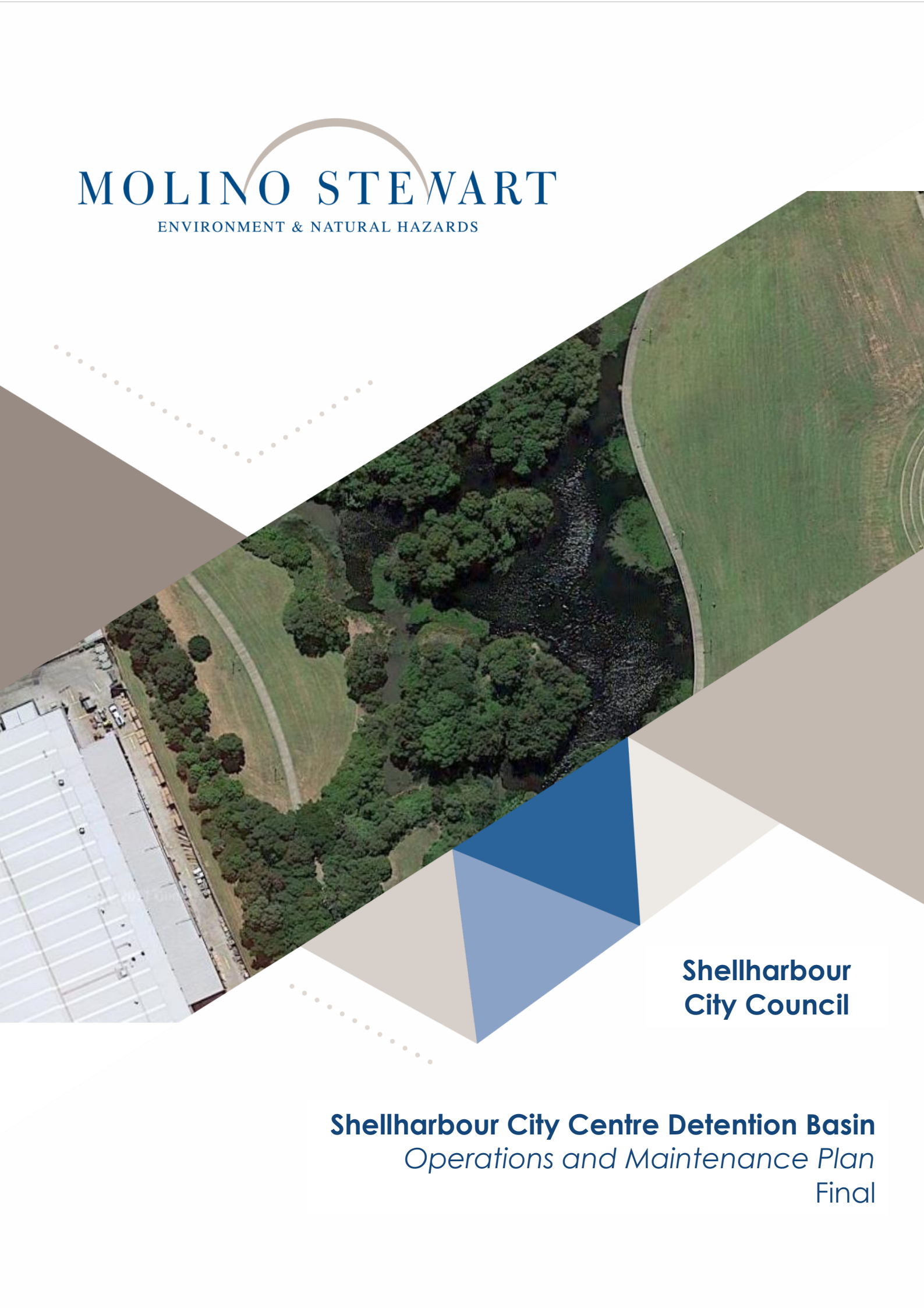




# MOLINO STEWART

ENVIRONMENT & NATURAL HAZARDS

**Shellharbour  
City Council**

**Shellharbour City Centre Detention Basin**  
*Operations and Maintenance Plan*  
Final

# **Shellharbour City Centre Detention Basin**

## **Operations and Maintenance Plan**

Final

Client: Shellharbour City Council

Prepared by:

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## Authority and Endorsement Statement

The Shellharbour City Centre Detention Basin Operations & Maintenance Plan (O&MP) has been prepared by Molino Stewart Pty Ltd for Shellharbour City Council (SCC) to comply with the Dams Safety Act, 2015 and the Dams Safety Regulation, 2019.

Prepared by Filippo Dall'Osso

Signed by



Steven Molino, Director  
Molino Stewart Pty Ltd

Dated: 19/12/2021

APPROVED

Shellharbour City Council (SCC / Council) hereby adopts the notification and responsibility details contained within this document in accordance with the requirements of Dams Safety NSW (DSNSW).

Signed by Ben Stewart  
Director Amenity and Assets  
Shellharbour City Council

(Representing Council as Asset Owners Representative)

Dated:

## Document Control and Review

Under Dams Safety New South Wales (DSNSW) definition, the consequence category of the Detention Shellharbour City Centre Detention Basin is currently Significant. As per Section 16 (3) of the Dams Safety Act 2015 and subclause 9 (4) of the Dams Safety Regulation 2019, this O&MP must be updated every five years. The review should generate a new version of this report. Appendix C provides the following forms to support revisions and amendments of this plan:

- **Document Revisions and Control.** This table should be used by Council to document the process for reviewing the O&MP on a five-yearly basis (i.e. document version, year, authors, reviewers)
- **Amendments to Contact Details.** This form should be used by Council to include the contact details of the staff covering the positions within Council that have responsibilities in this O&MP. These positions are nominated in Section 2.3 of this O&MP. Any amendments to the above contact details should be recorded in this form as soon as these occur.
- **Amendments to Text Items.** Any amendments to the content of this O&MP should be recorded in this form.

## Distribution List

| Designation/Organisation                         | Control Copy Number |
|--------------------------------------------------|---------------------|
| Director Amenity and Assets, SCC                 | 001                 |
| Group Manager Services, SCC                      | 002                 |
| Group Manager Asset Strategy, SCC                | 003                 |
| Group Manager Built and Natural Environment, SCC | 004                 |
| Manager, Risk and Audit                          | 005                 |
| Dam Safety New South Wales (DSNSW)               | 006                 |
|                                                  |                     |
|                                                  |                     |

### NOTES:

1. The number and location of each document within SCC is the responsibility of SCC
2. Asset Strategy is responsible for circulating any amendments to the O&MP internally and to DSNSW.
3. It is the responsibility of each nominated position to acknowledge receipt of the amendments and advise that their copy of the O&MP has been updated accordingly.



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# 1 | Introduction

## 1.1 Legislative Requirements

From 1 November 2019, the NSW legislation around dam safety was updated with the commencement of the Dams Safety Act, 2015 (the “Act”). The Act superseded the Dams Safety Act 1978 and introduced the new Dams Safety Regulation 2019 (the “Regulation”). The Regulation sets out operational details and safety standards that declared dam owners must comply with to satisfy the provisions of the 2015 Act.

A new body, Dams Safety NSW (DSNSW), was created under the new Act. It replaces the Dam Safety Committee and is tasked with regulating the safety of dams in NSW.

With regard to Operations and Maintenance Plans, Clause 9 of the Regulation specifies that:

- (1) *An operations and maintenance plan under section 16(1) of the Act for a dam must set out the following*
  - a) *the operating procedures for the dam with a concise description of the procedures and limits (operator controls) of plant and equipment used in the operation of the dam,*
  - b) *details of each circumstance in which an alarm will be triggered in respect of the dam and the response and reporting protocols that will occur when that alarm is triggered,*
  - c) *the maintenance (comprising corrective and preventive) that will be carried out on the dam, the times at which that maintenance will be carried out and who is responsible for the maintenance,*
  - d) *the procedures for reporting incidents in respect of the dam,*
  - e) *the procedures to ensure public safety in respect of the dam during its day to day operation,*
  - f) *the security measures that are in place in respect of the dam.*
- 2) *The operations and maintenance plan must*
  - a) *set out how the matters in subclause (1) will apply in normal, abnormal and extreme loading operation conditions, and*
  - b) *be appropriate to the size and complexity of the dam and its associated structures and systems.*
- 3) *The operations and maintenance plan may include any other matter that the dam owner considers to be relevant to the operation and maintenance of the dam.*
- 4) *The operations and maintenance plan for a dam categorised as significant consequence, low consequence or very low consequence must be updated at least once every 5 years. Note. Section 16 (3) of the Act requires all other operations and maintenance plans to be updated on an annual basis.*
- 5) *The owner of a declared dam must, if required by notice in writing to do so by Dams Safety NSW, provide Dams Safety NSW with a copy of the operations and maintenance plan within the time, and in the form, specified in that notice.*

Under the provisions of the *Dams Safety Act 2015*, DSNSW administers the legislation to ensure that any risks to public safety or environmental and economic assets are of a level that is acceptable to the community.

Amongst the functions of DSNSW is: *to provide guidance to owners of declared dams in complying with the requirements of this Act relating to the safety, operation and maintenance of dams (including*



*guidance in applying total risk management and the principles of cost benefit analysis for that purpose).*

Within that function, the need for Operations and Maintenance Plans is specifically identified. Under section 16(1) of the Act, an O&MP must set out the operating procedures for the dam and the maintenance (corrective and preventive) that will be carried out on the dam, the times at which that maintenance will be carried out and who is responsible for the maintenance.

## 1.2 Scope of this Plan

This document covers the general operations and maintenance of the detention basin known as Shellharbour City Centre Detention Basin and provides information necessary for monitoring its condition and any remedial actions required in both a day to day and emergency situations.

The Shellharbour City Centre Detention Basin lies within the commercial centre of Shellharbour and is bounded by New Lake Entrance Road to the north, Bunnings Warehouse to the west, Minga Avenue to the east and Cygnet Avenue to the south. The dam is primarily a detention basin with permanent storage of water for the purpose of wetland functionality. Shellharbour City Centre Detention Basin is Declared by DSNSW.

It is noted that the Act specifies that the O&MP must be appropriate to the size and complexity of the dam and its associated structures and systems. It recognises that the scope and complexity of the O&MP should reflect the status, type, size and complexity of the dam under consideration. This indication is consistent with the guidelines for Operations and Maintenance Plans (DSNSW, 2020), that were reviewed and considered in preparing this Plan.

Shellharbour City Centre Detention Basin is a relatively small, simple and passive detention basin with no operating parts, plant or any forms of technology. The major activities relating to the basin covered by this O&MP concentrate on the basic operation, inspection (monitoring) and maintenance of the structure and any repair work that may be required. The operation of the basin during a flood are described in the basin's Emergency Plan (EP, Molino Stewart, 2021).

Finally, Clause 9.2.a of the regulation requires that an O&MP sets out how the operation and maintenance instructions *will apply in normal, abnormal and extreme loading operation conditions*. Shellharbour City Centre Detention Basin holds water at all times, however the permanent depth at the dam embankment is approximately 1 m and the level differential between the permanent water level and the toe of dam is only <3 m. For these conditions Sunny Day Failure is considered highly unlikely and in the event of a breach the resulting flood wave is expected to be relatively insignificant (Cardno, 2014). As such, two main loading conditions were identified for this basin: a) normal loading, when the depth of water in the dam is about 1m, and b) emergency conditions, occurring during a flood event. As the management of the basin during flood emergencies is addressed in the EP, this O&MP will primarily refer to normal loading conditions and will cross reference to the EP for management under flood conditions.

## 1.3 Safety Management System

The Regulation requires that the owner of a declared dam establishes and implements a Dam Safety Management System (DSMS) as the primary means of ensuring that risks to public safety and to environmental and economic assets from dam failure are managed throughout the life cycle of the dam, including the design, construction, operation and maintenance and decommissioning of the dam.



Figure 1 (from DSNSW's guidelines), depicts the relationship between this plan, the Emergency Plan (formerly named DSEP) and the DSMS. The DSMS is to implement a risk management framework process, which informs the development and implementation of the O&M Plan.

The approach adopted by Shellharbour City Council is that the DSMS is primarily documented through the Risk Management chapter of the Stormwater Asset Management Plan. Through this document, the hazards that declared dams are susceptible to are considered and appropriate surveillance, operation and maintenance mitigation measures are determined. These mitigation measures are then enshrined within the Operations & Maintenance Plan and Emergency Plan.

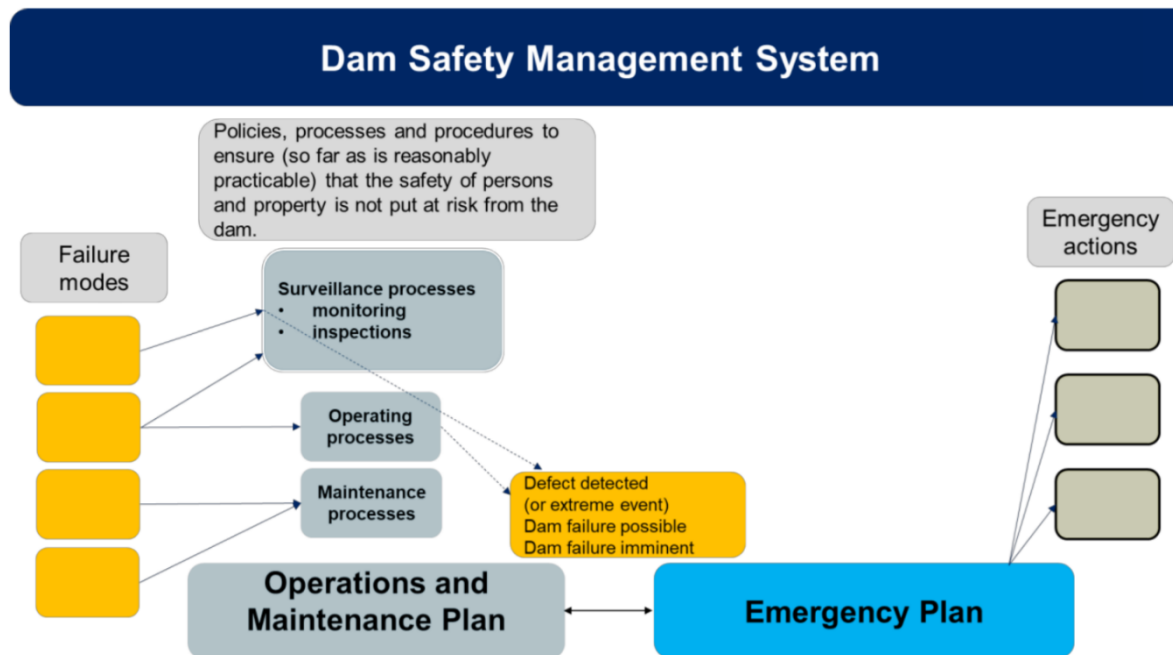


Figure 1. Relationship between this Plan and the overall DSMS (DSNSW, 2020).

## 1.4 Supporting Documents and Appendices

The major supporting documents for this Plan are:

- Emergency Plan – Shellharbour City Centre Detention Basin, Molino Stewart, 2021;
- Shellharbour City Centre Basin- Dam Break Study, Cardno, May 2014.

The following Appendices are provided at the end of this report:

Appendix A - Abbreviations and a glossary of the technical terms used in this report.

Appendix B - Summary of the key basin data.

Appendix C - Document Revision Forms.

Appendix D - Inspection Form.

Appendix E - Incident Report Form.

Appendix F - Emergency Remedial Measures.

## 2 | General

### 2.1 Description of the Basin

The Shellharbour City Centre Detention Basin lies within the commercial centre of Shellharbour and is bounded by New Lake Entrance Road to the north, Bunnings Warehouse to the west, Minga Avenue to the east and Cygnet Avenue to the south.

The dam is primarily a detention basin with permanent storage of water for the purpose of wetland functionality. The dam has one minor discharge outlet which consists of a 900 mm x 900 mm overflow pit and connecting outlet pipe. Flows exceeding the capacity of this outlet discharge via a depression in the embankment on the north-eastern extent of the dam. The spillway is directed towards Minga Avenue, which in turn falls towards New Lake Entrance Road.

The dam detains runoff from an urbanised catchment, which generally slopes from south to north before discharging into Lake Illawarra. The catchment consists of carparks, residential development, roads and grassed reserves. The dam is located on the elevated, southern side of New Lake Entrance Road. The catchment downstream of the dam is primarily residential development. Lake Illawarra lies approximately 1km downstream of the dam.

The layout of the basin is provided in Figure 3, while its main features are summarised in Table 1. For a full list of the key basin data, including design drawings and site access map, refer to Appendix B.

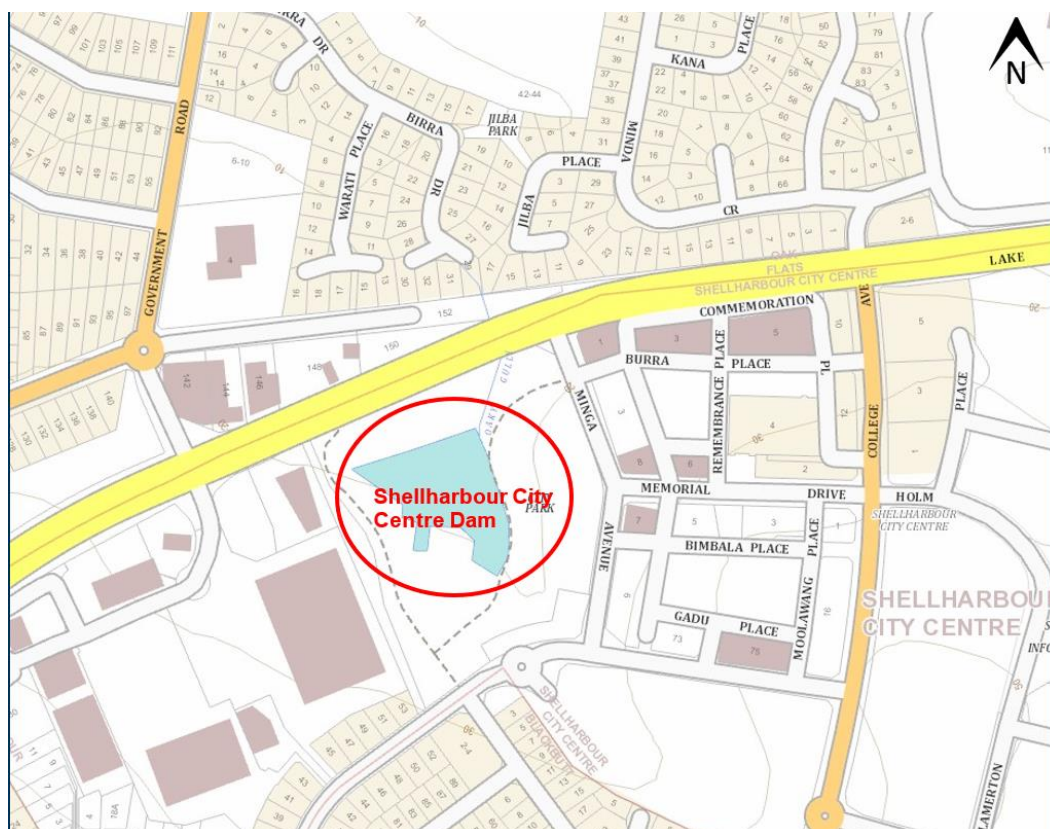


Figure 2. Location of the Shellharbour City Centre Detention Basin



Figure 3. Layout of the Shellharbour City Centre Detention Basin

Table 1. Principal features of Shellharbour City Centre Detention Basin

|                         |                                                                                                  |
|-------------------------|--------------------------------------------------------------------------------------------------|
| Type                    | Homogenous Earth Fill                                                                            |
| Maximum Height          | 5m                                                                                               |
| Length of dam crest     | 200m                                                                                             |
| Level of dam crest      | 21.0m AHD                                                                                        |
| Dam Capacity            | 8.7ML storage on sunny day<br>50ML storage at dam crest level (8.7ML + 41.3ML detention storage) |
| Outlet                  | 900mm x 900m Grated Field Inlet                                                                  |
| Grate Level             | 18.07 m AHD                                                                                      |
| Spillway Type           | Uncontrolled Weir – Homogenous Earth Fill                                                        |
| Weir crest length/level | 15m / 20.6m AHD                                                                                  |



## 2.2 Consequence Category (Consequence of Failure)

### 2.2.1 Sunny Day Consequence Category (SDCC)

The SDCC for Shellharbour City Centre Detention Basin is considered to be Very Low. A Sunny Day failure was considered in the dam break modelling exercise (Cardno, 2014), however it was identified that the permanent depth at the dam embankment is approximately 1 m and the level differential between the permanent water level and the toe of dam is only <3 m. For these conditions, Sunny Day Failure was considered highly unlikely and in the event of a breach the resulting flood wave is expected to be relatively insignificant. Hence detailed hydraulic modelling of the Sunny Day failure was not considered necessary.

### 2.2.2 Flood Consequence Category (FCC)

The FCC for the basin considered to be Significant (Cardno, 2014). This was based on a Potential Loss of Life (PLL) of 0.86 and a "Medium" loss severity. The incremental Population At Risk (PAR) was found to be maximum in the 1,000 year ARI event, and equal to 86 people for a night time event with dam break.

## 2.3 Management and Responsibilities

### 2.3.1 Key Personnel and their Responsibilities

General operation and maintenance of Shellharbour City Centre Detention Basin is the responsibility of SCC. Under the organisational arrangements within Council, the occupants of the following positions are the key personnel responsible for the operation and maintenance of the detention basin:

- Group Manager Asset Strategy – All safety inspections, determination of corrective maintenance measures, review and update of the Operations and Maintenance Plan.
- Group Manager Services – Preventive maintenance and emergency operations.
- Group Manager Built & Natural Environment - Nomination of Council's Dam Safety Specialist consultant, update and review of Emergency Plan.

The responsibilities of the above listed personnel with regard to operations, surveillance and maintenance are further detailed in the relevant sections of this Plan.

**Appendix C provides a table for Council to record and amend the contact details of the personnel covering the positions mentioned above.** Any changes in staff, role or contact details should be reflected in such table as soon as these occur.

### 2.3.2 Training and Competency

Council must ensure that all personnel involved in the operations and maintenance of the basin are competent, based on appropriate education, training, or experience. Importantly, it is a responsibility of Council that the personnel involved in this O&M Plan are trained to identify and report conditions that could lead to dam failure.

Alternatively, Council may utilise external contractors to carry out some of the operations and maintenance tasks listed in this report. In this case, Council must ensure that contractors are trained and competent.

### 2.3.3 Security Measures

Security measures are intended as measures to reduce the risk that the basin or any parts of it may be damaged by credible security threats. An assessment of security threats in respect to the basin was undertaken, which reviewed all possible threats and assessed if these would warrant the implementation of security measures. As the basin does not include any plant, equipment or machinery which could reasonably be considered to be exposed to or damaged by security threats, the analysis concluded that no special security measures are required. This O&M Plan recommends installing flood warning signs, gauge plates and/or a telemetered water level meter. Once installed, the risk of these items being damaged by vandalism or the weather will be managed by inspecting the basin regularly and promptly repairing or replacing any damaged items, as per the surveillance and maintenance arrangements set out in this O&M Plan.

### 2.3.4 Safety Measures

Safety measures are intended as measures to reduce the risk to public safety and protection of people attending the dam site during its day-to-day operation. It is a requirement of the regulation, Clause 9 (1)(e), that these measures are described in each O&M Plan.

The basin is a public space and no significant risks to the general public visiting the basin outside a flood emergency were identified. The risk of this happening during a flood event is managed by the use of suitable flood warning signage, to be installed within six months of adoption of this Plan.

All credible safety risks and relevant recommended controls are summarised in Table 2.

Table 2. Safety risk and controls

| Part of the Basin                | Potential Hazard                                                    | Associated Risks                                                                                                      | Risk Controls                                                                           |
|----------------------------------|---------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| <b>Dam reservoir</b>             | Permanent pond of water within dam                                  | <ul style="list-style-type: none"> <li>Contact to water if quality is poor</li> <li>Drowning</li> </ul>               | <ul style="list-style-type: none"> <li>Warning Sign "Do not enter the water"</li> </ul> |
| <b>Dam spillway</b>              | High velocity flow of water over spillway during a storm event      | <ul style="list-style-type: none"> <li>Injury/drowning</li> </ul>                                                     | <ul style="list-style-type: none"> <li>Flood Risk Warning Sign</li> </ul>               |
| <b>Low flow inlet pit</b>        | Water up to 3m deep draining through field inlet during storm event | <ul style="list-style-type: none"> <li>Entrapment underwater due to downward velocity of water towards pit</li> </ul> | <ul style="list-style-type: none"> <li>Flood Risk Warning Sign</li> </ul>               |
| <b>Stormwater Pits and Pipes</b> | Confined spaces                                                     | <ul style="list-style-type: none"> <li>Unsafe levels of oxygen</li> <li>Drowning</li> </ul>                           | <ul style="list-style-type: none"> <li>Use of locked grates at each pit</li> </ul>      |



## 3 | Risk Framework

### 3.1 Context

As discussed in Section 1.3 of this Plan, it is a requirement of the regulation that Council, as a declared dam owner, develops and implements a DSMS by November 2021.

Clause 14 of the regulation stipulates that the DSMS is to implement a risk management framework, which in turns informs the development and implementation of the O&M Plan. The scope of the risk framework is to identify all foreseeable hazards to the basin's safety and quantitatively assess the relevant risks. The hazards to be assessed include:

- (a) flood events including the contents of the dam rising higher than the wall of the dam and the performance of the spillways,*
- (b) seismic events including the impact of the event on the performance of the dam or the stability of the reservoir rim,*
- (c) internal erosion including the effects this may have on piping through the dam, the foundation of the dam or structures abutting the dam,*
- (d) seepage of the contents of the dam through the wall of the dam,*
- (e) the stability of the dam through all possible conditions,*
- (f) sabotage or vandalism,*
- (g) fire,*
- (h) mechanical, electrical or automated system failure that may result in an uncontrolled release of the contents of the dam,*
- (i) human factors.*

Results of the risk assessment are to inform the establishment of the basin operations and maintenance actions, so that these reduce the risks identified in the assessment to acceptable levels. Figure 4 (from DSNSW's guidelines), depicts the relationship between this O&M Plan, the DSMS and the risk framework.

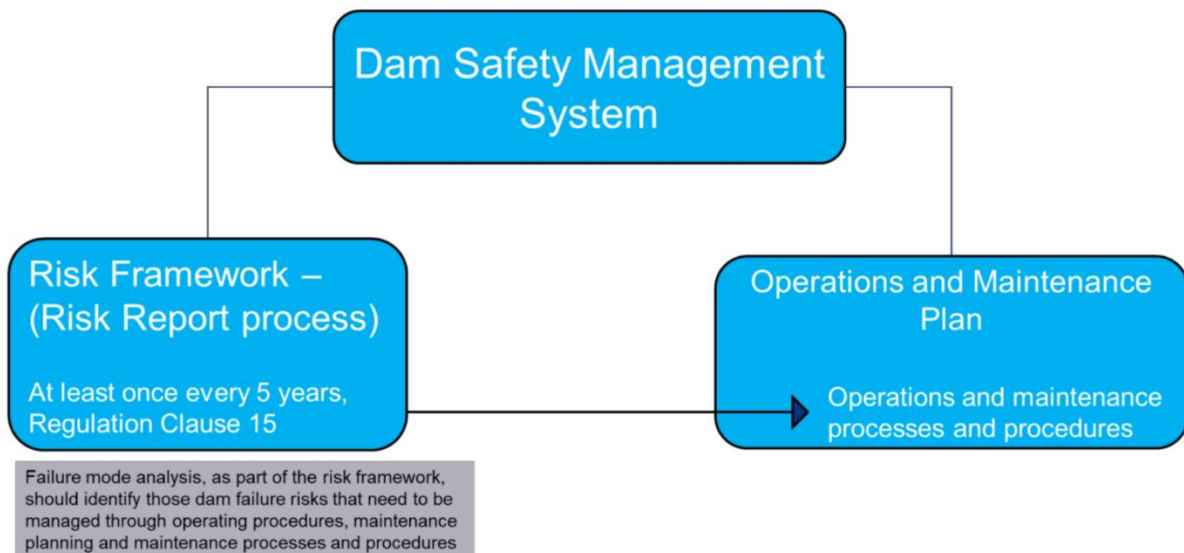


Figure 4. Chart showing how the risk framework and failure mode analysis is to inform the O&M Plan.

## 3.2 Risk Assessment

At the time this O&M Plan was prepared (i.e. September 2021), Council was finalising the dam safety management system, including the risk management framework. As such, a semi-quantitative risk assessment was undertaken as part of the development of this O&M Plan to identify the most typical occurrences that, in a basin like Shellharbour City Centre Detention Basin, may significantly increase the probability of a dam failure during a flood.

These “failure modes” and the relevant precursory signs are described in the following sub-sections. These were identified based on industry best practices for this type of detention basin (i.e. homogenous earthfill embankment with passive spillway), and on the assumptions and outcomes of the dam break assessment exercise (Cardno, 2014).

The operations and maintenance actions listed in this Plan were tailored to reduce the probability and consequences of the failure modes listed below. It is noted that these should be updated once the DSMS and a risk framework are put in place by Council.

### 3.2.1 Overtopping Failures

Overtopping failures result from the erosive action of water on the embankment. Erosion is due to uncontrolled flow of water over, around, and adjacent to the dam. Earth embankments are not designed to be overtopped and therefore are particularly susceptible to overtopping erosion. Once erosion has begun during overtopping, it is almost impossible to stop. A well vegetated earth embankment may withstand limited overtopping if its crest is level and water flows over the crest and down the face as an evenly distributed sheet without becoming concentrated. However, as soon as the overtopping flow concentrates, erosion may begin creating a deep, v-shaped scouring on the embankment crest.

The owner should closely monitor the reservoir pool level during severe storms as any sudden increase or decrease in level may indicate the failure of a basin component. After a flood event in which overtopping has occurred, severe overtopping erosion signs would be visible (i.e. deep, v-shaped scouring on the embankment crest).

It is also noted that a basin that cannot discharge floodwaters at the design flow capacity of the outlet or the spillway is more prone to overtopping erosion and failure, all other things equal. Occurrences which could lead to hydraulic deficiencies during a flood include, but are not limited to, significant obstructions of the spillway (e.g. debris, vegetation growth) or blocked pits or pipes (e.g. by siltation).

### 3.2.2 Seepage Failures

All earth dams have seepage resulting from water permeating slowly through the dam and its foundations. Seepage must be controlled in both velocity and quantity. If uncontrolled, it can progressively erode soil from the embankment or its foundation, resulting in rapid failure of the dam.

Erosion of the soil begins at the downstream side of the embankment, either in the dam proper or the foundation, progressively works toward the reservoir, and eventually develops a direct connection to the reservoir. This phenomenon is known as "piping." Piping action can be recognized by an increased seepage flow rate, the discharge of muddy or discoloured water, sinkholes on or near the embankment, or a whirlpool in the reservoir. Once a whirlpool (eddy) is observed on the reservoir surface, complete failure of the dam will probably follow in a matter of minutes. As with overtopping, fully developed piping is virtually impossible to control and will likely cause failure.

Seepage can also cause slope failure by creating high pressures in the soil pores or by saturating the slope. The pressure of seepage within an embankment is difficult to determine without proper instrumentation. A slope which becomes saturated and develops slides may be showing signs of excessive seepage pressure.

### 3.2.3 Structural Failures

Structural failures can occur in either the embankment or the appurtenances. Structural failure of a spillway, lake drain, or other appurtenance may lead to failure of the embankment. Cracking, settlement, and slides are the more common signs of structural failure of embankments. Cracks may appear in the crest or slopes of the dam. Cracking in an embankment dam falls into the following three principal categories:

- Longitudinal cracking
- Transverse cracking
- Desiccation cracking

#### (a) Longitudinal Cracking

Longitudinal cracking occurs in a direction roughly parallel to the length of the dam. It is an indication of:

- Uneven settlement between adjacent embankment zones of differing compressibility.
- Tension from excessive settlement and lateral spread of the embankment.
- The beginning scarp of an unstable slope. In this case, the crack may appear arc-shaped.

Longitudinal cracks allow water to enter the embankment. When water enters the embankment the strength of the embankment material adjacent to the crack may be lowered. The lower strength of the embankment material can lead to or accelerate slope stability failure.

#### (b) Transverse Cracking

Transverse cracking appears in a direction roughly perpendicular to the length of the dam. If Transverse cracks usually appear on the dam crest, near abutments, and in U-shaped or trapezoidal-shaped valleys.



The presence of transverse cracking indicates differential settlement within the embankment or underlying foundation. This type of cracking frequently develops when:

- Compressible embankment material overlies steep or irregular rock abutments.
- There are zones of compressible material in the foundation.

Transverse cracks may provide a path for seepage through the embankment. When the depth of the crack extends below the level of the reservoir, very rapid erosion of the dam may occur, eventually breaching the dam.

### (c) Desiccation Cracking

Desiccation cracking is caused by the drying out and shrinking of certain types of embankment soils. Desiccation cracks usually develop in a random, honeycomb pattern. Typically, desiccation cracking occurs in the crest and the downstream slope. The worst desiccation cracking develops when a combination of the following factors is present:

- A hot, dry climate accompanied by long periods in which the reservoir remains empty.
- An embankment that is composed of highly plastic soil, such as clay.

Usually, desiccation cracking is not harmful unless it becomes severe. The major threat of severe desiccation cracking is that this type of cracking can contribute to the formation of gullies. Surface runoff erosion concentrating in the desiccation cracks or gullies can result in eventual damage to the dam. In addition, heavy rains can fill up these cracks and cause portions of the embankment to become unstable and to slip along crack surfaces where the water has lowered the strength of the embankment material. Deep cracks that extend through the core conceivably can cause a breach of the dam when the water level rises and the cracks fail to swell rapidly enough to reseal the area.

Large cracks in either an appurtenance or the embankment, major settlement, and major slides will require immediate remedial measures to ensure safety, especially if these problems occur suddenly. If this type of situation occurs during a flood emergency, the water level should be lowered (if possible), the appropriate state and local authorities notified, and professional advice sought from Council's Specialist Dams Consultant.

## 3.2.4 Failure without Notice

A failure without any notice is likely to have a much worse impact on the Population At Risk (PAR), residing downstream of the basin, because the NSWSES may not have an opportunity to warn/evacuate these households in time. A failure without notice may occur if the gauge plate or the telemeter water level meter in the basin is damaged, removed or unreadable.

## 3.2.5 Considerations on Causality

The occurrences previously described are often interrelated in a complex manner. For example, uncontrolled seepage may weaken the soil and lead to a structural failure. A structural failure may shorten the seepage path and lead to a piping failure. Surface erosion may result in structural failure.

Minor defects such as cracks in the embankment may be the first visual sign of a major problem which could lead to failure of the structure. The seriousness of all deficiencies should be evaluated by someone experienced in dam design and construction. A qualified professional engineer can recommend appropriate permanent remedial measures.

## 4 | Operations

Clause 9 (1) (a) of the regulation stipulates that an O&M Plan *must set out the operating procedures for the dam with a concise description of the procedures and limits (operator controls) of plant and equipment used in the operation of the dam.*

As noted previously, Shellharbour City Centre Detention Basin does not incorporate any mechanical or electrical operational machinery or plant, relying on static pits, pipes and spillways to both store and release floodwaters after a flood event.

For this type of basins, DSNSW (personal communication) suggested to outline *the hydraulic functionality and expected performance of the basin.*

In addition to the above, this section will include a description of the basin's emergency operations. These include all instances in which the basin is subject to a flood and may contain water. Triggers, actions and responsibilities for all emergency operations are set in the basin EP (Molino Stewart, 2021) and summarised in this section.

Surveillance and monitoring procedures of the basin are outlined in Section 5, while Section 6 describes the procedures for incident recording and reporting.

### 4.1 Hydraulic Functionality and Expected Performance

The dam has one minor discharge outlet which consists of a 900 mm x 900 mm overflow pit and connecting outlet pipe. Flows exceeding the capacity of this outlet discharge via a depression in the embankment on the north-eastern extent of the dam. The spillway is directed towards Minga Avenue, which in turn falls towards New Lake Entrance Road. The current data available indicates that the basin exceeds the spillway level in the 0.2% AEP event (i.e. the 500 year ARI flood), i.e. the Dam Crest Flood.

The trigger heights reflected in Section 4.2.1 of this Plan and in the EP activate detailed actions as set out in the EP.

### 4.2 Emergency Operations

Emergency operations are here defined as all operations to be undertaken during an emergency. These operations are described in the basin's EP, (Molino Stewart 2021). The EP:

- Defines the triggers to be used by Council to switch from normal operation to emergency operation of the basin, as well as to escalate alert levels within an emergency;
- Provides detailed instructions for response actions, responsibilities and emergency reporting. The key items of the EP are summarized in the following sections.

#### 4.2.1 Emergency Triggers

The first trigger to go to emergency operations and monitoring is, as described in the EP, when the Bureau of Meteorology issues a Severe Weather Warning or a Severe Thunderstorm Warning for Illawarra/Wollongong or when rainfall in excess of 50mm/h is recorded at the Blackbutt pluviometer. Subsequent alert levels are defined by the storage level in the basin and by the overall condition of the basin, as shown in Table 3.



Table 3. Alert levels and corresponding alerts - flood

| <b>Alert</b>      | <b>Trigger</b>                                                                                                                           | <b>Annual Exceedance Probability</b> | <b>Time from beginning of rainfall in a PMF</b> |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-------------------------------------------------|
| <b>PROTECTION</b> | A Severe Weather Warning is issued by the Bureau of Meteorology<br>Or heavy rainfall (i.e. 50mm/h) recorded at the Blackbutt pluviometer | Several times per year               | NA                                              |
| <b>WHITE</b>      | 19.6m AHD (water 1.0 m lower than spillway)<br>OR<br>Serious structural damage without imminent flow through embankment                  | 5%                                   | 17 mins                                         |
| <b>AMBER</b>      | 20.2m AHD (water 0.4 m lower than spillway)<br>OR<br>Serious structural damage with imminent flow through embankment                     | 1%                                   | 22 mins                                         |
| <b>RED</b>        | 20.7m AHD (water 0.1m over spillway)<br>OR<br>Serious structural damage causing flow through embankment                                  | 0.1 – 0.2%                           | 27 mins                                         |

Actions, responsibilities and notification protocols for each alert level are described in the EP.

## 4.2.2 Emergency Monitoring

The main operational process during emergencies is the monitoring of water levels within the basin under flood conditions and the passage of that information to the necessary officers of Council in accordance with the measures outlined in the EP.

Water levels are to be monitored remotely via a telemetered water level meter (to be installed by Council within six months from adoption of the 2021 EP). In addition, when a White Alert is triggered, water levels, rate of rise and overall basin conditions are to be monitored on-site by an observer from Council, using a gauge plate labelled by heights and colours reflecting the warning trigger levels detailed in the Emergency Plan. The EP (Molino Stewart, 2021) defines roles and responsibilities during each phase of a flood emergency.



## 5 | Inspections

The section describes the scope, frequency, and responsibilities of the basin surveillance inspections.

### 5.1 Inspection Frequency

Routine inspections for Shellharbour City Centre Detention Basin should be undertaken monthly and comprehensive inspections undertaken on a five yearly basis as per the ANCOLD Guidelines on Dam Safety Management (2003). The nominated frequency of routine inspections was deemed consistent with the most likely failure modes and precursory signs listed in Section 3.2, and the consequence category of the basin.

Extraordinary inspections of the basin are to be carried out after any of the emergency triggers in the EP have been activated, and the emergency has passed. Typically, this will occur after a flood or earthquake event.

CCTV inspections of the drainage system that leads to and takes water from the basin is to be undertaken every five years in conjunction with the comprehensive dam inspection.

This approach is considered sufficient to meet the ANCOLD Guidelines on Dam Safety Management (2003).

### 5.2 Scope of Inspections

Appendix D of this Plan includes a checklist/report form listing all the possible issues which could be detected during a basin inspection. The inspection checklist/report form is based on DSNSW guidelines and is to inform the data to be collected in the field during inspections. The form includes, in addition to the basic data of basin name, date of inspection, and identity of inspector, the following aspects:

- Earth Structure Component (e.g. Embankment);
- Drainage Structure Component (e.g. Pit and pipes);
- Flow Area Component (e.g. overland flow paths, spillway, downstream channels, rock drop structures);
- Appurtenant Works (e.g. concrete footpath, signage, gauge plate, telemetry); and
- Site Inspection Photos

As all parts of the basin infrastructure are static, this form covers the scope of all inspection types. However, it is noted that:

- Comprehensive inspections are to undertake a more in-depth review of the basin structural soundness and may require additional analysis such as a geotechnical investigation; and
- The scope of CCTV inspections of the drainage system is restricted to the functionality of this system only, which is addressed in a subsection of Appendix D.

All observations/issues noted during the inspections are to be documented, including photographs of relevant details, and referred to Council's maintenance staff or senior engineering staff as appropriate.

The issues detected in routine inspections may include normal (i.e. lower priority) and unusual (i.e. higher priority) occurrences. For example, normal, lower priority issues for this basin may include the observation of grass cover requiring mowing, bare patches on crest or wall of earth embankment, minor holes in the crest and walls (particularly from rabbit infestations), and minor cracks in earthworks and concrete pathway.



Unusual, higher priority issues are those likely to increase the probability or the adverse impacts of a dam failure. For this basin, the following unusual occurrences may be observed during inspections:

- Severe damage on the embankment wall face. Signs of overtopping erosion (i.e. deep, v-shaped scouring on the embankment crest), significant cracking (>1cm in width or 50cm in length in one month), sinkholes, seepage erosion or piping signs;
- Occurrences that may cause severe hydraulic deficiencies (i.e. severe obstructions of outlets or spillway from debris, siltation, vegetation growth);
- Failure of any portion of the structures;
- Any damages to the gauge plate or telemetry which will compromise its functionality.

For a more detailed description of these occurrences and the failure mode these could induce, refer to Section 3.2.

**All unusual occurrences must be identified when completing the Inspection Form (Appendix D) and marked as requiring urgent repair.**

## 5.3 Responsibilities of Inspections

All inspections are to be carried out under the responsibility of Group Manager Asset Strategy. The Asset Officers within the Asset Planning Team, who reports to Group Manager Asset Strategy, are responsible for the successful completion of all routine inspections.

Personnel involved in undertaking, reviewing and reporting the basin inspections must be knowledgeable of the potential problems which can lead to failure of a dam. These people regularly view the structure and, therefore, need to be able to recognise potential problems so that failure can be avoided. Since only surface inspections of a dam can usually be made, it is imperative that owners and maintenance personnel be aware of the prominent types of failure and their telltale signs.

CCTV inspections of the stormwater system will be undertaken by specialised contractors.

Comprehensive, five-year inspections must be undertaken a qualified structural/dam engineer (e.g. Council's Specialist Dam Consultant). Following a comprehensive inspection, the structural/dam engineer may recommend further investigations (e.g. geotechnical analysis).

## 5.4 Inspections Recording and Reporting

The data collected during routine inspections will be captured through the Technology One Works System, specifically the test point & defects module. The Technology One system will automatically generate the inspection work order, notifying the Asset Officer of the required inspection, with the inspection sheet being attached to the work order. The inspection data will then be entered into this inspection sheet and any identified defects raised against the asset. Appendix D is to be used to inform the generation of the inspection sheets via the Technology One system.

The results of the routine inspections will be analysed and used to determine any required corrective maintenance works.

In addition to the above, any incidents detected during the inspections are to be reported within Council and to DSNSW as per the procedure set out in Section 6.

## 6 | Recording and Reporting Procedures

Clause 9 (1) (b) of the regulation stipulates that an O&M Plan must set out the *details of each circumstance in which an alarm will be triggered in respect of the dam and the response and reporting protocols that will occur when that alarm is triggered.*

The basin has a passive design with no automated alarms, other than the flood alerts triggered by the telemetry system (to be installed within 6 months from adoption of the EP). The EP sets the triggers for entering and escalating emergency response operations, as well as the corresponding recording and notification procedures and responsibilities. The EP emergency triggers are summarised in Section 4.2.

With regard to other types of “alarms” (i.e. those not necessarily triggering an emergency response), DSNSW recommended to consider *any alarms that are manually read (e.g triggered by operations staff for further actions which may include remedial and corrective actions)* (personal communication). For Shellharbour City Centre Detention Basin, these may include “normal” and “unusual” occurrences. Some of the unusual occurrences may be classified as “incidents”. **An incident is here defined as an unusual occurrence which, because of its serious safety implications, requires the involvement of DSNSW.** As such, incidents have a different recording and reporting procedure from all other occurrences. This is further detailed in the following sections.

### 6.1 General Occurrences

The recording and reporting procedures of normal and unusual occurrences **that are not incidents** are detailed in Section 5.4.

### 6.2 Incidents

Incidents may be typically detected in two main fashions:

- Through surveillance inspections, especially in extraordinary inspections, as discussed in Section 5; and
- When monitoring the basin during flood emergencies, as discussed in Section 4.2.

For Shellharbour City Centre Detention Basin, typical incidents include:

- Overtopping erosion (i.e. deep, v-shaped scouring on the embankment crest);
- Seepage erosion;
- Piping;
- Large sinkholes in the flow area or embankment;
- Cracking of the dam (>1cm in width or 50cm in length in one month);
- Rapid increase or decrease in the water level within the storage and/or turbid water seepage;
- Failure of any portion of the structures;
- Flood levels above the amber alert level;
- Earthquakes with magnitude greater than M4.

A more comprehensive description of these incidents and the relevant possible basin failure modes is provided in Section 3.2.

Any incidents detected during surveillance inspections are to be recorded in the relevant Inspection Form (Appendix D). In addition, any incidents (including those detected during surveillance inspections and/or during flood emergency monitoring) should be escalated immediately (the day they are



discovered) to the SCC Dam Owners Representative. This should be done in writing (via email) as a minimum, using the Incident Report form in Appendix E of this report, and including as much detail as possible.

As per Clause 19 of the regulation, the SCC Dam Owners Representative is to then forward this report directly to Dams Safety NSW (info@damsafety.nsw.gov.au), who will determine what further investigation or additional reports maybe be required. Alternatively, the submission to DSNSW can be undertaken using DSNSW's online incident reporting form (<https://www.damsafety.nsw.gov.au/report-an-incident/>). When submitting an incident to DSNSW, this is to be classified in the possible incident categories set by DSNSW, namely:

- *failure of the dam without release of the dam contents (the dam ceases to perform its functions)*
- *failure of the dam, with release of the dam contents, but without a catastrophic breach*
- *failure of the dam with loss of the dam contents due to a catastrophic breach*
- *any incident or change observed in the dam or its surrounds which could indicate an increased vulnerability to failure (for example, a sudden increase in seepage flow not related to rainfall, appearance of turbidity in seepage flow, appearance of new seeps, appearance of cracking in the dam). This would cause the owner of the dam to become aware of the likely failure of the dam*
- *an incident that results in the death or serious injury of a person or that results in significant damage to property or the environment*
- *a serious failure or inadequacy in the dam safety management system and associated documentation that could potentially have caused death, serious injury, property damage, or environmental impact*
- *a suspected terrorist attack*
- *an incident relating to dam safety that is reasonably likely to cause concern to members of the public*
- *any change in the dam or its surrounds that is abnormal and could indicate an increased risk of the failure of the dam. This includes incidents which could interfere with correct functioning of the dam (for example, a landslide into a spillway chute, malfunction of emergency dewatering valves, malfunction of spillway gate operating equipment)*
- *breaches of security with implications for dam safety*
- *a failure of a control system that had the potential to cause a dam failure.*

The above categories are included in DSNSW's online incident reporting form and in the Incident Report form in Appendix E, so that the relevant incident category can easily be determined regardless of the preferred reporting method.

It is critical that SCC staff report all unusual occurrences or incidents, even if they feel it may be a minor issue. Failure to do so will be dealt with under Council's Appropriate Work Health & Safety Policy and Code of Conduct Policy.



## 7 | Maintenance

It is reiterated that Shellharbour City Centre Detention Basin is a passive basin system without any significant plant or equipment, alarms or any forms of technology, other than the telemetry system (to be installed within 6 months from adoption of the 2021 EP). The relevant maintenance procedures have been divided in preventive and corrective maintenance, in line with DSNSW's guidelines.

It is essential that SCC identifies the basin as a maintenance activity in its overall area-wide maintenance systems. Council's Asset Strategy and Services Group branches are to be the determination authorities of this activity.

### 7.1 Preventive Maintenance

Preventive maintenance refers to all activities that are to be routinely undertaken independently of the outcomes of the safety inspections or any reported incident. Preventive maintenance is a responsibility of the Group Manager Services. The schedule of routine maintenance is shown in Table 4.

Table 4. Preventive maintenance

| Preventive Maintenance |                            |           |
|------------------------|----------------------------|-----------|
| Activity               | Team Responsible for works | Frequency |
| Mowing                 | Services Group             | Quarterly |

### 7.2 Corrective Maintenance

Corrective maintenance actions are defined as those to be undertaken in response to the any observations or incidents detected in routine or extraordinary inspections of the basin, or brought to Council's attention by third parties (e.g. a member of the public). Corrective maintenance includes any remedial actions that may be required during an emergency, in response to incidents or observations which could threaten the performance of the basin.

Upon receipt of the completed inspection sheet (to be informed by Appendix D), Council's Asset Strategy Group will follow the process below to ensure that any necessary repair work is undertaken timely:

- Review the inspection report and determines what work/repair action is required.
- Inform Council's Specialist Dam Consultant for any complex issues and seek technical advice as required.
- A work order is to be generated for the work/repair action(s) required through the Technology One Works System and tasked to the Services Group. The work order is to include details of the requirement – location of defect, remediation treatment, response time, etc.
- Services Group will then assign the work order to a Civil Coordinator to complete the identified work.
- In case of genuine emergency when urgent work or material is required to protect the detention basins from being detrimentally affected, normal procurement procedures may not be applicable. In these instances, Council's Services Group must remove the immediate threats or risk and secure the site. Once the site is secured, normal procurement procedures apply to any ongoing rectification works.



If any incidents are detected during a flood emergency, suitable emergency remedial actions are to be promptly conducted as per the basin EP. Appendix F provides guidance on remedial actions for typical incidents, including emergency remedial measures.

Examples of corrective maintenance interventions, classified according to the priority of the issue to be addressed, are shown in Table 5 and Table 6.

Table 5. Corrective maintenance for normal occurrences

| Corrective Maintenance for Normal Occurrences*                                               |                                                                                                       |                                                                               |                                                                              |
|----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| * Programmed repair recommended - repair to commence within one month                        |                                                                                                       |                                                                               |                                                                              |
| Issue                                                                                        | Treatment Description                                                                                 | Intervention Level                                                            | Team responsible for works                                                   |
| Scouring or cracking on earth embankment                                                     | Minor repairs of scouring<br><br>Fill, compact and revegetate eroded areas in the basin and channels. | Any scour depth >300mm                                                        | Asset Strategy Group to task the job to Council's Services Group             |
| Overgrown grass                                                                              | Mowing at specified frequency                                                                         | Maintain vegetation height to max 100mm                                       |                                                                              |
| Sediment accumulation in ponds                                                               | Remove accumulated sediment and dispose of off site                                                   | Performed when sediment accumulation occupies 20% of storage capacity         |                                                                              |
| Trees/shrubs/weeds in flow areas                                                             | Remove and reinstate site                                                                             | Vegetation above 300mm                                                        |                                                                              |
| Damaged or vandalised warning signs                                                          | Replace damaged or vandalised signs                                                                   | Sign unsuitable for use                                                       |                                                                              |
| Damaged drainage or ancillary assets (i.e. pits, grates, spillway, channel, rock protection) | Repair as required to maintain asset functional.                                                      | Damaged, crack, loss of function or safety concern.                           |                                                                              |
| Debris in drainage structures                                                                | Clean and dispose of debris offsite                                                                   | When debris occupies 20% of chamber                                           |                                                                              |
| Bare patch on embankment                                                                     | Placement of turf or grass seeding                                                                    | For patches where dirt is easily airborne, and greater than 0.5m <sup>2</sup> |                                                                              |
| Animal burrows                                                                               | Seek specialist advice                                                                                | Any animal burrow                                                             | Asset Strategy Group to seek advice from Council's Specialist Dam Consultant |
| Seepage                                                                                      | Seek specialist advice                                                                                | Any seepage                                                                   |                                                                              |
| Damaged or cracked concrete footpaths                                                        | Repair                                                                                                |                                                                               | Asset Strategy Group to task the job to Council's Services Group             |



Table 6. Corrective maintenance for unusual occurrences, including incidents

| <b>Corrective Maintenance for Unusual Occurrences or Incidents*</b><br><i>*Urgent repair is necessary - repair to commence within two (2) weeks</i> |                        |                                                                                      |                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Occurrence                                                                                                                                          | Treatment Description  | Intervention Level                                                                   | Team responsible for works                                                   |
| Overtopping erosion                                                                                                                                 | Seek specialist advice | Deep, v-shaped scouring on the embankment crest                                      | Asset Strategy Group to seek advice from Council's Specialist Dam Consultant |
| Severe obstruction of outlets by debris or siltation                                                                                                | Remove blockage        | When blockage exceeds 50%                                                            | Asset Strategy Group to task the job to Council's Services Group             |
| Severe blockage of spillway by debris or vegetation growth                                                                                          | Remove blockage        | Significant growth of plant or trees, large debris (e.g. furniture rubbish)          |                                                                              |
| Severe seepage erosion                                                                                                                              | Seek specialist advice | Equivalent to a drip per second                                                      | Asset Strategy Group to seek advice from Council's Specialist Dam Consultant |
| Piping                                                                                                                                              | Seek specialist advice |                                                                                      |                                                                              |
| Large sinkholes in the flow area or embankment                                                                                                      | Seek specialist advice | 500mm or more                                                                        |                                                                              |
| Cracking of flow area or embankment                                                                                                                 | Seek specialist advice | >1cm in width or >50cm in length in one month                                        |                                                                              |
| Any other significant structural failure                                                                                                            | Seek specialist advice |                                                                                      | Asset Strategy Group to task the job to Council's Services Group             |
| Damage to gauge plate or telemetry                                                                                                                  | Repair or replace      | Gauge plate or telemetry severely damaged, removed or with compromised functionality |                                                                              |

## 7.3 Budget Considerations

It is essential that Council includes sufficient funding the maintenance budgets of Council's Services Group to ensure the timely completion of any detention basin maintenance/repair work.



## 8 | References

ANCOLD (Australian National Committee On Large Dams), 2003. Guidelines on Dam Safety Management.

Cardno, Shellharbour City Centre Basin- Dam Break Study, May 2014

Dams Safety NSW, 2020. Guideline: Operations and Maintenance Plans.

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U S Bureau of Reclamation, Inspection of Embankment Dams, Chris J. Veesaert, P.E.

U S Bureau of Reclamation, Training Aids for Dam Safety, Inspection of Embankment Dams

United States Bureau of Reclamation, 1982. ACER Technical Memorandum No. 3 "Criteria and Guidelines for Evacuating Storage, Reservoirs and Sizing Low-Level Outlet Works."

## **Appendix A | Abbreviations and Glossary of Terms**

## Abbreviations

| <i>Term</i>   | <i>Meaning</i>                              |
|---------------|---------------------------------------------|
| <b>AEP</b>    | Annual Exceedance Probability               |
| <b>AHD</b>    | Australian Height Datum                     |
| <b>ANCOLD</b> | Australian National Committee On Large Dams |
| <b>DCF</b>    | Dam Crest Flood                             |
| <b>DFL</b>    | Dam Flood Level                             |
| <b>DSNSW</b>  | Dams Safety NSW                             |
| <b>EP</b>     | Emergency Plan                              |
| <b>FSL</b>    | Full Supply Level                           |
| <b>IFF</b>    | Imminent Failure Flood                      |
| <b>PAR</b>    | Population at Risk                          |
| <b>PMF</b>    | Probable Maximum Flood                      |
| <b>PMP</b>    | Probable Maximum Precipitation              |
| <b>SCC</b>    | Shellharbour City Council                   |

## Glossary of Terms

| <i>Term</i>                                | <i>Meaning</i>                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Abutment</b>                            | That part of the valley wall against which the basin/dam is constructed.                                                                                                                                                                                                                                                                       |
| <b>Australian Height Datum (AHD)</b>       | A system of control points for height based on a network of levelling measurements which covered the whole of Australia and which was fitted to mean sea level as measured at tide gauges distributed around the Australian coast, over the period 1968-1970.                                                                                  |
| <b>ANCOLD</b>                              | Australian National Committee on Large Dams.                                                                                                                                                                                                                                                                                                   |
| <b>Annual Exceedance Probability (AEP)</b> | The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, if a peak flood discharge of 500 m <sup>3</sup> /s has an AEP of 5%, it means that there is a 5% chance (i.e., a one-in-20 chance) of a 500 m <sup>3</sup> /s or larger events occurring in any one year (see ARI). |
| <b>Appurtenant Works</b>                   | All ancillary structures of a basin/dam including, but not limited to, spillways, inlet and outlet works, tunnels, pipelines, etc.                                                                                                                                                                                                             |
| <b>Average Recurrence Interval (ARI)</b>   | The long-term average number of years between the occurrence of a flood as big as or larger than the selected event. For example, floods with a discharge as great as or greater than the 20 year AEP flood event will occur on average once every 20 years. AEP is another way of expressing the likelihood of occurrence of a flood event.   |
| <b>Base of Dam / Basin</b>                 | The general foundation area of the lowest portion of the main body of the dam.                                                                                                                                                                                                                                                                 |
| <b>Catchment</b>                           | The land surface area which drains to a specific point, such as a reservoir.                                                                                                                                                                                                                                                                   |

|                                                |                                                                                                                                                                                                                                                                                                                                                     |
|------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b><i>Collapse</i></b>                         | The physical deformation of a structure to the point where it no longer fulfils its intended purpose.                                                                                                                                                                                                                                               |
| <b><i>Dam/Basin</i></b>                        | Any man made barrier, temporary or permanent, including appurtenant works which does or could impound, divert or control water, other liquids, silts, debris or other liquid-borne material.                                                                                                                                                        |
| <b><i>Dam Crest</i></b>                        | Frequently used to denote top of dam. However, the term Crest is usually applied to the level at which water may overflow the spillway section of the dam. The term “Top of Dam” is preferred to denote uppermost surface of the dam proper, excluding parapets, handrails, etc. – See Spillway Crest                                               |
| <b><i>Dam Crest Flood (DCF)</i></b>            | The flood event, which, when routed through the reservoir, results in a still water level, excluding wave effects, which for an embankment is the lowest point of the embankment crest.                                                                                                                                                             |
| <b><i>Dam Owner</i></b>                        | Any person, organisation or legal entity who owns a dam. Legal opinion indicates that the dam owner is that person, authority or legal entity that owns the land on which the dam structure is situated.                                                                                                                                            |
| <b><i>Dams Safety NSW (DSNSW)</i></b>          | Dams Safety NSW is an independent regulator established under the <i>Dams Safety Act 2015</i> . The agency administers the legislation to ensure that any risks to public safety or environmental and economic assets are of a level that is acceptable to the community.                                                                           |
| <b><i>Emergency Plan (EP)</i></b>              | A continually updated document incorporating instructions and maps that, together with ongoing public education, outlines the actions to be taken by a dam owner to deal with the emergency situation or unusual occurrence at a given dam or reservoir.                                                                                            |
| <b><i>Failure (Dam)</i></b>                    | The uncontrolled release of the contents of a dam. The failure may consist of the collapse of the dam or some part of it, or excessive seepage or discharges in cases where hazardous substances are being stored.                                                                                                                                  |
| <b><i>Emergency</i></b>                        | An emergency in terms of dam operation is any condition which develops unexpectedly, endangers the integrity of the dam or downstream property and life and requires immediate action.                                                                                                                                                              |
| <b><i>Failure</i></b>                          | The uncontrolled release of the contents of a reservoir through collapse of the dam or some part of it, or the inability of a dam to perform functions such as water supply, prevention of excessive seepage or containment of hazardous substances.                                                                                                |
| <b><i>Flood Consequence Category (SCC)</i></b> | An assessment category of incremental losses of life, property and infrastructure (but not including the value of the dam itself) as a consequence of dam failure due to inadequate spillway capacity (see DSNSW13 for details) - used in the ANCOLD Guidelines for selection of the RDF. Where IFF is greater than PMF, IFF is taken to be the PMF |

|                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Foundation</b>                                         | The undisturbed material on which the dam structure is placed.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Freeboard</b>                                          | The vertical distance between the surface of the stored water and the top of the dam. Examples of freeboards are the distances from the top of the dam to the normal full supply level (normal freeboard), and the design flood level (flood freeboard).                                                                                                                                                                                                                                                  |
| <b>Full Supply Level (FSL)</b>                            | The level of water surface when the reservoir is at maximum operating level, excluding periods of flood discharge.                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Height of Dam</b>                                      | Normally this is the difference in level between the natural bed of the stream or watercourse at the downstream toe of the dam or, if it is not across a stream, channel or watercourse, between the lowest elevation of the outside limit of the dam, and the top of the dam. (See definition "Top of Dam".)                                                                                                                                                                                             |
| <b>Imminent Failure Flood (IFF)</b>                       | The flood event which, when routed through the reservoir just threatens failure of a dam. The reservoir is assumed to be initially at FSL.                                                                                                                                                                                                                                                                                                                                                                |
| <b>Incident</b>                                           | An event which could deteriorate to a very serious situation or endanger the dam.                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Inspection (Dam)</b>                                   | A careful/critical viewing and examination of all visible aspects of a dam.                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Maintenance</b>                                        | The routine work required to maintain existing works and systems (civil, hydraulic, mechanical and electrical) in a safe and functional condition.                                                                                                                                                                                                                                                                                                                                                        |
| <b>Monitoring</b>                                         | The observing of measuring devices that provide data from which can be deduced the performance and behavioural trends of a dam and appurtenant structures, and the recording and review of such data.                                                                                                                                                                                                                                                                                                     |
| <b>Operator</b>                                           | The person, organisation, or legal entity, which is responsible for the control, operation and maintenance of the dam and/or reservoir and the appurtenant works. In this case, the owner/operator is the Shellharbour City Council (SCC).                                                                                                                                                                                                                                                                |
| <b>Outlet Works</b>                                       | The combination of intake structure, screens, conduits, tunnels and valves that permit water to be discharged under control from the reservoir.                                                                                                                                                                                                                                                                                                                                                           |
| <b>O&amp;M Manual (Operations and Maintenance Manual)</b> | The collection in One Document the complete accurate and current operating and maintenance instructions for the dam and its appurtenant works.                                                                                                                                                                                                                                                                                                                                                            |
| <b>Population at Risk (PAR)</b>                           | All those persons who would be directly exposed to flood waters within the dambreak affected zone if they took no action to evacuate. Note: The PAR may be much greater than the potential loss of life as PAR is determined by the floodwater inundation area in the dambreak affected zone. The floodwater may be as little as 100mm deep. However loss of life would generally not be expected unless the floodwater is greater than about 300mm deep with a velocity of flow greater than about 1m/s. |

|                                                    |                                                                                                                                                                                                                                                                                                                  |
|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b><i>Prescribed Dam</i></b>                       | A dam is prescribed under the <i>Dams Safety Act 2015</i> on the recommendation of Dams Safety NSW and is usually based on size and hazard ratings.                                                                                                                                                              |
| <b><i>Probable Maximum Flood (PMF)</i></b>         | The flood resulting from PMP coupled with the worst flood-producing catchment conditions that can be realistically expected in the prevailing meteorological conditions.                                                                                                                                         |
| <b><i>Probable Maximum Precipitation (PMP)</i></b> | The theoretical greatest depth of precipitation for a given duration that is physically possible over a particular drainage basin.                                                                                                                                                                               |
| <b><i>Recommended Design Flood (RDF)</i></b>       | The flood event which has the recommended annual exceedance probability or magnitude and which produces the highest flood surcharge for the dam. In the ANCOLD guidelines the RDF is selected for the appropriate SCC.                                                                                           |
| <b><i>Reservoir Capacity</i></b>                   | The total or gross storage capacity of the reservoir up to FSL excluding flood surcharge.                                                                                                                                                                                                                        |
| <b><i>Safety Check Flood</i></b>                   | The “limit state” overall safety flood relating to potential extraordinary flood events in the safe limit of dam integrity (previously called Imminent Failure Flood).                                                                                                                                           |
| <b><i>Spillway</i></b>                             | A weir, conduit, tunnel or other structure designed to permit discharges from the reservoir when water levels rise above the full supply level (FSL) and to convey flood-waters safely pass a dam.                                                                                                               |
| <b><i>Spillway Crest</i></b>                       | The uppermost portion of the spillway overflow section.                                                                                                                                                                                                                                                          |
| <b><i>Tailwater Level</i></b>                      | The level of water in the discharge channel immediately downstream of the dam.                                                                                                                                                                                                                                   |
| <b><i>Top of Dam</i></b>                           | The elevation of the uppermost surface of the dam proper, not taking into account any camber allowed for settlement, kerbs, parapets, guardrails or other structures that are not a part of the main water retaining structure. This elevation may be a roadway, walkway or the non-overflow section of the dam. |

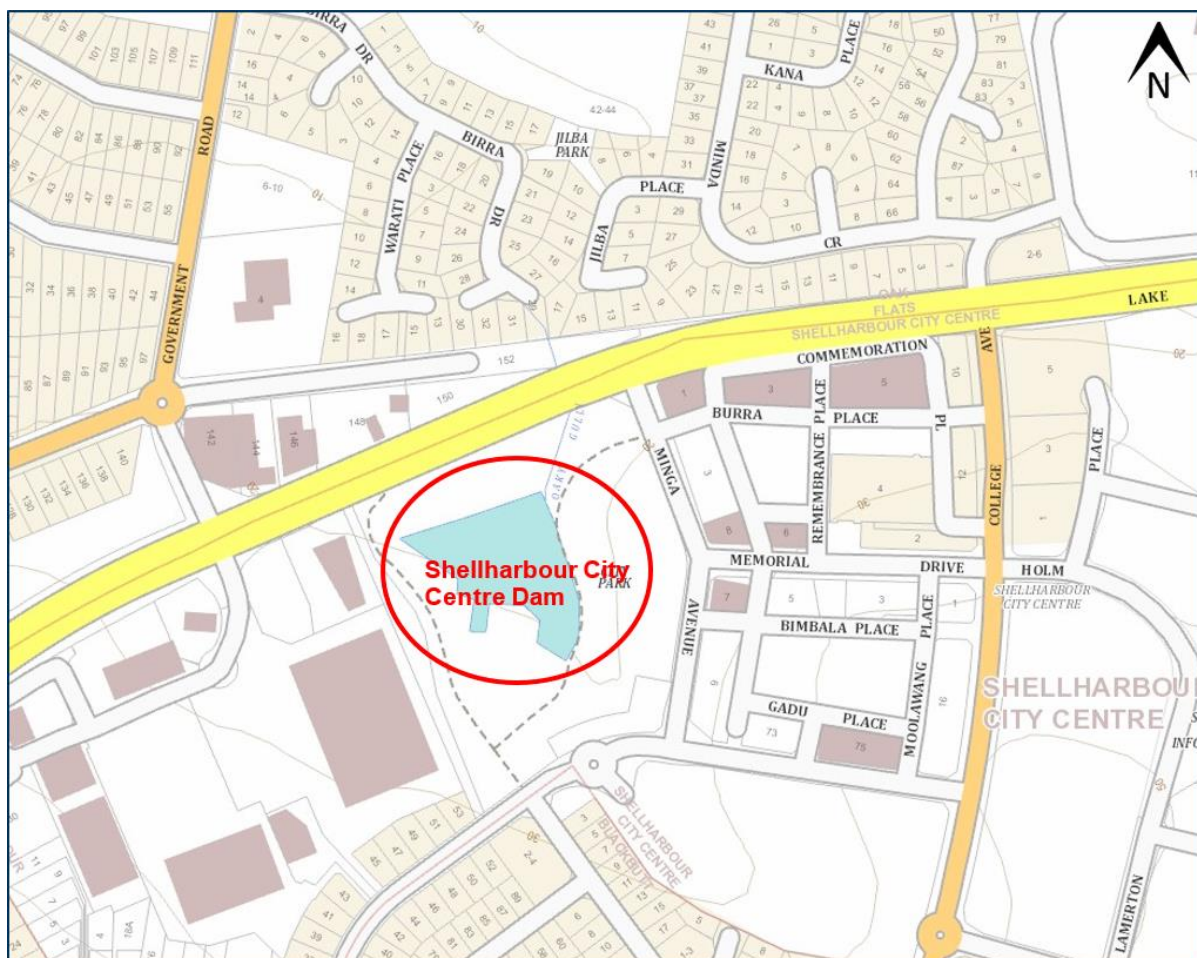
## **Appendix B | Summary Basin Data**

Table B1 - Summary Basin data –Shellharbour City Centre Detention Basin

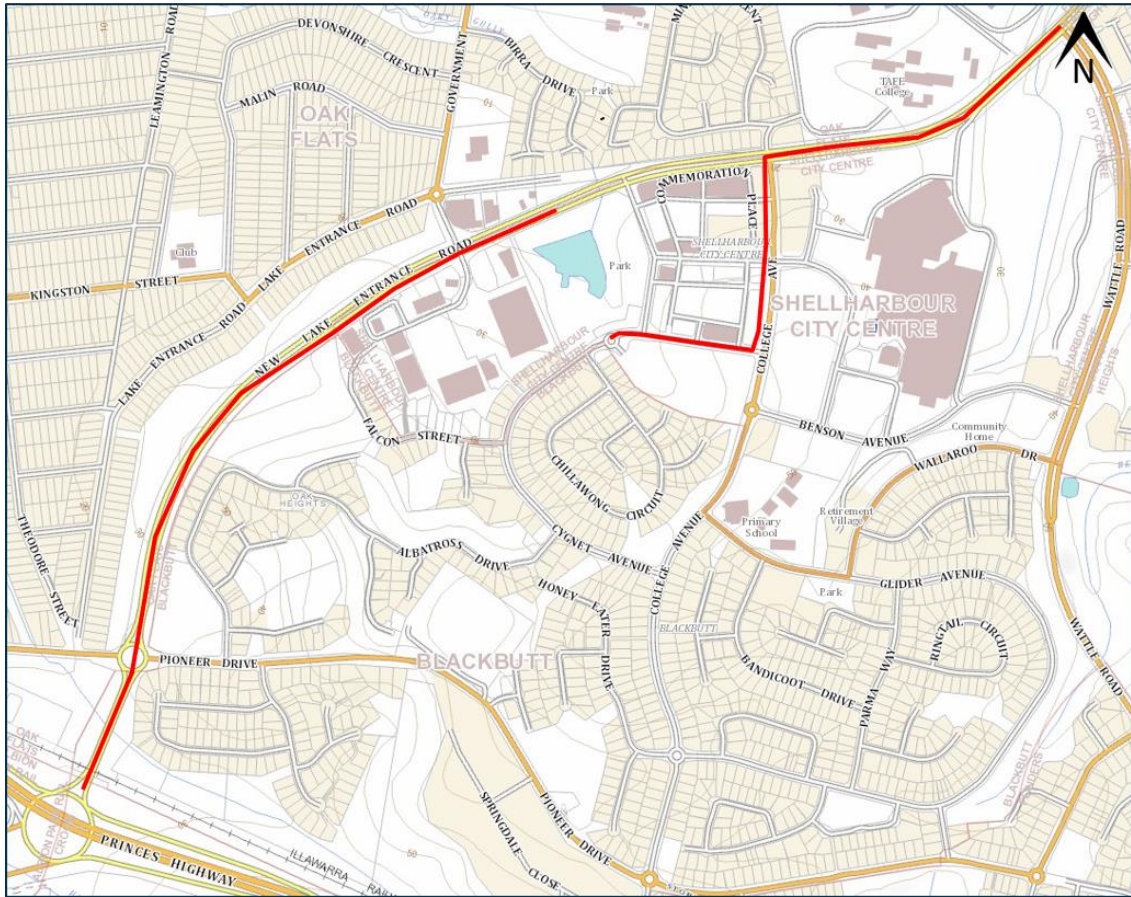
| General Information                      |                                                                                                                   |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| Dam Name                                 | Shellharbour City Centre Basin                                                                                    |
| Dam Owner                                | Shellharbour City Council                                                                                         |
| Location                                 | Minga Avenue, Shellharbour City Centre, NSW MGA zone 56, 301150 East 6173170 North                                |
| Engineered by                            | PPK Environment & Infrastructure                                                                                  |
| Constructed by                           | Landcom, 2000                                                                                                     |
| Purpose                                  | Flood detention and Water Quality                                                                                 |
| Consequence Category                     | Sunny Day – N/A<br>Flood - Significant                                                                            |
| Availability of Dam data                 | By visual observation only (Gauge plate and telemetry to be installed within 6 months from adoption of this Plan) |
| Dam Data                                 |                                                                                                                   |
| Capacity                                 | 8.7ML storage on sunny day<br>50ML storage at dam crest level (8.7ML + 41.3ML detention storage)                  |
| Dam Type                                 | Homogenous Earth Fill                                                                                             |
| Height                                   | 5m                                                                                                                |
| Embankment Length                        | 200m                                                                                                              |
| Embankment Width                         | 3m at top with 25% batters                                                                                        |
| Embankment Level                         | 21.0m AHD                                                                                                         |
| Spillway                                 |                                                                                                                   |
| Type                                     | Uncontrolled Weir – Homogenous Earth Fill                                                                         |
| Crest Length                             | 15m                                                                                                               |
| Crest Width                              | 14m                                                                                                               |
| Crest Level                              | 20.6m AHD                                                                                                         |
| Outlet                                   |                                                                                                                   |
| Type                                     | 900mm x 900m Grated Field Inlet                                                                                   |
| Grate Level                              | 18.07 m AHD                                                                                                       |
| Consequence of Dam Failure (PMF)         |                                                                                                                   |
| Number of Houses Affected - Total        | 28                                                                                                                |
| Population at Risk (PAR) - Total         | 86                                                                                                                |
| Hydrological Information                 |                                                                                                                   |
| Catchment Area                           | 39ha                                                                                                              |
| Dam Crest Flood (Credible Failure Flood) | 500 Year ARI, Water at dam crest level (20.6m)                                                                    |
| PMF peak inflow                          | 42.2 m <sup>3</sup> /s                                                                                            |
| PMF peak outflow                         | 38.1 m <sup>3</sup> /s                                                                                            |
| PMF peak water level                     | 21.2 m                                                                                                            |
| PMF time to peak                         | 39 minutes                                                                                                        |
| Alert Levels for Flooding                |                                                                                                                   |
| Red Alert                                | 20.7m AHD (Water 0.1m over spillway)                                                                              |
| Amber Alert                              | 20.2m AHD (Water 0.4m lower than spillway)                                                                        |
| White Alert                              | 19.6m AHD (Water 1.0m lower than spillway)                                                                        |
| Notification Protocols                   |                                                                                                                   |
| Emergency Authority                      | NSW SES                                                                                                           |
| Local Flood Plan                         |                                                                                                                   |
| Name                                     | Kiama / Shellharbour City Local Flood Plan                                                                        |

Table B2 - Alert Levels and Corresponding Alerts for Shellharbour City Centre Detention Basin

| <i>Alert</i>      | Trigger                                                                                                                       | Annual Exceedance Probability | Time from beginning of rainfall in a PMF |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------|-------------------------------|------------------------------------------|
| <b>PROTECTION</b> | A Severe Weather Warning is issued by the Bureau of Meteorology<br>OR<br>Heavy rainfall recorded at the Blackbutt pluviometer | Several times per year        | NA                                       |
| <b>WHITE</b>      | 19.6m AHD (water 1.0 m lower than spillway)<br>OR<br>Serious structural damage without imminent flow through embankment       | 5%                            | 17 mins                                  |
| <b>AMBER</b>      | 20.2m AHD (water 0.4 m lower than spillway)<br>OR<br>Serious structural damage with imminent flow through embankment          | 1%                            | 22 mins                                  |
| <b>RED</b>        | 20.7m AHD (water 0.1m over spillway)<br>OR<br>Serious structural damage causing flow through embankment                       | 0.1 – 0.2%                    | 27 mins                                  |



Basin location



Dam access



Dam layout

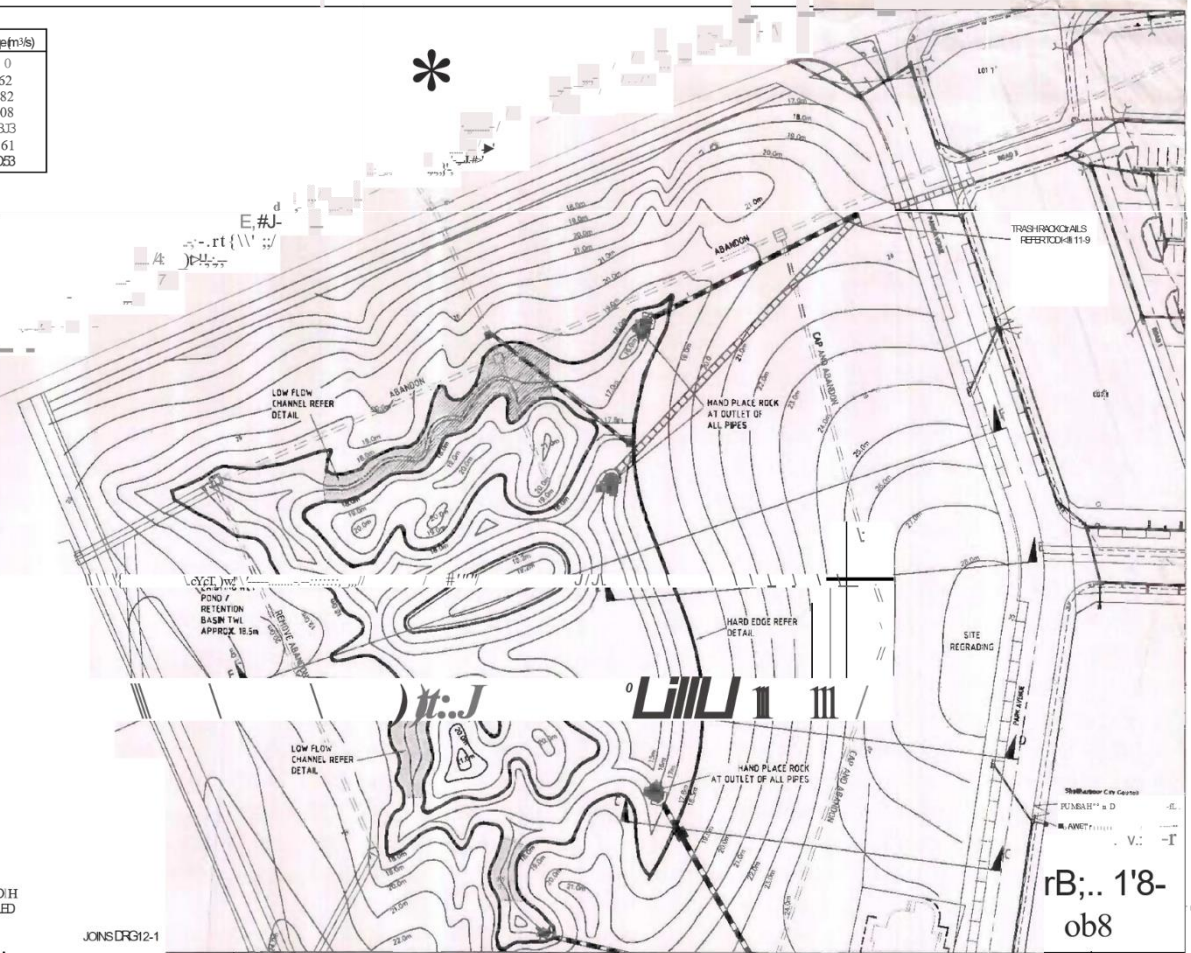
| Height (m) | Storage (m) | Discharge (m/s) |
|------------|-------------|-----------------|
| 1600       | 0           | 0               |
| 18.5       | 5270        | 1.62            |
| 19.0       | 11000       | 2.82            |
| 1m         | 19000       | 3.08            |
| 200        | 21580       | 3.13            |
| 2050       | 37100       | 161             |
| 110        | 4460        | 163             |

PERMANENT WATERLEVEL  
TOP OF BANK  
DOOR WATERLEVEL  
SPILLWAY LENGTH  
SPILLWAY LEVEL  
PI A AND P B FORCE

R.1800  
R.2110  
R.2036  
R.400m  
R.2000  
160m b.

CH-6:  
THE DESIGNER IS NOT TO BE RESPONSIBLE FOR THE  
SUPERVISION OF ANY WORKS OR FOR THE  
ALLEGING IN THE FOUNDATION SERVICE USE OF  
EXCEEDING FORCE OR FOR WORKS COMING AND IS THE  
RESPONSIBILITY OF THE PERSON USING THIS PLAN TO CONFIRM BOTH  
POSITION AND LEVEL OF THESE UTILITIES IN CONJUNCTION WITH THE  
SURVEY PLANS

|          |          |
|----------|----------|
| DATE     | 11/10/00 |
| REVISION | 1/11/00  |
| DATE     | 1/11/00  |
| REVISION | 1/11/00  |
| DATE     | 1/11/00  |
| REVISION | 1/11/00  |
| DATE     | 1/11/00  |
| REVISION | 1/11/00  |



JOINS DRG12-1

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CONTRACT AND REPRODUCTION

PPK

Environment & Infrastructure

LANCOM PROJECT-7200/200

COMMERCIAL FREIGHT DEVELOPMENT

SHELL HARBOUR MAIN CENTRE

WATER QUALITY CONTROL PLAN

Project No

67L108A

Order No

12-2

Revision

6

General layout plan

## **Appendix C | Document Revision Forms**

## DOCUMENT CONTROL

This table should be used by Council to document the process for reviewing the O&MP on a five-yearly basis (i.e. document version, year, authors, reviewers), as per Clause 9 (4) of the Regulation (Consequence Category = Significant).

| <i>Year of Revision</i> | <b>O&amp;MP version number</b> | <b>Authors</b>         | <b>Reviewed by</b>                                                                     | <b>Approved by:</b> |
|-------------------------|--------------------------------|------------------------|----------------------------------------------------------------------------------------|---------------------|
| <i>2021</i>             | 1                              | Molino Stewart Pty Ltd | Shaun Robinson,<br>Prabin Kayastha,<br>Adam De Clouett,<br>Ian Smith,<br>Matthew Apolo | Ben Stewart         |
| <i>2026</i>             |                                |                        |                                                                                        |                     |
| <i>2031</i>             |                                |                        |                                                                                        |                     |
| <i>2036</i>             |                                |                        |                                                                                        |                     |
|                         |                                |                        |                                                                                        |                     |
|                         |                                |                        |                                                                                        |                     |
|                         |                                |                        |                                                                                        |                     |

## AMMENDMENTS TO CONTACT DETAILS

### *O&MP for Shellharbour City Centre Detention Basin - Amendments to Contact Details*

All amendments to the O&MP contact details are to be entered and certified on the table below by Council then all the relevant pages together with the amended table forwarded to all the Organisations on the Document Distribution List.

| <b>CONTACT DETAILS</b> |              |                                           |                 |                     |          | <b>ENTERED BY</b>    |
|------------------------|--------------|-------------------------------------------|-----------------|---------------------|----------|----------------------|
| <i>Date</i>            | Organisation | Title                                     | Name            | Phone/E-mail        | Page Nos | Name<br>(Print Name) |
| <i>October 2021</i>    | SCC          | Acting Group Manager Asset Strategy       | Adam De Clouett | Phone: 02 4211 6106 |          | SCC                  |
| <i>October 2021</i>    | SCC          | Group Manager Services                    | Tony Fraser     | Phone: 02 4211 6111 |          | SCC                  |
| <i>October 2021</i>    | SCC          | Group Manager Built & Natural Environment | Matthew Apolo   | Phone: 02 4221 6104 |          | SCC                  |
| <i>November 2021</i>   |              | Council's Specialist Dam Consultant       |                 |                     |          | SCC                  |
|                        |              |                                           |                 |                     |          |                      |
|                        |              |                                           |                 |                     |          |                      |
|                        |              |                                           |                 |                     |          |                      |
|                        |              |                                           |                 |                     |          |                      |
|                        |              |                                           |                 |                     |          |                      |
|                        |              |                                           |                 |                     |          |                      |
|                        |              |                                           |                 |                     |          |                      |
|                        |              |                                           |                 |                     |          |                      |

#### NOTES:-

1. It is the responsibility of COUNCIL to advise each Organisation immediately of any changes to its organisational structure, his personnel and relevant contact numbers.
2. It is the responsibility of each Organisation to advise COUNCIL immediately of any changes to their organisational structure, their personnel and relevant contact numbers.
3. It is the responsibility of COUNCIL to contact each Organisation annually to check that there have been no changes to their organisational structure their personnel or relevant contact numbers.
4. **IT IS THE RESPONSIBILITY OF EACH ORGANISATION TO ACKNOWLEDGE RECEIPT OF THE AMENDMENTS TO THE CONTACT DETAILS**

### AMENDMENTS TO TEXT ITEMS

Approved amendments or additions to the text of the O&MP are to be entered and certified in the table below by COUNCIL then all the relevant pages together with the amended table forwarded to ALL the Organisations on the Document Distribution List.

#### *O&MP - Amendments to Flow Charts, Text Items & Drawings*

| AMENDMENT SECTION |              |       |      |              |          | ENTERED BY           |
|-------------------|--------------|-------|------|--------------|----------|----------------------|
| Date              | Organisation | Title | Name | Phone/E-mail | Page Nos | Name<br>(Print Name) |
|                   |              |       |      |              |          |                      |
|                   |              |       |      |              |          |                      |
|                   |              |       |      |              |          |                      |
|                   |              |       |      |              |          |                      |
|                   |              |       |      |              |          |                      |
|                   |              |       |      |              |          |                      |
|                   |              |       |      |              |          |                      |
|                   |              |       |      |              |          |                      |
|                   |              |       |      |              |          |                      |
|                   |              |       |      |              |          |                      |
|                   |              |       |      |              |          |                      |
|                   |              |       |      |              |          |                      |
|                   |              |       |      |              |          |                      |

#### NOTES:-

1. It is the **responsibility of the basin owner to circulate all proposed amendments** to the flow charts, text pages and drawings of the O&MP to all affected organisations for approval prior to forwarding the approved amendment(s) to all the organisations on the document distribution list.
2. It is the **responsibility of each organisation to acknowledge receipt of the amendments**, and advise COUNCIL that the relevant pages have been replaced and the O&MP document has been updated accordingly.
3. The flow charts text pages and drawings of the original document should show the date the document was issued in the footer.
4. Any subsequent amendments to flow charts text pages and drawings should show the date of the amendment in the footer of the affected page.

**Appendix D | Inspection Form**

# Dam Surveillance Inspection Report

**Asset Name**

## Shellharbour City Centre Detention Basin

## Inspection Details

|                     |  |                    |
|---------------------|--|--------------------|
| Date of Inspection: |  | Weather conditions |
| Time of Inspection  |  |                    |

|                                         |        |
|-----------------------------------------|--------|
| Inspecting Organisation:                |        |
| Inspection completed by (Officer Name): |        |
| Phone:                                  | Email: |

## Safety Status

|                          |                                                 |                                                                                |
|--------------------------|-------------------------------------------------|--------------------------------------------------------------------------------|
| <input type="checkbox"/> | Dam has Serious Defect.                         | Urgent repair is necessary as risk of failure under flood conditions is high   |
| <input type="checkbox"/> | Dam has Defect.                                 | Programmed repair recommended as risk of failure under flood conditions is low |
| <input type="checkbox"/> | Dam has No Defect that needs programmed repair. |                                                                                |

Note: Urgent repair is necessary - repair to commence within two (2) weeks  
Programmed repair recommended - repair to commence within one month

## Summary of Recommended Actions

|                |                    |
|----------------|--------------------|
| Urgent Repair: | Programmed Repair: |
|----------------|--------------------|

### Embankment

## Mark observations

|                                                     | Inspected | Action Needed | Note |
|-----------------------------------------------------|-----------|---------------|------|
| Misalignments along crest                           |           |               |      |
| Misalignment along upstream embankment slope        |           |               |      |
| Misalignment along downstream embankment slope      |           |               |      |
| Wet areas or lush growth along embankment toe       |           |               |      |
| Cracks-desiccation or shrinkage                     |           |               |      |
| Cracks-transverse                                   |           |               |      |
| Cracks-longitudinal                                 |           |               |      |
| Slides/slough-upstream slope                        |           |               |      |
| Slides/slough-downstream slope                      |           |               |      |
| Depressions                                         |           |               |      |
| Sinkholes                                           |           |               |      |
| Inadequate upstream slope protection (bare areas)   |           |               |      |
| Inadequate downstream slope protection (bare areas) |           |               |      |
| Erosion on upstream face                            |           |               |      |
| Erosion on downstream face                          |           |               |      |
| Vegetation obscuring embankment                     |           |               |      |
| Grass cover dying                                   |           |               |      |
| Deep rooted vegetation (trees/bushes/weeds)         |           |               |      |
| Deep rooted vegetation dying/fallen                 |           |               |      |
| Debris                                              |           |               |      |
| Animal burrows                                      |           |               |      |
| Wear on crest                                       |           |               |      |
| Other – see below                                   |           |               |      |
|                                                     |           |               |      |
|                                                     |           |               |      |
|                                                     |           |               |      |
|                                                     |           |               |      |

### Required actions and notes

[illegible]

### Storage Area and Basin Banks

## Mark observations

|                                                                                          | Inspected | Action Needed | Note |
|------------------------------------------------------------------------------------------|-----------|---------------|------|
| Vegetation and tree growth in islands and around storage area                            |           |               |      |
| Sinkholes around storage area                                                            |           |               |      |
| Seepage around storage area                                                              |           |               |      |
| Landslips/erosion around storage area                                                    |           |               |      |
| Eddy (vortices) in water surface                                                         |           |               |      |
| Water level should be approximately at outlet opening (RL 18.07m)                        |           |               |      |
| Unusual beaching (sediment deposit around storage area caused by erosion of basin banks) |           |               |      |
| Debris in water                                                                          |           |               |      |
| Basin banks instability: slides                                                          |           |               |      |
| Basin banks instability: rock movement                                                   |           |               |      |
| Basin banks instability: erosion                                                         |           |               |      |
| Basin banks: grass cover                                                                 |           |               |      |
|                                                                                          |           |               |      |
|                                                                                          |           |               |      |
|                                                                                          |           |               |      |
| Other – see below                                                                        |           |               |      |

### Required actions and notes

[illegible]

e.g. Pit, pipe, headwalls

*Pits and pipes are confined spaces and need to be inspected with caution. If there appears to be a blockage or pipe connection failure, consideration should be given to confined spaces experts or CCTV inspection. The first rule must be “Safety At All Times”.*

|                                                        | Inspected | Action Needed | Note |
|--------------------------------------------------------|-----------|---------------|------|
| Pit grates clear/partially/fully blocked (select one)  |           |               |      |
| Pit chamber clear/partially/fully blocked (select one) |           |               |      |
| Pit grate damaged                                      |           |               |      |
| Pit grate missing                                      |           |               |      |
| Outlet clear/partially/fully blocked (select one)      |           |               |      |
| Subsidence around pits                                 |           |               |      |
| Subsidence around outlets                              |           |               |      |
| Erosion around pits                                    |           |               |      |
| Erosion at outlets                                     |           |               |      |
| Depressions/sinkholes over drainage line               |           |               |      |
| Wet areas/seepage adjacent to drainage structures      |           |               |      |
| Other – see below                                      |           |               |      |
|                                                        |           |               |      |
|                                                        |           |               |      |
|                                                        |           |               |      |

### Required actions and notes

[illegible]

## Spillway

|                                                                 | Inspected | Action Needed | Note |
|-----------------------------------------------------------------|-----------|---------------|------|
| Erosion of banks                                                |           |               |      |
| Erosion of bed                                                  |           |               |      |
| Undercutting of bank                                            |           |               |      |
| Spillway clear/partially/fully blocked with debris (circle one) |           |               |      |
| Services exposed                                                |           |               |      |
| Slides/slough on flow area banks                                |           |               |      |
| Flow redirected by other works                                  |           |               |      |
| Water ponding                                                   |           |               |      |
| Wet areas/seepage                                               |           |               |      |
| Other – see notes                                               |           |               |      |
|                                                                 |           |               |      |
|                                                                 |           |               |      |
|                                                                 |           |               |      |
|                                                                 |           |               |      |

### Required actions and notes

[illegible]

**Appurtenant Component**

e.g. Footpaths, gauge plates, telemetry system

|                                                           | Inspected | Action Needed | Note |
|-----------------------------------------------------------|-----------|---------------|------|
| Water level plate securely attached                       |           |               |      |
| Water level plate paint work clear                        |           |               |      |
| Vegetation obscuring view of water level plate or signage |           |               |      |
| Concrete footpaths: movement signs                        |           |               |      |
| Concrete footpaths: misalignment                          |           |               |      |
| Concrete footpaths: tilting                               |           |               |      |
| Concrete footpaths: cracking                              |           |               |      |
| Concrete footpaths: other damage                          |           |               |      |
| Damages to signage                                        |           |               |      |
| Landscaping                                               |           |               |      |
| Damage to telemetry                                       |           |               |      |
| Other – see notes                                         |           |               |      |
|                                                           |           |               |      |
|                                                           |           |               |      |
|                                                           |           |               |      |

### Required actions and notes

[illegible]

## Site Inspection Photos

## **Appendix E | Incident Report Form**

| INCIDENT REPORT FORM                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                    |                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| <b>Date of the Incident:</b>                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                    |                                                      |
| <b>Time of the Day:</b>                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                    |                                                      |
| <b>Location:</b>                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                    |                                                      |
| <b>Incident Type:</b><br><i>(of the following incident types set by the Dams Safety Regulation 2019, pick the most relevant)</i>                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                    |                                                      |
| <ul style="list-style-type: none"> <li>failure of the dam without release of water (the dam ceases to perform its functions)</li> </ul>                                                                                                                                                                   | <ul style="list-style-type: none"> <li>a serious failure or inadequacy in the dam safety management system and associated documentation that could potentially have caused death, serious injury, property damage, or environmental impact</li> </ul>                                                              |                                                      |
| <ul style="list-style-type: none"> <li>failure of the dam, with release of water, but without a catastrophic breach</li> </ul>                                                                                                                                                                            | <ul style="list-style-type: none"> <li>a suspected terrorist attack</li> </ul>                                                                                                                                                                                                                                     |                                                      |
| <ul style="list-style-type: none"> <li>failure of the dam with loss of water due to a catastrophic breach</li> </ul>                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>any change in the dam or its surrounds that is abnormal and could indicate an increased risk of the failure of the dam. This includes incidents which could interfere with correct functioning of the dam (for example, obstruction of spillway or outlet pipes)</li> </ul> |                                                      |
| <ul style="list-style-type: none"> <li>any change observed in the dam or its surrounds which could indicate an increased vulnerability to failure (for example, erosion on the embankment, increase in seepage flow, turbidity in seepage flow, new seeps, appearance of cracking in the dam).</li> </ul> | <ul style="list-style-type: none"> <li>a serious failure or inadequacy in the dam safety management system and associated documentation that could potentially have caused death, serious injury, property damage, or environmental impact</li> </ul>                                                              |                                                      |
| <ul style="list-style-type: none"> <li>an incident that results in the death or serious injury of a person or significant damage to property or the environment</li> </ul>                                                                                                                                | <ul style="list-style-type: none"> <li>breaches of security with implications for dam safety</li> </ul>                                                                                                                                                                                                            |                                                      |
| <b>Provide details:</b><br><hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                    |                                                      |
| <b>Was the media involved?</b>                                                                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>YES</li> </ul>                                                                                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>NO</li> </ul> |

## **Appendix F | Emergency Remedial Measures**

This section details remedial measures and preventative actions that may be implemented both prior to and following the development of an emergency situation to reduce the risk of dam failure.

In close consultation with Council's Specialist Dams Consultant and depending on the severity and type of the emergency, it may be possible to implement remedial measures to reduce the damage to the structure(s) by:

- Addressing Hydraulic Deficiencies
- Sealing or draining cracks;
- Buttressing unstable slopes;
- Dewatering the basin (does not apply to dry basins).

### **Hydraulic Deficiencies**

Examples of situations resulting from hydraulic deficiencies include, but may not be limited to:

- Blocked spillway with floating debris;
- Blocked outlet pipes by siltation;

Emergency and temporary actions to deal with blocked spillway include:

- If possible, remove debris or vegetation growth in the spillway, the spillway approach channel and the crest of the basin;
- Removing vegetation growth in the downstream channel of the outlet pipe to prevent water backing up into the outlet conduit;
- Protecting and stabilising damage areas.
- Emergency and temporary actions to deal with blocked outlet pipe(s) includes:
- Minimising erosion of foundation material and stabilising spillway slabs by dumping heavy rip rap or other materials downstream of the spillway;
- Protecting and stabilising damage areas.

### **Sealing or Draining Cracks**

Any cracks in the dam or foundation may lead to leakage and erosion. Cracks may be sealed to reduce the amount of leakage and to lessen the potential of erosion or piping. Crack sealing, with proper crack drainage, can reduce detrimental uplift pressures.

Any leaking water is to be conducted to a suitable location in the drainage system. Drainage alone also can be used to relieve internal pressures that tend to keep the cracks open and propagate them.

### **Buttressing Unstable Slopes**

Unstable reservoir slopes or excavations may require buttressing with large, free-draining material. Buttressing can be used to improve stability, control piping and allow internal hydrostatic pressures to dissipate safely.

### **Dewatering (does not apply to dry basins)**

Failure due to a rapidly deteriorating structural deficiency such as may be induced by an extreme earthquake. This is generally referred to as a "Sunny Day" failure, i.e. not induced by an inflow flood, however there is always the possibility that such a failure can arise after the peak of the event when the basin is full but not overflowing.

If such a scenario arises, lowering the storage level is the single most useful preventative action. However, it is really only useful for Sunny Day failure modes, because flood inflows far exceed the release capacity.

### **Other Actions**

In the event of a rapidly deteriorating structural deficiency which is likely to threaten the security of basins, SCC staff having reported a potential emergency situation, should do the following:

- Ensure that a responsible person with portable communication is left in a safe position at basins to monitor the emergency condition.
- Restrict access to the dam area.
- Liaise with emergency management authorities.
- If possible, document the emergency condition with photographs and/or a video camera.
- Monitor and record weather forecasts, streamflow information and rain gauge information.
- Inform all involved personnel of any change in the emergency condition.

**Where a situation develops too rapidly to follow the above procedures, operating staff must take whatever action they consider appropriate. The above actions are to be used as a guideline.**

**Do not take any unnecessary risks in undertaking the above actions.**