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Water Cycle Management Strategy:

Concept Plan for the redevelopment of Lot 11 DP558723, Lot 1 DP400697 and Lot 2 DP262213 Eastern Creek, NSW.

ENVIRONMENTAL

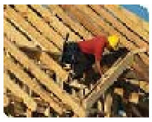
WATER

WASTEWATER

GEOTECHNICAL

CIVIL

PROJECT MANAGEMENT



P0601396JR05_v2 Final Report
October 2006

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Contents

1 INTRODUCTION ... 5
1.1 Overview 5
1.2 Development proposal 5
1.3 Project Scope 6
2 SITE CHARACTERISATION ... 7
2.1 Location and Site Description 7
2.2 Climate 7
2.3 Site Geology 8
2.4 Existing Surface Water Hydrology 9
2.4.1 Tributary of Ropes Creek and Stormwater Drainage Depression 9
3 WATER CYCLE ANALYSES ... 10
3.1 Current Water Supply and Demands 10
3.1.1 Supply 10
3.1.2 Demand 10
3.2 Projected Water Supply and Demand 11
3.2.1 Supply 11
3.2.2 Demand 11
3.3 Stormwater Recycling 11
3.3.1 Overview 11
3.3.2 Potential Stormwater Pollutants 12
3.3.3 Daily Water Balance Modelling 13
3.4 Capacity to Support Redevelopment Proposal 15
4 RECLAIMED STORMWATER RE-USE SCHEME – CONCEPT DESIGN ... 17
4.1 Operating Summary of Operations Flow Chart 17
4.2 Key Infrastructure Items 17
4.3 Management Plan 17
5 REFERENCES ... 18
6 ATTACHMENT A –SITE PLAN ... 19
7 ATTACHMENT B –RECYCLED STORMWATER SYSTEM CONCEPT DESIGN ... 21
8 ATTACHMENT C – MODELLING RESULTS ... 23

1 Introduction

1.1 Overview

This report provides a water cycle management strategy for the proposed redevelopment of the Hanson owned Eastern Creek Quarry industrial area. The redevelopment will result in the filling in of several current stormwater dams, construction of access roads, regrading, realignment of existing access roads and relocation of existing infrastructure.

Results presented in this assessment have been developed through a process of water balance modelling utilising local climate information and predicted water demands for industrial process to demonstrate that sufficient water supplies are already available at the site (i.e. there will be no additional demand on local services) and that the proposed development is sustainable and in accordance with best management practices.

Water Cycle Modelling works have been designed primarily to assess the following:

- Demonstrate that sufficient supply is available for the proposed development; and
- Demonstrate that water supply arrangements are ecologically sustainable and in accordance with the principles of water sensitive urban design (WSUD).

1.2 Development proposal

The proposed development relocates and restructures the current operation uses into a small, consolidated area and introduces more efficient industrial operational methods. The proposed redevelopment of the Eastern Creek Quarry is outlined in Table 1.

New activities forming part of the redevelopment include the Emulsion Plant and Concrete Masonry Plant. Part of the redevelopment also involves boundary adjustments and minor realignment of the existing internal roads. Preliminary layout concept plans are shown in Attachment A.

Table 1: Overview of proposed site redevelopment

Proposed Use	Indicative Land Area within each use is distributed (m^2)	Indicative Building and Plant Footprint (m^2)
Concrete Batching Plant	11,770	Office – 180 Workshop – 200 Fixed Plant Envelope – 3000
Office and Laboratory	5,600	2,000
Logistic Operation and Workshop	17,600	1,400
Concrete Recycling Plant	34,200	3,000
Asphalt and Emulsion Plant	37,000	Office and Lab – 300 Workshop – 700 Asphalt Plant – 7,000 Emulsion Plant – 2,000
Materials Storage and Transfer Depot	12,100	6,000
Concrete Masonry Plant	34,600	3,200

1.3 Project Scope

This report provides a water balance assessment and water cycle management strategy for the proposed development. The report examines the following:

- Current water supply and demand
- Projected water supply and demand
- Determination of water supply resources and constraints
- Water balance modelling for rainwater harvesting and re-use
- Determination of broad water cycle management operating principles.

2 Site Characterisation

2.1 Location and Site Description

The proposed redevelopment is located on Archbold Road and is situated within the Blacktown City Council local government area (LGA). The site is situated approximately 0.9 km north of Old Wallgrove Road and approximately 1.5 km south of the M4 motorway at Eastern Creek (Figure 1).

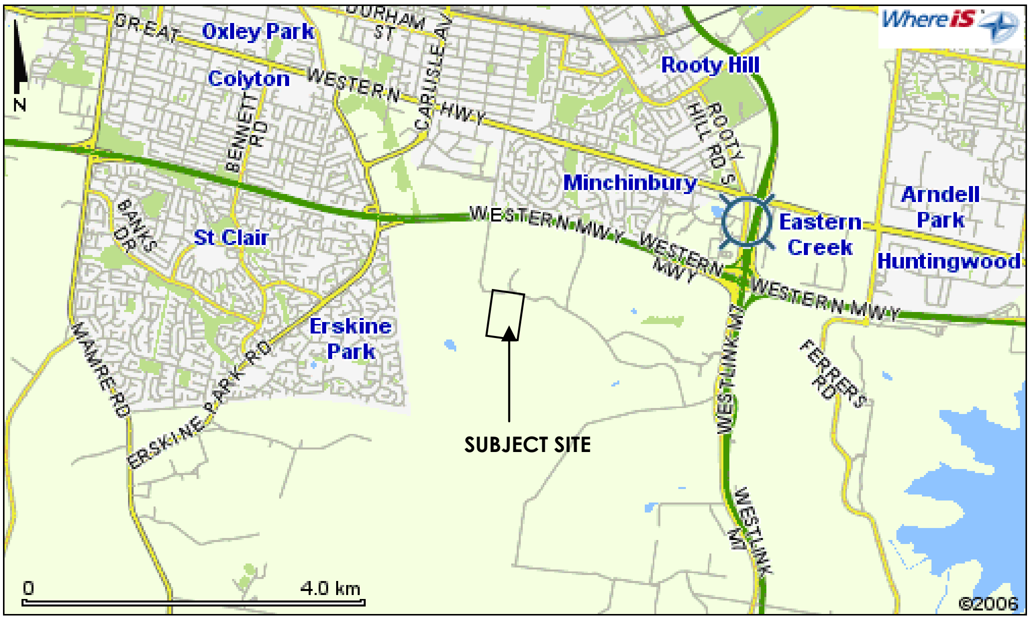


Figure 1: Location of subject site within the local context (www.whereis.com.au, 22/9/2006).

The site development proposal includes a boundary adjustment to Lot 11 DP 558723 and to include the relevant parts of the adjoining allotments Lot 1 DP 400697 and Lot 2 DP 262213. The new proposed lot is irregular in shape and has an area of approximately 27 hectares.

The site is characterised by mixed industrial operations, predominantly asphalt and concrete plants, and includes several areas for stockpiling of materials and plant machinery. A detailed site plan showing the proposed development plan is provided in Attachment A.

2.2 Climate

Climate data for the Quarry has been sourced from data supplied by the Bureau of Meteorology (2006).

Daily rainfall data was taken from Prospect Dam (station number 67019) approximately 3.5km south west of the site. Rainfall data indicates that the subject land experiences a mean annual rainfall of 871.0 mm (for the period 1995-2005). Rainfall is generally highest during the period from January to March (i.e. summer dominated), with mean monthly totals exceeding 90 mm per month over this period.

Evaporation data was also taken from the daily record at Prospect Dam station. Evaporation data indicates that mean site annual evaporation is 1392.1 mm. Potential evaporation is less than 100 mm/month during the period of April to August. Median evaporation exceeds median rainfall for the entire year.

Table 2: Summary of local evaporation and rainfall data for the period 1995-2005, Eastern Creek Quarry, NSW.

Month	**Median Precipitation (mm)**	**Median Evaporation (mm)**	**Moisture Balance[1] (mm) [Precip. - Evap.]**
January	110.9	172.5	-61.6
February	114.0	141.5	-27.5
March	91.0	127.4	-36.4
April	64.7	99.2	-34.5
May	93.1	66.4	26.7
June	34.0	50.4	-16.4
July	46.1	56.7	-10.6
August	43.7	87.6	-43.9
September	54.1	114.3	-60.2
October	72.2	147.4	-75.2
November	84.6	150.9	-66.3
December	62.6	177.8	-115.2
Total Average Mean	871.0	1392.1	-521.1

Note: [1] Precipitation data (1995 to 2005) obtained from Prospect Dam weather station [2] Evaporation data (1995 to 2005) obtained from Prospect Dam weather station Tocal AWS (67019). [3] Negative value indicates moisture deficit.

2.3 Site Geology

The Penrith 1:100,000 Geological Sheet 9030 (1991) describes the bedrock geology of the Rooty Hill region, including the site, as Bringelly Shale (Wianamatta Group, Liverpool Sub-group) with some sandstone beds and with alluvium gravel, sand, silt and clay buffering Eastern Creek.

The depth of soils across the site is variable due to the large amount of earthworks and regrading of the site over the past 40 plus years. The majority of the site is used for industrial operations which include large areas of stockpiles and plant machinery. The only natural soils unaffected by current and proposed site uses are located in the southern portion of the site surrounding the sedimentation ponds/dams (Attachment A).

2.4 Existing Surface Water Hydrology

2.4.1 Tributary of Ropes Creek and Stormwater Drainage Depression

Two waterways on the site have been previously identified in topographic mapping, recent site surveys and field investigations. The first is the upper tributary of Ropes Creek which starts from the catchment south of the site and flows from the property immediately to the south of the site and on to the south west corner of the site. The second waterway is a local stormwater drainage depression which flows from properties to the east, across the eastern edge of the site, into the south eastern corner of the site and into one of the site's sedimentation ponds/dams. Flows form the upper portion of the site also flow into this pond/dam. The flow then spills out via three (3) further detention ponds to the upper tributary of Ropes Creek in the south western corner of the site.

The upper tributary then passes to the west across a small portion of the site leaving it to the west approximately 40m from the site's south western corner.

3 Water Cycle Analyses

3.1 Current Water Supply and Demands

3.1.1 Supply

Current operations include the purchase of on average between 60-80 KL/day of water from Sydney Water and some stormwater recycling on site. Current operations have and allowance of up to 200KL/day from Sydney Water. However, actual demand fluctuates considerably on a daily basis depending on the following:

- Product demand
- Weather conditions (e.g. during wet weather no concrete production)
- Staff availability (e.g. Public holidays and staff rosters)

3.1.2 Demand

Table 3 outlines current water demands for the site according to activity. Estimations are based on advice from Hanson staff and review of Sydney Water accounts.

Table 3: Current water demand

Activity	Sydney Water Supply (KL/day)	Recycled Stormwater Supply (KL/day) [2]
Concrete Recycling	7	40
Materials Storage	4.5	4.5
Logistics and Workshop	16	9
Asphalt Plant	2	0
Concrete Plant	22	16
Dust Suppression	-	7
Toilets/Kitchens/Showers	4.8[1]	-
SUB-TOTALS	**61.3**	**76.5**
TOTALS	**137.8**	

NOTES: [1] Based on an average figure of 45 L/staff/day for 150 permanent staff over five days per week. [2] Proportion supplied is an estimate only and dependent on rainfall and available supply.

3.2 Projected Water Supply and Demand

3.2.1 Supply

Whilst the development application involves considerable relocation of existing works and some new activities, existing water servicing arrangements, including the purchase of on average between 60-80 KL/day of water from Sydney Water and stormwater recycling on site will remain relatively unchanged. Further to this, it is intended to improve the level of current stormwater treatment such that it can also be used in a broader range of industrial purposes.

3.2.2 Demand

Projected water demands are determined for each of the proposed site activities. Table 4 outlines predicted demands. This indicates that site demand increases from 192.75 KL/day to 235.20 KL/day.

Table 4: Predicted water demand

Activity	Average Demand (KL/day)
Concrete Recycling	54
Materials Storage	16
Logistics and Workshop (includes truck washing)	29
Asphalt Plant	2
Concrete Plant	42
Emulsion Plant	4
Concrete Masonry Plant	7
Dust Suppression	6.5
Office and Laboratory	2
Toilets/Kitchens/Showers[1]	6.5
TOTAL	**169**

NOTES: [1] Based on an average figure of 45 L/staff/day for 200 permanent staff over five days per week.

3.3 Stormwater Recycling

3.3.1 Overview

Following site regarding it will be possible to capture and treat the majority of stormwater runoff from the site. This water will include all roof water, surface water runoff from stockpile areas and hard stand areas.

Prior to flowing into the sedimentation dam/basin the water will be treated using an appropriately sized Hume*ceptor*. The water will then pass through the sedimentation dam/basin enabling further settling of suspended solids. A pump and filter will be located at the end of the basin which will pump treated stormwater to two header tanks strategically located on the site to allow recycled stormwater to be used. Attachment B illustrates the proposed water cycle to be used on the site.

3.3.1.1 Stormwater Catchments

The site has been partitioned into eight (8) stormwater sub-catchments for the purpose of evaluating stormwater capture, detention and recycling opportunities. Of the eight catchments, six (6) will drain directly into the new sedimentation pond/basin. Sub-catchments are located in Attachment A and described in Table 5.

Table 5: Stormwater sub-catchments used in water cycle analysis.

Catchment	Proposed Land-Use	Area (Ha)	Stormwater Re-used
C1	Asphalt Plant Emulsion Plant	3.95	Yes
C2	Main Access Road Area set aside for future expansion (North of site)	2.06	Yes
C3	Internal Access Roads Vacant land	1.58	Yes
C4	Concrete Recycling Plant Materials Storage & Transfer Depot Office and Laboratory	5.23	Yes
C5	Concrete Plant Logistics Operation & Workshop Plant	2.94	Yes
C6	Concrete Masonry Plant	3.46	Yes
C7	Sedimentation Ponds	3.45	Yes
C8	Area South east of site	3.65	No
Total		**26.32**	

3.3.2 Potential Stormwater Pollutants

In order that stormwater can be utilised for purposes such as the concrete plant or the emulsion plant, high grade non-potable water is required. A detailed analysis of stormwater contaminants and treatment systems for the development is provided in the 'Concept Stormwater Management Strategy' by Martens and Associates REF:P0601396JR06_v1. A summary of potential pollutants and treatment mechanisms is provided in Table 6.

Table 6: Stormwater Pollutants and treatment systems by sub-catchment.

Catchment	Pollutant Source	Possible Pollutants	Proposed Treatment	Risk Level
C1	Access Road Run-off Raw Material Storage Plant Processes	Hydrocarbons, Oils, Suspended Solids, Dust	Humeceptor & Sedimentation Ponds	High
C2	Road Run-off	Hydrocarbons, Oils, Suspended Solids , Dust	Humeceptor & Sedimentation Ponds	High
C3	Road Run-off	Hydrocarbons, Oils, Suspended Solids , Dust	Humeceptor & Sedimentation Ponds	High
C4	Stockpiles Plant Processes	Suspended Solids, Dust	Humeceptor & Sedimentation Ponds	Mod
C5	Workshop Fuel Station Washdown Area Stockpiles Plant Processes	Hydrocarbons, Oils, Suspended Solids, Dust	Humeceptor & Sedimentation Ponds	High
C6	Stockpiles Plant Processes	Suspended Solids, Dust	Humeceptor & Sedimentation Ponds	Mod
C7	Storm Events High Flows	Suspended Solids , Dust	Sedimentation Ponds	Mod
C8	Storm Events High Flows	Suspended Solids, Dust	None	Low

NOTES: Risk Level – Low : Minimal or no treatment required prior to re-use.
Moderate : Minor treatment required prior to re-use.
High : High quality treatment required prior to re-use.

3.3.3 Daily Water Balance Modelling

3.3.3.1 Approach

A daily water balance (supply / demand) model (WatCycle 1.0) was utilised to evaluate stormwater harvesting potential from the site. Outcomes from the modelling were used to determine the quantum of stormwater re-use inundation on-site.

Modelling assumptions were as follows:

- Demand rates were based on data discussed in Section 3.2.2 adjusted to represent a daily average figure over a seven day week. The mean daily demand used in modelling was therefore 169KL/day.
- Approximate total impervious area of the site is 19 Ha.
- Approximate total pervious area of the site (all stockpiles) is 7 Ha.
- Water supply from Sydney Water was taken as 80KL/day. Therefore total demand from stormwater was 89 KL/day.

3.3.3.2 *Modelling Results*

Modelling was undertaken for a 53 year historical rainfall/evaporation period. Results of the modelling are provided in Attachment C with a summary provided in Table 7 below.

Table 7: Stormwater Harvesting Modelling Results

Dynamic Storage (KL)	Average Volume Harvested (KL/day)	% Security	Days with Zero Dynamic Storage
5000	68.3	87	47.6
6000	72.9	89.9	37
6500	74.6	90.9	33.2
6200	**73.6**	**90.3**	**35.3**

On the basis of the water balance modelling we recommend that 6200 KL of dynamic storage be provided at the stormwater treatment ponds for stormwater re-use within the site. This figure is based on 0.5 Ha of surface area with an average depth of 1.24m.

If 90.3 % security is provided, this means that on average the stormwater shortfall will be made up approximately 35.3 days per year. This would be provided by Sydney Water at an average rate of 8.61 KL/day (35.3 days/365 X 89 KL/day = 8.61 KL/day). Therefore the average Sydney water demand will increase from 80 KL/day to 88.61 KL/day.

3.3.3.3 *Allocation of Water Resources*

On the basis of the water balance modelling, we recommend that potable (Sydney Water) and non-potable resources be allocated roughly in accordance with Table 8 below.

Table 8: Allocation of Water Resources

Activity	Sydney Water Supply (KL/day)	Recycled Stormwater Supply (KL/day)
Concrete Recycling	3.5	50
Materials Storage	7	9
Logistics and Workshop (including truck washing)	7	21.5
Asphalt Plant	2	0
Concrete Plant	6	36
Dust Suppression	0	7.5
Toilets/Kitchens/Showers	6.5[1]	0
Emulsion Plant	1	3.5
Concrete Masonry Plant	1.5	5.5
Office and Laboratory	1.5	0
SUB-TOTALS	**36**	**133** [2]
TOTALS	**169**	

NOTES: [1] Based on an average figure of 45 L/staff/day for 200 permanent staff over five days per week. [2]Any recycled water shortfall will be made up by existing Sydney Water supply. We estimate this will average at 8.61KL/day.

3.4 Capacity to Support Redevelopment Proposal

Our investigations indicate that the existing water supply system, including utilisation of recycled stormwater, has sufficient capacity to supply water to the proposed development. In summary, our analyses show:

- The existing water demand will increase from 137.8KL to 169KL per work day.
- Projected Sydney Water demand will be 88.61 KL/day. This is considerably less than the 200KL supply to the site and slightly higher than the 80 KL/day used presently on average.
- Recycled stormwater will supply 80.39 KL/day. This is a sustainable resource and recycling is in accordance with current best management practices and water sensitive urban design.

We understand that the redevelopment intends to incorporate internal water conservation devices in the dwellings as part of the proposed development (e.g. dual flush toilets, aerated water faucets, low flow shower heads *etc*). These measures, coupled with the use of recycled stormwater for industrial processes will result in no increase in the current demand for potable water supply from Sydney Water.

4 Reclaimed Stormwater Re-use Scheme – Concept Design

4.1 Operating Summary of Operations Flow Chart

A concept design for the recycled stormwater scheme is provided in Attachment B. This shows relevant supply sources, storages, demands and treatment systems. Further detail will need to be provided at the CC stage to further develop and design the scheme.

4.2 Key Infrastructure Items

A list of key infrastructure items is provided in Table 9 below. Note that these are subject to detailed design at the CC stage.

Table 9: Key recycled stormwater infrastructure items

Item	Location - Sub Catchment	Description/ Preliminary Design
Humeceptor	C1 C7	Final size and location to be determined at CC Stage
Swales	C2 C3	Grass swales along main access road and internal road to Offices and Laboratory
Water Quality – Sedimentation Dam/Basin	C7	Storage Volume 4670 KL Operational Volume 6200 KL
Pump Set and Final Filter	C7	Pump set and filter to be determined at CC stage.
Header Tanks	C1 C5	Min Volume 30KL each. Located above ground at highest point on site. Actual final location and tank size to be determined at CC stage.

4.3 Management Plan

The stormwater re-use system will require an operations and management plan to be prepared prior to issuing of the CC. This should consider, as a recommended minimum (but not be limited to) the following matters:

1. Roles and responsibilities of each relevant party (eg. site management, site maintenance, council, service contractor *etc*).
2. Operation and maintenance of the reclaimed water re-use system including storages, reticulation network, Humeceptors, filters and necessary pumps.

3. Documentation of necessary infrastructure.
4. Documentation of contingency management / response measures.
5. Routine inspections, maintenance and emergency/breakdown protocols.

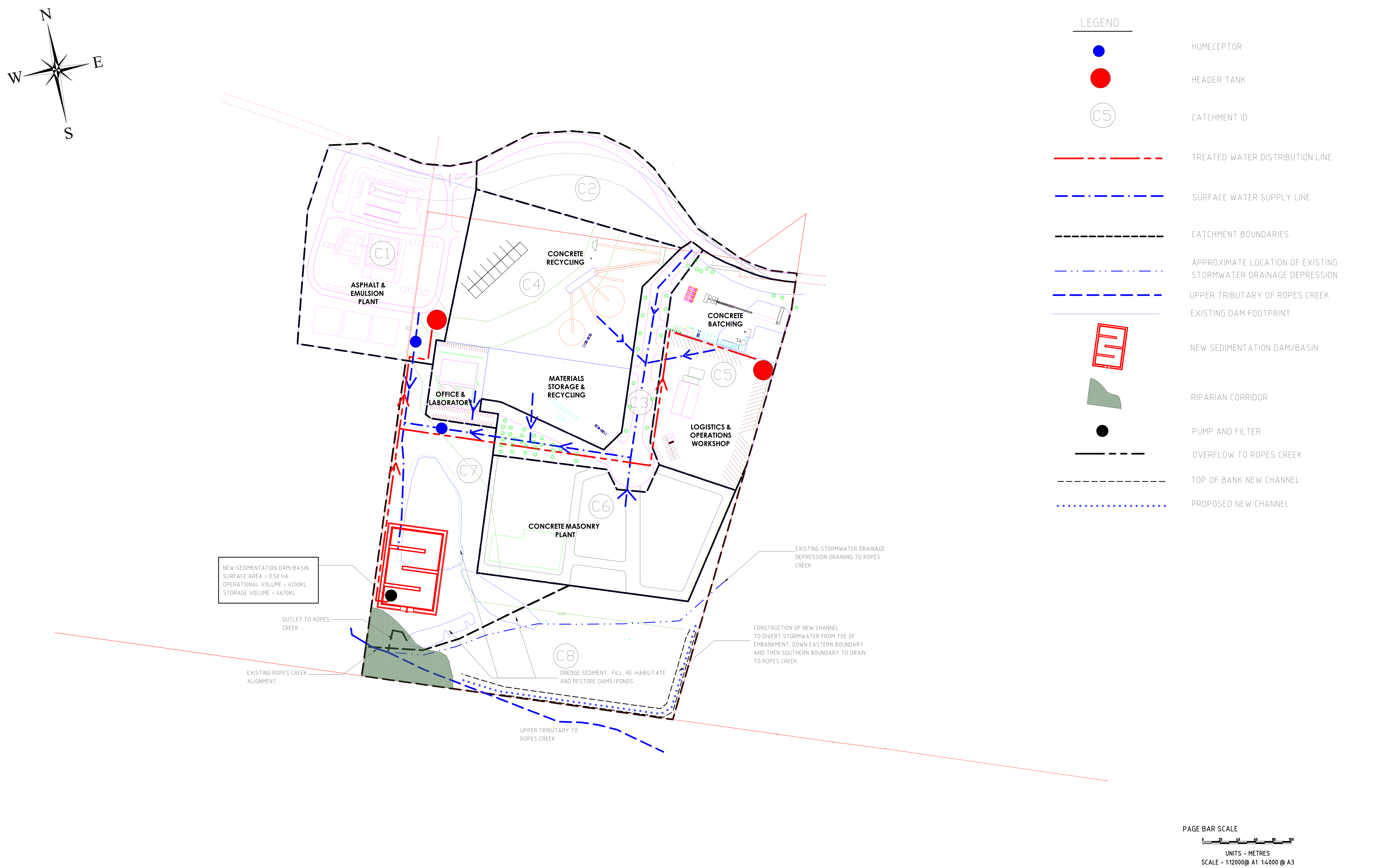
5 References

Bannerman S.M and Hazelton P.A (1990) *Soil Landscapes of the Penrith 1:100,000 Sheet*

Land and Property Information (2001) *NSW Topographic Maps - Prospect 9030-2-N*

The Institution of Engineers, Australia (1987) *Australian Rainfall and Runoff – A Guide tom Flood Estimation Volume 1 and 2*

6 Attachment A –Site Plan



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CLIENT/ PROJECT: HANSON CONSTRUCTION MATERIALS EASTERN CREEK QUARRY

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TITLE: WATER CYCLE - CONCEPT PLAN

PROJECT MANAGER: DR DANIEL MARTENS

DRAWING NUMBER: P0601396JD11_V1

DESIGNED: GT
DRAWN: GT
REVIEWED: DDM
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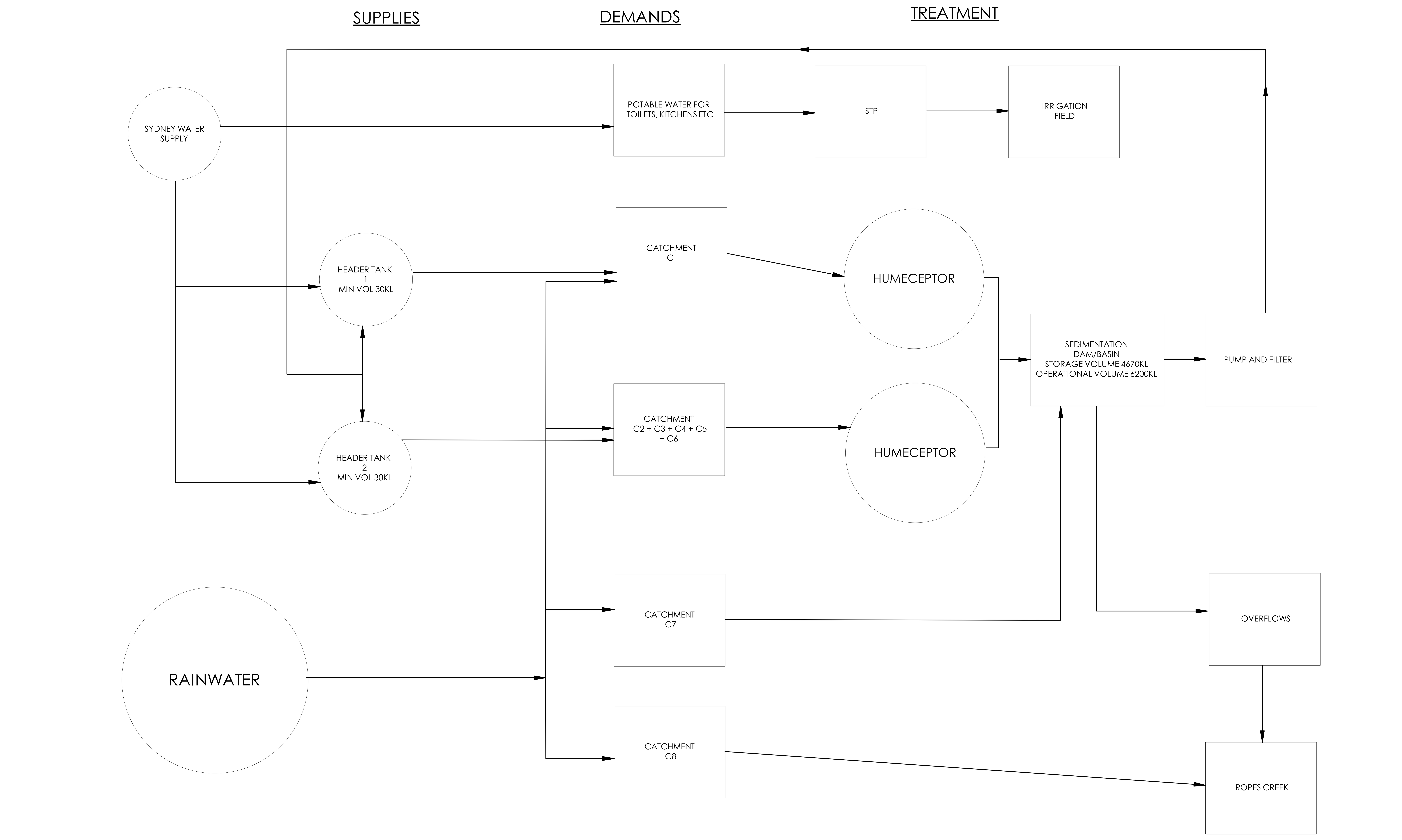
2.0	WATER CYCLE MANAGEMENT STRATEGY - FINAL REPORT	03.10.2006	GT

7 Attachment B –Recycled Stormwater System Concept Design



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TITLE: WATER CYCLE - CONCEPT DESIGN RECYCLED STORMWATER SCHEME

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8 Attachment C – Modelling Results

WATCYCLE - Water Balance Model - Control Panel

Run Complete

1. SUPPLY - RUNOFF FROM CATCHMENTS

	Impervious Areas	Pervious Areas
Area (ha)	19	7
Initial loss (mm/d)	1	10
On-going loss (mm/d)	0	3
TDS (mg/L)	250	300

2. SUPPLY - OTHER SOURCES

	Groundwater	Tanker	River	Rainfall
Rate (KL/d)		80		
Use if storage <				
TDS (mg/L)				

Effluent / Other Monthly Varying Input

TDS (mg/L)

COULD BE CONDITION

Month	Rate (KL/d)
Jan	
Feb	
Mar	
Apr	
May	
Jun	
Jul	
Aug	
Sep	
Oct	
Nov	
Dec	

3. STORAGE PROPERTIES

Area (ha)	Volume (KL)	Covered (Y/blank)	Initial Fraction Full	Pan E Factor	Seepage (m/d)	Initial TDS (mg/L)
0.5	5000		50%	60%	0.00020	1.0

4. DEMANDS

DEMAND 1 - SUPPLY

Month	Normal Rate (KL/d)	Drought A (KL/d)	Drought B (KL/d)
Use if storage <			
Jan	169		
Feb	169		
Mar	169		
Apr	169		
May	169		
Jun	169		
Jul	169		
Aug	169		
Sep	169		
Oct	169		
Nov	169		
Dec	169		

DEMAND 2 - IRRIGATION

Area (ha)

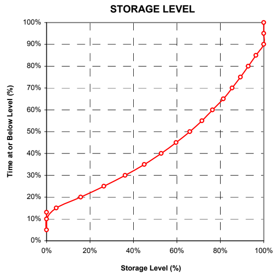
	Normal Irrigation	Drought A	Drought B
Use if storage <		50%	20%
Critical Rain (mm)	10	1	0.1
Critical Period (d)	7	7	7

Month	Crop Factor
Jan	0.85
Feb	0.80
Mar	0.65
Apr	0.55
May	0.45
Jun	0.40
Jul	0.40
Aug	0.45
Sep	0.55
Oct	0.65
Nov	0.80
Dec	0.85

WATCYCLE - Water Balance Model - Output

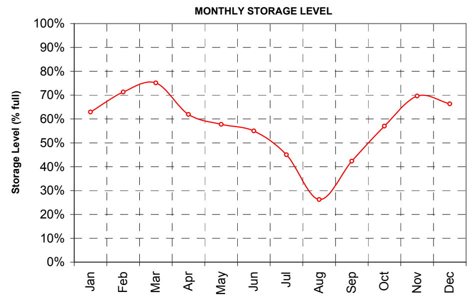
1. STORAGE SECURITY ANALYSIS

% Time	Level
13.0%	0.0%
5%	0.0%
10%	0.0%
15%	4.5%
20%	15.8%
25%	26.4%
30%	36.2%
35%	45.0%
40%	52.8%
45%	59.6%
50%	65.9%
55%	71.6%
60%	76.4%
65%	81.4%
70%	85.4%
75%	89.2%
80%	92.9%
85%	96.4%
90%	100.0%
95%	100.0%
100%	100.0%



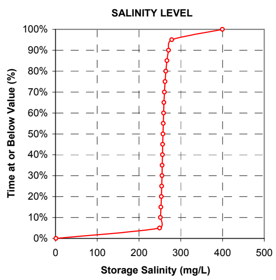
Statistic	Value	Units
Record length	19345	days
Security	87.0%	%
Days empty	47.6	days/year

Month	Average Level	Avg. Days Empty
Jan	63%	1.7
Feb	71%	1.5
Mar	75%	0.9
Apr	62%	2.7
May	58%	3.4
Jun	55%	4.1
Jul	45%	5.2
Aug	26%	13.2
Sep	42%	7.4
Oct	57%	4.6
Nov	70%	1.8
Dec	66%	1.2



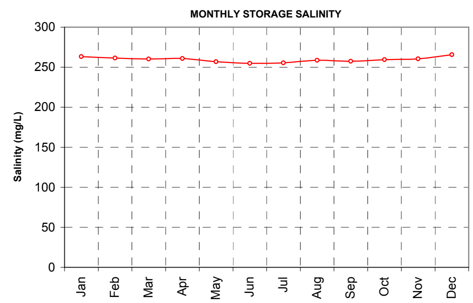
2. STORAGE SALINITY ANALYSIS

% Time	Salinity (mg/L)
0%	1.0
5%	249.3
10%	251.2
15%	252.5
20%	253.5
25%	254.3
30%	255.1
35%	255.7
40%	256.3
45%	256.9
50%	257.5
55%	258.1
60%	258.9
65%	259.8
70%	261.0
75%	262.5
80%	264.3
85%	266.9
90%	270.8
95%	278.6
100%	399.9



Statistic	Value	Units
Mean	259.7	mg/L
Median	257.5	mg/L
Maximum	399.9	mg/L

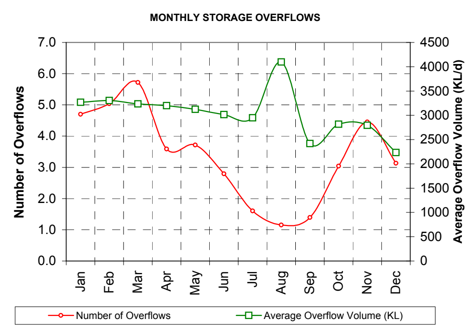
Month	Average (mg/L)
Jan	263.3
Feb	261.4
Mar	260.3
Apr	260.8
May	256.8
Jun	254.9
Jul	255.5
Aug	258.7
Sep	257.5
Oct	259.4
Nov	260.4
Dec	265.5



3. STORAGE OVERFLOW ANALYSIS

Statistic	Value	Units
Overflow No.	40.3	overflows/year
Overflow volume	3045.6	KL/event
Annual overflows	122800.7	KL/year
Annual salt lost	31434.9	kg/year

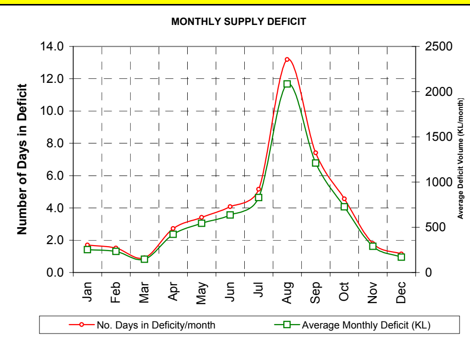
Month	Avg. Overflows	Avg. Vol. (KL/d)
Jan	4.7	3266.4
Feb	5.0	3304.8
Mar	5.7	3235.2
Apr	3.6	3199.8
May	3.7	3123.7
Jun	2.8	3015.4
Jul	1.6	2947.9
Aug	1.2	4099.4
Sep	1.4	2419.2
Oct	3.0	2818.2
Nov	4.5	2792.0
Dec	3.1	2232.2



4. SUPPLY DEFICIT ANALYSIS

Statistic	Value	Units
Avg. Deficit Days	47.6	deficity days/year
Avg. annual deficit	7541.7	KL/year

Month	Avg. Days in Deficit	Avg. Deficit (KL/month)
Jan	1.7	252.1
Feb	1.5	232.6
Mar	0.9	145.9
Apr	2.7	421.6
May	3.4	543.4
Jun	4.1	636.0
Jul	5.2	829.5
Aug	13.2	2084.2
Sep	7.4	1210.2
Oct	4.6	726.5
Nov	1.8	289.5
Dec	1.2	170.3



WATCYCLE - Water Balance Model - Control Panel

Run Complete

1. SUPPLY - RUNOFF FROM CATCHMENTS

	Impervious Areas	Pervious Areas
Area (ha)	19	7
Initial loss (mm/d)	1	10
On-going loss (mm/d)	0	3
TDS (mg/L)	250	300

2. SUPPLY - OTHER SOURCES

	Groundwater	Tanker	River	Rainfall
Rate (KL/d)		80		
Use if storage <				
TDS (mg/L)				

Effluent / Other Monthly Varying Input

TDS (mg/L)

COULD BE CONDITION

Month	Rate (KL/d)
Jan	
Feb	
Mar	
Apr	
May	
Jun	
Jul	
Aug	
Sep	
Oct	
Nov	
Dec	

3. STORAGE PROPERTIES

Area (ha)	Volume (KL)	Covered (Y/blank)	Initial Fraction Full	Pan E Factor	Seepage (m/d)	Initial TDS (mg/L)
0.5	6000		50%	60%	0.00020	1.0

4. DEMANDS

DEMAND 1 - SUPPLY

Month	Normal Rate (KL/d)	Drought A (KL/d)	Drought B (KL/d)
Use if storage <			
Jan	169		
Feb	169		
Mar	169		
Apr	169		
May	169		
Jun	169		
Jul	169		
Aug	169		
Sep	169		
Oct	169		
Nov	169		
Dec	169		

DEMAND 2 - IRRIGATION

Area (ha)

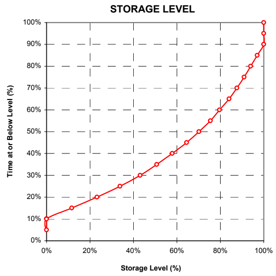
	Normal Irrigation	Drought A	Drought B
Use if storage <		50%	20%
Critical Rain (mm)	10	1	0.1
Critical Period (d)	7	7	7

Month	Crop Factor
Jan	0.85
Feb	0.80
Mar	0.65
Apr	0.55
May	0.45
Jun	0.40
Jul	0.40
Aug	0.45
Sep	0.55
Oct	0.65
Nov	0.80
Dec	0.85

WATCYCLE - Water Balance Model - Output

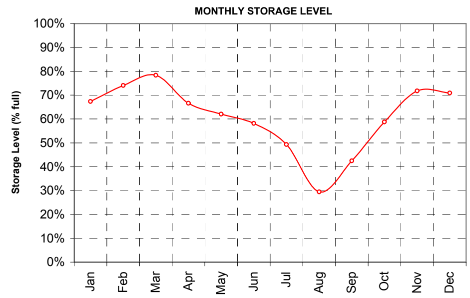
1. STORAGE SECURITY ANALYSIS

% Time	Level
10.1%	0.0%
5%	0.0%
10%	0.0%
15%	11.6%
20%	23.2%
25%	33.8%
30%	43.1%
35%	50.7%
40%	57.9%
45%	64.5%
50%	70.2%
55%	75.4%
60%	79.6%
65%	84.0%
70%	87.7%
75%	90.9%
80%	94.0%
85%	97.0%
90%	100.0%
95%	100.0%
100%	100.0%



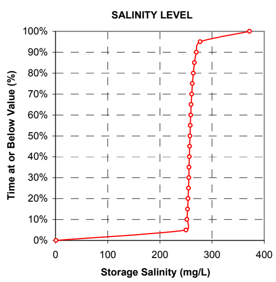
Statistic	Value	Units
Record length	19345	days
Security	89.9%	%
Days empty	37.0	days/year

Month	Average Level	Avg. Days Empty
Jan	67%	0.8
Feb	74%	0.9
Mar	78%	0.7
Apr	67%	1.7
May	62%	2.3
Jun	58%	2.6
Jul	49%	3.6
Aug	29%	11.0
Sep	42%	7.2
Oct	59%	4.2
Nov	72%	1.5
Dec	71%	0.6



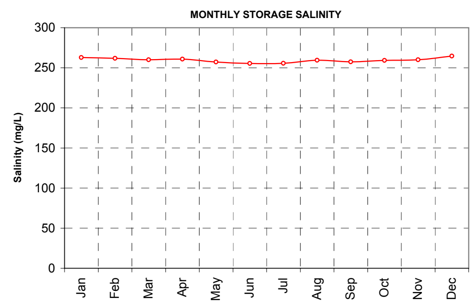
2. STORAGE SALINITY ANALYSIS

% Time	Salinity (mg/L)
0%	1.0
5%	250.2
10%	251.9
15%	253.1
20%	254.0
25%	254.8
30%	255.4
35%	256.0
40%	256.5
45%	257.1
50%	257.7
55%	258.4
60%	259.1
65%	259.9
70%	261.0
75%	262.3
80%	264.0
85%	266.3
90%	269.8
95%	277.3
100%	371.9



Statistic	Value	Units
Mean	259.7	mg/L
Median	257.7	mg/L
Maximum	371.9	mg/L

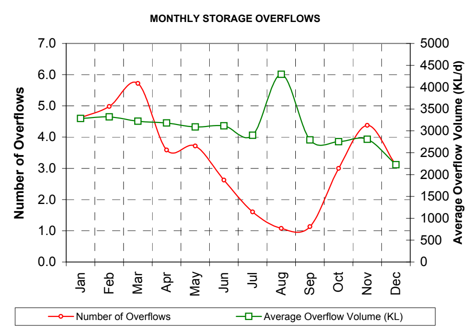
Month	Average (mg/L)
Jan	262.8
Feb	261.8
Mar	260.0
Apr	260.8
May	257.3
Jun	255.5
Jul	255.7
Aug	259.3
Sep	257.4
Oct	259.2
Nov	260.0
Dec	264.7



3. STORAGE OVERFLOW ANALYSIS

Statistic	Value	Units
Overflow No.	39.5	overflows/year
Overflow volume	3062.2	KL/event
Annual overflows	121045.1	KL/year
Annual salt lost	31008.0	kg/year

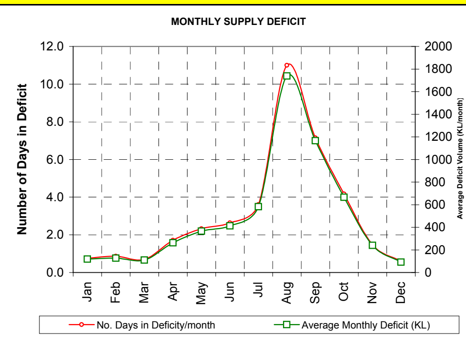
Month	Avg. Overflows	Avg. Vol. (KL/d)
Jan	4.6	3284.5
Feb	5.0	3319.4
Mar	5.7	3221.4
Apr	3.6	3180.4
May	3.7	3088.1
Jun	2.6	3115.8
Jul	1.6	2899.9
Aug	1.1	4295.1
Sep	1.1	2792.6
Oct	3.0	2752.3
Nov	4.4	2806.6
Dec	3.1	2225.3



4. SUPPLY DEFICIT ANALYSIS

Statistic	Value	Units
Avg. Deficit Days	37.0	deficity days/year
Avg. annual deficit	5883.2	KL/year

Month	Avg. Days in Deficit	Avg. Deficit (KL/month)
Jan	0.8	118.5
Feb	0.9	127.3
Mar	0.7	110.8
Apr	1.7	262.5
May	2.3	365.4
Jun	2.6	413.1
Jul	3.6	581.9
Aug	11.0	1738.6
Sep	7.2	1166.3
Oct	4.2	666.1
Nov	1.5	240.3
Dec	0.6	92.3



WATCYCLE - Water Balance Model - Control Panel

Run Complete

1. SUPPLY - RUNOFF FROM CATCHMENTS

	Impervious Areas	Pervious Areas
Area (ha)	19	7
Initial loss (mm/d)	1	10
On-going loss (mm/d)	0	3
TDS (mg/L)	250	300

2. SUPPLY - OTHER SOURCES

	Groundwater	Tanker	River	Rainfall
Rate (KL/d)		80		
Use if storage <				
TDS (mg/L)				

Effluent / Other Monthly Varying Input

TDS (mg/L)

COULD BE CONDITION

Month	Rate (KL/d)
Jan	
Feb	
Mar	
Apr	
May	
Jun	
Jul	
Aug	
Sep	
Oct	
Nov	
Dec	

3. STORAGE PROPERTIES

Area (ha)	Volume (KL)	Covered (Y/blank)	Initial Fraction Full	Pan E Factor	Seepage (m/d)	Initial TDS (mg/L)
0.5	6500		50%	60%	0.00020	1.0

4. DEMANDS

DEMAND 1 - SUPPLY

Month	Normal Rate (KL/d)	Drought A (KL/d)	Drought B (KL/d)
Use if storage <			
Jan	169		
Feb	169		
Mar	169		
Apr	169		
May	169		
Jun	169		
Jul	169		
Aug	169		
Sep	169		
Oct	169		
Nov	169		
Dec	169		

DEMAND 2 - IRRIGATION

Area (ha)

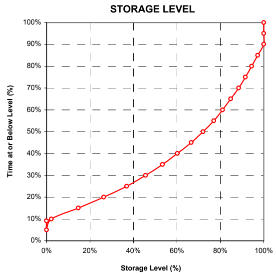
	Normal Irrigation	Drought A	Drought B
Use if storage <		50%	20%
Critical Rain (mm)	10	1	0.1
Critical Period (d)	7	7	7

Month	Crop Factor
Jan	0.85
Feb	0.80
Mar	0.65
Apr	0.55
May	0.45
Jun	0.40
Jul	0.40
Aug	0.45
Sep	0.55
Oct	0.65
Nov	0.80
Dec	0.85

WATCYCLE - Water Balance Model - Output

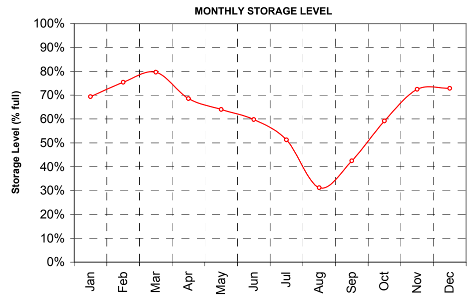
1. STORAGE SECURITY ANALYSIS

% Time	Level
9.1%	0.0%
5%	0.0%
10%	2.2%
15%	14.6%
20%	26.3%
25%	36.9%
30%	45.6%
35%	53.4%
40%	60.2%
45%	66.6%
50%	72.0%
55%	77.0%
60%	81.0%
65%	84.8%
70%	88.5%
75%	91.5%
80%	94.4%
85%	97.2%
90%	100.0%
95%	100.0%
100%	100.0%



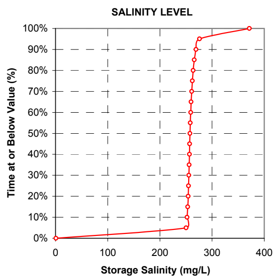
Statistic	Value	Units
Record length	19345	days
Security	90.9%	%
Days empty	33.2	days/year

Month	Average Level	Avg. Days Empty
Jan	69%	0.6
Feb	75%	0.7
Mar	80%	0.6
Apr	69%	1.3
May	64%	1.9
Jun	60%	2.2
Jul	51%	3.0
Aug	31%	10.0
Sep	42%	7.0
Oct	59%	4.1
Nov	72%	1.4
Dec	73%	0.4



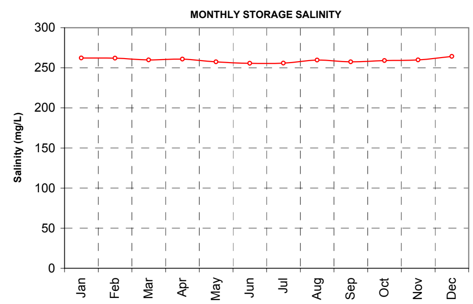
2. STORAGE SALINITY ANALYSIS

% Time	Salinity (mg/L)
0%	1.0
5%	250.5
10%	252.2
15%	253.4
20%	254.3
25%	255.0
30%	255.5
35%	256.1
40%	256.6
45%	257.2
50%	257.8
55%	258.4
60%	259.1
65%	259.9
70%	261.0
75%	262.2
80%	263.7
85%	265.9
90%	269.3
95%	276.2
100%	371.7



Statistic	Value	Units
Mean	259.5	mg/L
Median	257.8	mg/L
Maximum	371.7	mg/L

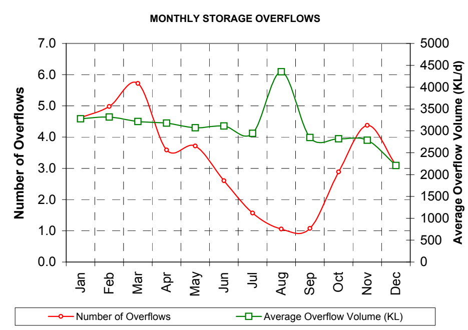
Month	Average (mg/L)
Jan	262.2
Feb	262.0
Mar	259.8
Apr	260.8
May	257.4
Jun	255.6
Jul	255.7
Aug	259.5
Sep	257.4
Oct	258.9
Nov	259.8
Dec	264.3



3. STORAGE OVERFLOW ANALYSIS

Statistic	Value	Units
Overflow No.	39.3	overflows/year
Overflow volume	3064.5	KL/event
Annual overflows	120381.6	KL/year
Annual salt lost	30849.0	kg/year

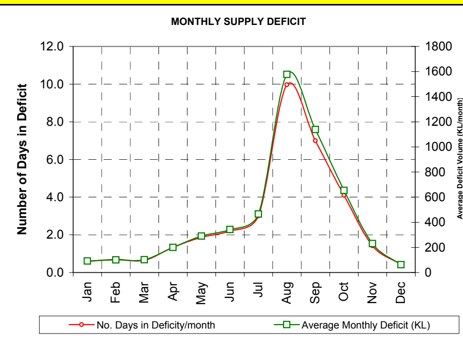
Month	Avg. Overflows	Avg. Vol. (KL/d)
Jan	4.6	3276.3
Feb	5.0	3315.6
Mar	5.7	3215.0
Apr	3.6	3177.8
May	3.7	3070.4
Jun	2.6	3113.0
Jul	1.6	2941.5
Aug	1.1	4352.9
Sep	1.1	2846.2
Oct	2.9	2817.7
Nov	4.4	2787.2
Dec	3.1	2207.0



4. SUPPLY DEFICIT ANALYSIS

Statistic	Value	Units
Avg. Deficit Days	33.2	deficity days/year
Avg. annual deficit	5254.5	KL/year

Month	Avg. Days in Deficit	Avg. Deficit (KL/month)
Jan	0.6	91.0
Feb	0.7	100.2
Mar	0.6	102.4
Apr	1.3	200.3
May	1.9	290.5
Jun	2.2	341.6
Jul	3.0	465.5
Aug	10.0	1577.4
Sep	7.0	1139.0
Oct	4.1	654.2
Nov	1.4	229.8
Dec	0.4	62.7



WATCYCLE - Water Balance Model - Control Panel

Run Complete

1. SUPPLY - RUNOFF FROM CATCHMENTS

	Impervious Areas	Pervious Areas
Area (ha)	19	7
Initial loss (mm/d)	1	10
On-going loss (mm/d)	0	3
TDS (mg/L)	250	300

2. SUPPLY - OTHER SOURCES

	Groundwater	Tanker	River	Rainfall
Rate (KL/d)		80		
Use if storage <				
TDS (mg/L)				

Effluent / Other Monthly Varying Input

TDS (mg/L)

COULD BE CONDITION

Month	Rate (KL/d)
Jan	
Feb	
Mar	
Apr	
May	
Jun	
Jul	
Aug	
Sep	
Oct	
Nov	
Dec	

3. STORAGE PROPERTIES

Area (ha)	Volume (KL)	Covered (Y/blank)	Initial Fraction Full	Pan E Factor	Seepage (m/d)	Initial TDS (mg/L)
0.5	6200		50%	60%	0.00020	1.0

4. DEMANDS

DEMAND 1 - SUPPLY

	Normal Rate (KL/d)	Drought A (KL/d)	Drought B (KL/d)
Use if storage <			
Month			
Jan	169		
Feb	169		
Mar	169		
Apr	169		
May	169		
Jun	169		
Jul	169		
Aug	169		
Sep	169		
Oct	169		
Nov	169		
Dec	169		

DEMAND 2 - IRRIGATION

Area (ha)

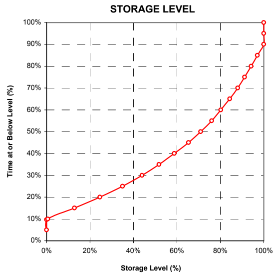
	Normal Irrigation	Drought A	Drought B
Use if storage <		50%	20%
Critical Rain (mm)	10	1	0.1
Critical Period (d)	7	7	7

Month	Crop Factor
Jan	0.85
Feb	0.80
Mar	0.65
Apr	0.55
May	0.45
Jun	0.40
Jul	0.40
Aug	0.45
Sep	0.55
Oct	0.65
Nov	0.80
Dec	0.85

WATCYCLE - Water Balance Model - Output

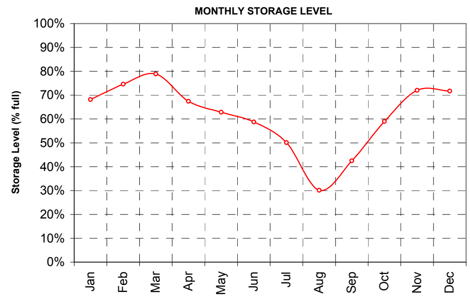
1. STORAGE SECURITY ANALYSIS

% Time	Level
9.7%	0.0%
5%	0.0%
10%	0.6%
15%	12.8%
20%	24.5%
25%	35.0%
30%	44.0%
35%	51.8%
40%	58.8%
45%	65.4%
50%	71.0%
55%	76.0%
60%	80.2%
65%	84.3%
70%	88.0%
75%	91.2%
80%	94.2%
85%	97.1%
90%	100.0%
95%	100.0%
100%	100.0%



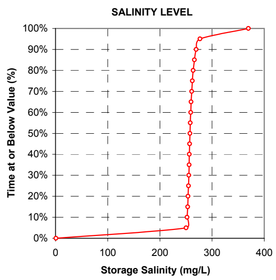
Statistic	Value	Units
Record length	19345	days
Security	90.3%	%
Days empty	35.3	days/year

Month	Average Level	Avg. Days Empty
Jan	68%	0.7
Feb	75%	0.8
Mar	79%	0.7
Apr	67%	1.6
May	63%	2.1
Jun	59%	2.4
Jul	50%	3.3
Aug	30%	10.5
Sep	42%	7.1
Oct	59%	4.1
Nov	72%	1.5
Dec	72%	0.5



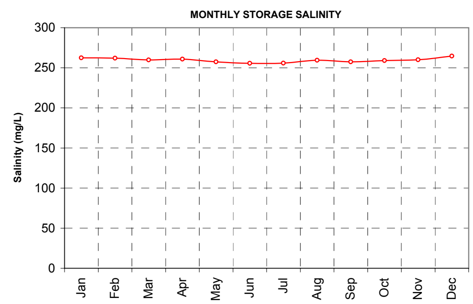
2. STORAGE SALINITY ANALYSIS

% Time	Salinity (mg/L)
0%	1.0
5%	250.3
10%	252.1
15%	253.3
20%	254.1
25%	254.9
30%	255.5
35%	256.0
40%	256.6
45%	257.1
50%	257.7
55%	258.4
60%	259.1
65%	259.9
70%	261.0
75%	262.3
80%	263.9
85%	266.2
90%	269.7
95%	277.0
100%	369.6



Statistic	Value	Units
Mean	259.6	mg/L
Median	257.7	mg/L
Maximum	369.6	mg/L

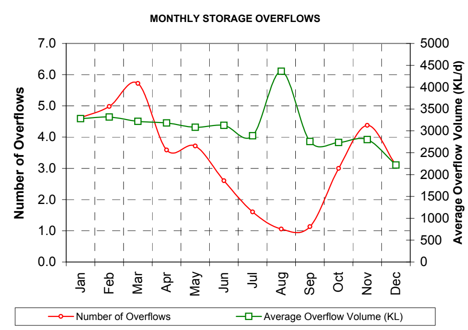
Month	Average (mg/L)
Jan	262.5
Feb	262.0
Mar	259.9
Apr	260.7
May	257.4
Jun	255.5
Jul	255.7
Aug	259.5
Sep	257.4
Oct	259.1
Nov	259.9
Dec	264.5



3. STORAGE OVERFLOW ANALYSIS

Statistic	Value	Units
Overflow No.	39.5	overflows/year
Overflow volume	3058.3	KL/event
Annual overflows	120773.6	KL/year
Annual salt lost	30943.1	kg/year

Month	Avg. Overflows	Avg. Vol. (KL/d)
Jan	4.6	3281.2
Feb	5.0	3317.9
Mar	5.7	3218.7
Apr	3.6	3179.4
May	3.7	3081.0
Jun	2.6	3127.2
Jul	1.6	2888.1
Aug	1.1	4363.6
Sep	1.1	2756.2
Oct	3.0	2733.4
Nov	4.4	2800.5
Dec	3.1	2218.0



4. SUPPLY DEFICIT ANALYSIS

Statistic	Value	Units
Avg. Deficit Days	35.3	deficity days/year
Avg. annual deficit	5626.3	KL/year

Month	Avg. Days in Deficit	Avg. Deficit (KL/month)
Jan	0.7	106.5
Feb	0.8	117.0
Mar	0.7	107.2
Apr	1.6	237.6
May	2.1	333.0
Jun	2.4	384.9
Jul	3.3	534.6
Aug	10.5	1672.5
Sep	7.1	1155.2
Oct	4.1	659.4
Nov	1.5	236.4
Dec	0.5	82.1