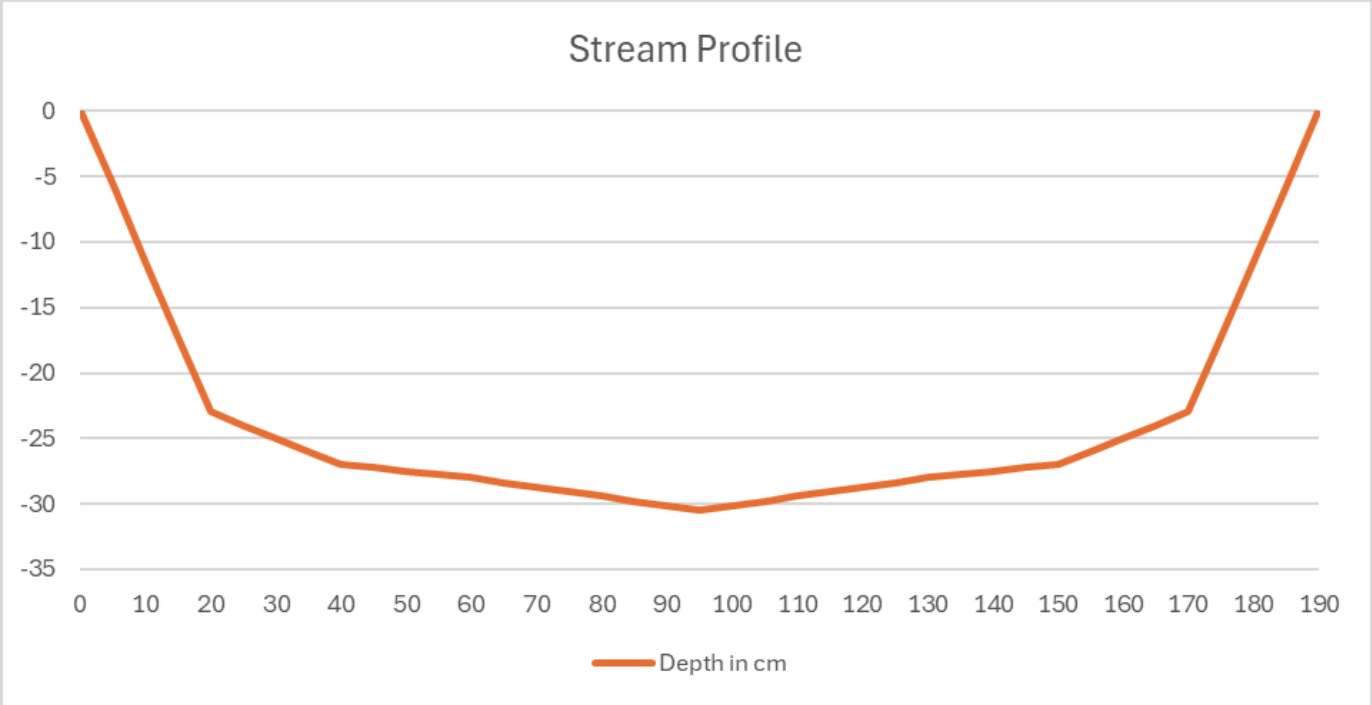
RO Concentrate Treatment and Disposal Plan

Stream Assessment for Potential Discharge Location

Stream Cross-Sectional Profile

The receiving watercourse has been surveyed with the following measurements:



Stream Width: 190 cm (1.9 m)

Measurement Points (from left edge):

- 0 cm from edge: 0.0 cm depth
- 20 cm from edge: 23.0 cm depth
- 40 cm from edge: 27.0 cm depth
- 60 cm from edge: 28.0 cm depth
- 95 cm from edge: 30.5 cm depth (centre)

(Mirror image on right side - symmetrical U-shape)

Cross-Sectional Area Calculation

Using the **trapezoidal rule** to calculate the area of one half of the channel, then doubling for total area:

Left half (0 to 95 cm from edge):

Segment	Width (m)	Depth 1 (m)	Depth 2 (m)	Area (m^2)
0-20 cm	0.20	0.000	0.230	0.0230
20-40 cm	0.20	0.230	0.270	0.0500
40-60 cm	0.20	0.270	0.280	0.0550
60-95 cm	0.35	0.280	0.305	0.1024

Calculation formula: Area = width × ($depth_1$ + $depth_2$) / 2

- Segment 1: 0.20 × (0.000 + 0.230) / 2 = 0.0230 m^2
- Segment 2: 0.20 × (0.230 + 0.270) / 2 = 0.0500 m^2
- Segment 3: 0.20 × (0.270 + 0.280) / 2 = 0.0550 m^2
- Segment 4: 0.35 × (0.280 + 0.305) / 2 = 0.1024 m^2

Half channel area: 0.0230 + 0.0500 + 0.0550 + 0.1024 = **0.2304 m^2**

Total cross-sectional area: 0.2304 × 2 = **0.4608 m^2**

Stream Flow Rate Calculation

Flow velocity measurement:

- Distance travelled: 3.0 metres
- Time taken: 59.17 seconds
- Flow velocity = 3.0 m ÷ 59.17 s = **0.05071 m/s** (5.071 cm/s)

Volumetric flow rate:

- Q = Cross-sectional area × Velocity
- Q = 0.4608 m^2 × 0.05071 m/s
- Q = **0.02337 m^3/s**

Flow rate in litres per day:

- Q = 0.02337 m^3/s × 1,000 L/m^3 × 86,400 s/day
- Q = **2,019,168 litres per day**
- Q = **2,019 m^3/day** or **2.02 ML/day**

Interim Disposal Arrangements

While awaiting EA permit determination and RO concentrate test results, waste concentrate will be tankered to an approved waste water treatment facility.

Disposal Facility Details

Yorkshire Water - Naburn Sewage Treatment Works

- Address: Naburn S T W, Naburn Lane, Naburn, York, North Yorkshire, YO19 4RN
- Operator: Yorkshire Water Services Limited
- Facility Type: Waste Water Treatment Centre accepting tankered liquid waste

Disposal Costs

Treatment Cost: £9.00 per m^3 (charged by Yorkshire Water)

Haulage Options:

Haulage Type	Cost per Load	Load Size
Internal (own vehicle/driver)	£250.00	28 m^3
External contractor	£400.00	28 m^3

Monthly Cost Analysis for Interim Disposal

Basis: RO system operates 5 days per week (260 working days per year)

The following table shows projected monthly costs for different RO concentrate production rates:

Daily Volume	Monthly Volume[1]	Monthly Treatment Cost[2]	Monthly Internal Haulage[3]	Monthly External Haulage[3]
10,000 L/day (10 m^3/day)	217 m^3	£1,950.00	£1,937.50	£3,100.00
30,000 L/day (30 m^3/day)	650 m^3	£5,850.00	£5,812.50	£9,300.00
50,000 L/day (50 m^3/day)	1,083 m^3	£9,750.00	£9,687.50	£15,500.00

Total Monthly Costs:

Daily Volume	Internal Haulage	External Haulage
10,000 L/day	£3,887.50	£5,050.00
30,000 L/day	£11,662.50	£15,150.00
50,000 L/day	£19,437.50	£25,250.00

Calculation Notes:

1. **Monthly volume** = Daily volume × 21.67 days (average working days per month: 260 ÷ 12)
2. **Monthly treatment cost** = (Daily volume × 260 working days × £9/m^3) ÷ 12 months
3. **Monthly haulage cost** = (⌈Annual volume ÷ 28 m^3⌉ × cost per load) ÷ 12 months

Annual Trip Requirements:

Daily Volume	Annual Volume	Trips per Year[4]
10,000 L/day	2,600 m^3	93 trips
30,000 L/day	7,800 m^3	279 trips
50,000 L/day	13,000 m^3	465 trips

4. **Trips per year** = ⌈Annual volume ÷ 28⌉ (rounded up to nearest whole number)

Notes and Considerations

Cost-Benefit Analysis

- Interim tankering is a temporary measure with significant ongoing costs
- Based on 5-day working week (260 days/year):
  - At 10,000 L/day, annual tankering costs would be **£46,650** (internal) to **£60,600** (external)
  - At 30,000 L/day, annual tankering costs would be **£139,950** (internal) to **£181,800** (external)
  - At 50,000 L/day, annual tankering costs would be **£233,250** (internal) to **£303,000** (external)
- Direct discharge to stream (if permitted) would eliminate all these costs

Regulatory Pathway

- Environment Agency permit application required for stream discharge
- Dilution ratio calculation pending RO concentrate test results
- Continuous discharge using buffer tank and dosing pump allows controlled dilution
- Stream flow of ~2.02 ML/day provides substantial dilution capacity

Next Steps

1. Obtain RO concentrate water quality analysis (TDS, conductivity, pH, specific contaminants)
2. Calculate dilution ratios for various discharge rates
3. Complete EA discharge consent application
4. Implement buffer tank and dosing pump system for controlled discharge
5. Establish discharge monitoring regime as required by permit conditions