



Water Quality and Water Cycle Management Report

Pasminco Cockle Creek Smelter

Fitzwalter Group Pty Ltd

June 2006

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Water Quality and Water Cycle Management Report

Prepared for

Fitzwalter Group Pty Ltd

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Executive Summary

It is proposed that the Pasmenco Cockle Creek Smelter (PCCS) site will undergo remediation to remove contaminated materials deposited during the smelter operations. It is anticipated that these works will be carried out at a relatively constant rate over a period of five (5) years.

This report is the Water Quality and Water Cycle Management Report, and it outlines the Stormwater Management Strategy (referred to herein as the Stormwater Management Strategy).

The PCCS site drains into Cockle Creek which is a tributary of Lake Macquarie. A stormwater management strategy has been developed that incorporates a series of measures and actions that are expected to provide protection of the environmental values for the receiving waters in accordance with the ANZECC 2000 guidelines.

The following principles have been developed for application to the site during the remediation process:

- Divert all clean water around contaminated sites to discharge topographically downstream of the site
- Separate “clean” and “dirty” water across the site
- Trap “dirty water” and eroded sediment from disturbed sites, as close to the source of the sediment as practical
- Runoff from contaminated sites to be treated before discharge to Cockle Creek
- Minimise the extent of disturbed areas during remediation
- Rapidly revegetate / stabilise remediated areas where possible
- Continue ETP operations during remediation
- Maximise the reuse of treated water on-site for dust suppression
- Maximise dam storages during remediation operations and minimise any overflows from dams thus retaining contaminated runoff
- Maintain the integrity of essential piped drainage networks during remediation
- Progressively cover containment cell to minimise leachate. All leachate to be appropriately treated.

Throughout the process of site remediation, the surface water on the PCCS site and in particular any areas undergoing remediation will be managed in accordance with this strategy to minimise the risk of detrimental impacts of receiving waters.

1.0 Introduction

1.1 Purpose of this Report

Pasminco Cockle Creek Smelter P/L (subject to deed of company arrangement) is seeking to gain approval from the Minister for Planning under Part 3A of the Environmental Planning and Assessment Act 1979, for various works associated with the remediation of the Pasminco Cockle Creek Smelter (PCCS) site and adjacent PCCS lands.

The purpose of this report is to describe the recommended stormwater management strategy, outlining the surface water management measures recommended for the handling of water flows and quality within the Smelter site during remediation.

The strategy is designed to be acceptable to the Department of Planning, the Department of Natural Resources and Lake Macquarie Council. It also conforms to current legislation, in particular considering the EPA Licensing requirements and the Australian and New Zealand Water Quality Guidelines 2000 (ANZECC 2000).

There are many options for achieving a satisfactory water quality and water cycle management strategy for the PCCS site. This report presents details of the recommended strategy and conceptual arrangements to be implemented during remediation works to demonstrate that adequate controls are possible to achieve satisfactory surface runoff water management. These conceptual arrangements will be used as a framework for specific actions to be taken as each area is being remediated.

The specific issues of water treatment and quality are addressed in the Pasminco Site Remediation Surface Water Quality Report by Fitzwalter May 2006.

1.2 Structure of this report

- 1.0 Introduction – Presents the purpose of this report
- 2.0 Previous Studies – Presents an overview of the previous studies that have been used as a basis for material presented in this report
- 3.0 Site Description – Describes the existing site conditions
- 4.0 Site Remediation – Presents the staging of the site remediation works and the potential impacts and the opportunities and constraints
- 5.0 Water Management Strategy – Presents design principles, strategies and guidelines and the proposed management measure options and recommendations
- 6.0 Conclusion
- 7.0 References

2.0 Previous Studies

The following studies were referenced to provide background data and information for:

- Preliminary Report of the Stormwater Management Requirements for the Future Planning of the Pasmenco Cockle Creek Smelter Site (Umwelt March 2004)
- Surface Water and Wastewater Management (CH2MHill 2004)
- Pasmenco Cockle Creek Smelter Site, January 2004 RAP SRoH Supplement Report (Fitzwalter, August 2005)
- Remediation Action Plan Pasmenco Cockle Creek Smelter Site, Boolaroo, NSW (Fitzwalter, September 2005)
- Site Audit Statement and Site Audit Report “Triangular Paddock” Site (HLA-Envirosciences August 2005).

2.1 Preliminary Report of the Stormwater Management Requirements for the Future Planning of the Pasmenco Cockle Creek Smelter Site (Draft) (Umwelt March 2004)

Umwelt were commissioned to investigate the engineering, stormwater and traffic constraints and opportunities for the future planning of the PCCS site. This report covers the preliminary investigation of the stormwater management requirements for the future development of the site.

2.2 Surface Water and Wastewater Management (CH2MHill 2004)

This report was undertaken at the PCCS site to provide a summary of the existing water control systems on site, together with consideration of future required water control systems as the site moves through the Post-Closure, Demolition and Remediation phases. This report provides background information and a description of on-site drainage and catchment conditions.

2.3 Pasmenco Cockle Creek Smelter Site, January 2004 RAP SRoH Supplement Report (Fitzwalter, August 2005)

At the time PCCS ceased operation in September 2003, it was subject to a Remediation Order (RO). The RO identified environmental issues that constituted a Significant Risk of Harm (SRoH) for the vacant site. A Remedial Action Plan (RAP) was prepared in January 2004, however it did not have a fully developed for water management strategy.

The RAP SRoH Supplement Report provided further information identifying the actions that have been implemented to address the SROH issues reported to in the RO, with Appendix 1 presenting measures implemented to address surface water management. This report provides information on site drainage, catchment conditions and management measures.

2.4 Remediation Action Plan Pasmenco Cockle Creek Smelter Site, Boolaroo, NSW Final (Fitzwalter, September 2005)

This report documents the overall Remediation Strategy for the PCCS site and has been endorsed by the Site Auditor. At the time of this report it was being reviewed by the NSW Environment Protection Authority.

2.5 Site Audit Statement and Site Audit Report “Triangular Paddock” Site (HLA-Envirosciences August 2005)

This report provided information on the catchment and existing conditions of the “Triangular Paddock” Site.

3.0 Site Description

3.1 Overview

The PCCS site is located at 13a Main Road, Boolaroo NSW approximately 13km south-west of Newcastle.

For planning purposes, the PCCS site has been divided into eleven discrete areas, known as:

- a) Cardiff West Industrial Estate
- b) Triangle Paddock Residential Estate (South)
- c) Rail Employment Zone
- d) Triangle Paddock (North) and Main Entry Precinct
- e) Boolaroo Heights Residential
- f) Munibung Hill Residential Estate
- g) Munibung Hill Industrial Estate
- h) Boolaroo North
- i) Cell Surrounds
- j) Mixed Use Employment Zone
- k) Containment cell.

These are shown in the site overview in **Figure 1**.

3.2 Catchments

The PCCS site is located within the Munibung catchment, which ordinarily drains directly into Cockle Creek and subsequently into Lake Macquarie (Fitzwalter, Sept 2005). The PCCS site occupies an area of approximately 192ha (Fitzwalter, Aug 2005). The site has historically been levelled by cutting and filling with by-products and waste products from previous on-site processes. Due to this, many of the fill areas which were formerly depressions and natural gullies may be acting as sub surface drainage routes (Fitzwalter, Sept 2005).

The catchment is defined by an east / west ridgeline and northwest / southeast ridgeline both from Munibung Hill. The ridgelines generally follow the same alignment as the southern and eastern site boundaries. The catchment area for water reporting to the site is increased by an undeveloped parcel of land along the northwest / southeast ridgeline. The property boundary deviates to the west, which drains onto the site.

Within the site boundary there is a high variability in catchment characteristics with diverse coverage of vegetation and slopes ranging from gentle to very steep. In the upper reaches of the site, closer to the Munibung Hill summit, there is existing surrounded by exposed rock and very steep slopes in excess of 25%. At the base of Munibung Hill and its ridgeline, above the former smelter operations and Incitec building, the site is characterised by more gentle slopes ranging from 2-10%. This area has predominantly been cleared and is vegetated by grasses. Within the area of the former smelter operations and Incitec, the areas have been highly modified, covered with factory buildings, roads and pavements (Umwelt, 2004). Demolition of the buildings on the former smelter site is currently underway and expected to be completed by June 2006.

The major overall site surface water subcatchments are shown in **Figure 2** and summarised in **Table 3.1** (Fitzwalter, 2005).

Table 3.1 PCCS Subcatchment Condition Summary

Catchment	Approximate Catchment Area (ha)	Contaminated / Uncontaminated	Flow Path Capture Area
South East	71	Uncontaminated	Freshwater Dam
South West	17	Heavily contaminated	South West Dam
North East	34	Relatively Uncontaminated	Hawkes Dams
Northern	25	Relatively Uncontaminated	Far eastern corner of catchment
Offsite	7.3	Uncontaminated	South West Dam
Central	7.7	Contaminated	Saltwater Dams and then offsite
Northern Dump	34	Contaminated	Hawkes Dams
Triangular Paddock	9.6	Contaminated	Cockle Creek Floodplain
Total	206		

3.3 Existing Conditions / Water Management Structure

Runoff from the overall site can be divided into runoff from non-plant / non-dump site areas and runoff from plant / dump site areas (CH2MHill, 2004).

Surface water flows are also depicted on a site plan on **Figure 2**. The major existing flow systems within the PCCS site are shown schematically on **Figure 3**.

Umwelt (March, 2004) investigated the drainage lines around the site perimeter. The existing infrastructure was described as:

- In the southwest, there is an open drain that discharges through a box culvert system under Lake Road and then into Cockle Creek. The open drain conveys stormwater from the site and Main Road, Boolaroo.
- Along the north-western boundary, adjacent to the Great Northern Railway, stormwater from the site discharges through a concrete culvert chute under the railway into a watercourse. This watercourse discharges through a box culvert under Lake Road, into another watercourse that conveys stormwater through the Waratah Golf Course.

Subsequent to this report, Lake Macquarie City Council (LMCC) constructed a detention basin adjacent to the north-eastern corner of the PCCS site that discharges under the Great Northern Railway into a watercourse and into Cockle Creek

Site Runoff: Non-plant / Non-dump

CH2MHill (2004) (provided in Appendix A) indicates that runoff from the northeast catchment is diverted around the plant / dump portion of the site. This diverted water has been indicated as clean runoff from Munibung Hill and it discharges into a detention basin (LMCC) that flows under the rail line discharging eventually into Cockle Creek.

Runoff from the far north of the site is considered clean and discharges with runoff from the northern slopes of Munibung Hill into the LMCC detention basin (CH2MHill, 2004).

Runoff from the slopes of Munibung Hill in the southeast of the site flows to the Freshwater Dam. The dam overflow is diverted under the plant through the six foot drain pipe / channel to a discharge location on the site west of the South West Dam (SWD). Runoff from any Freshwater Dam overflow event is considered to be clean runoff. (CH2MHill, 2004)

Site Runoff: Plant/Dump

The major features within the plant / dump site surface water runoff system are Hawkes Dam, South West Dam (SWD), the Effluent Treatment Plant (ETP) and the Saltwater Dams (CH2MHill, 2004).

At the time of closure of the smelter, a number of on-site dams were operational and were used to capture and treat the surface water runoff before it left the site. Collected water is treated in an ETP, with a capacity of 90m³/hr, before being discharged to Cackle Creek under an Environment Protection Licence (EPL) issued by EPA (Fitzwalter, Sept 2005). Since closure, sediment has been removed from a number of these dams. This is described further in **Section 3.4**.

The current plan and dump site surface water management system comprises:

- At the southern end of the plant site, stormwater is collected in the SWD. From the SWD, water is subsequently stored and pumped back to the ETP, via the Spray Pond, for treatment. Stored water can also be pumped from the SWD / Spray Pond to the Hawkes Dams. In rainfall events that exceed the SWD dam and pump capacity, the water in the SWD overflows and discharges offsite along the southern boundary of the Triangle Paddock Residential Estate and into Cackle Creek.
- At the south western end of the plant site, stormwater runoff is generated from the car park and open grassed areas. This flows offsite without treatment.
- In the eastern central part of the plant site, runoff flows are diverted to Hawkes Dam for subsequent treatment in the ETP. In the western central part of the plant site, runoff flows overland or via existing underground pipes to the saltwater dams. These are pumped back to the ETP via the Hawkes Dam.
- At the northern end of the plant site, runoff is collected in Hawkes Dam. Water from Hawkes Dams is pumped back to the ETP for treatment prior to being discharged from site. For additional storage capacity, water from Hawkes Dam can also be pumped to the Saltwater Dams. The water in the Saltwater Dams needs to be pumped back to the Hawkes Dam before being directed for treatment. Sediments from the Hawkes and Saltwater Dams have recently been removed to further increase the storage capacity of both dam systems. Water from Hawkes Dams is also used for dust suppression and road washing on the site. When the storage and pump capacities are exceeded, water overflows from Hawkes Dams and discharges offsite through a watercourse into Cackle Creek.
- Effluent from the ETP is either reused onsite or, should it not be required, mixed with water pumped from Cackle Creek to EPL criteria and discharged to Cackle Creek.

3.4 Flows and Storage Volumes

CH2MHill (2004) calculated the flows and anticipated on-site detention storages required for 1-year, 10-year and 100-year ARI events using the Rational Method and volumetric procedures from AR&R (1987). These are summarised in Table 3.2.

Table 3.2 PCCS Subcatchment Flows and Storage Summary

Catchment (Storage)	Area (Ha)	Mean Slope (m/m)	Q (m ³ /s)				Storage (m ³)		
			1year ARI 1 hour	10year ARI 1 hour	100year ARI 1 hour	100year ARI 5 mins	1year event ARI 1 hour	10year event ARI 20 min	100year event ARI 1 hour
South East (Freshwater Dam)	71	0.264	1.66	3.92	7.13	22.76	6000	8500	26000
South West (South West Dam)	17	0.039	0.78	1.83	3.33	10.63	3000	4000	12000
North East	34	0.093	0.91	2.14	3.90	12.44	4000	4700	14000
North	25	0.048	1.10	2.60	4.72	15.07	4000	5600	17000
Offsite	7.3	0.050	0.22	0.52	0.95	3.03	1000	1200	4000
Northern Dump ¹ (Hawkes Dam)	29	0.035	0.71	1.67	3.03	9.67	3000	3600	11000
Central ² (40% Hawkes Dams, 60% Saltwater Dams)	13	0.030	0.30	0.71	1.29	4.13	2000	1600	5000

1. Excludes 5.4 ha Acid Plant Catchment

2. Includes 5.4 ha Acid Plant Catchment

CH2MHill (2004) also assessed the dams and their capacities in terms of volume and effective storm event that can be captured. This information is summarised in **Table 3.3**.

Table 3.3 Summary of Dam Characteristics (as at August 2005)

Dam	Capacity (m ³)	Sediment volume in dam (m ³)	Actual capacity	Operational Level (m)	Effective Capacity	Storm event capture
Freshwater	95,000	0	95,000	Full	0	Greater than 100 year ARI, 1hr
South West	3,000	0	3,000	0	3,000	Marginally less than 10 year ARI, 20min
Hawkes 1	14,500	3,000	11,500	0.15	10,700	Greater than 10 year ARI, 20 min
Hawkes 2	7,000	1,000	6,000	0	6,000	Greater than 10 year ARI, 20 min

Hawkes Dams and South West Dam have historically overflowed due to periods of high and/or long duration rainfall events. CH2MHill (2004) found that during an overflow event from the dams, mean

concentration of pollutants exceed the ANZECC 2000 marine guidelines values by orders of magnitude in most cases. It was noted that overflow events were generally caused by having too high an inventory in the existing storages at the time of a rainfall event or, by significant rainfall events that filled reserve storage dam capacity before then overflowing.

Original

The RAP SRoH supplement (Fitzwalter, August 2005) reported that there has been a significant reduction in overflows since site closure as there is reduced water usage on-site, reduced rainfall due to drought conditions and the current management practice of maintaining the dams at the lowest possible operational levels. Fitzwalter's analysis of overflow records found that post smelter closure, there had been a 70% reduction in average annual overflows, from 4,000m³/month to 1200m³/month. They found there had been 33 days since the closure when overflows have occurred, most of these corresponding to 11 major rainfall events.

Suggested

The RAP SRoH supplement (Fitzwalter, August 2005) reported that there has been a significant reduction in overflows since site closure even though with reduced water usage on-site due to reduced rainfall due to drought conditions and the current management practice of maintaining the dams at the lowest possible operational levels

There is a works program being currently undertaken for the Hawkes Dams and Saltwater Dams. The Saltwater Dams have been disconnected from the ETP, cleaned out and the storage volume increased. They are now used in conjunction with the Hawkes Dams to provide stormwater retention up to the 10-year ARI, 20-minute duration event for the site. Hawkes Dam 2 will be excavated about a further 2m within 2006 as weather permits to provide additional storage. Hawkes Dam 1 is scheduled to be dredged and cleaned out after Hawkes Dam 2 is completely excavated and can replace the function of Hawkes Dam 1.

3.5 Loads

The CH2MHill report estimated that the post-closure requirements for the ETP were about 30m³/hour. It also estimated that during demolition, recirculation flow rates would be approximately 66m³/hour with additional new water (towns) being used for these activities of less than 10m³/hour. These estimated demands are significantly less than the 90m³/hr capacity of the ETP.

4.0 Site Remediation

4.1 Staging

The information relating to the activities and staging of the proposed remediation are drawn from the PCCS Remedial Works Outline report prepared by Maunsell, March 2006.

The site has been divided into 11 nominal areas, of which, nine will be subject to remediation and validation in order to make the sites suitable for development as either residential or industrial land. The two remaining areas are part of the containment cell (**Figure 1**).

It is proposed to remediate and validate these areas in a staged and orderly manner, although the actual boundaries of the areas may vary in actual implementation. Cell construction will occur progressively and concurrently with the remediation works of these areas. It has been estimated that the remediation, validation and all other associated activities will be carried out progressively over approximately five (5) years which for convenience of presentation has been divided into ten 6-month segments. It is proposed to conduct the excavation and cell construction at a steady rate across the ten segments, with the rate of excavation determining the rate of construction of the cell. Ancillary activities (including backfilling, importation of capping material and preparation of a remediated site for development) will be conducted as required, but with the intention of minimising the length of time a particular area is operational and potentially causing impacts.

The proposed staging is shown in **Figures 4 and 5**.

4.2 Impacts

During remediation of the site, areas of land will be cleared and opened up for excavation of contaminated materials. While most of the material excavated will be transported to the containment cell area, seen in **Figure 1** and stockpiled there before placement, there may be small stockpiles within the area being remediated. In addition, earthmoving equipment may be moved on and off the area being remediated.

The potential surface water impacts that may arise during the remediation works are:

- Clean water from catchments upstream of the disturbed areas flowing over contaminated areas and becoming contaminated.
- Contaminated runoff from contaminated areas flowing offsite and entering downstream waterways.
- Sediments being transported from the site on vehicles contaminating clean areas / roadways.

4.3 Opportunities and Constraints

4.3.1 Opportunities

The condition of the existing site has the following opportunities:

- Existing dams – The existing dams (Hawkes Dams; Saltwater Dams; South West Dam) that have been used for water management during the operation of the smelter can continue to be used to collect and store contaminated water prior to treatment for as long as practical during the remediation process

- Existing ETP – The existing ETP has a capacity of 90m³/hour, significantly more than the anticipated treatment load requirements for the site during remediation. The ETP and associated infrastructure (or equivalent) should therefore be kept on-site throughout remediation to provide treatment for contaminated waters.

4.3.2 Constraints

The existing site conditions and proposed remediation work could give rise to the following constraints:

- Scheduling of works – The proposed remediation schedule may result in an excess of excavated material, that is, a temporal imbalance in excavation volumes versus placement volumes. Excavated material will need to be transported to the containment cell area and stockpiled there. Any stockpiles on the area being remediated must be kept to a minimum.
- Staging timetable – As PCCS remediate and develop areas of land, new infrastructure may need to be constructed to meet the needs of developable land. For example, it is noted that the development of the Rail Employment Zone will require the extension of Munibung Hill Road. To do this, it will be necessary to remove part or all of Hawkes Dam 1, therefore, an alternative storage must be established prior to this.
- Existing dams – Should there be future works within 40m of the dam, Part 3A Permit process of the RFI Act may be triggered (Umwelt, March 2004). This could apply to Freshwater Dam in particular.
- Potential Acid Sulphate Soils (PASS) – The site audit report for the ‘Triangular Paddock’ (HLA Envirosiences, August 2005) noted that there is a high potential for ASS being present and that an ASS Management Plan should be developed prior to the commencement of any remedial works being undertaken. The provision of surface water management measures and any works in ASS areas must be in accordance with this plan.
- Flooding – Umwelt (March 2004) noted that the majority of the site is well above the 100-year ARI flood level for Cockle Creek of 1.64m AHD except for the south-western corner (triangular paddock). This area is low-lying with existing surface levels less than the 100-year ARI flood level.
- Incitec Site – The future of the Incitec site is uncertain however surface water flows across and from this site need to be considered during the PCCS site remediation.

4.4 Loads

As noted in Section 3.5, CH2MHill (2004) estimated that post closure, ETP flow rates would be approximately 30m³/hour. Additional loads will be required during remediation and to treat the extracted groundwater, but in total, they would always be less than the ETP capacity of 90m³/hour.

5.0 Water Management Strategy

5.1 Guidelines / Objectives

The following references have been considered in the development of guidelines and criteria for the management of water quantity and quality:

- Landcom – Managing Urban Stormwater: Soils and Construction, 4th Edition, March 2004 – Landcom’s manual (“the blue book”) provides practical guidelines for erosion and sediment control measures. Effective implementation of control measures will reduce water quality impacts to potentially receiving watercourses
- Managing Urban Stormwater: Strategic Framework (Draft), EPA 1996 – This document outlines policy and administrative framework within which a strategic approach to stormwater management can be supported. It summarises the processes and possible approaches to mitigating development impacts
- Managing Urban Stormwater: Treatment Techniques (Draft), EPA 1997 – This document presents a suite of techniques that can be used for treating stormwater runoff
- Australian and New Zealand guidelines for fresh and marine water quality (ANZECC 2000) – These documents provide guidance on the application of practices for water resource management and assessment, for the protection of a number of environmental values.

5.2 Principles

Using the above references and background report for the PCCS site, the following principles have been developed for application to the site during the remediation process:

- Divert all clean water around contaminated sites to discharge topographically downstream of the site
- Separate “clean” and “dirty” water across the site
- Trap “dirty water” and eroded sediment from disturbed sites, as close to the source of the sediment as practical
- Runoff from contaminated sites to be treated before discharge to Cockle Creek
- Minimise the extent of disturbed areas during remediation
- Rapidly revegetate/stabilise remediated areas where possible
- Continue ETP operations during remediation
- Maximise the reuse of treated water on-site for dust suppression
- Maximise dam storages during remediation operations and minimise any overflows from dams thus retaining contaminated runoff
- Maintain the integrity of essential piped drainage networks during remediation
- Progressively cover containment cell to minimise leachate. All leachate to be appropriately treated.

5.3 Criteria

5.3.1 Water Transport and Retention

Retention Basins

There is an existing practice of retaining contaminated water in on-site dams. This water is then treated in the on-site ETP and reused as needed for dust suppression and wash down. These dams have been generally sized to capture the 10-year ARI, 20-minute duration storm event.

A 10-year ARI will have 99.85% of the average annual runoff volume below the nominated flow (Managing Urban Stormwater: Strategic Framework (Draft), EPA 1996), thus the capture of the 10 year ARI event will mean that 99.85% of the average annual runoff volume is being retained.

The PCCS site IFD curve gives the intensity for the 10-year ARI, 20-minute duration storm event as 87mm/hr (CH2MHill, 2004); therefore a basin designed to these criteria will capture the first 29mm of runoff. As the first flush is up to the first 15mm of runoff, the capture of the 10-year ARI, 20-minute duration storm event provides a high level of stormwater retention for the site.

The 10-year ARI, 20-minute duration storm is therefore considered an acceptable level of treatment and is recommended to be adopted as the basis for sizing basins and dams during site remediation. Using the data presented by CH2MHill on storage volumes, it has been determined that a volume of 150m³/ha will need to be provided for the site.

Drains

The drainage network across the site is to be sized to carry a minimum of the 10-year ARI storm event.

5.3.2 Water Quality

The PCCS catchment drains to Cockle Creek, which is a tributary of Lake Macquarie and as such the ANZECC guidelines for human health values with respect to recreational water quality and aesthetic values have been adopted as the recommended parameters for surface water runoff from this site. These aim to protect freshwater rivers and lakes for recreational activities, such as swimming and boating, and to preserve their aesthetic appeal.

The ANZECC guidelines state that “water used for primary contact activities, such as swimming, bathing and other direct water-contact sports, should be sufficiently free from hazards (e.g. poor visibility or toxic chemicals) to protect the health and safety of the user”. The general guidelines desirable for aquatic scenery are also applicable for water used for primary contact.

The main risks from the surface water runoff from the PCCS site would be sediments and contamination from heavy metals deposited during smelter operations. The ANZECC guidelines state that waters containing chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreation. As heavy metals are directly toxic to biota, the presence of such chemicals may also be harmful to both human and aquatic life.

The PCCS EPL (number 5042) states that the following pollutants must be monitored off site:

- Arsenic
- Cadmium
- Lead
- Mercury
- Selenium
- Total solid particles
- Zinc.

The ANZECC parameter guideline values for each of these pollutants are given in **Table 5.1** below.

Table 5.1 Parameter Guideline values

Pollutant	(µg/L)
Inorganic	
Arsenic	50
Cadmium	5
Chromium	50
Lead	50
Mercury	1
Selenium	10
Other chemicals	
Total dissolved solids	1,000,000
Zinc	5,000

5.4 Site Water Management Requirements

To achieve optimal surface water management during the remediation process, the following water management strategy is recommended to be implemented wherever feasible during the remediation of the PCCS site. The key elements of the strategy are below and further detail on measures is provided in Section 5.4.1:

- Wherever possible during the remediation process, work is to be undertaken from uphill to downhill. This is to be applied both across the site and across any area being remediated
- Provide and maintain a network of drains:
 - Directing clean water from catchments above the PCCS and Incitec site around these sites to discharge downstream of the sites
 - Directing clean water around areas being remediated
- Separate and divert clean runoff from remediated areas as soon as practical
- Ensure that the existing dams providing retention storage for the plant and dump site areas meet the 10-year ARI 20-minute duration storm retention criteria. Continue to dredge and / or amplify these dams if necessary to achieve and maintain this capacity
- Ensure that a pipe network within and through the PCCS site is maintained for as long as it is needed to transport runoff between basins and / or transfer clean runoff across the site (e.g. the 6-foot drain)
- Ensure that there is suitable runoff retention capacity in existing dams and / or new temporary basins are available for all areas undergoing remediation works at any one time to collect 10-year ARI 20-minute duration storm event flows for those areas
- Provide diversion drains for any areas being remediated to direct all contaminated runoff from that segment to the appropriate dams and/or basins. Transfer all water collected in the dams / basins to the ETP, either directly or via an intermediary dam, for treatment before reuse or discharge
- Where retention basins are provided on a temporary basis, at the completion of the use of that basin for water retention during remediation works, the collected sediments are to be dredged and treated as contaminated material and the basin removed
- Where possible, disturbed areas within each segment are to be minimised
- The existing ETP treatment area must stay operational until remediation is finalised and the cell is finished or the new ETP associated with the cell is commissioned and can replace the existing ETP

- Continue to use saltwater dams as supplementary dam storages during remediation
- All stockpiling of contaminated material is to be contained within the containment cell area. Any stockpiling of contaminated material within other stages is to be kept to a minimum and transferred to the cell area if not needed at the excavation site. Measures to reduce erosion and sediment transport are to be used on all stockpiles. These measures are described further below
- Monitoring of water quality on and off site is to continue as per EPA licence requirements.

It is expected that the implementation of this strategy will minimise the risk of any contamination of surface water by pollutants on the PCCS during remediation, thus protecting the environmental values of the downstream receiving waters in accordance with the ANZECC 2000 guidelines.

5.4.1 Mitigation Measures

A further description of the mitigation measures forming part of the strategy is given below.

Drains

Prior to the commencement of any remediation works for any particular area and to the extent feasible, a network of catch drains, diversion drains, and other erosion control measures are to be installed to direct clean stormwater runoff around and / or away from the area to be remediated.

V-drains are also to be installed in appropriate areas / boundaries to catch and drain surface water runoff generated on the area being remediated to the suitable retention dam / basin for treatment. All drains should be lined with materials suitable to handle the design flow velocities.

A network of drains directing clean water from catchments above the PCCS and Incitec site around these sites to discharge downstream of the sites will also be installed. These drains should be extended if necessary to ensure all clean water is kept free from contamination. They will be maintained throughout the remediation works to ensure clean runoff from sites above the PCCS remains uncontaminated.

Sedimentation and Retention Basins/Dams

The provision of source control for the collection of potentially contaminated surface water is the primary water quality management measure. Throughout the progress of the remediation works, storage areas will be provided across the site of capacity sufficient to retain the 10-year ARI 20-minute duration storm event for the areas under remediation.

The existing dams, known as Hawkes Dam, South West Dam, the Spray Pond and the Fresh Water Dam have generally been sized to meet these criteria for the main catchments of the whole PCCS site. As such, these dams will be sufficient to provide the retention requirements of these remediation areas. However, as the remediation program progresses, the existing dams may be modified, reduced or removed, and suitable and adequate alternate retention systems will be installed in their place to cater for the remaining areas undergoing remediation at any time. Based on calculations and methodology presented by CH2MHill (2004), it has been determined this is 150m³/ha. These basins will be provided at suitable locations to effectively manage the water flows for the subject areas being remediated.

The capacity of the retention basins / dams should be sufficient to capture the runoff during the design storm event for the entire area(s) undergoing remediation that drain to that basin / dam. It should be assumed that all runoff from clean catchments will be directed around or through the site without requiring treatment within a basin.

Some areas of the site requiring remediation do not presently drain to these existing on-site dams. When remediation of these sites begins, there are two possibilities:

- Install a drainage network that allows contaminated runoff to be directed into an existing on-site dam, that dam may be used to retain contaminated site runoff, provided that the dam is of sufficient capacity to collect the additional runoff volume or can be dredged / augmented to provide this storage
- Should the site not be able to be drained to an existing basin or the existing basin not have or be able to be dredged / augmented to the required storage capacity, a new basin will be provided with capacity to retain the 10-year ARI 20-minute duration storm event from the subject area and constructed in accordance with the guidelines provided in Managing Urban Stormwater (Landcom 2004). Runoff retained in the basin will be pumped to the ETP for treatment.

The transfer and storage of water on-site will need to be managed such that the required storage volume is available within the relevant dams and basins. Inventory levels within the storages need to be monitored and reduced as required.

A drainage and pumping network will be provided and maintained to ensure that all 'dirty' water is collected and treated prior to discharge. The drainage and pumping infrastructure will need to be maintained / augmented throughout the duration of the remediation works to ensure all contaminated water collected can be moved around the site for storage, treatment and reuse.

As the remediation progresses, the storage capacity and drainage and pumping network will need to be checked and any modifications required to maintain the integrity of the system undertaken before new works commence. As areas are progressively remediated and considered 'clean', the retention capacity for water from the remaining contaminated areas will consequently and proportionately decrease.

Stockpiles

The following actions will mitigate erosion of and sedimentation from stockpiles:

- Bunds around stockpiles contain stockpile material and direct water flow away from stockpiles
- Stockpile slopes are to be no greater than 2:1 (horizontal to vertical)
- The stockpiling of surplus material will not be undertaken during heavy periods of rainfall
- Stockpiles will be located away from natural flow paths and watercourses
- Temporary erosion and sediments control structures will be placed around stockpiles to prevent erosion
- Stockpiles will be located away from the canopy of any tree that is to be retained
- Stockpiles to be retained for long periods will be stabilised.

Vehicle Wheel Cleaning Units

All earthworks vehicles leaving the site onto public roads will pass through an appropriate wheel cleaning unit. If a wheel cleaning unit is not feasible the major site egress point will at least be constructed from all weather material, such as crushed concrete, that will aid vehicle wheel cleaning prior to vehicles leaving the site. All water and sediment from the wheel cleaning units is to be collected and treated before discharge or re-used for dust control measures, where feasible.

A street sweeper unit may also be employed on an as required basis as an extra measure.

6.0 Conclusion

It is proposed that the PCCS site will undergo remediation to remove contaminated materials deposited during the smelter options. It is anticipated that these works will be carried out over 10 different segments over a period of 5 years.

The PCCS site drains into Cockle Creek which is a tributary of Lake Macquarie and as such a water management strategy has been developed that incorporates a series of measures and actions that are expected to provide protection of the environmental values for the receiving waters in accordance with the ANZECC 2000 guidelines.

Throughout the process of site remediation, the PCCS site and in particular each stage will be required to be managed in accordance with this strategy to minimise the risk of detrimental impacts of receiving waters.

7.0 References

EPA, 1996 – Managing Urban Stormwater: Strategic Framework (Draft) NSW Environment Protection Agency

ANZECC 2000 – Australian and New Zealand guidelines for fresh and marine water quality. Volume 1, The guidelines, Australian and New Zealand Environment and Conservation Council

CH2MHILL, 2004 – Surface Water and Waste Water Management Review, “Figure 8: Post Demolition Remediation Phase – Possible Flow Schematic”

Fitzwalter August 2005 – Summary of Actions Implemented to Address Significant Risk of Harm Issues at Pasminco Cockle Creek Smelter Site, Boolaroo, August 2005

Fitzwalter September 2005 – Remediation Action Plan, Pasminco Cockle Creek Smelter Site, Boolaroo, NSW, Fitzwalter Group Pty Ltd September 2005

Landcom (2004) – Managing Urban Stormwater: Soils and Construction, 4th Edition, March 2004

Figures

Figure 1: Site Overview

Figure 2: Surface Water Flows

Figure 3: PCCS Water Management System

Figure 4: Proposed Staging Plans

Figure 5: Proposed Staging Plans

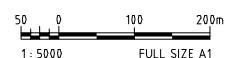
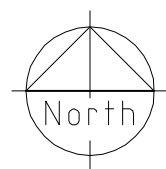


LEGEND:

- 1 CARDIFF WEST ESTATE
- 2 TRIANGULAR PADDOCK SOUTH
- 3 RAILWAY EMPLOYMENT ZONE
- 4 TRIANGULAR PADDOCK NORTH AND MAIN ENTRY PRECINCT (FORMERLY SUPERLOT 5A)
- 5 BOOLAROO HEIGHTS
- 6 MUNIBUNG HILL RESIDENTIAL
- 7 MUNIBUNG HILL INDUSTRIAL
- 8 BOOLAROO NORTH (FORMERLY SUPERLOT 5B)
- 9 CELL SURROUNDS
- 10 MIXED USE ZONE
- 11 CONTAINMENT CELL
- EXISTING EFFLUENT TREATMENT PLANT (ETP)
- PROPOSED EFFLUENT TREATMENT PLANT (ETP)

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LEGEND:

- CATCHMENT BOUNDARY
- ➔ FLOW DIRECTION
- PROPOSED CONTAINMENT CELL

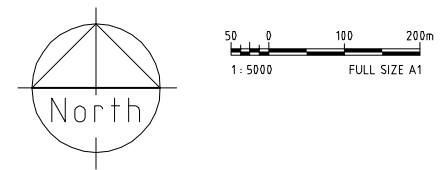
NUMBER	CATCHMENT	AREA (Ha)
1	SOUTH EAST	71
2	SOUTH WEST	17
3	NORTH EAST	34
4	NORTHERN	25
5	OFFSITE	7.3
6	NORTHERN DUMP	34
7	CENTRAL	7.7
8	TRIANGULAR PADDOCK	9.6

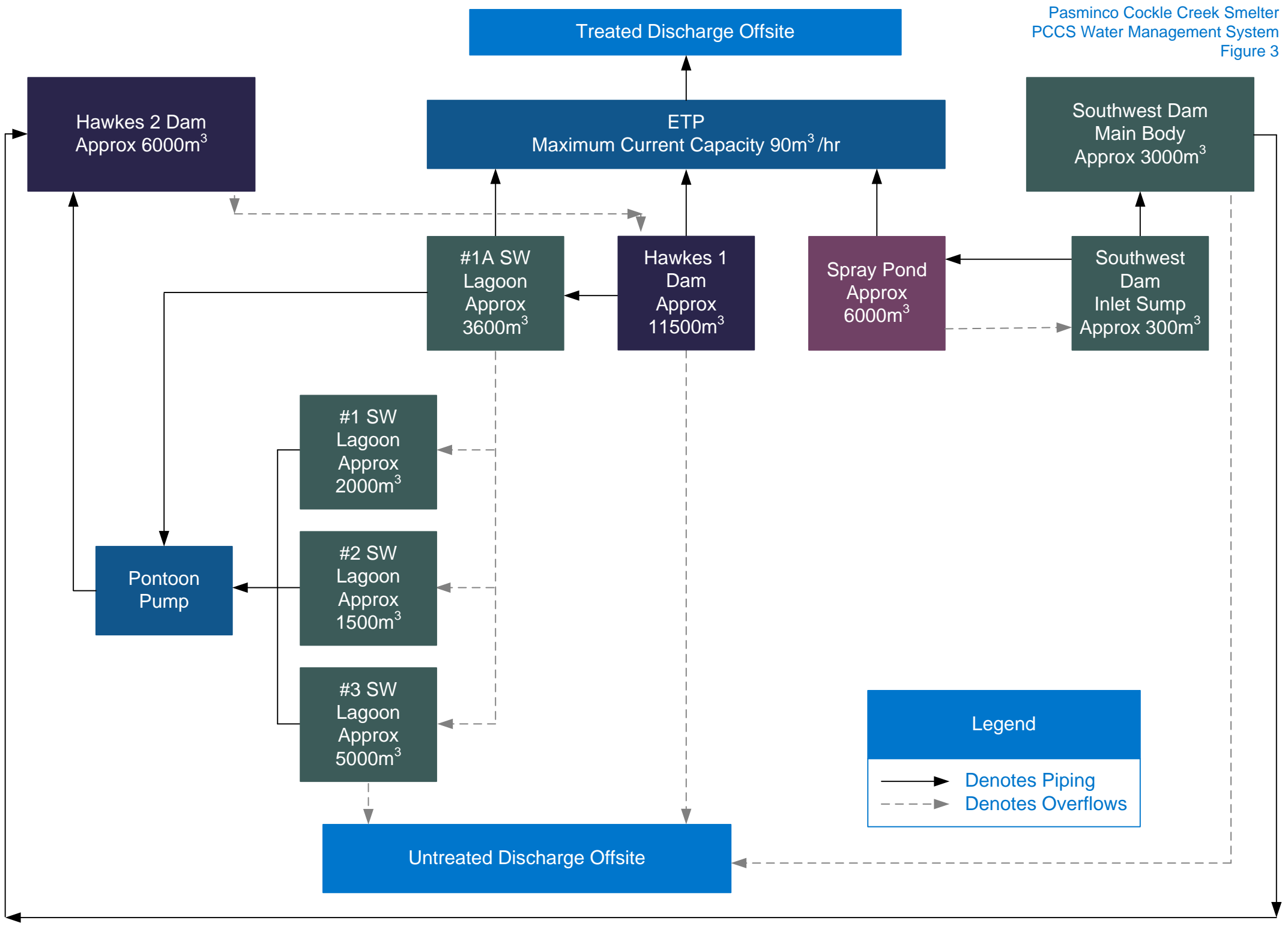
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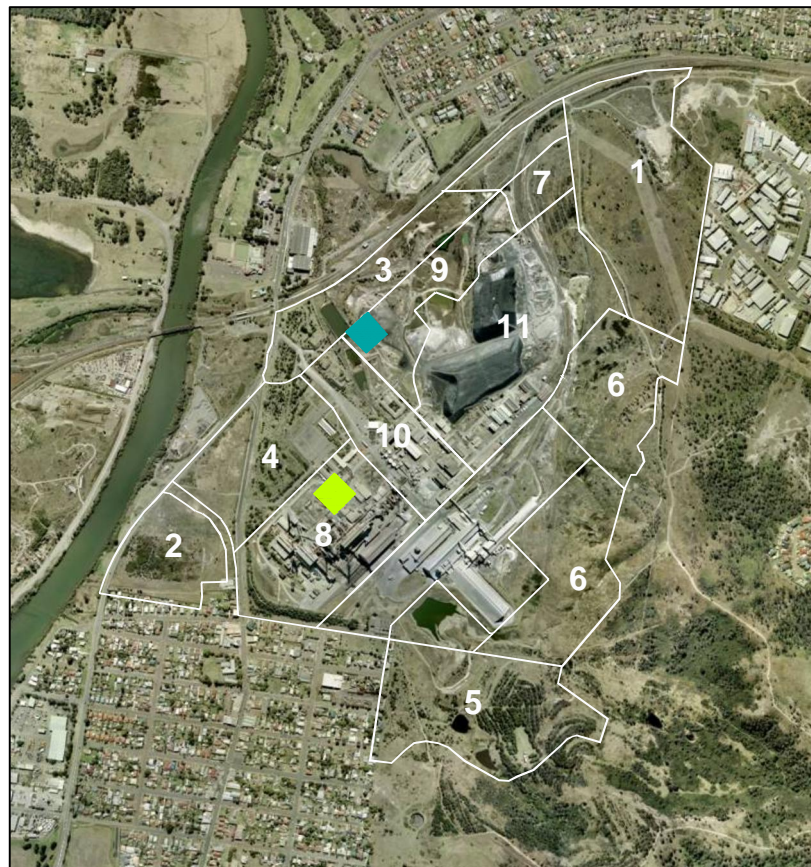
THESE CATCHMENT BOUNDARIES AND AREAS HAVE BEEN TAKEN FROM OF THE SURFACE WATER AND WASTEWATER MANAGEMENT REVIEW PRODUCED BY CH2MHILL (OCTOBER 2004) AND THE SITE AUDIT STATEMENT AND SITE AUDIT REPORT: "TRIANGULAR PADDOCK" SITE PRODUCED BY HLA-ENVIRONSCIENCES PTY LTD (AUGUST 2005). NO RESPONSIBILITY IS TAKEN BY MAUNSELL FOR THE ACCURACY OF THIS DATA.

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MONTH 0



MONTHS 1-6



MONTHS 7-12



MONTH 13-18



MONTHS 19-24



MONTHS 25-30

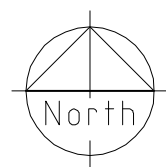
LEGEND:

- UNDERGOING REMEDIATION
- VALIDATED
- ACTIVE FILLING
- CAPPED CONTAINMENT CELL
- HAUL ROUTES
- MONTHS** FROM APPROVAL

LEGEND:

- 1 CARDIFF WEST ESTATE
- 2 TRIANGULAR PADDOCK SOUTH
- 3 RAILWAY EMPLOYMENT ZONE
- 4 TRIANGULAR PADDOCK NORTH AND MAIN ENTRY PRECINCT (FORMERLY SUPERLOT 5A)
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MONTHS 31-36



MONTHS 37-42



MONTHS 43-48



MONTHS 49-54



MONTHS 55-60



MONTHS COMPLETE

LEGEND:

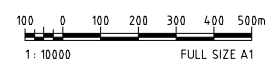
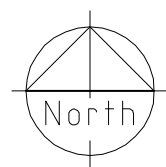
- UNDERGOING REMEDIATION
- VALIDATED
- ACTIVE FILLING
- CAPPED CONTAINMENT CELL
- HAUL ROUTES
- MONTHS** FROM APPROVAL

LEGEND:

- 1 CARDIFF WEST ESTATE
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Appendix A: Figure 8 – Post Demolition Remediation Phase – Possible Flow Schematic

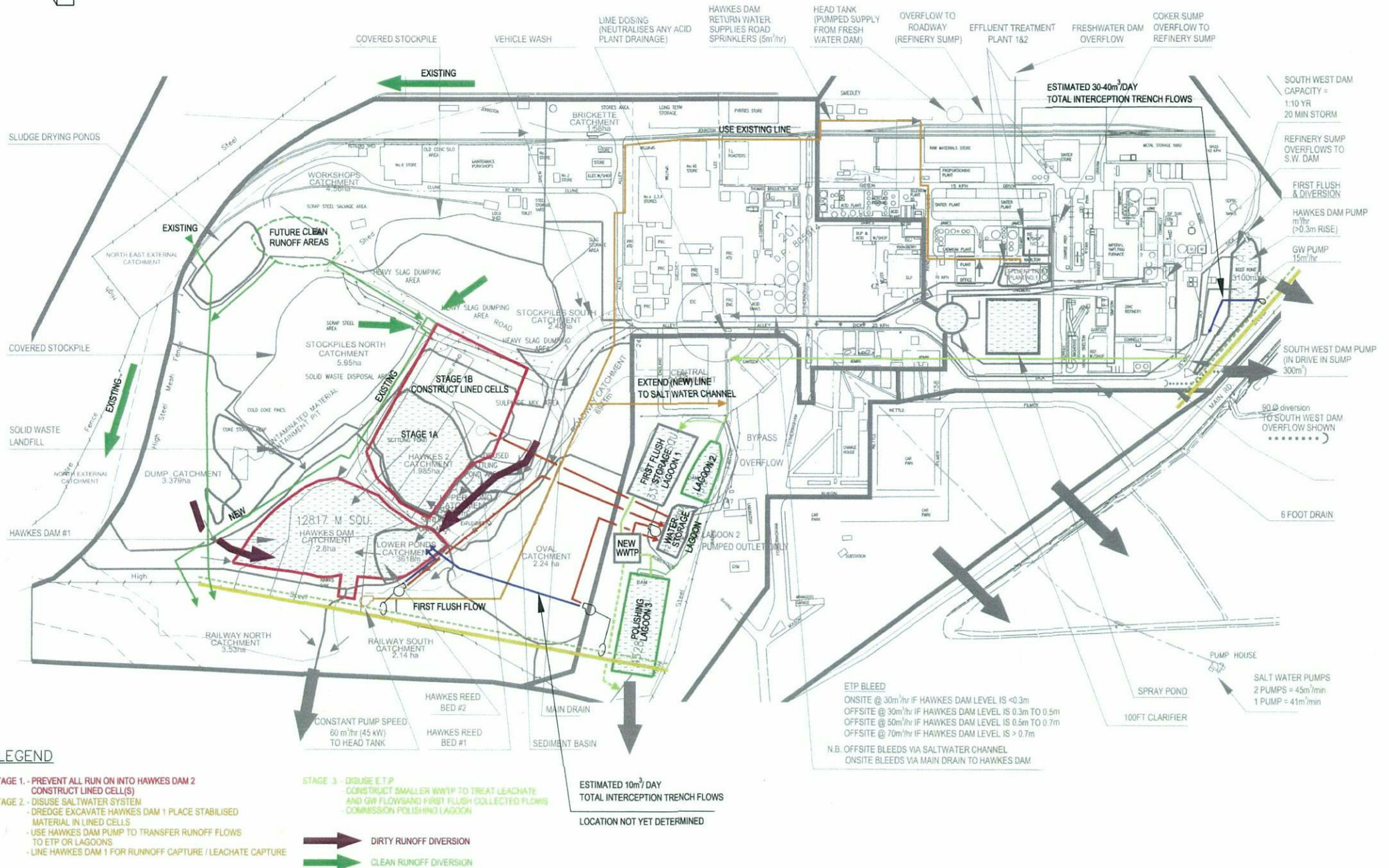


Figure 8 - Post Demolition Remediation Phase - Possible Flow Schematic