SOUTH WEST IRRIGATION MANAGEMENT COOPERATIVE

Brine Ocean Outfall – Sampling, Analysis and Reporting Procedure

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Contents

1 Introduction

The Harvey Water brine pipeline conveys brine from the Kemerton Strategic Industrial Area (KSIA) to an ocean outfall. The pipeline is 315mm in diameter and is designed to discharge up to 500ML/year of brine through a single outlet diffuser that is located approximately 400m offshore at a depth of 8m. The outlet is located approximately 3km south of Binningup in the Southwest of Western Australia.

As part of the start-up and ongoing operations, Harvey Water will undertake a sampling, monitoring and reporting program in accordance with this document. Results of this monitoring program will be reported to the Department of Water and Environmental Regulation (DWER) as required. The monitoring program will ensure compliance with operating conditions as set out by the Environmental Protection Authority (EPA) and DWER.

This sampling, analysis and reporting procedure has been developed for the initial start-up and operations of the brine pipeline, and it only relates to a single source of brine for discharge. Should further discharge sources be introduced into the system, the monitoring plan will be adjusted as required to comply with regulatory authorities. Through this monitoring plan, Harvey Water will continue to assess any impact the brine ocean outfall discharge has on the marine environment. Prior to the construction and operation of the brine ocean outfall, studies have been undertaken on the surrounding marine environment and a benthic habitat survey in order to provide a baseline data set.

The studies conducted indicate that the salinity of the marine waters in the vicinity of the outfall ranges from 34.5 PSU during the winter-spring period up to 36.5 PSU during summer. Water temperature ranged from 15°C during the winter-spring period, and up to 24°C during the summer-autumn period. Turbidity ranged from 1 – 4 NTU and dissolved oxygen ranged from 6.5 – 8.5 mg/L.

The benthic habitat survey that was carried out during November 2019 assessed the habitat type in the vicinity of the outfall as well as any dominant species and the presence of any benthic organisms. The survey found that the two major substrate types were unconsolidated sand and consolidated reef/hard rock/boulders. The reef types identified included low relief (<1m) dominated by algae, and low/moderate relief (1-3m) with mixed algae and epifauna assemblages. Reef structure and assemblages changed with distance from shore, where sandy patches became more frequent.

Benthic organisms identified include the following:

- Seagrass in the area was *Amphibolis spp.* Seagrass was observed in the near shore waters (combined with macroalgae), but not observed in the offshore transects (including the proposed outlet location). The seagrass identified during the underwater video transects were not at a density and coverage considered to constitute a seagrass meadow.

- Few species of macroalgae could be identified to species level, however, there appears to be high diversity and abundance throughout all transects ranging from filamentous to large canopy forming, with moderate to dense coverage across the survey area. Large macroalgae (e.g. *Ecklonia spp.*) dominated the nearshore waters and macroalgae reduced in size with distance offshore.

- Epifauna were observed on most consolidated substrate; however, given the density of macroalgae, coverage was rarely estimated to be >30%.

- Sponges were the dominant benthic macro-organism and appeared relatively diverse, ranging in colour from encrusting to erect forms.

- The sea tulip (*Pyura spp.*) a sessile ascidian, was also observed regularly.

It is noted that the marine waters in the vicinity of the brine ocean outfall are used for a range of activities involving primary and secondary contact, including swimming and wading at beaches, recreational boating, paddle craft and fishing. Recreational and commercial fishing in the area is generally for crabbing, handheld line fishing and beach seining for whitebait and herring. WA State Fisheries also operate in the vicinity for the blue swimmer crab and the whitebait fishery.

Though the Whale Shark, Great White Shark, Grey Nurse Shark and Mackerel Shark are listed or protected fish potentially found within the project area, all are unlikely to be present except the Great White Shark sporadically, particularly during periods of while migration.

Though the Loggerhead Turtle, Green Turtle, Leatherback Turtle and Flatback Turtle are listed or protected marine reptiles potentially found within the vicinity of the outfall, all are unlikely to be present.

The Australian Sea Lion is the only listed or protected pinnepid potentially found within the vicinity of the outfall, though it is unlikely to be present as there are no proximal breeding colonies, haul-out sites or foraging areas.

Though the Pygmy Blue Whale, Southern Right Whale, Humpback Whale, Bryde's Whale, Pygmy Right Whale, Killer Whale, Dusky Dolphin and Spinner Dolphin are listed or [protected cetaceans potentially found within the vicinity of the outlet, the occurrence of these species is:

- Unlikely for the Pygmy Blue Whale, Bryde's Whale, Pygmy Right Whale, Killer Whale and Dusky Dolphin.

- Likely for the Southern Right Whale during winter, and Humpback Whale during summer in the deeper waters.

2 Acronyms

Abbreviation	Definition
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZG	Australian and New Zealand Governments
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
As	Arsenic
Cd	Cadmium
COC	Chain of Custody
Cr	Chromium
CTD	Conductivity Temperature Depth profiler
Cu	Copper
DMMP	Discharge Monitoring and Management Plan

Abbreviation	Definition
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
EQC	Environmental Quality Criteria
EQG	Environmental Quality Guideline
EQMF	Environmental Quality Management Framework
EQO	Environmental Quality Objective
EQS	Environmental Quality Standard
EV	Environmental Value
HEPA	High Ecological Protection Area
Hg	Mercury
km	Kilometres
KSIA	Kemerton Strategic Industrial Area
L	Litre
LEP	Level of Environmental Protection
LEPA	Low Ecological Protection Area
m	Metre
mg	Milligrams
NATA	National Association of Testing Authorities
NH_4^+	Ammonium
Ni	Nickel
NO_x	Inorganic Oxidised Nitrogen
Pb	Lead
PO_4^{3-}	Phosphate
PSU	Practical Salinity Units
QA/QC	Quality Assurance/Quality Control
RO	Reverse Osmosis
SDS	Safety Data Sheet
s	Seconds
TBA	To Be Advised
TDS	Total Dissolved Solids
TN	Total Nitrogen
TP	Total Phosphorus

Abbreviation	Definition
WA	Western Australia
WET	Whole Effluent Testing

3 Marine Environmental Quality

This monitoring plan adopts the Environmental Quality Management Framework (EQMF) by the EPA (2016) for Western Australian marine waters as depicted in Figure 3-1.

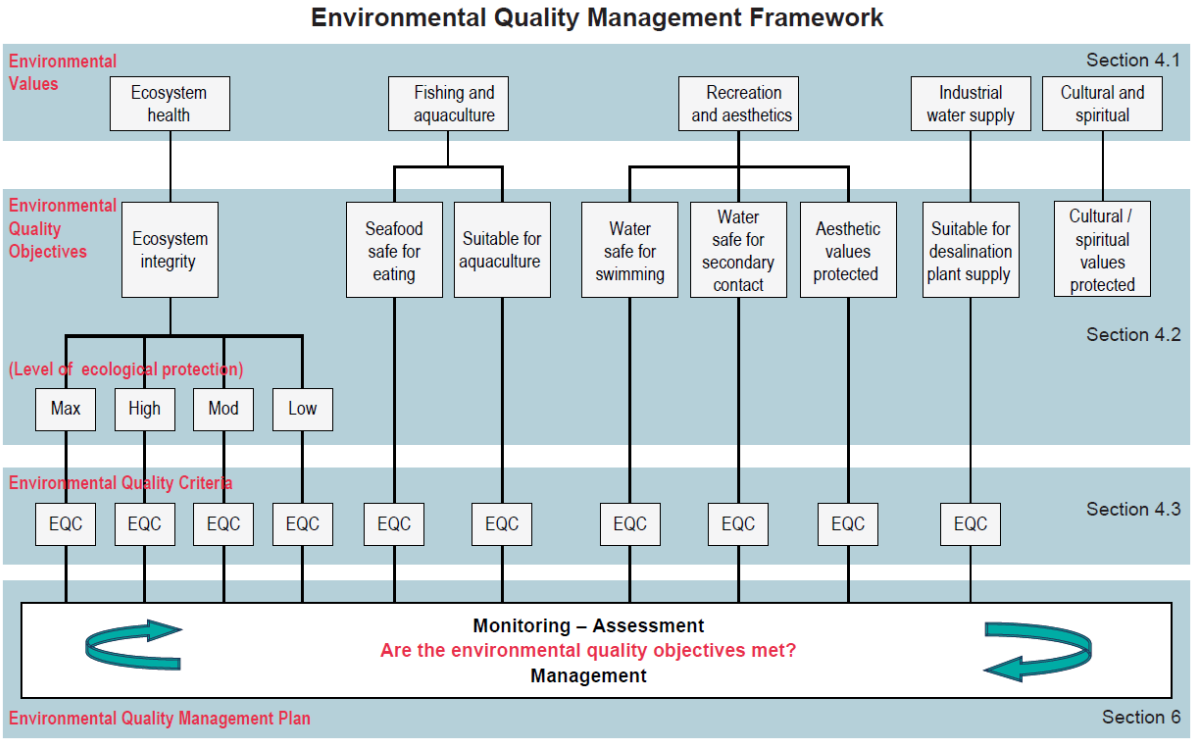

Figure 3-1 EQMF for Cockburn Sound (EPA 2016)

In order to operate the brine discharge pipeline, Harvey Water is responsible for establishing a baseline targets based on the key elements of the EQMF, these being:

- Environmental Value (EV) – establish a broad area of ecological or social importance to the stakeholders
- Environmental Quality Objective (EQO) – Specify the stakeholder aspirations for specific management objectives for each value. EQO's are qualitative with narrative descriptions.
- Environmental Quality Criteria (EQC) – Benchmarks that indicate level of performance in meeting objectives as monitored outputs or measured inputs. EQC's define the limits of acceptable change to environmental quality. There are two types of EQC:
    - Environmental Quality Guideline (EQG) – Threshold numerical value or narrative statement when satisfied indicates a high degree of certainty that the associated EQO is achieved. If not satisfied then assessment against an

environmental quality standard (EQS) is triggered because of uncertainty as to whether the associated EQO has been achieved.

- Environmental Quality Standard (EQS) – Threshold numerical value or narrative statement when not satisfied indicates a significant risk that the associated EQO is not achieved, and with continued EQS exceedance a management response is triggered.

The conceptual framework for applying EQC is illustrated in Figure 3-2.

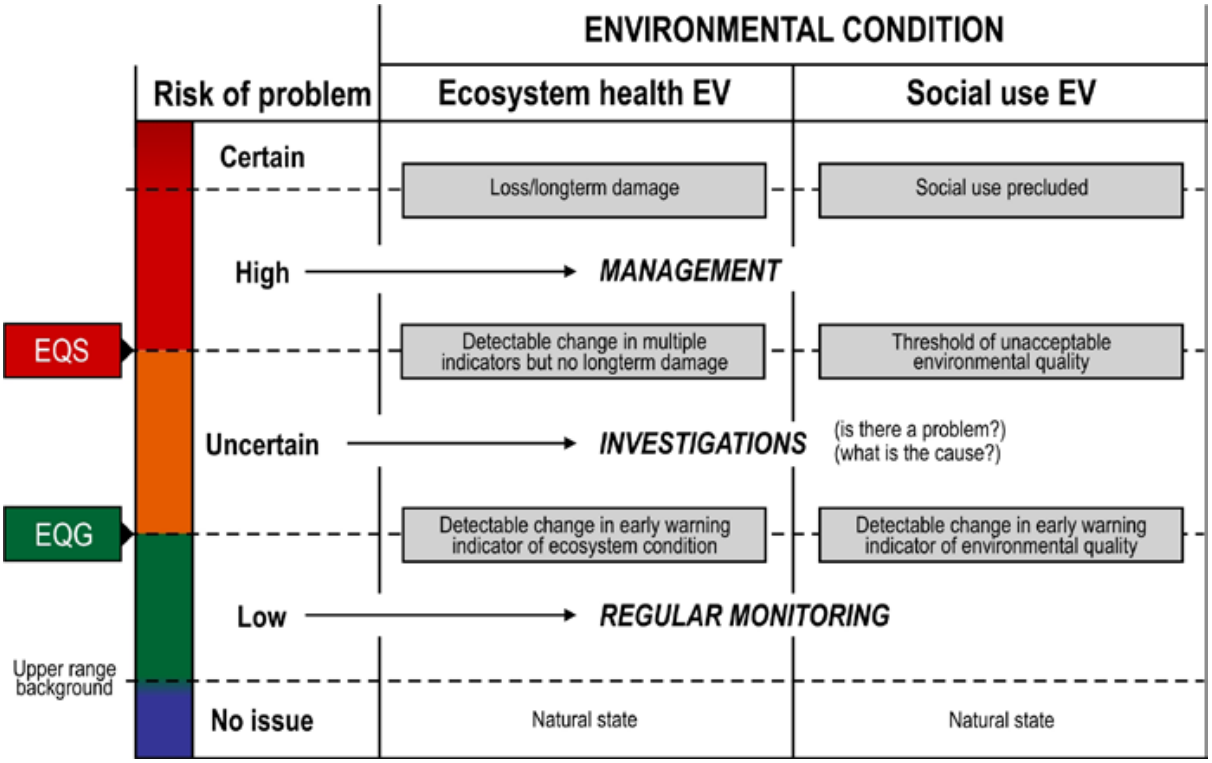

Figure 3-2 Conceptual diagram showing the relation between two types of EQC and associated environmental condition (EPA 2016)

Harvey Water is responsible for establishing a baseline of marine environmental of marine environmental quality with regard to the level of contaminants in the receiving water as well as in the brine to be discharged. This will be undertaken in the initial Phase 1 sampling and analysis program. Whole Effluent Testing (WET) will be undertaken on brine samples and will include nine marine ecotoxicity tests in order to estimate the 99% species protection level via species sensitivity distribution statistics. The number of dilutions required for the brine discharge with the receiving ambient seawater to achieve a 99% species protection level is a key Environmental Quality Guideline (EQG) and Environmental Quality Standard (EQS). The WET tests will include the following bioassays:

- 15-minute Acute Microtox Bioassay – *test species V. fischeri*
- 72-hour Microalgal Growth Bioassay – *test species I. galbana*
- 72-hour Microalgal Growth Bioassay – *test species N. Closterium*
- 72-hour Macroalgal Zoospore Germination Bioassay – *test species E. radiata*

- 48-hour Mollusc Larval Development Bioassay – *test species M. edulis*
- 1-hour Sea Urchin Fertilisation Bioassay – *test species E. mathaei*
- 72-hour Sea Urchin Larval Development Bioassay – *test species E. mathaei*
- 5-7-day Copepod Larval Development Bioassay – *test species G. imparipes*
- 7-day Fish Larval Development Bioassay – *test species S. lalandi*

Monitoring results of the brine discharge operation will be assessed in accordance with this procedure to ensure that the Environmental Quality Objectives (EQO's) are being achieved, and therefore whether the Environmental Value (EV) of the water in the vicinity of the KSIA brine outlet are protected.

4 Sampling and Analysis Program

4.1 Sampling Procedure

The sampling program is split into two separate phases. Phase 1 will cover the start-up operations whilst phase 2 will cover routine monitoring as described below. Any samples taken will be sent to a NATA registered laboratory for analysis of the relevant parameters. All samples will be shipped complete with a Chain of Custody (COC) form outlining the sample name and analysis to be performed on it. All water samples shall be taken in accordance with the following procedure:

Brine Wastewater Samples:

Brine wastewater samples shall be taken from the brine pump station located at the Albemarle Lithium Plant. The number and type of sample bottles required will be determined by the analysis required. Additional sample bottles will be required for WET tests during the phase 1 period of operation. The following procedure is to be followed to take brine samples:

- Label the sample bottle with the sample ID as well as the date and time that the sample is being taken.
- Complete a COC form, noting the sample ID and analysis required for each sample.
- Open the brine sample tap and allow water to purge from the system for at least two (2) minutes.
- Unscrew the cap of the sample bottle(s), keeping the cap in your hand with the open side down to avoid any contamination.
- Fill the sample bottle(s) from the sample tap to a point approximately 20mm below the top of the bottle, taking care not to touch the inside of the bottle or cap.
- Replace the bottle cap on the bottle.
- Store the sample bottle(s) in an esky with ice bricks. Courier to required laboratory as soon as possible after samples have been taken, complete with COC form.

Marine Samples:

Marine samples shall be taken from the following locations:

- Two (2) reference sites located 500m to the North and 500m to the South of the brine discharge outlet.
- One (1) site approximately 25m to the South along the prevailing current direction of the brine outlet, which is beyond the zone of initial dilution
- Three (3) sites 70m South of the brine outlet on the HEPA-LEPA boundary. The first of these samples is directly South of the brine outlet, with the remaining two (2) sites to be 15m either side of this site.

Note that these sample locations assume a current flow in a southerly direction. Should the current flow be in a northerly direction, the samples shall be taken from the North of the brine outlet rather than the South.

The following procedure is the be followed to take marine samples:

- Label the sample bottle with the sample ID as well as the date and time that the sample is being taken.
- Complete a COC form, noting the sample ID and analysis required for each sample.
- Record the GPS location of where the sample was taken.
- Take a sample of water from 0.5m below the surface of the water utilising a clean bottle (not the sample bottle(s) being sent to the laboratory for analysis).
- Unscrew the cap of the sample bottle(s), keeping the cap in your hand with the open side down to avoid any contamination.
- Decant water from the bottle with the marine sample into the sample bottle(s), filling the sample bottle(s) to a point approximately 20mm below the top of the bottle, taking care not to touch the inside of the bottle or cap.
- Replace the bottle cap on the bottle.
- Store the sample bottle(s) in an esky with ice bricks. Courier to required laboratory as soon as possible after samples have been taken, complete with COC form.

In addition to sampling taken for analysis, a series of vertical conductivity-temperature-depth (CTD) profiles will be collected through the water column utilising a Xylem Pro DSS handheld unit with GPS. This will be utilised to assess the salinity characterisation at the HEPA-LEPA boundary. The CTD profiles will be undertaken at each of the six monitoring sites listed above for marine monitoring.

4.2 Phase 1 – Start-up Operations

Phase 1 operation encompasses the first eight (8) weeks of operation. It is an intensive sampling and monitoring period with sampling and analysis in accordance with Table 4-1. All samples are to be taken in accordance with the sampling guidelines outlined in Section 4.1.

Table 4-1 – Phase 1 Sampling and Analysis Timetable

Week & Day	Sample Source	Tests
Week 1, Monday	Brine	• WET_1 • Dissolved metals (V, Cr(VI), Cr (III), Cr, Co, Ni, Cu, Zn, Ag, Cd, Pb, Hg) • Process Chemicals (Sodium Molybdate, THPS (Biocide), Phosphonates (PBTC), Phosphonates (HEDP), Polyacrylate, Azole, Molybdate. • Nutrients (TP, TN, NO_x, NH_x) • Total Recoverable Hydrocarbons (BTEX, PAHs) • Salinity • Chloride
	Marine Sampling Sites (6 off)	• Salinity • Chloride
Week 1, Thursday	Brine	• Dissolved metals (V, Cr(VI), Cr (III), Cr, Co, Ni, Cu, Zn, Ag, Cd, Pb, Hg) • Process Chemicals (Sodium Molybdate, THPS (Biocide), Phosphonates (PBTC), Phosphonates (HEDP), Polyacrylate, Azole, Molybdate. • Nutrients (TP, TN, NOx, NHx) • Total Recoverable Hydrocarbons (BTEX, PAHs) • Salinity • Chloride
Week 2, Monday	Brine	• Dissolved metals (V, Cr(VI), Cr (III), Cr, Co, Ni, Cu, Zn, Ag, Cd, Pb, Hg) • Process Chemicals (Sodium Molybdate, THPS (Biocide), Phosphonates (PBTC), Phosphonates (HEDP), Polyacrylate, Azole, Molybdate. • Nutrients (TP, TN, NO_x, NH_x) • Total Recoverable Hydrocarbons (BTEX, PAHs) • Salinity • Chloride
Week 2, Thursday	Brine	• Dissolved metals (V, Cr(VI), Cr (III), Cr, Co, Ni, Cu, Zn, Ag, Cd, Pb, Hg) • Process Chemicals (Sodium Molybdate, THPS (Biocide), Phosphonates (PBTC), Phosphonates (HEDP), Polyacrylate, Azole, Molybdate. • Nutrients (TP, TN, NOx, NHx) • Total Recoverable Hydrocarbons (BTEX, PAHs) • Salinity • Chloride
Week 3, Monday	Brine	• Dissolved metals (V, Cr(VI), Cr (III), Cr, Co, Ni, Cu, Zn, Ag, Cd, Pb, Hg) • Process Chemicals (Sodium Molybdate, THPS (Biocide), Phosphonates (PBTC), Phosphonates (HEDP), Polyacrylate, Azole, Molybdate.

Week & Day	Sample Source	Tests
		• Nutrients (TP, TN, NO_x, NH_x) • Total Recoverable Hydrocarbons (BTEX, PAHs) • Salinity • Chloride
Week 3, Thursday	Brine	• Dissolved metals (V, Cr(VI), Cr (III), Cr, Co, Ni, Cu, Zn, Ag, Cd, Pb, Hg) • Process Chemicals (Sodium Molybdate, THPS (Biocide), Phosphonates (PBTC), Phosphonates (HEDP), Polyacrylate, Azole, Molybdate. • Nutrients (TP, TN, NOx, NHx) • Total Recoverable Hydrocarbons (BTEX, PAHs) • Salinity • Chloride
Week 4, Monday	Brine	• Dissolved metals (V, Cr(VI), Cr (III), Cr, Co, Ni, Cu, Zn, Ag, Cd, Pb, Hg) • Process Chemicals (Sodium Molybdate, THPS (Biocide), Phosphonates (PBTC), Phosphonates (HEDP), Polyacrylate, Azole, Molybdate. • Nutrients (TP, TN, NO_x, NH_x) • Total Recoverable Hydrocarbons (BTEX, PAHs) • Salinity • Chloride
Week 4, Thursday	Brine	• Dissolved metals (V, Cr(VI), Cr (III), Cr, Co, Ni, Cu, Zn, Ag, Cd, Pb, Hg) • Process Chemicals (Sodium Molybdate, THPS (Biocide), Phosphonates (PBTC), Phosphonates (HEDP), Polyacrylate, Azole, Molybdate. • Nutrients (TP, TN, NOx, NHx) • Total Recoverable Hydrocarbons (BTEX, PAHs) • Salinity • Chloride
Week 5, Monday	Brine	• WET_2 • Dissolved metals (V, Cr(VI), Cr (III), Cr, Co, Ni, Cu, Zn, Ag, Cd, Pb, Hg) • Process Chemicals (Sodium Molybdate, THPS (Biocide), Phosphonates (PBTC), Phosphonates (HEDP), Polyacrylate, Azole, Molybdate. • Nutrients (TP, TN, NO_x, NH_x) • Total Recoverable Hydrocarbons (BTEX, PAHs) • Salinity • Chloride
	Marine Sampling Sites (6 off)	• Salinity • Chloride
Week 5, Thursday	Brine	• Dissolved metals (V, Cr(VI), Cr (III), Cr, Co, Ni, Cu, Zn, Ag, Cd, Pb, Hg) • Process Chemicals (Sodium Molybdate,

Week & Day	Sample Source	Tests
		THPS (Biocide), Phosphonates (PBTC), Phosphonates (HEDP), Polyacrylate, Azole, Molybdate. • Nutrients (TP, TN, NOx, NHx) • Total Recoverable Hydrocarbons (BTEX, PAHs) • Salinity • Chloride
Week 6, Monday	Brine	• Dissolved metals (V, Cr(VI), Cr (III), Cr, Co, Ni, Cu, Zn, Ag, Cd, Pb, Hg) • Process Chemicals (Sodium Molybdate, THPS (Biocide), Phosphonates (PBTC), Phosphonates (HEDP), Polyacrylate, Azole, Molybdate. • Nutrients (TP, TN, NO_x, NH_x) • Total Recoverable Hydrocarbons (BTEX, PAHs) • Salinity • Chloride
Week 6, Thursday	Brine	• Dissolved metals (V, Cr(VI), Cr (III), Cr, Co, Ni, Cu, Zn, Ag, Cd, Pb, Hg) • Process Chemicals (Sodium Molybdate, THPS (Biocide), Phosphonates (PBTC), Phosphonates (HEDP), Polyacrylate, Azole, Molybdate. • Nutrients (TP, TN, NOx, NHx) • Total Recoverable Hydrocarbons (BTEX, PAHs) • Salinity • Chloride
Week 7, Monday	Brine	• Dissolved metals (V, Cr(VI), Cr (III), Cr, Co, Ni, Cu, Zn, Ag, Cd, Pb, Hg) • Process Chemicals (Sodium Molybdate, THPS (Biocide), Phosphonates (PBTC), Phosphonates (HEDP), Polyacrylate, Azole, Molybdate. • Nutrients (TP, TN, NO_x, NH_x) • Total Recoverable Hydrocarbons (BTEX, PAHs) • Salinity • Chloride
Week 7, Thursday	Brine	• Dissolved metals (V, Cr(VI), Cr (III), Cr, Co, Ni, Cu, Zn, Ag, Cd, Pb, Hg) • Process Chemicals (Sodium Molybdate, THPS (Biocide), Phosphonates (PBTC), Phosphonates (HEDP), Polyacrylate, Azole, Molybdate. • Nutrients (TP, TN, NOx, NHx) • Total Recoverable Hydrocarbons (BTEX, PAHs) • Salinity • Chloride
Week 8, Monday	Brine	• Dissolved metals (V, Cr(VI), Cr (III), Cr, Co, Ni, Cu, Zn, Ag, Cd, Pb, Hg) • Process Chemicals (Sodium Molybdate, THPS (Biocide), Phosphonates (PBTC),

Week & Day	Sample Source	Tests
		Phosphonates (HEDP), Polyacrylate, Azole, Molybdate. • Nutrients (TP, TN, NO_x, NH_x) • Total Recoverable Hydrocarbons (BTEX, PAHs) • Salinity • Chloride
Week 8, Thursday	Brine	• Dissolved metals (V, Cr(VI), Cr (III), Cr, Co, Ni, Cu, Zn, Ag, Cd, Pb, Hg) • Process Chemicals (Sodium Molybdate, THPS (Biocide), Phosphonates (PBTC), Phosphonates (HEDP), Polyacrylate, Azole, Molybdate. • Nutrients (TP, TN, NOx, NHx) • Total Recoverable Hydrocarbons (BTEX, PAHs) • Salinity • Chloride

4.3 Phase 2 – Routine Monitoring

At the completion of the intensive eight week Phase 1 sampling period, operations will move into Phase 2 routine monitoring. Phase 2 monitoring will include a monthly sampling and analysis program for the two years after the completion of Phase 1 operations. After the completion of Phase 2 monitoring, Harvey Water will be permitted to request a reduction of frequency of monitoring to quarterly rather than monthly. Should this reduction in monitoring frequency be approved, this operations manual will be updated to reflect this. The sampling and analysis to be undertaken during Phase 2 operations will be in accordance with Table 4-2. All samples are to be taken in accordance with the sampling guidelines outlined in Section 4.1.

Table 4-2 – Phase 2 Sampling and Analysis Timetable

Month & Day	Sample Source	Tests
Month 1 to Month 24, First Monday of each month	Brine	• WET_1 • Dissolved metals (V, Cr(VI), Cr (III), Cr, Co, Ni, Cu, Zn, Ag, Cd, Pb, Hg) • Process Chemicals (Sodium Molybdate, THPS (Biocide), Phosphonates (PBTC), Phosphonates (HEDP), Polyacrylate, Azole, Molybdate. • Nutrients (TP, TN, NO_x, NH_x) • Total Recoverable Hydrocarbons (BTEX, PAHs) • Salinity • Chloride
	Marine Sampling Sites (6 off)	• Salinity • Chloride

5 Reporting

5.1 Reporting of EQS Exceedances

Should any sample return a result that exceeds the EQS, DWER shall be notified within two (2) business days of identification of the identification of the exceedance. The following information will be provided:

- Which EQG was exceeded.
- Monitoring data along the HEPA-LEPA boundary, reference sites and wastewater stream.
- Identification of the potential cause of the exceedance.
- The proposed management response.

A follow-up report will be provided to DWER within one (1) calendar month with the following information:

- Corrective actions to meet the EQC at the HEPA-LEPA boundary.
- All monitoring data collected since the exceedance including demonstration that corrective management has been effective.

5.2 Phase 1 – Start-up Operations

Within two (2) calendar months of the completion of the Phase 1 operations, a report will be compiled by Harvey Water and submitted to DWER. The report will, as a minimum, include the following:

- A summary of all monitoring results of marine waters and the brine stream.
- Verification of the modelling predictions in regard to near field mixing and the appropriateness of the LEPA spatial extent.
- A summary of the adopted EQGs.
- A summary of the two WET tests and the adopted EQS.
- An overview of the environmental performance of the outlet discharge at the HEPA-LEPA boundary.

5.3 Phase 2 – Routine Monitoring

During routine monitoring, an annual report will be compiled by Harvey Water and submitted to DWER by 1 March that will include:

- A summary of all monitoring results of marine waters and the brine stream.
- An overview of the environmental performance of the outlet discharge at the HEPA-LEPA boundary.
- Documentation of any management actions undertaken over the previous year and

that may be extending into the next annual reporting period.

6 Additional Discharges into Brine Outfall

This procedure relates to the sampling, monitoring, and reporting of the start up and routine monitoring of the KSIA brine discharge with a single point of wastewater (brine) supply. Should additional brine or wastewater streams be brought online, approval will be sought from the EPA and DWER. The monitoring program will also recommence, with Phase 1 and 2 monitoring to be undertaken again, with additional sampling required of each additional discharge source as well as a sample of the co-mingled waste immediately prior to discharge to the marine environment. Should additional sources be introduced to the system, this monitoring procedure will be updated to include the sampling and analysis of these additional streams.

7 References

Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000), Australian and New Zealand Guideline for Fresh and Marine Water Quality, October 2000

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