


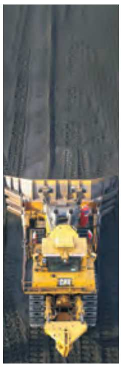

STRATFORDCOAL
Part of the Yancoal Australia Group

Stratford Mining Complex
Statement of Environmental Effects

APPENDIX C

SURFACE WATER ASSESSMENT

YANCOAL
兖煤澳大利亚有限公司

HYDRO ENGINEERING & CONSULTING PTY LTD

REPORT

Stratford Mining Complex Modification 1 Surface Water Assessment

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C	Per review comments & revised modelling	TSM	RS	TSM	19/5/2016
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F	Per client comments	TSM	Yancoal	TSM	16/6/2016
G	Per additional client comments	TSM	Yancoal	TSM	17/6/2016

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION, BACKGROUND AND SCOPE

Stratford Coal Pty Ltd, a wholly owned subsidiary of Yancoal Australia Limited (Yancoal), is the operator of the Stratford Mining Complex (SMC) which is located in the Gloucester Valley some 95 kilometres (km) north of Newcastle in New South Wales (NSW) (refer Figure 1). Since mining commenced in 1995, coal has been extracted from the Stratford Main Pit and several smaller satellite pits including Roseville West, Roseville Extension, Parkers and Bowens Road North. Open cut mining operations at the SMC were suspended in 2014.

Run-of-mine (ROM) coal from the active mine areas was trucked to the Stratford coal handling and preparation plant (CHPP), where it was blended with ROM coal sourced from the nearby Duralie Coal Mine (DCM), prior to washing. Reprocessing of previously emplaced co-disposal CHPP rejects from an area adjacent to the CHPP (refer Figure 2) is occurring and would continue until late 2017 together with processing of coal from the DCM.

In November 2012, an Environmental Impact Statement (EIS) was prepared for the Stratford Extension Project (SEP), which included the extension of the Roseville West Pit and development of new Avon North and Stratford East Open Cuts, with a proposed project life of 11 years from July 2013. As part of the EIS, Gilbert & Associates Pty Ltd (now Hydro Engineering & Consulting Pty Ltd – HEC) were engaged to undertake a surface water assessment, including a site water balance (Gilbert & Associates, 2012). Following Planning Assessment Commission review, the SEP received Development Consent on 29 May 2015. However the mining operations under the SEP, including the approved additional and extended open cut pits, has not yet commenced.

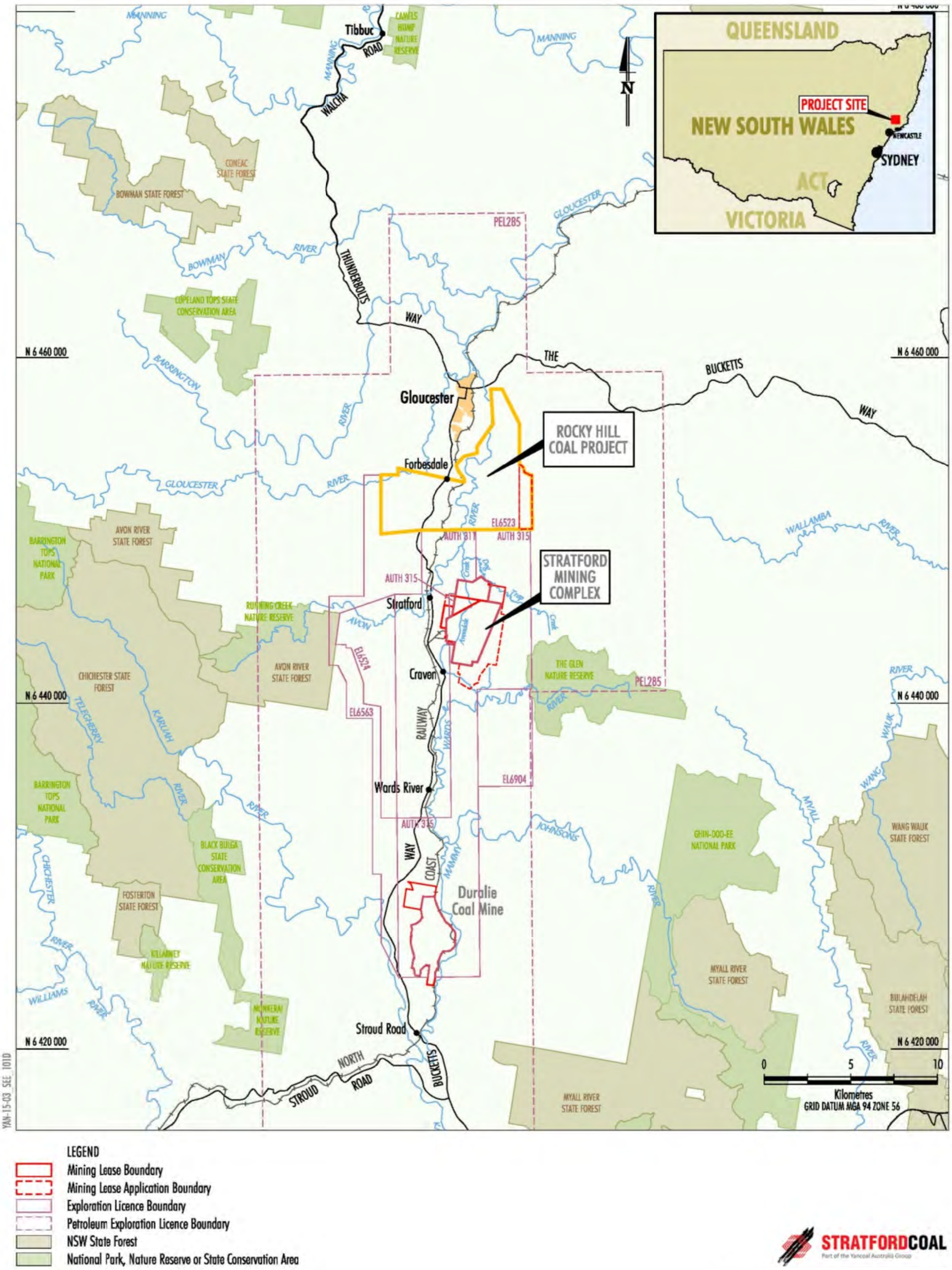
The Rocky Hill Coal Project (RHCP) is a proposed open cut coal mine located 3.5 km to 7 km southeast of the town of Gloucester and approximately 5 km north of the SMC. The RHCP proponent, Gloucester Resources Limited (GRL), submitted a Development Application (DA) including an EIS in 2013 (R.W.Corkery & Co., 2013), seeking approval for the development, including four open cut pits and a CHPP. In 2015, GRL requested that the DA be put on hold pending investigation of proposed changes to the RHCP.

Yancoal is now seeking to modify the SEP Development Consent under Section 96(2) of the NSW *Environmental Planning and Assessment Act, 1979*, in order to allow interactions between the SEP and RHCP. These principally relate to the transportation of RHCP ROM coal to the SMC (via a purpose built haul road) and the processing of the RHCP ROM coal, together with SEP ROM coal, in the existing CHPP. CHPP rejects would continue to be disposed of at the SMC, resulting in an increase in total rejects volume over the life of the mine.

A Statement of Environmental Effects (SEE) is being prepared to facilitate the modification of the SEP Development Consent. HEC have been engaged by Yancoal to undertake the following:

- a rejects balance for the SMC, with processing of RHCP ROM coal;
- a water balance for the SMC, with processing of RHCP ROM coal; and
- assessment of potential hydrological impacts of the proposed private haul road crossing of Dog Trap Creek (refer Figure 2).

This report builds on the surface water assessment and site water balance presented in the SEP EIS (Gilbert & Associates, 2012). Water balance results are compared with the forecasts presented in the SEP EIS.



Source: Geoscience Australia (2009); SCPL (2016); DECC (2011); LPI (2016); DPI-C&L (2012)

Figure 1 Regional Location

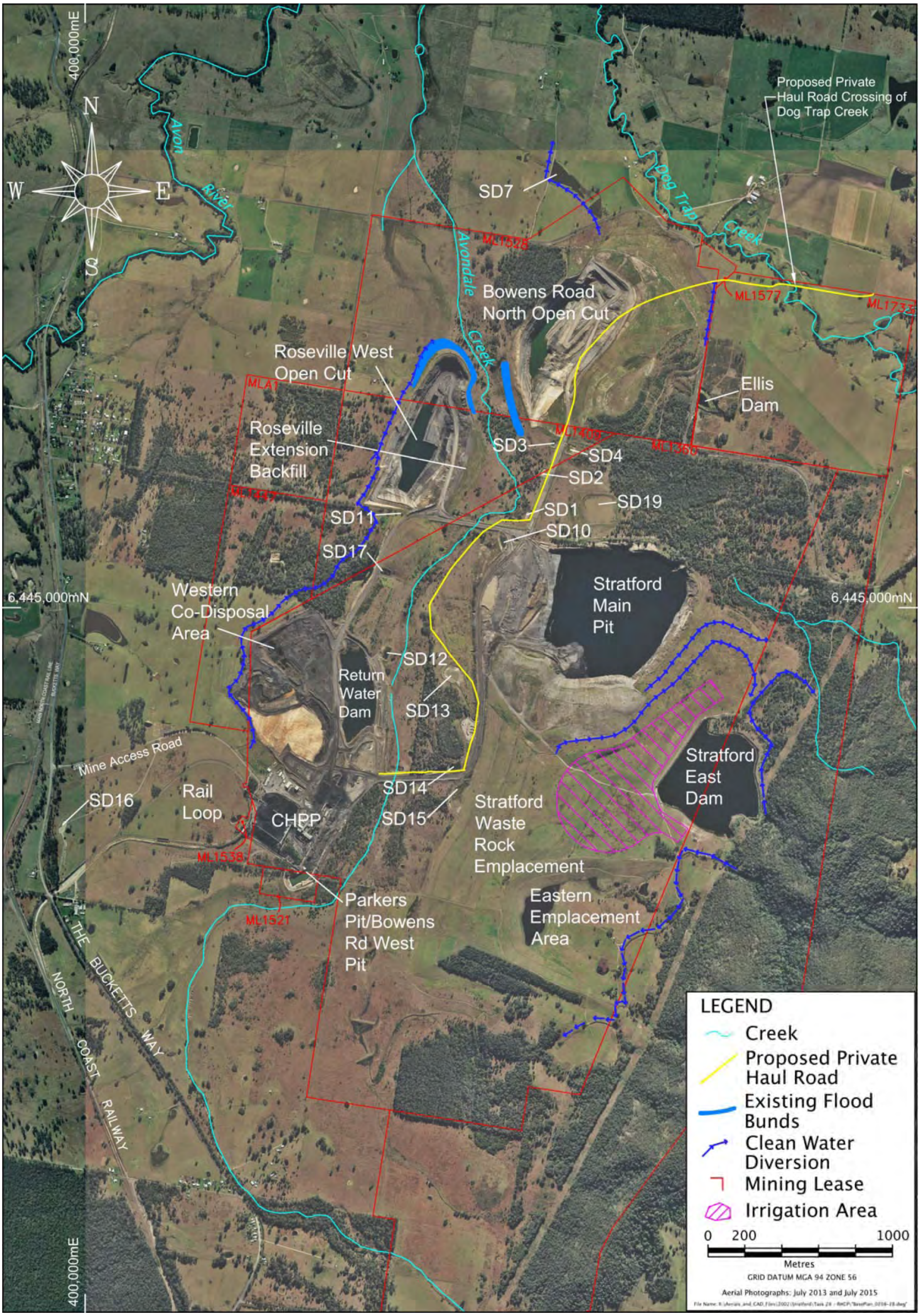


Figure 2 Stratford Mining Complex Layout - 2015

2.0 MINE WATER MANAGEMENT SYSTEM

2.1 Existing Operations

The water management system at the SMC is based on the following principles:

1. Runoff from undisturbed and rehabilitated areas is diverted around areas disturbed by mining activity.
2. Mine and process water on site is collected and re-used in the CHPP and for haul road watering.
3. Excess water which accumulates on site is held in site storages. The largest of these is the Stratford Main Pit, which is also used for disposal of CHPP rejects.

As at the beginning of 2016, no active mining was occurring at the SMC. Up to 3 Million tonnes per annum (Mtpa) of ROM coal from the DCM is railed to SMC and is processed at the SMC CHPP. Coal rejects from a former rejects co-disposal area (western co-disposal area, refer Figure 2) north of the CHPP are being recovered at a rate of approximately 0.2 Mtpa and are re-processed in the CHPP. Combined coarse and fine CHPP rejects are pumped as a slurry and emplaced in the mined-out Stratford Main Pit.

The existing water management system at the SMC is based on the management of five separate water types namely: up-catchment diversions/runoff, mine water, sewage, water carrying sediments from areas disturbed by mining activities and runoff from rehabilitated or partially rehabilitated areas. It includes the following components:

- contained water storages including the Return Water Dam (RWD), Parkers Pit void, Stratford Main Pit, Stratford East Dam, the Bowens Road North Open Cut (BRNOC) and the Roseville West Open Cut (RWOC);
- diversion of runoff from catchment areas upstream of the mine disturbance area;
- runoff control on disturbed and rehabilitated areas at the mine;
- runoff control on infrastructure areas;
- sedimentation control;
- disposal of excess water through on-site agricultural irrigation; and
- sewage treatment and disposal of effluent.

The four largest contained water storages on site comprise (refer Figure 2):

- The RWD located north of the CHPP area and west of Avondale Creek. It has an estimated capacity of 551 megalitres (ML).
- The Parkers Pit void located south-west of the RWD and west of Avondale Creek. It has an estimated capacity of 106 ML.
- The Stratford Main Pit located south of the BRNOC and east of Avondale Creek. It has an estimated capacity of 18,304 ML as at early January 2016.
- The Stratford East Dam located to the south-east of the Stratford Main Pit. It has an estimated capacity of 2,872 ML.

In addition, the BRNOC and RWOC comprise storages that could be used for the interim storage of water (refer also Section 2.2).

The main water requirements at the SMC have historically been for CHPP make-up supply and for dust suppression. The water balance at the SMC has historically been in surplus which means that over time there has been a trend for more water to report to site storages from the mine workings and associated project site catchments than is required to support processing and mining activities.

The major water inflows to the site are rainfall-runoff generated from operational areas and (to a lesser extent) groundwater inflows to the open cut pits. The SMC water management system does not release water from disturbed areas off site other than from sediment dams and rehabilitated landforms.

Water generated from the ROM and product stockpiles, CHPP, contractors workshop, hardstand areas, western co-disposal area and mine water storage dams is pumped to and contained mainly in the Stratford Main Pit and the RWD – refer Figure 2. During mining, the BRNOC and RWOC were pumped back to the Stratford Main Pit, however since mining ceased, dewatering pumps were removed and water is currently allowed to accumulate in these two voids. The Parkers Pit void is used as a transient storage for runoff from the CHPP and coal stockpile area. Any water which accumulates in the void is transferred either directly to the CHPP for re-use or is transferred to the RWD.

The Stratford East Dam (previously used for storage of excess mine water, while mining of the Stratford Main Pit occurred) is no longer actively used for storage of mine water, however irrigation of water from the Stratford East Dam occurs over approved areas of the Stratford waste rock emplacement to increase the freeboard within the Stratford East Dam ahead of its re-integration with the system as part of the SEP (refer Section 2.2).

The RWD is a balancing storage used to supply water for the CHPP and haul road dust suppression. Runoff from the former (filled and partially reclaimed) above ground rejects western co-disposal area is pumped to the RWD. Water recovered from the Stratford Main Pit void is pumped to the RWD and is the main source of water for the CHPP.

The catchment area of the Stratford Main Pit void includes the incident pit area, its surrounds and a portion of the rehabilitated Stratford waste rock emplacement area. Seepage from the waste rock emplacement area is also believed to report to the Stratford Main Pit void. Sediment dams SD12, SD13, SD14 and SD15 are located adjacent to haul roads around the Stratford Main Pit void (refer Figure 2) and water is pumped to the RWD. Water captured in SD16 and SD17 is pumped back to Parkers Pit and the RWD respectively.

Water is ponded within the eastern emplacement area – behind an existing waste rock emplacement (refer Figure 2). Up-catchment runoff has been diverted around this area to Avondale Creek in order to limit inflows – inflow to this area originates from incident rainfall, runoff and seepage from portions of the surrounding rehabilitated Stratford waste rock emplacement. This water pond does not form part of the water management system and is periodically pumped to upslope clean water diversions.

2.2 Approved Stratford Extension Project

The approved SEP includes the continued mining of the RWOC to the west and south, and development of two additional open cut pits: Avon North Open Cut and Stratford East Open Cut. Figure 3 to Figure 6 (taken from Gilbert & Associates, 2012) show the progressive development of the SEP, water management system and associated catchment areas.

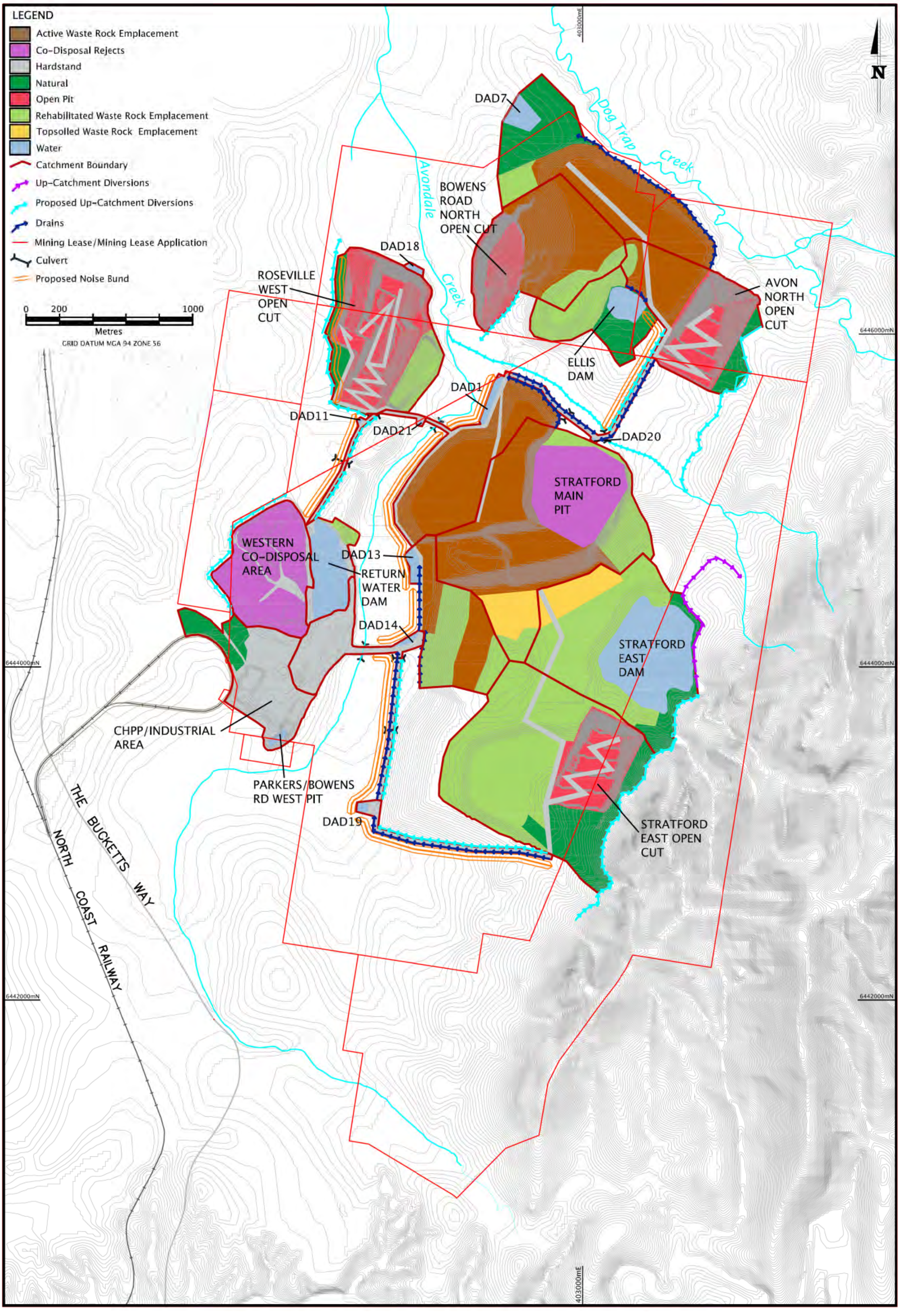


Figure 3 SEP Year 2 (2019) Indicative General Arrangement and Catchment Areas

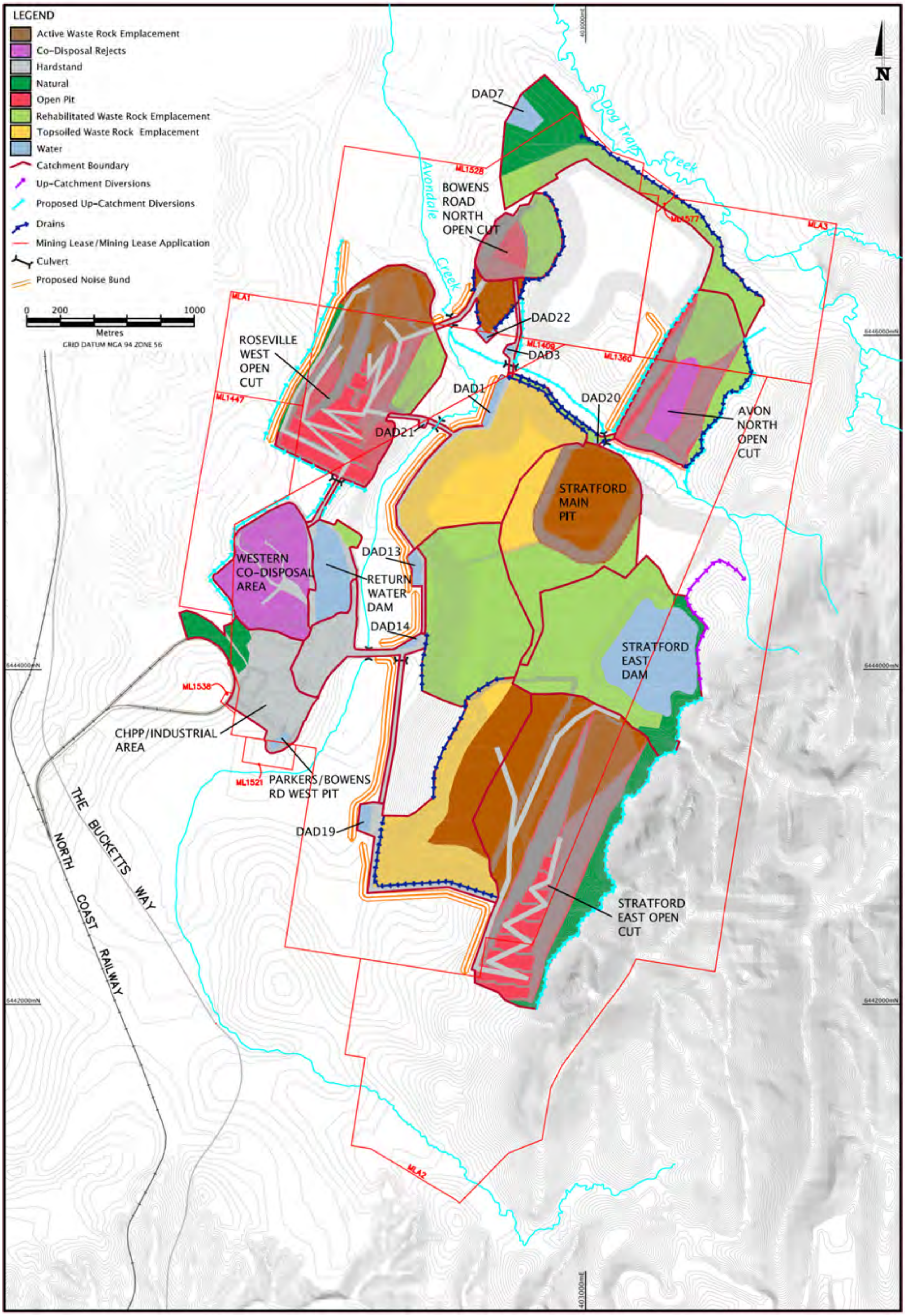


Figure 4 SEP Year 7 (2024) Indicative General Arrangement and Catchment Areas

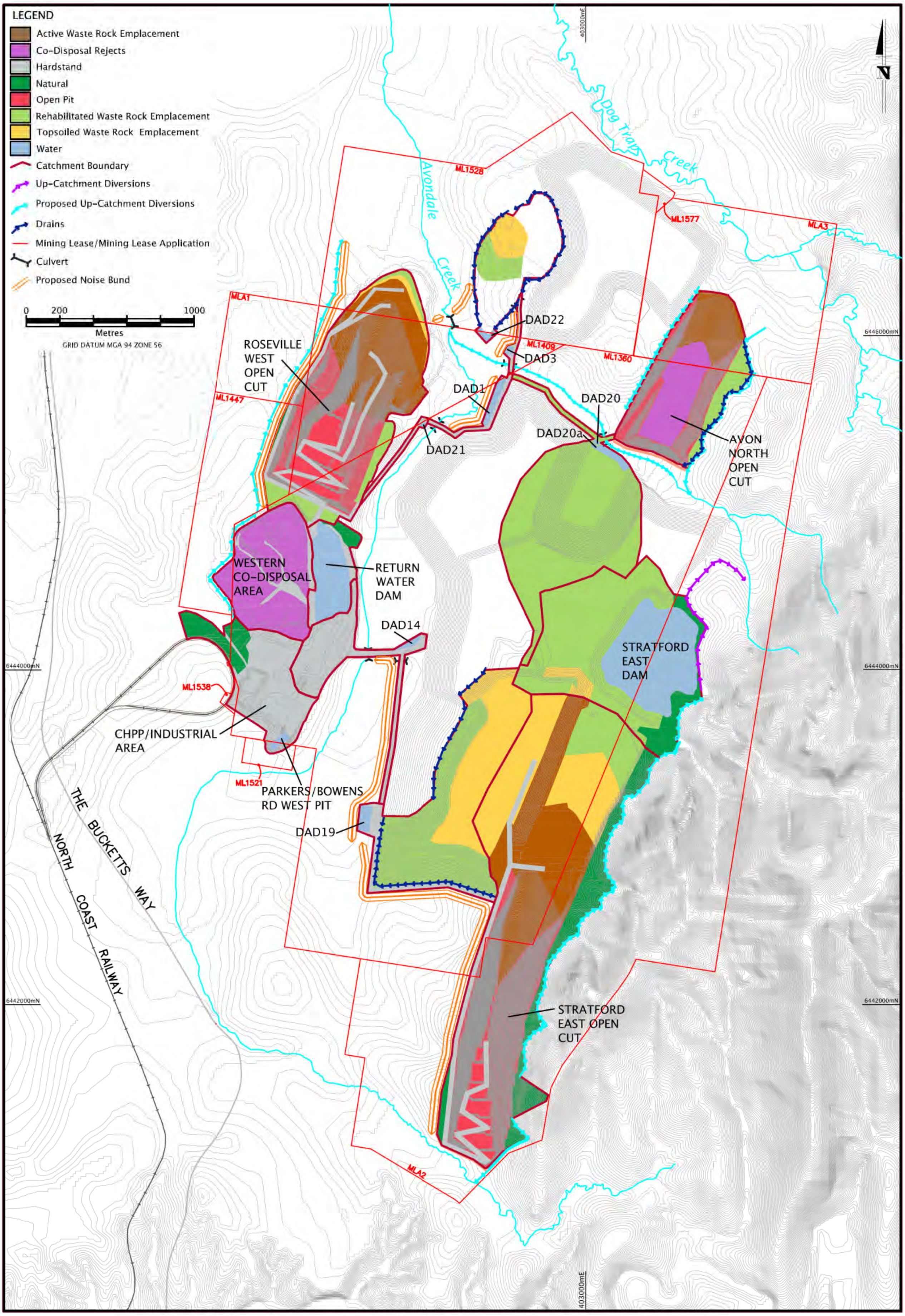


Figure 5 SEP Year 10 (2027) Indicative General Arrangement and Catchment Areas

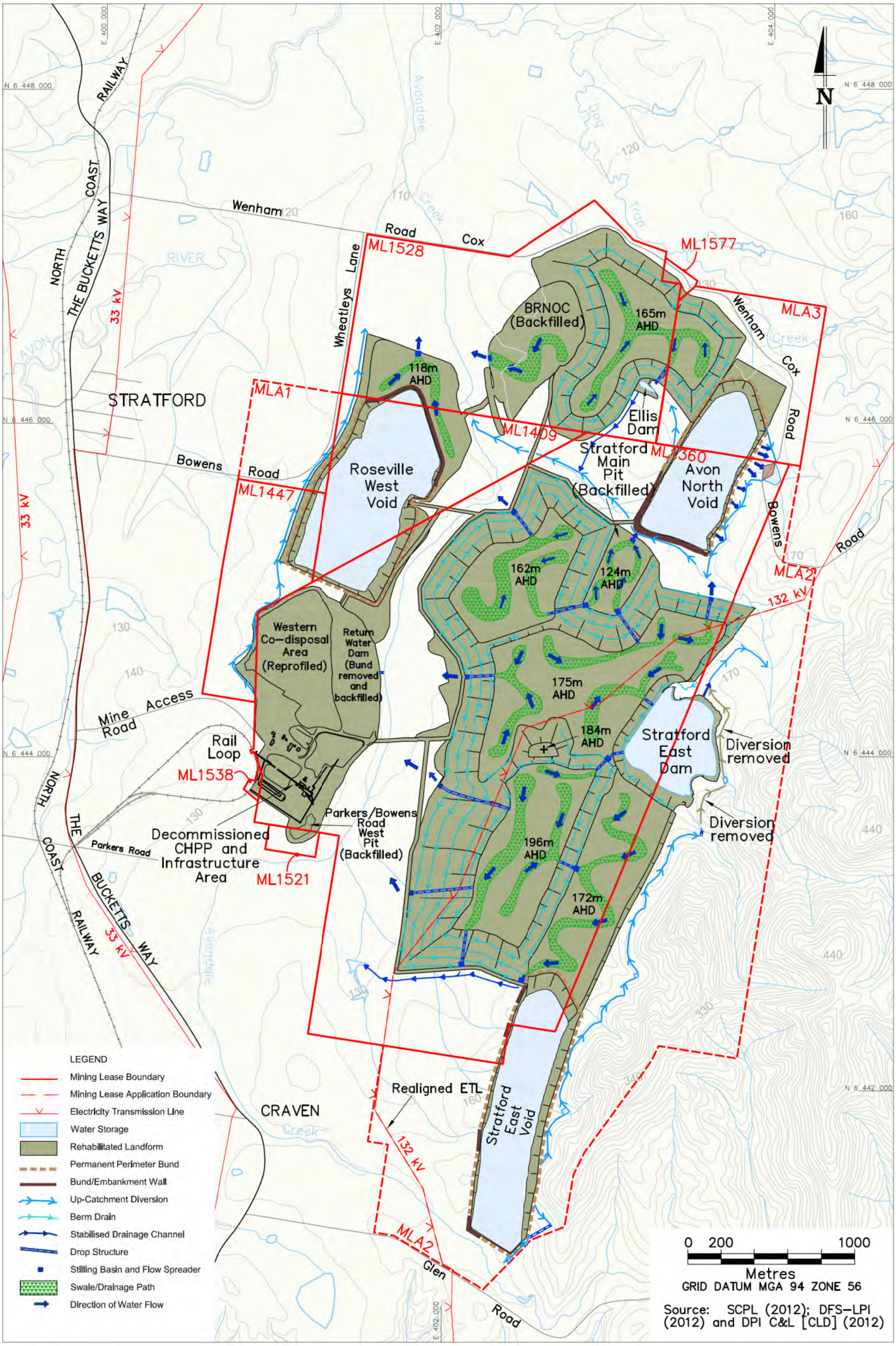


Figure 6 SEP Post-Mining General Arrangement

The progressive development of the SEP water management system is described in detail in the SEP EIS (Gilbert & Associates, 2012). The SEP water management system would integrate with the existing SMC water management system with the continued use of the contained water storages and other water management features described in Section 2.1. Runoff from upslope undisturbed areas and from stabilised rehabilitated areas would be diverted around areas of disturbance and to downstream receiving waters. Runoff from topsoiled/partially rehabilitated areas (likely to contain elevated suspended solids) would be directed to sediment dams[1] for gravity settling of sediment prior to release off site. Mine water, extracted from open pits and contained water storages, runoff from active waste rock emplacements or other areas disturbed by mining activities and runoff from haul roads or the CHPP area would either be directed to contained water storages, open pits or to Disturbed Area Dams (DADs). DADs would be sized consistent with the criteria for sediment dams in the existing SMC Site Water Management Plan, with pumped transfer of accumulated water back to contained water storages.

The approved SEP water management system is shown in schematic form in Figure 7. The SEP water management system is to be based on the existing SMC water management system with augmentations undertaken as required over the life of the SEP.

Features additional to those shown on Figure 7 include:

- Progressive installation of extensions to up-catchment diversions west of the Roseville West Pit and east of the proposed Stratford East Open Cut, and construction of an up-catchment diversion east of the proposed Avon North Open Cut.
- Development of new irrigation areas within the rehabilitated catchments of contained water storages, progressively on an as-required basis (i.e. as determined by periodic reviews of the site water balance), as new rehabilitated areas become available.
- Development of irrigation for dust suppression upon active waste rock emplacements.

[1] Sized in accordance with Landcom (2004) and DECCW (2008).

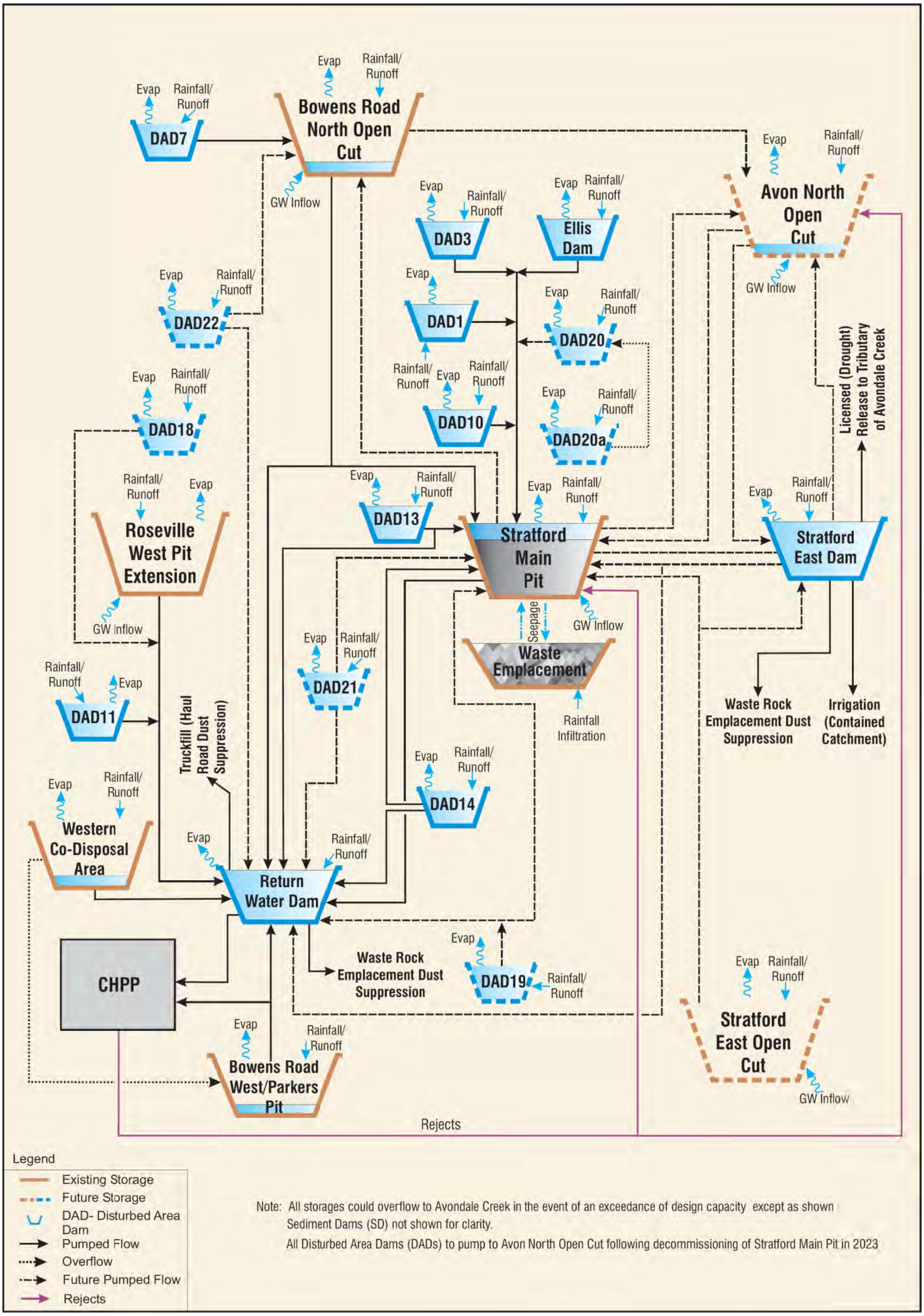


Figure 7 Approved SEP Water Management System Schematic

2.3 Approved Stratford Extension Project with Rocky Hill Coal Project Integration

There would be no major changes to the planned SEP water management system as a result of integration with the RHCP. As indicated in Section 1.0, the SEP was planned to commence in mid-2013. The SEP is now planned to commence in mid-2018 (i.e. 5 years later). The progressive development of the SEP and its water management system will similarly occur 5 years later than indicated in the SEP EIS (Gilbert & Associates, 2012) and Figure 3 to Figure 6 indicate the planned modified calendar years for the respective general arrangements. The only notable changes to these general arrangements would be:

a) an increased volume of rejects deposited in the Stratford Main Pit and (following completion of mining) the Avon North Open Cut (refer Section 3.0); and

b) the proposed haul road linking the SMC to the RHCP.

Within the SMC, the majority of the haul road would lie within the catchment of existing contained water storages or DADs. Only within the far northern portion of the SMC would the haul road be located outside these catchments – refer Section 5.0.

Figure 8 shows planned ROM tonnages (including the planned remaining tonnage prior to the commencement of the SEP – primarily sourced from the DCM). Processing of RHCP ROM coal at the SMC CHPP is planned to commence in mid-2019. Mining and processing of ROM coal from the SEP will be complete by approximately mid-2028, while processing of RHCP coal will continue until approximately mid-2034.

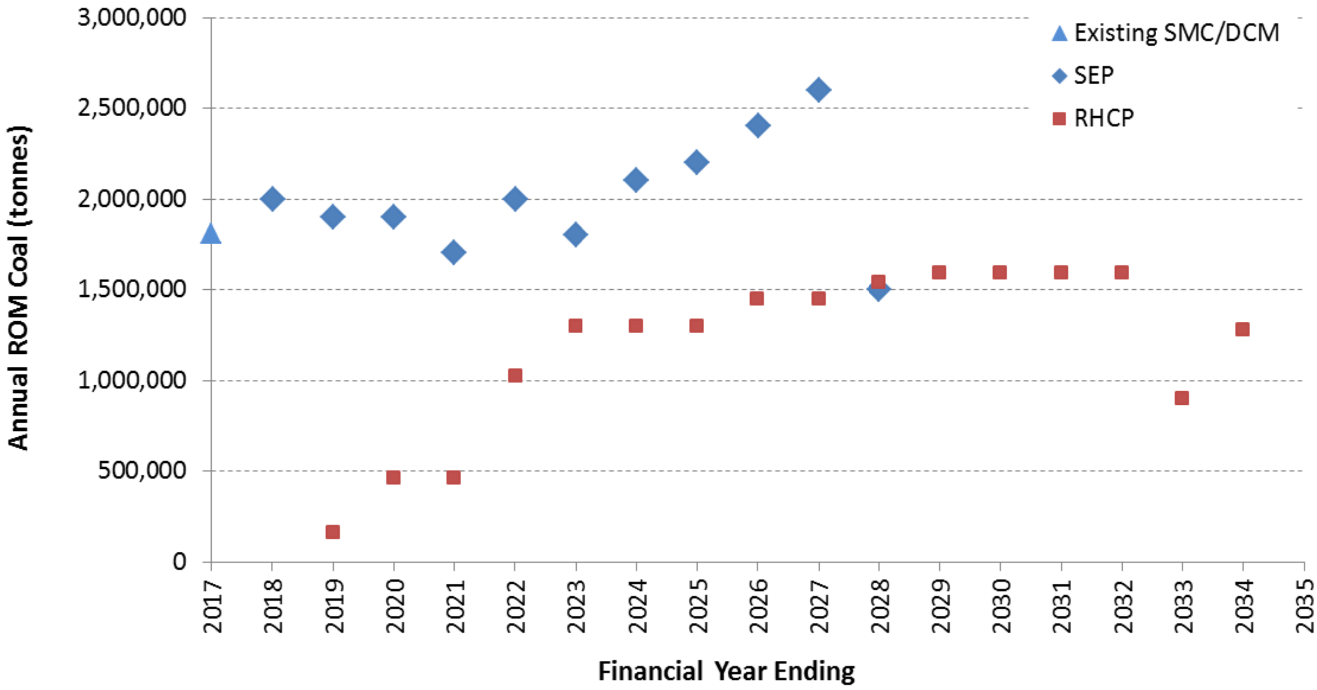


Figure 8 SEP and RHCP Planned Annual ROM Tonnes

3.0 REJECTS BALANCE

Rejects comprising coarse rejects and fine tailings are pumped as a slurry to the Stratford Main Pit for co-disposal. Therefore the available capacity of the Stratford Main Pit (which is also a contained water storage) has historically and will continue in the future to reduce with time. The mine plan for the SEP sees the waste rock emplacement to the west of the Stratford Main Pit enlarged including placement of waste rock into the Stratford Main Pit in between Year 2 and Year 7 (refer Figure 3 and Figure 4). On the basis of future mine layout plans provided for the SEP, it has been assumed that this would occur during the second half of 2022. Co-disposal of rejects to the Stratford Main Pit would continue until approximately July 2023 when mining in the Avon North Open Cut is complete and it becomes available as a rejects and water storage.

Additional rejects would need to be placed in both the Stratford Main Pit and the completed Avon North Open Cut as a result of processing of RHCP coal in the SMC CHPP. Figure 9 shows the comparative tonnages on an annual basis – from data supplied by Yancoal.

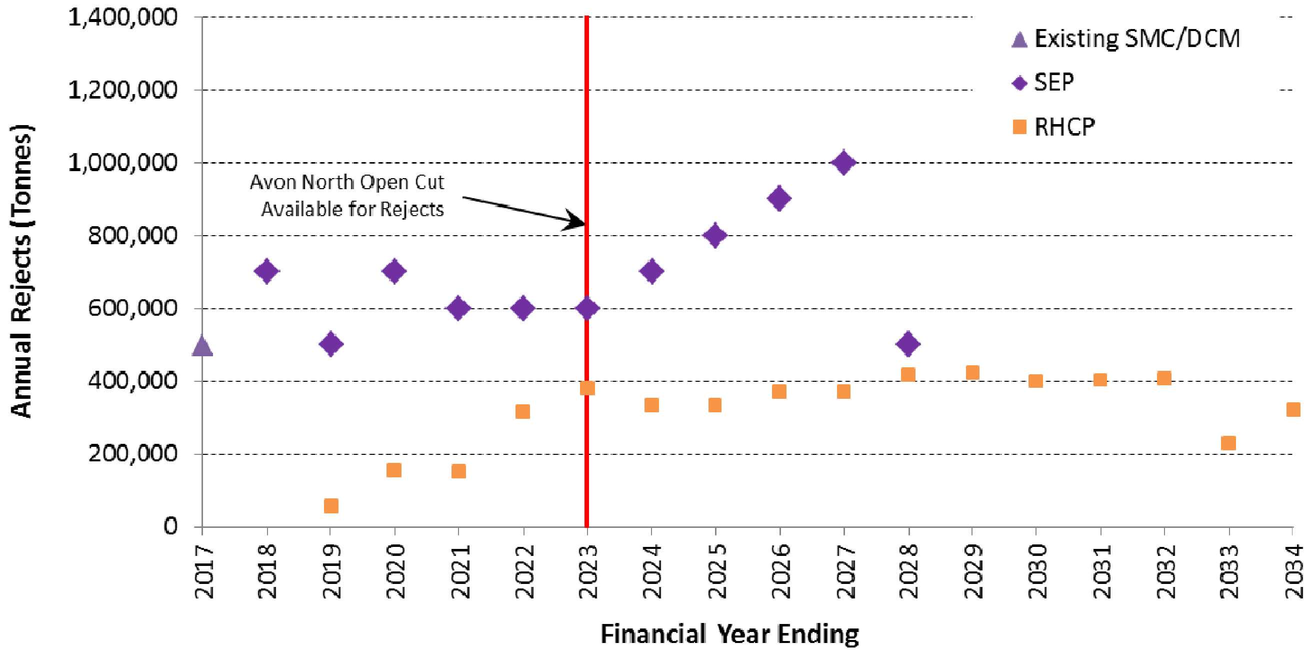


Figure 9 SEP and RHCP Planned Annual Rejects Tonnes

Calculation of the capacities of the Stratford Main Pit and the completed Avon North Open Cut was undertaken in order to assess their progressive capabilities for storing the planned rejects tonnages. The current capacity of the Stratford Main Pit was calculated from a survey (both above and below water) provided by Yancoal for 27 January 2016. The capacity of the completed Avon North Open Cut was calculated from the SEP future mine layout plan corresponding to the end of mining in the Avon North Open Cut. The following assumptions were made in the calculations:

- Rejects annual tonnages as provided by Yancoal and summarised in Figure 9.
- A rejects dry density of 1.2 tonnes per cubic metre – consistent with assumption in the SEP EIS (Gilbert & Associates, 2012).
- That the profile of the rejects measured in the January 2016 survey would be maintained as the rejects level rises within the Stratford Main Pit.
- A uniform rejects longitudinal gradient of 8% in the Avon North Open Cut void (based on Stratford Main Pit January 2016 survey profile) sloping from south (assumed discharge side) to north.

- Placement of waste rock within the Stratford Main Pit in November 2022, reducing its capacity. Figure 4 shows the extent of the reduced Stratford Main Pit.
- A current spill level of 115 metres Australian Height Datum (m AHD) for the Stratford Main Pit, rising to 120 m AHD in October 2022 after waste rock emplacement.
- A spill level of 122 m AHD for the Avon North Open Cut void.

Table 1 summarises the results of the calculations.

Table 1 Summary of Calculated Rejects Void Capacities and Rejects Volumes

Stratford Main Pit	
Capacity as at 27 January 2016	18,304 ML
Capacity prior to waste rock emplacement November 2022	14,253 ML
Capacity after waste rock emplacement November 2022	8,769 ML
Capacity at end of rejects storage 1 July 2023	8,246 ML
Volume of SEP rejects to be discharged	3,698 ML
Volume of RHCP rejects to be discharged	874 ML
Avon North Open Cut Void	
Capacity as at 1 July 2023	20,327 ML
Capacity as at 1 July 2034 (final void)	13,723 ML
Volume of SEP rejects to be discharged	3,250 ML
Volume of RHCP rejects to be discharged	3,330 ML

The calculations summarised in Table 1 indicate that:

- both rejects storages have adequate capacity to store the planned rejects tonnages at the assumed density;
- only a relatively minor volume of rejects from processing of RHCP ROM coal would be discharged into the Stratford Main Pit, with the majority discharged to the Avon North Open Cut void; and
- the volume of rejects discharged to the Avon North Open Cut void would approximately double with the processing of RHCP ROM coal but that only approximately one third of the capacity of the void would be occupied by the total planned rejects volume.

The above calculations resulted in the development of a series of storage characteristics (level-volume-area) at different points in time for the storage of water in each of the rejects voids (water stored on top of the rejects). These were used in subsequent water balance modelling (Section 4.0).

4.0 WATER BALANCE MODELLING

4.1 MODEL DESCRIPTION

A water balance model of the SEP water management system was developed to simulate the behaviour of the water management system over the project life. The model structure is generally per the schematic in Figure 7 – i.e. each storage shown in Figure 7 is included in the model. The model simulates daily changes in volumes of water in each storage in response to inflows (rainfall, runoff, groundwater, rejects water and pumped inflow) and outflows (evaporation, dust suppression use, irrigation loss, pumped outflow and spill [if any]). Modelling includes simulation of storage in the contained water storages, open pits, Stratford Main Pit waste rock emplacement (pore water storage) and DADs.

The model has been developed using the GoldSim simulation package and operates on a less than daily time-step (1/6th of a day). It uses the full period of available climatic data for the region from 1889 to 2015 inclusive[2]. The model simulates 127 possible mine life “realizations”, each of 18½ years’ duration – forecasting the period from the start of 2016 to mid-2034 (the end of RHCP ROM coal processing). Realization 1 uses climatic data from 1889 to 1907 inclusive, realization 2 uses data from 1890 to 1908, realization 3 uses data from 1891 to 1909 and so on. In order that recent climate be included in as many realizations as all other years in the record, climate data was “wrapped” with data from 1889 to 1908 added to the record after 2015. The results from all realizations are used to generate water storage volume estimates and other relevant water balance statistics. This method includes all recorded historical climatic events in the water balance model, including high, low and median rainfall periods. In this way, historically representative climatic realizations are produced which can be used to test the water management system over a wide range of climatic conditions. By ranking simulated outcomes, the model can be used to estimate the probability and consequences of different water management outcomes occurring.

The model was developed for the SEP EIS, as described in detail in Gilbert & Associates (2012) and remains substantially the same. Changes to the model assumptions and data to simulate the RHCP integration are described in Section 4.2 below.

4.2 MODEL ASSUMPTIONS AND DATA

4.2.1 CHPP Make-Up Demand

CHPP make-up was calculated as the water required to be made up to replace water pumped with co-disposed rejects. This rate is therefore related directly to the rate of ROM coal feed to the CHPP and the rate of production of rejects. These rates (annual tonnages) are summarised in Table 2 below, including the rates assumed in the SEP EIS (Gilbert & Associates, 2012) but with 5 years added to the SEP EIS dates to facilitate direct comparison.

[2] Daily rainfall and pan evaporation data sourced from the Data Drill system – refer https://www.longpaddock.qld.gov.au/silo/datadrill/

Table 2 CHPP ROM Coal and Rejects Rates

Financial Year Ending	ROM Coal Feed (Mt)		Rejects (Mt)	
	SMC*	SEP/RHCP Integration	SMC*	SEP/RHCP Integration
2017	1.8	1.8	0.5	0.5
2018	2.0	2.0	0.7	0.7
2019	1.9	2.1	0.5	0.6
2020	1.9	2.4	0.7	0.9
2021	1.7	2.2	0.6	0.7
2022	2.0	3.0	0.6	0.9
2023	1.8	3.1	0.6	1.0
2024	2.1	3.4	0.7	1.0
2025	2.2	3.5	0.8	1.1
2026	2.4	3.8	0.9	1.3
2027	2.6	4.0	1.0	1.4
2028	1.5	3.0	0.5	0.9
2029	-	1.6	-	0.4
2030	-	1.6	-	0.4
2031	-	1.6	-	0.4
2032	-	1.6	-	0.4
2033	-	0.9	-	0.2
2034	-	1.3	-	0.3

Mt = million tonnes.

* Approved SEP and Western Co-Disposal Area Coal Recovery.

The CHPP water demand was calculated based on a pumped rejects solids concentration of 28.5% (Gilbert & Associates, 2012) – i.e. the water pumped with the rejects was assumed to equal the make-up demand to the CHPP. The resulting annual make-up demands are summarised in Figure 10 below, including demands derived for the SEP EIS but with 5 years added to facilitate direct comparison. Estimated make-up for the SEP/RHCP integration peaks at a rate of 9.4 ML/day – less than the peak rate for the approved SEP which included processing of coal from the DCM. Note that this assumes no change in moisture from ROM to product coal.

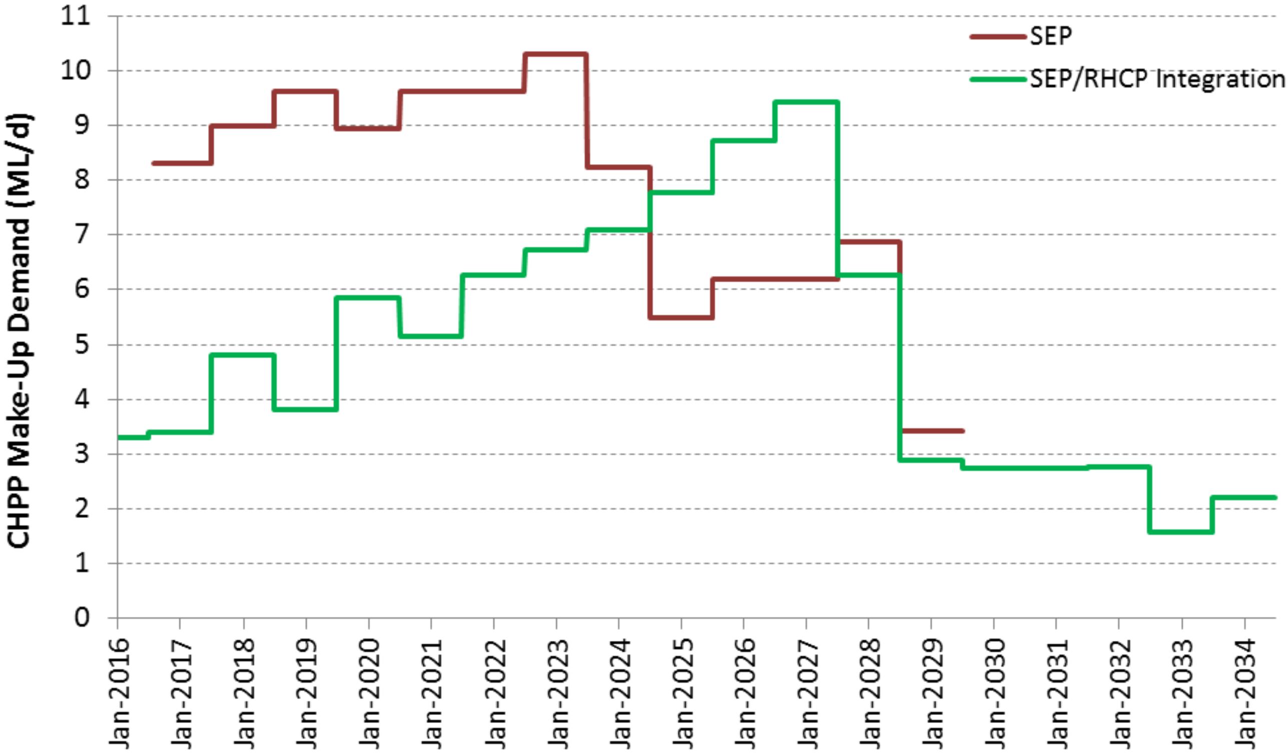


Figure 10 Estimated CHPP Make-Up Demand

4.2.2 Haul Road Dust Suppression Demand

Project haul road dust suppression demand was calculated based on estimated future haul road lengths, derived from annual haul road layouts and assumed widths to calculate haul road areas (Gilbert & Associates, 2012). For the RHCP, allowance was made for an additional length of haul road between the existing haul road adjacent to BRNOC and the SMC lease boundary near Dog Trap Creek (an additional length of approximately 2 km) plus an additional period of operation of this haul road (to 2034) (although in reality it is expected that a portion of this length of road would be sealed). Daily dust suppression demand was calculated as pan evaporation minus rainfall over the total road area multiplied by 1.35, to allow for higher evaporation off the dark, highly trafficked haul roads. Figure 11 summarises estimated haul road water demand averaged over all climatic realizations for the SEP/RHCP integration and for the SEP EIS but with 5 years added to facilitate direct comparison.

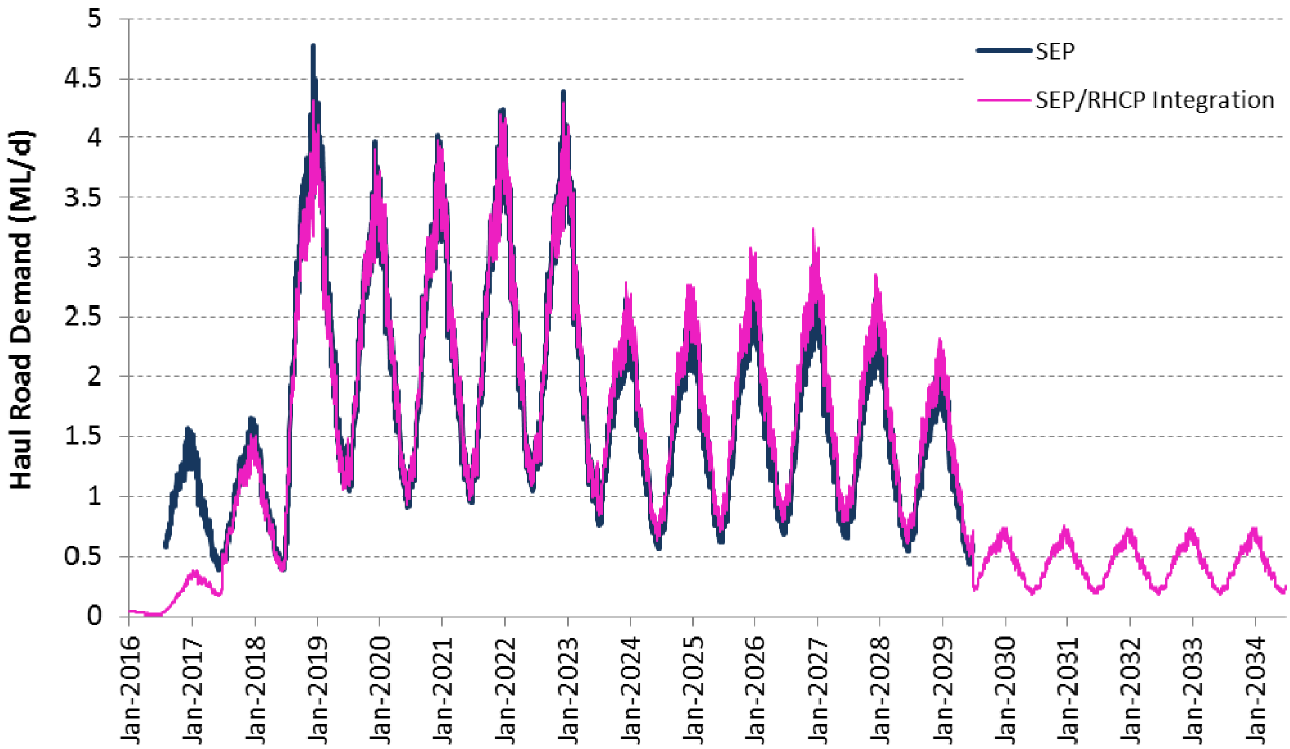


Figure 11 Estimated Haul Road Dust Suppression Demand

4.2.3 Active Waste Rock Emplacement Dust Suppression

In order to control dust generation from waste rock emplacement operations, "active" waste rock emplacements are to be watered in a similar fashion to haul roads (Gilbert & Associates, 2012). Areas were calculated from future mine layout plans provided for the SEP (e.g. Figure 3 to Figure 5). Daily demand was calculated by multiplying this area by pan evaporation minus rainfall multiplied by an "efficiency" factor of 67% (recognising that not all areas of waste rock emplacement may be able to be accessed for watering at any one time). Figure 12 summarises estimated waste rock emplacement dust suppression water demand averaged over all climatic realizations for the SEP/RHCP integration and for the SEP EIS but with 5 years added to facilitate direct comparison.

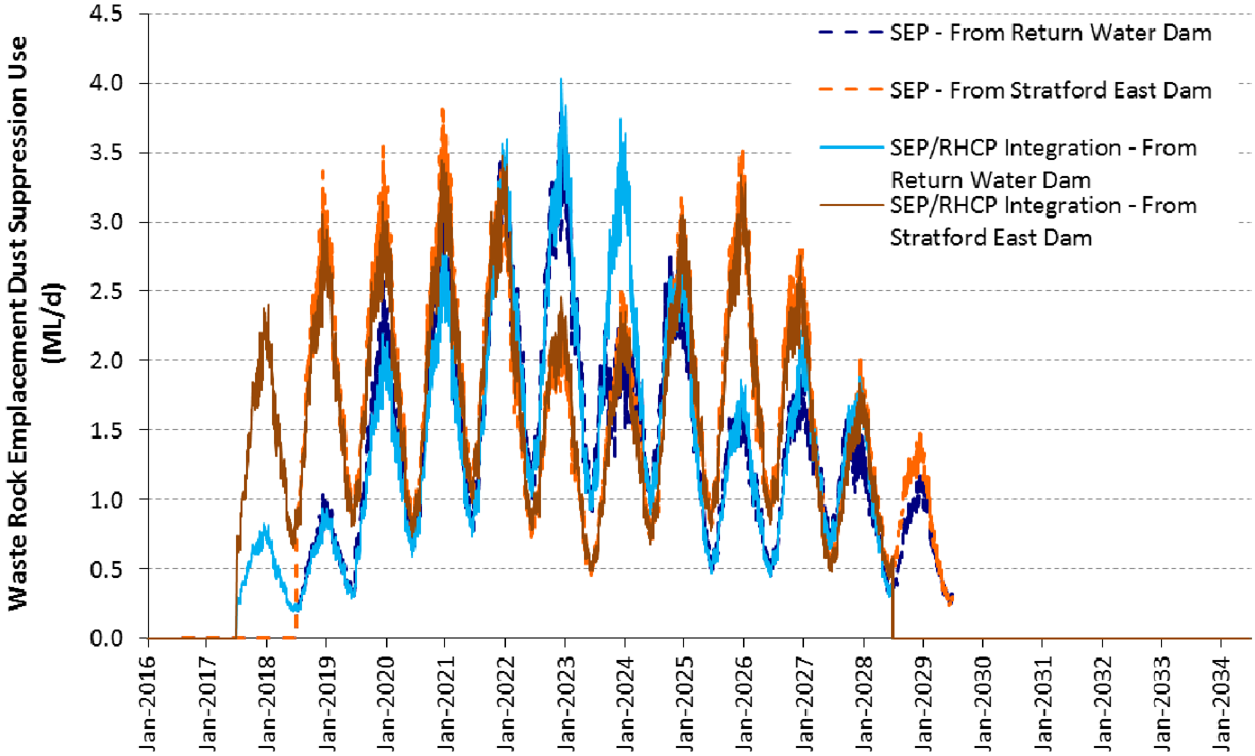


Figure 12 Estimated Average Waste Rock Emplacement Dust Suppression Use

4.2.4 Catchment Areas

Catchment and sub-catchment areas were calculated from current and future mine layout plans (Gilbert & Associates, 2012). The total catchment area reporting to the mine open pits, contained water storages and DADs varying over the mine life is shown in Figure 13. No change was assumed to the future catchment areas calculated for the SEP EIS except for a five year delay in SEP commencement and, at the end of mining activities associated with the SEP (in 2028), that storage catchment areas would remain constant until the end of RHCP coal processing in 2034.

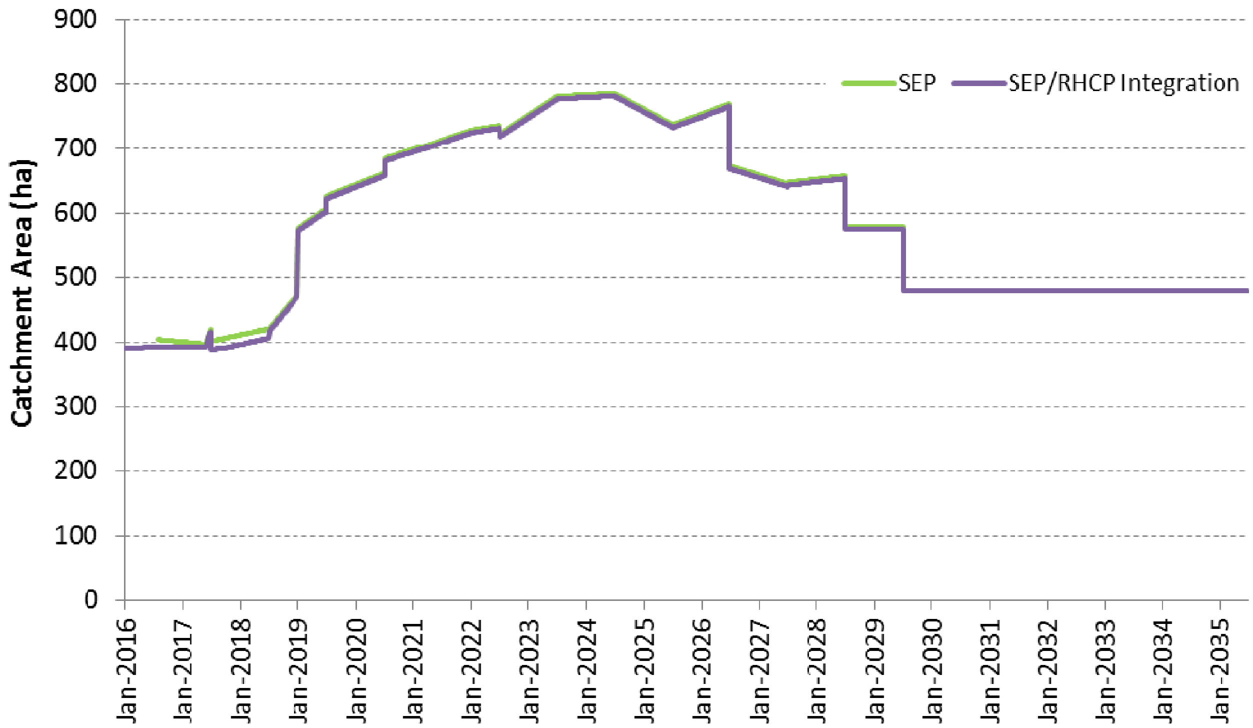


Figure 13 Modelled Total Catchment Area Versus Time

4.2.5 Storage Characteristics and Capacities

Storage characteristics (level-volume-area) were used in the model to calculate water surface area from simulated volume for the purpose of calculating evaporation and direct rainfall on water surfaces. Storage capacities were used to calculate spill risk and spill volumes for storages which were simulated to spill. No change to storage characteristics and capacities simulated as part of the SEP EIS (Gilbert & Associates, 2012) was assumed, with the exception of the Stratford Main Pit and the Avon North Open Cut void rejects storages – refer Section 3.0 and Table 1.

It has been assumed that waste emplacement would occur into the Stratford Main Pit in November 2022. Up to 13 months prior to this emplacement (i.e. October 2021) if the volume of water contained in the Stratford Main Pit was in excess of 8,243 ML[3] it was assumed that water would be pumped out to other contained water storages. This reduces the stored water inventory in the Stratford Main Pit in order to avoid simulated spills from occurring.

4.2.6 Pump Rates

Water management system pump rates were generally as documented in the SEP EIS (Gilbert & Associates, 2012), with the following changes:

- Stratford East Dam to RWD increased from 100 litres per second (L/s) to 250 L/s.
- BRNOC pump rate increased from 85 L/s to 300 L/s when either Avon North Open Cut is available for use as a rejects/water storage (post mining) or if the RWD level drops to a low level (to maintain supply to the CHPP and for haul road dust suppression).

These changes were undertaken to maintain water supply reliability given the changes in demand for the SEP/RHCP integration.

4.2.7 Groundwater Inflow Rates

Predicted groundwater inflow rates to open cut pits were assumed to not change from those given in the SEP EIS (Gilbert & Associates, 2012) which were taken from Heritage Computing (2012), except for a five year delay in SEP commencement and hence a five year delay to the corresponding years at which the predicted groundwater inflow rates were applied.

4.2.8 Initial Stored Water Volumes

Model simulations commenced on 1 January 2016, with an estimated total stored surface water volume of approximately 12,390 ML in all SMC water storages, including 10,180 ML in the Stratford Main Pit (based on bathymetric survey and water level data provided by SMC personnel).

4.3 MODEL RESULTS

4.3.1 Overall Water Balance

The overall system water balance for the SEP and the integrated SEP/RHCP, averaged over all climatic realizations is summarised in Table 3.

For the SEP, results are averaged over the 13 year simulation period undertaken for the SEP EIS while for the integrated SEP/RHCP, results are averaged over the 18½ year simulation period.

[3] 7,069 ML is 94% of the capacity of Stratford Main Pit after waste emplacement occurs (7,520 ML).

Table 3 Predicted Average Water Balance

Inflow Component	Average Inflows (ML/year)	
	SEP*	Integrated SEP/RHCP
Groundwater	451	371
Rainfall-runoff	3,267	2,921
Stratford Main Pit Waste Rock Emplacement Recharge	65	52
Tailings (co-disposed rejects) Water	2,395	1,505
TOTAL	6,178	4,849
Outflow Component	***Average Outflows (ML/year)***	
	SEP*	**Integrated SEP/RHCP**
Evaporation	733	856
CHPP Supply	2,805	1,762
Haul Road Dust Suppression	663	483
Waste Rock Emplacement Dust Suppression	1,114	657
Irrigation	748	606
DAD Overflow	117	107
TOTAL	6,180	4,471

* From Gilbert & Associates (2012)

Rainfall runoff provides the greatest average system inflow, accounting for 60% of total inflows, followed by water liberated from settling co-disposed rejects (31%). Average outflows are dominated by supply to the CHPP, accounting for an average 39% of all outflows.

On average there is an increase in predicted inflows over outflows for the integrated SEP/RHCP, likely due to the reduced demands, particularly later in the extended mine life (e.g. Figure 10 and Figure 11).

4.3.2 Overall System Performance

Water balance simulation showed that there were no simulated releases of mine water from the contained water storages in any of the 127 realizations simulated.

Predicted total stored water volumes (in all storages – including open cut pits) are shown in Figure 14. These probability plots show the range of likely total stored water volumes that are likely, with the blue plot representing the median or "most likely" volumes and the red/green plots representing the 5th/95th percentile volume plots. There is a 90% chance that the total water volume will fall in between the 5th/95th percentile volume plots. It is important to note that none of these plots represents a single climatic realization – these probability plots are compiled from all 127 realizations (refer Section 4.1) - e.g. the median volume plot does not represent model forecast volume for median climatic conditions. Also plotted as broken lines on Figure 14 are the corresponding probability plots from the SEP EIS (Gilbert & Associates, 2012), but with 5 years added to facilitate direct comparison. A similar overall pattern is evident in the plots for the SEP EIS as for the SEP/RHCP integration, although the starting total water inventory for the latter is higher (i.e. the starting volume is higher for the Modification simulation of the SEP/RHCP than for the SEP only simulation undertaken for the SEP EIS because water inventory at the SMC has since increased) and the simulation is for a longer period (to 2034).

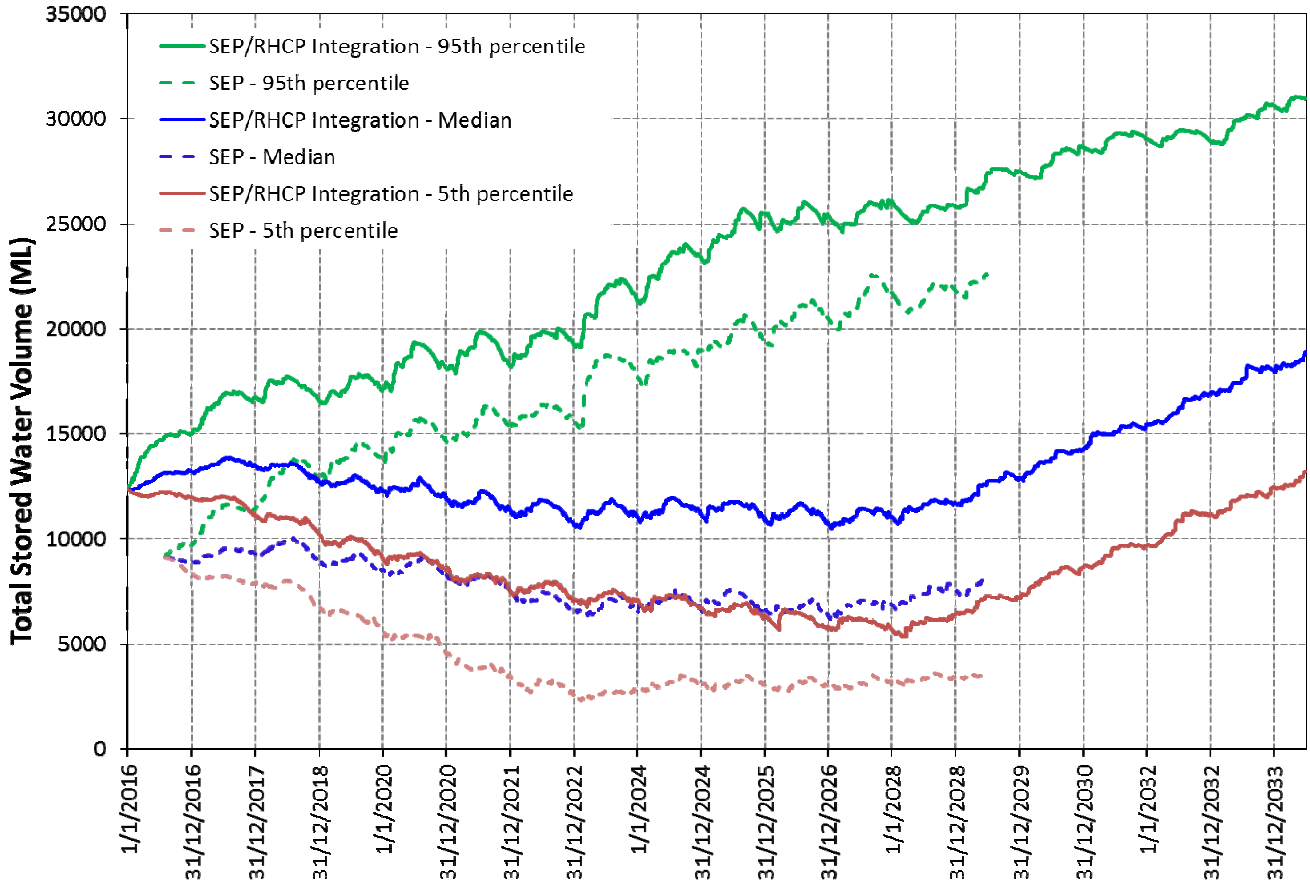


Figure 14 Predicted Total Stored Water Volume

Figure 14 indicates that the most likely (median) scenario would be for an overall increase of approximately 6,545 ML over the extended life of the integrated SEP/RHCP project compared with the estimated inventory at the start of 2016. The increase in modelled total inventory in the last 6 years is due to the reduction in demand in these latter stages (refer Figure 10 and Figure 11). However in these latter stages, the final voids of the RWOC (approximately 27,500 ML capacity), Stratford East Open Cut (approximately 48,000 ML capacity) as well as Avon North Open Cut (at least 13,723 ML capacity – refer Table 1) would be available for storage of water.

The Project would be operated with an operational risk of disruption to mining which could occur as a result of exceedance of the design capacity of the water management system and the need to store water in active open pits if required (refer Table 4). The operational risk as a result of this has been assessed by Yancoal and has been determined to be an economically and operationally acceptable risk.

Table 4 Predicted Risk of More than 200 ML Water Volume in Open Cut Pits

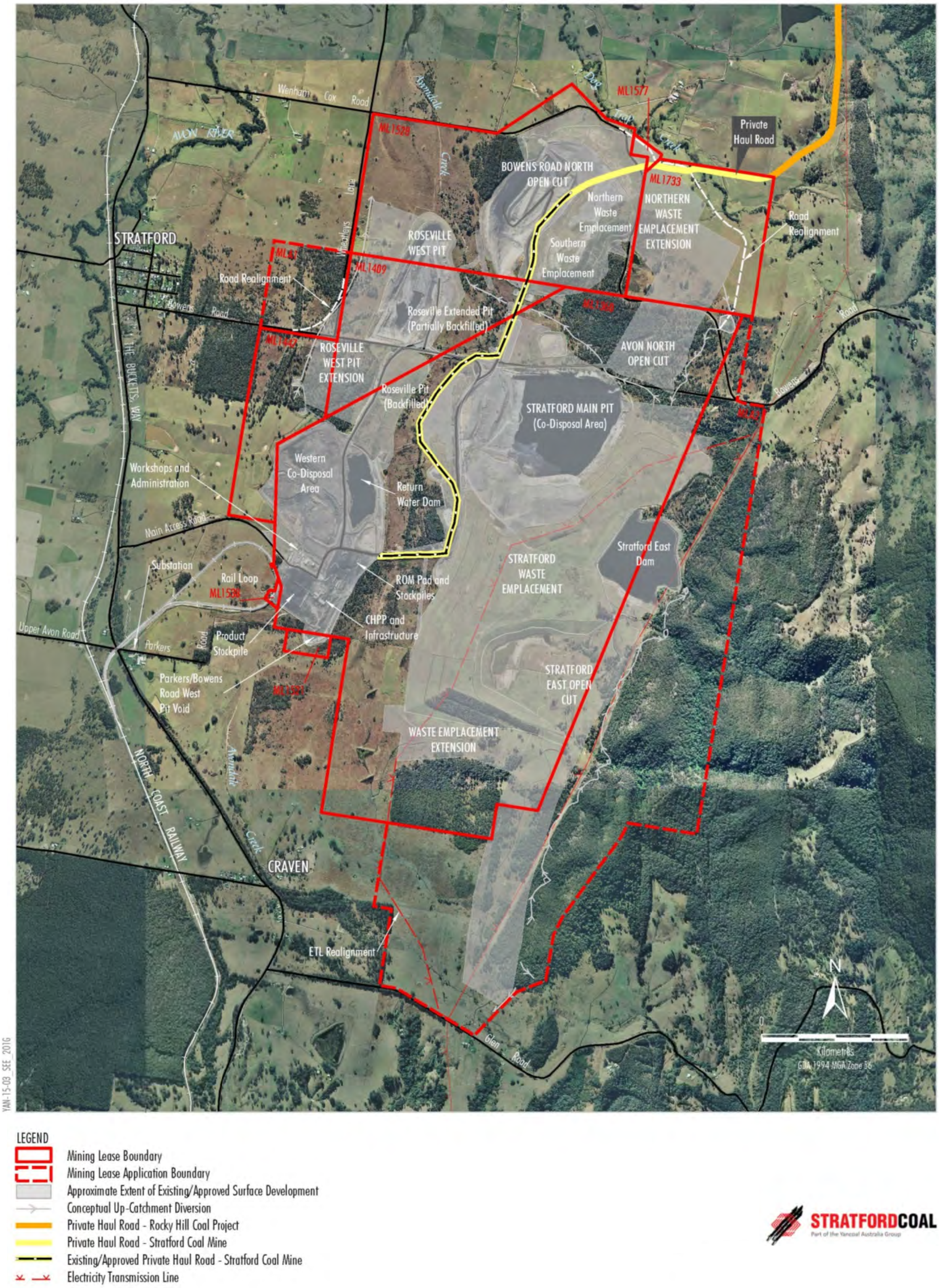
Open Pit	Percentage of days simulated where volume contained in open pit exceeded 200 ML					
	Average over all realizations		95th percentile value over all realizations		Highest of all realizations	
	SEP	SEP/RHCP Integration	SEP	SEP/RHCP Integration	SEP	SEP/RHCP Integration
Roseville West Pit Extension*	4.0%	3.2%	21%	17%	45%	39%
Avon North Open Cut*	0.8%	0.2%	0.4%	0.0%	27%	8.8%
Stratford East Open Cut*	2.5%	2.9%	11%	16%	23%	35%

* Up to end of mining of given open cut pit.

There were no water supply shortfalls simulated in any of the 127 realizations for either CHPP make-up supply or for haul road dust suppression.

5.0 POTENTIAL IMPACTS OF PROPOSED HAUL ROAD CROSSING ON DOG TRAP CREEK

As part of the SEP/RHCP integration, a private haul road is proposed linking the SMC CHPP to the RHCP. The proposed route of the haul road within the SMC is indicated in Figure 15.



STRATFORDCOAL

Source: LPI (2016); Geoscience Australia (2006); NSW Department of Industry (2016); SCPL (2016)

Figure 15 Proposed Haul Road Route

Within the SMC, the majority of the haul road would lie within the catchment of existing contained water storages, open cut pits or DADs. However to the north of the proposed Avon North Open Cut, within ML 1733, the proposed haul road is outside the above catchment areas and would lie within the catchment of Dog Trap Creek over which a crossing is proposed. The exact details of the crossing are subject to detailed design, however it is likely to comprise an elevated crossing using infrastructure such as prefabricated culverts or a low bridge structure.

5.1 DOG TRAP CREEK BASELINE CONDITIONS

Dog Trap Creek has its headwaters in the foothills east of the SMC and flows north-westwards passing north of the existing BRNOC. Avondale Creek joins Dog Trap Creek to the north of the SMC in an area known as Avondale Swamp, and Dog Trap Creek then flows into the Avon River approximately 1 km further north. Dog Trap Creek (upstream of the Avondale Creek confluence) comprises a tightly meandering, well defined, incised channel (refer Plate 1). The estimated longitudinal gradient of the creek near the proposed haul road crossing is approximately 0.4%. Dog Trap Creek in the vicinity of the SMC is a second and third order stream according to the Strahler classification system.

Plate 1 Dog Trap Creek North of Proposed Avon North Open Cut

Yancoal have records of flow depth and Electrical Conductivity (EC) in Avondale Creek just upstream of Wenham Cox Rd (monitoring site W5) which is upstream of the Dog Trap Creek confluence. The reporting catchment of Avondale Creek at this location is 20.5 square kilometres (km^2), compared with an estimated 17 km^2 for Dog Trap Creek upstream of the confluence with Avondale Creek (i.e. the catchment areas are quite similar in magnitude). Records indicate typical reductions in EC during times of increased stream water level and increases in EC at times of low stream water level. For the period of available data flow persistence is also indicated except in summer (although the cease-to-flow depth is unknown).

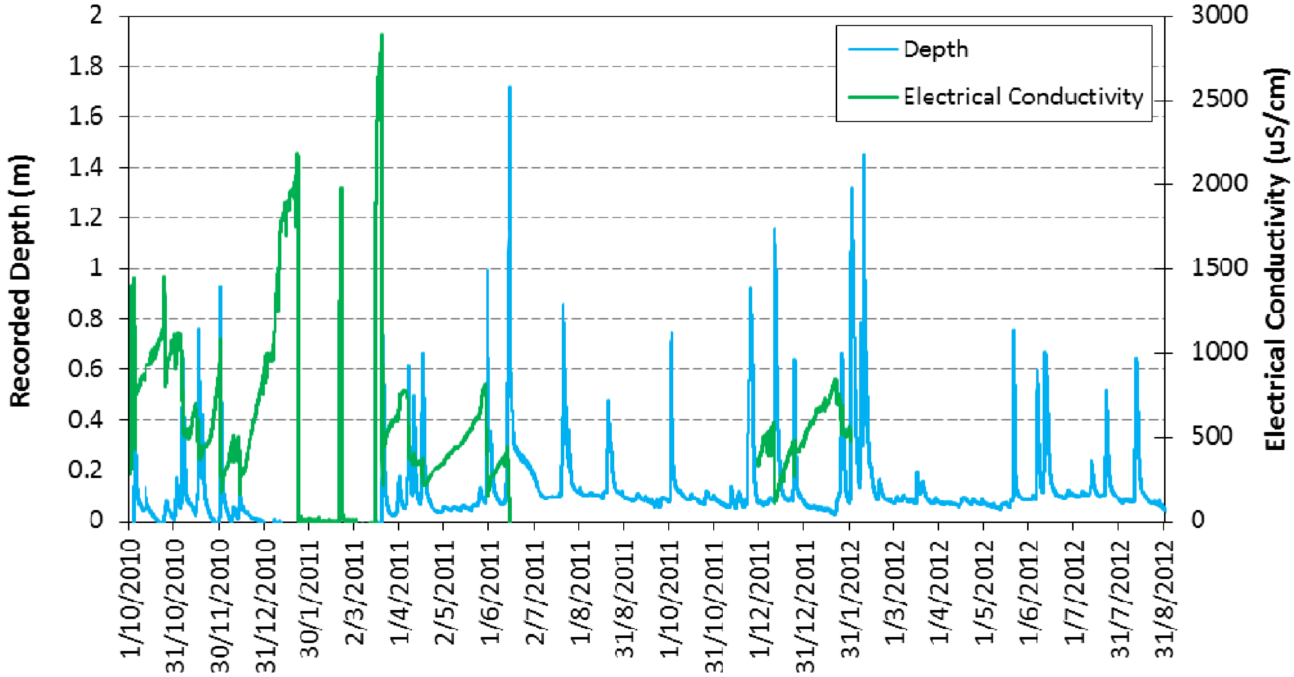


Figure 16 Recorded Depth and Electrical Conductivity – Avondale Creek at W5

No streamflow information is available for Dog Trap Creek. Anecdotal evidence suggests the creek has similar flow patterns to Avondale Creek, but may be regarded as ephemeral with less flow persistence, given its catchment comprises a higher proportion of timbered area and less flat, swampy terrain than the lower reaches of Avondale Creek.

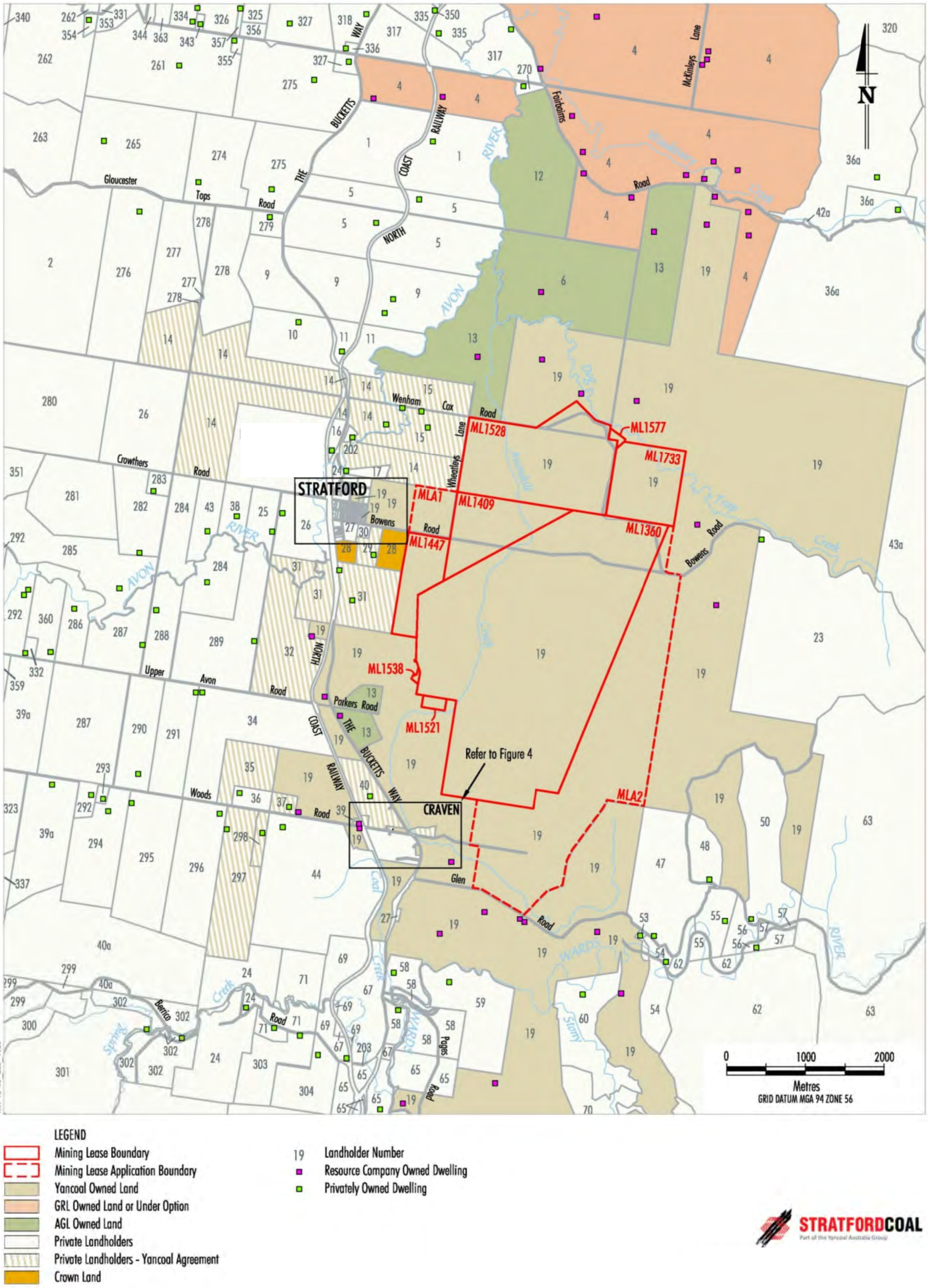
Water quality data from four monitoring locations on Dog Trap Creek is detailed in Gilbert & Associates (2012). Recorded total nitrogen and total phosphorus exceeded the ANZECC (2000) guidelines for protection of aquatic ecosystems on more than 50% of occasions at all locations. With regard to metals, the ANZECC (2000) guidelines for protection of aquatic ecosystems were exceeded for cadmium, chromium, copper, lead and manganese.

5.2 POTENTIAL IMPACTS AND MITIGATION MEASURES

The potential impacts of the proposed haul road and crossing on Dog Trap Creek are:

- increases in flood levels upstream of the crossing due to afflux (increase in flood level) caused by the crossing infrastructure;
- increased erosion downstream of the crossing due to alterations to the hydraulic regime; and
- discharge of sediment-laden water from the surface of the haul road, the road embankment and batters (no changes are anticipated to other water quality indicators).

The majority of the length of Dog Trap Creek upstream of the Avondale Creek confluence is located on Yancoal owned land (refer Figure 17). The potential for flooding impacts on non-Yancoal owned land is therefore limited.



Source: SCPL (2016); DFS-LPI (2016) and DPI-C&L (2012)

Figure 17 Land Ownership Plan

With respect to the potential for the Dog Trap Creek crossing to result in flooding impacts, it is noted that the nearest non-Yancoal owned land from the crossing is located approximately 1.8 km upstream. Given the significant length of the creek upstream, it is anticipated that discernible afflux at this location would be mitigated by appropriate crossing design (i.e. detailed design of the pre-fabricated culverts or low bridge structure would have the objective of minimising afflux from the crossing). This is expected to be readily achieved as there are already such crossings of local creeks in the area, including Wenham Cox Road on Avondale Creek and two existing SMC haul road crossings of Avondale Creek.

In addition, for comparative reference the AHD elevations of key points along and in the vicinity of Dog Trap Creek are:

- At haul road crossing – 124 m AHD;
- Property 23 dwelling (1.8 km from haul road crossing) – 163 m AHD;
- Property 23 Boundary (3.5 km from haul road crossing) – 192 m AHD; and
- Mapped upstream start of Dog Trap Creek (on Figure 17 – 4.1 km from haul road crossing) – 231 m AHD.

From review of the above elevations, it is noted that upstream private land holdings are significantly higher in elevation than the location of the proposed haul road crossing, which further emphasises that any afflux at these upstream privately owned locations is unlikely to be discernible.

The design of the crossing would also include appropriate armouring downstream of the crossing location in order to mitigate the effects of increased flow velocities through and over the crossing in high flows, in accordance with accepted road design practice.

The design of the haul road within ML 1733 and outside the catchment of existing contained water storages, open cut pits or DADs would include appropriate sediment control measures in accordance with Landcom (2004) and DECC (2008). These may include the following:

- appropriately sized roadside sediment basins (including monitoring of suspended solids in captured water);
- road surface sealing;
- roadside table drains including stabilised (armoured) outfalls;
- the use of straw bale filters or sediment fence;
- grassed filter strips; and
- regular monitoring and maintenance.

The as-designed control measures would be included in an update to the SMC Erosion and Sediment Control Plan.

6.0 CONCLUSIONS

The following summarises the key conclusions from this report.

Rejects Balance

- Both the Stratford Main Pit and the Avon North Open Cut void have adequate capacity to store the planned rejects tonnages that would result from the SMC, with processing of RHCP ROM coal at the assumed density.
- The volume of rejects discharged to the Avon North Open Cut void would approximately double with the processing of RHCP ROM coal but only approximately one third of the capacity of the void would be occupied by the total planned rejects volume.

Water Balance

- There were no simulated releases of mine water from the contained water storages or supply shortfalls in any of the simulations undertaken.
- On average there is an increase in predicted inflows over outflows for the integrated SEP/RHCP over the SEP alone, likely due to the reduced demands, particularly later in the extended mine life.
- The most likely scenario for the integrated SEP/RHCP project is for an overall increase of approximately 6,545 ML in total stored water volume over the extended Project life.
- There is a small predicted increase in the operational risk of disruption to mining which could occur as a result of exceedance of the design capacity of the water management system and the need to store water in active open pits if required. The operational risk as a result of this has been assessed by Yancoal and has been determined to be an economically and operationally acceptable risk.

Proposed Haul Road Crossing of Dog Trap Creek

- The potential impacts of the proposed haul road and crossing on Dog Trap Creek include increases in flood levels upstream, increased erosion downstream and discharge of sediment-laden water from the surface of the haul road, the road embankment and batters.
- The potential for flooding impacts on non-Yancoal owned land is limited due to the majority of the length of Dog Trap Creek upstream of the Avondale Creek confluence being located on Yancoal owned land.
- The nearest non-Yancoal owned land from the crossing is located approximately 1.8 km upstream and the creek invert level rises significantly upstream of the crossing. Appropriate crossing design should be able to limit flood level increase at upstream privately owned locations such that it was not discernible.
- The design of the crossing would include appropriate armouring downstream of the crossing location in order to mitigate the effects of increased flow velocities through and over the crossing in high flows, in accordance with accepted road design practice.
- The design of the haul road within ML 1733 and outside the catchment of the existing SMC water management system would include appropriate sediment control measures in accordance with relevant standards.

7.0 REFERENCES

ANZECC/ARMCANZ (2000). "National Water Quality Management Strategy Paper No. 4 - Australian and New Zealand Guidelines for Fresh and Marine Water Quality". Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, October.

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