FLANAGAN CONSULTING GROUP

DEVELOPMENT CONSULTANTS • MANAGERS • ENGINEERS • PLANNERS

PROJECT NO: 5002/02

Townsville Ocean Terminal

&

Breakwater Cove

5002/02
R-KO0131 –Rev 3
30 July 2008

Water Quality Management during Construction

TABLE OF CONTENTS

TOWNSVILLE OFFICE
7TH FLOOR CENTRAL PLAZA 370 FLINDERS ST MALL
PO BOX 891 TOWNSVILLE QLD 4810

PHONE: 07 4724 5737 FAX: 07 4721 4684
EMAIL: townsville@fcgroup.com.au
WEB: www.fcgroup.com.au

1.0 INTRODUCTION

City Pacific is the proponent for the proposed Townsville Ocean Terminal and associated residential/commercial development. In November 2007, the EIS for the proposed development was released for public comment.

Responding submissions to the EIS were received from a number of government agencies, commercial organisations and clubs and private individuals.

This report documents the response to all submissions regarding the potential construction impacts on water quality.

2.0 BACKGROUND

The submissions and concerns regarding potential construction impacts on water quality are summarised in Table 1: Summary of Submissions Relevant to Potential Construction Impacts on Water Quality.

Table 1: Summary of Submissions Relevant to Potential Construction Impacts on Water Quality.

Respondent	Summary of Concern/Issue	Refer Section
Department of Primary Industries and Fisheries (DPIF)	The EIS should identify future management options, responsibilities and testing procedures for inclusion in dredge management plan.	5.2, 5.4, 5.5.2.2, 5.5.2.3
	Performance indicators: CEMP on dredging needs refinement – will dredging cease if turbidity exceeds 10% of control sites (i.e. what action will be taken)	5.2, 5.4
Department of Natural Resources and Water (DNRW)	DNRW recommends regular monitoring of standing water in the dewatering for any indicators of acidification as an additional monitoring activity be specified as a condition of approval -	5.5
Environmental Protection Agency (EPA)	If land based dredge spoil disposal, provide assessment to demonstrate water quality will meet water quality objectives and therefore maintain receiving water environmental values.	5.5
	The EM plan for water quality is amended to state that all water quality monitoring will be undertaken in accordance with EPA Water Quality Sampling Manual.	5.5
	Further investigation is undertaken prior to construction into elevated nutrient and phosphorous levels within sediment of construction site.	5.5
	Monitoring program: The proponent refer to Queensland water Quality Guidelines 2006 to determine physio-chemical indicators. Primary water quality parameters (Chlorophyll-a, pH, dissolved oxygen, conductivity, salinity and turbidity should be used to develop a real time	5.5

	monitoring program. Pre-construction samples should be collected and analysed to establish ambient conditions of these water quality parameters.	
	Groundwater: Provide detailed information showing levels of existing aquifer across construction site and demonstrate that excavation and reclamation will not interfere with aquifer.	6.0
	A prediction of the fate of contaminants in discharge water should be provided using predicted volumes, pumping rates and water quality parameters of the discharge.	5.5
	Modelling should be coupled with detailed habitat mapping to derive a management plan for the discharge of water to reduce the risk to sensitive habitats.	5.5
Townsville Port Authority	The Queensland Water Quality Guidelines 2006 have a defined process for developing accepted guidelines at a local level which the project water quality study did not follow.	5.5
	Water Quality monitoring program designed for general state of environment monitoring rather than specifically for pollutant control monitoring.	5.5
	Water quality monitoring program is poorly defined.	5.5
	Report does not indicate if harbour or Ross Creek waters will be impacted.	5.5

3.0 CONSTRUCTION ACTIVITES LIKELY TO IMPACT WATER QUALITY

The EIS defined a construction methodology and sequencing including the following construction activities which have potential to impact water quality of the environment outside of the development:

1. Enclosure of FDA (Placement of Rock for Outer Wall)
2. Construction of TOT berth and Swing Basin
3. Removal of Outer Temporary Works (Bund/Rock Walls)
4. Dredging of outer entry for new marina access
5. Water Discharges from the site

3.1 Enclosure of FDA (Placement of Rock for Outer Walls)

The placement of rock for the base of the outer rock walls has the potential to disturb underlying and adjacent sediment. The primary concern is that the increased turbidity will adversely impact sea grass and marine organisms.

3.2 Construction of TOT berth and Swing Basin

The proposed staged construction indicates that construction of the TOT berth and swing basin will comprise:

1. Dry excavation techniques of 110,000 m^3 of sediment materials for the TOT berth pocket;
2. Cutter suction dredging of approximately 150,000 m^3 of sediment to extend the existing Port of Townsville swing basin for access into the TOT berth pocket

The EIS indicated that:

1. The bulk of the material dredged for the TOT berth pocket and swing basin will not be suitable for engineered fill and will likely be disposed of at Port of Townsville approved spoil disposal site at sea.
2. The stiff clay from the TOT berth would be stockpiled and reused on-site

The primary concerns associated with water quality for the construction of the TOT berth and swing basin are:

1. The management of large volumes of dredge spoil from cutter suction dredge;
2. The assessment and viability of disposal/reuse options for dredge spoil
3. Increased turbidity associated with dredging on the water quality in Ross Creek
4. The methodology proposed for excavation and construction of the TOT berth

3.3 Removal of Outer Temporary Works (Bund/Rock Walls)

The outer rock bunds, located near the Temporary Breakwater Marina entrance will be removed towards the end of construction to allow flooding of the development area and to provide access to the new and existing marina.

The primary concern with this activity is that the removal of the base rock layer has the potential to increase turbidity and adversely impact the marine environment. In addition, as the activity is undertaken at the end of the project the 42,000m^3 of rock materials will need to be reused on-site.

3.4 Dredging of outer entry for new marina access

The EIS indicated that cutter suction dredging of approximately 15,000 m^3 of material associated with the outer entry dredge area for access for large vessels into the new marina is required. The dredging of this area is outside the enclosed site and consequently has the potential to adversely impact the marine environment. The EIS indicated that the dredged material is to be dewatered, possibly mixed with other materials, and reused on-site.

3.5 Water Discharges

During construction, water from a range of sources will accumulate within the enclosed FDA. The potential sources of water which will be collected include:

1. Water from the dredged sediments from TOT berth, swing basin and outer access channel.

2. Water from dewatering of excavated wet sediments in the development of land forms
3. Site Rainfall and Stormwater
4. Inflow of marine water from outside the FDA
5. Groundwater discharge

The primary risks to water quality and potential impact from discharge to the receiving environment are:

1. Elevated turbidity
2. Low dissolved oxygen from released or stagnant water in contact with reducing marine muds
3. Elevated ammonium released from organic rich reducing muds
4. Induced acidity from run-off and dewatering of oxidised potential acid sulfate soil
5. Poor water quality management

4.0 CONSTRUCTION SUMMARY AND WATER VOLUMES

4.1 Construction Methodology

The construction methodology proposed in the EIS involves utilising the existing breakwater walls which upon review do not appear to be impermeable. Consequently under this methodology the development area is likely to be subject to large unquantifiable volumes of water infiltration through the permeable rock walls. In addition, the proposed sequencing is towards the south west which would work against the natural gradient of the site. This is not considered the most practical construction methodology. Following careful review best practice construction and water quality management requires:

1. Isolation of the site
2. Collection, management and, if necessary, treatment of all site generated water
3. Ability to dewater, drain and dry large volumes of excavated and dredged materials
4. A down-gradient construction sequence to allow water to drain and flow via gravity, where possible.
5. A series of water collection ponds so active water collection and compliance testing for discharge water can be undertaken separately.

The EIS did not include an assessment on the volumes of water and how water will be managed or how it will meet discharge requirements.

As a consequence of this review, an improved construction methodology which facilitates best practice water quality and environmental management has been developed and is provided in the FCG report *Review of Construction Issues (PF3946-Rev. 5)*.

To understand the potential water issues in relation to the construction of the TOT berth, swing Basin and FDA an understanding of the volumes and likely chemical impacts on water quality is required.

4.2 Calculation of Water Volumes

The calculations of volumes of water generated on site are presented in **Appendix A – Calculation of Water Volumes and Storage Capacity** and summarised below in **Table 2: Summary of Water Volumes**

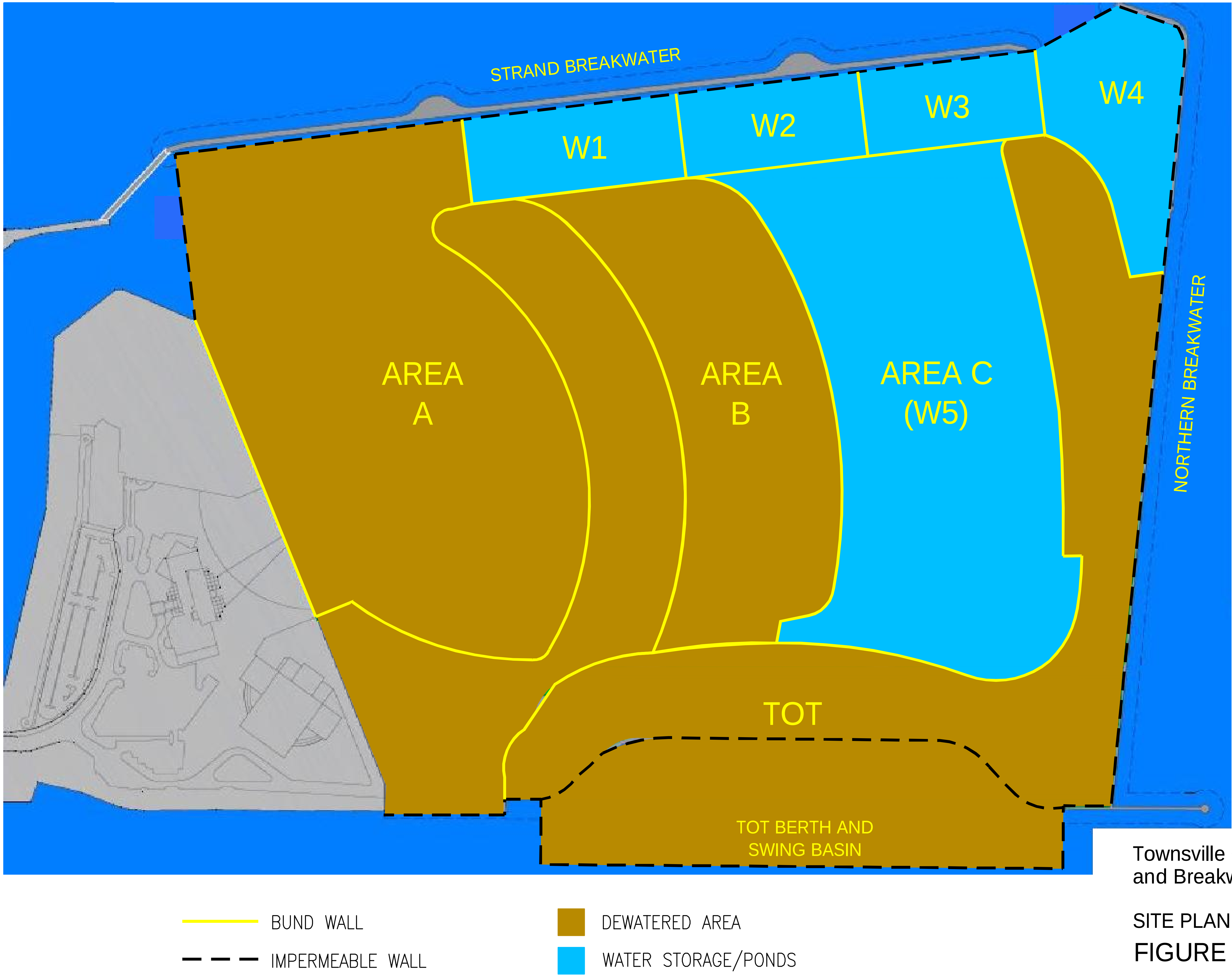
Table 2: Summary of Water Volumes

Source	Volume (ML)
Enclosed water in FDA and TOT berth/swing basin to 0.4m depth to be pumped direct to marine environment	1,232 ML
Lower 0.4 m water to be pumped to Ponds W1-W5	268ML
TOT Berth and Swing Basin Scenario 1 (no cutter suction dredge) Scenario 2 (20,000 m^3 excavation by cutter suction dredge)	 26ML 24ML plus 260ML dredge spoil
Drained Water from sediments from bucket dredged outer entry dredge area	2ML
Drained water from FDA and TOT berth& swing basin sediments	164 ML
Rainfall - 2 year ARI event Rainfall – 50 year ARI event	15ML 42ML

4.3 Storage Capacity

The revised construction plan has taken into account the need for storage areas and water collection and control within the enclosed site.

The site plan (**Figure 1**) shows the layout of the storage areas (Area A, B & C) and water ponds (W1-W5)



FLANAGAN CONSULTING GROUP

Townsville Ocean Terminal and Breakwater Cove

SITE PLAN

FIGURE 1

NOT TO SCALE

Acad No. 5002AGA

30 June 2008

The capacity of each pond and area has been calculated as shown in **Appendix A Calculation of Water Volumes and Storage Capacity**. Each of these areas may be further subdivided as identified in operational works and as required during construction works. The layout of the ponds allows for at least two ponds for each stage of construction and the development of a treatment train, if required. The sizing of the ponds allows for capture and containment of a 50 year ARI event, should it occur.

The holding capacity of storage areas and water ponds is summarised below in Table 3: Storage Volumes

Table 3: Storage Volumes

Storage Type	Storage Nomenclature	Storage Area (m^2)	Storage Volume (ML)
Water Storages	W1, W2, W3,W4 (4x 60ML)	80,000	240
Total Water Storage Capacity	W5*	110,000	330
			570
Landform + Canal/Marina	Area A	216,000	-
	Area B	80,000	-
	Area C	115,000	-
Total Storage Area		**336,000**	-
Marina/Canal Sump Capacity	Marina Sump	80,000	240
	Canal A	20,000	60
	Canal B	20,000	60
	Canal C	20,000	60
Total Sump Capacity		**140,000**	**420**

**W5 is within Area C and will only be required for water storage in the dewatering program for the lower 0.4m of water and if cutter suction dredging is undertaken for up to 20,000m^3 of material from the swing basin.*

5.0 MITIGATION CONTROLS

5.1 Enclosure of FDA (Placement of Rock for Outer Walls)

To minimise the disturbance the following controls will be implemented for the placement of rock for the outer walls:

1. A silt blanket will be installed along the transect of the Rock Wall. This may comprise either a washed gravel blanket or a geotextile fixed to the seabed prior to the placement of the basal rock layer. The design of the silt blanket will be subject to assessment and approval under the Operational Works Approvals by TCC, the EPA and DPIF prior to operational works commencing.

2. Silt curtains will be installed on both the outside and inside of the rock wall during placement of the washed gravel blanket and basal rock layer.

3. To reduce the risk of adverse impact on sea grass, placement of the basal rock will not occur during the peak growth season for sea grass (November and December).

Monitoring of turbidity outside of the silt curtains will be undertaken as per the water quality monitoring program being developed as per Hyder Consulting " Draft Water Quality Monitoring Program" July 2008.

Should additional analysis confirm exceedence of trigger values additional silt curtains will be installed and/or the rate of placement will be decreased to suit the prevailing marine conditions and to comply with water quality criteria being developed. If additional measures are unsuccessful, works will cease until suitable measures are installed and/or approval is obtained to continue works. Any exceedence of trigger values shall be reported to the Technical Review Panel as defined in the EMP.

5.2 Construction of TOT berth and Swing Basin

Cutter suction dredging for the excavation of the TOT berth and swing basin is not a viable solution unless the TPA undertake the dredging and subsequent offshore disposal as part of their operations or allow disposal to their reclamation area. Both of these are unlikely propositions and therefore alternative options have been developed as per FCG Report *Review of Construction Issues (PF3946-Rev 3).*

The alternative methodology of enclosing the TOT Berth and either all, or most of, the swing basin minimises dredge spoil and excavation volumes and the volume of contained water. It also reduces/removes the risk of elevated turbidity due to dredging as there would be reduced or no dredging operations.

Although not the preferred option, some dredging may still be required for the outer section of the swing basin. The primary concern for this disturbance is turbidity. To mitigate the risk, the following mitigation program is proposed:

1. Whilst dredging or potential high impact activities are in progress, a silt curtain or sheet pile will be installed between the area to be disturbed and the open marine environment;

2. To reduce the risk of adverse impact on sea grass, dredging will not be undertaken during November and December;

3. Should a visible turbid plume be observed 5 m outside the silt curtain or sheet pile, works shall cease immediately;

4. During high disturbance activities, monitoring of turbidity will be undertaken in accordance the water quality monitoring program and guidelines being developed in consultation and agreed with EPA, DPIF and legislative authorities.

If agreed trigger values are exceeded, additional protective measures will be emplaced as soon as possible to improve environmental outcomes and meet the water quality criteria.

These measures may include, but not be limited to:

- Additional silt curtains
- Reduced rate of dredging
- Refer to Technical Review Panel

Should turbidity criteria continue to be exceeded, works shall cease until suitable measures are emplaced and/or approval from legislative authorities is obtained to continue works.

5.3 Removal of Outer Temporary Works (Bund/Rock Walls)

To minimise elevation of turbidity and the impact on the marine environment the following procedure for the removal of the outer bund/rock walls will be implemented:

1. The base layer of the rock wall should not be removed until the FDA has flooded;
2. The base layer should only be removed between low tide and 1 hour before high tide and when the tidal difference between low and high tide is less than 1m;
3. A silt curtain should be installed between the area to be disturbed and the open marine environment;
4. To reduce the risk of adverse impact on sea grass, the base layer of the outer rock walls should not be removed during November and December;
5. Should a visible turbid plume be observed 5 m outside the silt curtain, works shall cease immediately;
6. Monitoring of turbidity will be undertaken in accordance the water quality monitoring program and guidelines being developed in consultation and agreed with EPA, DPIF and legislative authorities.

If trigger values are exceeded over an extended period, additional protective measures will be installed as soon as possible to improve environmental outcomes and meet the water quality criteria. These measures may include, but not be limited to:

- Additional silt curtains;
- Reduced rate of dredging and/or wall removal;
- Refer to Technical Review Panel.

Should turbidity criteria continue to be exceeded, works will cease until suitable measures are emplaced and/or approval from legislative authorities is obtained to continue works.

5.4 Dredging of outer entry for new marina access

Dredging will be required for the outer entry for the new marina access. To reduce material volumes, it is suggested that a clam shell dredge be utilised rather than a cutter suction dredge. This will significantly reduce materials handling, water volumes and drying times. The primary concern for dredging is turbidity. To mitigate the risk, the following mitigation program is proposed:

1. Whilst dredging or potential high impact activities are in progress, a silt curtain will be installed around the clam shell dredge and drainage barge;

2. To reduce the risk of adverse impact on sea grass, high potential impact activities will not be undertaken during November and December;

3. Should a visible turbid plume be observed 5 m outside the silt curtain, works will cease immediately;

4. With the exception of winds from the south, dredging shall not be undertaken in wind exceeding 10 knots.

5. Monitoring of turbidity will be undertaken in accordance the water quality monitoring program and guidelines being developed in consultation and agreed with EPA, DPIF and legislative authorities.

6. If trigger values are exceeded, additional protective measures will be installed as soon as possible to improve environmental outcomes and meet the agreed water quality criteria.

   These measures may include, but not be limited to:
   - Additional silt curtains;
   - Reduced rate of dredging;
   - Refer to Technical Review Panel.

7. Should turbidity criteria continue to be exceeded, works shall cease until suitable measures are emplaced and/or approval from legislative authorities is obtained to continue works.

5.5 Water Discharges

5.5.1 Existing Conditions

The existing discharge from the FDA site is tidal discharge largely via the open western end of the site which is the proposed location of the Strand Breakwater. Assuming no rainfall, two tidal cycles per day, and a 1.5m fall from high to low tide this would equate to approximately 2000 Ml/day of water discharged from the existing FDA site to the adjacent marine environment. Although the turbidity of the water is not well defined, it is reasonable to assume that the water proximal to the seabed will have elevated turbidity relative to the overlying water. The water quality monitoring program being completed in consultation with the EPA will define the existing conditions on the site.

5.5.2 Mitigation Strategy

The overall basis for control of water discharge will be:

1. Isolation of site
2. Segregation and containment of water
3. Settlement, and if necessary treatment, of water to meet water quality discharge criteria
4. Compliance testing against agreed discharge criteria prior to discharge

A separate strategy is required for each source of water from the project. The potential water sources include:

1. Dewatering of site
2. Cutter Suction dredging (if required) of 20,000m^3 from swing basin
3. All other water sources - stormwater, drained water from sediments, groundwater, interception water (if required)

The original EIS did not entail isolation of the site with high level water control. In addition, it would have entailed 165,000 m^3 of dredging outside of breakwater walls. This methodology had the potential to create a turbidity plume and consequently plume dispersion modelling to assess the potential impact would be an appropriate assessment measure.

The revised strategy entails isolation of the site with dredging volumes reduced to an estimated 15,000 m^3 which is less than 10% of the volume of dredging operations identified in the EIS. Given the reduced dredging and the isolation and containment strategy, the potential discharge of turbidity from the proposed development is likely to be less than the existing turbid water discharge from the site. Once the site is enclosed and isolated there will be an overall improvement in turbidity levels.

Given proposed controls and isolation of the site, it is considered that the potential impact on the sea grass beds from the 15,000 m^3 of dredging from the outer entry access channel would be nominal. As a precautionary measure plume modelling, aligned with the controls described above, is being undertaken.

5.5.2.1 Dewatering of Site

The water within the FDA and the TOT berth/swing basin will have higher turbidity close to the sea bed relative to overlying water. To ensure potential impacts from turbidity to the marine environment are less than the existing impact from the FDA site, the initial dewatering program has been split into two stages:

1. Dewatering to a nominal 0.4m depth
2. Remaining Water below nominal 0.4m depth

The initial dewatering program in Stage 1 of the Construction Program will be to approximately 0.4 depth will be via skimmer pumps and discharged from a series of points along the length of Strand Breakwater. The proposed baseline water quality programme will define the nominal depth to which the initial dewatering program can be undertaken.

Controls will be emplaced (diffusers and/or rock walls) and monitoring undertaken to ensure there is no disturbance of sediment at the discharge point. Discharge will be over a 24 hour period for a number of weeks and the daily discharge rate would not exceed 200ML/day. Given 2,000 ML per day discharges from the FDA site including the lower 0.4m of more turbid sediment, this initial dewatering strategy will have a lower overall turbidity relative to the existing turbidity discharge from the FDA site.

Water from the lower 0.4m will be discharged to W1, W2, W3, W4, W5 as required. All water will be emplaced into W1-W4 for settlement and testing prior to discharge. As with the initial dewatering program, skimmer pumps will be utilised to pump water from above 0.4m depth. Discharge will be from a series of points along the length of Strand Breakwater. There is sufficient storage capacity to isolate and store water for two weeks prior to discharge.

Controls will be placed (diffusers and/or rock walls) and monitoring undertaken to ensure there is not disturbance of sediment at the discharge point. Discharge will be over a 24 hour period for a number of weeks and the daily discharge rate would not exceed 200ML/day.

5.5.2.2 *Cutter Suction dredging (if required) of 20,000m^3 from swing basin*

Cutter suction dredging may be required for up to 20,000 m3 of material from the swing basin. If required this material will produce 260,000 m3 of dredge spoil. This material will be pumped to W5 and allowed to dewater and settle. It is expected some of the coarser sediment will settle proximal to the spigot point and may be able to be reused on site. The remaining material will eventually dewater by evaporation to form a thick sludge which will either be laid out to dry and/or disposed into one of the sumps at the bottom of the canals or marina.

Some water may be able to be decanted to one of the other water ponds (W1-W4) via skimmer pump. The water would be allowed to settle in one of the smaller, deeper ponds, and discharged via skimmer pump to 0.4m depth if compliant with discharge criteria. If non compliant with discharge criteria, consideration will be given to extended residence time or flocculation using gypsum or another flocculant.

5.5.2.3 *Other water sources*

All other water sources include:

1. Stormwater
2. Drained water from excavated sediments
3. Drained water from clam shell dredged sediments from outer entry dredge area
4. Groundwater and interception water (if required)

Dredged material and any water collected in the barge will be emplaced within the FDA area and allowed to drain as per other excavated sediments. All site generated water will be collected in one or more of the water ponds (W1-W4).

To mitigate the potential risks to the environment, the following overall strategy will be adopted in the management of site water:

1. All water from the site will be collected in water treatment ponds prior to discharge from the site;

2. Discharge water will be collected from the final water treatment pond via a surface skimmer or similar device to no deeper than 0.4m above the bottom of the pond – water below 0.4m depth will not be discharged with depth specific compliance testing;

3. Treatment for elevated ammonium or low dissolved oxygen will be via aeration through either active surface aerators or passive aeration such as pumps and rock water falls;

4. Treatment for low pH will be via addition of a base such as lime slurry, caustic soda and or limestone gravel races to achieve required water quality criteria;

5. Treatment for elevated turbidity will be via gravitational settlement and flocculation, should it be required. Flocculant will be using hydrated gypsum slurry if turbidity is only marginally elevated and low doses of alum if turbidity is highly elevated. Alum will be added at a low rate to ensure overdosing does not occur;

   Late stages of additive of flocculant should be hydrated gypsum slurry. If alum is utilised as the flocculant, testing for soluble aluminium shall be undertaken to demonstrate water quality has not been adversely effected by overdosing with alum;

6. Discharge water shall be discharged via a diffusive device and mixing zone such as a permeable rock wall, a rock chute and/or behind a silt curtain;

7. All discharge water is to meet water quality criteria specified and agreed in consultation with EPA, DPIF and legislative authorities;

8. Monitoring quality monitoring shall be undertaken in accordance with EPA Water Quality Sampling Manual and is being developed in consultation and agreed with EPA, DPIF and legislative authorities;

6.0 GROUNDWATER

C&R consulting have since provided clarification on their report. The C&R letter report is presented in **Appendix B**.

7.0 CONCLUSIONS

Following consideration of issues raised by Agencies in response to the EIS, and review of the construction methodologies originally proposed, the following conclusions have been drawn:

- The revised construction program and site water management program provides an isolated and contained site and best practice water management;
- Development of the site will remove an existing local source of turbidity – the open, shallow water environment of the existing FDA site;
- Controls and monitoring measures have been developed to ensure environmental impacts associated with the placement of the base layer of rock (outside of the isolated site) are minimized;
- The risk of adverse impact to the marine environment can be mitigated by the proposed procedures and controls which will limit the disturbance outside of the isolated site to periods of low impact regimes;
- The volumes of water which will be generated during the development of the FDA site can be collected and managed within the confines of the site;
- Allocations have been made to allow for treatment facilities of sufficient capacity to ensure that the residence time and gravitational settlement will be sufficient to meet water quality criteria, which are being developed in consultation with the EPA. As a contingency measure, flocculation may be utilised.
- The activities of placement of basal rock (outside of isolated site), dredging and water discharges will need to be monitored in accordance with the monitoring program being developed in consultation with the EPA.

APPENDIX A

Calculation of Water Volumes and Storage Capacity

FLANAGAN CONSULTING GROUP

Supplementary EIS TOT Project - Calculation of Total Water Volumes

Untreated discharge water						
Water collected from FDA and sheetpiled TOT berth and swing basin						
	Length	Breadth	Depth		Volume	
	m	m	m	Cu Metres	Kilolitres	Megalitres
Contained water in Duckpond	900	700	2	1,260,000	1,260,000	1,260
Contained water in TOT berth and swing basin	400	100	6	240,000	240,000	240
Total				**1,500,000**	**1,500,000**	**1,500**
Treated Discharge Water						
Water collected from dredged and excavated materials						
					Volume	
			%	Cu Metres	Kilolitres	Megalitres
Potential water from bucket dredge materials from outer entry dredge area			10	15,000	1,500	2
Drained water from excavated TOT berth and swing basin			10	240,000	24,000	24
Potential contained water from cutter suction dredge material from outer swing basin			1,200	20,000	240,000	240
Drained water from FDA excavated materials			10	1,644,691	164,469	164
Remaining 0.4m water from FDA enclosure	900	700	0.4m	252,000	252,000	252
Rainfall V2				15,000	15,000	15
Total					**696,969**	**697**

PROJECT No.	5002-02		
CALCULATION BY	RD	DATE	13/06/08
CHECKED BY		DATE	
SHEET	1	OF	1

TOWNSVILLE OCEAN TERMINAL - ESTIMATE OF STORMWATER RUNOFF

The outer perimeter of the construction site will collect rainfall which will flow to the sump point.
Assumed that the future marina channel will be the lowesr point on the site

Area of construction site 70.65 Ha
length of run off path 820 m

Use Rational Method (QUDM)

runoff flow from a catchment for a n year ARI event = 2.78_{10}-3 * C_n *I_n *A

For the TOT site , time of concentration = 20 minutes (200m @5% overland; 620m in channel @5%)

$^1I_{10}$ = 81 mm/h

f_i = 70 % *saturated soils will not absorb more water*
therefore C_{10} = 0.84 *Table 5.04.2*

F_2 = 0.85 F_{50} = 1.15
Thus C_2 = 0.71 C_{50} = 0.97

From Rainfall Intensity Chart for Townsville I_2(20min)= 90 mm/h
I_{50}(20m) = 186 mm/h

Run off flow Q_2 = 12.5504 m^3/s

Q_{50} = 35.0704 m^3/s

Assumption, the volume of rainfall in the storm hydrograph is approximated as 50% peak flow for a duration of 2 times time of concemntration

V_2 = 15000 m3 or 15 ML

V_{50} = 42000 m3 or 42 ML

Recommendation

Treatment be aimed at treating the V_2 *volume*

APPENDIX B

C&R Consulting Letter 13 June 2008

C&R CONSULTING
Geochemical & Hydrobiological Solutions Pty Ltd
ABN 72 077 518 784

Marine and Coastal Processes and Dynamics
Groundwater and Environmental Specialists
Environmental Compliance and Monitoring
Contaminated Site and Soil Assessment
HydroGeomorphic Evaluations
Chemical & Water Modelling
Spatial Analysis
GIS Services

PO Box 1777
Thuringowa Qld, 4817, AUSTRALIA

Tel: +61 (0) 7 4725 3751
Mob: +61 (0) 417 635 032

info@candrconsulting.com.au
www.candrconsulting.com.au

13 June 2008

Ms K Lynch
Environmental Consultant
Hyder Consulting Pty Ltd
Locked Bag 2017
South Brisbane QLD 4101

Dear Kelly

RE; WITH RESPECT TO GROUNDWATERS BENEATH PROPOSED TOT PROJECT SITE

With respect to C&R Consulting's report *Impact of Proposed Townville Ocean Terminal Development on the Water Quality of Cleveland Bay* dated 25 June 2007, I provide the following clarifications:

- Groundwaters from three monitoring wells within the proposed development site were sampled, with one being dry. In order to assess any stratification in the water column, assessment was made of waters present at the top and bottom of the water column. These analyses are provided as ALS EB0612050.
- Assessment indicated these waters were of marine origin and consequently should be considered as "interstitial" rather than groundwaters sensu stricto.
- These interstitial waters under the development area fluctuate in level in response to the daily tidal cycle with levels varying from 4 to 5m below the current coherent surface to 7 to 8m below this level.
- Given the proposed depth of dredging and excavation and the possible nature of the aquifers, the probability of significant disturbance during development is considered low.
- It is extremely unlikely that, due to its salinity, any use will be made of this groundwater resource. Thus, the project is highly unlikely to have any impacts on groundwater sustainability or depletion. Additionally, since the waters are tidally pushed, the development is unlikely to have any impacts on aquifer recharge.
- Since the waters are tidally influenced, it is unlikely that land based disturbance will impact on groundwater regimes by changing subsurface porosity and permeability conditions.
- Waters are generally consistent with ambient water quality existing in Cleveland Bay (refer text table 4). Exceptions are:
  - Manganese, where levels (3750,3950µg/L in hole 2 and 3060,3000 µg/L in hole 1) may represent colloidal material passing 0.45µ filters, and
  - Ammonia where levels (1560,1490µg/L in hole 2 and 1220,1200µg/L in hole 1) may represent a palaeo, axoic mangrove environment (consistent with Quaternary geomorphology).
- Values of cobalt (26,24.9µg/L in hole 2 and 29.1,28.3µg/L in hole 1) are at the upper end of the ambient range for cobalt in un-impacted groundwater holes in the area.
- Generally, there are no differences in water quality between tops and bottoms of the holes and only, possibly, a small difference between holes 1 and 2.

Given the current levels of metals and nutrients in the existing interstitial (ground) waters and the high probability that they are almost entirely marine dominated and tidally flushed, it is expected that the analyte levels found reflect those already existing with the Bay and Port area. Additionally, the mere existence of “wonky” holes (points of submarine groundwater discharge) implies that many shallow, subsurface aquifers already have submarine expression at the bottom of Cleveland Bay.

Thus, waters of the compositions found in the groundwater bores already mix with the waters of the Bay in general. Consequently, it is believed that, although conceptually and theoretically possible, submarine expression of any aquifers occurring beneath the development will have minimal or no detectable effects on the ecosystems of Cleveland Bay in the vicinity of the development. It is, therefore, considered that the development will not cause adverse impact on the shallow groundwaters beneath the site nor their possible downflow expression as “wonky” holes.

It should be noted that the inner harbour and surrounds and the Platypus Channel are excavated to levels well below those envisaged for the development area. It is with this fact in mind that I strongly believe that the excavation proposed for the development will have minimal impacts on the shallow groundwater systems beneath the site.

It is obvious from the comments received from the reviewers that some of the comments made in the original draft may have been misinterpreted. While, in an absolute sense, in a non-impacted environment the statements are theoretically valid, the environments of Cleveland Bay are in fact significantly anthropogenically impacted. As stated above, the groundwater flows naturally out on to the sea bed and already excavations for Port infrastructure have already been to levels beneath the natural sea-floor, both in the inner harbour and port access channels, well in excess of those envisaged for the development area.

The monitoring strategy proposed, providing suitable locations are agreed between all stakeholders, will permit early detection of any significant changes in water quality due to a variety of causes including the possible breach of a shallow aquifer system high in ammonia. Such a monitoring strategy will permit proactive rather than reactive mitigation strategies and will provide buffer time for corrective and remedial strategies prior to intervention levels being exceeded.

In conclusion, it is reiterated that the proposed development would, in all likelihood, only have minimal impacts on the shallow aquifer systems in the vicinity of the development. Thus, possible impacts on these aquifer systems themselves provide no grounds for rejection of the development proposal.

Yours Sincerely

Christopher Cuff

Dr Chris Cuff