Knight Piésold
CONSULTING

**MEMORANDUM**

| | | | |
|---|---|---|---|
| **To:** | **Salt Lake Potash** | **Date:** | 5th July 2018 |
| **Attn:** | David Linton | **Our Ref:** | PE18-00635 |
| | | **KP File Ref.:** | PE801-00349/02-A dss M18009 |
| **cc:** | | **From:** | Dean Sawyer/Peter Veld |

**RE: LAKE WAY PROJECT – TEMPORARY HOLDING POND DESIGN – REV 2**

Knight Piésold Pty Limited (KP) is currently providing assistance to Salt Lake Potash (SLP) as part of the Scoping Study of the Lake Way Sulphate of Potash (SOP) Project. The project is located on Lake Way approximately 20 km southeast of Wiluna in Western Australia. KP was requested to provide details for constructing a temporary holding pond facility on the lake in the vicinity of the existing Williamson Pit within the current Blackham lease.

The temporary holding pond is to contain concentrated brine from Williamson Pit and be supplemented with additional lake brine from a trial trench. This memo provides the design basis and details of the temporary holding pond facility for the purpose of approvals for the proposed concept.

## 1. TEMPORARY HOLDING POND DESIGN

### 1.1 DESIGN INTENT

The design intent of the temporary holding pond is to construct a large shallow evaporation pond on the lake bed to concentrate water abstracted from the Williamson Pit lake and local groundwater using solar radiation. There is approximately 1.2 GL of brine in the pit lake to be concentrated. In addition, brine pumped from a proposed 2 km long trench will also be concentrated.

The holding pond will allow SLP to monitor berm constructability, brine concentrations over time, evaporation rates, seepage estimates and precipitated salt chemistry.

### 1.2 FACILITY DETAILS

The proposed temporary holding pond facility is to include 2 ponds. Pond 1 will be rectangular and approximately 2 km by 500 m, and Pond 2 will be square and approximately 500 m by 500 m. Both ponds will include 2m high perimeter berms as shown on Figure 1.1.Internal baffles may be constructed to extend the flow path of the brine movement within the pond if needed.

Berm details are shown in Figure 1.2 with a nominal 1.5 m full supply pond depth. This allows for 300 mm of freeboard above the 1% Average Exceedance Probability (AEP) storm depth (Ref 1) of 199 mm.

The temporary holding pond will be located away from low spots in the lake (Ref 1) whilst remaining in the Blackham lease area. These low spots are known to be natural flow paths and would flood often, remaining saturated for long periods making access and construction more difficult. An access track from the edge of Williamson Pit will be constructed to allow light vehicles and low bearing equipment to access the site.

### 1.3 DMIRS CLASSIFICATION

Although the ponds may be considered water (brine) dams, an assessment against The Department of Mines, Industry Regulation and Safety (DMIRS, formally DMP) Code of Practice for Tailings Storage Facilities in Western Australia (Ref 2) was utilised.

The impact on the environment of the downstream area in the event the perimeter berm loses integrity has a Hazard Rating of "Low" as the stored brine originated from the lake. No public or mining infrastructure is located downstream. The Williamson Pit is slightly up hill and a flood protection bund exists around the pit. The perimeter berm can be easily repaired and only loss of brine (pump costs and lost time) would occur to SLP.

As the temporary holding pond is below 5 m in maximum height, the facility is classified as "Low: Category 3".

### 1.4 GEOTECHNICAL INFORMATION

An initial geotechnical investigation on the Lake Way shallow subsurface (Ref 3) consisted of 24 hand augers, shear vane tests and laboratory testing of samples. The in-situ clay materials can be expected to provide low permeability foundation materials to control seepage out of the pond. The clays should be suitable for berm construction purposes provided there is adequate moisture control and borrow pit dewatering. Mine waste from Williamson Pit may also be used if approved by Blackham.

The water table is very shallow to surface, around 200 – 300 mm at the time of the investigation.

### 1.5 SEEPAGE ASSESSMENT

The issue concerning SLP is the temporary holding pond may leak back into the lake bed, losing product and reducing pond efficiency. An initial loss due to the first wetting of the foundation is to be expected. This was estimated to be around 57 mm to 133 mm of initial loss per unit area over a relatively short duration during first filling.

A seepage model was also developed using the Geostudio Seep/W finite element package to determine steady state seepage rates. The foundation properties were estimated from the geotechnical investigation. The model assumed vertical ground permeabilities of $1x10^{-8}$m/s. Recent test work indicates in-situ permeability of the lake clays at about $1x10^{-9}$m/s. Thus the model is conservative. The modelling results with a pumped downstream borrow pit and without (similar to no pumping) are provided in Figure 1.3.

Due to the shallow groundwater, the shallow pond depth and presence of clay in the foundation, the modelling showed it is not overly sensitive to the embankment and foundation parameters. A seepage rate of 50 – 100 $m^3$/day (total for pond) is expected once steady state is reached.

## 2. CONSTRUCTION

There are challenges in both lake access with construction equipment and suitable material availability with a workable moisture content to construct the embankments. Construction material will be sourced immediately adjacent to the embankments in small borrow pits using the following methodology:

- The embankment footprint and borrow pit will be cleared of the ~200 mm surface sand and evaporite layer to expose clay but not to expose groundwater;
- A key trench will be constructed at the upstream toe of the embankment;
- An excavator will borrow from adjacent to the embankment using lake clays and spread material within the embankment footprint;

- The fill would be progressively spread, air dried, rotated and mixed to bring the moisture content closer to optimum;
- Dewatering of the borrow pits will be conducted if required to limit the saturation of fill;
- Material will be compacted with excavator traffic compaction;
- A geotextile will be pinned to the upstream face of the perimeter berm; and
- The final crest of the perimeter berms will be sheeted with a suitable wearing course.

Any short term liquefaction failures or settlement of the lake bed during material placement will be examined. The requirements for drying time for the materials prior to compaction will be assessed. Compaction equipment, particle size sieves, drying oven and scales will be set up on site to conduct moisture content tests and material characteristics.

A construction report should be prepared at completion to document the activities and testing conducted. An as built ground survey of the basin should be conducted to relate pond level with volume, critical for seepage estimation.

## 2.6 EMBANKMENT QUANTITIES

The quantity estimate for the works is broken down in Table 2.1 as a guide for estimating purposes.

**Table 2.1:** Temporary Holding Pond Embankment Quantities

| Item | Description | Unit | Quantity |
|---|---|---|---|
| **1** | **Access road** | | |
| 1.1 | Win from borrow area, load, haul, spread and compact mine waste rock material in access track | $m^3$ | 6,900 |
| 1.2 | Supply and install Bidim geotextile (nominal allowance) | $m^2$ | 13,700 |
| **2** | **Pond 1** | | |
| **2.1** | **Perimeter Berms** | | |
| 2.1.1 | Strip sand and evaporite (200 mm depth) from footprint areas and stockpile adjacent | $m^2$ | 140,800 |
| 2.1.2 | Scarify and compact insitu subgrade (200 mm) within embankment footprint area | $m^2$ | 75,500 |
| 2.1.3 | Excavate and compact key trench | Lin m | 5,100 |
| 2.1.4 | Win from adjacent, spread, dry and compact salt lake clay material in embankment | $m^3$ | 105,100 |
| 2.1.5 | Supply and Install Bidim Geotextile | $m^2$ | 29,800 |
| 2.1.6 | Win from borrow area, load, haul, spread and compact mine waste rock material as wearing course | $m^3$ | 3,100 |
| **2.2** | **Baffle** | | |
| 2.2.1 | Cut to fill material to form baffle | Lin m | 1,600 |
| **3** | **Pond 2** | | |
| 3.1 | **Perimeter Berms** | | |
| 3.1.1 | Strip sand and evaporite (200 mm depth) from footprint areas and stockpile adjacent | $m^2$ | 56,500 |
| 3.1.2 | Scarify and compact insitu subgrade (200 mm) within embankment footprint area | $m^2$ | 30,800 |
| 3.1.3 | Win from adjacent, spread, dry and compact salt lake clay material in embankment | $m^3$ | 44,500 |
| 3.1.4 | Win from borrow area, load, haul, spread and compact mine waste rock material as wearing course | $m^3$ | 1,200 |

## 3. OPERATING AND MONITORING

The following operating procedure recommendations are provided in addition to standard procedures SLP will conduct for brine chemistry assessments:

- Two Class A evaporation pans or small HDPE lined control ponds should be set up on the lake bed with clean water and brine water. These should provide pan factors of clean water to brine at different concentrations (SG or Mg%) for published pan and lake evaporation rates;
- Flow rates/totals of brine into (and if out of) the pond from various sources should be tracked;
- Pond levels in each pond should be monitored on at least a daily basis;
- Observe any surface seepage at the downstream toe of any perimeter berm;
- Visually monitor any wave action erosion on the upstream face of berms;
- Visually monitor any salt build up on the upstream face of berms; and
- Visually monitor and survey any embankment settlement.

The program may be used to estimate seepage from the facility as it varies over the operation.

We trust this is sufficient information for your current requirements. If the temporary holding pond facility is to be implemented, more detailed construction and operation documentation may be required to ensure correct data is being recorded and observations made. We can also provide construction supervision inclusive of soil testing facilities as required.

Yours faithfully
**KNIGHT PIÉSOLD PTY LTD**

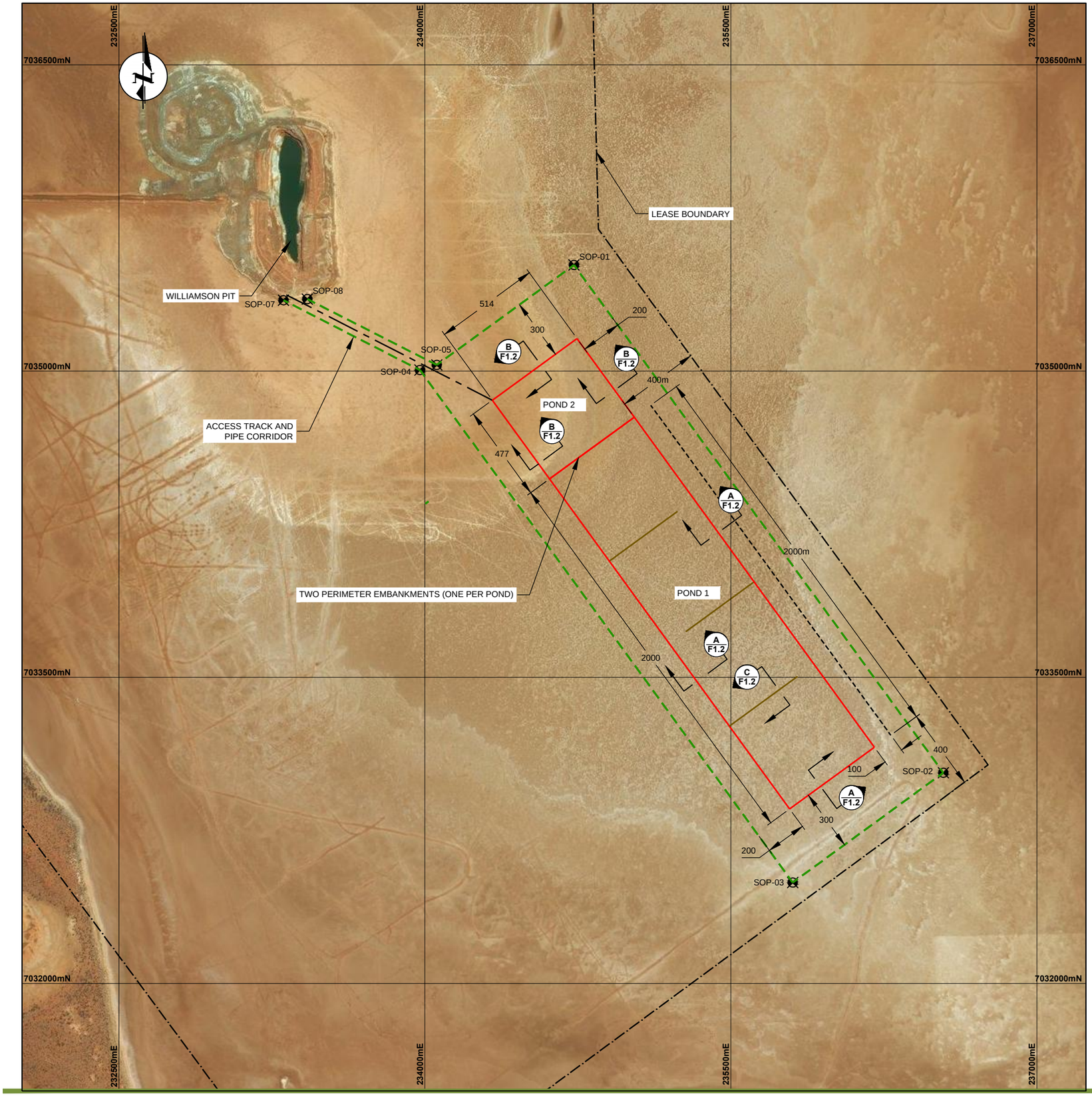
**DEAN SAWYER**
Senior Engineer

**PETER VELD**
Technical Consultant

**REFERENCES**

1. PE18-00456 Climatology and hydrologic assessment Rev 1
2. Department of Mines and Petroleum, 2013, Tailings storage facilities in Western Australia - code of practise: Resources Safety and Environment Divisions, Department of Mines and Petroleum, Western Australia, 13 pp.
3. PE18-00389 Phase 1 Geotechnical Site Investigation

FIGURES




## LEGEND:

- BLACKHAM TORO 1 LEASE BOUNDARY
- PERIMETER BERM
- BAFFLES
- TEMPORARY POND TRENCH
- GROUND DISTURBANCE FOOTPRINT

## COORDINATES FOR GROUND DISTURBANCE FOOTPRINT

| POINT | EASTING | NORTHING |
|---|---|---|
| SOP-01 | 234731.1 | 7035519.7 |
| SOP-02 | 236541.8 | 7033031.9 |
| SOP-03 | 235803.0 | 7032494.3 |
| SOP-04 | 233975.6 | 7035005.0 |
| SOP-05 | 234058.4 | 7035030.1 |
| SOP-07 | 233306.7 | 7035347.1 |
| SOP-08 | 233423.7 | 7035352.8 |

400 300 200 100 0 200 400 600 800
SCALE (METRES) 1:20,000 (A3)

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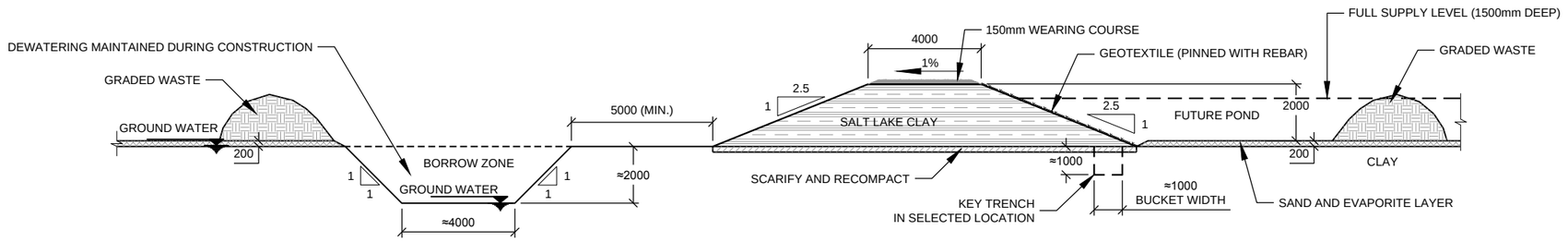
LAKE WAY PROJECT
TEMPORARY HOLDING POND
GENERAL ARRANGEMENT

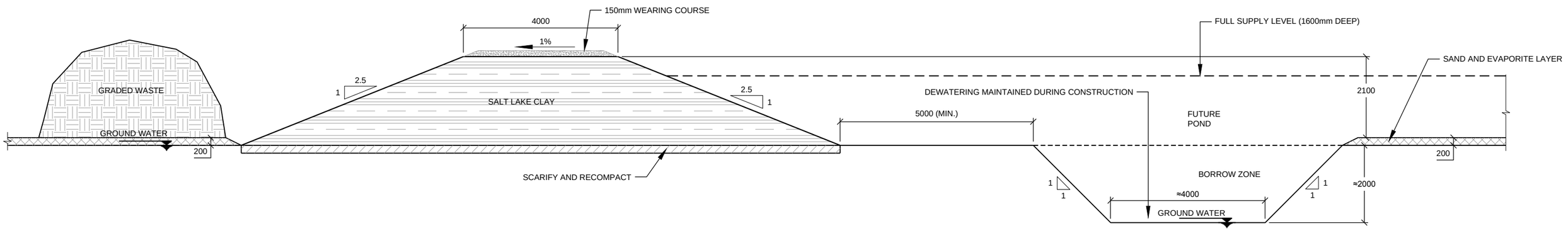
Ref: PE801-00349 M18009
Figure 1.1

## NOTES:

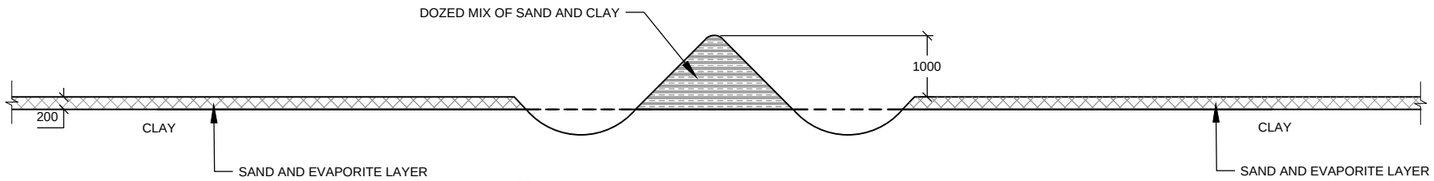
1. SALT LAKE CLAY TRAFFIC COMPACTED.




**A F1.1 TYPICAL PERIMETER BERM SECTION (POND-1)**
1:200

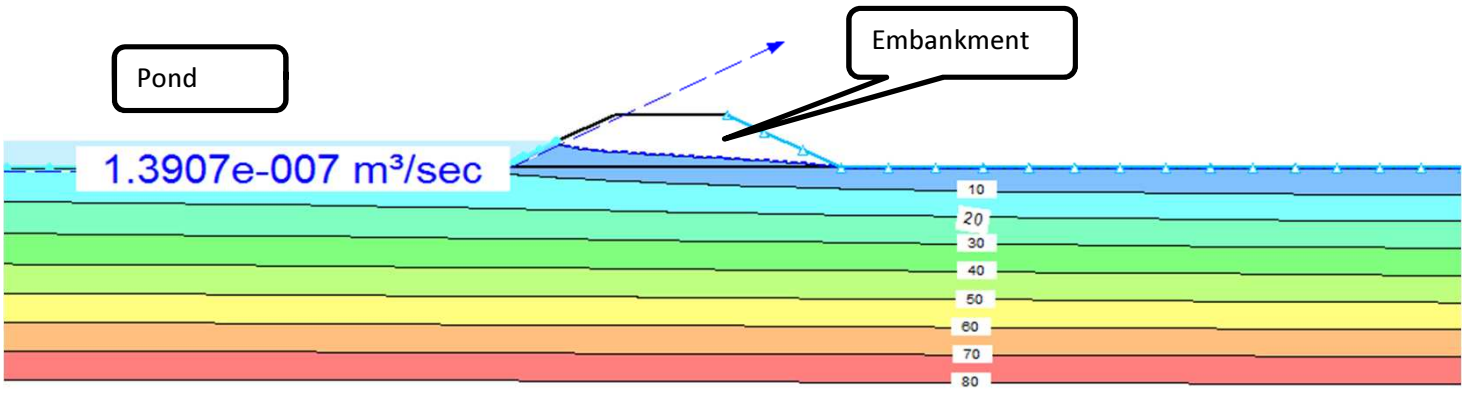



**B F1.1 TYPICAL PERIMETER BERM SECTION (POND-2)**
1:100

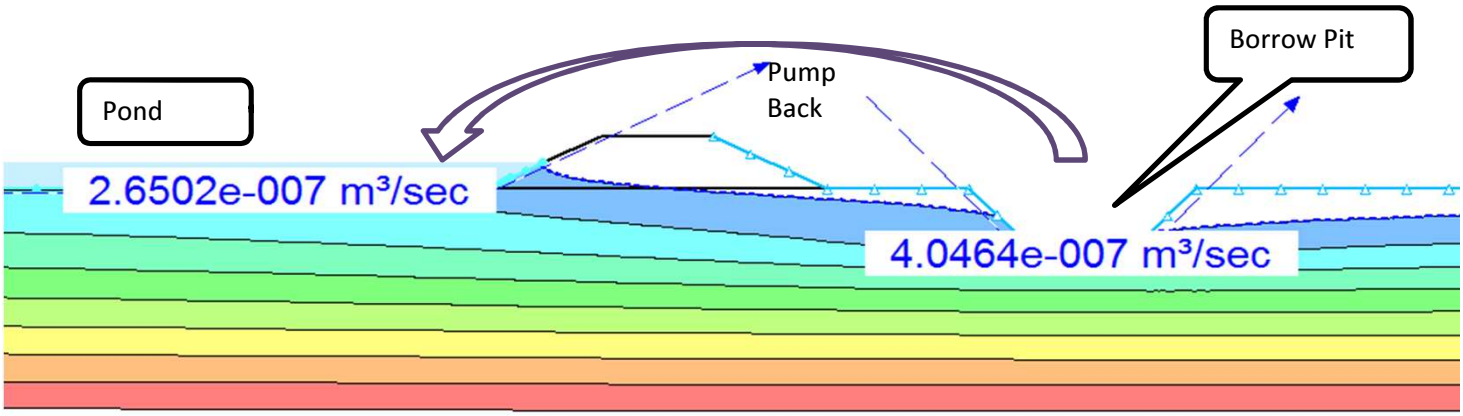



**C F1.1 TYPICAL BAFFLE SECTION (POND-1)**
1:100

Name: Embankment Model: Saturated / Unsaturated K-Function: Embankment (ke=1e-8)
Name: Soil : ky/kx = 0.01 Model: Saturated / Unsaturated K-Function: Soil - 0.01 (kx=1e-6)




NO HDPE LINER, NO BORROW PIT(Kh:Kv of 100:1)




NO HDPE LINER, WITH BORROW PIT(Kh:Kv of 100:1)