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SUPPLIER DOCUMENT REVIEW COVER SHEET

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Surface Water Management Report

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ADDITIONAL COMMENTS

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Stanley Point Berth 3 Port Landside

Surface Water Management Report

Prepared for Roy Hill

October 2024
Roy Hill Document Number 4000-CI-REP-3024
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Contents

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Figures

Tables

1. Introduction

1.1 The Project

The Stanley Point Berth 3 (SP3) Expansion Project (the Project) is targeted at increasing the current Roy Hill Port Hedland export capacity. The original project location with an export capacity of 60 Mtpa is presented in Figure 1-1. Two potential expansion scenarios are proposed:

- 82 Mtpa expandable to 102 Mtpa.
- 102 Mtpa capped.

The proposed landside infrastructure for 102 Mtpa is presented in Figure 1-2 and includes:

- Partial duplication of the rail loop.
- Stockyard expansion for one additional Stacker, one additional Reclaimer and two stockpiles.
- A second car dumper (CD2).
- Surge bin for the new reclaimer outload.
- Additional conveyors.
- Laboratory expansion and associated conveyors.
- Ancillary structures including NPI infrastructure.
- An expansion of the existing laydown area to the south of the stockyard, which will be used for construction contractor laydown as well as a laydown area during operations.
- The 82 Mtpa scenario excludes the additional stacker and two stockpiles.

In conjunction with this, modifications and additions to the existing Project drainage and surface water management infrastructure are proposed. The basins shown on Figure 1-1 are of three types:

- Sedimentation Basins
  - Receive surface water runoff from stockpile areas.
  - The basins have a large surface area and relatively long flow length to allow settlement of sediment prior to surface water being discharged from the ponds.
  - Outlets are free draining to discharge from site in normal conditions but can be temporarily surcharged in some high tide or storm surge scenarios.
  - Assist with stormwater volume management as a secondary function.
- Settlement Ponds
  - Receive pumped flows from washdown or other process areas.
  - Pairs of ponds allow sediment to settle and dry in one pond while the other receives flows.
  - Include overflows to the larger sedimentation basins.
- Stormwater Basins
  - Receive stormwater runoff from other site areas and assist with stormwater collection and stormwater volume management.
  - Do not serve a specific treatment function.

1.2 Report Objective

The sitewide drainage design and philosophy for the original Stanley Point landside development was detailed by Samsung/Halcrow in 2014 and requires updating to support the proposed Project. This Report considers the management of surface water for drainage purposes, as well as the management of potentially sediment laden or hydrocarbon contaminated water at the landside facilities.

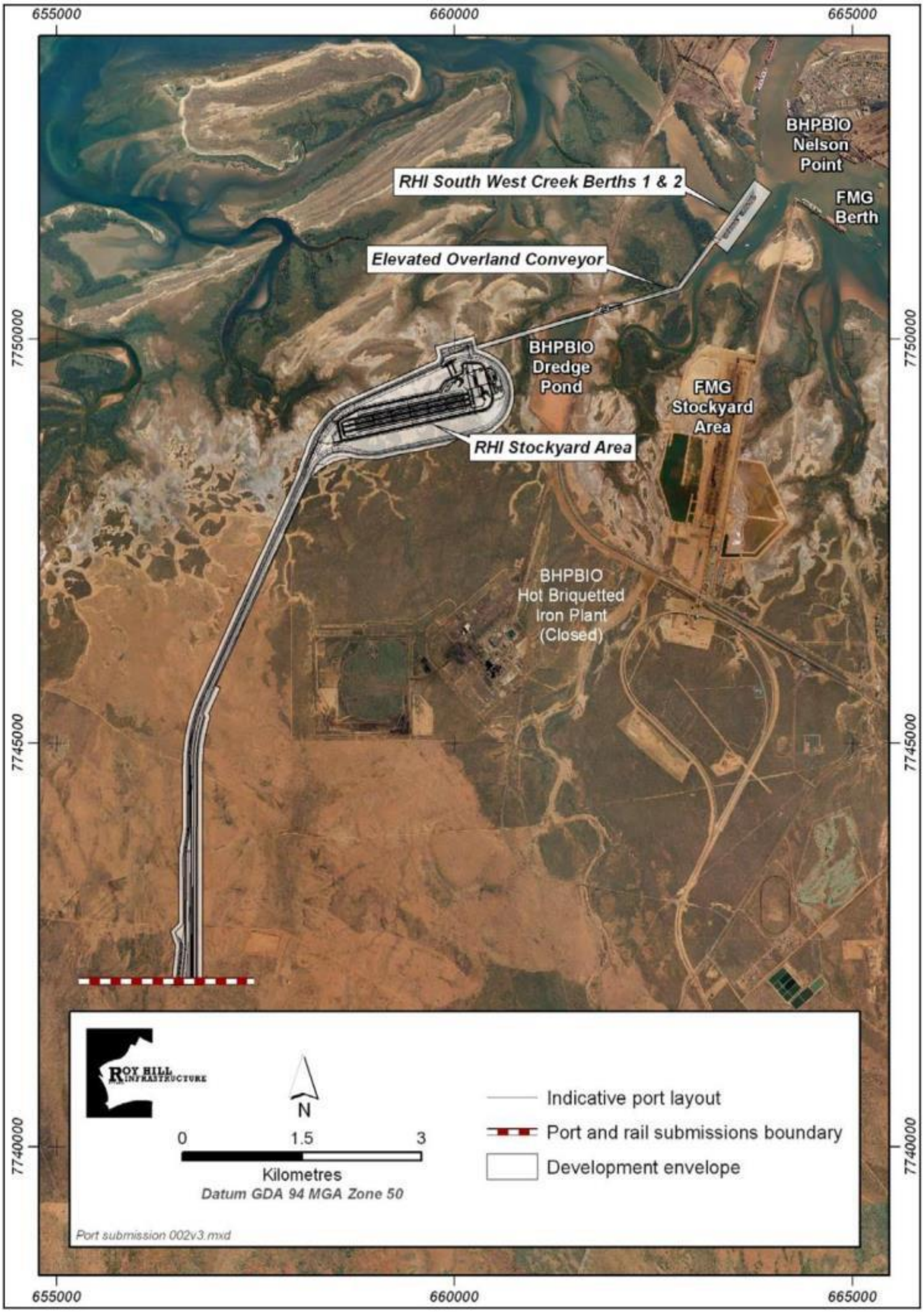

Figure 1-1: Stanley Point Berth 1 and 2 Development Extent

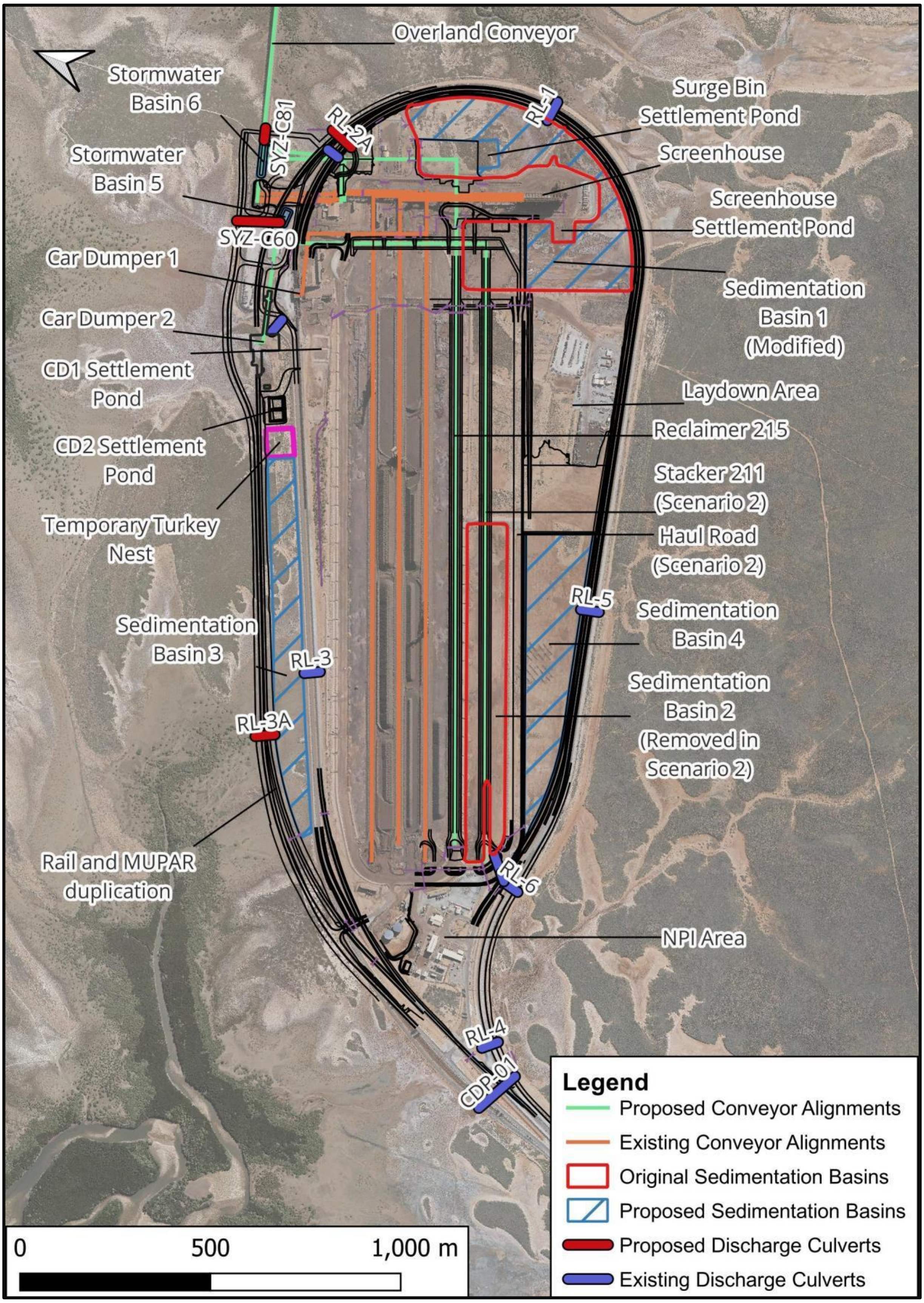

Figure 1-2: Stanley Point Berth 3 Proposed Infrastructure Layout

2. Baseline Environment

2.1 Climate

2.1.1 Rainfall and Evaporation

Port Hedland, located along the Pilbara Coast, experiences a hot desert climate, with mean monthly temperatures ranging from 12.5°C in July to 36.8°C in March and November. Average annual rainfall is 316 mm, the majority of which falls between December and June, but annual totals have ranged from 44.5 mm (1944) to 713.2 mm (2013). Average climate statistics from the Bureau of Meteorology (BOM) station at Port Hedland Airport are presented in Table 2-1.

Table 2-1: Table 1 Mean Climate Statistics (BOM 004032 Port Hedland Airport)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max Temp (°C)	36.4	36.3	36.8	35.3	30.7	27.7	27.4	29.3	32.5	35.1	36.3	36.8	33.4
Mean Min Temp (°C)	25.7	25.6	24.7	21.6	17.4	14.3	12.5	13.3	15.5	18.6	21.5	24.2	19.6
Mean Monthly Rainfall (mm)	62.3	89.3	54.6	21.3	27.3	22.8	10.1	4.6	1.3	0.9	2.6	19.0	316.1
Mean Daily Evaporation (mm)	10.4	9.6	9.3	8.8	7.4	6.5	6.6	7.5	8.9	10.6	11.5	11.4	9.0

2.1.2 Probability Terminology

Australian Rainfall and Runoff (ARR) (Ball, et. al, 2019) recommends the use of Annual Exceedance Probability (AEP) when defining flood probability, which has been adopted throughout this report. AEP is defined as the probability or likelihood of an event occurring or being exceeded within any given year, usually expressed as a percentage. This new terminology supersedes the Average Recurrence Interval (ARI) terminology adopted in the earlier revision of ARR (Institution of Engineers, Australia, 1987). Conversions between common events are presented in Table 2-2.

Table 2-2: AEP and ARI Conversions

Frequency Descriptor	AEP (%)	AEP (1 in X)	ARI (years)
Very Frequent	63.21	1.58	1
Frequent	50	2	1.44
	39.35	2.54	2
	20	5	4.48
	18.13	5.52	5
	10	10	9.49
Rare	5	20	20
	2	50	50
Very Rare	1	100	100

2.1.3 Intensity-Frequency-Duration Data

Intensity-Frequency-Duration (IFD) data was extracted from the BOM website for the Project. The 2016 IFD data is presented in Table 2-3. It is noted that the design IFDs used for the original facility were from the 1987 dataset, which differ to the 2016 data. For rare to very rare events, the 1987 IFDs suggest up to 40% greater rainfall depths for durations less than 12 hours.

Table 2-3: 2016 IFD Data for the Project (20.3375°S, 118.5375°E) (Rainfall in mm)

Duration	50%	20%	10%	5%	2%	1%
5 min	6.65	9.72	11.9	14	17.1	19.4
10 min	11.4	16.7	20.4	24.1	29.1	32.9
20 min	17.2	25.1	30.7	36.2	43.5	49.3
30 min	20.8	30.4	37.1	43.8	52.7	59.8
45 min	24.6	36	43.9	51.9	62.7	71.3
1 hour	27.5	40.2	49.1	58.2	70.7	80.6
2 hour	35.2	52.5	64.7	77.2	95	109
3 hour	40.9	61.9	76.9	92.5	115	133
4.5 hour	47.7	73.6	92.6	112	140	163
6 hour	53.3	83.7	106	129	162	189
9 hour	62.6	100	129	158	199	233
12 hour	70.1	114	147	182	229	268
24 hour	89.8	149	195	243	307	360
36 hour	101	168	219	274	347	406
48 hour	108	179	233	291	368	431
72 hour	116	189	244	305	385	450

2.2 Regional Hydrology and Topography

The Project is located across the coastal floodplain and tidal mudflats of the Port Hedland Coast catchment, which are intersected by tidal creeks that interact with infrastructure footprints. The terrain generally slopes downwards from south to north, transitioning from broad gently sloping plains to flat intertidal areas at the northern part of the rail loop. The area is at risk of tidal inundation during high tides and storm surges, particularly with coincident rainfall.

The South West Creek catchment flows from the south into the Coastal catchment, with the Turner River catchment immediately to the west, as shown on Figure 2-1. South-West Creek itself flows in a northerly direction approximately 1.5 km to the east of the Project and no major watercourses cross the Project area itself. While the flatter intertidal areas are relatively free of vegetation, the deeper tidal creeks, generally to the north of the site, support mangrove communities (Hydro Geochem Group, 2023).

The ‘POSCO_Survey_MGA94Z50_Nov2022’ 1 m DEM topographical dataset sourced from a LiDAR survey was available for use in this study to represent the existing land surface at the Project.

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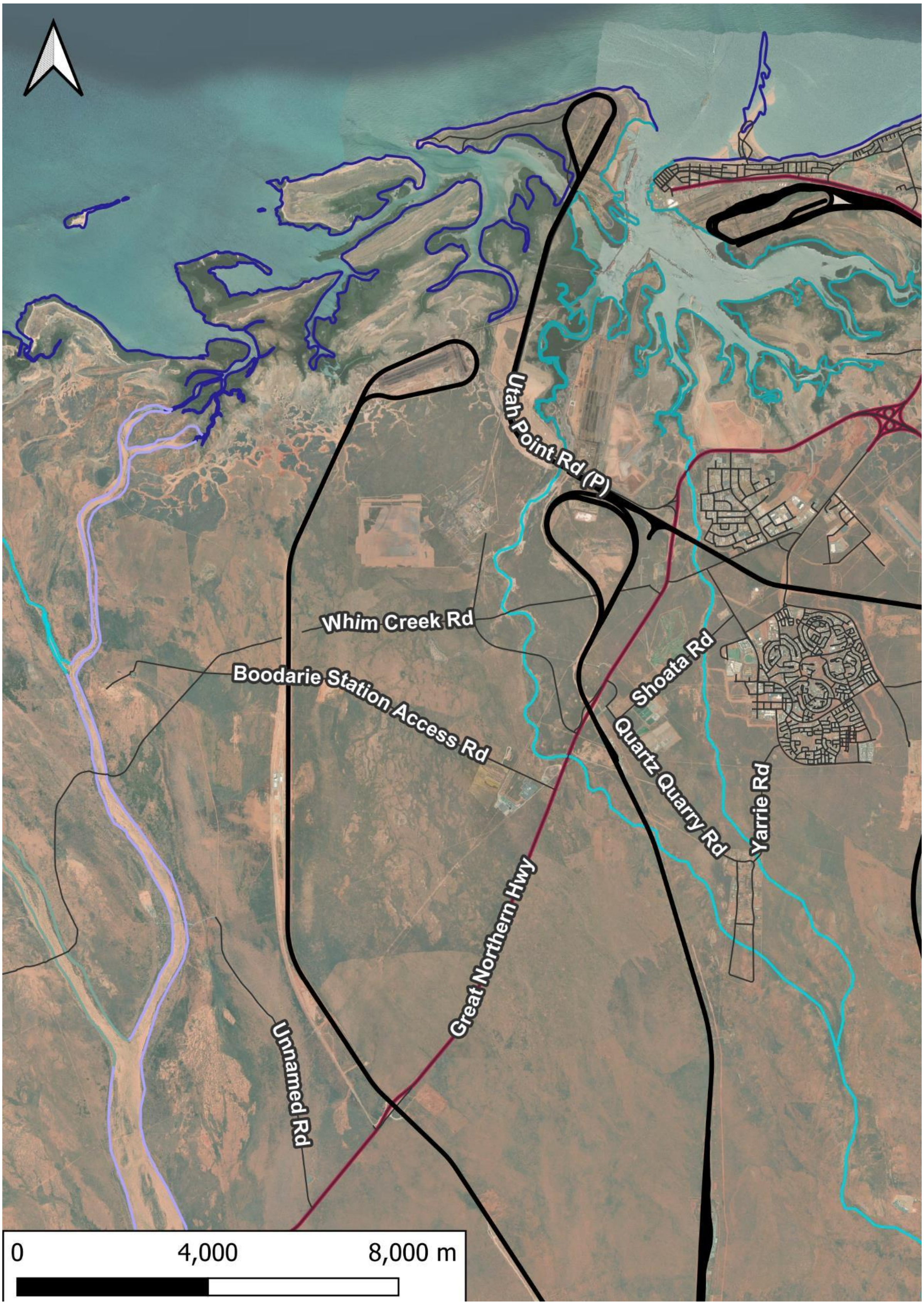

Figure 2-1: Regional Hydrology

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2.3 Existing Site Drainage Philosophy

The site-wide drainage design and philosophy was originally detailed by Samsung (2014) and is described below, as the majority of the drainage philosophy is retained for the Project. Areas of the site are unsuitable for the placement of structures without specific surface water management measures.

2.3.1 Sediment and Potential Contamination Management

In general, the stormwater system (Figure 1-2) functions by collecting runoff in a network of open drains and culverts that discharge to sedimentation basins or traps (dirty water) for treatment, or directly to the culverts passing through the rail loop embankment (clean water). Dirty water in this context is characterised as all runoff originating from the screening facility, stacker and reclaimer embankments, product stockpiles, haul roads and materials handling facilities, but does not include water that has been contaminated with hydrocarbons originating from infrastructure areas.

Runoff generated from potentially hydrocarbon-contaminated areas is collected and discharged to oily water separator (OWS) systems. The treated effluent from the OWS systems is then transported through the wider site drainage network for discharge offsite.

Runoff originating from iron ore stockpiles drains longitudinally from a central hip point, is collected in an open drain network and is directed to two sedimentation basins (1 and 2) prior to discharging to receiving waters through the rail loop embankments. Runoff from around the screening building is also directed to sedimentation basin 1 for treatment prior to discharging to the receiving environment.

The two existing sedimentation basins (1 and 2) located south and southeast of the stockyard collect dirty water runoff from the stockpile pad area and were designed to remove 80% of all sediments greater than 125 microns for the 10% AEP design event, with a maximum retention time of 48hrs.

Sumps to collect heavily sediment-laden water from the washdown of materials handling equipment have been placed methodically across the site. These facilities trap sediment at the source, rather than directly discharging turbid water to the sedimentation basins. The sumps are manually cleaned out when sufficiently dried out or are pumped to settlement ponds.

The settlement ponds act to catch high sediment loads prior to water reaching the main sedimentation basins, which minimises maintenance and clean-out requirements of the large ponds. The settlement ponds are cleaned out when sufficiently dried out and are provided in pairs at each location to enable one pond to be in use while the other is drying.

Sediment and potential contamination management is undertaken in accordance with the existing Environmental Protection Act (EPA) Part V Operating Licence for the facility.

2.3.2 Stormwater Volume Management

Runoff generated from other pad areas and undisturbed catchments, where it is not deemed to carry sediment loads or be potentially contaminated with hydrocarbons, is collected in open drains and directed to one of six rail loop (RL) embankment culverts for eventual discharge to external catchments. All rail loop discharge culverts have been designed with non-return valves (Tideflex) to prevent tidal flows from entering the rail loop.

The surfaces within the rail loop zone outside of the stockpile pad region have been graded to manage stormwater flow. This grading directs the runoff towards the rail loop culverts through open channels and barriers, reducing water accumulation near embankments and facilities.

Storm surge combined with high tide conditions can inundate the culverts discharging under the rail loop. In these circumstances sufficient stormwater storage capacity is provided within the rail loop area to allow the high tide conditions to subside such that the culverts can begin discharging again. Storage volume has been provided within the sedimentation basins and surrounding areas to accommodate the design 1% AEP rainfall event. A minimum building level of 5.0 mAHD is required surrounding the stockyards and sedimentation basins. This provides 400 mm freeboard to peak water levels.

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Areas near the Car Dumper which are elevated above the internal rail loop area grade to external areas to discharge water, or through the use of a small stormwater basin for trapped catchment areas. The basin then discharges to the coast using a culvert without consideration for substantial storage.

2.3.3 Surface Water Catchments

Baseline catchments for the existing surface water management system at the Project have been delineated using the available topographical data and are shown on Figure 2-2, with their characteristics reported in Table 2-4.

Table 2-4: Baseline Catchments

Catchment Number and Name		Drainage Description	Area (km^2)
1	Stockyard west	• Captured by Sedimentation Basin 2 and discharged off site by culvert RL-6.	0.48
2	Laydown area	• Runoff is discharged off site by culvert RL-5.	0.31
3	Stockyard east and screenhouse	• Captured by Sedimentation Basin 1 and discharged off site by culvert RL-1. • Includes the settlement pond for the screenhouse.	0.72
4	Area to the northeast of the stockyard	• Runoff is discharged off site by culvert RL-2.	0.04
5	East of CD1 and north of the railway	• Runoff captured in local area drains and discharged through sea wall via culvert SYP-C26.	0.04
6	Haul road and area to the north of the stockyard	• Runoff is discharged off site by culvert RL-3.	0.14

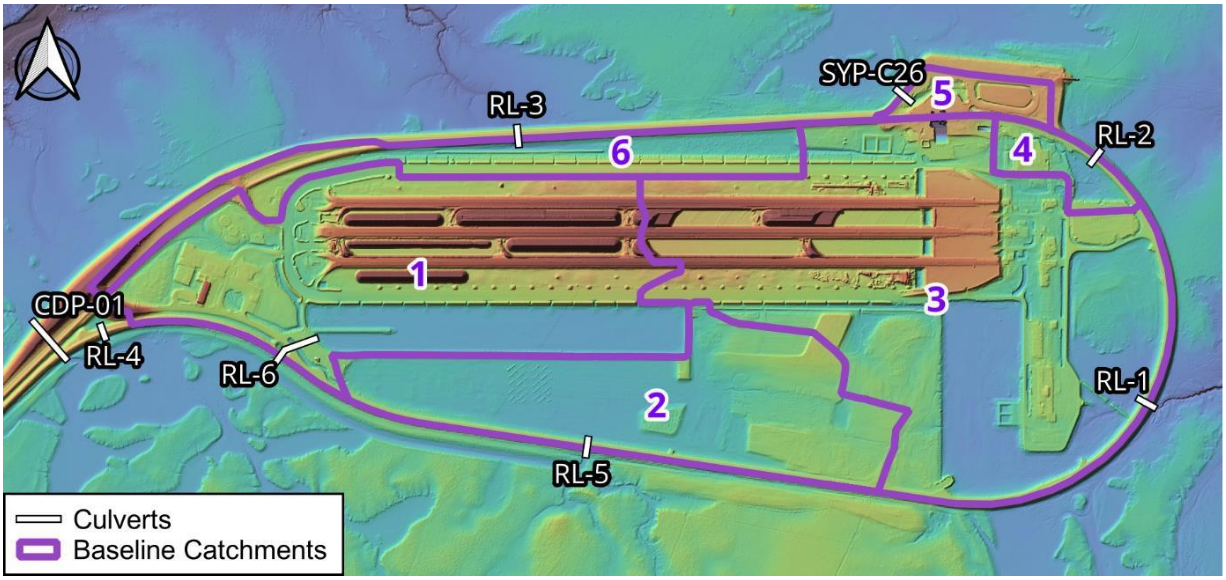

Figure 2-2 Baseline Catchments with Existing Discharge Culverts Overlaid

2.4 Coastal Conditions

The coastal conditions adjacent the site adopted for modelling are based on:

- The Port Hedland Tidal submergence curve as presented in Figure 2-4.
- Roy Hill Iron Ore Project (RHIOP) – Extreme Metocean Conditions Study (Cardno, 2010) (document 100RH-5500-GT-REP-1005_0) for consideration of sea level rise and storm surges for rare events.
    - The water levels include consideration of sea-level rise to 2060 which is a +0.4 m adjustment.

The adopted coastal still water levels at the site are presented in Table 4-1. It is noted that the Mean High Water Neaps level does not directly affect the site, as the water levels do not reach the invert levels of the site discharge culverts. The inundation extent of the coastal still water levels is presented in Figure 2-3. Potential inundation within the existing loop has been omitted as these areas are protected by one-way valves on the rail loop.

Table 2-5: Adopted Still Water Levels

Event	Chart Datum (m)	AHD (m)
Mean High Water Neaps	4.65	0.78
Mean High Water Springs	6.70	2.83
Highest Astronomical Tide	7.54	3.67
10% AEP (with storm surge and sea level rise)	7.87	4.00
5% AEP (with storm surge and sea level rise)	8.17	4.30
2% AEP (with storm surge and sea level rise)	8.57	4.70
1% AEP (with storm surge and sea level rise)	8.87	5.00

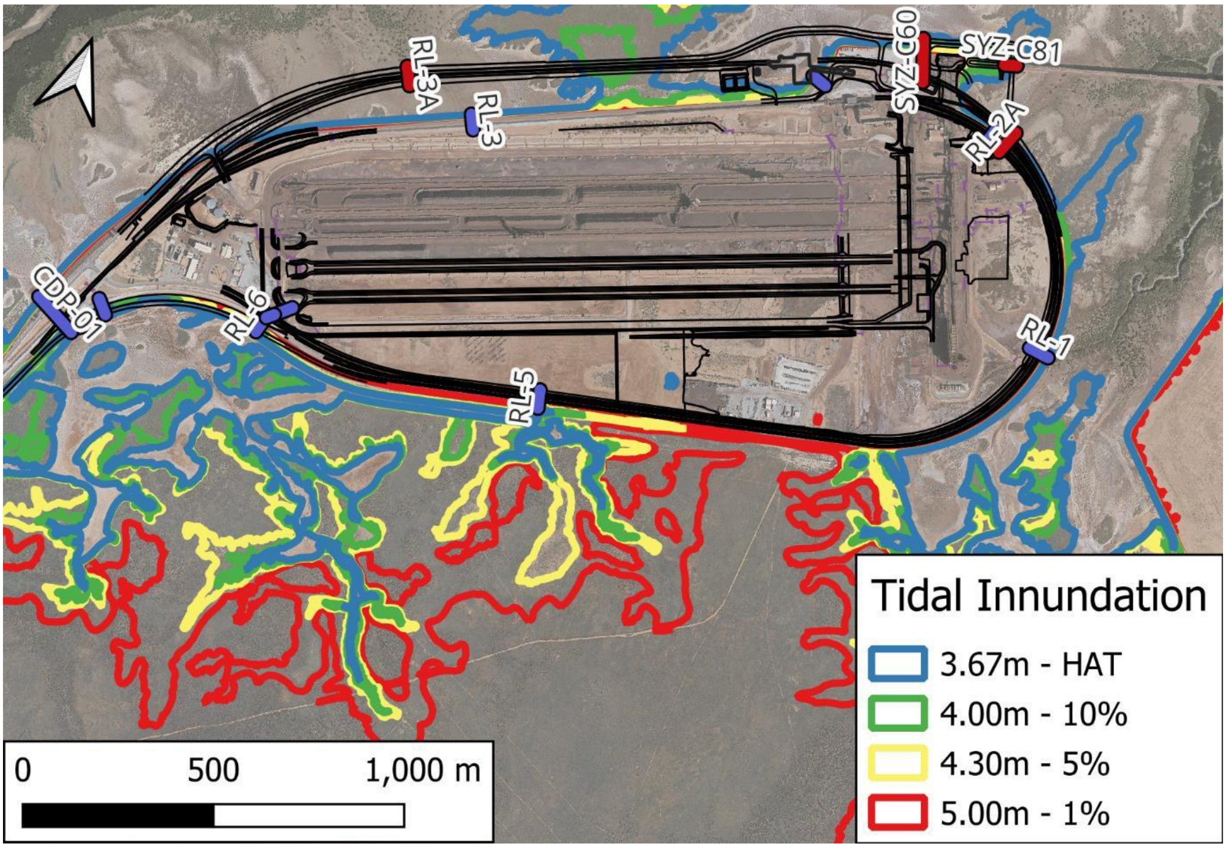

Figure 2-3: Tidal Inundation Extent with discharge culverts overlaid

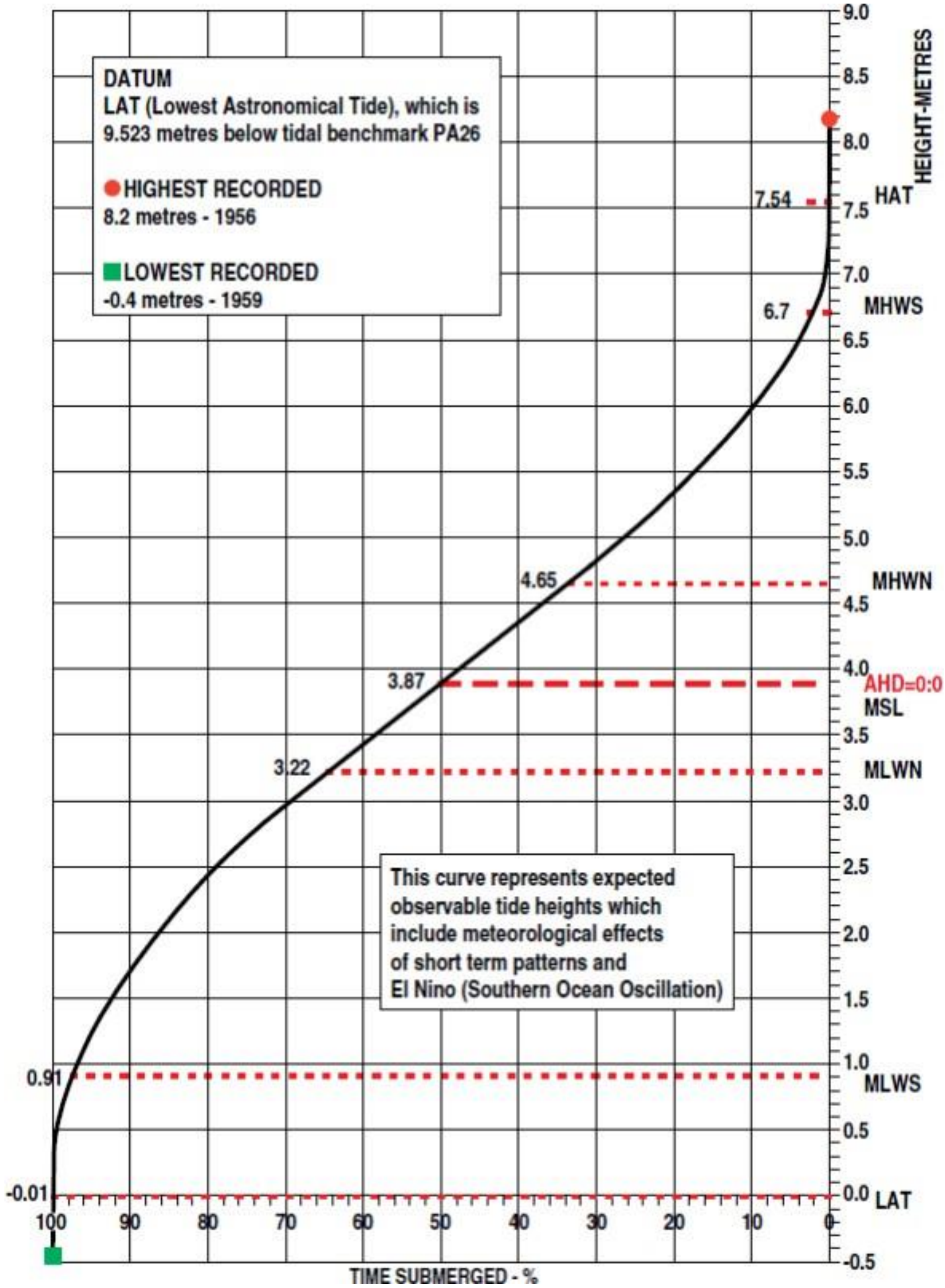

Figure 2-4: Port Hedland Submergence Curve - May 2006 (Source PHPA)

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2.5 Flood Modelling

The baseline flood characteristics of the Project were mapped by creating a 2D hydraulic flood model using TUFLOW. TUFLOW is a computational engine that provides 1D and 2D solutions of the free-surface flow equations to simulate flood and tidal wave propagation. TUFLOW is ideally suited to modelling flooding of surface water with complex flow patterns and overland flows. TUFLOW version 2023-03-AE with the HPC (GPU) engine was utilised.

The 2D model was developed using the 2022 survey DEM to reflect existing conditions, to predict inundation extents across the site resulting from a range of AEP design events. Rainfall was directly applied across the model domain as Rain-on-Grid (RoG) to simulate the localised site runoff conditions.

The following parameters and properties were adopted for the model, as shown on Figure 2-6:

- Grid cell size:
  - 8 m across the model domain for volumetric modelling and consideration of temporal patterns.
  - 2 m across areas of interest where higher detail is required to assess performance (e.g. drains), using adopted design storms determined using the 8 m resolution model.
- A constant Manning's n of 0.03 $s/m^{1/3}$ was applied across the model to represent the developed state of the site with minimal vegetation in undeveloped areas.
- RoG hydrology was applied across the model using ARR2019 temporal patterns sourced from ARR Datahub, and the rainfall depths as presented in Table 2-3 for durations ranging from 180 minutes to 2,160 minutes (36 hours).
- The median flows and water surface elevations were extracted from each set of temporal patterns (ten temporal patterns for each duration and AEP combination). The maximum of the medians for each AEP group was then selected as the adopted value.
- No rainfall losses were applied to the model. This is a conservative approach, however runoff rates are expected to be high at the site given the minimal vegetation, and the infiltration rate of water into the soil could vary depending on coastal water levels.
- No adjustment for climate change has been made to the rainfall data.
- Discharge culverts have been set as type 'CU' to represent the Tideflex flow control devices installed on the outlet of the culverts which permit flow in one direction only.
- Time varying boundary conditions were adopted for the model outflow boundary based on tidal conditions.
  - For peak water level considerations, the Highest Astronomical Tide (HAT) to Lowest Astronomical Tide (LAT) with an additional storm surge and sea level rise allowance was applied to achieve the levels presented in Table 2-6 as shown in Figure 2-5.
  - For consideration of more common events the Mean High Water Neaps Level was used. Due to the comparatively low tide level, this acts as an outflow boundary only.
  - In consideration of joint probability of the coastal and rainfall conditions, the 1% AEP rainfall storm was combined with the 5% AEP coastal condition.
  - Similarly, the 5% AEP rainfall condition was combined with the 1% AEP coastal condition to test whether the rainfall or coastal boundary condition was critical for stormwater volume management.
  - The 2% AEP event was combined with the 10% AEP coastal condition.
  - Combining the 1% AEP rainfall and 1% AEP coastal condition would consider a scenario which is rarer than a 1% AEP.
  - No consideration of wave effects has been made within the model. Sea wall design has been considered in reporting by others.

The flood mapping produced by the model, presented in Figure 2-7 to Figure 2-10 for a range of AEP design events, shows the maximum depth of water experienced through the model duration. This indicates that the rail embankment is not overtopped by a 1% AEP rainfall or coastal design event.

When required, surface water is temporarily stored within the existing Sedimentation Basins 1 and 2 (including surrounding low-lying areas). The existing culverts operate to convey runoff to on-site storage/retention locations, and also off the site.

Water depths in excess of 2 m are experienced outside the rail loop in areas of low topography. Within the rail loop, the highest water depths are present in areas of intended water storage and conveyance. There are no areas of unintended flooding.

A drain is present on the external south side of the rail loop, which connects RL-5 and RL-6 to culverts underneath the railway (CDP-01). CDP-01 assists with conveying flow discharged from the site, as well as flows external to the rail loop.

Table 2-6: Adopted water levels for various events

Location	1% Rain, 5% Coastal	AHD (m)
Mean High Water Neaps	4.65	0.78
Mean High Water Springs	6.70	2.83
Highest Astronomical Tide	7.54	3.67
10% AEP (with storm surge and sea level rise)	7.87	4.00
2% AEP (with storm surge and sea level rise)	8.57	4.70
1% AEP (with storm surge and sea level rise)	8.87	5.00

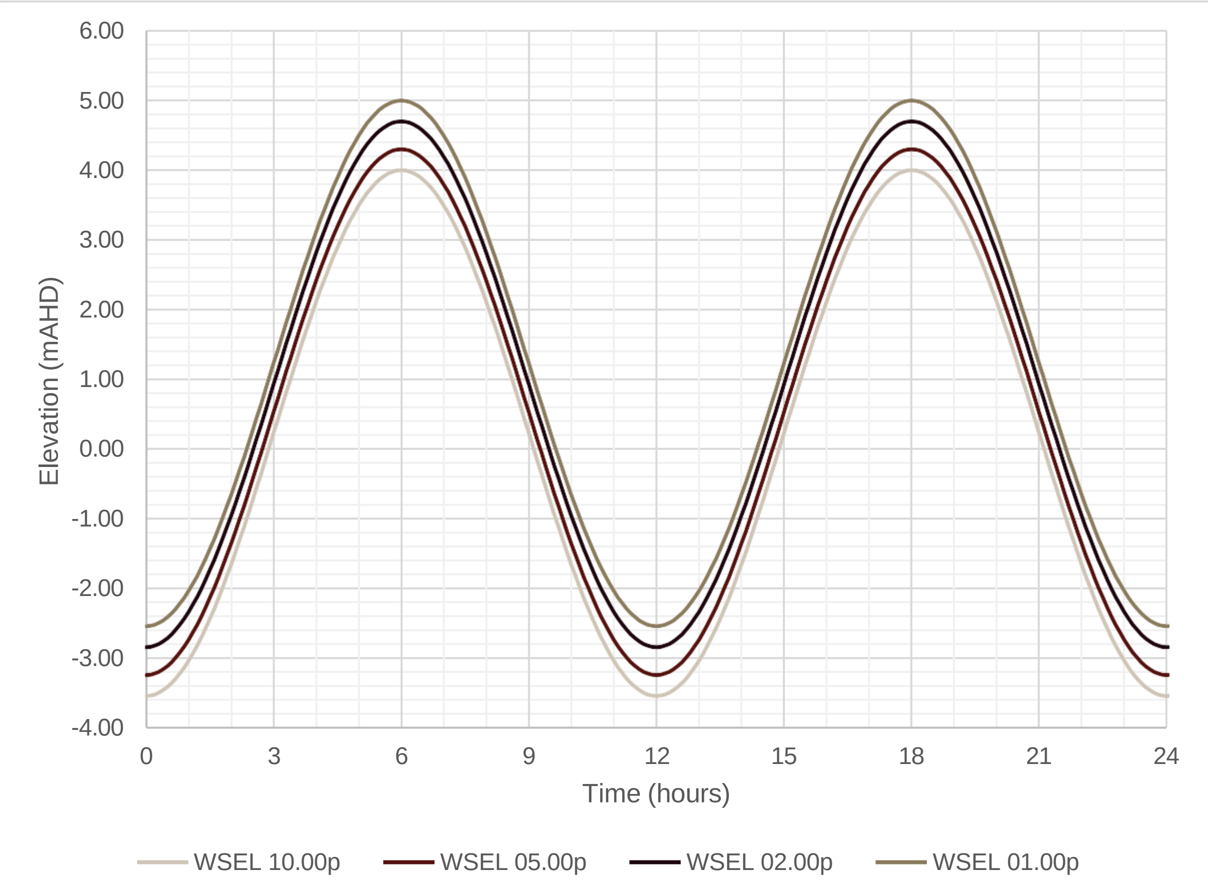

Figure 2-5: Tidal Boundary Condition

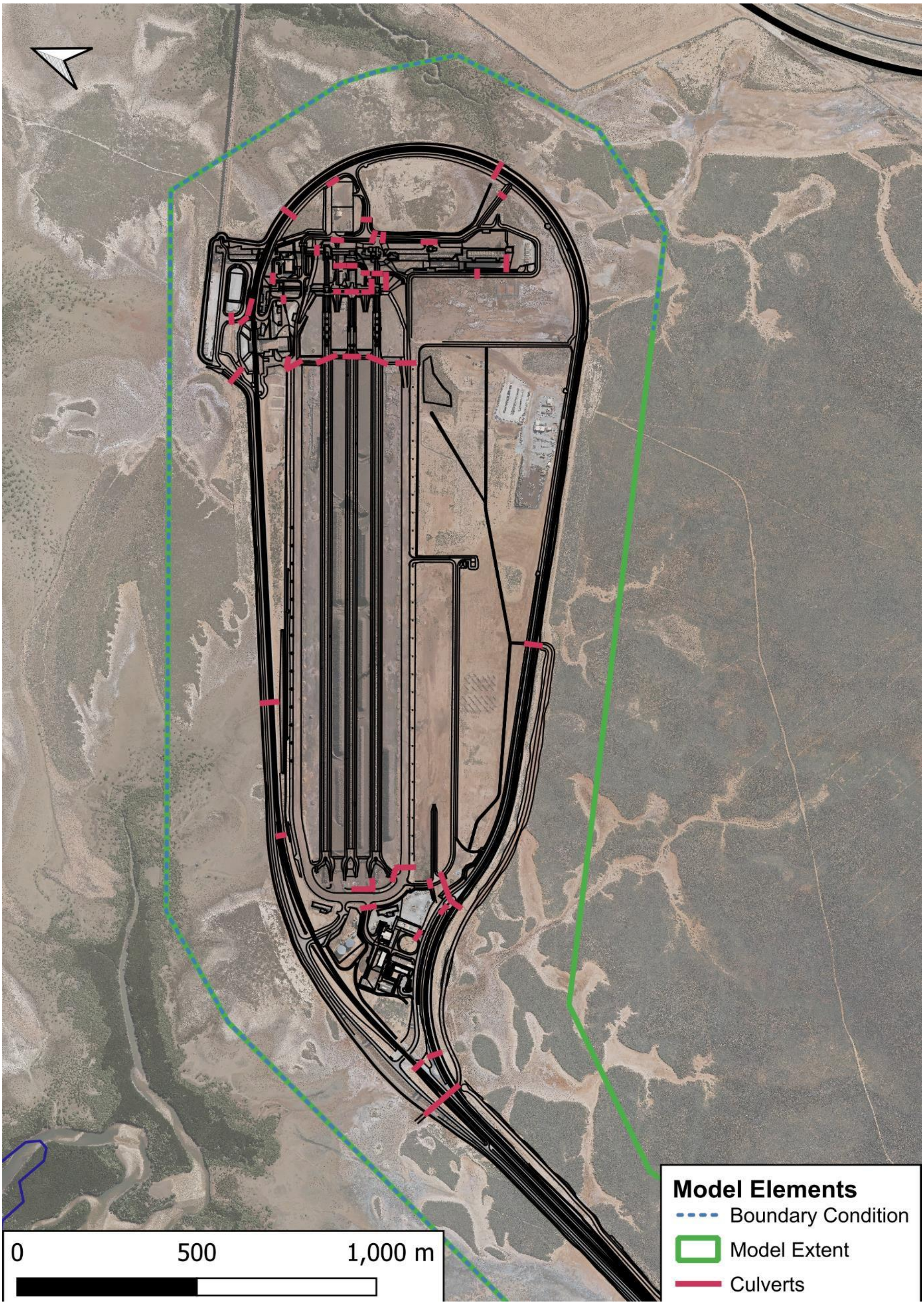

Figure 2-6: Baseline Model Setup

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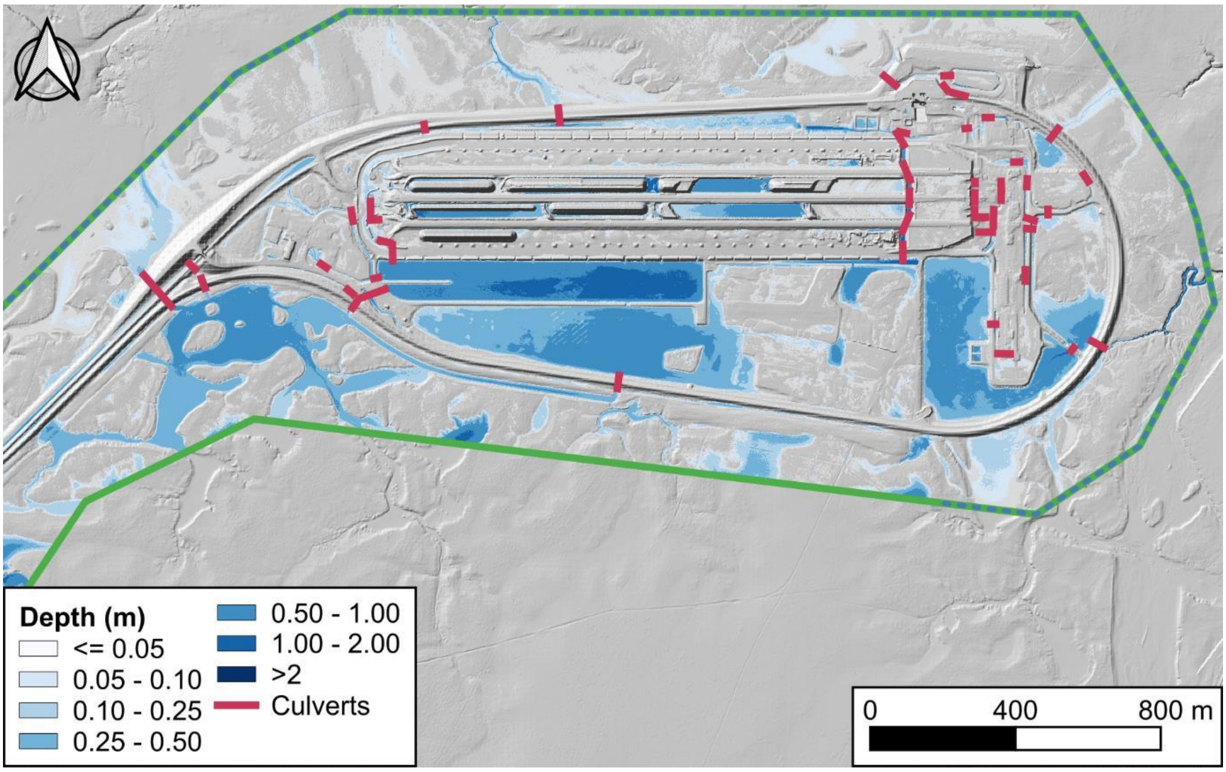

Figure 2-7 Baseline Flood Map – 5% AEP rainfall with Mean High Water Neaps coastal boundary condition

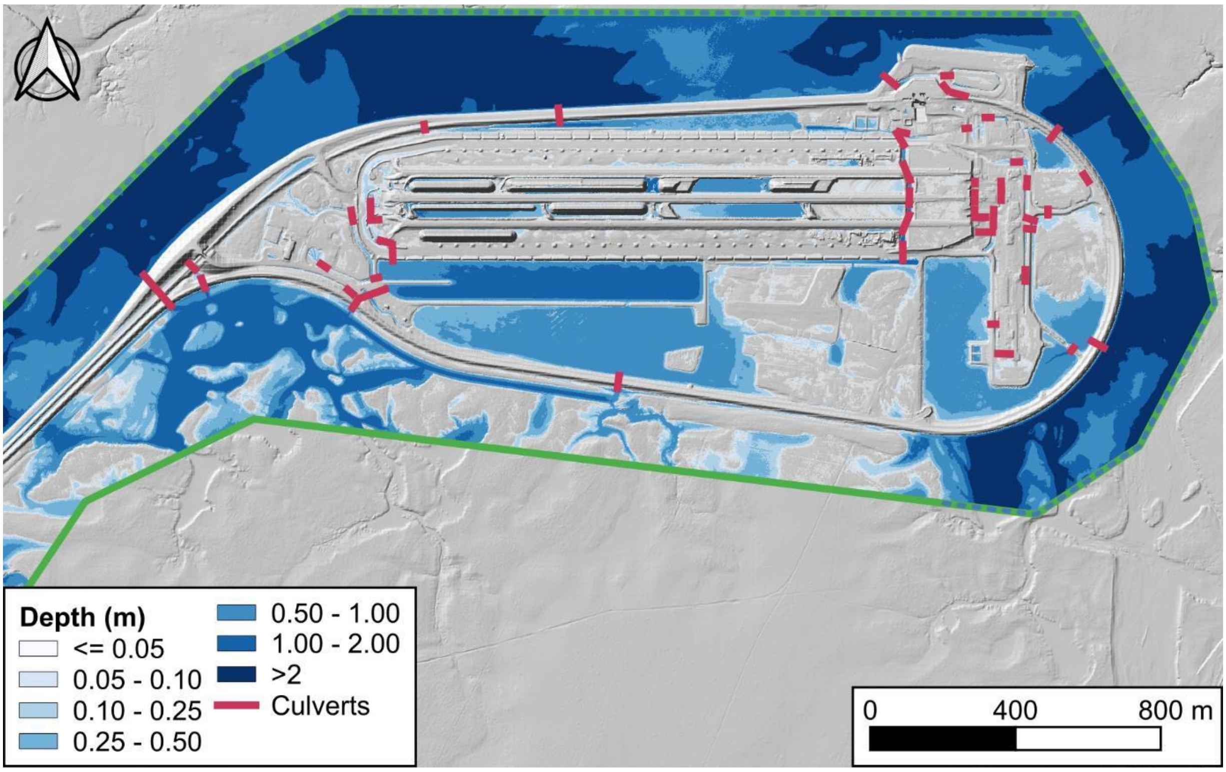

Figure 2-8 Baseline Flood Map – 5% AEP rainfall with 1% AEP coastal boundary condition

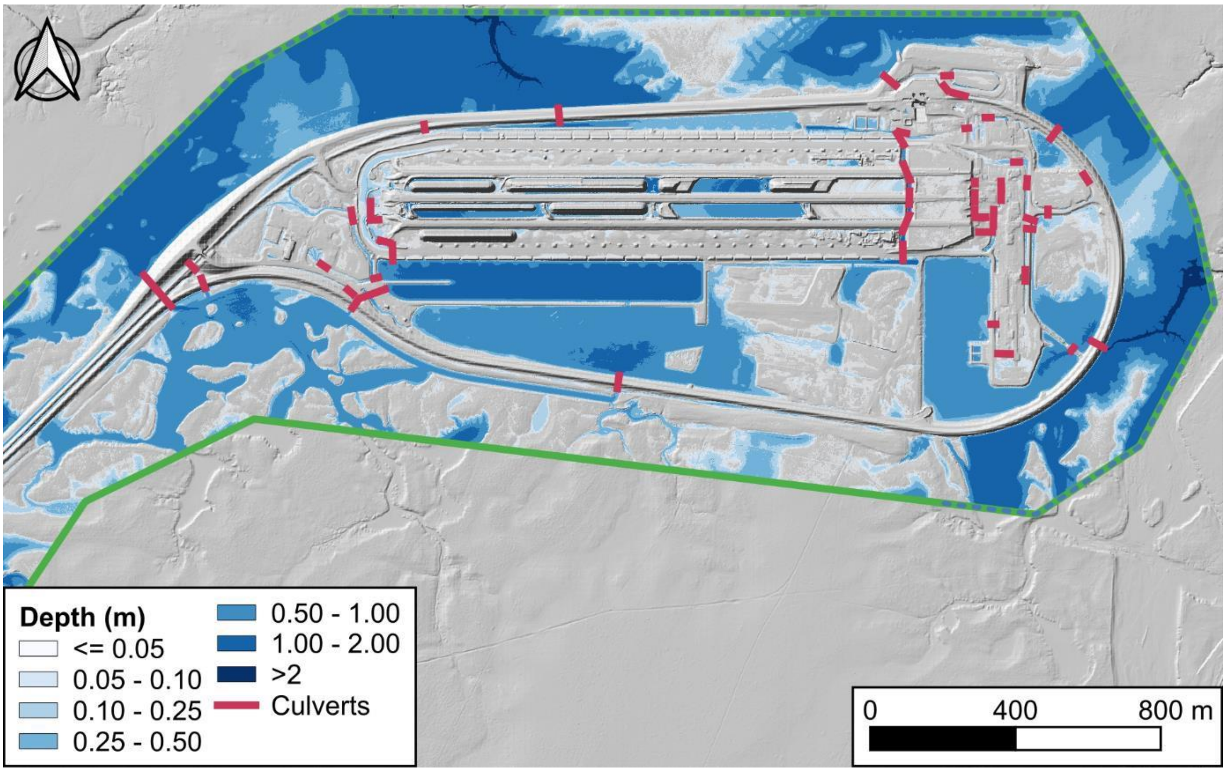

Figure 2-9 Baseline Flood Map – 2% AEP rainfall with 10% AEP coastal boundary condition

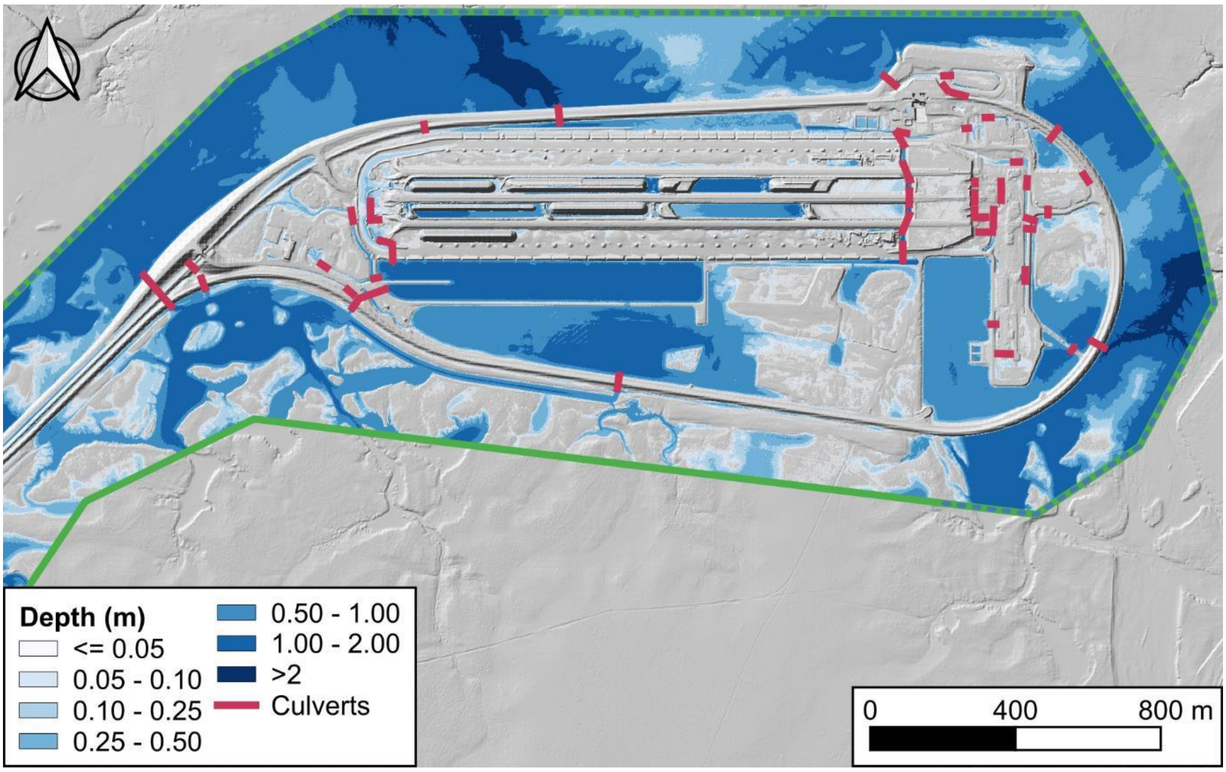

Figure 2-10 Baseline Flood Map – 1% AEP rainfall with 5% AEP coastal boundary condition

3. Project Expansion

3.1 Scenarios

The first proposed expansion scenario would involve a staged increase in infrastructure, including that related to the management of surface water, which is discussed below. Modifications to the existing drainage infrastructure are proposed at multiple areas on site, in addition to new drainage infrastructure. The new works and modifications align with the existing surface water management philosophy for the site detailed in Section 2.3. Refer to Figure 1-2 for the proposed layout.

3.1.1 Scenario 1 – 82 Mtpa Expandable to 102 Mtpa

The infrastructure modifications required for Scenario 1 are as follows:

- Duplication of the outgo rail loop with nominal 10 m separation between track centrelines.
    - The drainage catchments between the two railways have been graded with crossfall such that there is a ridge on the sub-ballast capping between the railways so that surface water will grade into the loop for the inner line and to the sea wall for the outer line.
- Duplication of the rail loop at the north of the site to suit the new car dumper location.
    - The adjacent Multiple User Port Access Road (MUPAR) (on the outside of the railway duplication) will be realigned suit the new railway and grade directly to the coast.
    - The existing MUPAR will be retained with minor realignment and a new level crossing.
- One additional reclaimer for use with the existing dead stockpile (south). This will be built on top of an existing haul road alignment.
- A second car dumper (CD2).
- Surge bin for the new reclaimer outload.
- Additional conveyors.
- Laboratory expansion and associated conveyors.
- Ancillary structures including NPI infrastructure.
- Regrading of the existing laydown area to the south of the stockyard, which will be used for laydown.

3.1.1.1 <u>Drainage Infrastructure</u>

The 82 Mtpa scenario requires the following modifications to drainage and surface water management infrastructure:

- Adjustment to the pipework discharging to Sedimentation Basins 1 and 2 to accommodate the new reclaimer alignment.
- A new northern Sedimentation Basin 3 will be placed between the two railway embankments to receive flows from the existing car dumper (CD1) area, the existing northern bulk-in stockpile and existing northern haul road.
    - Flows will discharge through existing culvert RL-3 to the new Basin and will also be received from a portion of the CD2 area.
    - The Basin will discharge through new culvert RL-3A after allowing sufficient flow distance to settle out sediment.
    - As per Sedimentation Basin 2, the volumetric storage provided is to suit the critical 1% AEP event, and the same sediment management target is achieved (Section 2.3.1).
- New pairs of Settlement Ponds will be provided near CD2 and the Surge Bin to receive highly sediment-laden pumped flows prior to discharge into the Sedimentation Basins.
    - The Surge Bin ponds will overflow to existing Basin 1.
    - The CD2 ponds shall overflow to Basin 3.
    - The ponds will function in the same way as the existing ponds to the screenhouse and CD1.

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- Oily Water Separator for CD2.
- Drive-in wash down sumps to process infrastructure.
- Two new Stormwater Basins (5 and 6):
  - The area to the east of CD2 and south of the new railway will grade to Stormwater Basin 5 located between the railways.
  - Basin 6 is provided for the expanded marine abutment / overland conveyor area and discharges directly to the coast.
  - These basins will discharge directly to the coast similar to the Existing scenario catchment 5 and are provided for stormwater volume management only.
- Two new discharge culverts beneath the rail loop (RL-2A and RL-3A).
- Extension of existing railway discharge culverts to suit the railway duplication.
- Stormwater Basin 5 shall discharge directly to the coast via a culvert.
- The marine abutment area is graded to the edge of the embankment such that surface water will be directly discharged to the coast or graded towards Basin 6.

The following drainage infrastructure remains unchanged:

- CD1 and Screenhouse Settlement Ponds.
- Except for the RL-1 extension, and new Surge Bin area, the operation and discharge from Sedimentation Basin 1 is unaffected and the internal weir system is retained.
- CDP-01 is an external culvert passing under the ingo and outgo railway lines. It receives flow from RL-4, 5 and 6 and does not interface directly with the interior of the rail loop.

3.1.2 Scenario 2 - 102Mtpa Capped

Scenario 2 represents the maximum proposed extent of the Project expansion. The infrastructure modifications required to enable Scenario 2 are the same as for Scenario 1, with the addition of the following:

- Expansion of the stockyard through one additional stacker, allowing the addition of one active and one dead stockpile to the south of the new reclaimer.
- A new haul road adjacent to the edge of the expanded stockyard.

3.1.2.1 Drainage Infrastructure

This scenario requires the following additional modifications to drainage and surface water management infrastructure:

- Removal of Sedimentation Basin 2 due to the expansion of the stockyard.
- Construction of Sedimentation Basin 4 as a replacement for Basin 2.
- A new drain adjacent to the new haul road to connect Sedimentation Basins 1 and 4.
  - This drain is required to balance stormwater storage between the basins in rare rainfall events with constrained outflow. Flow is typically from Basin 4 to Basin 1.
- Culvert discharge from Sedimentation Basin 4 (RL-5) requires the installation of a weir upstream of the culvert due to the removal of the previous sedimentation basin and levee arrangement.
  - The weir is required to assist with sediment management in the new basin.
- Basin 4 is disconnected from RL-6, which will only discharge from the NPI area.
- Modification of existing stockpile culverts at the north-east side of the stockyard to direct a portion of flows from the first stockpile to the north (rather than to the south). This is required to assist with stormwater volume management and is possible due to the new sedimentation basin installed to the north between railways.

3.1.3 Staging

If scenario 1 (82 Mtpa) is constructed, then expanded to Scenario 2 (102 Mtpa) there would be minor abortive works such as the construction of some culvert end treatments, or the finishing of batters which would be demolished for Scenario 2. These minor items would not restrict the full development of Scenario 2 and would not compromise the overall stormwater management outcomes.

The changes to stormwater Sedimentation Basin 1 (partial filling in of the basin) can be made without adversely impacting treatment outcomes. Sedimentation Basin 4 would need to be constructed prior to filling in of Sedimentation Basin 2 for both sedimental management as well as stormwater volume management requirements.

3.2 Dewatering

Dewatering is required for the construction of CD2 as a substantial portion of the structure is below the water table. CD2 requires an excavation approximately 14 m deep into a multi-layer aquifer (Hydro Geochem Group, 2023; Western Environmental, 2023). The preferred dewatering option was identified to be discharging dewatering effluent to Southwest Creek via 4,000 m OD400 HDPE piping as a result of the Dewatering Study Options Assessment completed by BGER (2024). The discharge rate could be up to 200 L/s for nominally 16 hours per day. This daily duration could increase due to rainfall or maintenance periods.

An allowance for a 70 m x 70 m x 2.5 m turkey nest to be used for storage and treatment during construction has been made. This provides for nominally 16 hours storage capacity should there be temporary issues with treatment or offsite disposal infrastructure. The Turkey Nest is indicated in Figure 1-2.

The dewatering effluent will be appropriately treated prior to discharge. The specifics of the treatment are not considered in this report and will be detailed as part of a separate dewatering management plan. The dewatering operation could be in place for two years, depending on construction progress.

No dewatering is proposed following completion of construction works. Scenario 1 and Scenario 2 both require dewatering to construct the new car dumper. No additional dewatering will be required to expand to Scenario 2 from a constructed Scenario 1.

3.3 Emissions

Potential sources of emissions from the Project due to runoff of contaminated stormwater are identified below. Sections 4.4 and 5.4 discusses how the identified risks are managed. Only new or modified sources are considered in this report; existing unmodified facilities are not considered.

3.3.1 Sediment

Materials-handling operations will inherently lead to the generation of dust and sediment, which could lead to an increase in sediment loads transported in runoff and result in sedimentation of vegetated and other sensitive ecological areas downstream.

The processes by which the sediment could be generated are as follows:

- Stormwater runoff from stockpiles.
- Runoff of water used for dust suppression.
- Spillage from conveyor and transfer systems (dry product, or overflow caused by rainfall or other water flows accumulating on the belt).
- Wash down of conveyors or other materials handling equipment.

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3.3.2 Hydrocarbons and Chemicals

The Project has the potential for adverse impacts to surface water quality due to spillage of hydrocarbons. Contaminated discharges have the potential to impact on vegetated areas and other sensitive ecological areas downstream if allowed to enter nearby waterways.

The Project has the potential for impacts on surface water quality due to:

- Spillage of oil from wheel grippers used as part of the rail car dumping process at CD2.
- Spillage of hydrocarbons and chemicals during storage or handling will be managed in accordance with existing site management procedures.

4. Scenario 1 – 82Mtpa Expandable to 102Mtpa

The Scenario 1 infrastructure was described in Section 3.1.1 and is shown in Figure 4-1. This section presents the results of the surface water assessment (SWA) for this scenario, including consideration of management measures to minimise potential impacts on the downstream environment.

4.1 Catchments

Surface water catchments and discharge locations for Scenario 1 are presented in Figure 4-1 and described in Table 4-1.

Table 4-1: Proposed Scenario 1 Catchments

Catchment Number and Name		Drainage Description	Area (km^2)
1	Stockyard west	• Captured by Sedimentation Basin 2 and discharged off site by RL-6.	0.48
2	Laydown and stormwater overflow area	• Runoff is discharged off site by RL-5.	0.33
3	Stockyard east, screenhouse and surge bin	• Captured by Sedimentation Basin 1 and discharged off site by RL-1. • Includes the settlement ponds for the screenhouse and surge bin.	0.59
4	Area to the northeast of the stockyard	• Existing culvert RL-2 is relocated and extended (RL-2A) to suit new infrastructure to provide an outlet.	0.04
5	East of CD2 and north of the existing railway	• Directed to Stormwater Basin 5 for volume management but is otherwise free draining to the coast through a culvert (similar to existing CD1 arrangements).	0.08
6	Northern stockpile and other areas to the north of the stockyard	• Flows are directed to Sedimentation Basin 3 prior to discharge through RL-3A. • Includes settlement ponds for the car dumpers. • Additional surface water catchment from northern stockpile (compared to existing arrangement). • No change from Scenario 1.	0.44
7	Expanded pad for the overland conveyor	• Surface water flows directly off the pad to the coast or into Stormwater Basin 6 for direct discharge to the coast through Culvert SYZ-C81 (within catchment 7 in Figure 4-1).	0.02

4.2 Stormwater Volume Management

Peak surface water levels within the site basins are detailed in Table 4-2 based on the model setup as described in Section 2.5. Figure 4-2, Figure 4-3, and Figure 4-4 present typical peak flooding conditions.

Table 4-2: Peak Surface Water Levels – 82 Mtpa Scenario

Location	5% AEP rainfall 1% AEP coastal	2% AEP rainfall 10% AEP coastal	1% AEP rainfall 5% AEP coastal
Sedimentation Basin 1	3.62	3.74	3.98
Sedimentation Basin 2	4.19	4.28	4.41
Sedimentation Basin 3	3.99	4.19	4.29
Stormwater Basin 5	5.47	5.57	5.61
Stormwater Basin 6	4.70	4.42	4.46

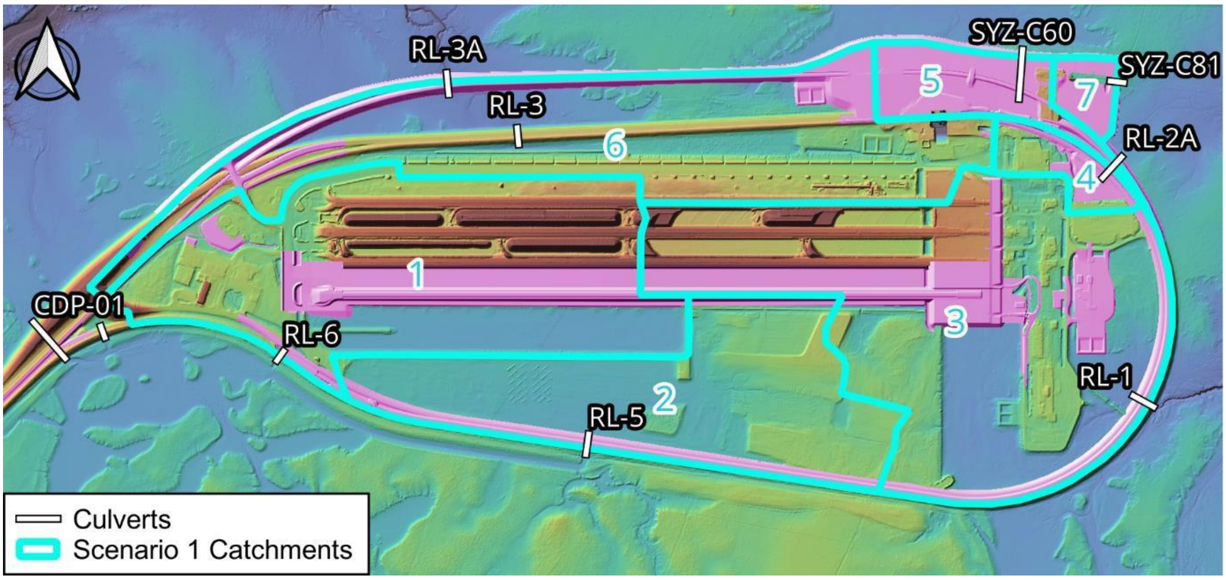

Figure 4-1: Catchment and Schematic Infrastructure Plan – Scenario 1

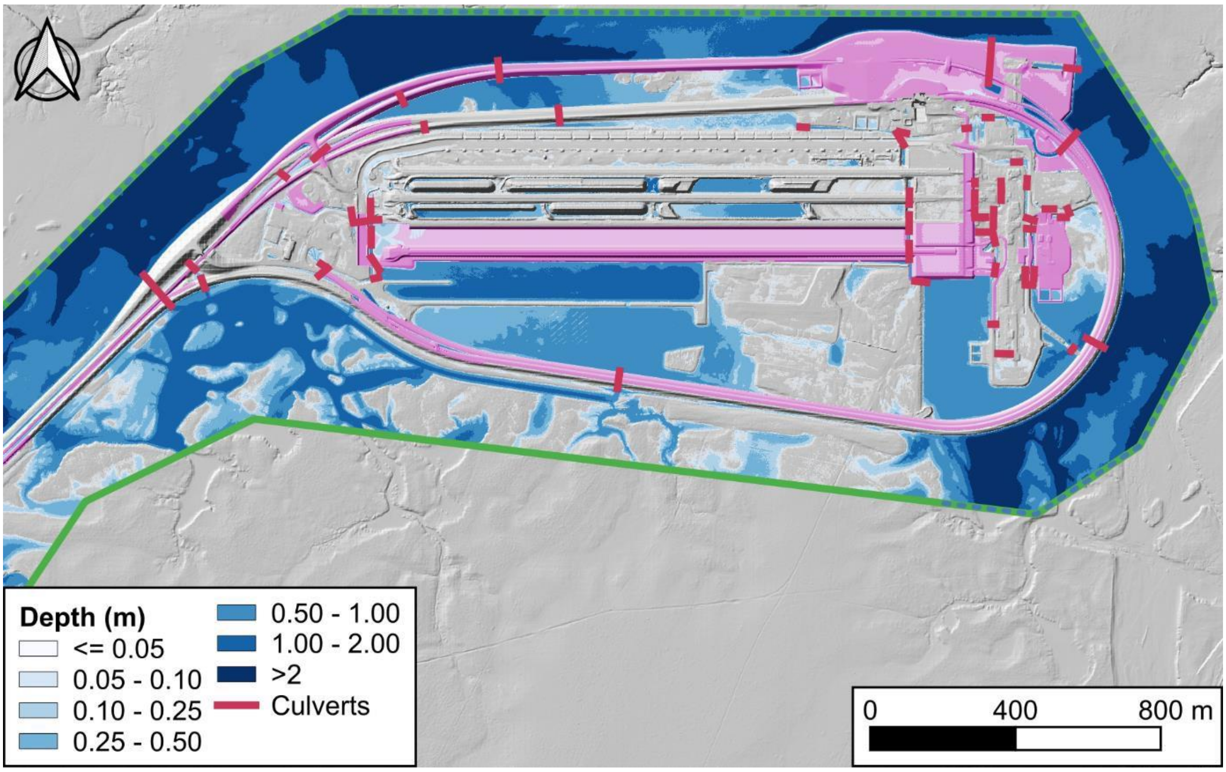

Figure 4-2 Scenario 1 Flood Map – 5% AEP rainfall with 1% AEP coastal boundary condition

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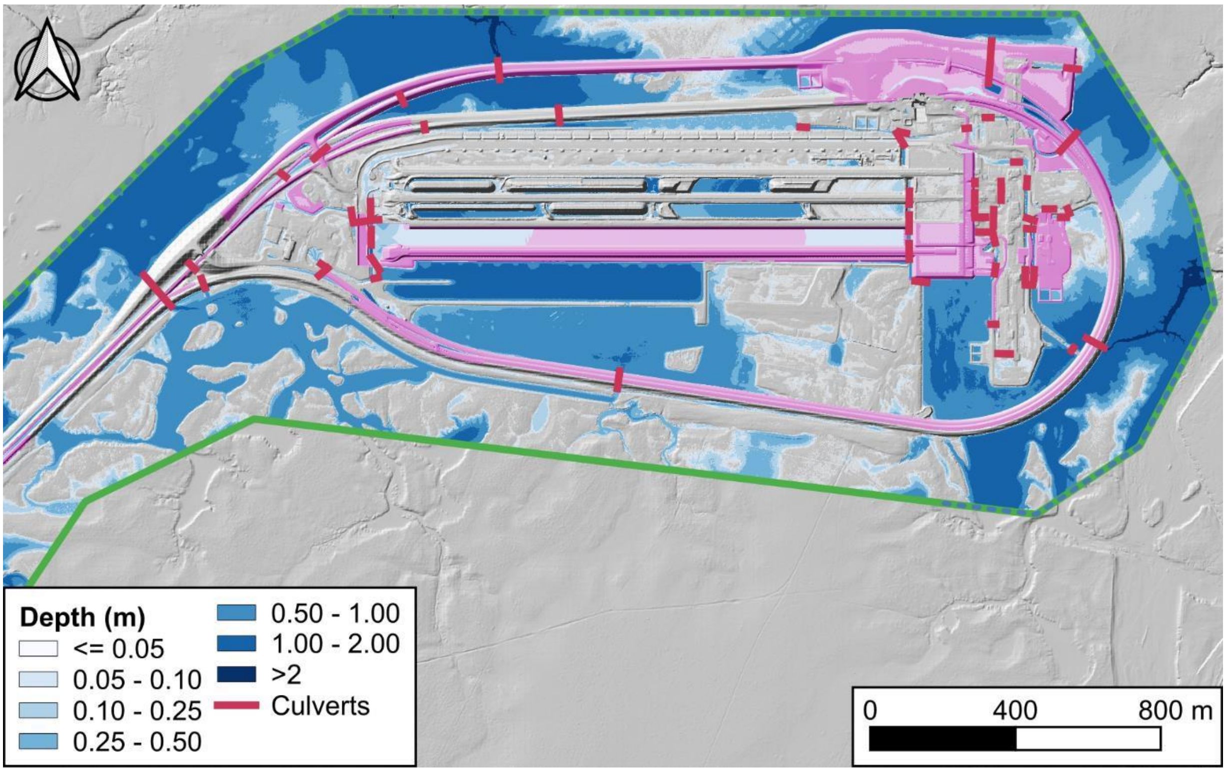

Figure 4-3 Scenario 1 Flood Map – 2% AEP rainfall with 10% AEP coastal boundary condition

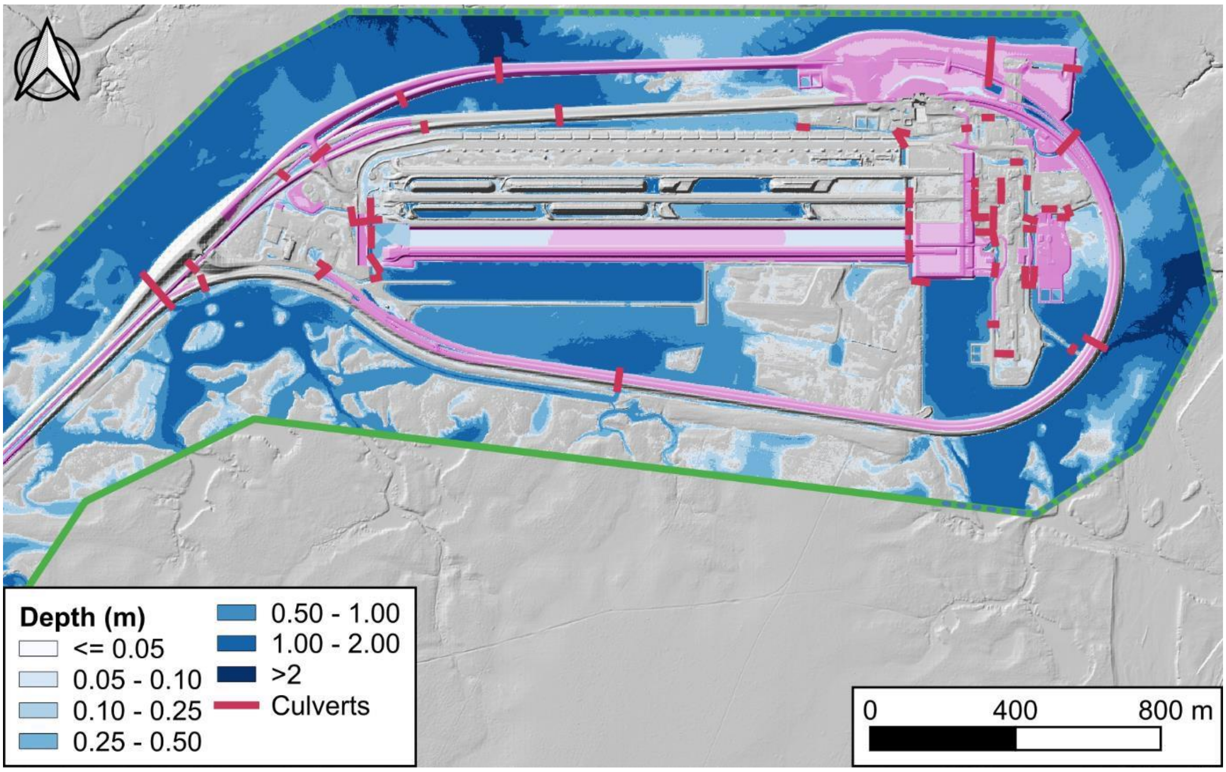

Figure 4-4 Scenario 1 Flood Map – 1% AEP rainfall with 5% AEP coastal boundary condition

4.3 Surface Water Management Measures

Dimensions, depths and capacities for all sedimentation basins, settlement ponds and stormwater basins are provided in Table 4-3. Information related to the sizing of sedimentation basins is provided in Section 4.4.1.

- Sedimentation basins will discharge from the site in all rainfall events, however the ponds will settle out particles prior to the discharge.
- Stormwater volume management basins will discharge from site in all rainfall events.
- The locations of discharge from the sedimentation and basins and stormwater ponds are as shown in Figure 4-1. Some areas of the site directly discharge to the coast without specific basins, such as from the outer rail loop, MUPAR and marine abutment.
- Settlement ponds may discharge to the sedimentation ponds during rainfall events depending on the available storage within the ponds at the time of rainfall events.
- Settlement ponds may discharge to the sedimentation ponds during operation, depending on the volume of water discharged to the ponds. Retention within the settlement ponds will simplify cleanout operations.

Table 4-3: Scenario 1 Basin Sizes

Basin	Type	Catchment Area (km^2)	Surface Area (m^2)	Volume (m^3)	Dimensions (m)
1	Sedimentation	480,000	160,000	224,000	170 x 260 x 1.8 340 x 200 (not a rectangular area)
2	Sedimentation	610,000	92,000	119,000	880 x 100 x 1.3
3	Sedimentation	440,000	49,000	58,000	700 x 70 x 1.2 (D)
5	Stormwater	34,000	570	740	38 x 15 x 1.3
6	Stormwater	12,500	720	1,440	90 x 8 x 2
CD2	Settlement	N/A	225	N/A	15 x 15 x 0.8 (x2 ponds)
SB	Settlement	N/A	225	N/A	15 x 15 x 0.8 (x2 ponds)

1. Flow rate estimated using rational method for 10% AEP, 6-hour storm for use in the CALM method.

4.4 Sediment Control

The general approach to sediment control for the Project is discussed in Section 2.3.1. Modifications required to accommodate the proposed expansion are discussed below.

4.4.1 Sedimentation Basins

All stockpile areas will grade to sedimentation basins to enable settling of particles to prevent uncontrolled releases of sediment-laden stormwater from the site:

- Sedimentation Basin 2 will be retained with minor changes to the inlet culverts. The function of the basin will be unchanged.
- The function of Sedimentation Basin 1 is not compromised by the addition of the Surge Bin area.
- Sedimentation Basin 3 will treat the small catchment discharging from the north of the stockyard, as well as any overflow from the CD1 and CD2 Settlement Ponds.
- Sumps at the car dumper and marine conveyor areas do not grade to sedimentation ponds, so will need to be appropriately cleaned out at regular intervals to avoid uncontrolled sediment discharges.

4.4.1.1 Sedimentation Basin Design Basis

The design of sedimentation basins should allow sufficient retention time of sediment-laden water to allow for settlement of sediment and require infrequent sediment removal. The sedimentation basin outlet structure should consist of a spillway plus an outlet that allows continuous seepage from the basin.

The volume of sediment be in each trap should be inspected after each significant rain event to determine if clean out is required to prevent sediment transport during the next event. During larger events, flow is still processed through the sediment basin, but the detention time is reduced, and the sediment removal efficiency reduced.

The CALM method (Goldman et al., 1986; Witheridge and Walker, 1996) determines a sedimentation basin size based on free settling of particles larger than a design particle size, with settling velocities determined using Stokes' Law. The basin volume is then calculated based on the design particle settling velocity and the design inflow rate.

The sedimentation basin sizes have been estimated using the following process:

- Delineate the catchment area that may report to the sediment basin (Section 4.1).
- Estimated the design inflow rate for a 10% AEP 6-hour rainfall event using the IFD information in Table 2-3 applied to the Rational Method.
- The adopted particle size for the Project is 125 microns (0.125 mm) based on the existing site design basis (Section 2.3.1). Based on this, and the associated settling velocity of 0.01 m/s, a minimum basin surface area has been calculated to remove 80% of all sediments greater than 0.125 mm.
- Calculated the length of the basin based on the criteria that the length/width ratio should not be less than 3:1. The settling depth was then calculated as L/200, where L is the minimum length of the basin, with a minimum depth of 0.6 m being applied.
- Estimated the annual sediment yield using the RUSLE. Given this is a disturbed catchment, the RUSLE figure provides an order of magnitude yield only.

The Universal Soil Loss Equation (USLE) and its replacement, the Revised Universal Soil Loss Equation (RUSLE) can be used to estimate soil loss from uniform slopes subject to sheet and rill erosion (Witheridge and Walker, 1996; Witheridge, 2009). They are erosion models that predict the long-term average annual soil losses in runoff from areas under defined land and cover management systems.

Annual erosion rates are based on

$$A = R \times K \times LS \times C \times P$$

Where:

A = annual soil loss due to erosion
R = rainfall erosivity factor
K = soil erodibility factor
LS = topographic factor derived from slope length and gradient
C = cover and management factor
P = erosion control practice factor

The approximate catchment area reporting to each basin is presented in Table 4-4 along with the following parameters:

- The required ponded surface area to manage the target 0.125 mm particle size assuming a 3:1 aspect ratio of the basin.
- The actual surface area of the basin.
- The computed 10% AEP, 6-hour duration storm design flow using the rational method for the basin based on the contributing catchment area.

The substantially larger basin areas compensate for the basins not achieving a 3:1 aspect ratio, as the large basin areas act to reduce overall flow rates to achieve the same effect. Due to the large surface area of the basins in comparison to the required surface areas, the basins are expected to achieve treatment for smaller particle sizes than the target particle size, on the order of 50 microns (0.05 mm).

Table 4-4: Indicative Sedimentation Basin Sizes

Sediment Basin	Catchment Area (m^2)	10% AEP Flow Rate (m^3/s)	Required Ponded Surface Area (m^2)	Actual Surface Area (m^2)
1	480,000	1.9	269	101,000
2	610,000	2.4	342	92,000
3	440,000	1.7	247	49,000

4.4.2 Bunded CD2 Catchment Areas

- Some elements of the conveyor systems will be bunded with drive-in sumps to manage sediment from operations or maintenance activities. These areas trap sediment at sources of high sediment load.
- Regular inspection and cleaning (if appropriate) of these bunded areas is required prior to the wet season.

4.4.3 Marine Abutment (Northeast corner of site)

- Materials handling transfer stations in the area are bunded to manage potential sediment generated.
- Regular inspection and cleaning (if appropriate) of these bunded sumps is required prior to the wet season.

4.5 Management of Hydrocarbons and Chemicals

4.5.1 CD2 Oily Water System

- The risk of hydrocarbon spills at CD2 has been identified. This will be managed using the following:
- The potential catchment area which could experience an oil spill from the grippers has been graded to collection pits, which are pumped to an Oily Water System (OWS).
- The OWS must be sized to manage short intense storms through the provision of storage tanks, and the treatment rate of the unit is suitable to manage longer duration (but lower intensity) rainfall.
- The unit will discharge clean water to Sedimentation Basin 3, while retaining contaminated fluids for disposal by a specialist contractor.
- Areas outside of the wheel gripper catchment are considered clean water and managed as part of other site water.

The management of spills in other areas such as from vehicles will be as per existing site incident management procedures.

5. Scenario 2 –102Mtpa Capped

Scenario 2 incorporates the modifications discussed in Section 4 for Scenario 1, plus the additional changes discussed below.

5.1 Catchments

Surface water catchments and discharge locations for Scenario 2 are presented in Figure 5-1 and described in Table 5-1.

Table 5-1: Proposed Scenario 2 Catchments

Catchment Number and Name		Drainage Description	Area (km^2)
1	Stockyard west	• Originally captured by Sedimentation Basin 2. • Will drain to Sedimentation Basin 4 and be discharged off site by RL-5.	0.76
3	Stockyard east, screenhouse and surge bin	• Captured by Sedimentation Basin 1 and discharged off site by RL-1. • Includes the settlement ponds for the screenhouse and surge bin.	0.61
4	Area to the northeast of the stockyard	• Existing culvert RL-2 is relocated and extended (RL-2A) to suit new infrastructure to provide an outlet. • No change from Scenario 1.	0.04
5	East of CD2 and north of the existing railway.	• Directed to Stormwater Basin 5 for volume management but is otherwise free draining to the coast via Culvert SYZ-C60 (similar to existing CD1 discharge arrangements). • No change from Scenario 1.	0.08
6	Northern stockpile and other areas to the north of the stockyard	• Flows are directed to Sedimentation Basin 3 prior to discharge through RL-3A. • Includes settlement ponds for the car dumpers • Additional surface water catchment from northern stockpile (compared to existing arrangement). • No change from Scenario 1.	0.44
7	Expanded pad for the overland conveyor	• Surface water flows directly off the pad or into Stormwater Basin 6 for direct discharge to the coast through Culvert SYZ-C81. • No change from Scenario 1.	0.02
8	Existing NPI area	• Originally discharged to Sedimentation Basin 2. • Will connect directly to RL-6 for discharge.	0.03

5.2 Stormwater Volume Management

Peak surface water levels within the site basins are detailed in Table 5-2 based on the model setup as described in Section 2.5. Figure 5-2, Figure 5-3, and Figure 5-4 present typical peak flooding conditions.

Table 5-2: Peak Surface Water Levels – 102 Mtpa Scenario

Location	5% AEP rainfall 1% AEP coastal	2% AEP rainfall 10% AEP coastal	1% AEP rainfall 5% AEP coastal
Sediment Basin 1	4.20	4.29	4.54
Sediment Basin 3	3.99	4.19	4.29
Sediment Basin 4	4.22	4.39	4.56
Stormwater Basin 5	5.47	5.57	5.61
Stormwater Basin 6	4.70	4.42	4.46

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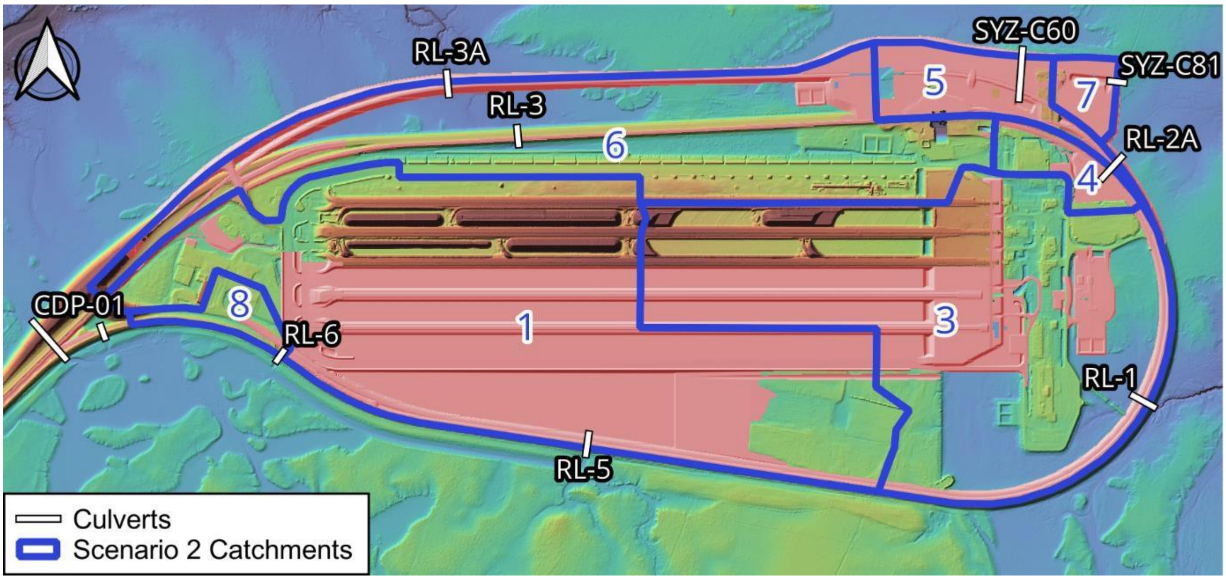

Figure 5-1: Scenario 2 Catchment and Schematic Infrastructure Plan

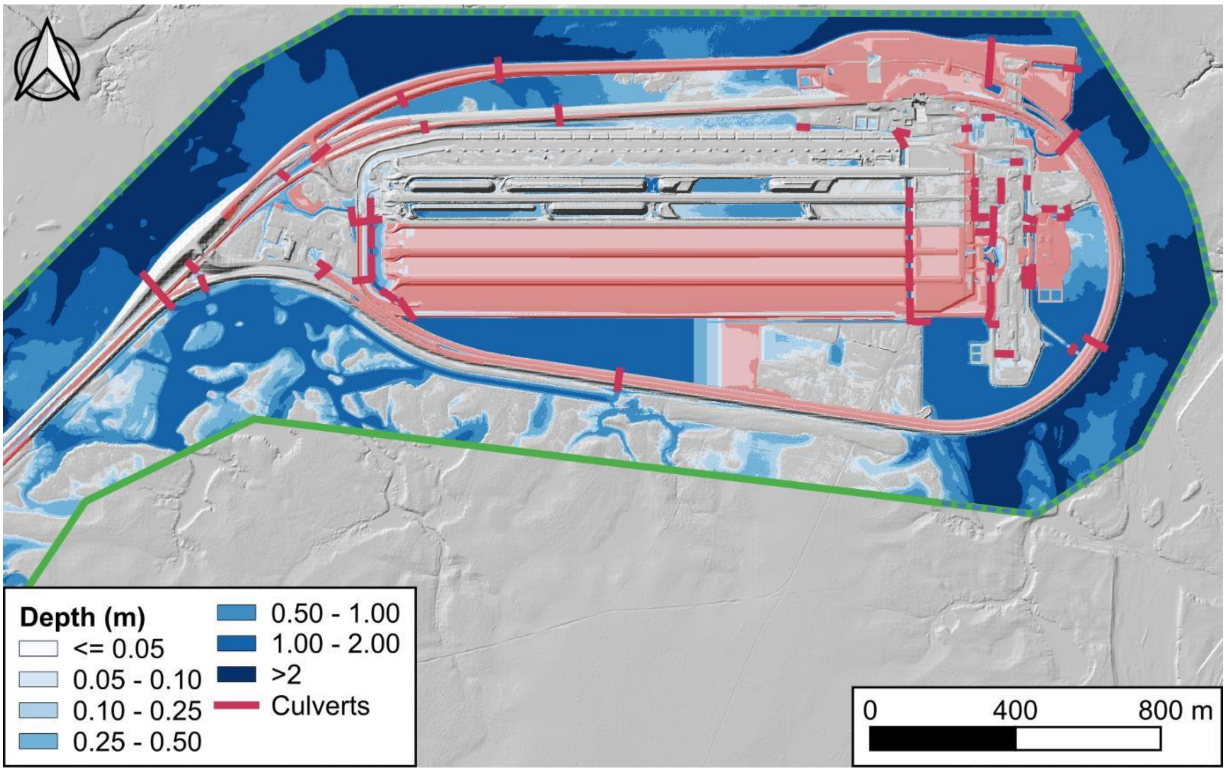

Figure 5-2 Scenario 2 Flood Map– 5% AEP rainfall with 1% AEP coastal boundary condition

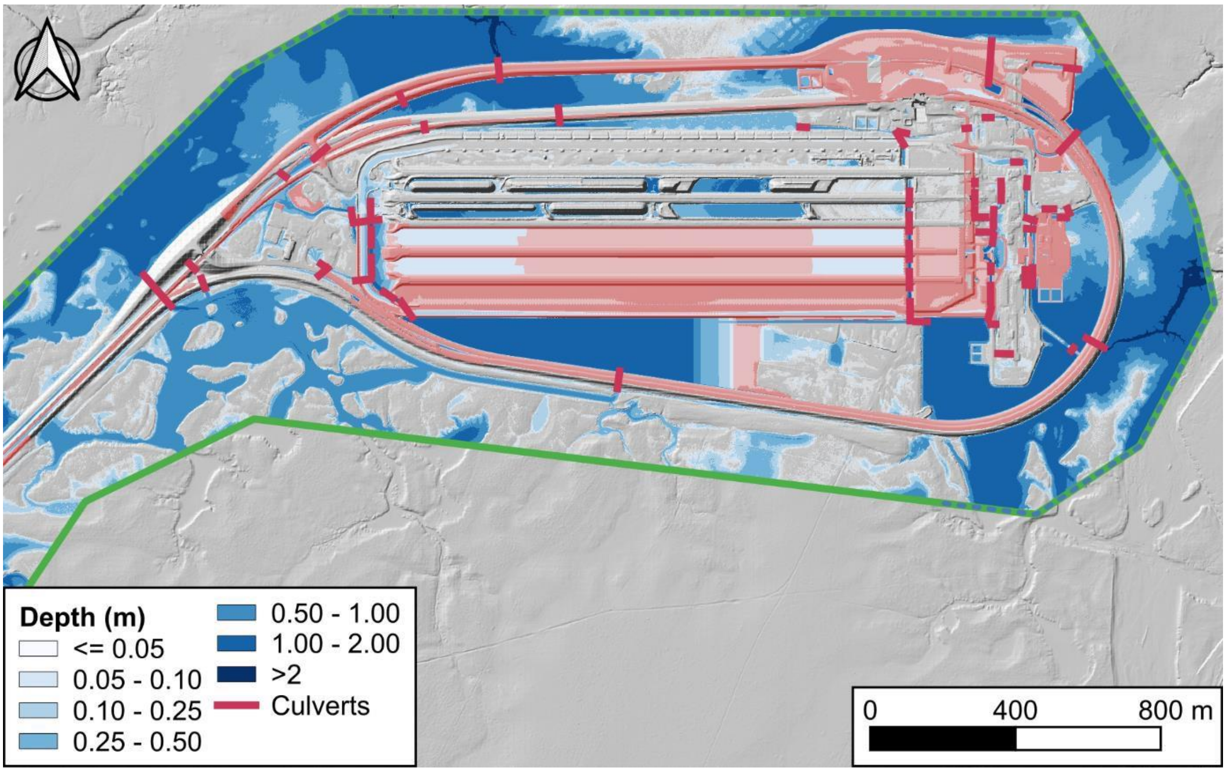

Figure 5-3 Scenario 2 Flood Map – 2% AEP rainfall with 10% AEP coastal boundary condition

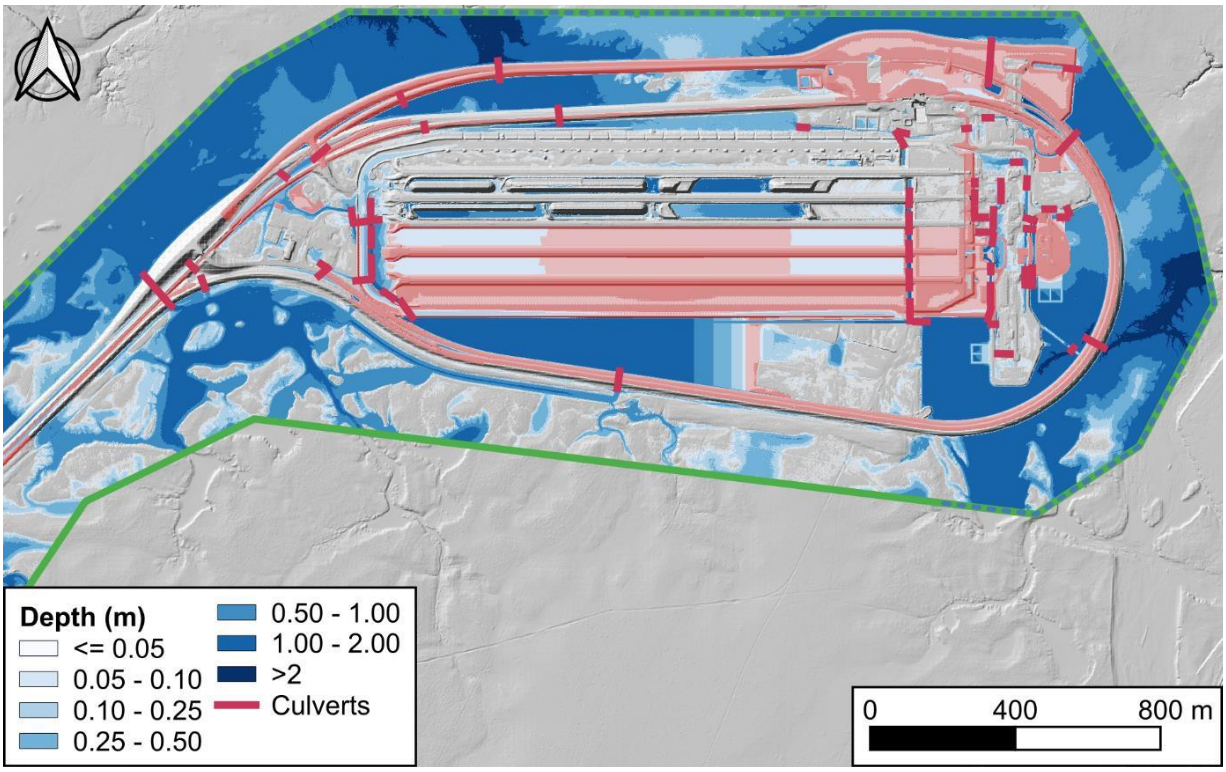

Figure 5-4 Scenario 2 Flood Map – 1% AEP rainfall with 5% AEP coastal boundary condition

5.3 Surface Water Management Measures

Dimensions, depths and capacities for all sedimentation basins, settlement ponds and stormwater basins are provided in Table 5-3. Information related to the sizing of sedimentation basins is provided in Section 4.4.1.

- Sedimentation basins will discharge from the site in all rainfall events, however the ponds will settle out particles prior to the discharge. There could be a short period where surface water is retained on site during high tide or storm surge conditions, but discharge offsite will recommence within 6 hours.
- Stormwater basins will discharge from site in all rainfall events. The outflow rate will be impacted by tide / storm surge levels.
- The locations of discharge from the sedimentation and basins and stormwater ponds are as shown in Figure 4-1. Some areas of the site directly discharge to the coast without specific basins, such as from the outer rail loop, MUPAR and marine abutment.
- Settlement ponds may discharge to the sedimentation ponds during rainfall events depending on the available storage within the ponds at the time of rainfall events.
- Settlement ponds may discharge to the sedimentation ponds during operation, depending on the volume of water discharged to the ponds. Retention within the settlement ponds will simplify cleanout operations.

Table 5-3: Scenario 2 Basin Sizes

Basin	Type	Catchment Area (m^2)	Surface Area (m^2)	Volume (m^3)	Dimensions (m)
1	Sedimentation	480,000	101,000	141,000	170 x 260 x 1.8 340 x 100 (not a rectangular plan area)
3	Sedimentation	440,000	49,000	58,000	700 x 70 x 1.2 (D)
4	Sedimentation	760,000	84,000	109,200	740 x 160 x 1.3 (not a rectangular plan area)
5	Stormwater volume	34,000	570	740	38 x 15 x 1.3
6	Stormwater volume	12,500	720	1,440	90 x 8 x 2
CD2	Settlement	N/A	225	N/A	15 x 15 x 0.8 (x2 ponds)
SB	Settlement	N/A	225	N/A	15 x 15 x 0.8 (x2 ponds)

5.4 Sediment Control

5.4.1 Sedimentation Basins

All stockpile areas will grade to sedimentation basins to enable settling of particles to prevent uncontrolled releases of sediment-laden stormwater from the site:

- Sedimentation Basin 4 will replace Basin 2 (refer Figure 1-2) and act as an effective control for sediment management in instances where the sumps or settlement ponds are at capacity, as it is downstream of the stockyard facilities.
- Sedimentation Basin 3 will treat the small catchment discharging from the CD1 and CD2 Settlement Ponds, and other associated areas, and a portion of the northern stockpile.
- The sediment management targets for the new sedimentation basins (3 and 4) will be achieved as per the existing design.

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The approximate catchment area reporting to each basin is presented in Table 5-4, along with the following parameters:

- The required ponded surface area to manage the target 0.125 mm particle size assuming a 3:1 aspect ratio of the basin.
- The actual surface area of the basin.
- The computed 10% AEP, 6-hour duration storm design flow using the rational method for the basin based on the contributing catchment area.
- The substantially larger basin areas compensate up for the basins not achieving a 3:1 aspect ratio as the large basin areas act to reduce overall flow rates to achieve the same effect.

Table 5-4: Indicative Sediment Basin Sizes – Scenario 2

Sediment Basin	Catchment Area (m^2)	10% AEP Flow Rate (m^3/s)	Required Ponded Surface Area (m^2)	Actual Surface Area (m^2)
1	480,000	1.9	269	101,000
3	440,000	1.7	247	49,000
4	760,000	3.0	426	84,000

6. Conclusions

The surface water management arrangements for the SP3 landside expansion builds on the established management methods for the existing facility. The drainage design has considered sediment, contaminant and stormwater volume management.

Potential emission risks and appropriate management controls will be defined as part of the EPA Part V Works Approval. A summary of recommended infrastructure considerations and sizing and associated water levels is provided in Table 6-1 to Table 6-4. A summary of peak water levels in various events is provided in Table 6-5 (Note: events include a coastal boundary condition in addition to a rainfall input, as discussed in previous sections).

It is noted that the critical factor for the sizing of the sedimentation basins when using the CALM method is the effective surface area, for which the provided area is exceeds the required area for all of the sediment basins. The large surface area and low flow velocity in the basins enables suspended sediment to settle. The storage volume required for the basins is for the storage of deposited sediment. The depth of the basins has allowed for deposition of sediment in excess of the yearly sediment load, however the performance and sediment volume within the basins should be reviewed as part of wet-season preparations.

Table 6-1: Sediment management controls – Scenario 1

Sediment Basin	Catchment Area (m^2)	10% AEP Flow Rate (m^3/s)	Required Ponded Surface Area (m^2)	Actual Surface Area (m^2)	Comment
1	480,000	1.9	269	101,000	Minor modifications to existing basin
2	610,000	2.4	342	92,000	Existing basin, adjustments to inlet
3	440,000	1.7	247	49,000	New basin

Table 6-2: Sediment management controls – Scenario 2

Sediment Basin	Catchment Area (m^2)	10% AEP Flow Rate (m^3/s)	Required Ponded Surface Area (m^2)	Actual Surface Area (m^2)	Comment
1	480,000	1.9	269	101,000	Reduction to existing basin
3	440,000	1.7	247	49,000	New basin
4	760,000	3.0	426	84,000	New basin to replace existing sediment basin 2

Table 6-3: Stormwater volume management elements – Scenario 1 and 2

Location	Area (m^2)	Depth (m)	Volume (m^3/s)	Comment
Basin 5	570	1.3	740	Capturing a portion of the area east of CD2, and discharging through SYZ-C60
Basin 6	720	2.0	1,440	Capturing a portion of the marine abutment area, and discharging through SYZ-C81

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Table 6-4: Permanent Surface Water Discharge Locations and Arrangements – Scenario 1 and 2

Location	Type	Comment
RL-1	Culvert, 1 x 900 mm	• Culvert extended to suit railway. • Discharge from Sediment Basin 1. • One way valve on outlet.
RL-2A	Culvert, 1 x 900 mm	• New culvert, offset from existing by 40 m and extended to suit new infrastructure. • External discharge with minimal catchment area. • One way valve on outlet.
RL-3A	Culvert, 1 x 900 mm	• New culvert draining area between railway lines. • Receives discharge from sediment basin 3. • One way valve on outlet.
RL-4	Culvert, 1 x 900 mm	• Extension to existing culvert to suit railway. • No change to catchments. • One way valve on outlet.
RL-5	Culvert, 1 x 900 mm	• Culvert extension. • Provides outlet for modified SB-2 and associated storage area for Scenario 1, and the outlet for SB-4 in Scenario 2. • One way valve on outlet.
RL-6	Culvert, 1 x 600 mm	• Culvert extended, connection to sediment basin removed due to turnout and associated infrastructure. • One way valve on outlet.
SYZ-C60	Culvert, 1 x 900 mm	• New culvert to discharge Stormwater Basin 5.
SYZ-C81	Culvert, 1 x 600 mm	• New culvert to discharge Stormwater Basin 6.

Table 6-5: Comparison of peak water levels at sediment and stormwater basins (mAHD)

Basin	Baseline			Scenario 1			Scenario 2		
	5%	2%	1%	5%	2%	1%	5%	2%	1%
1	3.39	3.56	3.72	3.62	3.74	3.98	4.20	4.29	4.54
2	4.20	4.33	4.51	4.19	4.28	4.41			
3				3.99	4.19	4.29	3.99	4.19	4.29
4							4.22	4.39	4.56
5				5.47	5.57	5.61	5.47	5.57	5.61
6				4.70	4.42	4.46	4.70	4.42	4.46

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