Appendix C Surface Water Management Plan

Hinze Dam Alliance

Hinze Dam Stage 3 Upgrade

DRAFT REPORT
Quarry and Clay Borrow Area Surface Water Management

ENVIRONMENTAL

- **13 August 2007**

Contents

Tables, Plates and Figures

Figures

1.1 Introduction

In conjunction with the Hinze Dam Stage 3 Upgrade Project, the Hinze Dam Alliance (HDA) prepared a draft environmental impact statement (EIS). The Queensland Environmental Protection Agency (EPA) reviewed and issued comments on the EIS. This report endeavours to clarify the issues raised in the EPA's comments, particularly regarding surface water management for the rock quarry and the clay borrow area for the project.

1.2 Storm Water Management

1.2.1 Surface Contours to Control Surface Flow

Rock Quarry

The existing topography around the rock quarry area indicates that it is nearly a closed system, with virtually all parts of this catchment area draining into the previous quarry excavations.

The haul road around the western perimeter of and leading into the quarry will be sloped away from the quarry. Surface drainage from this very small catchment area on the haul road will achieve adequate filtering through the natural vegetation to its west. As the road heads down hill to the southwest, the slope of the road will direct surface flow into the quarry area. All other quarry access roads drain into the quarry.

The base profile of each rock quarry pit will slope, generally, toward the east and toward the reservoir. The quarry access track traverses the southern and eastern perimeters of the quarry will act as an embankment to prevent water discharge directly to the reservoir. At the lowest points of the quarry and adjacent to up-gradient (west) side of the access road, a sediment basin excavated in the quarry floor will capture surface flow. A primary spillway outlet (refer to details in Figures 2 and 4) constructed in the floor of the basin will allow settlement of sediments and slow controlled discharge of collected waters. The treated water will discharge directly into the reservoir. An additional contingency measure will include a secondary filter (silt curtain) around the lower Hinze Dam intake structure to reduce the potential for adverse impact on the water supply from the dam.

Figures 1 and 2 illustrates the present surface profile of the rock quarry and approximate locations of the associated haul roads and sediment basins within the quarry. The configurations of the sediment basins are tabulated in Tables 1, 2 and 3.

Clay Borrow Area

The clay borrow catchment area will be developed as a closed system, with virtually all parts of this catchment draining into either of two sediment dams excavated into the floor of the borrow pit. Drainage in the borrow pit will be separated into two distinct sub-catchments. Drainage from haul roads across the clay borrow area will drain directly into the clay borrow pit and be contained in the two dedicated sediment dams.

The base of the clay borrow pit will slope, generally, to the northeast of each respective borrow pit sub-catchment. In the northeast corner of each borrow pit, an excavated sediment basin in the pit floor will collect surface water runoff from the borrow area catchment. Surface drains shaped across the pit floor will direct flow to the sediment basins. A primary spillway constructed into the base of each sediment basin will regulate the containment and release of collected storm water. Dispersive and / or colloidal soils are anticipated within this catchment; and thus, collected waters will require flocculation prior to disposal. After treating the storm water to prescribed water quality criteria (refer

EIS and Supplement), the water will be reused on the site for dust suppression, soil conditioning or other suitable purposes, or will be discharged to the unnamed natural drainage gully east of the clay borrow area.

Figure 3 illustrates the preliminary geometry of the clay borrow pit and the locations of the sediment basins within the borrow pit.

1.2.2 Sedimentation Basins

The planned sediment basins generally function as the final treatment mechanism for sediment removal from storm water prior to discharge of that water as "clean" to a waterway that requires no further treatment. Illustrations of a typical sediment basin are presented in Figures 4 and 5. For this project sediment basins have been planned using Brisbane City Council guidelines, as there are no comparable guidelines specific to the Gold Coast region recommended by Gold Coast City Council.

Brisbane City Council (BCC) sediment basin design guidelines present two types sediment basins, being dry (Type C) and wet (Types D and F). The "C" designation indicates that the basin is primarily designed to capture sediments from coarse soils with less than 33% of soil particles smaller than 0.02 mm. The alternative Type "D" and "F" basins are applicable for dispersive soils or fine-grained soils, respectively where the catchment surfaces have more than 33% of soil particles smaller than 0.02 mm or more than 10% of surface soils containing dispersive soils.

Geotechnical information in the vicinity of the clay borrow area indicates that the percentage of soil particles finer than 0.002 mm is greater than 33%; thus, sediment basins are designed as Type F basins. Soils associated with the quarry areas to the southwest of the dam wall are coarse-grained soils (primarily crusher dust from rock quarrying), and the design of quarry area basins will is in accordance with Type C sediment basin guidelines. For this preliminary design stage, design information generated for sizing sediment basins generally conforms to Type F sediment basins, giving a conservative size to Type C basins. A summary of relevant basin design data is presented in the following table.

Table 1: Sediment Basin Configuration Data

Sed Dam (SD)	Accum Area (ha)	Settling Zone Volume, m^3 (V_s) Types F&D	Sediment Storage Volume, m^3 (V_{st}) Types F&D	Total Storage Volume, m^3 (V_T) Types F&D	Total Storage with 0.75m Freeboard, m^3 (V_{TFB}) Types F&D	Top Width (m)	Top Length (m)	Total Depth to Basin Crest (m)	Basin Foot-print (m^2)
18	13.	3,933	1,966	5,899	8,265	32.9	96.4	2.9	4,821
19	5.6	1,694	847	2,541	4,316	26.7	77.7	2.35	3,306
21	4.1	1,325	663	1,988	3,621	24.5	74.5	2.25	2,975
25	3.5	1,063	532	1,595	2,394	18	56	3	2,040
26	4.2	1,265	633	1,898	2,763	20	57	3	2,208

Design criteria are a 1-year, 24-hour recurrence interval storm and a rainfall intensity of 6.09 mm / hour for that storm.

The design information indicates the preferred theoretical size of each sediment basin for the represented catchment area; however, topographic features in some areas may inhibit the practical construction of such structures to the exact dimensions. In such cases, a basin of the greatest practical capacity that fits into the available area will be constructed.

Design guideline recommendations for each basin are:

- Sediment storage capacity equal to the rainfall of the 1-year, 24-hour design storm over the respective catchment;
- Settling zone equal to at least half the sediment storage capacity, and with a minimum depth of 0.6 metres;
- Metal standpipe and primary discharge spillway with its crest at the top of the settling zone (0.6 metres above the sediment storage zone);
- Minimum vertical separation from the crest of the primary flow outlet to the crest of the emergency spillway of 0.3 metres; and,
- Emergency overflow spillway to manage a 100-year ARI storm[1]; and a freeboard depth of at least 0.75 metres above the crest of the overflow spillway.

[1] BCC sediment control guidelines dictate a 100-year ARI storm. The duration is not indicated in the guideline, so a duration of 24-hours is assumed.

Other design features of the basins include:

- The basin embankment crest width should be at least three metres for ease of maintenance by heavy machinery; and,
- Maximum internal and external side batters of the basin embankment shaped at a slope of 1 (horizontal) to 2 (vertical).

The aforementioned design features are represented in the sediment basin design details of Figures 4 and 5.

1.2.3 Spillways

Each sediment basin will include a primary outlet to release treated water to the environment in a controlled manner. For each basin, the primary spillway will comprise a concrete base, steel riser and steel discharge from the riser. The effluent end of each discharge pipe will be armoured with rock scour protection. The primary outlet will pass and filter normal storm water flows, and will have limited effectiveness for storms events exceeding the design capacity of the outlets. For large storms, emergency spillways will be provided to ensure that flows can pass through the basins and maintain the integrity of the basin embankment and structures.

Emergency spillways will be excavated through in natural ground where practical. In some cases, this will not be practical, and emergency spillways will need to be constructed over fill with significant armour protection against scour provided by geotextile overlaid by crushed aggregate and / or rock-filled mattresses. Energy dissipation (rock-filled gabions) and scour protection (rock-filled mattresses) will also be required at the toe of each emergency spillway.

Primary Outlet

The primary outlet (discharge structure) for each sediment basin will comprise a vertically-oriented steel pipe (riser) set in a concrete base with an outlet pipe oriented at approximately 90 degrees through the base of the vertical pipe and resting on top of the concrete base. The top of the concrete base will be approximately flush with the floor of the sediment basin. The top of the riser will be at the level equivalent to the calculated depth of sediment storage and design storm depth. This total depth varies between sediment basins.

The outlet pipe will extend through the basin embankment and discharge to the nearest open drainage feature. The discharge pipe will have at least one seepage collar installed along the pipe's length. Energy dissipation, in the form of rock-filled gabions, geotextile fabric and loose rock, will be required at the outlet end of each discharge pipe. The following table summarises the anticipated dimensions of sediment basin outlet structures. Illustrations of typical primary spillway outlets are presented in Figures 4 and 5.

Table2: Primary Outlet Configuration Data

Sed Dam (SD)	Standpipe Height, m	Sed Storage Depth, m	Standpipe Diameter, m	Concrete Base Horizontal Dimensions, W = L = Pipe dia (m) + 1m	Concrete Base Thickness *, m	Primary Spillway Outlet Dia, m
18	2.15	1.5	1.50	2.50	0.50	1.200
19	1.60	1.0	1.20	2.20	0.30	0.900
21	1.50	0.9	0.90	1.90	0.20	0.600
25	2.25	??	0.90	1.90	0.30	0.600
26	2.25	??	0.90	1.90	0.30	0.600

* The concrete base horizontal dimensions and thickness are based on overcoming buoyancy of the riser when the basin is full to the top of the riser.

Actual topographic conditions of the site might render installation of riser pipe and outlet pipe structures impractical. In such cases, field adjustments will be required to best adapt sediment basins to the topographic features at each site. The important aspects for such adjustments will be to ensure that the required total storage, sediment storage and preferred basin length are maintained.

Primary Outlets for Type C "Dry" Basins

An exception to the configuration of primary outlets applies to the Type C (dry) basins in the rock quarry area. Whilst sediment basins at most other areas of the site (Types D and F) will hold water for gravitational or induced (flocculant) settlement of sediments on a long-term basis, the design of primary outlets for Type C basins allows water to slowly and continuously discharge from the storage area of the basin until the basin is empty.

The vertical riser section of Type C basin outlets includes rows of perforations from the top of the riser to required depth of sediment storage and crushed rock surrounding the exterior of the riser from the riser's base to just below its crest. Figures 4 and 5 presents a illustration of a typical Type C basin primary spillway riser.

Emergency Spillway

The emergency spillway for each sediment basin will comprise a broad-crested weir and discharge channel. The crest of each weir will be at a level of at least 0.3 metres above the crest of the riser pipe on the primary outlet. The depth of flow from the crest of the weir to the crest of the basin embankment will be at least 0.75 metres. Design guidelines also dictate that a 100-year, 24-hour ARI storm event be used for the hydraulic design capacity if the useful life of the basin is expected to exceed twelve months. Each of the sediment basins presented in this section are expected to have a useful life of more than 12 months; thus the 100-year, 24-hour ARI storm event was chosen as the design storm. The rainfall intensity of the design storm is estimated as 18.3 mm/hr. Illustrations of typical emergency spillways are presented in Figure 4 and 5. The following table summarises design configuration data of an emergency spillway for each basin.

Table 3 Emergency Spillway Configuration Data

Sed Dam (SD)	Accumulative Area (ha)	C_{100}	Peak Discharge, Q (m^3/sec)	Crest Width, m	Flow Depth, m	Outflow Velocity, m/s
18	12.916	0.95	0.62	1.0	0.27	2.3
19	5.564	0.95	0.27	1.0	0.18	1.8
21	4.145	0.94	0.20	1.0	0.16	1.6
25	3.492	0.95	0.17	1.0	0.15	1.6
26	4.156	0.95	0.20	1.0	0.16	1.6

To the extent practical, the emergency spillways should be excavated through natural ground in favour of constructing them over fill. If construction of the spillway on fill cannot be practically avoided, the construction of the spillway channel rock armour will be a critical feature to protect the integrity of the basin for large storm events.

Sediment Basin Baffles

The actual orientation of each sediment basin and the orientation of inlet arrangements for each basin are presently not defined in detail. Dependent on the final design arrangement of basins to suit ground topography at each basin site, inlet drains / channels, and baffles may be required to increase the effective flow distance of water from and the inlet to the discharge point of each basin. Baffles will typically be constructed of pickets / posts and silt fence fabric and should cover a depth from the sediment basin floor to the crest of the emergency spillway.

1.2.4 Performance Criteria

To the extent practical, performance criteria for discharges of water from sediment basins include:

Sediment basins on the Hinze Dam upgrade project endeavour to control the discharge of sediment from the site of the works such that runoff leaving the site into downstream receiving waters does not detrimentally impact the quality of receiving waters. The criterion will be that the turbidity readings of at least 80% of all water quality monitoring results (80^{th} percentile) are less than the turbidity water quality objective defined by the EIS.

The turbidity of reservoir water drawn into the intake towers should meet Gold Coast City Council (GCCC)'s requirements for treatable maximum turbidity limits acceptable at the Molendinar and Mudgeeraba water treatment plants. The EIS will define turbidity criteria for the bulk water supply to the water treatment plants. Additional criteria may apply for reservoir water quality for the protection of aquatic fauna in the reservoir.

1.2.5 Monitoring Requirements

Assessing the discharge from sediment basins will indicate the effectiveness of the basins to reduce turbidity and sediment load from surface runoff. The Hinze Dam Alliance will monitor each of the sediment basins in the rock quarry and clay borrow area in accordance procedures in Table 4:

Table 4 - Sediment Basin Outlet Monitoring

COMPLIANCE REQUIREMENTS	• Environmental Protection (water) Policy 1997 • Gold Coast Water (GCW) guidelines for water intake quality at Molendinar water treatment plant.
OBJECTIVES	Reduce the potential for: • "clean" surface water mixing with "dirty" surface water; • erosion; • unauthorised release of sediment from the site.; and Achieve compliance with water quality objectives defined by the EIS in at least 80% (80th percentile) of all surface water quality monitoring results for turbidity.
SCOPE	Design, construct, operate and maintain water quality management features that achieve compliance with the objectives of this procedure.
CONTROL MEASURES / MANAGEMENT STRATEGY	■ Diversion bunds and/or drains to limit off-site stormwater flowing across rock quarry and clay borrow areas. ■ Clean stormwater diverted around the areas; ■ Stormwater collected within the rock quarry and clay borrow areas, and where applicable, diverted into sediment basins (e.g. in the quarry site) for treatment and reuse or treatment and discharge; ■ Revegetation of areas impacted by quarrying / borrow activities, as is practical; ■ Velocity of stormwater flow within the quarrying / borrow area reduced by using energy dissipation techniques; ■ Sediment basins may require regular maintenance to maintain effective capacity. Sediment removed from sediment basins will be dewatered on site and used as construction fill material. **Catchment Management** ■ Water Quality Monitoring performed by qualified personnel.
PERFORMANCE INDICATORS	• Surface water quality as measured near the inlet points of sediment basins. • Surface water quality, as measured by results of water sample analysis in nearest receiving water. • Surface water quality (turbidity and TDS), as measured by results of water sample analysis at discharge end of primary outlet structures. • Surface water quality, as measured by results of water sample analysis in the nearest receiving waters.
RESPONSIBLE PARTIES	Hinze Dam Alliance (HDA) Project Manager (PM): • Overall implementation of surface water components of the construction environmental management plan (CEMP); • Authorise all works necessary for successful implementation and operation of the CEMP; • Provide adequate resources to implement control measures and management strategies. HDA Environmental Manager (EM): • Provide qualified environmental personnel to conduct environmental sampling, analysis assessment, reporting and auditing; • Provide qualified environmental personnel to oversee design, construction, operation and maintenance of environmental controls of the CEMP within the quarrying / borrow areas; • Assist HDA Construction Manager with planning and implementation of CEMP control measures and management strategies. HDA Construction Manager (CM) • Manage available resources to successfully construct, maintain and operate required controls of the CEMP • Assist HDA Environmental Manager with planning of implementation of CEMP control measures and management strategies.

MONITORING / MONITORING FREQUENCY	• CM and EM to visually inspect erosion and sediment controls during (if safe and practical) and as soon as is safe and practical after rainfall events that cause or are likely to cause a discharge from the sediment basins, to assess the condition and effectiveness of mitigation measures.
	• CM and EM to visually inspect erosion and sediment controls on a daily basis (if safe and practical) during extended rain events (rain events that are continuous or frequently intermittent for periods greater than 24 hours, e.g. 10mm/day).
	• CM and EM to visually inspect surface water management features on a two-weekly basis during periods without rain events.
	• To the extent practical, collect water quality samples from each sediment basin from which a discharge occurs and analyse the samples for pH and turbidity.
	  • Prior to treatment (flocculation), where such treatment is required, to assist in determining flocculant dosing,
	  • After treatment to validate success or otherwise of treatment, but before discharge of the treated water,
	  • Daily during uncontrolled discharge (overflow) due to storm events exceeding the primary outlet flow capacity.

REVIEW / AUDITING & REPORTING	• CM to report any actual or impending failure / non-compliance of the surface water management controls to the EM as soon as is practical after identification of such a failure / non-compliance. • CM to report surface water management operational and maintenance activities on a regular periodic basis to the EM, and as otherwise necessary to achieve the objectives of this procedure. • CM and EM to review effectiveness of surface water management control features on an as-needed basis (at least monthly recommended). • EM to review effectiveness of this procedure annually, or as necessary to achieve the objectives of this procedure. Recommended modifications to the procedure shall be reported in periodic reports to administering authorities (e.g. – EPA, GCW) and implemented at the site, as necessary, to achieve compliance. • PM to ensure relevant erosion and sediment control activities are included in periodic reports to the administering authorities.
CORRECTIVE ACTIONS	• Order complete or partial cessation of work, as necessary, to reduce, stop or prevent an actual or impending non-compliant or otherwise unauthorised discharge resulting from that work. • Modify, repair or add new erosion and sediment controls per site inspections and as necessary to improve erosion and sediment control to achieve compliance with this procedure. • Revise this procedure as necessary to achieve compliance with relevant requirements. • Provide staff training as necessary to ensure competency with implementing this procedure.

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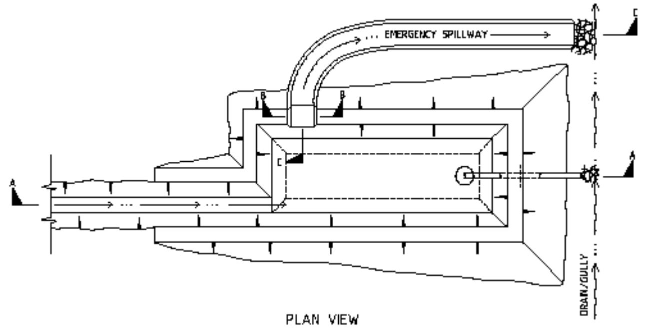
NOTE A:
DIMENSIONS OF PRIMARY SPILLWAY ARE LISTED IN TABLE 2



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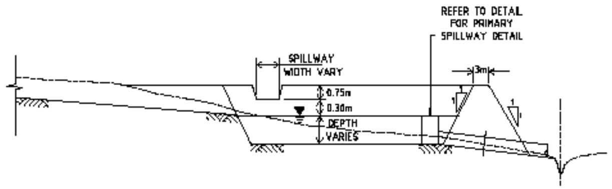

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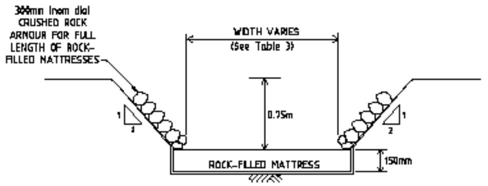

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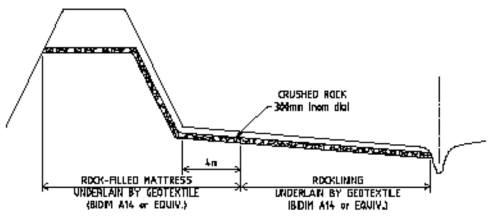

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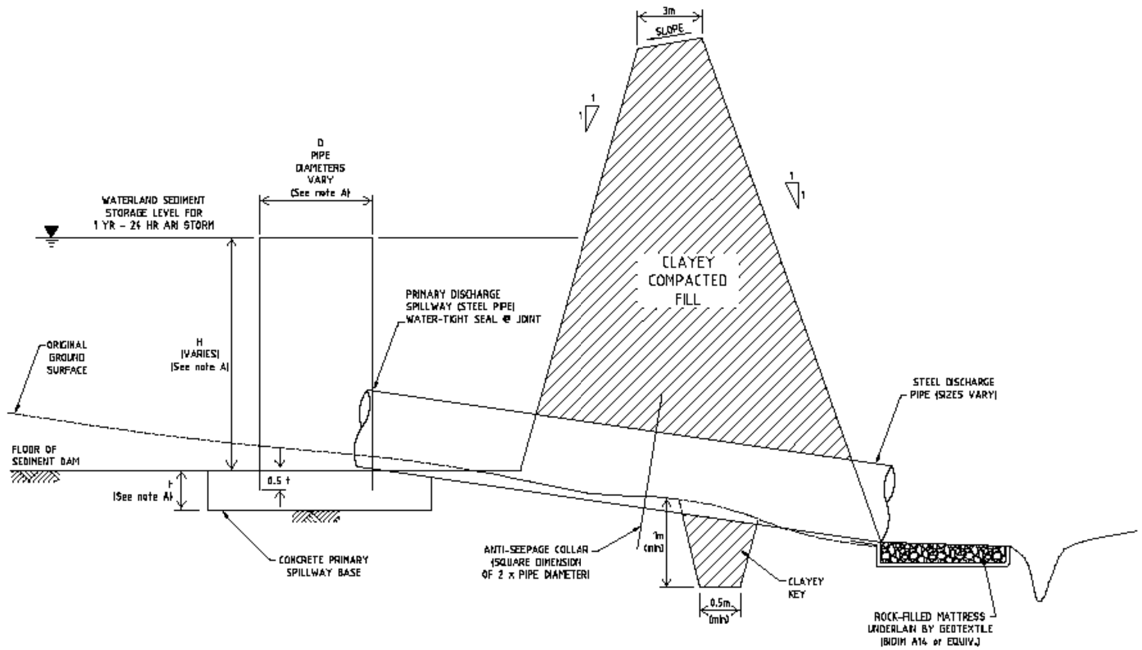

WET BASIN PRIMARY SPILLWAY DETAIL
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Designed	NH
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Scales	AS SHOWN

Rev | By | Appd | Date | REVISION RECORD

Client: Gold Coast City Council

Project Title: HINZE DAM STAGE 3

Drawing Title: TYPICAL SEDIMENT BASIN (WET BASIN)

Status: PRELIMINARY

Datum: GDA94 ZONE 56 AHD

Date: 1/5/07

CAD File Number: ESC-001-2.DWG

Job Number: 42626000

Drawing Number: FIGURE 5

Rev: A

Hinze Dam Alliance

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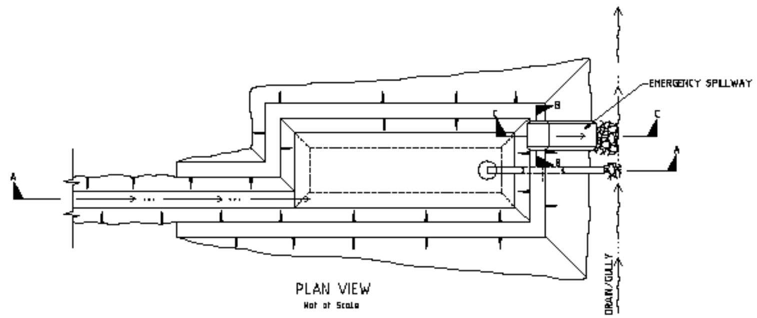
NOTE A:
DIMENSIONS OF PRIMARY SPILLWAY
ARE LISTED IN TABLE 2



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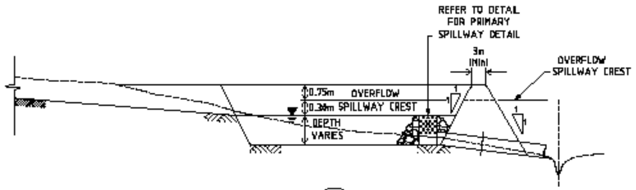

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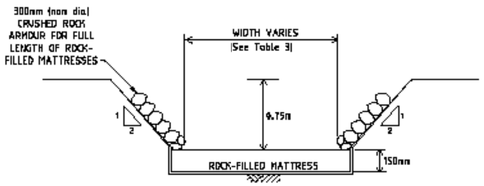

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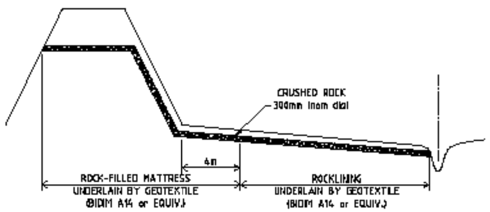

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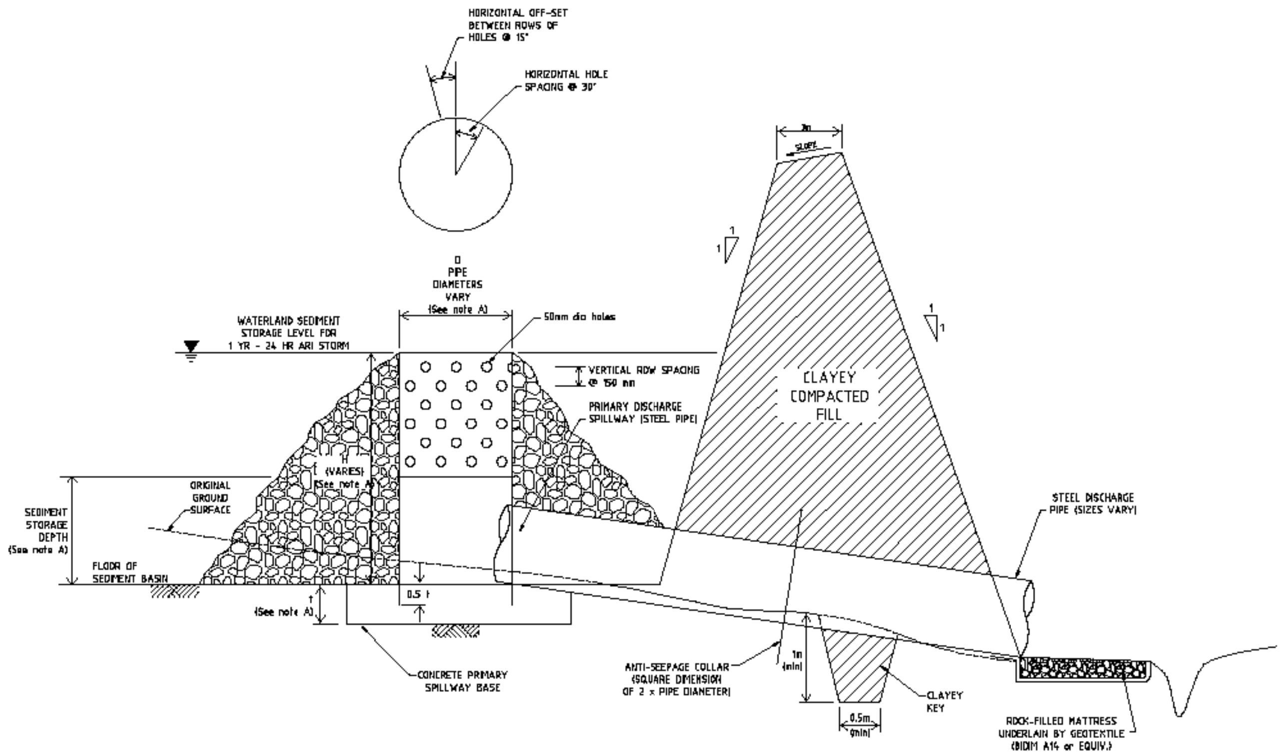

DRY BASIN
PRIMARY SPILLWAY
DETAIL
Not to Scale

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Scales	AS SHOWN

Client: Gold Coast City Council

Project Title: HINZE DAM STAGE 3

Drawing Title: TYPICAL SEDIMENT BASIN (DRY BASIN)

Status	PRELIMINARY
Datum	GDA94 ZONE 56 AHD
Date	1/5/07
CAD File Number	ESC-001-2.DWG
Job Number	42626000
Drawing Number	FIGURE 4
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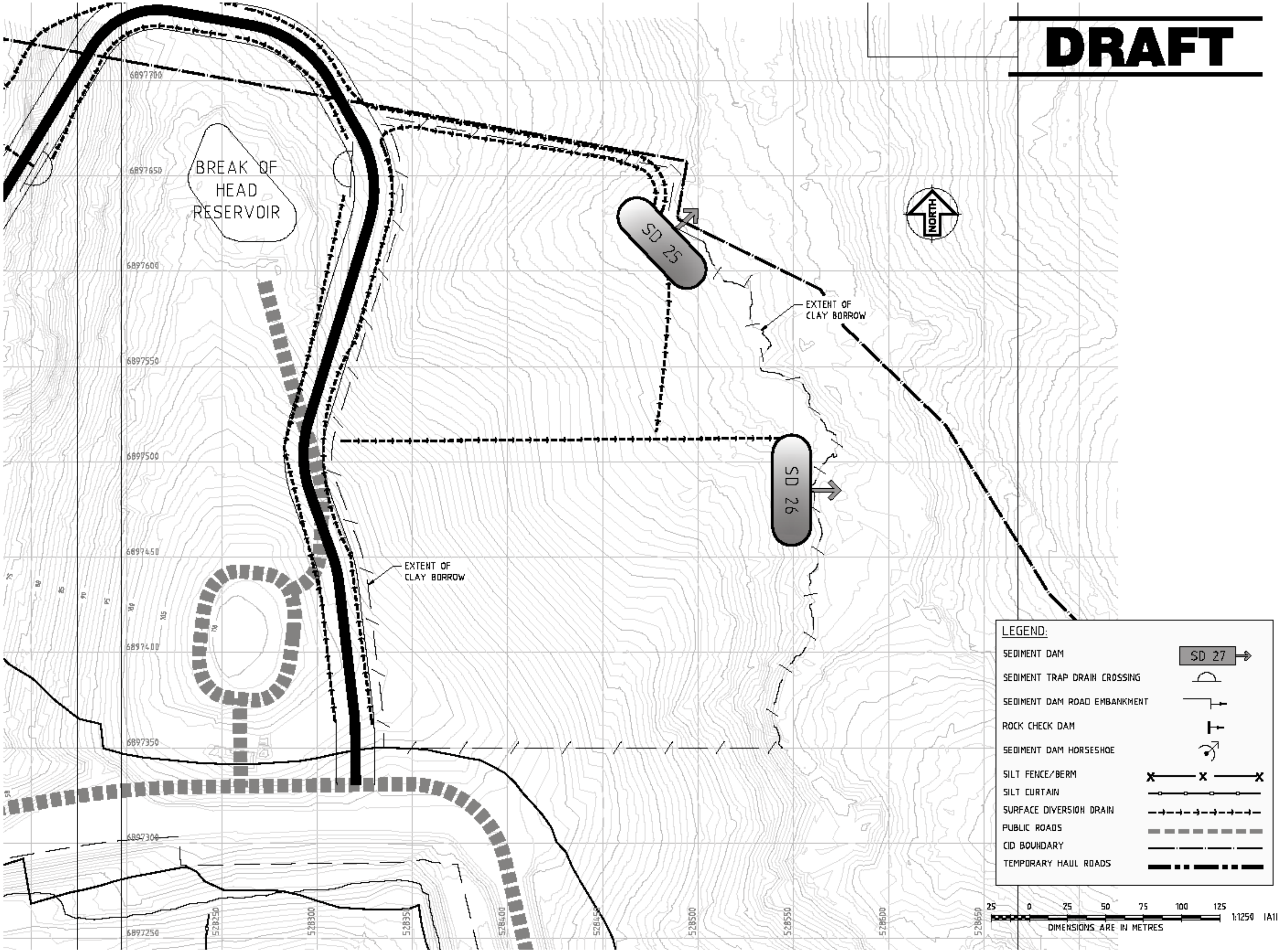

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Scales: AS SHOWN

Client: Gold Coast City Council

Project Title: HINZE DAM STAGE 3

Drawing Title: CLAY BURROW AREA SURFACE WATER MANAGEMENT

Status: PRELIMINARY

Datum: GDA94 ZONE 56 AHD

Date: 1/5/07

CAD File Number: ESC-001-2.DWG

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Drawing Number: FIGURE 3

Rev: A

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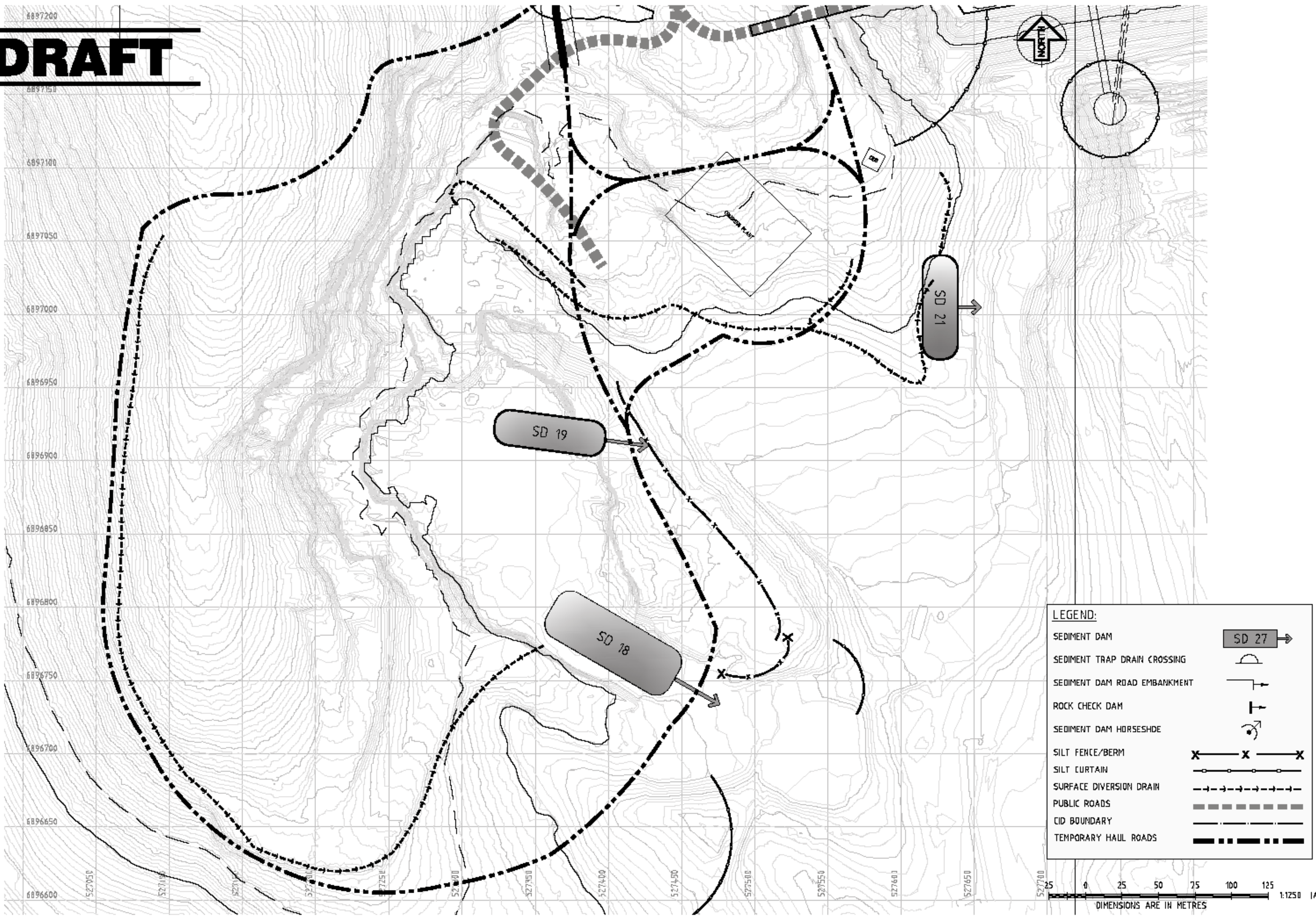

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Client: Gold Coast City Council

Project Title: HINZE DAM STAGE 3

Drawing Title: ROCK QUARRY SURFACE WATER MANAGEMENT

Status: PRELIMINARY

Datum: GDA94 ZONE 56 AHD

Date: 1/5/07

CAD File Number: ESC-001-2.DWG

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Rev: A

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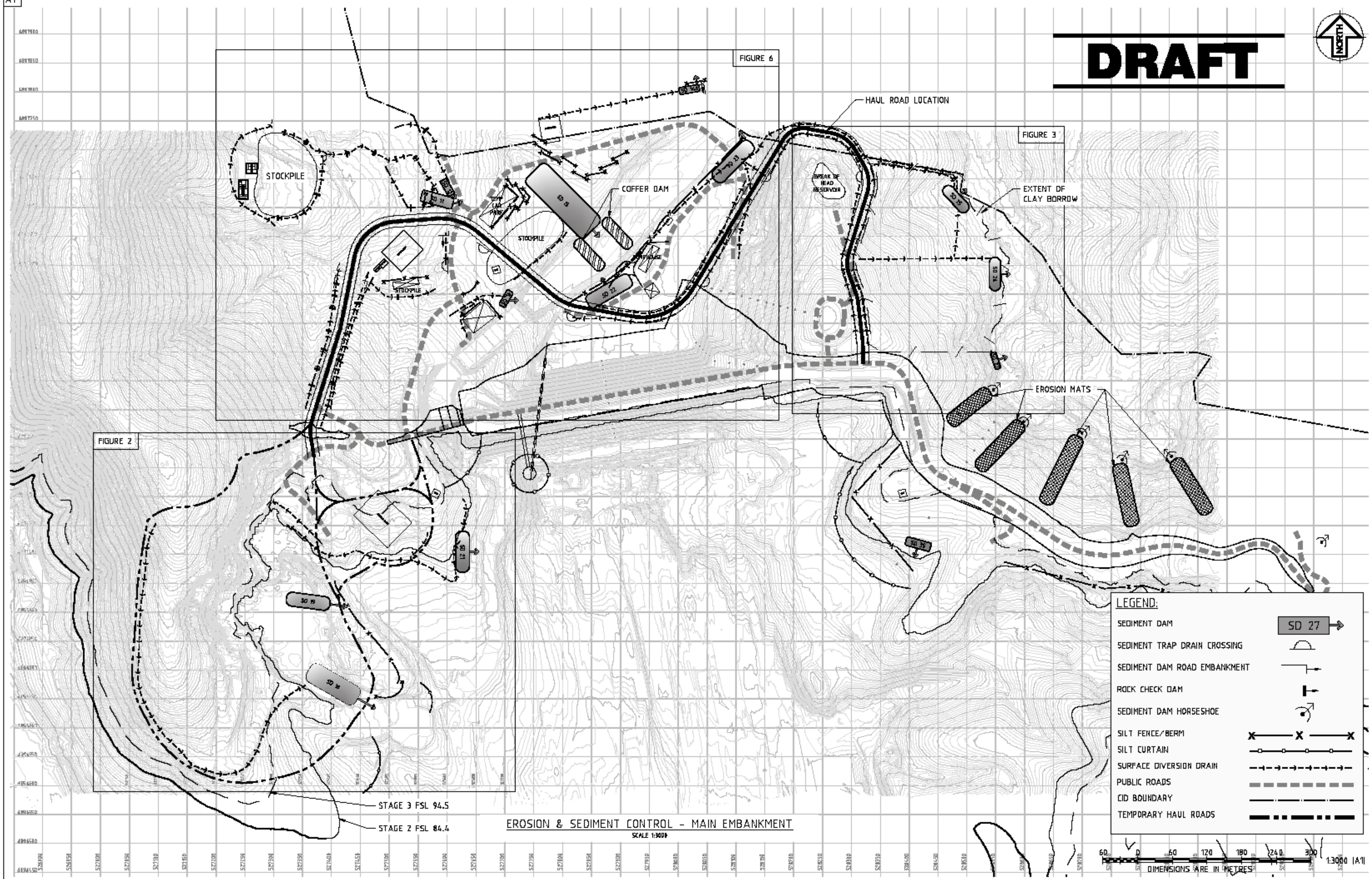

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Client: Gold Coast City Council

Project Title: HINZE DAM STAGE 3

Drawing Title: GENERAL ARRANGEMENT EROSION & SEDIMENT CONTROL AND SURFACE WATER MANAGEMENT

Status: PRELIMINARY

Datum: GDA94 ZONE 56 AHD

Date: 1/5/07

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Drawing Number: FIGURE 1

Rev: A

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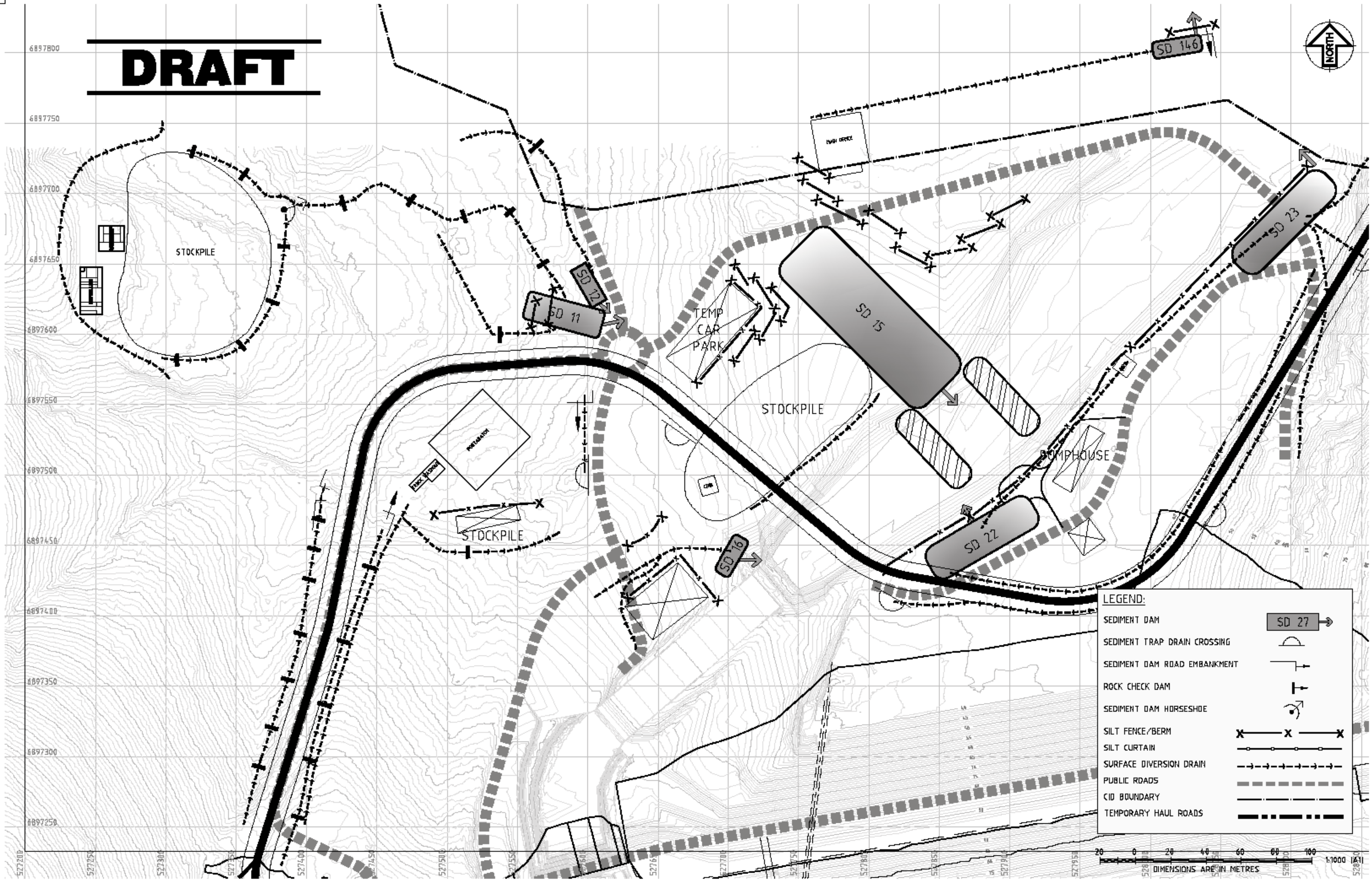

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Client: Gold Coast City Council

Project Title: HINZE DAM STAGE 3

Drawing Title: GENERAL ARRANGEMENT EROSION & SEDIMENT CONTROL

Status: PRELIMINARY

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Rev: A