Prepared for
Cadia Holdings Pty Ltd
ABN: 95 062 648 006

Study Report

Cadia East Dust Suppression Pre-Feasibility Study

27-Apr-2023
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Doc No. 730-22016-PF-REP-0009

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Client: Cadia Holdings Pty Ltd

ABN: 95 062 648 006

Prepared by

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Executive Summary

Cadia East UG Mine (CEUG) is located approximately 25 kilometres from the city of Orange in central west New South Wales and is 250 kilometres west of Sydney. As a part of the early work for the PC1-2 project, the Western Ventilation project undertook dust emissions testing from the recently installed VR81 surface fans. The purpose of the testing was to establish a base case for specifying the operating requirements for the future VR51 and VR11 fans which are required for PC1-2 to commence production. The testing highlighted that the Cadia Valley Operations (CVO) are currently exhausting significant dust load emissions from the operating caves.

CVO engaged a third-party ventilation specialist to validate the testing results and to provide recommendations on dust mitigation measures to achieve compliance with current allowable dust emission levels as well as measures for reducing the dust loading and subsequent maintenance requirements on the fans.

CVO subsequently engaged AECOM to undertake a Pre-Feasibility Study (PFS) including a technology assessment, with the support of a dust management subject matter expert from the University of Wollongong (UoW).

The integration of the dust suppression and extraction equipment, capital and operating cost is outlined in this report.

Previous Studies

A concept study was undertaken by a third-party ventilation specialist in 2022 (22400-0000-VEN-REP-001) for the dust suppression. A wet scrubber system was selected in the concept study as the most efficient technology to reduce the dust content at the exhaust. However even with the most optimistic performance (77%-88%) of the wet scrubber, the emission targets will not meet the requirements recently set by the NSW Resources regulator.

In theory a dry filtration system in the return airways would have the improved efficiencies that would satisfy the emission requirements. However, the return air way infrastructure would do nothing to improve the underground environment for the operational and maintenance workforce. Furthermore, the capital costs of a dry filtration system would be absurdly high because the filtration costs are approximately proportional to flow rate. The total exhaust flow rate for the mine is approximately 2000 m3/sec and to filter all that air would cost in the order of $50M of direct costs, in addition to the filtration system the following would be required:

- Development mining to create space for the filtration units.
- Approximately 2MW of additional ventilation demand power to overcome the pressure drop across the filter media.
- Independent system for removing the captured dust (rather than using the existing materials handling system).

Total costs of a dry filtration in the return airways would be approximately $100M. This approach would also have extremely high operating costs with the regularly cleaning of filter media and the increased power costs for the ventilation.

Pre-Feasibility Study Strategy

While this project has used some of the inputs from the original concept study a different approach has been taken to address the dust. The strategy of the PFS includes the following:

- Proactive approach to address the dust at the sources rather than at the exhausts.
- Moisture addition to the ore to reduce the amount of airborne dust particles produced from the ore.
- Dry filtration only where wet dust suppression is not possible, air flow rates are lower and dust concentrations higher.

Key inclusions of the PFS scope are:

- Analysis of available dust measurement data vs allowable dust concentrations.
- Identify major sources of dust underground.

- Undertake a Technology Assessment to assess options for dust management and mitigation.
- Multi Criteria Analysis including options assessment and recommendation of the preferred technology for PFS level engineering development.
- Undertake PFS level engineering design for the integration of the dust suppression technologies with existing plant.
- Developing a Class 2 capital cost estimate (-20% to +25%) and a level 3 execution schedule.
- Identifying and managing risks and driving improved safety outcomes.

Basis of Design

There are two dust concentration limits that are being targeted by the project:

- Underground and above ground dust exposure limit to workers.
- Dust discharge limit at each individual vent raise.

The aim of these limits is to ensure the health, safety and wellbeing of workers and neighbouring residents, and to minimise the impact of dust generated by mining on the surrounding environment. These limits are outlined in the following table:

Table 1 Dust Concentration Limits

Limit Name	Location	Limit Type	Limit (mg/m3)	Source
Exposure	Working Areas	Respirable Crystalline Silica	0.05 (TWA over 8 hrs)	Safe work Australia
Emission	Exit of Vent Raises	Total Suspended Particles (TSP)	20 (per point source)	NSW Resources Regulator

To achieve these dust limits, a variety of controls were considered, assessed and proposed for CVO's consideration.

Dust measurement data has been analysed at various infrastructure areas as well as at the exhaust raises and is listed in the 730-22018-PF-REP-0005.

Physical Scope

The Cadia East dust suppression project scope includes the following:

- Extraction Level drawpoint spray trial. Post successful trial, roll out of the sprays across the remaining drawpoints and extraction drives.
- PC1 ROM bin tipple high pressure water sprays, including high pressure pump and water filtration.
- PC2 ROM bin tipple (PC2E, PC2W & PC2-3) Dry Scrubber filtration system tied into the existing dust extraction ductwork, or alternative primary ventilation changes to remove tipple dust extraction fans and ducting as detailed in separate report to be undertaken by the Newcrest Ventilation team.
- ROM Feeder sprays for dust suppression and bulk moisture addition.
- COB feeder water addition and skirt modifications.
- Conveyor transfer station skirt modifications.
- Multiple moisture analysers.
- Electrical, Instrumentation and Control (EIC) supporting infrastructure to the new equipment in each area.

The scope for PC1 tipple and PC2 tipples differs because of the current primary ventilation arrangement in the PC2 Tipples. The PC2 tipples have exhaust ventilation ducts which prohibit the use of high pressure water sprays. Scoping the PC2 tipples dust suppression with dry scrubber arrangement allows a comparison to be made between dry scrubber dust suppression with current exhaust ventilation arrangement and high pressure water sprays with primary ventilation modifications to remove the exhaust ducting for each of the PC2 ROM bin tipples. This will be confirmed in the next phase of engineering.

Execution Plan

The Integrated Owners Team (IOT) delivery strategy has been recommended as the optimal delivery method for the project as it leverages existing capability at CVO, offers improved schedule outcomes, provides a high degree of owner control to assist with the mine design interface and is best suited for execution in a brownfield environment with a staged delivery.

Based on an IOT delivery strategy, the project execution has been further defined and reflected in the estimate and schedule. The plan is centred on the following key points:

- Engagement of an Engineering Service Provider (ESP) for detailed design and to support the Newcrest IOT.
- Competitive, fixed price packages for the procurement of the equipment and commodities.
- Bulk materials sourced from local Australian vendors (steel, concrete, piping, cable, etc).
- Local Cadia construction contractors with specific installation and commissioning expertise in the underground mining environment and working at CVO, to be led by incumbent Newcrest team members who can leverage experience on delivering recent similar projects and who also have established relationships with the key CVO stakeholders.
- Multidiscipline construction contracts for the major scope areas.

Capital Costs

The capital costs (CAPEX) associated with the underground materials handling system and infrastructure have been estimated from first principles to achieve a Class 2 (±25%) estimate as per the PRJ-340-05-C *Newcrest Estimating Standards and Guidelines*. The base date for the estimate is Q2 2023 and the base currency is Australian dollars.

The capital cost estimate for the fixed plant and equipment, inclusive of all direct and indirect costs, excluding owners' costs and escalation, is summarised in Table 2 below.

Table 2 Infrastructure CAPEX Summary

WBS	WBS Description		AMOUNT $AUD
2000	**Underground Mine**	**$**	**30,523,448**
2100	**Common Decline**	**$**	**6,152,769**
2130	Incline Conveyor Transfer Stations	$	810,446
2140	Underground Mine Services & Facilities	$	5,342,323
2300	**PANEL CAVE 1 (formerly Lift 1)**	**$**	**4,779,153**
2330	PC1 Undercut, Drawpoints and Roads	$	2,661,351
2340	PC1 Ore Crushing	$	1,044,486
2350	PC1 Horizontal Conveyors	$	462,381
2360	PC1 Horizontal Conveyor Transfer Stations	$	147,052
2370	PC1 Underground Mine Services & Facilities	$	463,883
2400	**PANEL CAVE 2 (formerly Lift 2)**	**$**	**20,364,665**
2430	PC2 Undercut, Drawpoints and Roads	$	7,576,108
2440	PC2 Ore Crushing	$	10,161,682
2450	PC2 Horizontal Conveyors	$	1,398,503
2460	PC2 Horizontal Conveyor Transfer Stations	$	455,233
2470	PC2 Underground Mine Services & Facilites	$	773,138
4000	**Surface Infrastructure**	**$**	**291,613**
4100	**Surface Infrastructure - On Site**	**$**	**291,613**
	Total Direct Cost		**31,588,199**
7000	**Project Delivery Management**	**$**	**365,637**
7500	**Spares**	**$**	**305,637**
7600	**Commissioning**	**$**	**40,000**
7700	**Vendor Representation**	**$**	**20,000**
8000	**Other Capitalised Costs**	**$**	**2,193,553**
8100	**Integrated Owners Team & ESP**	**$**	**2,193,553**
	Total Indirect Cost		**2,559,190**
9000	**Contingency/Escalation**	**$**	**8,536,847**
9100	**Contingency**	**$**	**8,536,847**
	Total Cost	**$**	**42,684,237**

Execution Schedule

The Execution Schedule has been broken into the following three phases.

Phase 1 – Engineering & Procurement

Phase 2 – Construction and Installation high priority areas

Phase 3 – Construction & Installation low priority areas

A summary of the execution schedules is provided in the figure below.

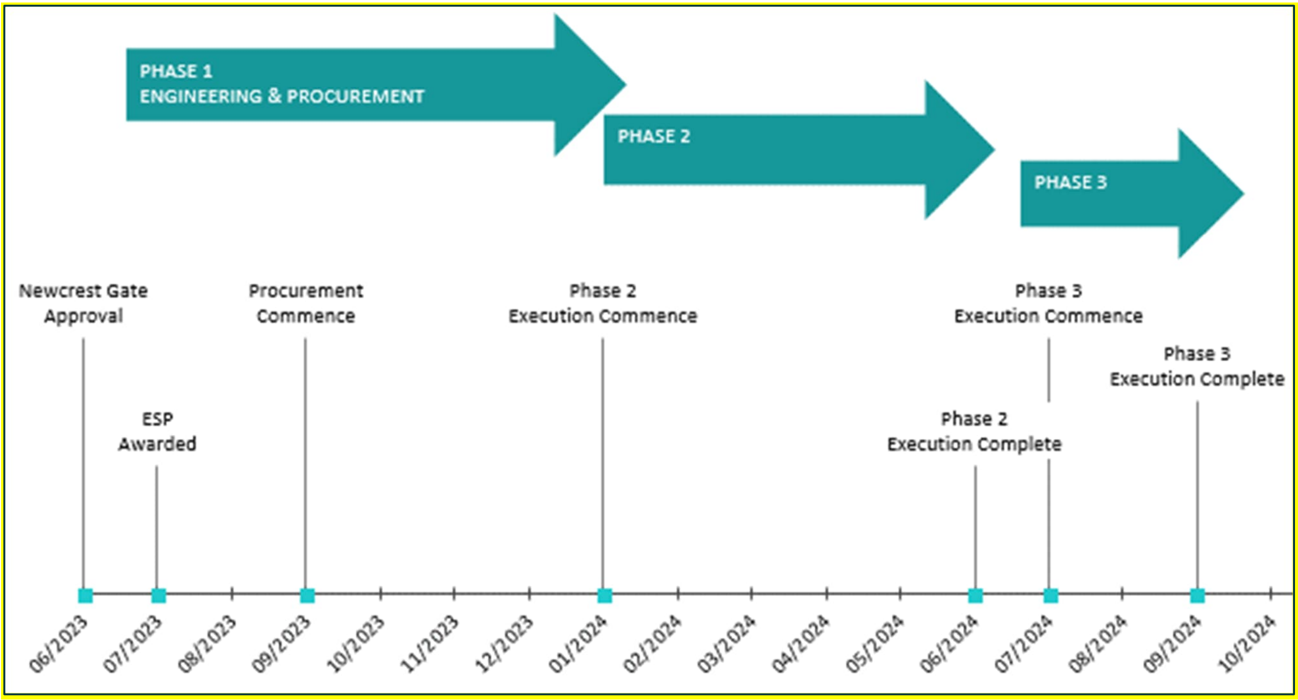

Figure 1 Cadia East Underground Dust Suppression Schedule

Opportunities

The following major opportunities have been documented during the PFS.

- There is the opportunity to reduce capital costs and schedule by reducing the scope of the project. Once phase 2 of the scope is complete dust measurements are required to be taken to confirm the effectiveness of the control measures. Once the overall objective is met where the operating environment underground and the vent raise emissions are satisfactory the remaining phase 3 scopes can be removed.
- Long lead equipment such as MCC cells may be procured by NML and free-issued to the site contractor for assembly / installation.
- Long lead equipment such as Remote I/O Panels may be procured by NML and free-issued to the site contractor for assembly / installation.

Risks

The following major risks have been documented during the PFS.

- Equipment lead time may be further extended in the current market dynamics.
- The extraction level roll out of is dependent on the outcome of the trials.
- If the above strategies does not result in satisfactory exhaust emissions then future exhaust air filtration of a partial stream of the return airways can be undertaken. The size of this system has not been included in the estimate as it is expected that it will not be required. The ability to add additional infrastructure to improve the exhaust air quality (after the dust suppression at the source is implemented) is a benefit as it provides addition dust suppression options.

Path Forward

The path forward involves the project moving forward through the approvals gate into an abbreviated Feasibility Study. focussing on market engagement to complete equipment and spray trials to facilitate firming up the Capital Estimate before moving into Detail Design.

The following way ahead is proposed:

- CVO approving the Feasibility Study phase of the Project by May 2023.

- IOT to confirm the approach for the PC2 ROM bin tipples by undertaking a Feasibility study of alternative ventilation arrangements, to confirm whether the PC2 Tipples will have high pressure sprays or dry scrubber.
- Market engagement to formally tender the equipment.
- Undertake extraction level spray trials to facilitate firming up the Capital Estimate before moving into Detail Design.
- Identifying resources for the IOT roles and assembling the team for execution.

1.0 Introduction

1.1 Background

Cadia is one of Australia's largest gold mining operations and is 100 percent owned by Newcrest. It is located approximately 25 kilometres south-west of the city of Orange in central west New South Wales and is 250 kilometres west of Sydney.

Cadia currently comprises one operating mine - the Cadia East (CEUG) underground mine, a large-scale mining operation using caving mining methods.

As a part of the PC1-2 cave expansion projects, the CVO projects undertook dust testing from the recently installed VR81 surface fans to establish a base case for fan selection on the future VR51 and VR11 fan installations, required for PC1-2 to commence production. During this dust testing the Cadia East Operations realize they are currently experiencing significant dust load emissions from the operating panel caves placing the existing mine development approvals and the associated regulatory conditions of consent at risk.

Following this, CVO engaged BBE to undertake a study to validate the testing results via analytical means and propose mitigation measures that can be implemented to reduce the dust loading as presented to the surface fans. The BBE Technical report proposes to assess the installation of three wet scrubbers located in horizontal return airways feeding VR81, VR51 and VR11 as a Pre-Feasibility Study. This may mitigate the larger dust particle sizes, however, may not remove smaller particles.

CVO then engaged AECOM seeking a complete solution to mitigate the dust issue onsite. The aim of this PFS is to identify and select a holistic solution to mitigate the dust issue onsite.

1.2 Purpose of the Pre-Feasibility Study (PFS)

The purpose of this PFS is to progress the engineering design and execution planning to support development of a capital cost estimate and implementation plan to mitigate the dust issue onsite. This information will be used to support Newcrest's internal approvals for the Cadia East Dust Suppression Project. The following key tasks form part of this PFS:

- Review of work completed to date.
- Complete PFS level engineering for the infrastructure design.
- Development of engineering drawings, including:
    - Process Flow Diagrams.
    - General Arrangement Drawings.
- Development of a -20% to +25% Capital Cost Estimate in accordance with Newcrest Class 2 estimate guidelines.
- Development of a project execution schedule to support the capital cost estimate.
- Capture of project risks and opportunities.
- Establish cost profiles for wet (high pressure sprays) and dry (dry filtration) approaches to dust suppression of the ROM bin tipples.

1.3 Scope of Facilities

The facilities are grouped appropriately with the major elements of the works described by the figure and table below.

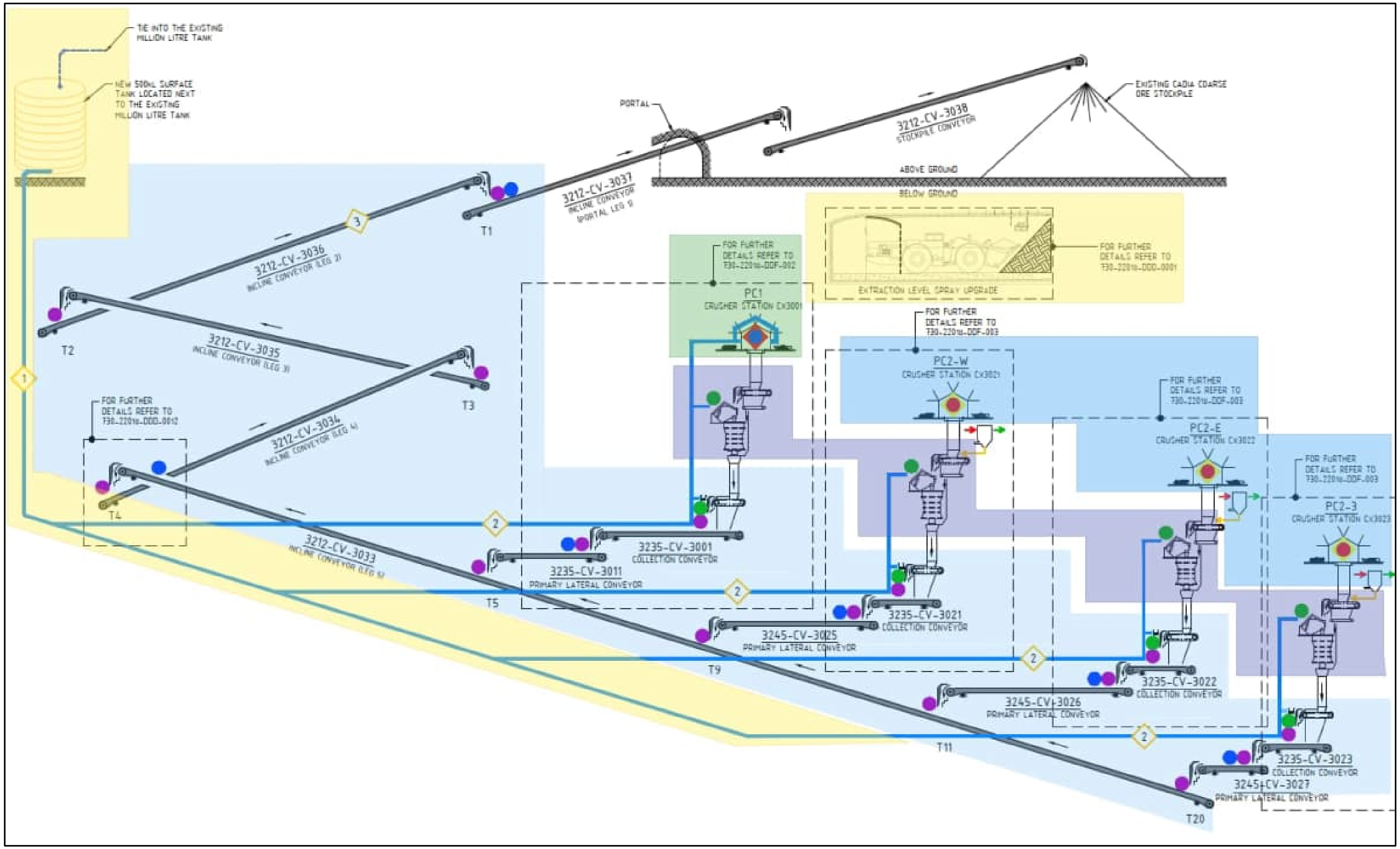

Figure 2 Scope of Facilities

Note the colours indicate the grouping and is described further in Table 3 below.

Table 3 Scope of Facilities

Location	WBS Included	Scope of Facilities	Inclusions
Extraction Levels	WBS2330 WBS2430	Extraction level sprays	The PC1 Extraction Level Spray upgrade trial will be undertaken to determine the effectiveness and durability of several different extraction level dust suppression strategies. The trial would include the following level of dust suppression defined further in this PFS report: • Basic extraction level spray upgrade • Intermediate extraction level spray upgrade • Advanced extraction level spray upgrade The most effective solution from the PC1 extraction level spray trial will be implemented in the balance of the PC1 Extraction level and across the PC2 Extraction Levels
PC1 Tipples	WBS2340	PC1 Tipple High Pressure Dust Suppression & Bulk water Addition	The PC1 Tipples would include High Pressure Dust suppression sprays including below components: • A filtration system to filter the raw water • High pressure positive displacement pump, • Duty / Standby Spray bars with valving located at the crusher staiton
PC2 Tipples	WBS2440	**Option 1 -** PC2E, PC2W and PC23 Dry Air filtration	The PC2 Tipples Option 1 would include a new Dry scrubbing system incorporating the following: • Two new dry air filtration skid mounted scrubbers for each crusher station. • A new compressor to provide clean dry compressed air to the dry scrubber to reverse pulse the filters for each crusher station. • New interconnecting ductwork from the existing ductwork to the intake of the dry scrubbers. • New mixer and water pump to transport the collected dust back to each ROM feeder as a slurry.

Location	WBS Included	Scope of Facilities	Inclusions
			• Development chamber to suit the positioning of a scrubbers (PC2-W only).
		Option 2 – PC2E, PC2W and PC23 High Pressure Dust Suppression, Bulk Water Addition and Primary Ventilation Changes.	The PC2 Tipples Option 2 would include new a Tipple High Pressure Dust suppression system incorporating the following: • A filtration system to filter the raw water • High pressure positive displacement pump, • Duty / Standby Spray bars with valving located at the crusher station • Primary ventilation changes as detailed in separate report to be undertaken by the Newcrest Ventilation team
Crusher Stations	WBS2340 WBS2440	Bulk Water Addition at the ROM Feeder and Crusher Throat	Each Crusher Station would include the bulk water addition incorporating the following requirements: • Low pressure bulk water addition at each ROM feeder discharge including piping and low pressure sprays. • Flow control and Flow indication of the bulk water addition.

Location	WBS Included	Scope of Facilities	Inclusions
Collection Conveyors & Transfer Stations	WBS2350 WBS2450 WBS2360 WBS2460 WBS2120	Bulk Water Addition at the COB Feeder Dust Sprays & Skirt Modifications at every Transfer Station	The transfer station modifications would include the following • Bulk water addition at the discharge of the COB feeder • Spray bars and bulk water addition at the transfer between the COB Feeder and the Collection Conveyor. • New spray bars and piping in the loading zone of each conveyor. • Skirt modifications at the COB Feeder discharge. • Skirt modifications in the loading zone of each conveyor. • Moisture Analysers on each on the lateral conveyor and on T4 and T1 only.
Water Supply Upgrade	WBS4100 WBS2370 WBS2470	Surface Water Storage Tank and distribution piping	The water supply upgrade in WBS4100, WBS2470 & WBS2370 includes the following • WBS 4100 includes the New 500kL water storage tank adjacent to the existing Million litre water tank on the surface. • Water supply pipework from the portal to each crusher station and collection area, following the existing water supply routes and making use of the existing break tanks.

1.4 Project Flowsheet

The Overall Project Flowsheet associated with the Cadia East Dust Suppression project is shown in the following figure.

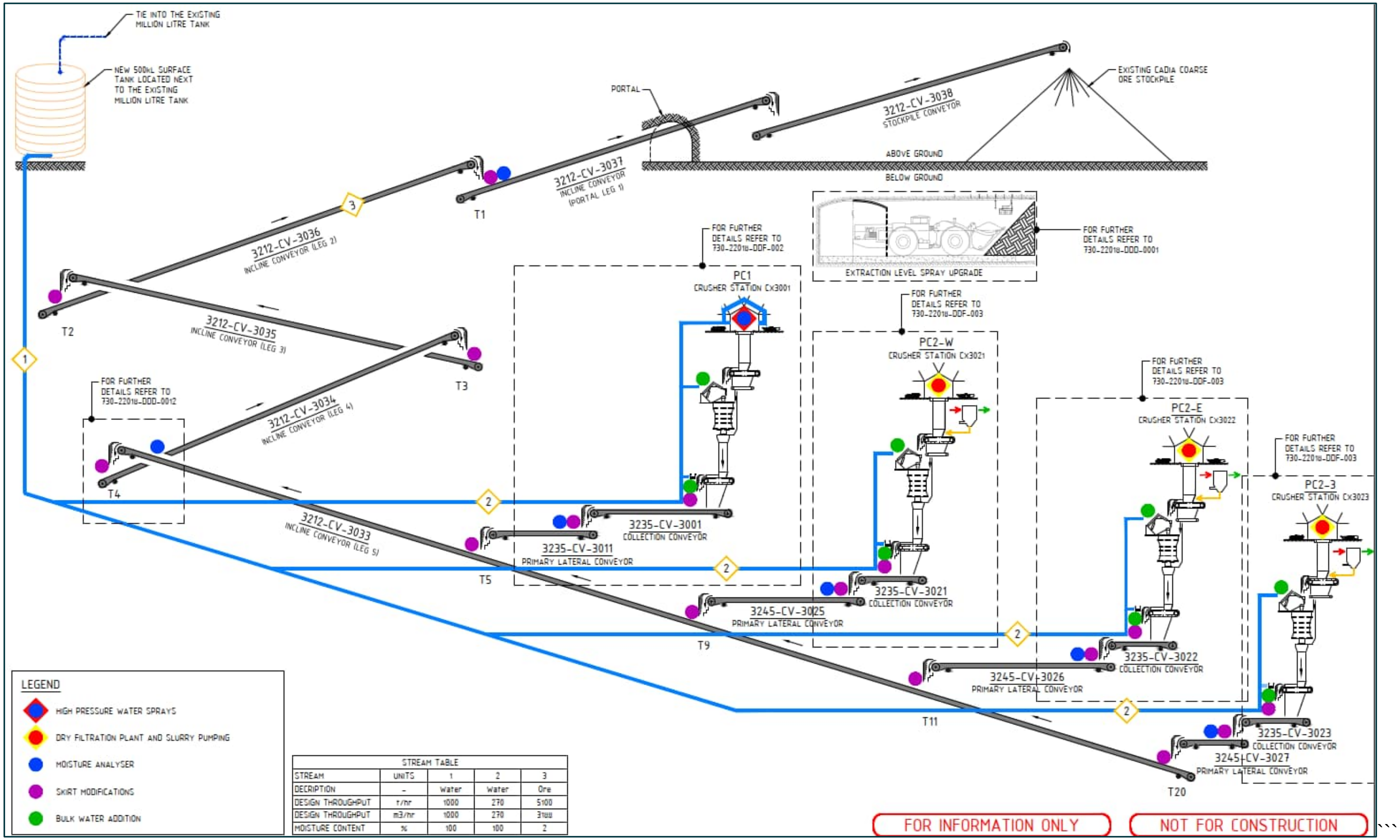

Figure 3 Cadia East Dust Suppression PFS

1.5 Battery Limits

The general battery limits for the Project are shown in Table 4 below.

Table 4 Battery Limits

Battery Limit	Description
Concrete	• Existing Footings/Floor
Steelwork	• Existing Structures
Mechanical	• Existing Mechanical Equipment
Low Voltage Power	• Existing 415V MCCs • Existing Light and Small Power Distribution Boards • Load terminals of the new EIC equipment.
Communications / Control / Instrumentation	• Outgoing terminals of the existing PCS Panels and Communications Cabinets. • Control and communications terminals of the new EIC equipment.
Water supply	• Water supply at the Million litre tank on the surface.

1.6 Key Study Inputs

The following inputs have been used in the development of the study for the PC1 Extraction level dust suppression upgrade:

- Cadia East As-Built mine plan as provided in AEC ANZ-RFI-000072.
- Cadia PC2-3 detail design drawings, 3D model and data .
- Ventilation as per VentSim model provided in AEC ANZ-RFI-000117.
- Water Quality as described in AEC ANZ-RFI-000134.
- Drawings provided in 710-NML-TRANSMIT-009663 and 710-NML-TRANSMIT-009706.
- Dust Control Technology Assessment – Dump Pockets 730-22018-PF-REP-0002.
- Dust Control Technology Assessment – Materials Handling Systems 730-22018-PF-REP-0003.
- Dust Control Technology Assessment – Ventilation Raises 730-22018-PF-REP-0004.
- Dust Extinction Moisture Testing of Cadia East Ore 730-22018-PF-REP-0006.
- Dump Pocket Spray System CFD Analysis - 730-22018-PF-REP-0013.
- Stage 1 Design Definition Report 730-22018-PF-REP-0005.

1.7 Project WBS

The Project includes modifications and additional infrastructure in the following Work Breakdown Structure (WBS) areas and the capital costs have been allocated accordingly.

Table 5 WBS Structure

WBS	WBS Description	Level
2000	**Underground Mine**	**1**
2100	**Common Decline**	2
2130	**Incline Conveyor Transfer Stations**	3
2132	TX3109 T1 CV3036 Conveyor to CV3037 Conveyor	4
2133	TX3108 T2 CV3035 Conveyor to CV3036 Conveyor	4
2134	TX3107 T3 CV3034 Conveyor to CV3035 Conveyor	4
2135	TX3106 T4 CV3033 Conveyor to CV3034 Conveyor	4

WBS	WBS Description	Level
2140	**Underground Mine Services & Facilities**	3
2135	Raw and Fire Water Reticulation	4
2300	**PANEL CAVE 1 (formerly Lift 1)**	2
2330	**PC1 Undercut, Drawpoints and Roads**	**3**
2340	**PC1 Ore Crushing**	3
2341	PC1 Crusher Station CX-3001	**4**
2350	**PC1 Horizontal Conveyors**	3
2351	PC1 Collection Conveyor CV-3001	4
235F	PC1 Lateral Conveyor CV-3011	4
2360	**PC1 Horizontal Transfer Stations**	3
2367	PC1 Transfer Station TX3105 T5 Lateral Conv CV3011 to Incline Conv CV3033	4
2370	**PC1 Underground Mine Services & Facilities**	3
2373	PC1 Raw and Fire Water Reticulation	4
2400	**PANEL CAVE 2 (formerly Lift 2)**	2
2430	**PC2 Undercut, Drawpoints and Roads**	3
2440	**PC2 Ore Crushing**	3
2441	PC2W Crusher Station CX 3021	4
2442	PC2E Crusher Station CX 3022	4
2443	PC23 Crusher Station CX 3023	4
2450	**PC2 Horizontal Conveyors**	3
2451	PC2W Collection Conveyor CV3021	4
2452	PC2E Collection Conveyor CV3022	4
2453	PC23 Collection Conveyor CV3023	4
2455	PC2W Lateral Conveyor CV3025	4
2456	PC2E Lateral Conveyor CV3026	4
2457	PC23 Lateral Conveyor CV3027	4
2460	**PC2 Horizontal Conveyor Transfer Stations**	3
2461	PC2W Transfer Station TX3101 T9 Lateral Conv CV3025 to Incline Conv CV3033	4
2462	PC23 Transfer Station TX3100 T20 Lateral Conv CV3027 to Incline Conv CV3033	**4**
2464	PC2E Transfer Station TX3111 T11 Lateral Conv CV3026 to Incline Conv CV3033	**4**
2470	**PC2 Underground Mine Services & Facilities**	**3**
2476	PC2 Raw and Fire Water Reticulation	4
4000	**Surface Infrastructure**	**1**
4100	**Surface Infrastructure - On Site**	**2**
4130	Mining Surface Infrastructure	2
4132	Water Storage	4
7000	**Project Delivery Management**	**1**
8000	**Other Capitalised Costs**	**1**
8100	Integrated Owners Team & ESP	2

1.8 Study Approach

The study work is split into 2 distinct phases as described below. For further details on the project delivery refer to 730-22018-PF-PLA-0003 Study Execution Plan.

Table 6 Study Approach Summary

Stage	Scope Notes
Stage 1 – Scoping and Multi Criteria Assessment Timeline: Oct 2022 – Jan 2023	• Review and validation of already completed dust prediction and measurement assessments. • Technology Assessment to assess options of dust management. • Dust suppression equipment at the sources identified in the Technology Assessment. • Establish evaluation criteria for comparing dust technologies and recommendation of the preferred technology. • Refer to 730-22018-PF-REP-005 for Stage 1 report.
Stage 2 – PFS Engineering Timeline: Jan 2023 – April 2023	• Completion of PFS level engineering on the preferred option including: - Dust separation, collection and transport equipment identified in the Technology Assessment. - Concrete and structural steel to support the above equipment. - Electrical power, controls, and instrumentation to support the above equipment. • Engage the market for Quotations. • Develop material take offs. • Develop the project execution CapEx estimate. • Develop the project execution schedule. • Develop the basis of estimate and basis of schedule. • Issue PFS study report for review.
Stage 3 – Close Out (May 2023)	• Finalise PFS study report. • Hand over all native files via document control. • Close out all systems. • Final project filing and billing.

1.9 Study Deliverables

A full list of the project study deliverables is included in Appendix A. The deliverables are available via the CVO Projects Aconex instance managed by Newcrest. The study deliverables are tagged with the following meta data.

Table 7 Aconex Meta Data

Aconex Meta Data Field	Value
Created by	AECOM
Attribute 1	22-018 Cadia East Dust Suppression

2.0 Project Execution Strategy

2.1 Project Execution Strategy Overview

The strategy adopted for this scope is an Integrated Owners Team (IOT) that has team members sourced from Newcrest and external contractors and aligns with the strategy used for previous underground installation works at CVO. The execution strategy informs both the estimate and the schedule.

The IOT strategy is centred on the following key points:

- Engagement of an Engineering Service Provider (ESP) to support the Newcrest IOT.
- Competitive, fixed price packages for the procurement of the equipment and commodities.
- Bulk materials sourced from local Australian vendors (steel, concrete, piping, cable, etc).
- Discipline based construction contracts for the major scope areas.
- PLC and SCADA System Integration works.

2.2 Procurement and Contracts

2.2.1 Procurement

The execution phase procurement strategy is to maximise competitive market engagement. All procurement packages will be tendered on a lump sum pricing basis.

The IOT will procure all major and/or specialised equipment and free issue it to the construction contractors. A summary of the packages, including lead time is included below in Table 8.

Table 8 Procurement Package Summary

Package No.	Package Description	Estimated Lead Time (weeks)
P001	Piston Pump and Water Filtration Skid	20
P002	Dry Filtration Plant (Baghouse)	24
P003	Moisture Analysers	14

2.2.2 Contracts

The scope and schedule of the construction of the project logically encompasses the following packages to provide the optimal outcome for the project. The contract packages are summarised in Table 9 below. The contract packages are separated based on work area, rather than discipline. It is recommended that all contracts are competitively tendered.

Table 9 Contracts Summary

Contract No.	Package Description
C001	CSMP Installation – Dust Suppression Equipment Installation
C002	ECI Installation – Dust Suppression Equipment Installation
C003	Surface Tank – Design and Construct
C004	HDPE Piping Supply and Installation
C005	Engineering Detail Design

3.0 Extraction Levels

The following section describes the technical details developed during the PFS for the dust suppression at the extraction level. A trial will be undertaken on three extraction drives at PC1 before the dust suppression solution is rolled out for the remainder of the PC1 level and across the extraction level of PC2E, PC2W and PC23.

Dust measurements taken on 5/4/23 show a typical extraction drive (EXT212) to have dust levels 21mg/m3 (RFI AEC ANZ-RFI-000141). Given the typically low ventilation velocities (approx. 1m/s) in each extraction drive it is expected that the size distribution of this dust would be extremely fine and unlikely to drop out in the return airways and there for would eventually discharge at the exhaust raises.

This confirms that that the dust generation on the extraction level warrants this trial to reduce vent raise emissions.

3.1 General Description

The PC1 Extraction Level Spray upgrade trial will be undertaken to determine the effectiveness and durability of several different extraction level dust suppression strategies. The trial would include the following:

- Basic extraction level spray upgrade.
- Intermediate extraction level spray upgrade.
- Advanced extraction level spray upgrade.

The table below shows the size of the trial relative to the entire roll out.

Table 10 Cadia East Extraction Level Dust Suppression

Trial / Rollout	Cave	Extraction Drives	Drawpoints
Trial	PC1 Basic	1	26
	PC1 Intermediate	1	26
	PC1 Advanced	1	26
Roll out	PC1 Balance	7	158
	PC2W	8	146
	PC2E	8	172
	PC23	13	308
Total Existing Extraction Drives & Drawpoints		39	862

3.2 Assumptions

The following assumptions have been made for the Extraction Level area:

- While three strategies will be trialled for the dust suppression at the PC1 extraction level, it is assumed that the intermediate extraction level spray upgrade is rolled out across the entire PC1 level and the PC2 levels for the purpose of the baseline estimate and schedule.
- All the valving and pumps for the drawpoint and extraction drive sprays will be located off the operational areas at the extraction level.
- 1000V Supply and Tie-in to PCS Fibre Optic Network is available on the perimeter drive.

3.3 Options Considered

In addition to typical design development factors including performance, constructability, maintainability, operability and cost, the following opportunities and options were considered during the study development:

1. Do Nothing on the extraction level.

2. Varying the nozzle types.
3. Constraining the pressure for the misting curtains to maximum allowable pressure of the HDPE pipeline that is already installed at that level.

These opportunities / options have been discussed further as follows:

3.3.1 Do nothing at the draw points

It was considered not to change the current practice at the extraction level i.e.having a single spray hose mounted away from the draw point. The reason for this consideration is that it is likely that the current arrangement is in place because the original spray bars installed in the past have been susceptible to damage from the LHD. LHDs build a bund for the draw point whenever the draw point is not active. A bund is built from wall to wall across a draw point and must be a minimum 1.5m high. There must be a valley of at least 1m behind the bund to catch any materials. Building a bund in a draw point requires the bogger operator to position the bucket up high and against the backs as shown in the figure below. This process has a very high chance of damaging the sprays, and is likely why the current spray arrangement is so far away from the drawpoint. Refer to the two figures below.

Figure 4 LHD approaching a drawpoint

Figure 5 LHD building a bund

3.3.2 Varying the nozzle types

The following nozzles were considered for the draw points:

- Polyethylene Cobra head nozzles (as per the PC1 original design).
- Full Cone 60 degree Spiral nozzles, Brass.

Both nozzles are approximately the same cost of around $25 so both nozzles can be implemented for the trial. The nozzles will be interchangeable in the spray bar manifold. The final selection of nozzles will be an outcome of the trial. See image below for the different nozzle styles.

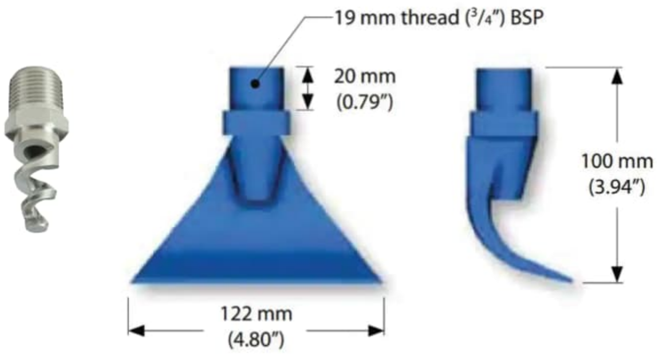

Figure 6 Spiral Nozzle and Cobra Head Nozzle

3.3.3 Constraining the pressure for the Misting curtains

There was consideration to constraining the misting curtain design to the maximum allowable pressure of the existing HDPE pipeline that is already installed the level. While limited information is available for the piping on the level the existing drawings call up “32 Poly Pipe”. It is assumed that this pipework has been installed in accordance with the Cadia Piping Design Criteria (730-800-PP-SPE-0001) as Underground Raw Water (URA) Pipe Class H4 which has a maximum service pressure of 1250 kPa (PE100 PN12.5).

Given the water supply on the level is expected to have a supply pressure of 900 kPa the performance of the misting curtains will not be significantly different to the basic draw point spray bars if the pressure for the misting curtains was limited to 1250kPa.

To overcome this limitation all misting curtains on the level will have a Steelwire Reinforced Composite Polyethylene pipe (SRCP) from the pump on the northern perimeter to each misting curtain. SRCP is commonly used in underground mining for backfill piping. The pipe lengths would be connected with Victaulic style couplings. SRCP would be better for installing in the extraction drives where there is ground movement (convergence).

3.4 Implementation

The PC1 Dust Suppression Upgrade area comprises all infrastructure required for the upgrade of the existing PC1 Extraction level to suppress and contain dust in the ore stream. The following general facilities are included in this WBS:

- Basic extraction level spray upgrade including:
  - New mains pressure poly spray bars at each draw point on one extraction drive taking advantage of the existing HDPE pipework from the dust suppression manifold on the perimeter to each draw point.
  - Dust measurement at the end of the extraction drive.
- Intermediate extraction level spray upgrade.
  - New mains pressure spray bars at each draw point on one extraction drive taking advantage of the existing HDPE pipework from the dust suppression manifold on the northern perimeter to each draw point.
  - One high pressure misting curtain at the end of the extraction drive and a single run of a steel wire mesh-reinforced high density polyethylene (HDPE) pipe to the spray bar and a pressure pump located at the extraction drive vent door.
  - Dust measurement at the southern end of the extraction drive.
- Advanced extraction level spray upgrade:
  - New high pressure steel misting curtain at each draw point on the extraction drive, and final misting curtain at the end of the extraction drive. This would include new high pressure steel wire mesh-reinforced high density polyethylene (HDPE) pipe from the perimeter to each draw point, and a pressure pump located at the extraction drive vent door.

The primary purpose of the PC1 Dust suppression upgrade is to suppress the dust generated from the extraction level and capture any dust released as soon as practical and return it to the ore stream.

Figure 7 below provides the overall arrangement of the tipple spray bars.

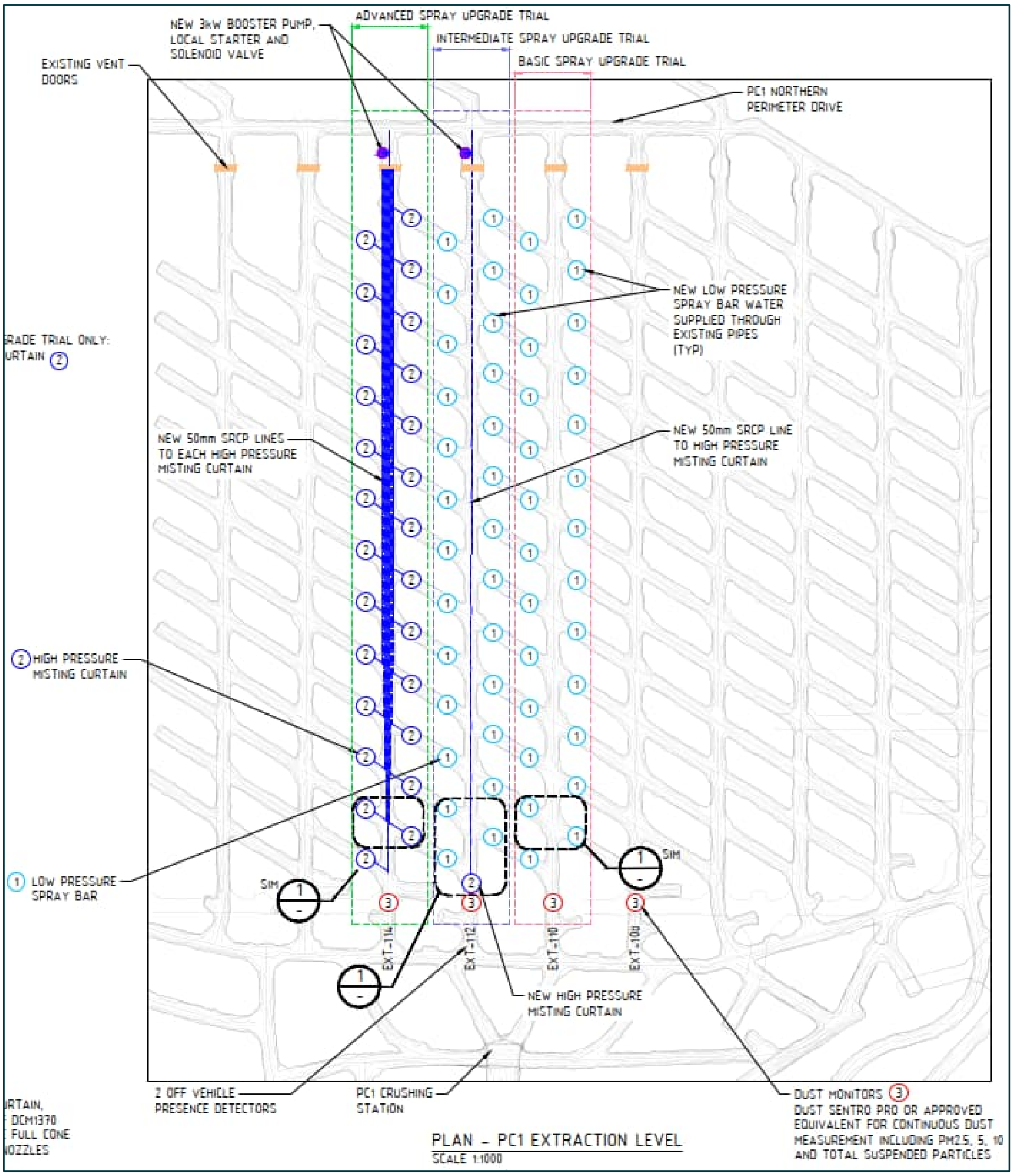

Figure 7 PC1 Extraction Level Typical Spray Arrangement

Figure 8 below provides the arrangement of the proposed basic drawpoint sprays. The basic drawpoint arrangement is based on the flow beams and spray bars installed as part of the original PC1 extraction level development approximately one decade ago.

The basic spray bar is made from HDPE to lower the installation cost and make it easier to handle (replace). The high pressure misting curtains would be made from steel to withstand the higher pressure. The spray bar is supported from the backs and protected by the draw point regulator beam.

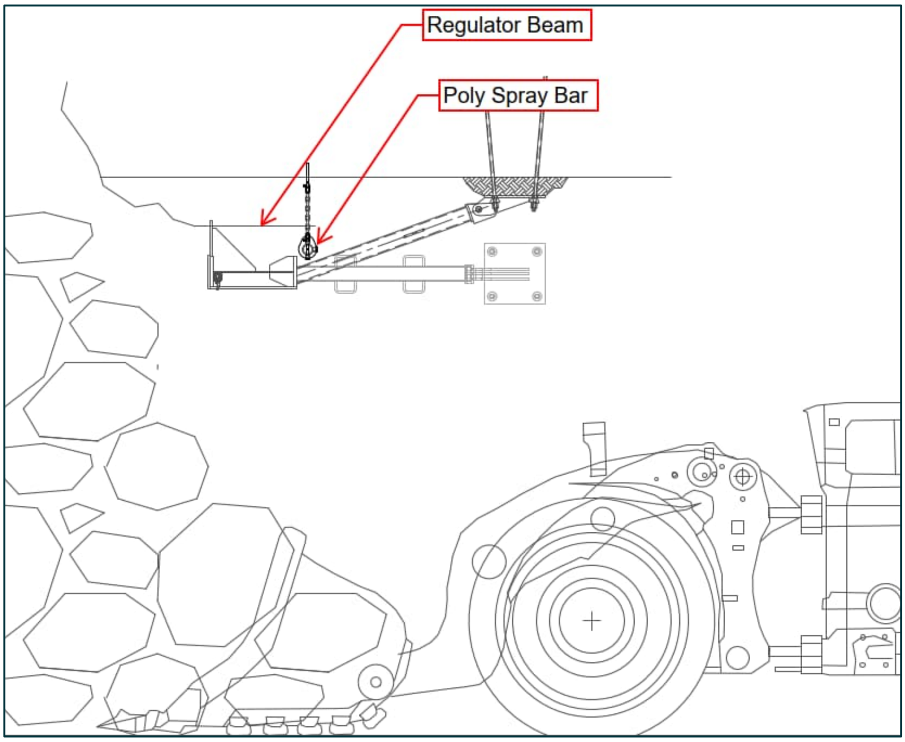

Figure 8 PC1 CX-3001 Crusher Station Tipple Upgrade Arrangement

Figure 9 below shows a photo of the original spray bars installed behind the regulator beam. While a cobra head spray is nominated as the original PC1 design, this design interchangeable with spiral nozzles.

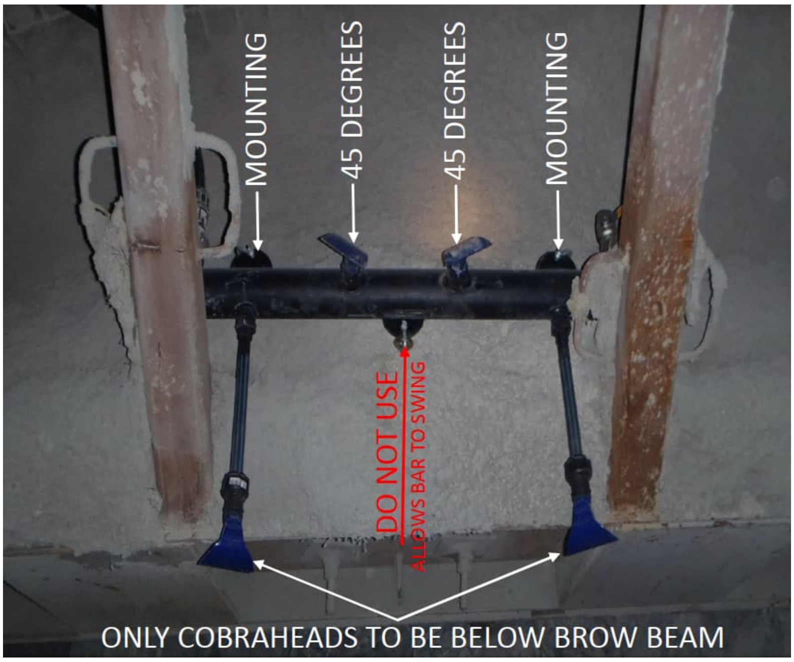

Figure 9 PC1 Poly Spray bar Pump

The trial would run for a duration of between 3 and 6 months. The expectation is that one of the arrangements (basic intermediate or advanced) would subsequently be selected to be rolled out across the remainder of PC1 and the PC2 extraction levels. For the purpose of the base estimate, it is assumed that the intermediate spray arrangement will be selected. The differential for other spray arrangements being implemented across the remaining extraction drives is nominated in basis of Capex document 730-22018-PF-REP-0010.

3.4.1 Electrical Control and Instrumentation

A local starter panel has been included for the booster pump to provide control, monitoring and local isolation of the booster pump. Remote I/O included in the local starter panel will be used to connect the associate instrumentation for the trial.

Instrumentation includes vehicle presence detectors to be mounted at the southern end of the drive to determine when loaders are entering / exiting the level to allow the sprays to be shut down when the extraction drive is vacant. A solenoid valve is used to control the water flow spray bar, and online dust monitors are included in each drive during the trial phase to monitor the effectiveness of the solutions.

Power to the local starter has been sourced from a new 415V Distribution board fed from a new 1000/415V step down isolation transformer. An Ampcontrol RKS Brake Gauge Box has been included to allow the connection of the isolation transformer into the existing 1000V mining distribution network on the extraction level.

Communications to the local start shall be via fibre optic connection pending availability of spare cores on the extraction level.

Refer to Figure 10 for a block diagram of the extraction level trial EIC works.

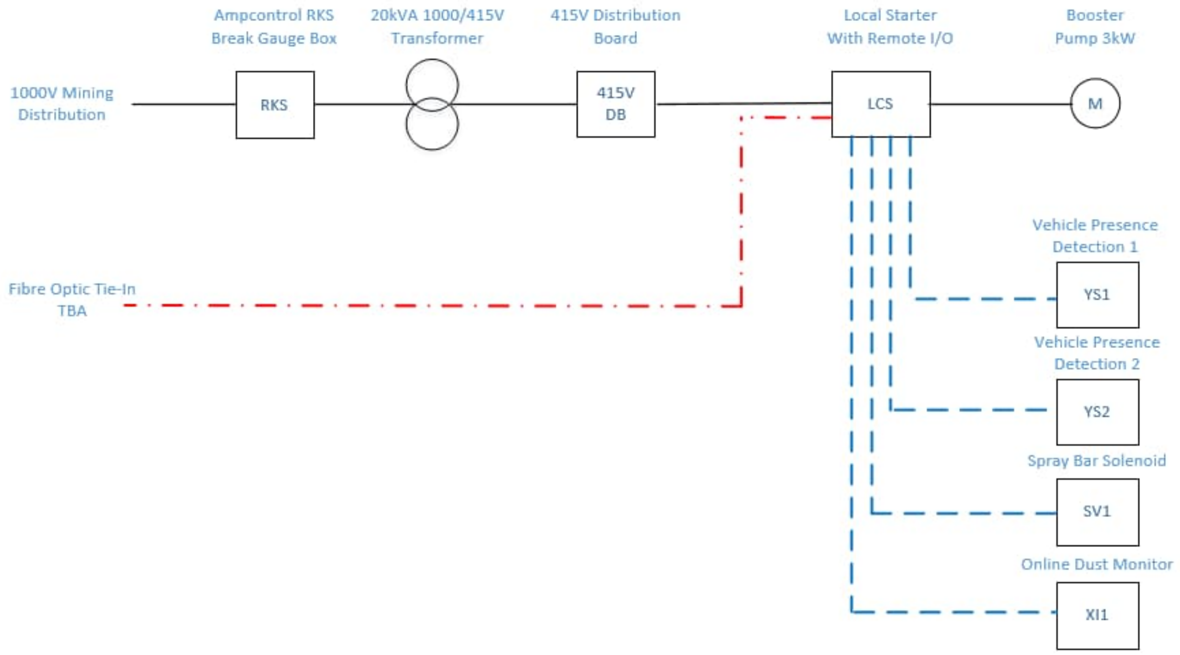

Figure 10 Extraction Level Trial EIC Block Diagram

Full scale implementation of the intermediate spray option on the extraction level will utilise a local starter (same as the trial) for each extraction drive. Each local starter will control and monitor the pressure pump and instrumentation for the associated drive.

Instrumentation shall be as per the trial above, however the online dust monitors have not been included in the full scale implementation.

The 415V Distribution Board and associated transformer and RKS break gauge box will be utilised for the first five drives, with a duplicated arrangement allowed for to service the remaining drives.

Pre-made fibre optic cables have been included to connect the local starters via a daisy chain back to the PCS fibre optic tie-in. The fibre optic cores in each local starter shall be patched to allow a device level ring to be formed between the remote I/O in each local starter to for communication to the PCS network.

Refer to Figure 11 for a block diagram of the extraction level implementation EIC works.

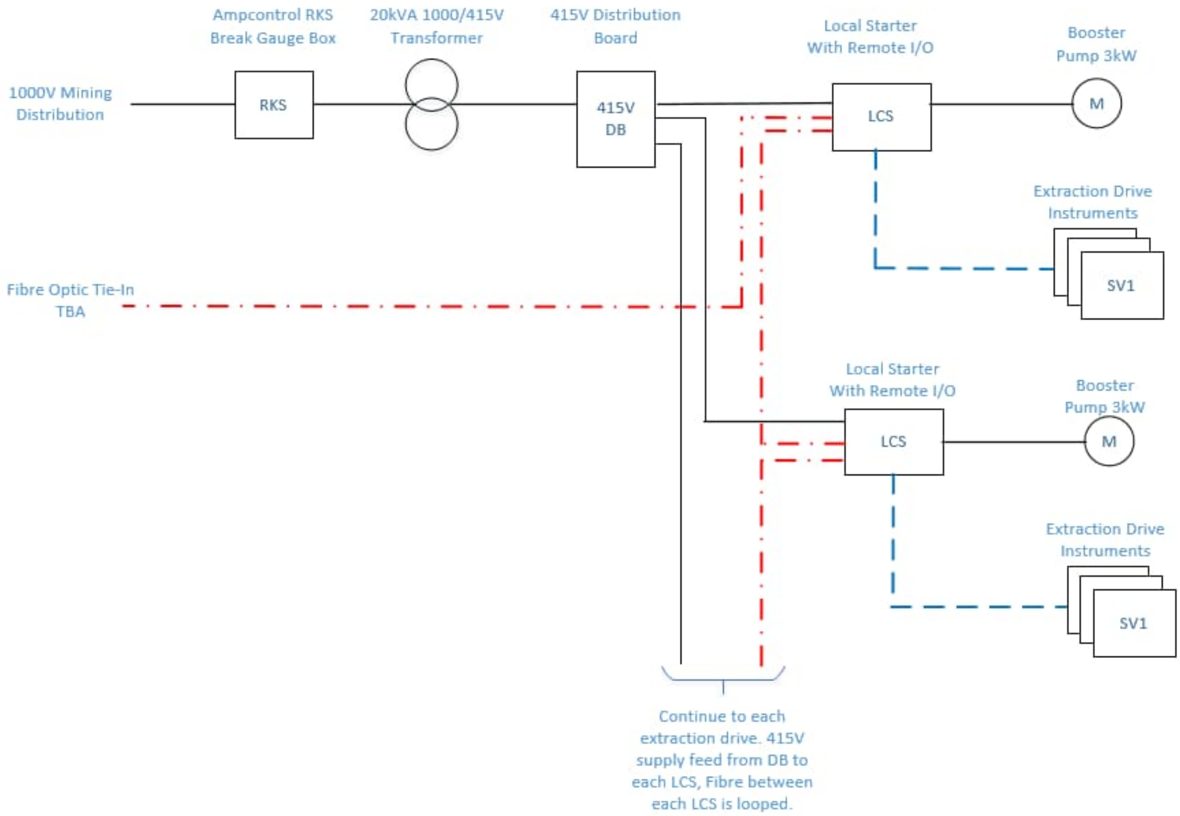

Figure 11 Extraction Level Implementation EIC Block Diagram

3.4.2 Key Data

Based on the inputs, assumptions and consideration discussed in the previous sections of this report, the key performance requirements presented in Table 12 were selected as the PFS study basis for the Extraction Level Trial.

Table 11 Area 1 Performance Criteria

Description	Units	Details	Source
Basic Spray Upgrade			
Drawpoint Spray Bar	-	DN110 PN12.5, Nominal Diameter increased from 80 based on feedback form the poly pipe fabricator	730-200-ME-DWG-1112
Drawpoint Pressure	kPa	900	BBI Concept Study 22400-0000-VEN-Rep-001
Number of Spray Bars	Qty	21 (1 per drawpoint for one extraction drive)	730-22018-PF-DDD-0001
Intermediate Spray Upgrade			
Drawpoint Spray Bar	-	DN110 PN12.5, Nominal Diameter increased from 80 based on feedback form the poly pipe fabricator	730-200-ME-DWG-1112

Description	Units	Details	Source
Drawpoint Spray Bar Pressure	kPa	900	BBI Concept Study 22400-0000-VEN-Rep-001
Number of Spray Bars	Qty	21 (1 per drawpoint for one extraction drive)	730-22018-PF-DDD-0001
Extraction Drive Misting Curtain		2 x 50 mm Steel Pipe with 4 Nozzles	
Misting Curtain Pressure	kPa	4000-5000	Recommended by U of W
Number of Misting Curtains	-	1 (1per extraction Drive)	
Advanced Spray Upgrade			
Drawpoint Misting Curtain	-	2 x 50 mm Steel Pipe with 4 Nozzles	730-200-MEDWG-1112
Drawpoint Misting Curtain Pressure	kPa	4000-5000	As recommended by U of W
Number of Misting Curtains	Qty	21 (1 per drawpoint and one for the extraction drive)	730-22018-PF-DDD-0001
Misting Curtain Pumps			
Number of Pumps	-	2 (1 per pump)	730-200-MEDWG-1112
Pump Flow rate	L/min	10l/m	As recommended by U of W
Pump Power	kW	3.2kW	730-22018-PF-DDD-0001
Pump Location	-	In the stripping for the extraction drive vent doors.	
Dust Measurements			
Type	-	Optical particle counter complete with heated inlet sampling tube	Proposal
Details	-	Dust Sentry Pro	Proposal
Measurement		PM10 (0-5000 µg/m3), PM2.5 (0-2000 µg/m3), PM1 (0-200 µg/m3), TSP (0-5000 µg/m3)	Proposal
Interface			

3.5 Risks and Opportunities

The following risks and opportunities are provided for the Extraction Level Spray upgrade trial.

3.5.1 Risks

The following risks are evident for the Project, which will require further mitigation in further stages of the Project:

- Any infrastructure that is provided on the extraction level is at high risk of damage from the loaders.
- There will be an additional cost of approximately $28M if the advanced spray upgrade trial is selected over the intermediate spray upgrade.

3.5.2 Opportunities

The following Project opportunities are identified. These should be investigating in future stages of the Project:

- Dust measurements should be undertaken to justify the costs of the trial.
- There is an opportunity of saving approximately $1.5M if the basic spray upgrade trial is selected over the intermediate spray upgrade.
- If the online dust measurement devices prove to be effective and require minimal maintenance, then these dust measurement devices should be installed in additional locations underground.

3.6 Further Work

The following further work is recommended to be completed during the next phase of the Project:

- Confirm and finalise all project risks and opportunities described above.
- Undertake detailed site investigation to confirm there is suitable location available to position the misting curtain pumps and LCS.
- Confirm tie-in points for power and communications to the local starters, along with location of PLC processor.
- Establish pump station operating philosophy with the Operations Team and develop functional description to support the PLC & SCADA programming and System Integration works.

4.0 PC1 Tipples

The tipples at each crusher station are the major source of dust produced underground. Refer to figure below for the typical amount of dust produced each time the Loader tips into the dump pocket.

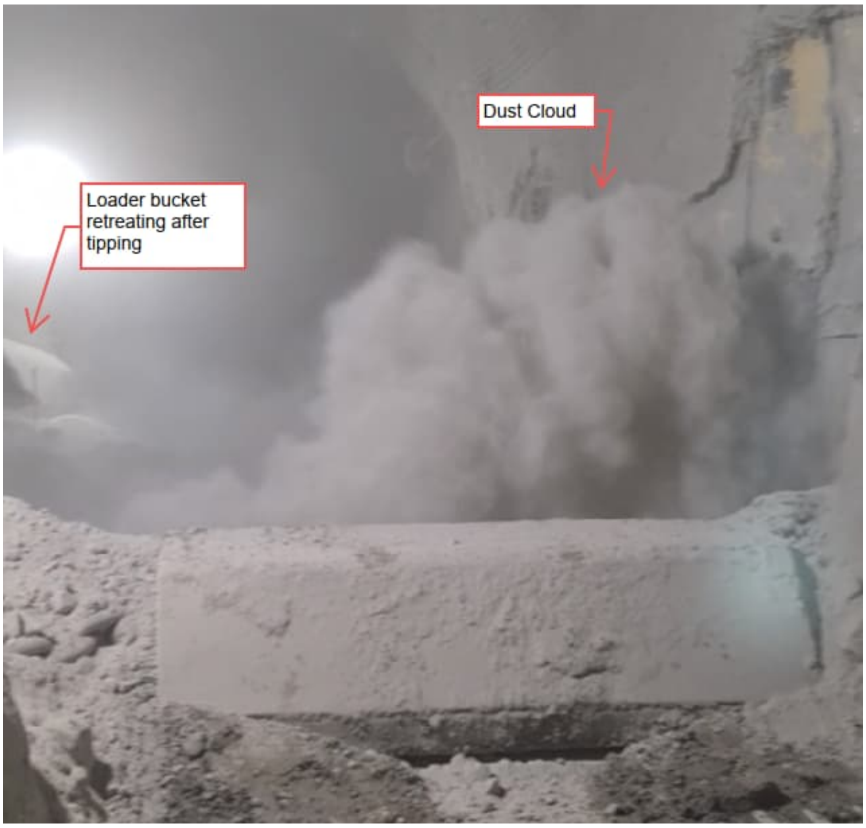

Figure 12 Typical dust produced from a loader tipping

Each loader tip is approximately 20 tonnes so there are approximately 1.5 million tips a year to produce 30Mtpa, or a tip every 20 seconds.

4.1 General Description

The PC1 Tipple Dust Suppression comprises all infrastructure required to suppress and contain dust in the tipple and dump pocket. A High Pressure Dust suppression system will address the dust at the tipple. The primary ventilation flow at the PC1 tipple is across the tipple and down the drop down raises to the sewer drive. The following equipment and facilities are included in this area:

1. A new Water Filtration system located in the existing crusher station compressor cuddy.
2. A new Piston Pump in the existing crusher station compressor cuddy.
3. Tipple spray bars and spray blocks and interconnecting piping.
4. Valve station in the crusher station.

4.2 Inputs and Assumptions

The following inputs and assumptions have been used in the development of the study for the PC1 Crusher Station Dust suppression upgrade:

- Feedback from the 2016 PC1 Fogging system is as follows:
  - Fogging nozzles were expensive and very susceptible to damage from fly rock.
  - The supporting infrastructure for the fogging system (valving manifold and water filtration system was on the extraction level making it difficult to access).

- The seismic event caused damaged to the fogging system and there was limited incentive to reinstate it.

- The majority of the dust produced underground is from the tipples and dump pockets.
- Dust extinction moisture content required is 2% (refer 730-22018-PF-REP-0006)

4.3 Options Considered

In addition to typical design development factors including performance, constructability, maintainability, operability and cost, the following options were considered during the study development:

1. Valving for the High-Pressure sprays at the tipple.
2. Valving for the High-Pressure sprays at the crusher station.

These options have been elaborated further as follows:

1. ***Valving at the tipple*** - A single header pipe from the high pressure pump in the crusher compressor cuddy to a ring main above the tipple with a single dropper between each tipple. The benefits of this are reduced piping and line of site between the valve and the spray.
2. ***Valving at the crusher station*** – Following the same design philosophy as the drawpoint sprays with the valving off the level, this would have the valving in the crusher station with 10 pipes from the valve manifold to the spraybars and spray blocks.

Based on the feedback from the CVO stakeholders regarding the PC1 fogging system and the relatively marginal increase in costs for the extra piping, valving has been included at the crusher station. To reduce the pipework, the valving would be located on the crusher side of the ROM bin wall near the operator's cabin.

4.4 Implementation

Based on the performance requirements and PFS considerations, the process system and infrastructure selected for the PC1 Crusher Station dust suppression upgrade area is as listed below.

Figure 13 below provides the overall arrangement of the tipple spray bars.

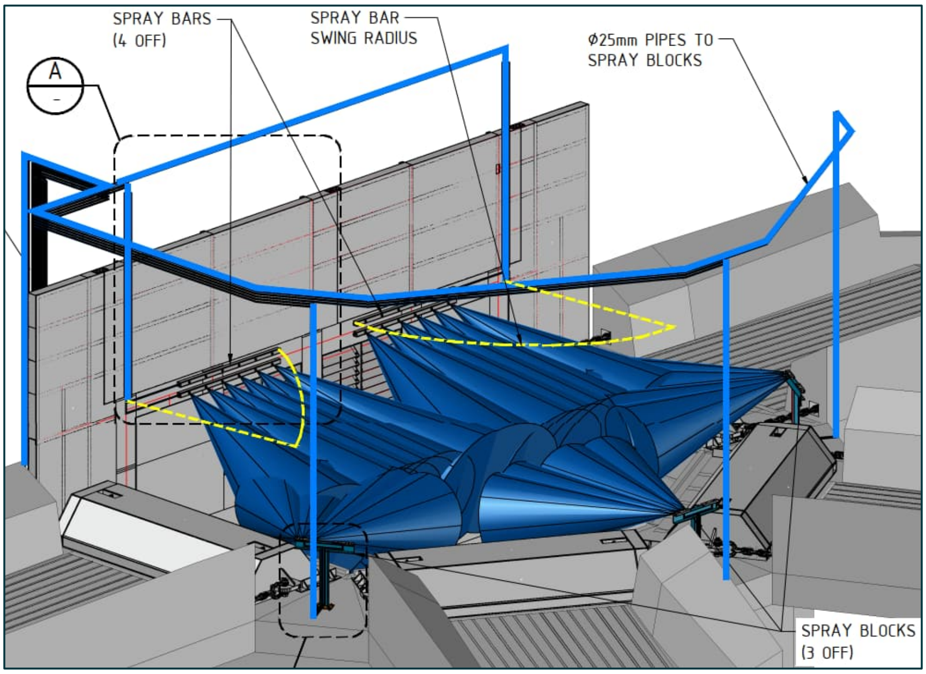

Figure 13 PC1 Tipple Typical Spray Arrangement

Figure 14 below provides the overall arrangement of the proposed new tipple arrangement PC1.

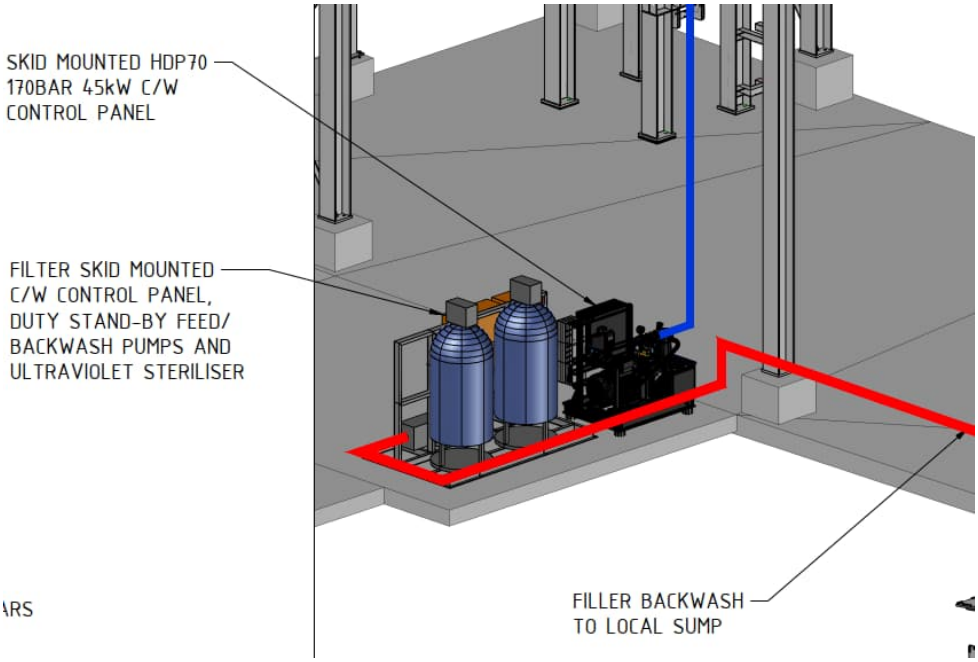

Figure 14 PC1 Filter Skid and High-Pressure Pump

4.4.1 Process Flow Diagram

The general process flow details for the PC1 Crusher Station dust suppression upgrade are as follows:

- Raw Water flows from the water distribution network to the PC1 Crusher Area and splits off into two primary streams.
- One primary water stream goes through a filter, then high pressure pump, then discharged through the sprays bars at the tipple.
- A secondary stream of the water is discharge from the filter system that discharges waste as part of the back wash process of the filter system. The backwash water is discharged to a local sump.
- Another primary stream which is the bulk water addition at the ROM feeder described in further detail in Section 6.0

See Figure 15 below for further details on the Crusher and Tipple Station process flow.

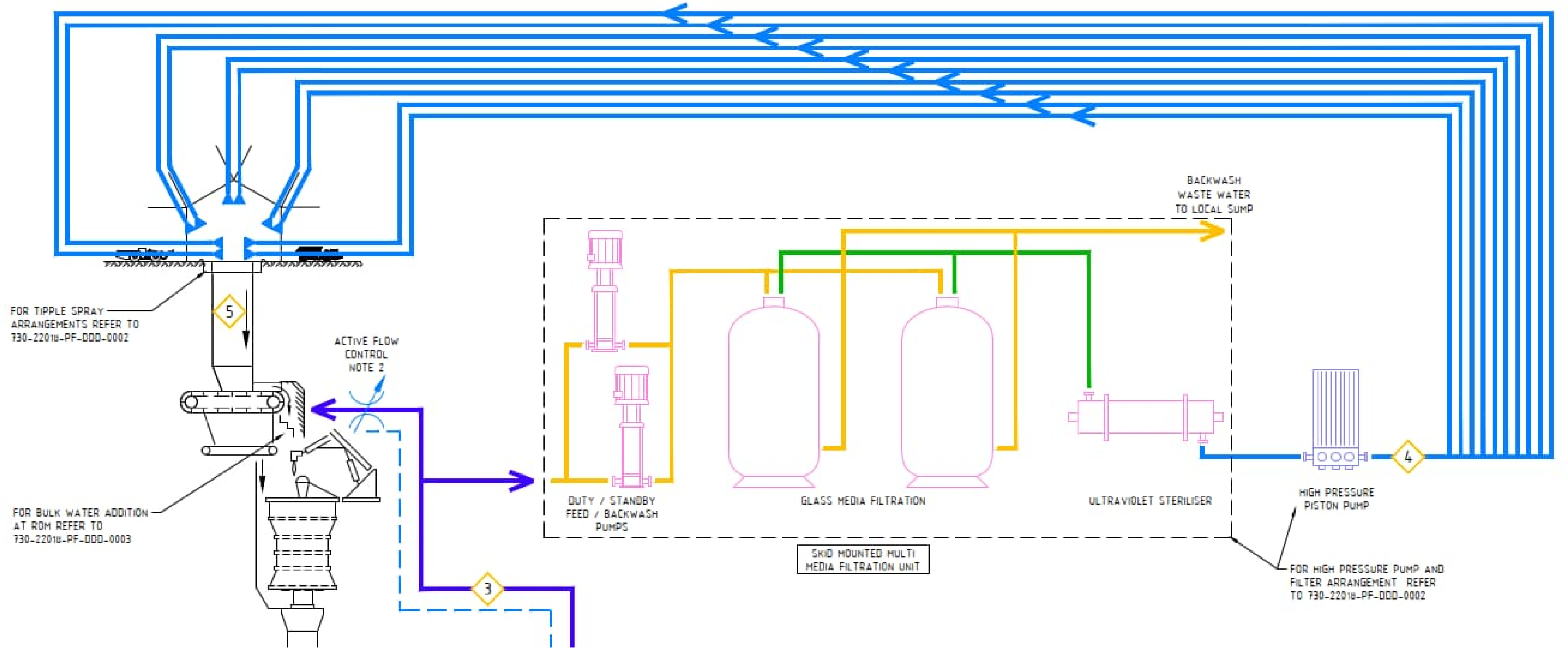

Figure 15 PC1 Crusher and Tipple Station Flowsheet

Note coloured items indicate new equipment and infrastructure.

4.4.2 Electrical Control and Instrumentation

The high-pressure pump and filter units shall be supplied with their own local starter panels and associated onboard electrical control and instrumentation equipment required for their operation.

Two new MCC Feeder cells have been allowed for in the local crusher substation 415V MCC to supply power to the package units.

Instrumentation cabling and additional PLC/DCS hardware has been allowed to provide hardwired interface between the PCS and the local starter panels along with a Cat 6 Ethernet connection to the switchroom communications panel for connection for higher level monitoring and control functions.

The existing I/O and control wiring for the existing tipple solenoid valves shall be maintained.

Refer to Figure 16 for a block diagram of the tipple spray EIC works.

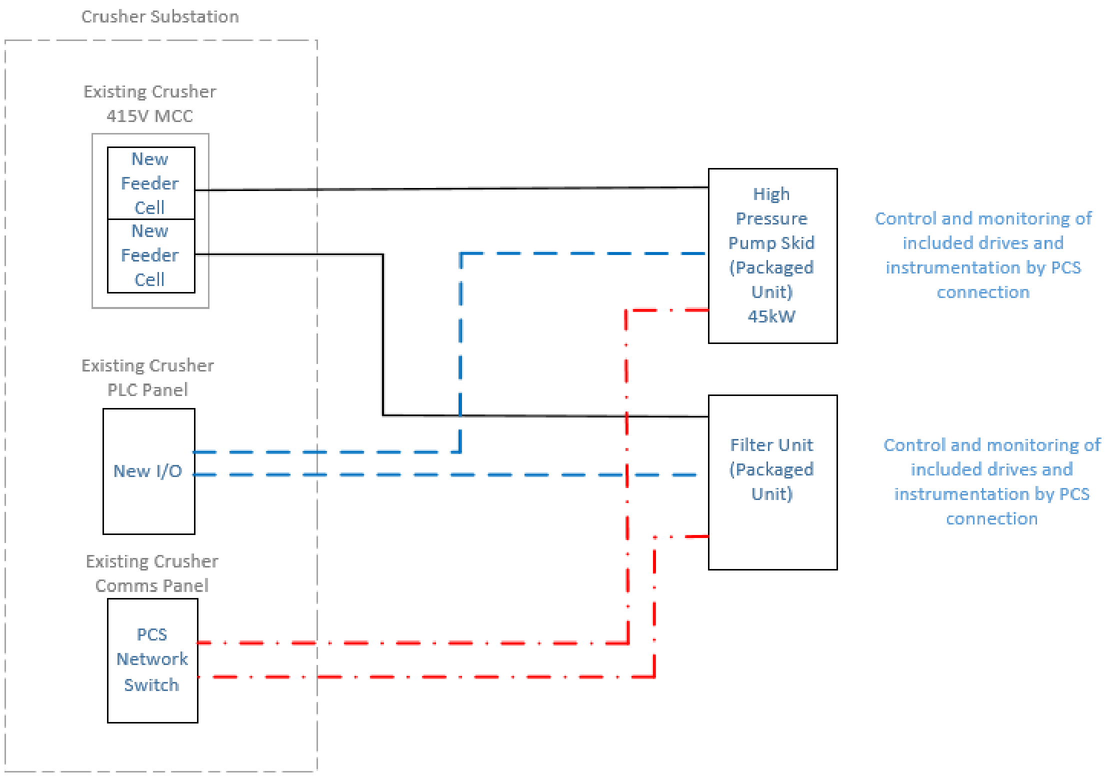

Figure 16 Tipple Sprays EIC Block Diagram

4.4.3 Key Data

Based on the inputs, assumptions, options and considerations discussed in the previous sections of this report, the key performance requirements presented in Table 12 were selected as the PFS study basis for the PC1 Crusher Station Dust suppression.

Table 12 Area 1 Performance Criteria

Description	Units	Details	Source
Tipple Sprays			
Droplet Size d50	µm	25 – 45	730-22018-PF-REP-0002
Droplet Velocity at orifice exit	m/s	>100	730-22018-PF-REP-0002
Spray Cone Angle	degrees	20-30	730-22018-PF-REP-0002
Spray Pattern	-	Full Cone Pattern	730-22018-PF-REP-0002
Spray Penetration	-	2m in 3-5m/s cross-wind	730-22018-PF-REP-0002

Description	Units	Details	Source
Quantity of Spray Nozzles	-	31	730-22018-PF-REP-0002
Flow Rate per Nozzle	L/min	4	Calculated
Pressure	Bar	150	730-22018-PF-REP-0002
Total flow rate	L/min	120	730-22018-PF-REP-0002
Tipple Sprays High Pressure Pump			
Pump type	-	Positive Displacement Skid mounted.	Pump Proposal
Pump Brand / Model		Hammelmann HDP 70	Pump Proposal
Pressure	Bar	170	Pump Proposal
Flow Rate	L/min	135	Pump Proposal
Power	kW	55	Pump Proposal
Filtration System			
Raw Water Quality	-	As per Sample data	AEC ANZ-RFI-000134
Filter Type		Multimedia Filtration with Glass Media	Filter Proposal
Pumps	-	duty/standby feed/backwash pumps	Pump Proposal
Bacteria Control	-	Ultraviolet Steriliser	Pump Proposal
Raw Water Quality	-	As per Sample data	AEC ANZ-RFI-000134
Bulk Water Addition			
Water design flow rate	M3/hr	40	Refer to Section 6.0 for further details

4.5 Risks and Opportunities

To undertake the installation and construction of these works the PC1 extraction level will need to be shutdown. With PC1 providing the least amount of ore currently it is assumed that PC1 can be shutdown by itself and PC2 levels can maintain the required production rate.

4.6 Further Work

A detailed construction schedule is required for implementation, taking into consideration operational and shutdown requirements, and confirming what work can happen while the level is still operating.

While there has been engagement with fixed plant maintenance, to date there has been limited engagement from the people that operate on the level, so further stakeholder engagement is recommended.

5.0 PC2 Tipples

5.1 General Description

The PC1 Tipple Dust Suppression comprises all infrastructure required to suppress and contain dust in the tipple and dump pocket. A High Pressure Dust suppression system will address the dust at the tipple. The primary ventilation flow at the PC1 tipple is across the tipple and down the drop down raises to the sewer drive. The following equipment and facilities are included in this area:

The PC2 tipples are very similar to the PC1 crusher station with the main difference being the dust extraction exhaust system on the ROM bin wall between the tipple and local exhaust raise. The primary ventilation is along the tipple access drives, through the tipple exhaust ducts and into the return air raises. The following facilities are included in the PC2 ROM bin tipples:

1. Dry scrubber system at each crushing station:
    a. Two new dry scrubbers for PC2W, PC2E and PC2-3.
    b. New slurry transport system for the dust to return to the ore stream at each PC2W, PC2E and PC2-3.

Purpose of the new infrastructure for the PC2 Tipples is to remove the dust from the tipple dust extraction airstream and return it to the oreflow, preventing the dust from entering the surrounding work areas and emitting from the return air raises.

PC2E and PC2W both have 2 x 1200 mm dia ducts from the tipple to the return raise with single stage 110kW axial fans on each duct.

PC2-3 has 2 x 1400 mm dia. ducts from the tipple to the return raise with single stage 110kW axial fans on each duct.

Figure 17 below provides the overall arrangement of the proposed dry scrubber for the PC2-3 crushing station.

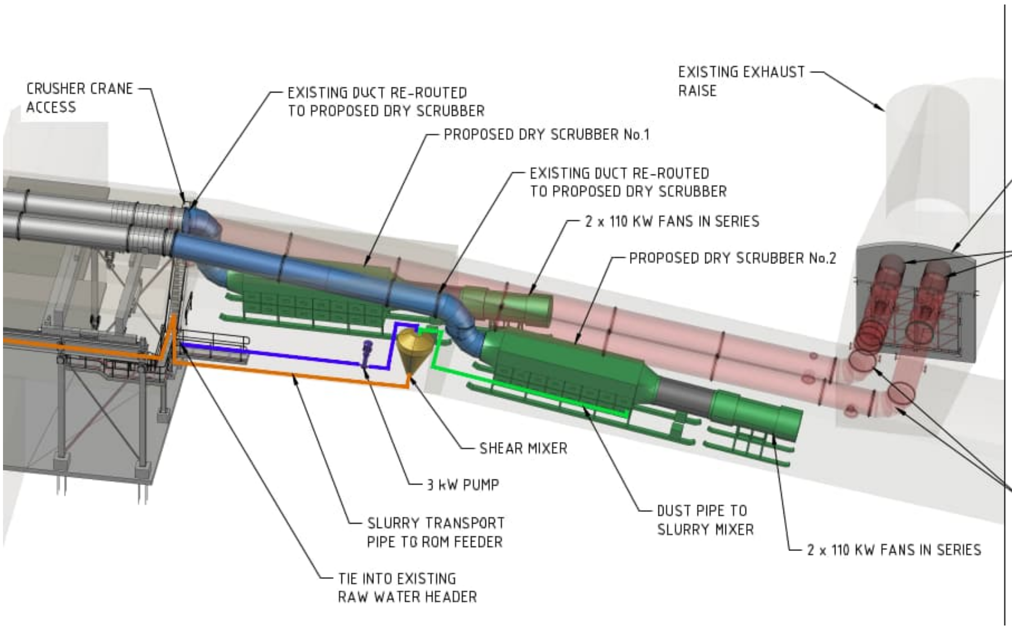

Figure 17 Dry scrubber Arrangement for PC2-3

5.2 Key Inputs & Assumptions

The following inputs and assumptions have been used in the development of the study for the PC1 Crusher Station Dust suppression upgrade:

- The tipple exhaust ducting prevents high pressure sprays being used for PC2 crusher as moisture in the tipple exhaust ducting causes mud build up in the ducts and creates a risk of duct failure.

- After the air has been through the dry filtration unit the air is considered fresh and does not have to be exhausted into the return air system.
- There is sufficient capacity in the existing PC2E and PC2W Crusher 415V MCCs and associated transformers to supply power to the Dry Filtration Units. This has been reviewed for PC2-3 from available maximum demand data.

5.3 Opportunities and Options Considered

In addition to typical design development factors including performance, constructability, maintainability, operability and cost, the following opportunities and options were considered during the study development:

1. High pressure misting sprays with duct modifications.
2. High Pressure misting sprays with primary ventilation changes.
3. Dust discharge from the dry scrubber returns to the ore stream options.
4. Wet scrubber as opposed to dry scrubbing.

These options are discussed further as follows:

5.3.1 High pressure misting sprays with duct modifications

High pressure misting sprays with duct modifications to prevent water entering the ducting has been investigated. To understand the effectiveness of the duct modifications, Computational Fluid Dynamics (CFD) analysis was undertaken. Three scenarios were modelled for investigation:

1. Current layout with spray system located above intake into extraction system. Refer to image below.

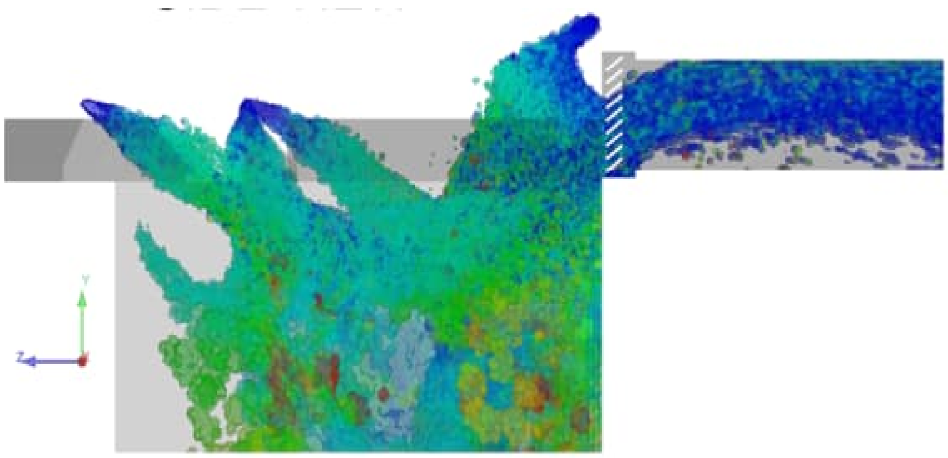

Figure 18 Current Duct position with Sprays above the duct with high pressures prays.

2. Inlet to extraction ducting raised by 2000mm allowing the spray system to be mounted below the inlet. Refer to image below.

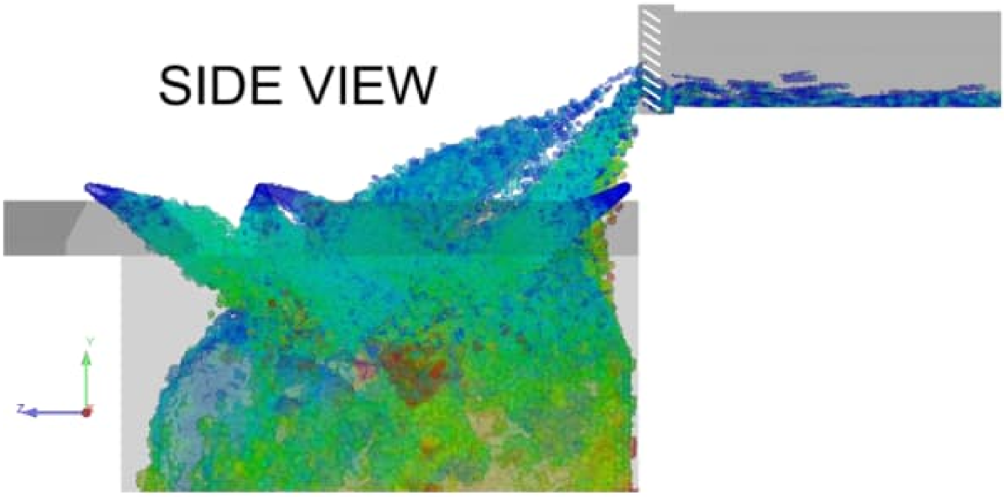

Figure 19 Raised Tipple extraction ducting with High Pressure Sprays

3. Inlet to extraction system raised by 2000mm and the cross-section maximised 4500 x 2000 deep to reduce the inlet velocity and allow the spray system to be mounted below the inlet.

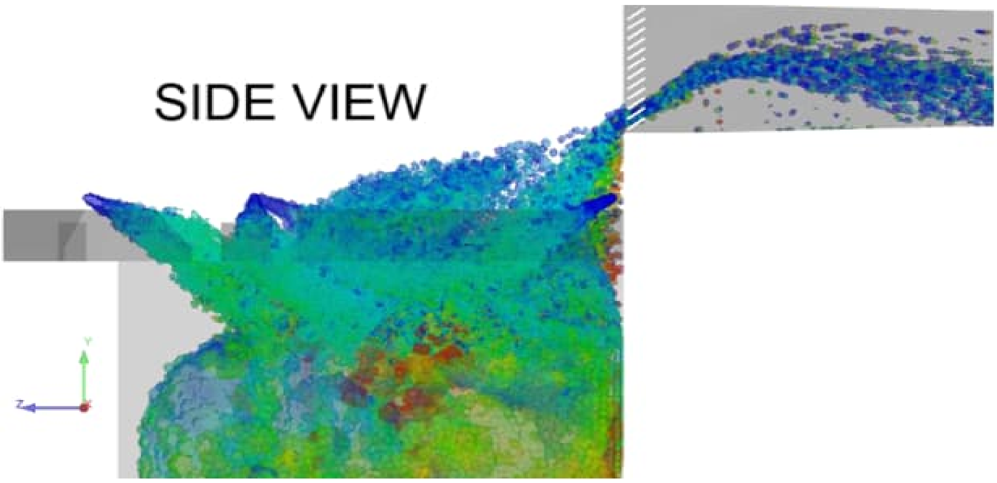

Figure 20 Raised Tipple extraction ducting with

The water concentration in the ducts for the three scenarios is shown in the following table.

Table 13 CFD Results for Water in Ducts

Scenario	Maximum Water Concentration	Water Addition
Current Duct Arrangement	0.304 kg/m3	28 l/min
Raised Duct	0.032 kg/m3	0.6l/min
Raised Duct and widened inlet duct	0.033 kg/m3	1.8 l/min

It is evident that modifying the current extraction system would significantly reduce the propensity for mist to be drawn into the duct work, however, there would still be a considerable amount of water drawn into the duct work. Therefore, high pressure misting sprays similar to the arrangment proposed for PC1 can only be implemented with primary vent changes to remove the tipple exhaust ducting.

Due to the as mined envelope the inlet ducting can not be increased further. See Figure 21 below.

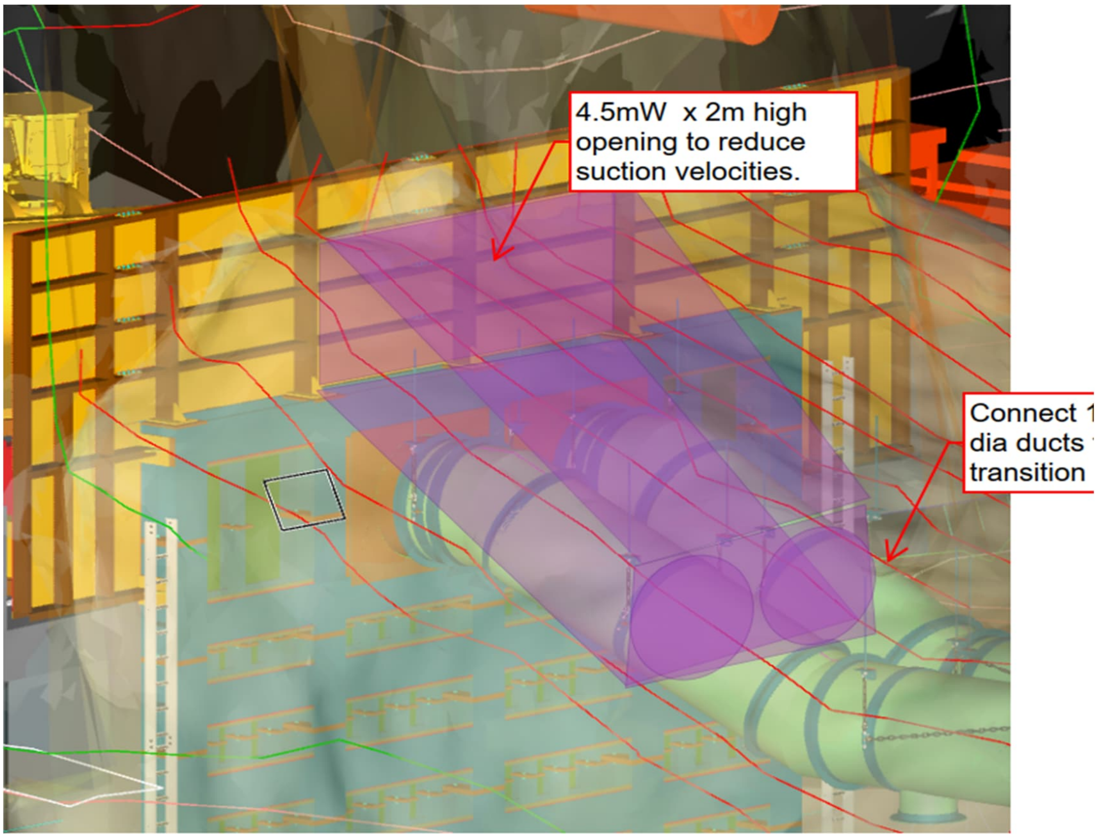

Figure 21 Exhaust ducting inlet modifications

5.3.2 High Pressure misting sprays with primary ventilation changes.

Newcrest's Primary vent investigation is outstanding and will be undertaken in the next phase of the project.

5.3.3 Dust discharge from the dry scrubber return to the ore stream options.

The dust is separated from the airstream by the dry filtration scrubbers and is collected below the filters. The following four options were investigated for returning the dust to the ore stream:

- Condition the dust to between 5-10% moisture content the collect and transport the dust cake with IT or loader directly to ROM bin
- Condition the dust to between 5-10% moisture content then discharge to a pocket conveyor to transport the dust cake to the ROM feeder skirted zone
- Pneumatically transport the dry dust with a dense phase conveyor and then condition the dust to between 5-10% moisture content before discharging into either the ROM feeder skirted zone or the vault underneath the crusher.
- Slurry transport of the dust (50% moisture content) and discharge into the ore stream either at the ROM feeder skirted zone, or into the crushed ore bin underneath the crusher.

Transporting the cake with an IT (or Loader) was ruled out because of the high operating costs, and risks to surrounding infrastructure and people with having heavy vehicles regularly driving through the infrastructure areas.

Transporting the cake with a pocket conveyor was rejected because the head end of the pocket conveyor was too large to fit into the crusher stations.

The pneumatic and slurry transport both enabled flexibility by transporting through a pipe. The throughput is such that a small pipe (50mm or less) is required. The slurry transport is preferred over the dense phase pneumatic conveyor because the dense phase system requires additional air dust separation at the discharge. The slurry system is therefore simpler and has lower capital and operating costs.

Slurry transport is a very common process at Cadia in the concentrator, and the design reliability and performance will be well known with appropriate input from Cadia's concentrator operations and maintenance team.

5.3.4 Wet scrubber as opposed to dry scrubbing

Wet scrubbing was investigated with vendors as opposed to dry scrubbing. The feedback from all vendors was consistent, that the dry scrubbing was preferred over wet scrubbing for the following reasons:

- Dry scrubbers have existing designs suitable for the nominated flowrates as opposed to wet scrubbers
- Dry scrubbers will have improved performance over wet scrubbers particularly with respect to the PM10 fraction and below.
- Wet scrubbers will require additional infrastructure for recycling water and separating water from the dust.
- The largest component of wet scrubber, the separator vessel, would be much larger than the dry scrubber of the same capacity.

The wet scrubber system is considered fatally flawed due to the size of the equipment and supporting infrastructure for the nominated flow rates.

5.4 Implementation

Based on the performance requirements and considerations, the process system and infrastructure selected as the PFS study basis for the PC2 ROM bin tipples area is described below.

5.4.1 Process Flow Diagram

The general process flow details for the PC2 crushing are dust suppression is as follows:

- Dusty air is extracted from the tipple and the dust is separated from the exhaust air stream by the dry scrubber.
- The dry scrubber discharges clean air and dust via screw conveyor to a shear mixer.
- The shear mixer combines the dust and pressurised water to homogenous slurry for transport via a pipe to the ROM apron feeder skirted zone.

See Figure 31 below for further details on the PC2 Crushing station process flow.

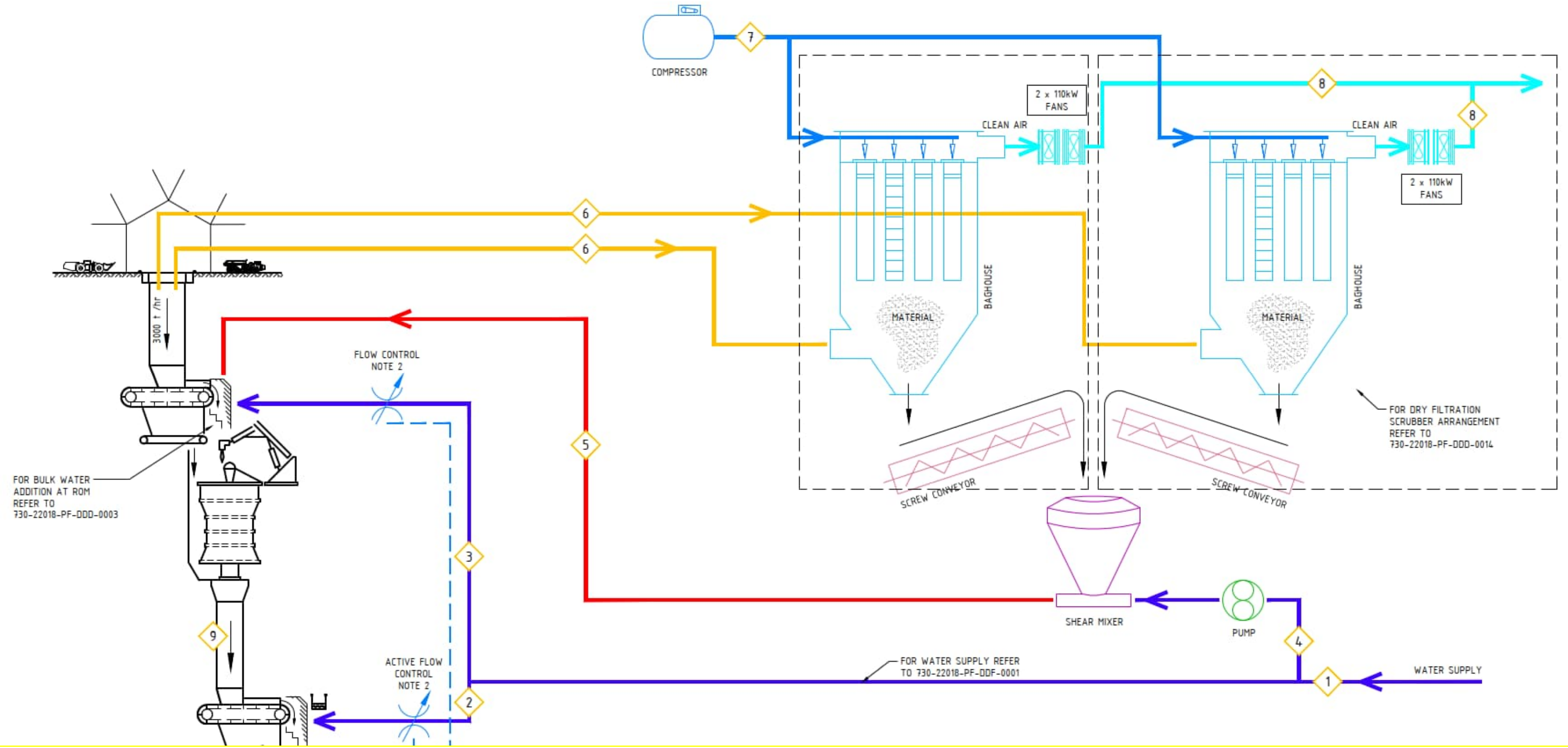

Figure 22 Process Flow Diagram for the PC2 Crushing Area.

Note Coloured items indicate new equipment and infrastructure.

5.4.2 Electrical Control and Instrumentation

The Dry Filtration units and the Air Compressor units shall be supplied with their own local starter panels and associated onboard electrical control and instrumentation equipment required for their operation.

Three new MCC Feeder cells have been allowed for in the local crusher substation 415V MCC to supply power to these package units. A new MCC DOL starter and local control station have been allowed to supply power and control to the slurry pump. An additional MCC Tier has been allowed to house the new starter and feeder cells.

Instrumentation cabling and additional PLC/DCS hardware has been allowed to provide a hardwired interface between the PCS slurry pump starter / LCS, and the Air Compressor. Cat 6 Ethernet connections have been included for each Dry Filtration unit to the switchroom communications panel for connection for higher level monitoring and control functions.

Refer to Figure 23 for a block diagram of the tipple spray EIC works.

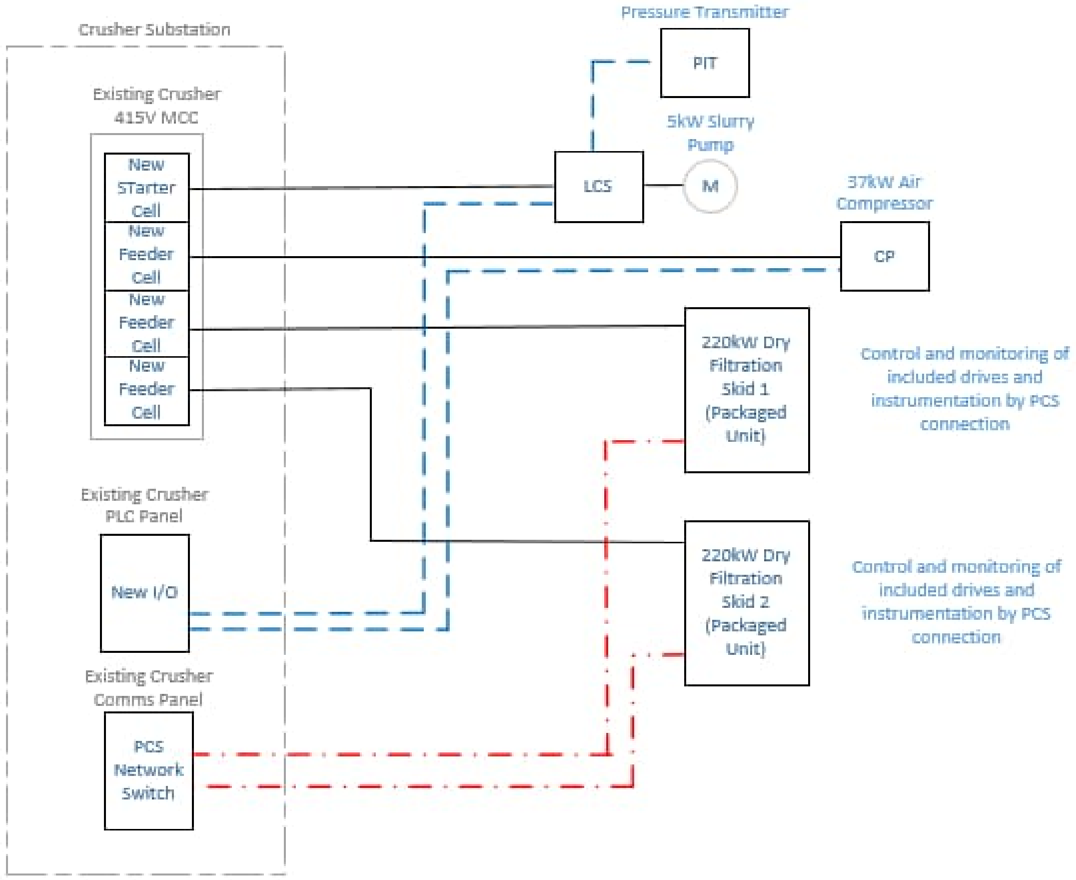

Figure 23 Dry Filtration EIC Block Diagram

5.4.3 Key Data

Based on the inputs, assumptions, options, and considerations discussed in the previous sections of this report, the key data presented in Table 14 were selected as the PFS study basis for the PC2 Tipple Dust Suppression is as follows.

Table 14 PC2 Crusher Station Key Data

Description	Units	Details	Source
Dry Filtration			
Tipple Exhaust	m3/s	80 (40 per duct)	
Exhaust Dust Loading	g/m3	10-100g/m3	730-22018-PF-REP-0002
Maximum Dust Loading	t/hr	6	730-22018-PF-REP-0002

Description	Units	Details	Source
Filter Elements		480 per unit	CFT Dry Scrubber Proposal
Filter Area	m2	1080 per unit	CFT Dry Scrubber Proposal
Blowback pressure	Bar	4.5	CFT Dry Scrubber Proposal
Blowback air consumption	m3/min	4	CFT Dry Scrubber Proposal
Dust collection	-	Screw conveyor	CFT Dry Scrubber Proposal
Slurry Transport			
Max dust accumulation	t/hr	6	730-22018-PF-REP-0002
Slurry Concentration	% by Weight	50	Assumed
Slurry Concentration	% by Volume	30	Calculated
Slurry Flowrate	t/hr	12	Calculated

5.5 Risks and Opportunities

The following risks and opportunities are provided for the PC2 Crushing Area dust suppression.

5.5.1 Risks

The following risks are evident, which will require further mitigation in further stages of the Project:

- The slurry potentially has too high a solids concentration and will need to be diluted with water. This extra water for slurry transport can be offset by reducing the water used for bulk water addition. The concentrator on the surface has many slurry processes and advice can be sought from the operations and maintenance from the surface team prior to detailed design.
- The dust loading is currently not confirmed, this will be confirmed as part of the Grydale trial by CVO.
- There is concern that the package units for dust extraction will not be able to handle the high dust loading produced from the tipple. With the Grydale trial being undertaken, the capabilities of dry filtration at these high dust loads will be confirmed.

5.5.2 Opportunities

The following Project opportunities have been identified and should be investigating in future stages of the Project:

- If the tipple exhausts fans and exhaust ducting can be decommissioned, the preference would be to implement high pressure sprays as per PC1. This would result in the same dust suppression across all the tipples. This would require primary ventilation change and be investigated separately by the Newcrest ventilation team.

5.6 Further Work

The following further work is recommended to be completed during the next phase of the Project:

- Undertake PC2 ventilation investigation to remove the exhaust ducting from the PC2 tipple, to enable a decision on the strategy for PC2 ROM bin tipple dust suppression between dry filtration and high pressure sprays.
- A detailed construction schedule is required for implementation, taking into consideration operational and shutdown requirements, and confirming what work can happen while the crusher is still operating.
- Confirm and finalise all Project risks and opportunities described above.
- Confirm vendor power requirements and ensure sufficient physical and electrical capacity in the PC2E and PC2W 415V MCCs.

6.0 Crusher Stations

The following photo shows typical dust concentration at the crusher station.

Figure 24 Typical Dust at PC1 Crusher Station

The section below describes the technical details developed during the PFS for the dust suppression for the Panel Cave 1.

6.1 General Description

The dust at the crusher stations will be addressed using low pressure sprays at the ROM feeder and bulk water addition.

6.2 Key Inputs & Assumptions

The following inputs and assumptions have been used in the development of the study for the PC1 Crusher Station Dust suppression upgrade:

- Typical dust loading at crusher station is greater than 20mg/m3.
- Dust extinction moisture content required is 2% (refer 730-22018-PF-REP-0006).

6.3 Options Considered

6.3.1 Flow control for the bulk water addition

Originally the plan for flow control at the ROM Feeder would be manually set with an automatic flow control at the COB feeder. An on / off solenoid valve would be included and interlocked with the apron feeder running or stopped. The intent was most of the bulk water addition would happen at the ROM feeder where there is a very good opportunity for water to mix with the ore to create a homogeneous moisture content in the ore because of the large face of ore on the feeder and the mixing that would happen as the ore rills off the feeder and is crushed inside the crusher.

The alternative to manual flow control would be to have active flow control at the ROM feeder. Active flow control would have the following additional benefits

- Active flow control interlocked with apron feeder speed to account for the various throughputs, which would account for slower feeder operation and more likely to achieve a homogenous moisture content.
- Active flow control is less likely to be continually changed by operators and maintainers without the appropriate understanding of the system.

- Active flow control can vary the amount of water added at the ROM feeder and divert the water addition to the COB feeder. Potential problems of water addition at the ROM feeder are as follows:
  - Increased wear in the crusher
  - Blockages in the ROM feeder spillage chute
  - Increased spillage / mess underneath the ROM feeder.

Given the benefits described above active flow control has been included in the PFS design.

6.4 Implementation

Figure 25 below provides an arrangement for the sprays and bulk water addition at the ROM feeder. The sprays positioned on the ROM bin wall address any dust that is drawn through from underneath the brow and wets the top surface of the ore. The sprays mounted on the head box are directed toward the falling ore that rills of the burden profile and the feed chute. The objective of these sprays is to increase the moisture content in the ore stream homogeneously.

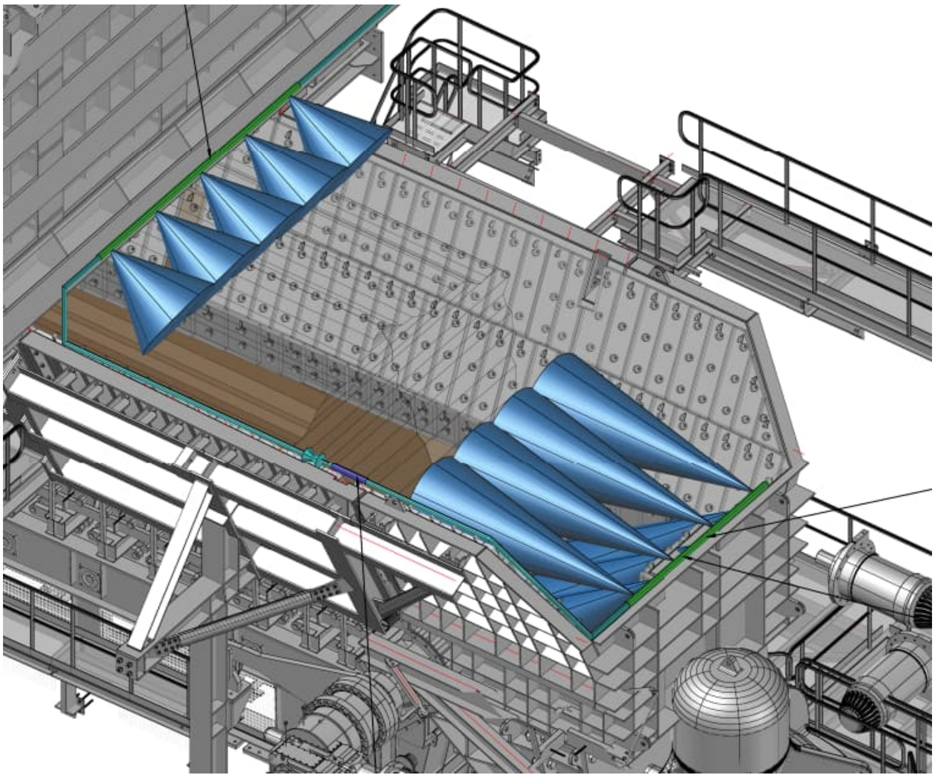

Figure 25 PC1 ROM Feeder bulk Water addition

6.4.1 Process Flow

A simple process flow is nominated for the crusher stations. A primary stream of water is added to the ore at the ROM feeder discharge to increase the moisture content of the ore. For the PC2 crushers where dry filtration is proposed an additional slurry of dust and water is added in the same location. The batch water addition from the slurry dust can be offset with the active flow control on the bulk water addition.

The amount of water addition will be controlled with inputs on the ore flow rate (apron feeder speed), moisture analyser, and slurry addition (PC2 only).

Refer to Figure 15 & Figure 22 for PC1 and PC2 Crusher Station PFDs respectively.

6.4.2 Electrical Control and Instrumentation

EIC works for the ROM feeder will be as per the COB feeder detailed in Section 7.4.2. Functionally the flow control valve will operate the same as the COB feeder based on belt weigher feed rate, and downstream moisture analyser feedback to automatically adjust flow rate in concert with COB water addition to achieve target moisture content.

6.4.3 Key Data

Bulk Water Addition			
Ore throughput	t/hr	3000	Based on max throughput of PC2-3 and historical hourly throughputs
Target Ore moisture content	%	2	Dust Extinction Moisture Content Testwork undertaken 730-22018-PF-REP-0006
Water design flow rate	M3/hr	40	Calculated
Water Pressure	kPa	600	Nominal
Type of Nozzles	-	60 Degree, ¾" Non clogging, full cone nozzle	Nominated by BMEA
Number of Nozzles	-	12	To suit nominal flow rate
Droplet Size d50	µm	100-400	730-22018-PF-REP-0002

6.5 Risks and Opportunities

6.5.1 Risks

The following risks are evident for the Project, which will require further mitigation in further stages of the Project:

- There is concern that the water addition at the crusher will increase wear to the crusher liners. This has been discussed with crusher and liner vendors and the feedback was that less than 5% moisture content would not be a problem. The target moisture content is only 2%.
- There is concern that unforeseen operational and maintenance issues eventuate with bulk water addition at the ROM such as blocked dribble chute, excessive mess at the crusher station, too much water in the COB bin. The bulk water addition can potentially be reduced at the ROM Feeder and supplemented at the COB feeder discharge.
- If too much water is added to the ore stream there is potential for ore runback on the conveyors. The moisture analysers will monitor the moisture content to prevent excessive water addition. Testing of the ore is proposed to establish the moisture content when runback risk is valid.

6.5.2 Opportunities

The following Project opportunities are seen. These should be investigating in future stages of the Project:

- With the bulk water addition at the ROM feeder the amount of dust inside the COB will significantly reduce. There will be an opportunity to potentially decommission the underpocket vent fan.

6.6 Further Work

The following further work is recommended to be completed during the next phase of the Project:

- A detailed construction schedule is required for implementation, taking into consideration operational and shutdown requirements, and confirming what work can happen while the crusher is still operating.
- Undertake ore moisture testing to confirm the moisture content of the ore when the runback risk on the incline conveyors is significant.
- Confirm and finalise all Project risks and opportunities described above.

7.0 Collection Conveyors & Transfer Stations

The horizontal conveyors have a significant dust loading as can be seen in in the image below.

Figure 26 Typical Dust haze in the collection area

The following section describes the technical details developed during the PFS for the dust suppression for the Collection Conveyor areas. The West Collection area has had dust measurement in the past as high as 11mg/m3 and 0.89mg/m3 of respirable dust and respirable silica respectively.

7.1 General Description

Each Collection Conveyor would include bulk water addition at the discharge of the COB feeder including the following requirements:

- Spray bars at the transfer between the COB Feeder and the Collection Conveyor.
- Moisture analyser on the lateral conveyor at the end of the loading skirts.
- New spray bars and piping in the loading zone of the lateral conveyor.
- New skirt modifications at the COB Feeder discharge.

7.2 Key Inputs & Assumptions

The following inputs and assumptions have been used in the development of the study for the PC1 Crusher Station Dust suppression upgrade:

- Dust loading at collection areas have been measured as high as 40mg/m3
- Dust extinction moisture content required is 2% (refer 730-22018-PF-REP-0006)
- Sprays are existing on the transfer stations and have operating logic and solenoids that constrains the operation of the sprays to when the conveyors are operating and transporting ore.

- No additional electrical infrastructure is required

7.3 Opportunities and Options Considered

In addition to typical design development factors including performance, constructability, maintainability, operability and cost, the following opportunities and options were considered during the study development:

1. Dry filtration at the transfer stations
2. Delaying the implementation of the skirt upgrades
3. Infrared verses Microwave type moisture analysers

These options are discussed further as follows:

7.3.1 Dry filtration at the transfer stations

Dry filtration was considered in the PFS for the transfer stations, however, was rejected in favour of passive containment with water dust suppression sprays for the following reasons:

1. Dry filtration would not work well with any moisture addition, as the moisture would bock the filters
2. Dry filtration would require much more area for the infrastructure and be more difficult to implement.
3. A staged approach can be undertaken with the dust suppression sprays followed by the skirt modifications

7.3.2 Delaying the skirt upgrades.

The moisture addition in the ore is likely to contribute the majority of the dust suppression with the skirt upgrades only contributing a marginal benefit comparatively. Therefore, there is consideration to only implement the skirt upgrades if the initial moisture addition and sprays does not satisfy the local dust generation requirements. This will increase the overall duration of the project but will potentially remove scope and hence capital costs.

7.3.3 Infrared vs Microwave type moisture analysers

Initially an infrared moisture analyser was considered. Infrared type analysers only measure the surface moisture of the material, which is then calibrated against a sample to nominate full moisture content.

Microwave moisture analysers measure through the full depth of the ore profile with software that calculates the moisture content based on the changes of the microwaves from the transmitter to the receiver. The transmitter is located above the ore stream and the receiver is located between the carry side and the return side of the belt.

With microwave moisture analysers already being installed on the incline system at Cadia, it was decided to use the existing vendor and instrument model for the project.

7.4 Implementation

The following modifications are included

1. Spray bars and bulk water addition at the transfer between the COB Feeder and the Collection Conveyor with active flow control.
2. Moisture analyser on the lateral conveyor at the end of the loading skirts.
3. New skirt modifications at the COB Feeder discharge to enclose the transfer (with appropriate allowance for the fixed magnet).
4. New spray bar with the following features:
    a. The new spray bar is in the loading section of the conveyor skirts.
    b. The spray bar ties in at the head chute spray bar to enable the existing solenoid and control logic to be used without modification.
    c. The additional water will help maintain the dust extinction moisture content of the ore.

5. New Conveyor Skirt upgrade
    a. The conveyor skirt upgrades are only required if bulk moisture addition and spray bar modifications prove to be insufficient to supress the dust locally.
    b. The conveyor skirts are approximately 1100mm high above the conveyor belt to keep the air flow velocities less than 2 m/s

Figure 27 below provides the overall arrangement of the proposed arrangement for the COB feeder to Collection conveyor transfer.

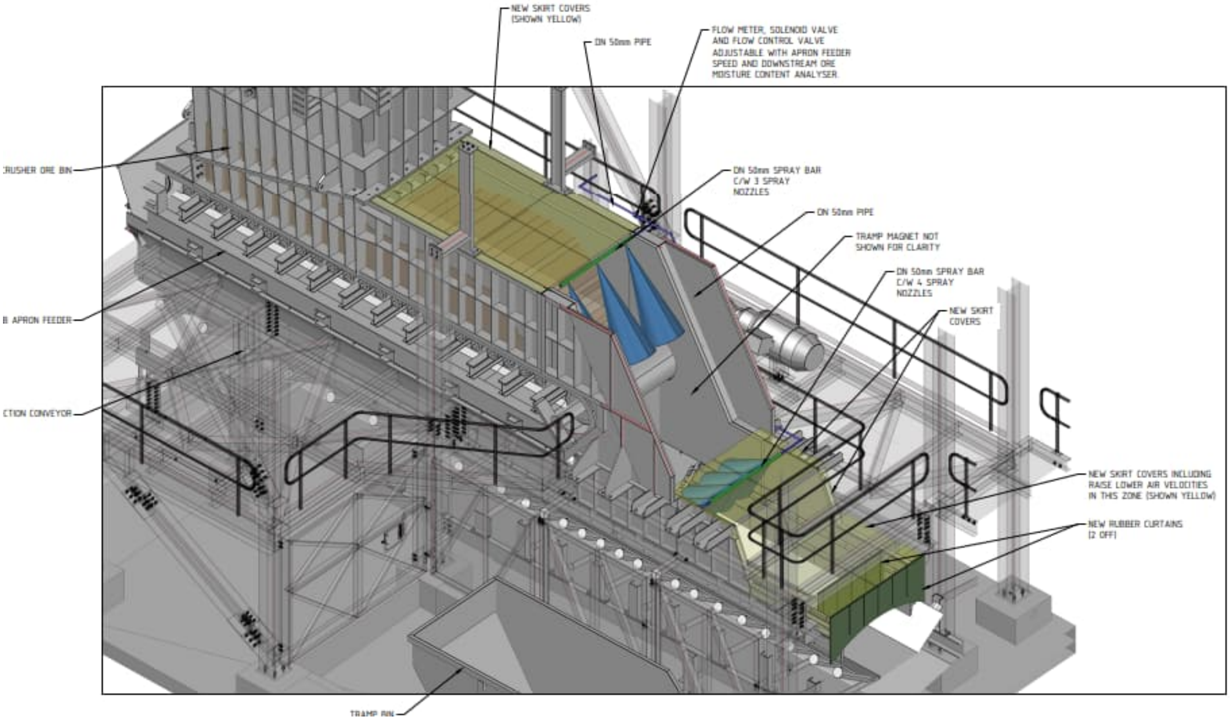

Figure 27 COB Feeder to Collection Conveyor Transfer

Figure 28 below shows the proposed changes to the loading stations on each of the lateral conveyors.

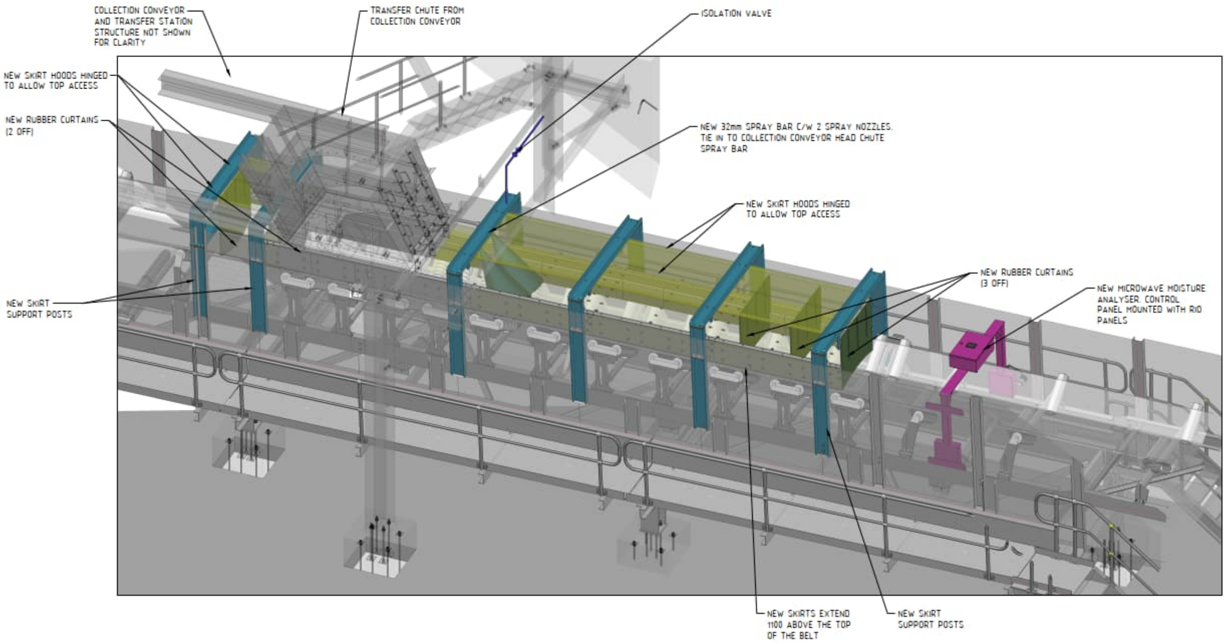

Figure 28 Lateral Conveyor Loading Zone skirt upgrade and Moisture Analyser

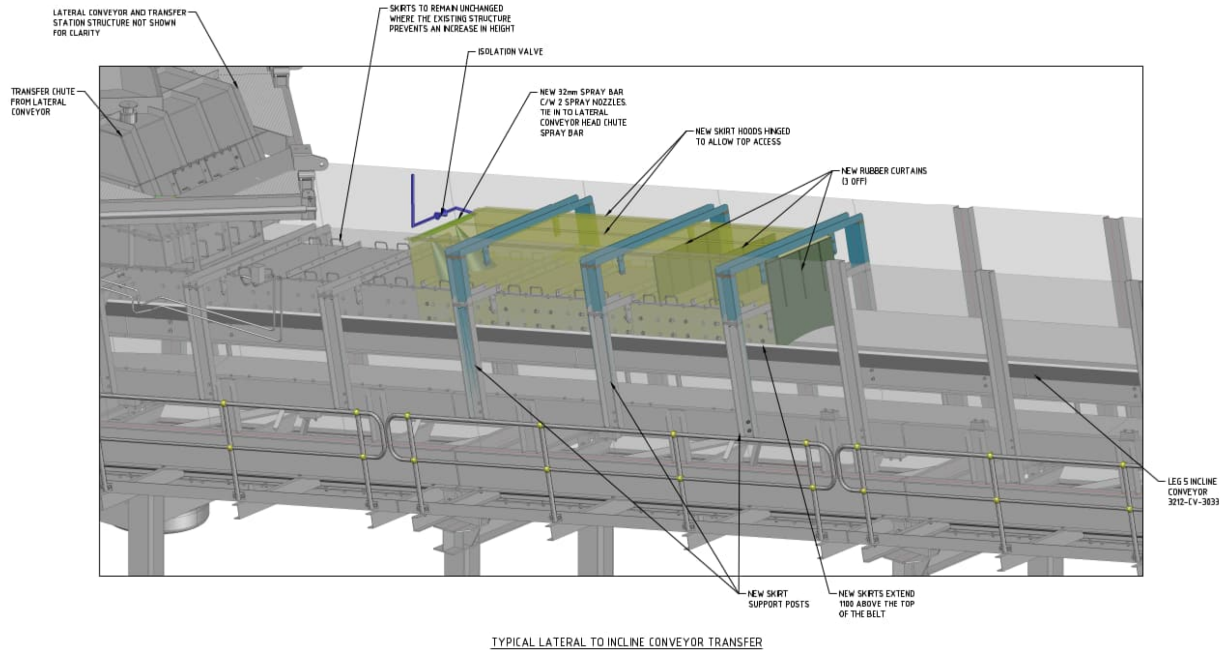

Figure 29 Typical Horizontal Transfer station modifications(T5, T11, T9 & T20)

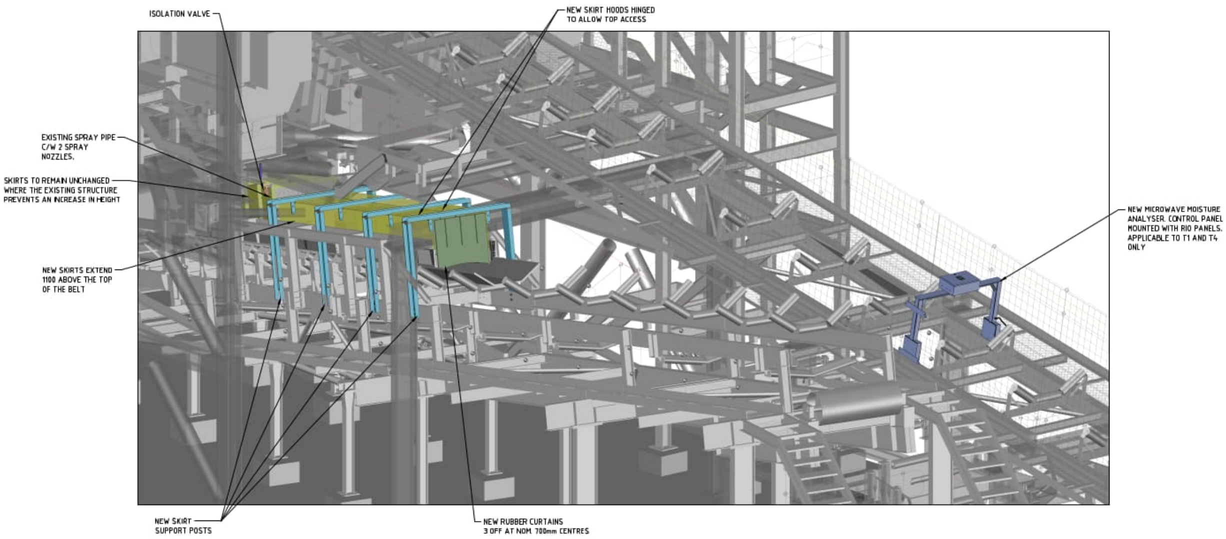

Figure 30 Typical Incline Transfer station modifications (T4, T3, T2 & T1)

7.4.1 Process Flow Diagram

The general process flow details for the Conveyors Transfers are as follows:

- The bulk water is added where the ore is transferred from the COB apron feeder to the collection conveyor with active flow control.
- A moisture analyser at the lateral conveyor transfer provides feedback to maintain the dust extinction moisture content and prevent excessive water addition.
- Additional sprays suppress dust at the transfers and prevents the ore drying out as it is transported on the high speed conveyor, with moisture analysers on the at T4 and T1 enabling fine tuning of the water to be added.

See Figure 31 below for a process flow of the bulk water addition at the collection area.

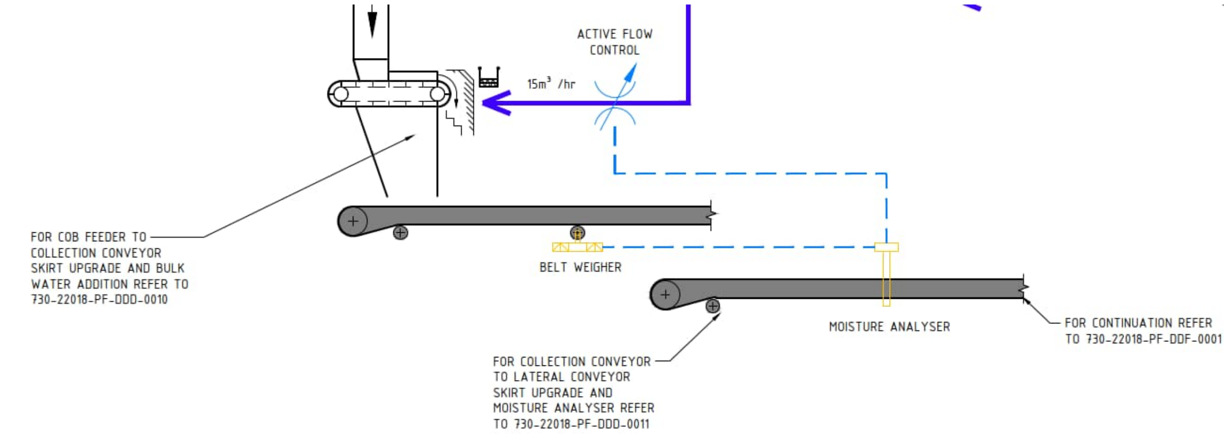

Figure 31 Process Flow Diagram for bulk water addition at the collection conveyor area.

7.4.2 Electrical Control and Instrumentation

Spray bars at the COB feeder will include a flow control valve to adjust flow rates, magflow flow meter to monitor flow rates, and solenoid valve to turn sprays on / off. A downstream moisture analyser on the collection conveyor provides closed loop feedback. Flow rates for the sprays are automatically adjusted based on the product flow rate over the belt weigher and moisture analyser via the PCS system.

For PC1, PC2E and PC2E a remote I/O panel has been allowed to monitor and control the above instrumentation. The new remote I/O panels have been fed via 240V supply from the Crusher Substation, and communications are via a fibre optic cable to the crusher substation communications panel. For PC2/3 the existing local remote I/O will be utilised with an allowance made for additional I/O modules in the RIO panel.

Refer to Figure 32 for a block diagram of the water addition EIC works.

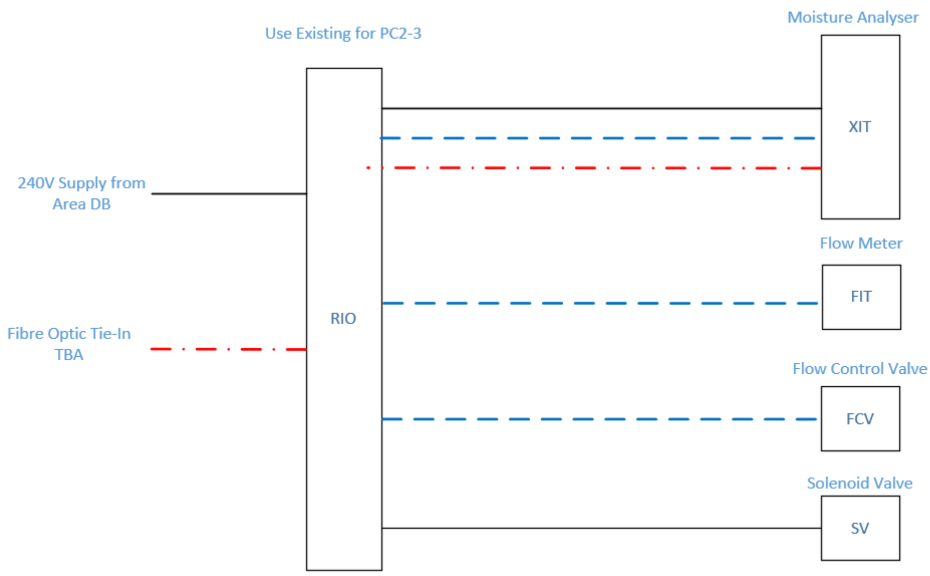

Figure 32 COB Feeder water addition EIC Block Diagram

7.4.3 Key Data

Based on the inputs, assumptions, options and considerations discussed in the previous sections of this report, the key data presented in Table 15 were selected as the PFS study basis for the collection conveyors dust suppression.

Table 15 PC1 Crusher Station Key Data

Description	Units	Details	Source
Moisture Addition			
Ore throughput laterals	t/hr	3000	Based on max throughput of PC2-3 and historical hourly throughputs
Ore throughput incline system	t/hr	5150	Incline Conveyor System upgrade report 730-212-FS-REP-4000
Target Ore moisture content	%	2	Dust Extinction Moisture Content Testwork undertaken 730-22018-PF-REP-0006
Skirt Modifications			
Cross Sectional Area	m2	1m2	730-22018-PF-REP0003
Velocities inside the Skirt Zone	m/s	<2	730-22018-PF-REP0003
Moisture Analyser			
Moisture Analyser Type	-	Microwave	Proposal
Moisture Analyser model	-	Scantech TBM 210	Proposal (as per existing moisture analyser on portal conveyor CV3037)

7.5 Risks and Opportunities

The majority of the dust issue mitigation will be achieved by the water addition and the dust sprays. The skirt modifications can potentially be removed from the scope if the water addition proves to be effective at meeting the dust emissions and underground environment criteria.

7.6 Further Work

The following further work is recommended to be completed during the next phase of the Project:

- A detailed construction schedule is required for implementation, taking into consideration operational and shutdown requirements, and confirming what work can happen while the conveyors are still operating.
- An existing microwave moisture analyser is installed on CV3037, the same model proposed for the dust suppression project. Feedback on the performance and maintainability of the existing microwave moisture analyser should be confirmed so that any lessons learnt can be implemented for the dust project.
- Confirm and finalise all Project risks and opportunities described above.

8.0 Water Supply Upgrade

8.1 General Description

Cadia East operations and maintenance already experience a lack of raw water supply. The amount of water that is used underground is measured by a flow indicator adjacent to the Million litre tank.

To increase the dust extinction moisture content significant extra water will be used than what is currently being used. To accommodate this new water use the following infrastructure has been allowed for:

- 500kL Surface tank.
- A new pipe line running parallel to the existing DN225 water supply pipeline running down the conveyor portal and down the conveyor inclines. The new pipeline is the same spec as the existing pipeline but with a reduced diameter of DN160 (PE100 PN12.5).
- To handle the increasing pressure of water as the pipeline descends underground the existing break tanks can be used to reduce the pressure in the pipeline.

8.2 Key Inputs & Assumptions

8.2.1 Inputs

The following inputs have been used in the development of the study for the PC1 Crusher Station Dust suppression upgrade:

- Dust extinction moisture content required is 2% (refer 730-22018-PF-REP-0006)
- Current water consumption is XXXX (AEC ANZ-RFI-000142)

8.2.2 Assumptions

The following assumptions have been used in the development of the study for the dust suppression in the Collection area:

- The existing break tanks can be used for pressure regulation on the new pipeline.
- The pipeline all require their own ground support anchors.

8.3 Implementation

Refer to the figure below for a schematic of the new water supply network underground.

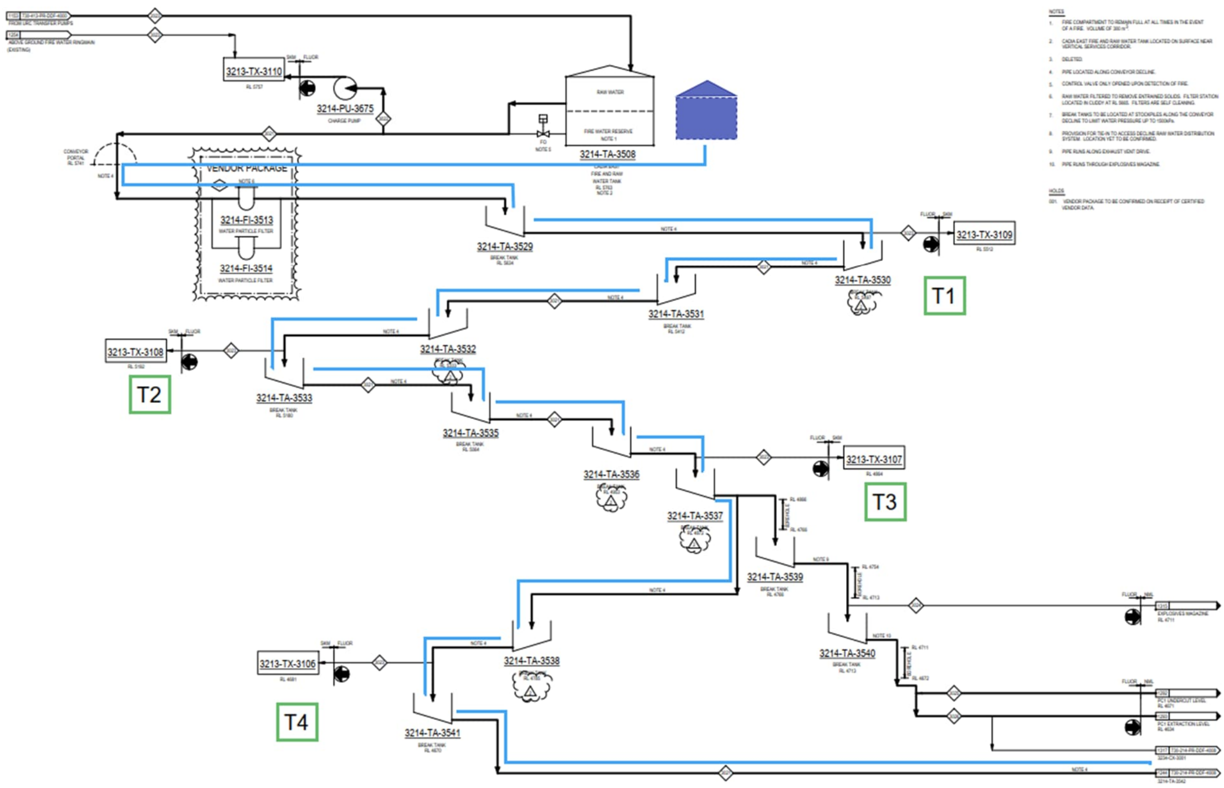

Figure 33 New Water Supply underground

The new tank will tie into the existing million-litre tank with appropriate valving to enable one of the tanks to be shut down for maintenance while the other continues to operate and supply water to the mine.

8.3.1 Key Data

Based on the inputs, assumptions, options and considerations discussed in the previous sections of this report, the key data presented in Table 16 were selected as the PFS study basis for the collection conveyors dust suppression.

Table 16 Water Supply Upgrade Key Data

Description	Units	Details	Source
Moisture Addition			
Ore throughput incline system	t/hr	5150	Incline Conveyor System upgrade report 730-212-FS-REP-4000
Target Ore moisture content	%	2	Dust Extinction Moisture Content Testwork undertaken 730-22018-PF-REP-0006
Max Water supply	m3/hr	103	Calculated
Surface Tank Size	M3	500,000	Assumed
Water Pipeline Diameter		160 DN	Calculated (max velocity of 2m/s)

8.4 Risks and Opportunities

The following Project opportunities are seen. These should be investigating in future stages of the Project:

- Rather than following the existing water supply route and break tanks, a bore hole from the surface could be mined similar to the dewatering boreholes. This would require high pressure piping and could potentially be constructed at the same time the new dewatering piping line is installed. Positioning of the dewatering and water supply boreholes will need to consider interactions with cave, subsidence zone as well as locations for clean water dams.
- Rather than a new water supply underground consideration was given to reusing the water from the dewatering system to save on capital costs. The likely unreliability of water supply from the dewatering system has excluded this option from the PFS however should be investigated further in the following phases.

8.5 Further Work

The following further work is recommended to be completed during the next phase of the Project:

- A detailed construction schedule is required for implementation, taking into consideration operational and shutdown requirements, and confirming what work can happen while the conveyors are still operating.
- Confirm and finalise all Project risks and opportunities described above.

9.0 Capital Cost Estimate

The capital cost estimate has been developed to comply with the criteria requirement for a Pre-Feasibility Study - Class 2 level estimate. Refer to *730-19018-FS-REP-5011 Basis of CAPEX Estimate* for the full capital cost estimate

9.1 Estimate Classification and Accuracy

The capital costs (CAPEX) associated with the dewatering infrastructure have been estimated from first principles in compliance to the requirements set out in PRJ-340-05-C *Newcrest Estimating Standards and Guidelines*.

Table 17 Estimate Classification

Key Estimate Criteria	Remarks
Estimate Class	Class 2 – Pre-Feasibility Study
Maturity Level of Project Deliverables	10% to 15% of full project engineering definition
Level of Estimating Accuracy	-20% to +25%
Level of Project Design Definition	Mix of material take-offs (MTO's) and factored quantities, semi-detailed unit costs

9.2 Estimate Base Date

The base date for the capital cost estimates is 2nd quarter of the year 2022 (Q2 2022) and excludes all forward escalation and any EBA increase to the labour rates for the duration of the works.

9.3 Direct Costs Basis

Direct costs are the costs of installed equipment, materials, and labour directly involved with the physical construction of the permanent structures. All direct costs for the Project Estimate were built from detailed Material Take-offs developed by the Engineering Team and compiled using the following sources:

Table 18 MTO Sources

Major Commodity	MTO Source
Earthworks	3D Model – Calculated
Concrete	3D model – Calculated
Structural Steelwork	3D Model – Calculated
Architectural	Drawings
Platework - Mechanical Bulks	3D Model – Calculated
Mechanical Equipment	3D Model, Equipment List, P&ID's
Piping	3D Model, Pipe and Valve Lists, P&ID's
Electrical	3D Model, Electrical Drawings, Equipment List
Instrumentation	3D Model, Electrical Drawings, Instrument List
Other Items	3D model, Drawing, Past Projects, Engineering Judgement

Direct costs have been made up of individual Code of Accounts inclusive of the following cost elements:

- Man Hours
- Plant Equipment
- Bulk Materials
- Freight

- Labour
- Subcontract Costs
- Contractor Distributable
- Growth

9.4 Contractor Distributable

Contractor Distributable for the Project Estimate were calculated from historical norms and are based on the following table.

Table 19 Contractor Distributable % of labour costs

Indirect Items	Concrete	Structural Mechanical & Piping	Electrical & Instrumentation
Mob / Demob	5%	5%	5%
Temporary Facilities	15%	15%	15%
Small Tools & Consumables	9%	15%	15%
Construction Equipment	30%	50%	30%
Management & Supervision	50%	50%	50%
Manual Indirects	6%	6%	6%
Head Office Support	4%	4%	4%
Insurance & Finance	1%	1%	1%
Contractors Site Office Admin / operations inc. clerk, waste removal, cleaning, dust mitigation, medical supplies, minor repairs	12%	12%	12%
Profit on Cost above	15%	15%	15%
Total	147%	170%	153%

9.5 Contingency

A 25% contingency allowance calculated on the direct and indirect costs of the estimate has been allocated for the PFS. Contingency is generally provided in the estimate to cover the anticipated risk of variances between the specific values given in the estimate and the final actual project cost, for the total estimated value to represent the most likely outcome. Contingency does not cover scope changes.

9.6 Capital Cost Summary

The following table summarises the capital cost estimate for the FS. Refer to *730-22016-PF-REP-0003 Basis of CAPEX Estimate* for the full capital cost estimate.

WBS	WBS Description	AMOUNT $AUD	
2000	Underground Mine	$	30,523,448
2100	Common Decline	$	6,152,769
2130	Incline Conveyor Transfer Stations	$	810,446
2140	Underground Mine Services & Facilities	$	5,342,323
2300	PANEL CAVE 1 (formerly Lift 1)	$	4,779,153
2330	PC1 Undercut, Drawpoints and Roads	$	2,661,351
2340	PC1 Ore Crushing	$	1,044,486
2350	PC1 Horizontal Conveyors	$	462,381
2360	PC1 Horizontal Conveyor Transfer Stations	$	147,052
2370	PC1 Underground Mine Services & Facilities	$	463,883
2400	PANEL CAVE 2 (formerly Lift 2)	$	20,364,665
2430	PC2 Undercut, Drawpoints and Roads	$	7,576,108
2440	PC2 Ore Crushing	$	10,161,682
2450	PC2 Horizontal Conveyors	$	1,398,503
2460	PC2 Horizontal Conveyor Transfer Stations	$	455,233
2470	PC2 Underground Mine Services & Facilites	$	773,138
4000	Surface Infrastructure	$	291,613
4100	Surface Infrastructure - On Site	$	291,613
	Total Direct Cost		31,588,199
7000	Project Delivery Management	$	365,637
7500	Spares	$	305,637
7600	Commissioning	$	40,000
7700	Vendor Representation	$	20,000
8000	Other Capitalised Costs	$	2,193,553
8100	Integrated Owners Team & ESP	$	2,193,553
	Total Indirect Cost		2,559,190
9000	Contingency/Escalation	$	8,536,847
9100	Contingency	$	8,536,847
	Total Cost	$	**42,684,237**

Table 20 Capital Cost Estimate

9.6.1 Estimate by Direct, Indirect and Contingency

The graph below shows the overall distribution of the Project directs, Indirects and Contingency.

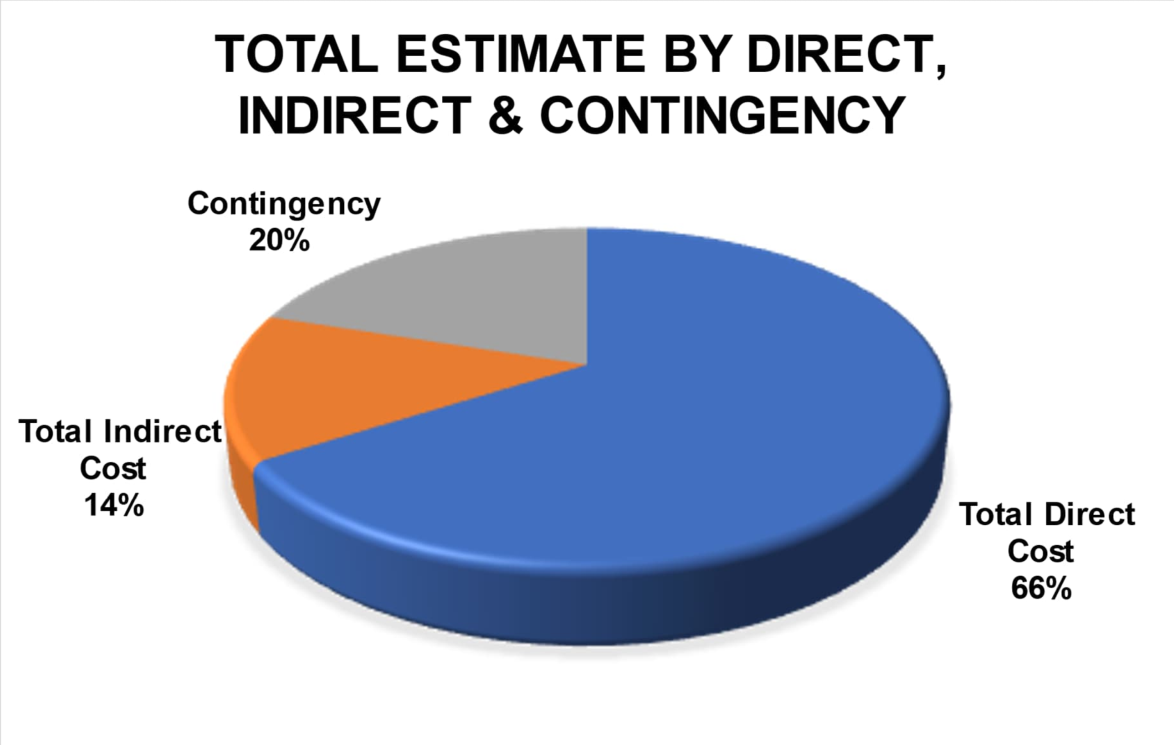

Figure 34 Total Estimate by Direct, Indirect and Contingency

9.6.2 Direct Cost – Location

The graph below shows the Project directs cost by Location.

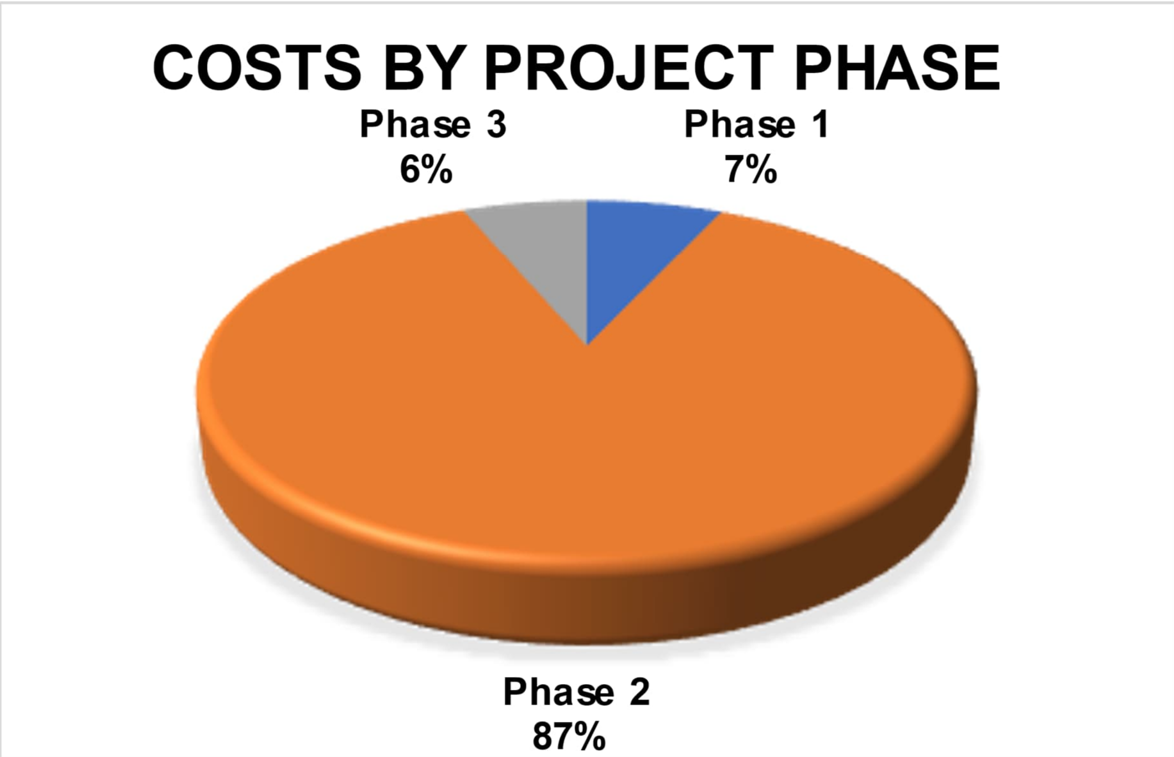

Figure 35 Cost by Phase

9.6.3 Capital Estimate by Dust Suppression Technology

The graph below shows the Project cost by Dust Suppression Technologies

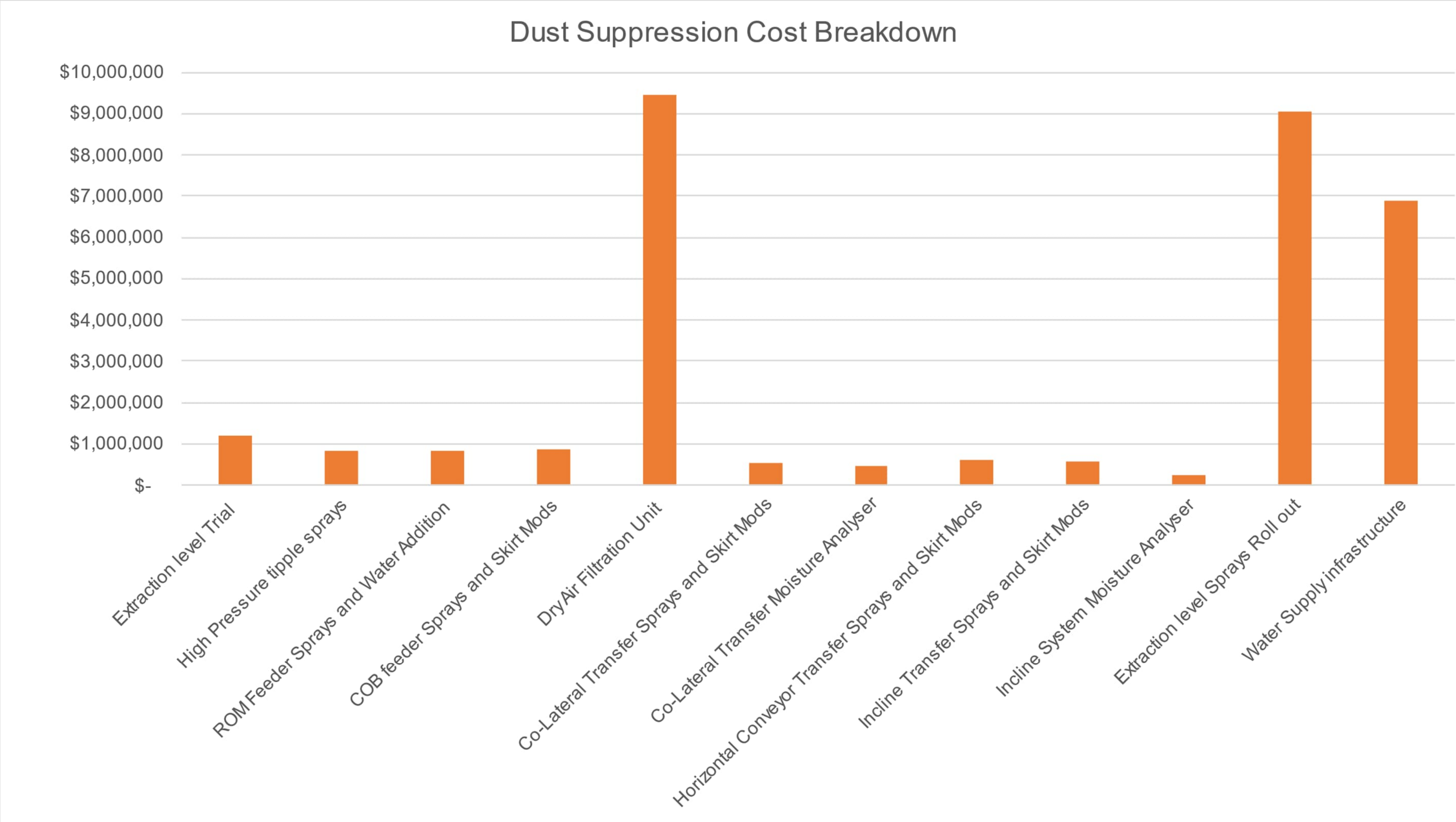

Figure 36 Estimate by Dust Suppression Technology

9.6.4 Capital Estimate comparison for PC2 ROM bin Tipples

To support the decision making to be undertaken in the next phase regarding the high pressure tipple sprays or a dry scrubber for the three PC2 ROM bin tipples the following figure is provided in terms of Capital Costs. Note the Dry filtration costs nominated in Figure 37 are approximately one third of the costs nominated in Figure 36 because there are three ROM bins included in Figure 36.

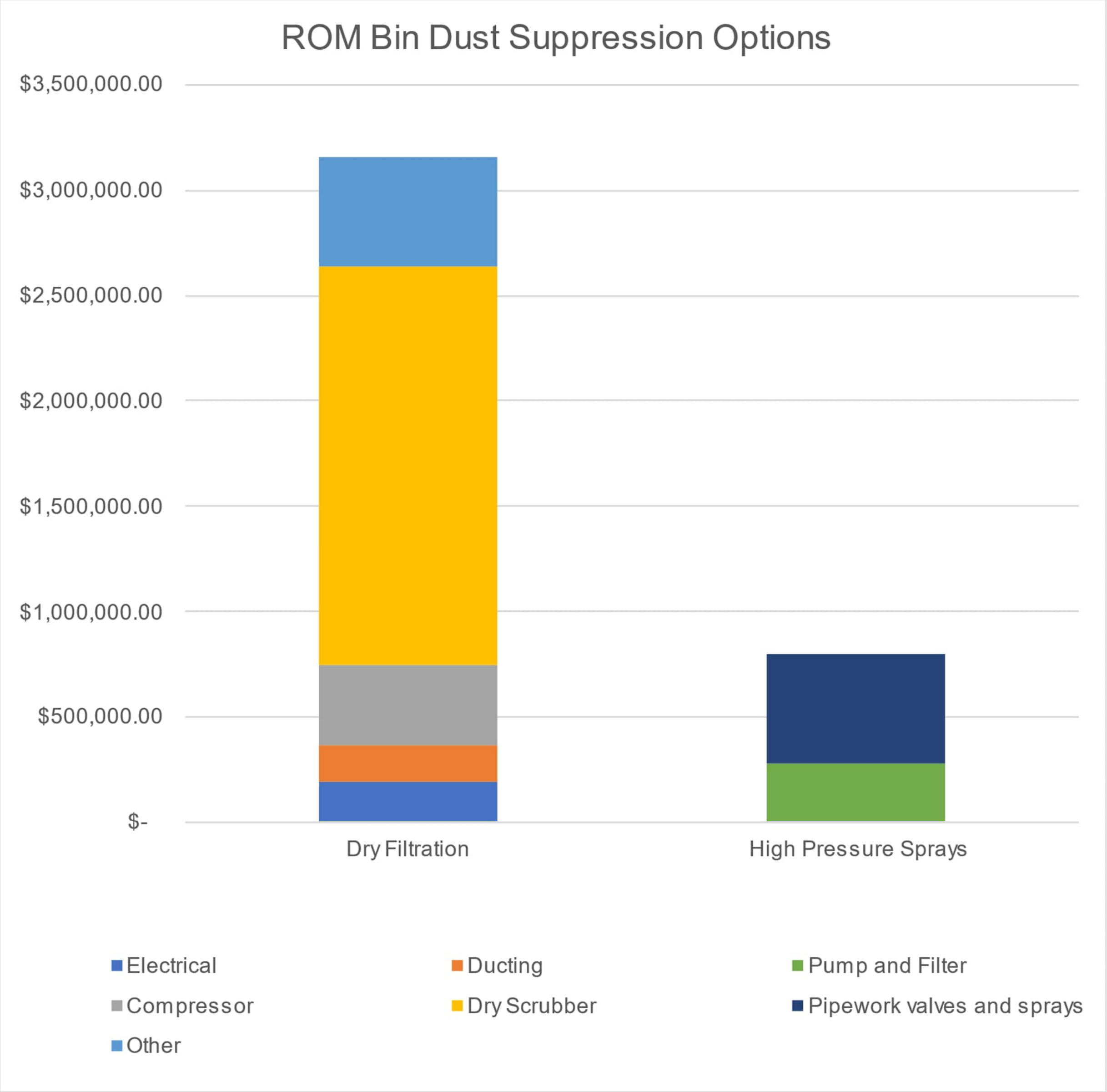

Figure 37 ROM Bin Tipple Dust Suppression Options

Note the above capital costs exclude any potential extra costs associated with new ventilation infrastructure required to enable high pressure sprays to be installed on the PC2 ROM tipples.

10.0 Operating Cost Estimate

The operating costs are relatively low cost with respect to the operating cost of the mine. The operating costs are estimated below.

10.1 Extraction Level Sprays

The operating costs for the extraction level sprays is primarily as a result of loaders damaging the sprays bars and the spray bars having to be replaced. It is assumed that the whole spray bar is replaced rather than individual nozzles. The frequency of damage to the sprays will be established during the trial. An initial assessment is made below for the purposes of the PFS.

	Activity frequency /day	Likelihood of damaging spray bar	Predicted replacements/ year
Mucking from a drawpoint	4200 (30mtpa / 20t / 365 days/ annum)	1 in 20,000	77
Building a bund at the drawpoint	25	1 in 200	45
Total			122

Assume 2hr to replace one Spray bar therefore total costs is approximately $180,000 per year.

10.2 PC1 High Pressure tipple sprays

The operating costs for the PC1 high pressure tipple sprays will be based on damage to the sprays in the tipple area from flyrock. The spray bars are based on a duty standby arrangement. The operating costs assume that each duty spray bar is damaged every three months.

The costs to replace the spray bars at the tipple are therefore $20K per quarter or $80K per year. An allowance of $20K per year is estimated for the pump and filter maintenance. Power for high pressure pumping system and filtration system are approximately $30K per year.

Total costs for the PC1 High pressure tipple sprays is $130K per year.

10.3 PC2 Dry Filtration

An allowance has been made for Dry filtration maintenance costs of $200,000 per crusher per year. Electricity costs for the fans and the compressor and pump at each crusher station are estimated at 1,700,000 kWhr per year. With an electricity price 10.1c/kWhr the electricity costs are $170,000 per crusher station

To be updated with feedback from the vendors and the Grydale trial.

10.4 Sprays

The majority of the remaining infrastructure that requires maintenance will be the sprays. Assumptions can be made on how long the sprays last due to wear/blockage and damage.

The total number of spray nozzles (excluding the extraction level) proposed for the project is as follows

Nozzle Location	Number of spray nozzles in each location	
4 x ROM Feeders	4 x 12	48
4 x COB Feeder	4 x 7	28
4 x Collateral Transfers	4 x 2	8
4 x Horizontal Transfers	4 x 2	8

Nozzle Location	Number of spray nozzles in each location	
4 x Incline Transfers	4 x 2	8
Total Number of sprays	**100**	

The nozzles in the transfers are much less likely to be damaged than the sprays on the extraction level. However the nozzles will block and require attention. With the water quality underground and debris it is expected that the majority of the maintenance will be unblocking nozzles. An allowance is made to cover a nominal amount of maintenance and inspection of the spray bars that will happen as part of normal maintenance practices, and inspection routines of $50K per year.

10.5 Moisture Analysers

The moisture analyses will have low operating costs however it is proposed to have calibration to be undertaken on one of the analysers every 3 monthly shutdown. With the 6 moisture analysers installed there will be a cycle of calibration every 18 months. Calibration costs are approximately $10K per unit or $50K per year to allow for product support from the vendor

The total allowance for operating costs are as follows

Table 21 Operating Costs Summary

Area	Operating Cost Allowance
Extraction Level Sprays	$180,000
PC1 High Pressure Sprays	$130,000
PC2 Dry Filtration	$1,110,000
Transfer station sprays and bulk water addition	$50,000
Moisture Analysers	$50,000
Total	$1,520,000 per year

To support the decision making to be undertaken in the next phase regarding the high pressure tipple sprays or a dry scrubber for the PC2 ROM tipples the following table is provided.

Table 22 Operating Costs Comparison (one ROM bin tipple only)

ROM Tipple Strategy	Power	Maintenance Costs	Total Operating Costs /year
High Pressure Sprays	$30,000	$100,000	$130,000
PC2 Dry Filtration	$170,000	$200,000	$370,000

Note the above operating costs exclude any potential extra operating costs associated with new ventilation infrastructure required to enable high pressure sprays to be installed on the PC2 ROM tipples.

11.0 Execution Schedule

The project Execution Schedule contains the client approval, early works, detailed engineering, procurement, contracts, fabrication and delivery, construction, and commissioning activities. The schedule has been developed to provide overall project timing for completing scope of works that are required for the project.

To better suit the overall Project timing and constraints, the Execution Schedule has been broken into three (3) phases as below:

- Phase 1 - Detailed Engineering
- Phase 2 – PC1 Area Execution
- Phase 2 – PC2W, PC2E and PC23 Area Execution
- Phase 3 - Conveyor Skirts Upgrade

Phase 2 and 3 contains the client approval, enabling works, procurement, contracts, fabrication and delivery, construction, and commissioning activities. The schedule has been developed to provide overall project timing for completing scope of works that is required for the project.

11.1 Schedule Classification

The Schedule Classification has been developed to categorise the maturity and quality of the schedule. The Execution schedule has been built to meet the minimum requirements of a Level 3 schedule as appropriate at this PFS stage, in compliance with the requirements set out in Newcrest's Planning and Scheduling Standards *PRJ-340-03*.

The execution schedule complies with the requirements set out in the table below.

Table 23 Schedule Classifications

Schedule Detail	Dewatering Optimisation Schedule
Schedule Class	Level 3 – Project Detailed Schedule
Methodology	Critical path method (bottom-up scheduling)
Expected Contingency Range	20% to 25%
Critical Path Definition	Primary and near CPs defined
Start-to-Finish (SF) Relationship	None. Most activities scheduled FS
Lags	Limited use of lags with justification provided in the Basis of Schedule. Use of negative lags is not permitted
Project Calendar	Finalised
Schedule Characteristics	• Detailed logic driven • Work packages detailed as necessary to reflect the execution sequence, including any internal/external interfaces

11.2 Key Milestones

The key milestones identified for the Project are provided in the figures below.

Task Mode	Task Name	Duration	Start	Finish
	Cadia East Dust Suppression - PFS Execution Schedule	**348 days**	**Thu 1/06/23**	**Mon 30/09/24**
	Milestones	**347 days**	**Thu 1/06/23**	**Mon 30/09/24**
	Newcrest Gate Approval for Detailed Design and Execution	0 days	Thu 1/06/23	Thu 1/06/23
	Phase 1 - Detailed Engineering Commence	0 days	Mon 3/07/23	Mon 3/07/23
	Phase 1 - Detailed Engineering Complete	0 days	Fri 10/11/23	Fri 10/11/23
	Procurement Commence	0 days	Mon 11/09/23	Mon 11/09/23
	Procurement Complete	0 days	Fri 10/11/23	Fri 10/11/23
	Execution Tender Period Commence	0 days	Mon 23/10/23	Mon 23/10/23
	Execution Tender Period Complete	0 days	Fri 22/12/23	Fri 22/12/23
	Phase 2 - PC1 Area Execution Commence	0 days	Mon 8/01/24	Mon 8/01/24
	Phase 2 - PC1 Area Execution Complete	0 days	Fri 19/04/24	Fri 19/04/24
	Phase 2 - PC2 Area Execution Commence	0 days	Mon 8/01/24	Mon 8/01/24
	Phase 2 - PC2 Area Execution Complete	0 days	Fri 28/06/24	Fri 28/06/24
	Phase 3 - Conveyor Skirts Upgrade Commence	0 days	Mon 1/07/24	Mon 1/07/24
	Phase 3 - Conveyor Skirts Upgrade Complete	0 days	Mon 30/09/24	Mon 30/09/24

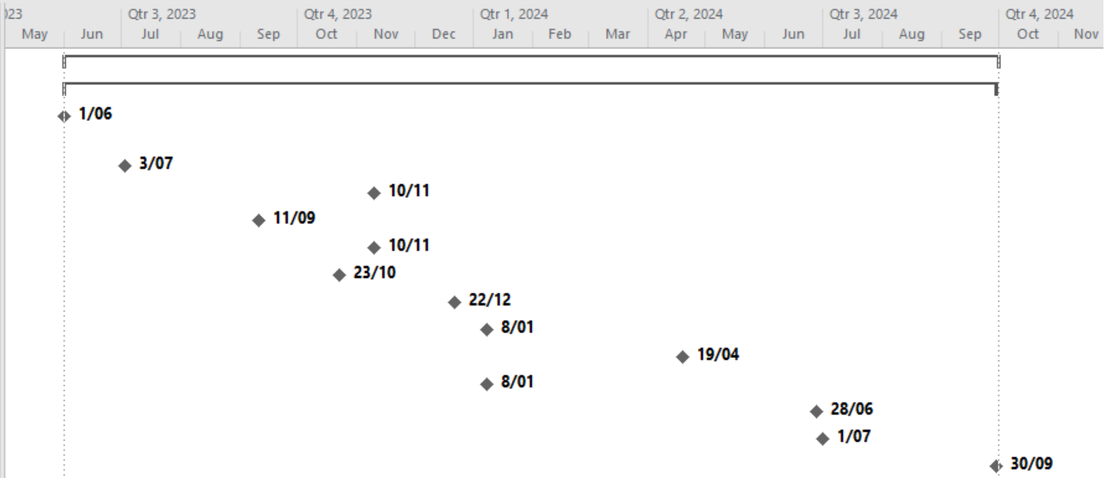

Image 38 Key Milestones

11.3 Critical Path

The Critical Path (CP) is determined as activities with a Total Float of zero (0) days or less. Near critical path is deemed as activities with a Total Float of 10 days or less.

The overall critical path is shown in the figures below:

Task Mode	Task Name	Duration	Start	Finish
	Critical: Yes	**66d**	**Mon 1/07/24**	**Mon 30/09/24**
	Contractor Mobilization Onsite	0 days	Mon 1/07/24	Mon 1/07/24
	Conveyor Skirts upgrade - Transfer Chute 1 to 5	20 days	Mon 1/07/24	Fri 26/07/24
	Conveyor Skirts upgrade - Transfer Chute 6 to 10	20 days	Mon 29/07/24	Fri 23/08/24
	Conveyor Skirts upgrade - Transfer Chute 10 to 16	25 days	Mon 26/08/24	Fri 27/09/24
	Phase 4 Complete	0 days	Mon 30/09/24	Mon 30/09/24

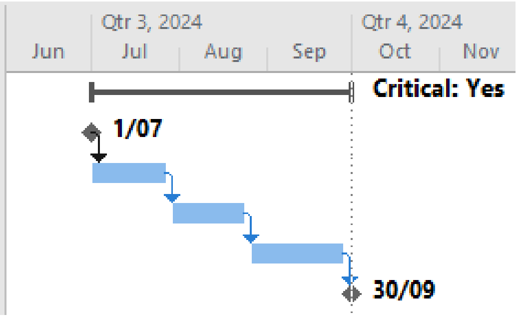

Image 39 Critical Path Activities

12.0 Safety in Design and Risk Management

12.1 General Description

Safety and risk on the Cadia East Dewatering Optimisation PFS are managed in accordance with R3AN-500-PR1 *AECOM's Risk Management Procedure* and the Newcrest project risk management procedure PRJ-330-01 *Project Risk Management.*

The project was categorised as a "**Multi discipline complex project with high industry safety risks**" with a "**Possible multiple fatalities or permanent disabilities**" likely safety risk.

As part of the management of risks, the following tasks were undertaken on the PFS:

- Management of a project register to record risks (730-22016-PF-REG-0001 *Action Register).*
- Completion of risk assessment activities including:
  - 20% Project Status Hold and Review.
  - 60% Project Status Hold and Review.
  - PFS level HAZID analysis.
- Completion of Safety in Design activities as per I3AN-221-PR1 *AECOM Safety in Design Procedure* and PRJ-330-01 *Newcrest Project Risk Management*.
- Peer review in accordance with AECOM's standard QA procedure.

12.2 Risk Documents

Table 24 below provides a summary of the risk documents associated with the PFS.

Table 24 Risk Management Reference Documents

Document No.	Document Title
AEC ANZ-MM-000095	60% Design Review | Close-Out Meeting Minutes
XXXXXXXXXXX	HAZID Meeting Minutes

12.3 Handover Items

Table 25 below provides a summary of all Handover items that require further work in the Detailed Design of the Project. Refer to *730-22018-PF-REG-0006 Actions Register* for full details of actions identified during the project.

Table 25 Risk Handover Items

Reference	Action / Issue / Decision / Risk Description
	To be populated post the HAZID

13.0 PFS Compliance

The following sections outline the compliance to the Newcrest requirements achieved on the Pre-Feasibility Study.

13.1 Scope

The table below provides a comparison of the Newcrest engineering scope requirements for the Project and the achieved compliance to these key scope items; noting deviations where applicable.

Table 26 Scope Compliance – Key Items

Scope Area	Requirement	Compliance	Comments
Project Management	Execute to a Project Execution Plan	Complies	Refer to *730-22018-PF-PLA-0002*
Project Management	Maintain a Deliverables Tracking Register	Complies	Refer to *Tracking Register*
Project Management	Utilise Aconex Document Control	Complies	Refer to Aconex Instance *AECOM 730.22.018*
Project Management	Maintain Project Schedule	Complies	Refer to *730-22018-PF-PLA-0002*
Engineering	Development of PFS level drawings and documentation	Exceeds	Level of Detail exceeds requirements expected for PFS level development.
	Development of PFS 3D Model	Exceeds	Level of Detail exceeds requirements expected for FS level development.
Safety	Undertake PFS Safety in Design Processes	Complies	A comprehensive review approach including: • HAZID • 60% Design Review

13.2 Estimate

The table below provides a direct comparison between Newcrest Classification tables *PRJ-340-05-C Estimating Standards and Guidelines Rev 2* for a Class 2 PFS Estimate and the achieved compliance for key estimate items, noting deviations where applicable.

Table 27 Capital Estimate Compliance – Key Items

Classification	Requirement	Compliance	Comments
Estimate Class	Class 2	Complies	Meets Newcrest requirements outlined in PRJ-340-05-C.
Level of Definition	10% to 15% of full project engineering definition	Complies	Engineering estimated at 15% complete.
Accuracy Range	± 20 to ± 25%	Complies	Meets Newcrest requirements outlined in PRJ-340-05-C.
Estimating methodology	Mix of material take-offs (MTOs) and factored quantities, semi-detailed unit costs.	Exceeds	Preliminary MTO's
Equipment Quotes	Budget priced - Single check price	Complies	Budget priced - Single check price
Civil / Structural Material Supply and Construction Costs	Budget priced - Take-off sketch / preliminary drawings	Complies	Preliminary MTO's Site provided rates
Mechanical / Piping Costs	Mix of MTOs and factors	Complies	Preliminary MTO's
Electrical / Instruments Costs	$ per kw per drive	Exceeds	Preliminary MTO's

Classification	Requirement	Compliance	Comments
Information Systems / Control Systems Cost	% of Total direct costs	Complies	Engineering Estimate
Labour Rates	Factorised or benchmarked	Exceeds	Recent quotes from CXP Contractors, benchmarked against AECOM pricing.
Labour Productivity	Assumed	Exceeds	PF calculation completed. Output has been benchmarked against CXP.
Construction Equipment	Factorised $ / Hr on Labour Rates	Exceeds	Construction equipment costs are included in distributable costs build up.
Indirect Costs	% of Direct costs	Exceeds	Indirect costs are a mixture of detailed build up (ESP fee, spares, etc) and factored costs (e.g. first fills, vendor reps).
Contingency	Deterministic or Probabilistic 15% to 25 % of total costs	Complies	Contingency calculated based on high level risk assessment of critical project factors.
Engineering Deliverables	Generally started / preliminary	Exceeds	Level of design definition achieved is higher than started/preliminary due to the design being based on existing detailed design. A comprehensive review approach was used including 2 x design reviews and HAZID.

13.3 Schedule

The table below provides a direct comparison with Newcrest Classification tables *PRJ-340-05 Estimating Standards and Guidelines Rev 2* and *PRJ-340-03 Planning and Scheduling Standards* for a Level 3 PFS Schedule and the achieved compliance for key schedule items, noting deviations where applicable.

Table 28 Schedule Compliance – Key Items

Classification	Requirement	Compliance
Overall Schedule Level	Level 3	Complies
Critical Path	Verified	Complies
Engineering	Defined	Complies
Long Lead Deliverables	Defined	Complies
Commissioning and Ramp up	Outlined	Complies

Appendix A

Study Deliverables

Appendix A Study Deliverables

Deliverable	Number
22-018 CADIA EAST DUST SUPPRESSION PRE-FEASIBILITY STUDY | STUDY REPORTSTUDY EXECUTION PLAN	730-22016-PF-PLA-0003
22-018 CADIA EAST DUST SUPPRESSION PRE-FEASIBILITY STUDY | STUDY REPORT	730-22018-PF-REP-0009
22-018 CADIA EAST DUST SUPPRESSION | STAGE 1 | BMEA | TECHNOLOGY ASSESSMENT | TIPPLES AREA	730-22018-PF-REP-0002
22-018 CADIA EAST DUST SUPPRESSION | STAGE 1 | BMEA | TECHNOLOGY ASSESSMENT | CRUSHING AREA & TRANSFER CHUTES	730-22018-PF-REP-0003
22-018 CADIA EAST DUST SUPPRESSION | STAGE 1 | BMEA | TECHNOLOGY ASSESSMENT | VENT EXHAUST & ROADWAYS	730-22018-PF-REP-0004
22-018 CADIA EAST DUST SUPPRESSION | STAGE 1 DESIGN DEFINITION REPORT	730-22018-PF-REP-0005
DUST CONTROL – TECHNOLOGY ASSESSMENT REVIEW AND MULTI-CRITERIA ANALYSIS WORKSHOP	730-22018-PF-REP-0007
22-018 CADIA EAST DUST SUPPRESSION | WORKSHOP OUTCOMES REPORT	730-22018-PF-REP-0008
22-018 CADIA EAST DUST SUPPRESSION | CAPITAL ESTIMATE BASIS OF ESTIMATE REPORT	730-22018-PF-REP-0010
22-018 CADIA EAST DUST SUPPRESSION | BASIS OF SCHEDULE REPORT	730-22018-PF-REP-0011
22-018 CADIA EAST DUST SUPPRESSION | DUMP POCKET SPRAY SYSTEM CFD ANALYSIS	730-22018-PF-REP-0012
22-018 CADIA EAST DUST SUPPRESSION | ACTIONS REGISTER	730-22018-PF-REG-0006
CADIA EAST DUST SUPPRESSION PFS | UNDERGROUND MINE | OVERALL INFRASTRUCTURE ADDITION | PROCESS FLOW DIAGRAM	730-22018-PF-DDF-0001
CADIA EAST DUST SUPPRESSION PFS | PC1 ORE CRUSHING | TIPPLE DUST SUPPRESSION & H20 ADDITION | PROCESS FLOW DIAGRAM	730-22018-PF-DDF-0002
CADIA EAST DUST SUPPRESSION PFS | PC2 ORE CRUSHING | TIPPLE DRY SCRUBBING & H20 ADDITION | PROCESS FLOW DIAGRAM	730-22018-PF-DDF-0003
CADIA EAST DUST SUPPRESSION PFS | PC1 UNDERCUT, DRAWPOINTS & ROADS | EXTRACTION LEVEL SPRAY TRIAL | GENERAL ARRANGEMENT	730-22018-PF-DDD-0001
CADIA EAST DUST SUPPRESSION PFS | PC2 ORE CRUSHING | TIPPLE HIGH PRESSURE SPRAYS | GENERAL ARRANGEMENT	730-22018-PF-DDD-0002
CADIA EAST DUST SUPPRESSION PFS | PC2 ORE CRUSHING | TIPPLE DRY SCRUBBING & H20 ADDITION | PROCESS FLOW DIAGRAM	730-22018-PF-DDD-0003
CADIA EAST DUST SUPPRESSION PFS | PC2 HORIZONTAL CONVEYING | COB FEEDER TO COLLECTION CONVEYOR | GENERAL ARRANGEMENT	730-22018-PF-DDD-0010
CADIA EAST DUST SUPPRESSION PFS | PC2 HORIZONTAL CONVEYING | COLLECTION TO LATERAL TRANSFER | GENERAL ARRANGEMENT	730-22018-PF-DDD-0011
CADIA EAST DUST SUPPRESSION PFS | HORIZONTAL CONVEYOR TRANSFERS | LATERAL TO INCLINE TRANSFER STATION | GENERAL ARRANGEMENT	730-22018-PF-DDD-0012
CADIA EAST DUST SUPPRESSION PFS | INCLINE CONVEYOR TRANSFER STATIONS | TYPICAL TRANSFER | GENERAL ARRANGEMENT	730-22018-PF-DDD-0013

Deliverable	Number
CADIA EAST DUST SUPPRESSION PFS | PC2 ORE CRUSHING | DRY SCRUBBER & DUCTING | GENERAL ARRANGEMENT	730-22018-PF-DDD-0014