 (Volume 1 Landcom, 2004) and the calculated runoff volume (on a per ha basis) for:

- soil hydrologic groups B, C and D; and
- the full range of 5 day duration rainfall events.

Table E.4 Design runoff volumes

		Soil Hydrologic Group B		Soil Hydrologic Group C		Soil Hydrologic Group D	
		Cv	**Runoff**	**Cv**	**Runoff**	**Cv**	**Runoff**
5 day duration rainfall	(mm)	-	(m^3/ha)	-	(m^3/ha)	-	(m^3/ha)
80th Percentile event	24.2	0.19	46	0.35	85	0.50	121
85th Percentile event	30.6	0.34	104	0.51	156	0.64	196
90th Percentile event	41.6	0.42	175	0.58	241	0.69	287
95th Percentile event	56.8	0.48	273	0.63	358	0.74	420

E.4 Sedimentation basin volumes

Sedimentation basin volumes will be established on a case by case basis having consideration for:

- the contributing catchment area to the basin;
- the duration of disturbance; and
- Soil hydrologic groups (pre and post construction disturbance).

Sediment treatment volumes will be established using the volumes provided inTable E.4. An additional sediment storage volume equivalent of 20% of the treatment volume will also be incorporated into the design.

Following rainfall, water captured in sedimentation basins will be dewatered and used for dust suppression.

E.5 Erosion and Sediment Control Plans

Detailed Erosion and Sediment Control Plans (ESCP) will be prepared for each stage of the project at detailed design. The ESCP will include a civil design of proposed sedimentation basins and other erosion and sediment controls.

Appendix F

Summary of Proposed Controls

Table F.1 Summary of proposed controls

Control	Description
Flood Management Controls	
FM_1.1	Camp and Wallaces bridges will be designed in accordance with AustRoads bridge design standards which require the: • bridge deck soffit to be located above the 1% AEP flood level; • bridge structure to be designed to withstand a 0.05% AEP event; and • abutments to be protected by appropriately designed scour protection.
FM_1.2	The western emplacement will be designed to prevent the risk of emplacement material being entrained in flood waters during a 0.2% AEP event. This may require a flood protection berm or rock armouring along the northern toe of the emplacement.
FM_1.3	A flood emergency response plan will be prepared as part of the project's emergency response plans
Clean water management controls	
WM_1.1	Where possible, all clean water will be diverted around or through water management areas. Runoff from clean water areas than cannot be diverted must be accounted for in the design of water management systems.
WM_1.2	All clean water drainage will be designed and constructed to convey the 1% AEP peak flow and will have adequate scour protection.
WM_1.3	Where possible, diversions will seek to avoid materially increasing flow rates in adjoining watercourses.
WM_1.4	Where possible, the diversion of drainage lines or watercourses using contour drains[1] will be avoided.
Controls for construction disturbance areas	
Controls for all construction areas	
WM_2.1	An ESCP will be prepared for each construction area. The plan will consider local soil characteristics, clean water management and the proposed construction methods.
WM_2.2	The clean water management controls WM_1.1 to 1.4 apply to all ESCPs.
WM_2.3	Source controls such as mulching, matting and sediment fences will be utilised where appropriate.
WM_2.4	Stockpiles will also be located where they are not exposed to overland or flood flow. Monitoring for dispersion and erosion of soil stockpiles will be undertaken, particularly on moderately dispersive soils. Addition of ameliorants, such as gypsum and organic matter for dispersive soils will be undertaken as needed.
WM_2.5	Soils will be lightly scarified on the contour to encourage rainfall infiltration and minimise run-off. As soon as practicable after respreading, a sterile cover crop should be established to limit erosion and soil loss. This will also provide good mulch for native plant establishment.
WM_2.6	Sediment traps or filters will be maintained at all discharge locations. The filters will only use biodegradable materials. The sediment traps and filters will target the removal of coarse sediments.
Additional controls for construction areas that are not constrained by terrain	
WM_2.7	Where appropriate, sedimentation dam will be constructed in accordance with the methods recommended in Managing Urban Stormwater: Soils and Construction: Volume 1 (Landcom, 2004) and Volume 2D (DECC, 2008). Sedimentation dam sizing methodologies are provided in Appendix E. Sedimentation dams will reduce the frequency and volume of discharge and will provide sedimentation treatment during overflow.
WM_2.8	Water captured in sedimentation basins will be used for dust suppression.
Water management controls for access roads	
WM_3.1	Existing dirt tracks that will no longer be required following the construction of the new access roads will be removed and rehabilitated. This will reduce associated sediment loads.
WM_3.2	All cut and fill batters will be stabilised by vegetation.
WM_3.3	The clean water management controls WM_1.1 to 1.4 will apply to the design of all access roads.

Table F.1 Summary of proposed controls

Control	Description
WM_3.4	Access road surfaces will be maintained with appropriate aggregate material to reduce sediment loads.
WM_3.5	Access roads will be single cross fall and will grade to a tables drain located against the toe of the cut batters. The drains will be stabilised by rock armouring as required. The table drains will drain into either sedimentation basins or clean water transverse drainage structures.
WM_3.6	Sediment traps or filters will be maintained at all discharge locations. The filters will only use biodegradable materials. The sediment traps and filters will target the removal of coarse sediments.
WM_3.7	Where appropriate, the sedimentation dams established to manage runoff during construction of the access roads will be maintained to provide ongoing treatment of runoff from access roads.
Water management controls for the accommodation camp	
WM_4.1	A stormwater management plan will be prepared as part of the detailed design of the project. The plan will consider geotechnical constraints including shallow soils.
WM_4.2	Clean water from upslope areas will be diverted around the accommodation camp.
WM_4.3	A piped drainage system will be established to capture stormwater and convey it to the proposed water quality improvement ponds. The drainage system will have a 20% AEP capacity. Overland flow paths will be provided as required.
WM_4.4	All pervious areas including batters will be vegetated with endemic native vegetation.
WM_4.5	Runoff from roof areas will be collected in rainwater tanks where possible. Captured water will be used for non potable uses, reducing runoff volumes.
WM_4.6	Source controls including permeable pavers and rain gardens will be used where possible.
WM_4.7	All runoff from the accommodation camp will be treated in one of two water quality improvement ponds. The ponds will be designed as constructed wetlands and will provide a water quality improvement function and attenuate peak runoff rates from the accommodation camp.
WM_4.8	Collectively, the stormwater controls will be sized and configured to achieve the following pollution load reductions (as calculated using the MUSIC water quality model): • 85% reduction in post development mean annual load of total suspended solids; • 60% reduction in the post development mean annual load of total phosphorous; and • 45% reduction in the post development mean annual load of total nitrogen.
WM_4.9	The water quality improvement pond batters will be established using retaining structures to avoid disturbance of the Watercourse 3 channel.
Water management controls for the portal construction pad	
WM_5.1	A stormwater management plan will be prepared as part of the detailed design of the project. The plan will be integrated with the process water system.
WM_5.2	Where practical, all activities that will occur on the portal construction pad with potential to contaminate stormwater runoff will be isolated from the stormwater system through the use of covering (ie by a building or roof) and bunding. Water produced within the covered and bunded areas will be either: • managed by the process water system; or • disposed as liquid waste to an appropriate facility.
WM_5.3	Clean water from upslope areas will be diverted through the portal construction pad in a designated clean water drainage system.
WM_5.4	A piped drainage system will be established to capture stormwater and convey it to the water management basin. The drainage system will have a 1% AEP capacity. Overland flow paths will be provided as required.
WM_5.5	All aggregate storage and stockpile areas will be bunded to prevent stormwater ingress. Runoff from these areas will be treated in sediment wedge pits to remove all coarse material. Sediment wedge pits will overflow into the piped drainage system.

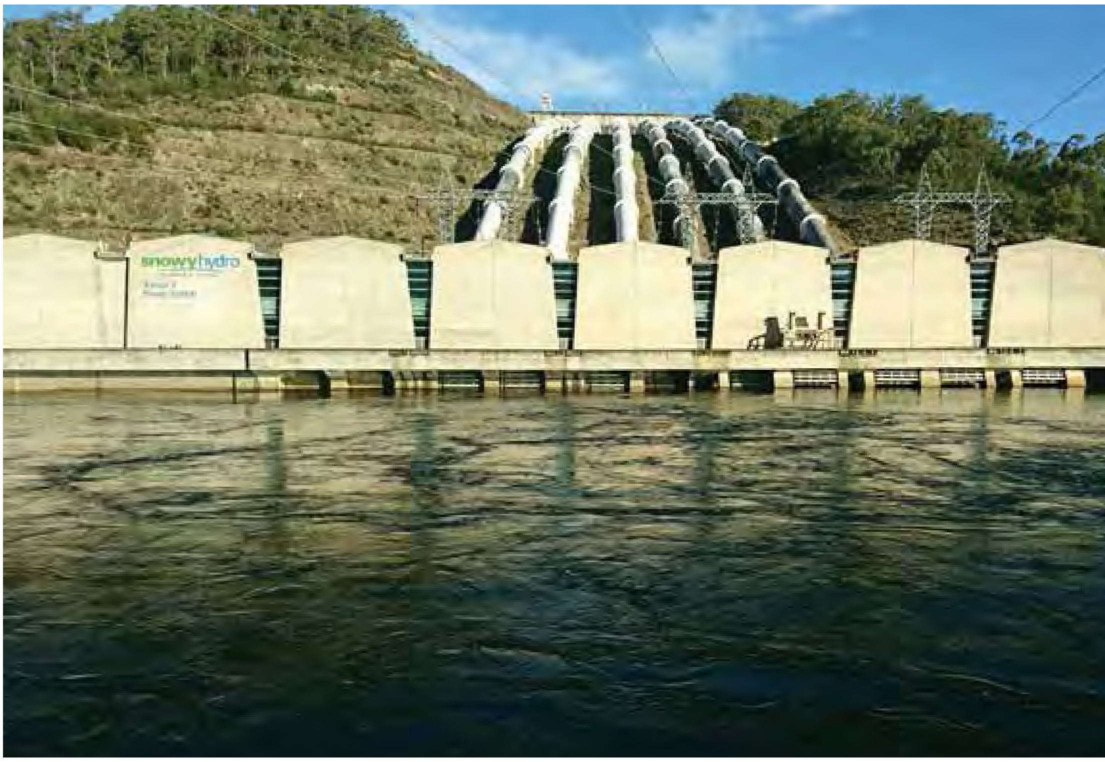
Table F.1 Summary of proposed controls

Control	Description
WM_5.6	All runoff from the portal construction pad and adjoining access road will be conveyed to a water management basin that will have a volume of at least 2,500 m^3. The basin will be designed as a constructed wetland and will provide a water quality improvement function. Water captured in the basin will be extracted to supply the process water system.
WM_5.7	The water management basin will be designed to provide a freeboard between its overflow pipe and spillway. The freeboard volume will be calculated to contain all conceivable leaks, spills and firewater runoff volumes. The overflow pipe will have a manual shutoff valve that will enable site management to shut off the overflow pipe to enable the basin to contain any leak, spill or fire water runoff.
Water management controls for the process water system	
WM_6.1	A process water system will be established to manage any potentially contaminated water that may be produced by the construction activities.
WM_6.2	The process water system will be separated from the stormwater system to avoid uncontrolled overflows associated with stormwater ingress.
WM_6.3	The process water system will incorporate a water treatment plant that will treat water to a suitable quality for its proposed use in construction activities or discharge to Talbingo Reservoir (if required).
WM_6.4	The process water system will have the ability to extract water from the construction pad's water management basin. This will be done to top-up supply.
WM_6.5	A reticulation system will be established to enable the process water system to: • extract water from Talbingo Reservoir (as required); and • discharge treated process water into Talbingo Reservoir (as required).
Water management controls for the waste water management system	
WM_7.1	Waste water from the accommodation camp will be reticulated to a waste water treatment plant via a sewer system. The sewer system will be designed to restrict stormwater ingress into the waste water system.
WM_7.2	Water efficient fittings will be used to minimise waste water loads.
WM_7.3	Low phosphorus products are to be used for washing activities controlled by site management (ie laundry services and mess hall) and encouraged (via education) for general use.
WM_7.4	The waste water storage system will include emergency storage of untreated waste water. The storage volume will be calculated at detailed design based on analysis of response times from regional waste management contractors to provide emergency trucking and offsite disposal options.
WM_7.5	A waste water treatment plant will treat all waste water produced by the Exploratory Works. The plant will treat waste water to the water quality specifications provided in Table 6.15 or as specified by an EPL.
WM_7.6	Treated waste water will be disposed to Talbingo Reservoir via the controlled discharge pipeline.
Water management controls for the waste water management system	
WM_8.1	A water management system for the eastern and western emplacement areas will be further developed, applying the water management concepts described in Section 6.9.2.

Notes: 1.Contour drains refer to diversion drains that are constructed along the contour. Contour drains for larger watercourses can require substantial earthworks and are prone to failure on the fill batter side if uncontrolled overflows occur due to the drain capacity being exceeded or a blockage (such as a tree falling into the drain).





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