JBT Consulting Pty Ltd
ABN 46 134 273 224
PO Box 2212
NEW FARM, QLD, 4005
Mob +61 409 266 469

Our reference: JBT01-076-009

30 January 2024

Rod Hailstone
Director
AARC Environmental Solutions Pty Ltd
164 Wharf Street, Spring Hill QLD 4000

Predicted Mine Inflows – Meadowbrook Underground and Open Cut Mines

1. Introduction

This letter report presents an update to groundwater modelling predictions of inflow rates to the Meadowbrook underground and open cut mines. Predicted rates of groundwater inflow rates to the Meadowbrook underground workings and the Meadowbrook Open Cut were presented previously in the Meadowbrook Project Groundwater Impact Assessment Report[1] as well as the Groundwater Modelling Technical Report[2]. For these reports, the groundwater model predicted mine inflow volumes as time-weighted averages off the outputs reported by ZoneBudget software for the Drain cells that were placed in both the open cut and underground mining areas (SLR 2022). Following a request from the Department of Environment and Science (DES) to provide data on the relative contributions of each groundwater unit to the total mine inflows.

As discussed in the following sections, the methodology for calculating the relative contributions of each groundwater unit to the total mine inflows varied between the open pit and the underground mine.

For reference, the lowest mine seam is Vermont Seam that is represented in the model as Layer 7. the upper 7 layers of the model are as follows:

- Layer 1 (L1) – Alluvium, colluvium
- Layer 2 (L2) – Tertiary sediments
- Layer 3 (L3) – Rewan Group
- Layer 4 (L4) – Permian overburden above Leichardt Seam
- Layer 5 (L5) - Leichardt Seam
- Layer 6 (L6) - Interburden
- Layer 7 (L7) – Vermont Seam

The results are discussed below for both the underground mining area and the Meadowbrook Open Cut.

---

[1] JBT (2022) Meadowbrook Project Groundwater Impact Assessment. Report from JBT Consulting Pty Ltd to Jellinbah Resources, July 2022.
[2] SLR (2022) Meadowbrook Underground – Groundwater Modelling Technical Report. Report prepared by SLR Consulting Australia Pty Ltd for Jellinbah Group Pty Ltd, March 2022.

2. Underground Mining Area

The figure from the Groundwater Impact Assessment Report that showed groundwater inflow rates to the underground mining workings for the Base Case and Fracture to Surface Case is included in this report as Figure 2-1 below.

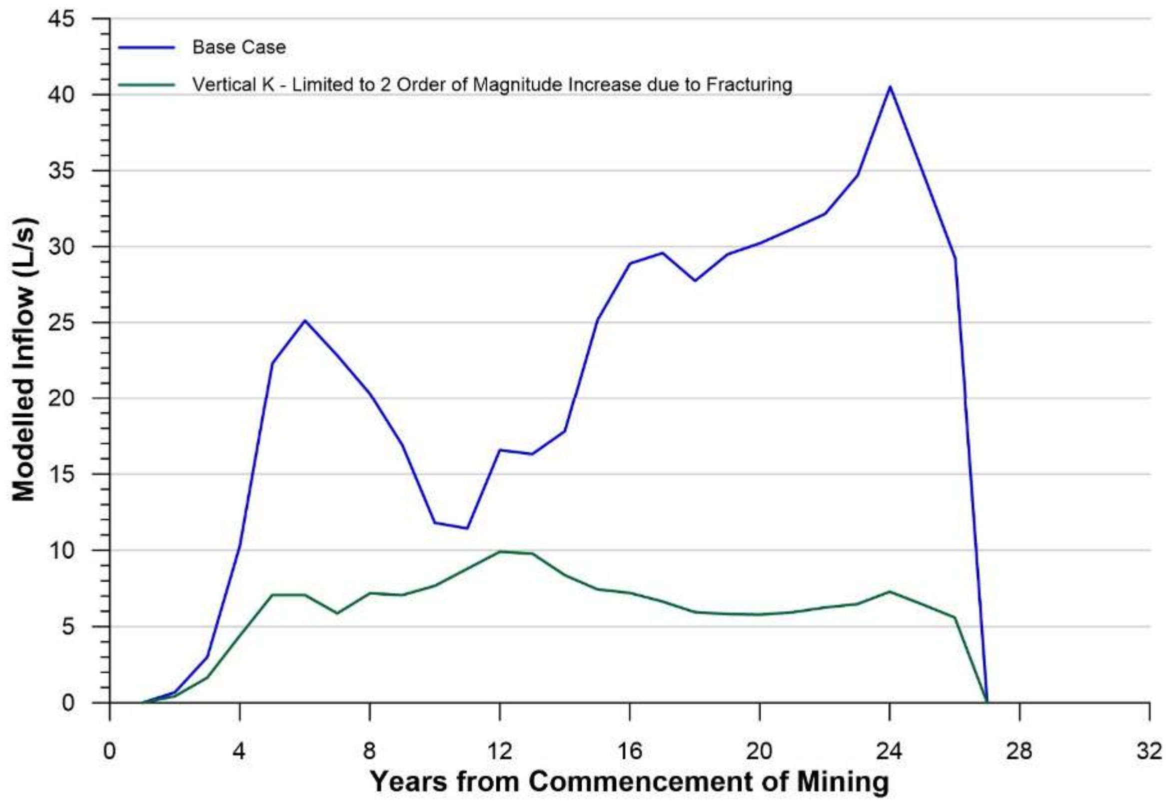

Figure 2-1: Model Predicted Groundwater Inflow Rates to Underground Workings

In the original model[3], Drain boundary condition was exclusively applied to the mined seams (represented by Layer 5 and Layer 7 in the model) to simulate the underground mine progression. The reported inflow rates to the underground workings were obtained from the ZoneBudget software for Drain cells in the underground mining areas.

The underground operations will result in a volumetric transfer of groundwater from other hydrostratigraphic units through the introduction of enhanced vertical hydraulic gradients between adjacent units (i.e. induced leakage between aquifers). These changes in groundwater volumes within each unit as a result of the underground mine are represented as changes in storage for each unit within the numerical groundwater model. Therefore, to determine the contribution to the total inflow, the predicted change in storage resulting from mining was extracted separately for each layer of the

[3] SLR (2022) Meadowbrook Underground – Groundwater Modelling Technical Report. Report prepared by SLR Consulting Australia Pty Ltd for Jellinbah Group Pty Ltd, March 2022.

model using the ZoneBudget utility. This process involved comparing the change in storage for each model layer between two model runs: one with the Meadowbrook underground mine and one without.

The contribution (as a relative percentage) from each model layer (1 to 7) to groundwater inflows to the underground workings are shown below in Table 2-1 (Base Case) and Table 2-2 (Fracture to surface case, where the change in vertical hydraulic conductivity due to mining was limited to 2 orders of magnitude).

With respect to information provided in Table 2-1 (Base Case) the following observations are made:

- The values for each model layer indicate additional water that has flowed into the impact zone from mining, as either:
  - Recharge (in the case of Layers 1 and 2, with most recharge being applied to water table in Layer 2 as Layer 1 was dry (as an initial condition) over the majority of the mining area;
  - Lateral flow within the model layer (i.e., as the cone of depression due to mining progressively developed, groundwater flowed laterally within the layer towards the cone of depression under a hydraulic gradient); and,
  - Vertical flow (predominantly downward) between model layers and towards the underground voids.
- The relatively low percentage contribution for Layer 5 (Leichhardt Seam) and Layer 7 (Vermont Seam) does not take into account water that is lost from the model in areas where the coal is removed by mining.
- Downward seepage from Layer 2 (Tertiary sediments) provides the most significant volume of water to the underground workings. This is interpreted to be related to the following:
  - Fracturing due to mining extends to the base of Tertiary. Therefore, an increased potential exists for drainage from the Tertiary sediments to the underlying units;
  - The Tertiary sediments have a higher hydraulic conductivity than the underlying units (also, the Tertiary sediments are not truncated by faults), therefore the cone of depression can extend further in the Tertiary sediments and source water from a greater area (relative to the underlying low-permeability and fault-truncated sediments);
  - The Tertiary sediments have a higher specific yield than the underlying units, therefore drainage of the Tertiary sediments yields more water for a given volume relative to the underlying units;
  - Recharge that occurs to Layer 2 within the mine-affected area also seeps downwards to the underground workings. Therefore, the total volume of mine inflows thar are sourced from Layer 2 represents a combination of rainfall recharge and groundwater that existed within the formation at commencement of mining.

Table 2-1 –Percentage Contribution to Underground Mine Inflow – Base Case

Year of Mining	Percentage Contribution to Mine Inflows								Modelled Inflow Rate (ML/Year)
	L1	L2	L3	L4	L5	L6	L7	Total	
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	0
2	0.0	58.7	2.4	19.7	1.3	8.9	9.0	100	21
3	0.0	80.4	1.2	8.0	0.6	5.5	4.2	100	95
4	0.1	89.2	0.5	3.4	0.3	3.2	3.4	100	324
5	0.2	89.0	0.4	2.2	0.2	5.9	2.1	100	704
6	0.5	89.9	0.3	2.2	0.2	5.4	1.5	100	792
7	0.7	92.1	0.4	2.2	0.1	3.3	1.2	100	719
8	0.7	93.6	0.4	2.4	0.3	1.8	0.8	100	640
9	0.8	95.4	0.5	1.8	0.2	0.8	0.6	100	533
10	1.2	94.7	0.6	2.1	0.7	0.6	0.1	100	372
11	1.4	93.0	0.6	3.2	0.6	1.0	0.1	100	361
12	1.6	90.1	0.7	5.1	0.9	1.6	0.1	100	523
13	1.8	91.0	0.6	4.2	0.9	1.3	0.1	100	514
14	1.6	91.6	1.0	3.2	0.8	1.4	0.5	100	562
15	1.2	91.9	0.8	3.1	0.4	1.9	0.7	100	794
16	0.9	92.5	0.5	3.2	0.5	1.8	0.5	100	911
17	0.7	94.3	0.7	2.4	0.1	1.2	0.6	100	933
18	0.7	94.7	0.6	2.4	0.0	0.9	0.7	100	875
19	0.5	95.1	0.5	2.4	0.0	0.9	0.6	100	930
20	0.5	95.6	0.5	1.9	0.0	0.9	0.6	100	953
21	0.5	96.0	1.2	1.2	0.0	0.6	0.5	100	983
22	0.3	94.7	2.2	1.6	0.0	0.6	0.6	100	1014
23	0.2	94.4	3.4	1.2	0.0	0.3	0.6	100	1094
24	0.2	91.2	6.1	1.1	0.0	0.9	0.5	100	1278
25	0.2	88.7	10.2	0.4	0.0	0.4	0.1	100	1101
26	0.3	87.4	11.7	0.1	0.2	0.2	0.0	100	922

The results for the Fracture to Surface Case are presented below in Table 2-2. Observations that relate to the data within Table 2-2 (and relative to data within Table 2-1) include:

- The general observations that applied to Table 2-1 (e.g. the relative contribution of Layer 2 (Tertiary) water to the underground operation) also apply to the data within Table 2-2.
- However, the total volume of water that reports to the underground operations is significantly lower for the Fracture to Surface Case (Table 2-2) than for the Base Case (Table 2-1), even though fracturing only extended to the base of Tertiary for the Base Case. This is interpreted to be related to the following:
  - The increase in vertical conductivity for the Fracture to Surface Case was limited to 2 orders of magnitude, whereas an increase in vertical conductivity of 3-4 orders of magnitude was

allowed for the Base Case. The potential for downward seepage was therefore lower for the Fracture to Surface Case than for the Base Case (a maximum increase of 2 orders of magnitude was regarded as being more realistic by model reviewers).

- For the Base Case, mining-induced fracturing extended to the base of Tertiary sediments. Enhanced drainage of the Tertiary sediment was therefore possible for both the Base Case and the Fracture to Surface Case, though the vertical conductivity of the units below the Tertiary was lower for the Fracture to Surface Case

Table 2-2 –Percentage Contribution to Underground Mine Inflow – Fracture to Surface Case

Year of Mining	Percentage Contribution to Mine Inflows								Modelled Inflow Rate (ML/Year)
	L1	L2	L3	L4	L5	L6	L7	Total	
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	0
2	0.0	20.5	1.9	12.3	1.0	25.8	38.4	100	13
3	0.0	48.2	1.4	9.2	0.7	19.8	20.7	100	52
4	0.0	58.8	0.9	5.4	0.4	12.7	21.8	100	139
5	0.0	67.3	0.7	3.6	0.3	9.8	18.4	100	223
6	0.0	73.3	0.6	2.9	0.2	7.8	15.3	100	223
7	0.3	76.5	0.8	4.4	0.4	6.1	11.6	100	185
8	0.5	71.7	2.5	12.9	2.3	3.8	6.3	100	226
9	0.8	79.4	2.5	9.1	1.2	3.0	4.0	100	223
10	1.0	79.1	3.3	10.3	3.3	2.6	0.4	100	242
11	1.1	82.7	2.6	8.2	2.8	2.3	0.3	100	277
12	1.1	80.4	2.6	9.9	3.3	2.3	0.3	100	312
13	1.2	84.1	2.2	7.8	2.3	2.0	0.3	100	309
14	1.2	85.9	1.7	5.9	2.0	2.0	1.2	100	264
15	1.1	87.4	1.3	4.6	1.4	2.1	2.3	100	235
16	0.8	88.0	1.2	4.0	1.9	2.1	2.1	100	227
17	0.7	90.5	0.6	2.8	0.6	1.9	3.0	100	210
18	0.7	91.4	0.2	1.9	0.1	1.9	3.9	100	187
19	0.3	92.7	0.0	1.3	0.0	1.9	3.8	100	183
20	0.8	93.0	0.0	1.1	0.0	1.7	3.4	100	182
21	0.6	93.2	0.0	0.9	0.1	1.8	3.4	100	187
22	0.7	92.6	0.0	0.7	0.0	1.8	4.1	100	197
23	0.7	93.1	0.0	0.6	0.0	1.6	4.0	100	204
24	0.6	93.5	0.0	0.9	0.0	1.8	3.3	100	230
25	0.8	98.0	0.0	0.3	0.0	1.2	0.1	100	204
26	0.8	98.6	0.0	0.1	0.0	1.1	0.1	100	176

3. Meadowbrook Open Cut

The figure from the Groundwater Impact Assessment Report[4] that showed groundwater inflow rates to the Meadowbrook Open Cut is included in this report as Figure 3-1 below.

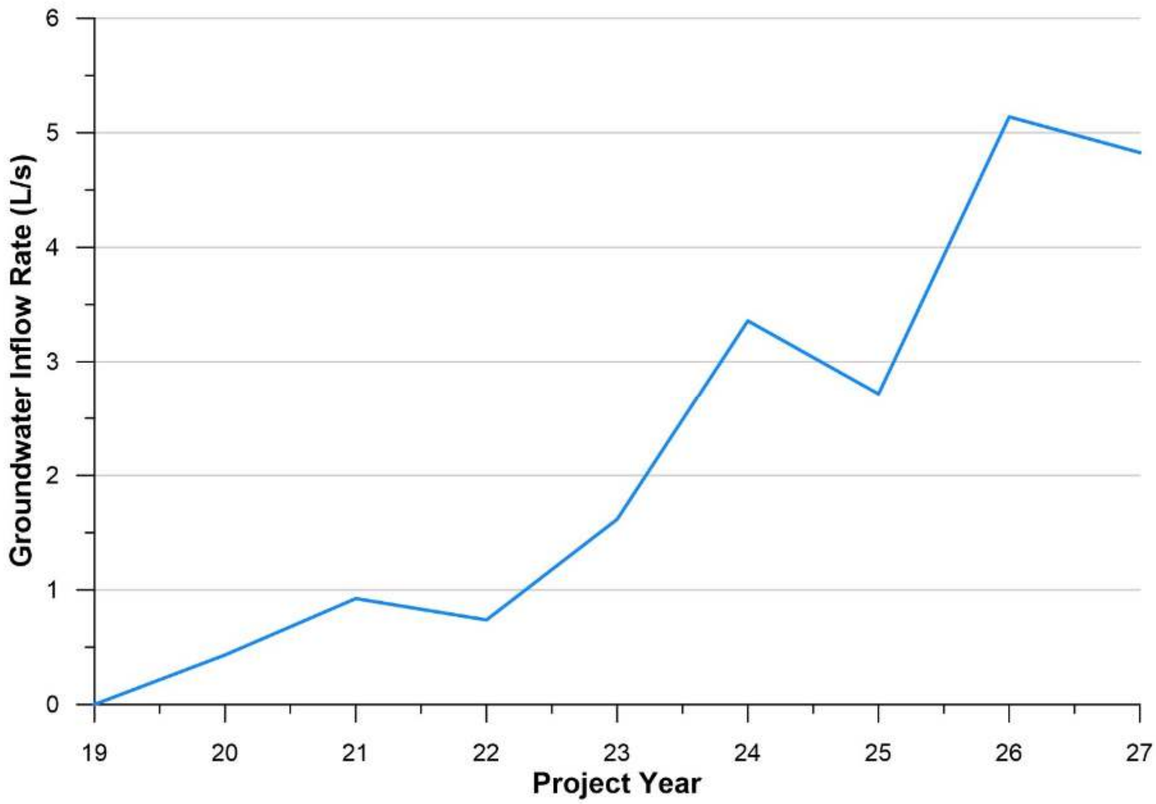

Figure 3-1: Model Predicted Groundwater Inflow Rate to Meadowbrook Open Cut

For the original model[4], a Drain boundary condition was applied to all layers above base of the mined seam to simulate Meadowbrook Open Cut mine progression. The reported inflow rates to the Meadowbrook Open Cut were obtained from the ZoneBudget software for Drain cells applied to all the layers above base of the mine. In order to provide data on the relative contribution of each model layer (Layers 1 to 7), the inflow rates were extracted separately for each layer above base of the mine using the ZoneBudget utility.

The breakdown of inflow rates to the Meadowbrook Open Cut from each model layer (i.e. inflow through the walls of the pit) is shown below in Table 3-1. The relative percentage contribution of each layer to mine inflows is shown in Table 3-2. Observations include:

- Quaternary alluvium (Layer 1) is not present in the open cut area, therefore there is no inflow contribution from Layer 1;

[4] SLR (2022) Meadowbrook Underground – Groundwater Modelling Technical Report. Report prepared by SLR Consulting Australia Pty Ltd for Jellinbah Group Pty Ltd, March 2022

- The greatest contribution to pit inflows is from Layer 2 (Tertiary sediments). As noted above, the Tertiary sediments have a higher specific yield relative to the underlying units and are therefore capable of releasing more water from storage than the underlying units (for an equivalent drawdown);
- The Leichhardt Seam (Layer 5) is thin in the area of the Meadowbrook open cut and does not contribute significant water to the operation;
- Both Layer 6 (Interburden) and Layer 7 (Vermont Seam) contribute similar volumes of water to the open cut. The Layer 6 interburden has a lower hydraulic conductivity than the underlying Layer 7 Vermont Coal Seam, but the unit is thicker, so the overall transmissivity of Layer 6 and Layer 7 is similar within the Meadowbrook Open Cut area.

Table 3-1: Inflow Rates to the Meadowbrook Open Cut (ML/Year)

Year of Mining	L1	L2	L3	L4	L5	L6	L7	Total
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
20	0.0	63.9	0.0	0.0	0.0	0.0	10.2	74
21	0.0	106.0	0.0	7.7	2.2	42.7	47.1	206
22	0.0	49.4	20.4	11.9	4.7	80.2	56.5	223
23	0.0	127.9	9.9	9.7	0.9	61.0	63.0	272
24	0.0	207.2	0.0	0.0	0.0	56.5	62.7	326
25	0.0	191.4	7.9	0.0	0.0	50.2	94.2	344
26	0.0	189.0	10.3	14.6	3.8	39.6	69.7	327
27	0.0	176.2	0.0	1.1	3.6	75.3	57.4	314
28	0.0	147.5	1.8	18.6	1.5	60.6	67.3	297
29	0.0	108.8	1.1	0.0	0.0	71.1	56.9	238

Table 3-2: Percentage Contribution to Meadowbrook Open Cut Groundwater Inflows

Year of Mining	Percentage Contribution to Mine Inflows							
	L1	L2	L3	L4	L5	L6	L7	Total
19	0.0	86.4	0.0	0.0	0.0	0.0	13.8	100
20	0.0	51.5	0.0	3.7	1.1	20.7	22.9	100
21	0.0	22.2	9.1	5.3	2.1	36.0	25.3	100
22	0.0	47.0	3.6	3.6	0.3	22.4	23.2	100
23	0.0	63.6	0.0	0.0	0.0	17.3	19.2	100
24	0.0	55.6	2.3	0.0	0.0	14.6	27.4	100
25	0.0	57.8	3.1	4.5	1.2	12.1	21.3	100
26	0.0	56.1	0.0	0.4	1.1	24.0	18.3	100
27	0.0	49.7	0.6	6.3	0.5	20.4	22.7	100
28	0.0	45.7	0.5	0.0	0.0	29.9	23.9	100
29	0.0	86.4	0.0	0.0	0.0	0.0	13.8	100

Yours Faithfully,

John Bradley
Principal Hydrogeologist
JBT Consulting Pty Ltd