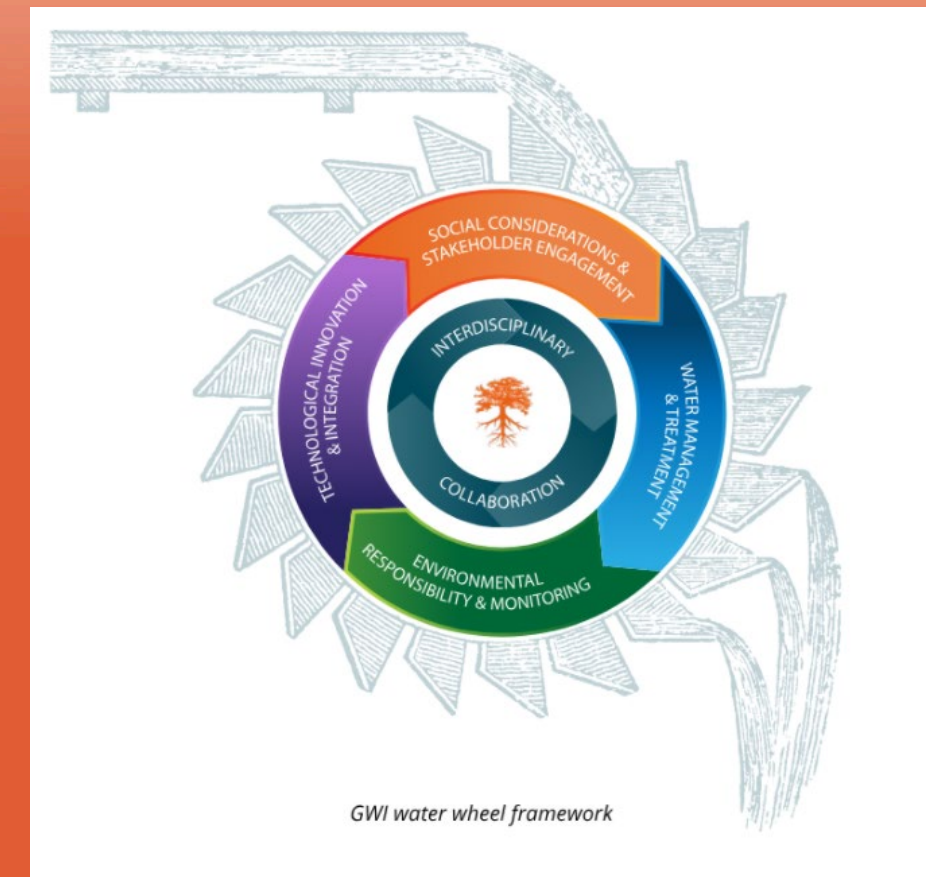


## Water Effects with the Neo-Marvin Orebody - Emerging insights

11/12<sup>th</sup> June 2025 Communications Session



## Global Water Initiative



[www.whittleconsulting.com.au](http://www.whittleconsulting.com.au)



# Your Study Team

## Whittle Consulting

### **Craig Davies** **Melbourne, VIC, Australia**



Over three years with Whittle Consulting, Geology and Maths, numerical modeling and programming expert.

### **Leigh Lawrence** **Melbourne, VIC, Australia**



Tech Services Specialist. Geologist and Research Scientist.

### **Philip Bangerter** **Brisbane, QLD, Australia**



Project manager with 40 years experience; Process Engineer, Sustainability Specialist, Study Manager.

### **Gerald Whittle** **Melbourne, VIC, Australia**

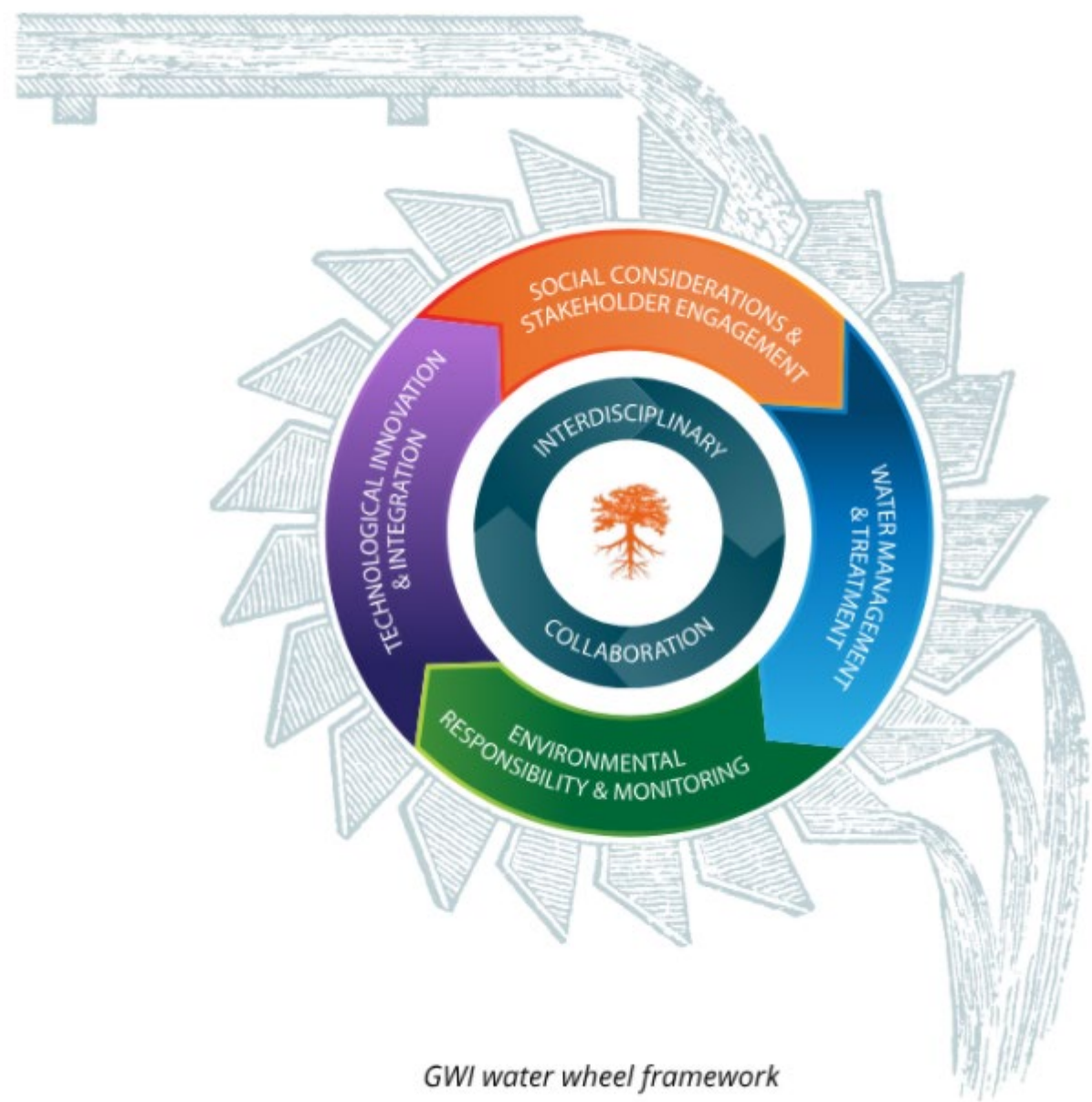


CEO. Peer review and Consultant support.



# Context & Objectives

## CEEC GWI Enterprise Optimisation Case Study



This case study seeks to:

- Combine the objectives of the GWI with the notion of Integrated Strategic Planning
- Promote comparisons between context-specific options for the preservation of water resources.

It is a preliminary meta-study exploring how to model water consumption, treatment & management, and link directly to:

- the LOM plan;
- the production scale; whilst,
- considering climatic & geological contexts.



# Highest Level Hypotheses

There is a link between hydrology and mine planning that is not accounted for in modelling in either discipline; it should be.

Material changes in water-related costs (infrastructure, treatment, source or cost-structure) will have an effect on the size, shape and scheduling of the orebody. (Second-order effects).

Material changes motivated by third-order issues (social, environmental) are nonetheless mitigated by such second-order effects.



# Agenda

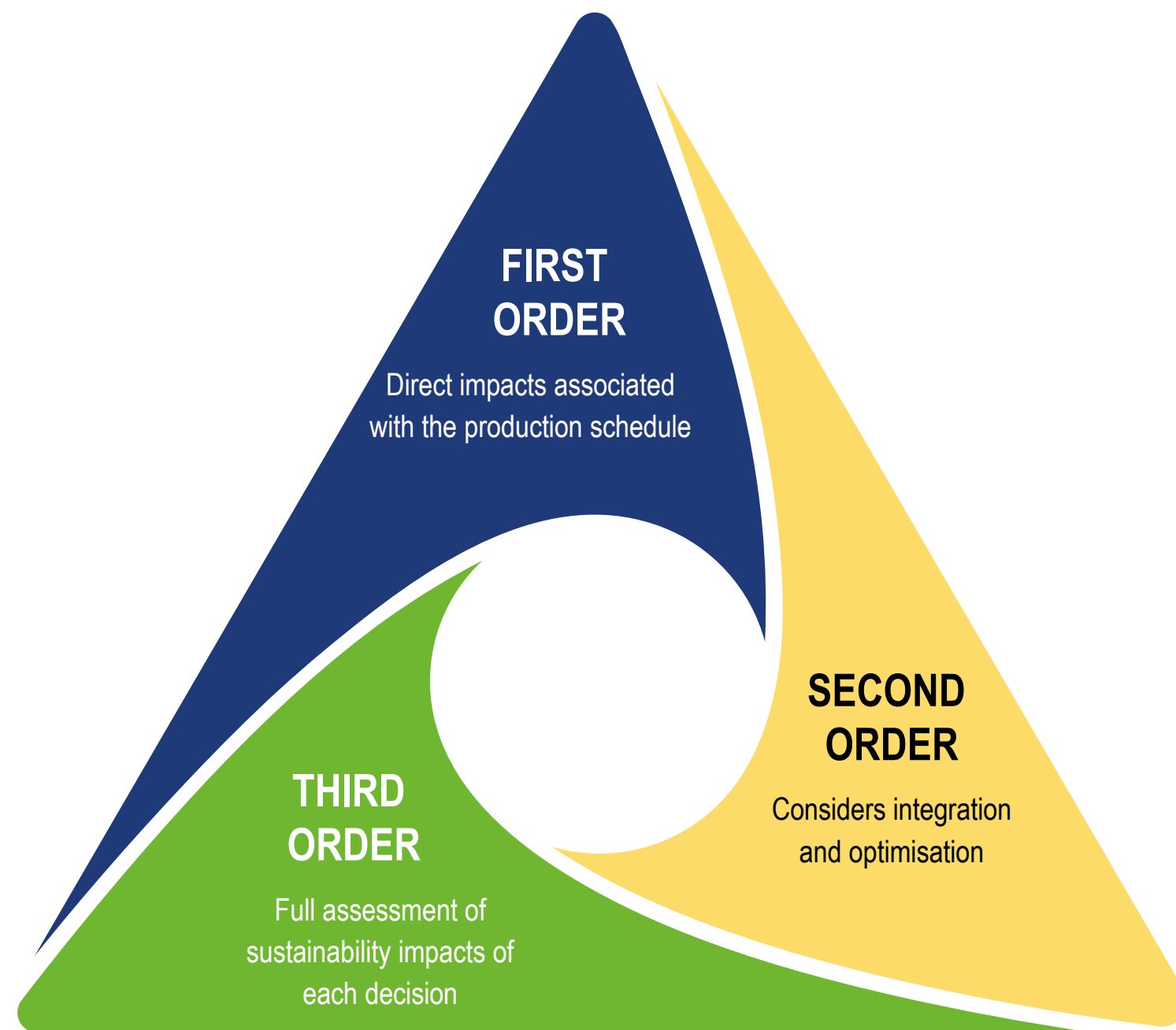
1. Introductions & Context
2. Neo Marvin Orebody
3. Scenarios and Objectives
4. Model synopsis
5. First-order Effects
6. Second-order Effects
7. Outputs and Observations
8. The extension work contemplated
9. Discussion





# Dynamic Influences of Optimisation on Water

## How does optimisation play a role?



### FIRST ORDER

Effects concerned with assembling capital and operating costs and calculating a net-present-cost for these

**Cost to pump water**

### SECOND ORDER

Effects concerned with the orebody as an integrated whole and its optimisation

**Implications for cut-off grade/value**

### THIRD ORDER

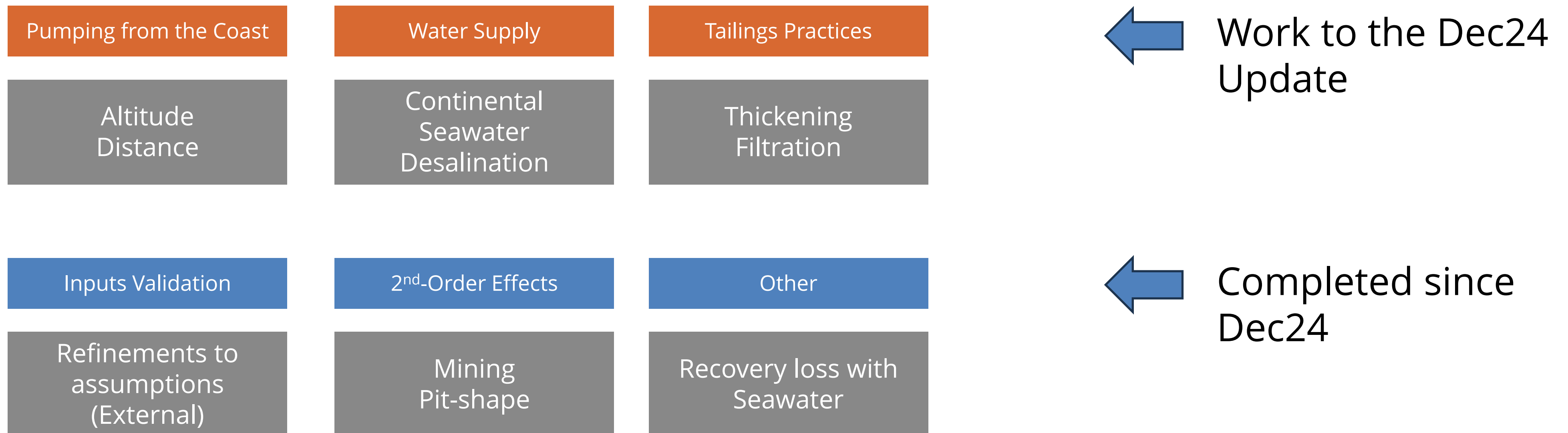
Effects concerned with environmental and community value or impact

**Carbon Footprint**



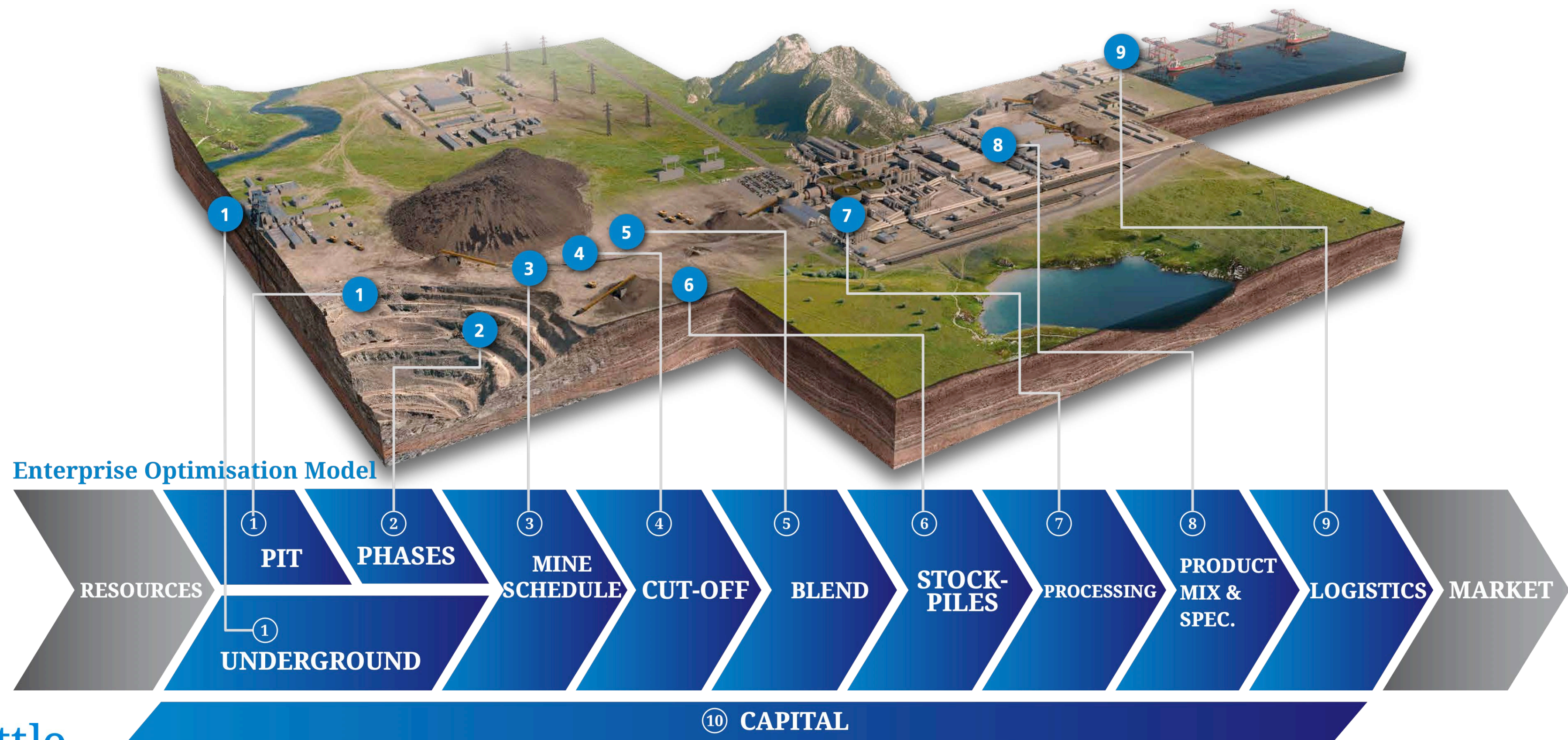
# Narratives for Chilean Desert Archetype

## Local water is unavailable or restricted for a New Project





# Whittle Optimisation Modelling Approach





# Premise

Neo-Marvin is a Porphyry Cu and Au deposit containing 2.1 Mt of copper and 4.3 M Oz gold.  
Designed and permitted to process 100 kt per day using locally sourced continental groundwater.

Groundwater access is subsequently extremely limited or completely prohibited.

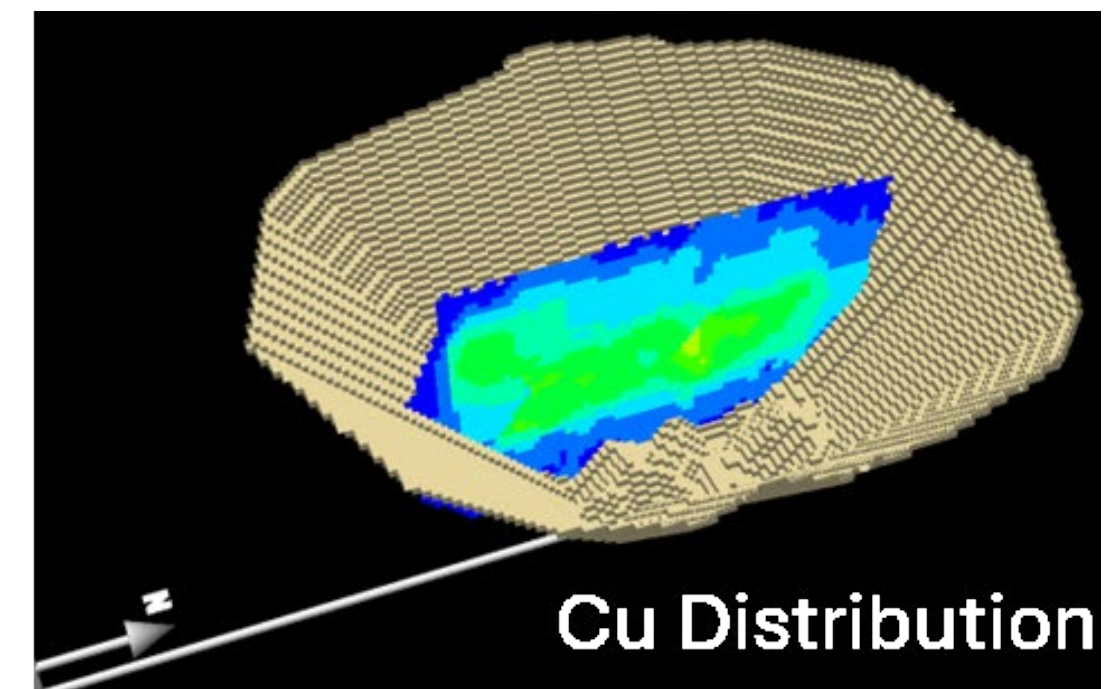
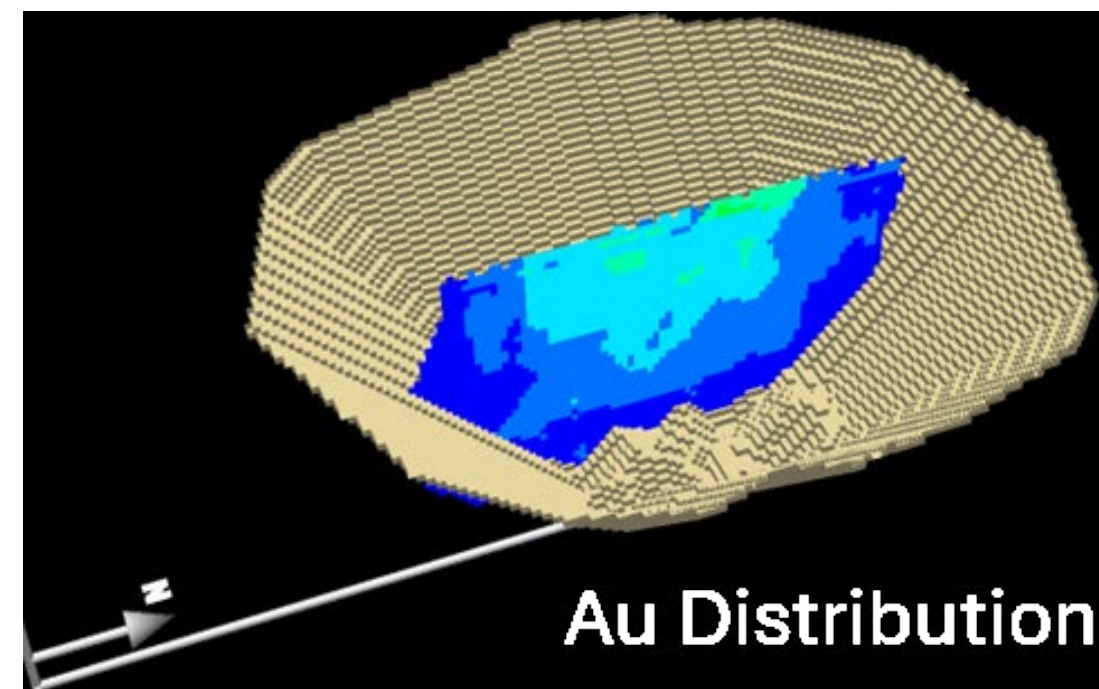
## So what next?

Shelve the mining operation / prospect?

Secure an alternate water source  
and/or reduce water requirements.

Metrics for success?

	Inside Pit
Total Mass:	1,348 Mt
Ore Mass:	657 Mt
Cu rec:	2,121 kt
Au rec:	4.27 M Oz
Mining Fleet:	90 Mt per annum
Plant:	100kt per day
LOM:	19 years
Water intensity:	206.65 m <sup>3</sup> per Cu t





# Scenarios

So what options do we evaluate?

**Water Source:** *Fresh Groundwater (Base Case), Desalinated Seawater or Raw Seawater.*

**Tailings Technology:** Thickened Low Reclaim (Base Case), Thickened High Reclaim, Paste Thickened, Stacked Filtered.

		Tailings Technology			
		Thickened Low Reclaim	Thickened High Reclaim	Paste Thickened	Stacked Filtered
Water Source	Fresh Groundwater	Base Case (F_T1)			
	Desalinated Seawater	D_T1	D_T2	D_T3	D_T4
	Raw Seawater	S_T1	S_T2	S_T3	S_T4

To reduce water consumption

**Mine Location:** 650masl 80km and 4400masl 165km.



# Measuring success?

## Mining operation is financially viable

NPV

CAPEX

Guidance  $\text{NPV} / \text{CAPEX} > 100\%$

## Social Licence to operate

Water intensity

Carbon footprint

Community impact?

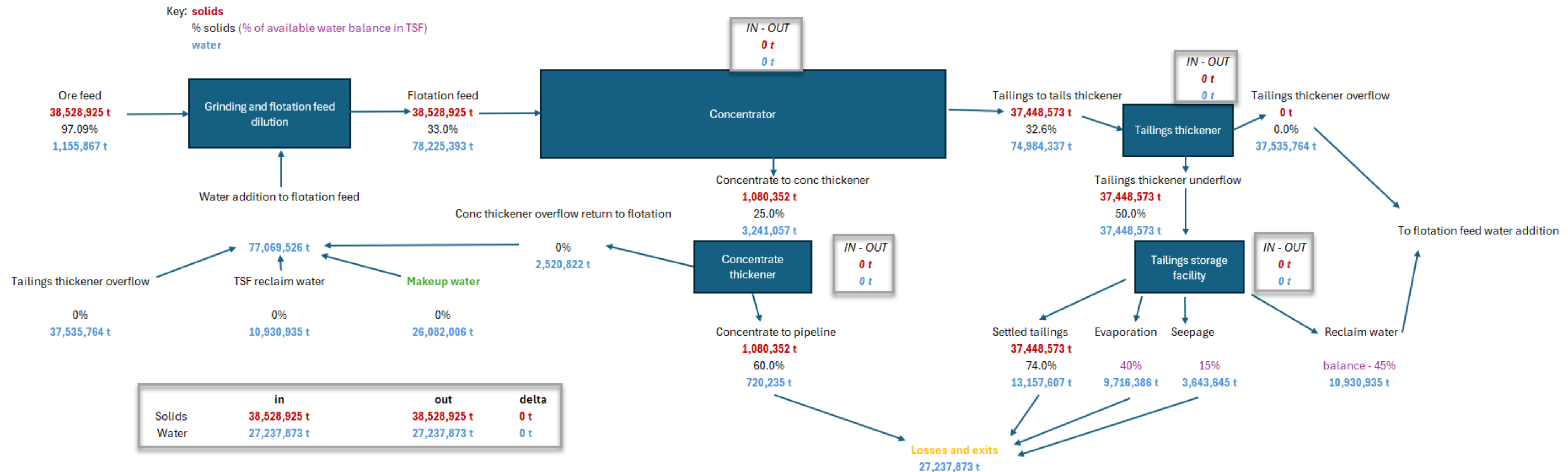
Permitting?





# Model Inputs

## Water Balance Block Flow Diagram





# Model Inputs

## GW11 - CEEC Water Case Study Business Model

### Water assumptions

		v003	Fresh groundwater	Desalinated seawater	Raw Seawater
Density	t/m3	v003	0.997	0.997	1.024
Viscosity	Pa.s	v003	0.0008891	0.0008891	0.0009020
Cu Recovery delta	0-100%	v003	-	-	1.00%
Au Recovery delta	0-100%	v003	-	-	1.00%
Treatment Power	kWh/m3	v004	-	3.00	0.10
Power Price	USD/kWh	v003	0.12	0.12	0.12
Capex	MUSD per (l/s)	v003	0.02	1.00	0.05

### Tailings assumptions

			Thickened low reclaim	Thickened high reclaim	Paste thickened	Stacked Filtered
Tailings thickener Feed	% Solids	v003	33.0%	33.0%	33.0%	33.0%
Tailings thickener UnderFlow	% Solids	v003	50.0%	52.0%	64.0%	52.0%
TSF consolidated	% Solids	v003	74.0%	74.0%	75.0%	85.0%
Evaporation losses	% Water	v003	40.0%	30.0%	25.0%	0.0%
Uncaptured seepage	% Water	v003	15.0%	5.0%	2.0%	0.0%
Tailings Filter cake moisture	% water	v003	50.0%	48.0%	36.0%	15.0%
Dewatering power	kWh/t tails	v003	0.20	0.20	0.20	0.30
Dewatering opex excl. Power	USD/t tails	v003	0.10	0.12	0.20	2.00
Dewatering capex estimate	USD/tpa tails	v003	2.00	2.50	3.00	15.00



# Modelling Calculations - Example

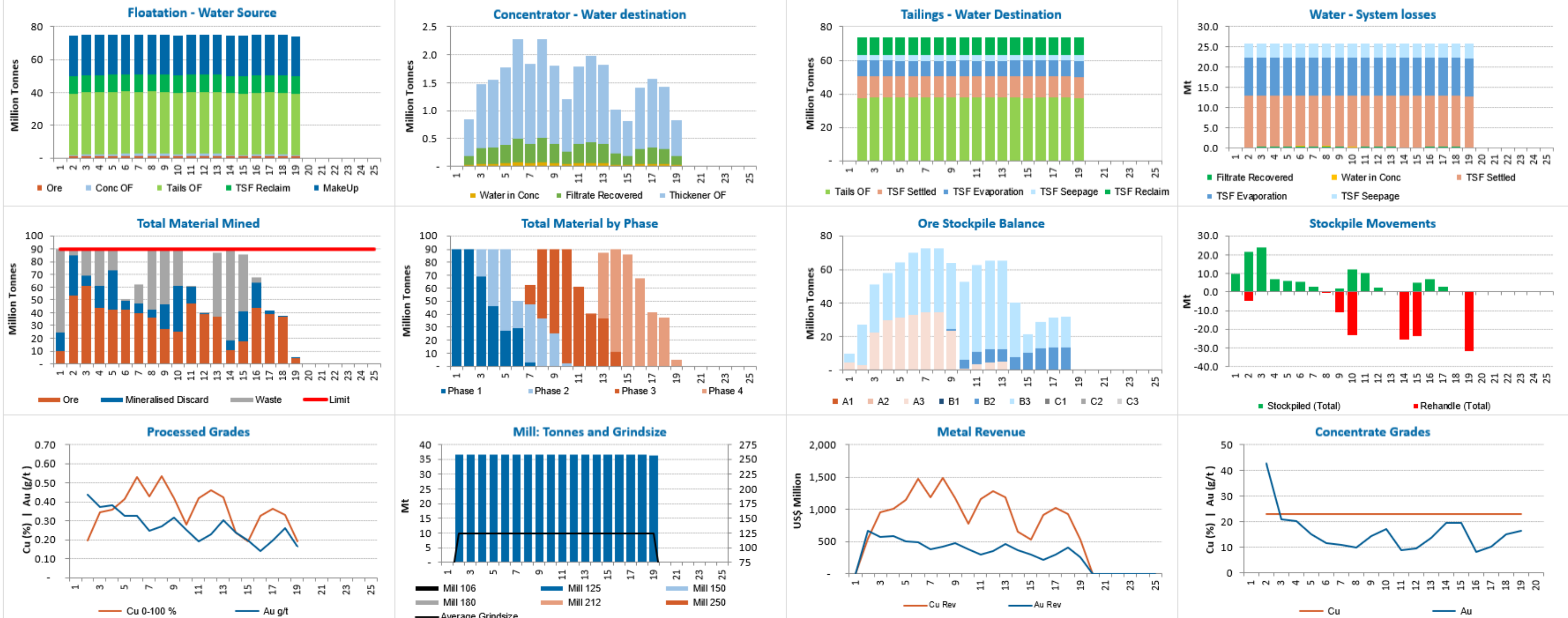
<b>Calculations</b>					
Pipe Diameter	v001			m	0.92
Reynolds number (Re)	v001			-	1,568,895.83
Friction head	v001	Friction factor	0.012	m	246.46
<b>Pumping</b>					
Static head	v001	$m/s^2$	9.81	kw	44,199.94
Friction head	v001			m	2,475.76
Total head	v001			m	46,675.69
Pumping power	v001	Pump Efficiency	80%	kw	58,344.62
Specific power	v001			kWh/m <sup>3</sup>	16.21
Net make up water requirement	v001			m <sup>3</sup>	9,434,447.05
Pumping power used	v001			kWh	152,902,557.77
Pumping power cost	v001	\$/kWh	0.12	\$	\$ 18,348,306.93
Pumping non-power cost	v005	\$/m <sup>3</sup>	0.20	\$	\$ 1,886,889.41
Pumping unit cost - cubic metre of water	v004			\$/m <sup>3</sup>	\$ 2.145
Pumping unit cost - tonne of ore	v004			\$/t	\$ 0.525
<b>Water Treatment</b>					
Treatment Power	v004	kWh/m <sup>3</sup>	0.10	kw	943,444.71
Treatment Power Cost	v004	\$/kWh	0.12	\$	\$ 113,213.36
<b>Tails dewatering</b>					
<b>Drivers</b>					
Tailings mass (solids)	v003			t	37,460,576.74
<b>Tailings Paradigm</b>					
Dewatering Power	v003	kWh/t solids	Paste thickened 0.20	kWh	7,492,115.35
Dewatering Power Cost	v003	\$/kWh	0.12	\$	\$ 899,053.84
Dewatering Opex excl. Power	v003	\$/t solids	0.20	\$	\$ 7,492,115.35
Total tailings Opex	v003			\$	\$ 8,391,169.19
Tailings Opex unit cost - per tonne of tails solids	v003			\$/t solids	\$ 0.224



LOM NPV:	3,737	US\$M	Water Type:	Fresh groundwater	Mined Material:	1,347.9	Mt	MakeUp Water:	25.82	Mtpa	Water supply OPEX:	156.9	MUSD
Mine Life:	19.0	Years	Tailing Paradigm:	Thickened low reclaim	Ore Processed:	656.9	Mt	Tailings Volume:	471.32	M m <sup>3</sup>	Water treat OPEX:	0.0	MUSD
Comp. LOM NPV:	3,737	US\$M	Location:	4400masl 165km	Discarded Mineralised:	246.7	Mt	Slurry Density:	1.86	t/m <sup>3</sup>	Tail Dewater OPEX:	80.3	MUSD
Comp. Delta:	-	%			Peak Stockpiled:	73.0	Mt	SG of Dry Tailings:	1.37	t/m <sup>3</sup>	Water supply CAPEX:	0.0	MUSD
					Cu Produced:	2,121.0	Kt				Water treat CAPEX:	27.0	MUSD
CAPEX:	2,154	US\$M			Au Produced:	4.27	M TrOz	Water Intensity:	0.67	m <sup>3</sup> /Ore t	TSF dewater CAPEX:	108.8	MUSD
NPV/CAPEX:	174%	%			As Produced:	35.8	Kt	..for Cu produced:	206.65	m <sup>3</sup> /Cu t			

Fresh groundwater - Thickened low reclaim - 4400masl 165km  
Static grindsize and Concentrate grade

## RUN o19\_F\_T1\_L4 DASHBOARD





# First Order Effects - Revenue

For the purposes of this study using raw seawater causes 1% recovery loss of Cu and Au, it is noted that this may vary wildly based on the mineralogy of the ore body.





# First Order Effects – Water Related Capex

## Water supply pipeline construction.

Varies primarily with distance

80km	165km
\$ 240	\$ 495

**Million USD**

## Desalination and Water treatment.

Varies with required water mass/volume

Water	Operating Tailing Paradigm			
	Thickened low reclaim	Thickened high reclaim	Paste thickened	Stacked Filtered
Fresh groundwater	\$ 27			
Raw Seawater	\$ 66	\$ 47	\$ 26	\$ 16
Desalinated seawater	\$ 1,208	\$ 997	\$ 655	\$ 443

## Processing Plant and TSF dewatering.

Varies with throughput and tails paradigm

Operating Tailing Paradigm			
Thickened low reclaim	Thickened high reclaim	Paste thickened	Stacked Filtered
\$ 109	\$ 136	\$ 163	\$ 815

The quality of the orebody determines if it can support the Capex (metal price, operational costs, et al.)



# First Order Effects – Water Related Opex

**Water Supply (including treatment) and dewatering.**

**Desalination** -> varies with water mass/volume.

**Water supply pumping** -> varies with elevation, mass/volume and power cost.

**TSF** -> varies with tails volume and tailings paradigm.

**Plant** -> varies with throughput and tailings paradigm.

**Water treatment** -> varies with water quality and mass/volume.



# First Order Effects – Water related Opex

## Aggregated numbers – Back calculated from Prober model outputs

### Water related operating expenses – Per cubic metre (m<sup>3</sup>) of water

Location	Water	Operating Tailing Paradigm			
		Thickened low reclaim	Thickened high reclaim	Paste thickened	Stacked Filtered
Comparison	Fresh groundwater	\$ 0.54			
650masl 80km	Raw Seawater	\$ 0.70	\$ 0.81	\$ 1.39	\$ 16.00
	Desalinated seawater	\$ 1.06	\$ 1.16	\$ 1.75	\$ 16.36
4400masl 165km	Raw Seawater	\$ 2.29	\$ 2.39	\$ 2.98	\$ 17.59
	Desalinated seawater	\$ 2.64	\$ 2.75	\$ 3.33	\$ 17.94

**Calculated as:** The sum of all water related operating expenses over the Life of Mine (including water treatment, water supply and tailings dewatering) divided by the total external water requirements of the system.

### Water related operating expenses – Per tonne of processed ore

Location	Water	Operating Tailing Paradigm			
		Thickened low reclaim	Thickened high reclaim	Paste thickened	Stacked Filtered
Comparison	Fresh groundwater	\$ 0.36			
650masl 80km	Raw Seawater	\$ 0.47	\$ 0.40	\$ 0.35	\$ 2.08
	Desalinated seawater	\$ 0.71	\$ 0.58	\$ 0.44	\$ 2.12
4400masl 165km	Raw Seawater	\$ 1.53	\$ 1.19	\$ 0.76	\$ 2.28
	Desalinated seawater	\$ 1.76	\$ 1.36	\$ 0.85	\$ 2.33

**Calculated as:** The sum of all water related operating expenses over the Life of Mine (including water treatment, water supply and tailings dewatering) **divided by the total mass of ore material processed.**



# Adjust the current mine plan – First Order Effects.

Lets adjust the current mine plan in a spreadsheet.  
Desalination Capex looks expensive -> so I'll use raw seawater.

**Step #1** - Edit the current schedule outputs to reduce metal recovery by 1%  
-23.6 kt Cu metal, -57k Oz Au over 19 year LOM.  
-\$298MUSD revenue.  
-\$130MUSD NPV.

	Net NPV (Millions)	
	Original Case	Adjust Recovery
Net NPV <sub>10</sub>	\$ 3,737	\$ 3,606
DELTA	-	-\$ 130
Total CAPEX	\$ 2,154	\$ 2,154
Water OPEX	\$ 237	\$ 237
NPV/CAPEX	174%	167%



# Adjust the current mine plan.— First Order Effects.

**Step #2** – additional Capital costs, dominantly the water supply pipeline (\$495M) including pumping stations.

Capex increased 27%, directly reducing NPV. Causing a significant reduction on capital returns 174% -> 110%, investing in this operation is now much less appealing.

	Net NPV (Millions)		
	Original Case	Adjust Recovery	Adjust Capex
Net NPV <sub>10</sub>	\$ 3,737	\$ 3,606	\$ 3,018
DELTA	-	-\$ 130	-\$ 588
Total CAPEX	\$ 2,154	\$ 2,154	\$ 2,742
Water OPEX	\$ 237	\$ 237	\$ 237
NPV/CAPEX	174%	167%	110%



# Adjust the current mine plan.— First Order Effects.

## Step #3 – Apply additional water related Operating costs.

An additional \$1.07 Billion of water related operating costs.

Primarily composed of the energy cost of transporting water to site, but also including any additional water treatment costs, tails dewatering costs et al.

	Net NPV (Millions)			
	Original Case	Adjust Recovery	Adjust Capex	Adjust Opex
Net NPV <sub>10</sub>	\$ 3,737	\$ 3,606	\$ 3,018	\$ 2,576
DELTA	-	-\$ 130	-\$ 588	-\$ 442
Total CAPEX	\$ 2,154	\$ 2,154	\$ 2,742	\$ 2,742
Water OPEX	\$ 237	\$ 237	\$ 237	\$ 1,306
NPV/CAPEX	174%	167%	110%	94%



# Adjust the current mine plan.– First Order Effects.

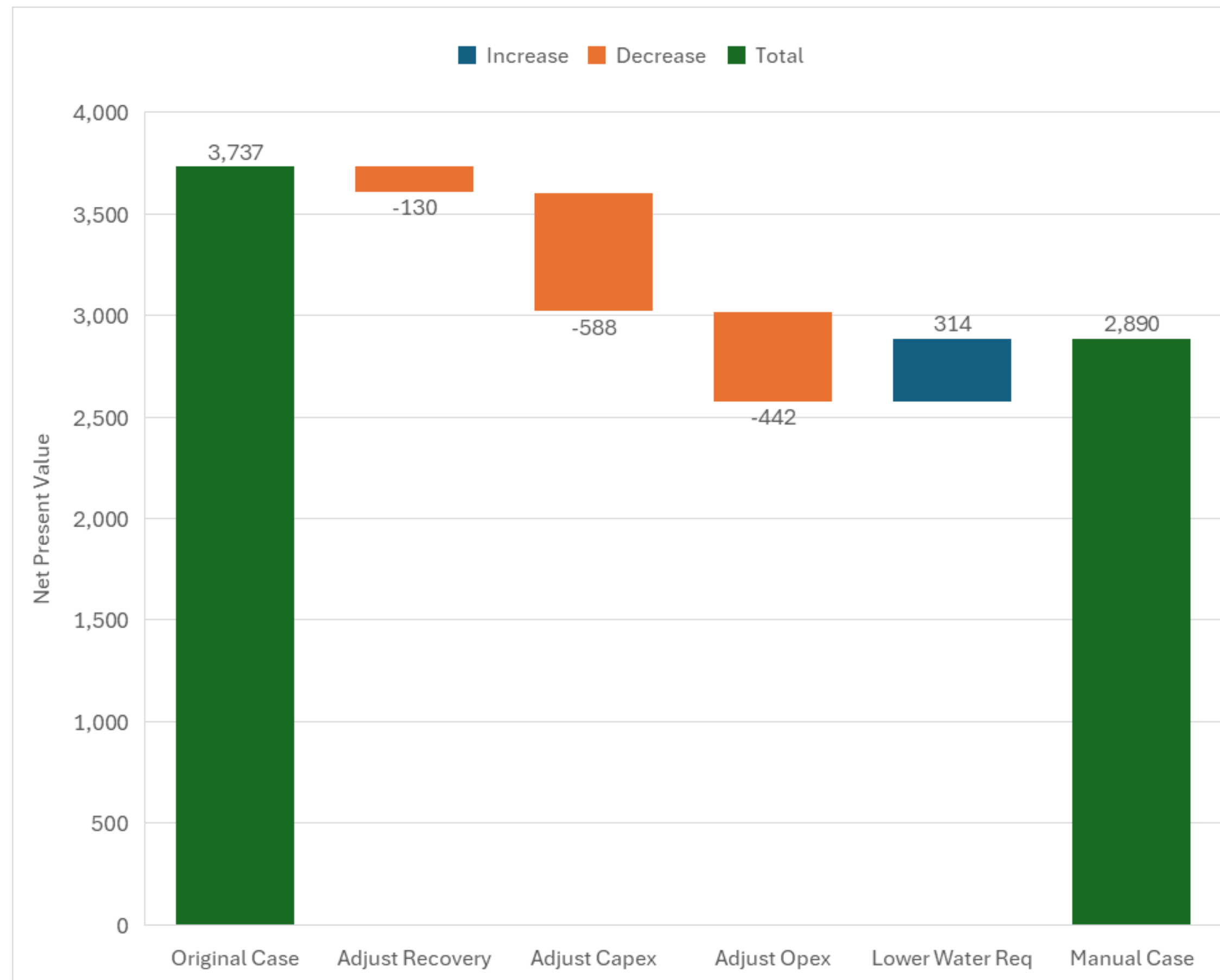
## Step #4 – Adjust water balance.

Changing from Thickened Low Reclaim tailings paradigm to Paste Thickened reduces make up water requirements at site by ~60% by volume.  
Reducing water related operating expenses proportionally.

	Net NPV (Millions)				
	Original Case	Adjust Recovery	Adjust Capex	Adjust Opex	lower water req
Net NPV <sub>10</sub>	\$ 3,737	\$ 3,606	\$ 3,018	\$ 2,576	\$ 2,890
DELTA	-	-\$ 130	-\$ 588	-\$ 442	\$ 314
Total CAPEX	\$ 2,154	\$ 2,154	\$ 2,742	\$ 2,742	\$ 2,742
Water OPEX	\$ 237	\$ 237	\$ 237	\$ 1,306	\$ 546
NPV/CAPEX	174%	167%	110%	94%	105%



# Adjust the current mine plan – First Order Effects.





# Create a new mine plan – Second Order Effects

## Step #5 – New Optimisation / Reschedule.

Our understanding of Revenue and Costs have changed since we initially optimised the schedule, therefore our definition of Ore and Waste have also changed – as these are economic terms.

Rescheduling this mine in Prober makes better decisions on material destination and timing. Increasing NPV by \$65M USD.

	Net NPV (Millions)					
	Original Case	Adjust Recovery	Adjust Capex	Adjust Opex	lower water req	Reschedule
Net NPV <sub>10</sub>	\$ 3,737	\$ 3,606	\$ 3,018	\$ 2,576	\$ 2,890	\$ 2,955
DELTA	-	-\$ 130	-\$ 588	-\$ 442	\$ 314	\$ 65
Total CAPEX	\$ 2,154	\$ 2,154	\$ 2,742	\$ 2,742	\$ 2,742	\$ 2,702
Water OPEX	\$ 237	\$ 237	\$ 237	\$ 1,306	\$ 546	\$ 499
NPV/CAPEX	174%	167%	110%	94%	105%	109%



# Create a new mine plan – Second Order Effects

## Step #6 – Create new Pits, and re optimise.

As noted in Step 5, Revenue and costs have changed since we initially ran a pit and phase optimisation.

The new final Pit is 7% smaller (total mass 1.35Mt -> 1.26Mt), and contains 5% less ore (0.66Mt -> 0.63Mt). Reducing LOM by 10.5 months (from 19.1 years to 18.2 years).

Water OPEX per tonne of processed ore		Operating Tailing Paradigm			
Location	Water	Thickened low reclaim	Thickened high reclaim	Paste thickened	Stacked Filtered
Comparison	Fresh groundwater	\$ 0.36			
650masl 80km	Raw Seawater	\$ 0.47	\$ 0.40	\$ 0.35	\$ 2.08
	Desalinated seawater	\$ 0.71	\$ 0.58	\$ 0.44	\$ 2.12
4400masl 165km	Raw Seawater	\$ 1.53	\$ 1.19	\$ 0.76	\$ 2.28
	Desalinated seawater	\$ 1.76	\$ 1.36	\$ 0.85	\$ 2.33

*This is a significant change from adding 40 cents per ore tonne into the mining optimization.*



# Create a new mine plan – Second Order Effects

## **Step #6 continued**

NPV is surprisingly unchanged, within 0.28% of previous model.

### **Compared to Step #5**

3.7% less Cu produced.

2.6% less Au produced.

~8.2% reduced carbon footprint.

4.8% less water required over LOM.

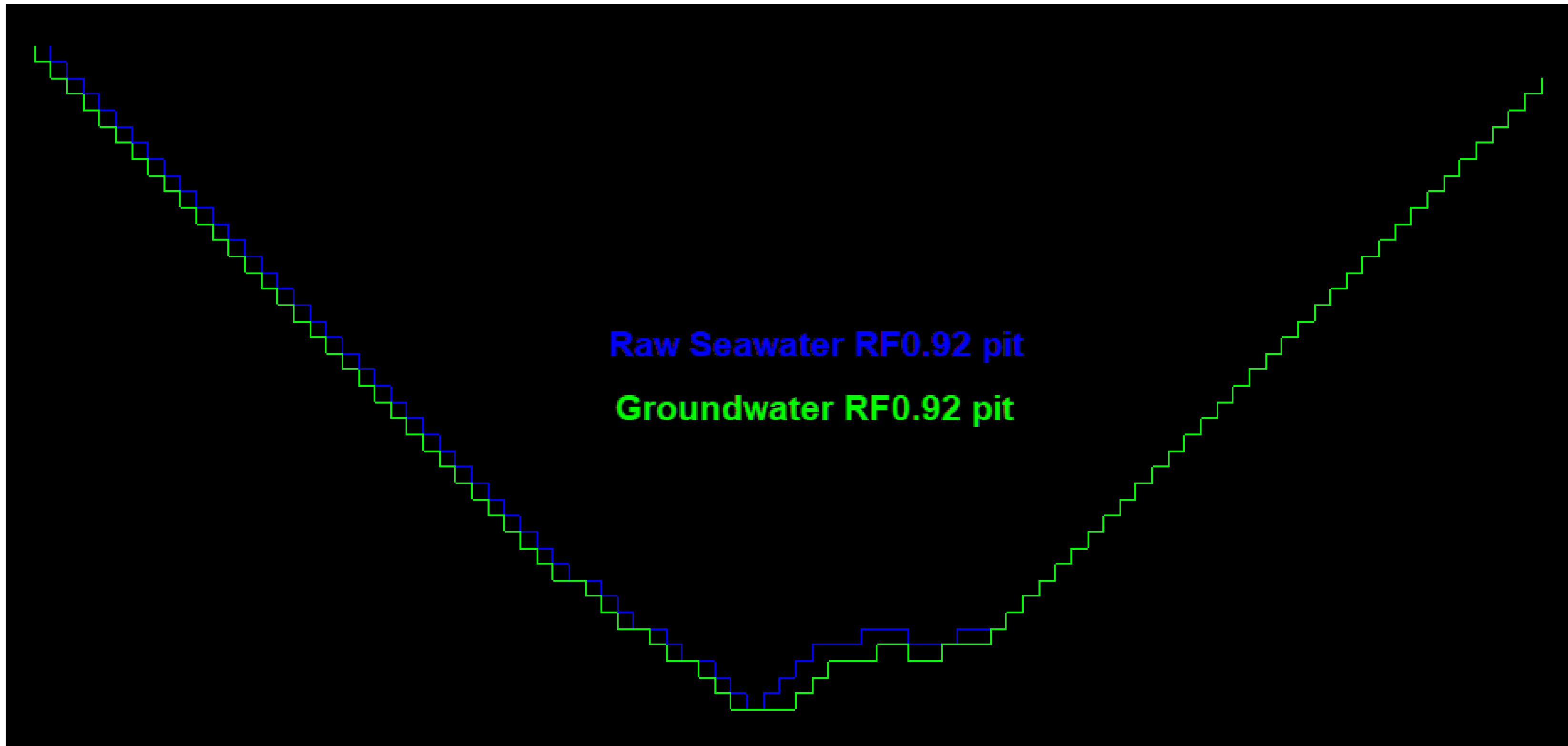
1.1% reduction in water intensity per tonne of copper.

4.8% reduction in total tailings volume.



# Create a new mine plan – Second Order Effects

Image of the difference between final pit shells.





# Create a new mine plan – Second Order Effects





# Bonus Points

If +\$0.40 opex per ore tonne reduced total input rock mass by 7%  
what is the impact of Stacked filtered tailings?

Adding \$1.97 to the opex per ore tonne.

Reduced TMM 16.4% and ore mass by 15.3%.

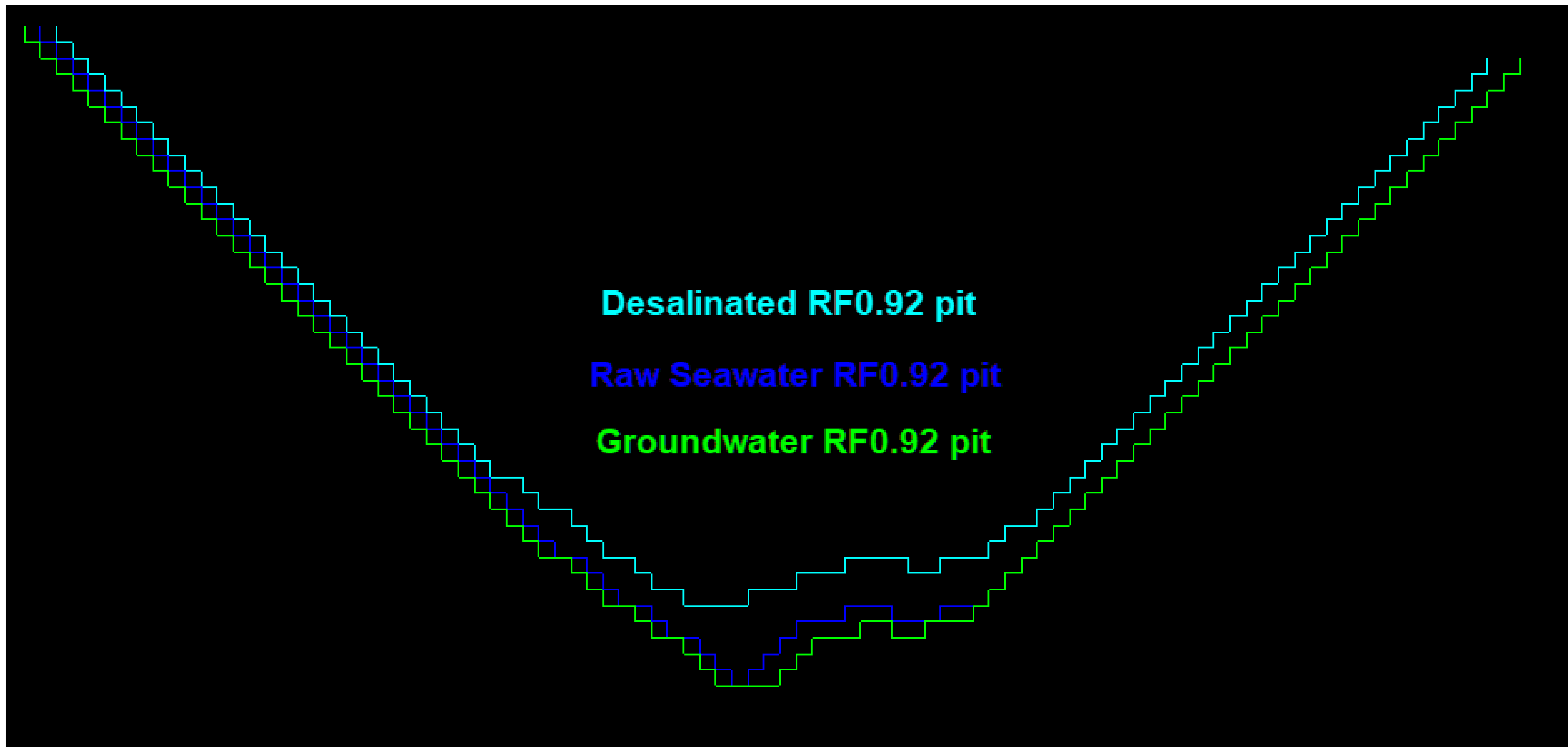
Reduced metal production, Cu by 12% and Au by 9%.

Water OPEX per tonne of processed ore		Operating Tailing Paradigm			
Location	Water	Thickened low reclaim	Thickened high reclaim	Paste thickened	Stacked Filtered
Comparison	Fresh groundwater	\$ 0.36			
650masl 80km	Raw Seawater	\$ 0.47	\$ 0.40	\$ 0.35	\$ 2.08
	Desalinated seawater	\$ 0.71	\$ 0.58	\$ 0.44	\$ 2.12
4400masl 165km	Raw Seawater	\$ 1.53	\$ 1.19	\$ 0.76	\$ 2.28
	Desalinated seawater	\$ 1.76	\$ 1.36	\$ 0.85	\$ 2.33



# Bonus Points

Image of the difference between final pit shells.





# Outputs

Case	Net NPV	CAPEX	NPV/CAPEX	Mine Life:	Water OPEX	Water CAPEX	Water Total	Mined Material:	Ore Processed:
	MUSD	MUSD	0-100%	Years	Undiscounted MUSD			Mt	Mt
Original Case	3,736.6	2,153.6	174%	19.0	237	136	373	1348	656.9
Adjust Recovery	3,606.3	2,153.6	167%	19.0	237	136	373	1348	656.9
Adjust Capex	3,018.1	2,741.7	110%	19.0	237	724	961	1348	656.9
Adjust Opex	2,575.7	2,741.7	94%	19.0	1306	724	2029	1348	656.9
lower water req	2,890.1	2,741.7	105%	19.0	546	724	1270	1348	656.9
Reschedule	2,954.9	2,702.1	109%	19.1	499	684	1184	1348	660.8
New Pits	2,946.6	2,702.1	109%	18.2	475	684	1159	1257	628.9



LOM NPV: **2,947** US\$M  
 Mine Life: **18.2** Years  
 Comp. LOM NPV: **3,737** US\$M  
 Comp. Delta: **(30.11%)** %

CAPEX: **2,702** US\$M  
 NPV/CAPEX: **109%** %

Water Type: Raw Seawater  
 Tailing Paradigm: Paste thickened  
 Location: 4400masl 165km

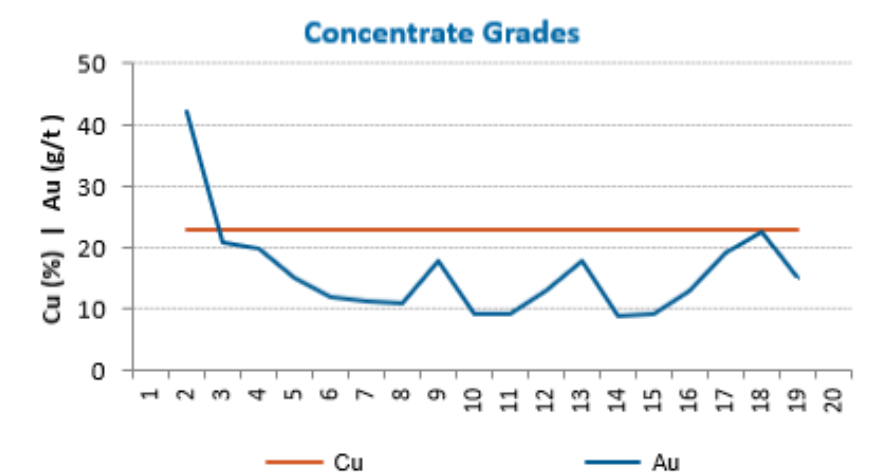
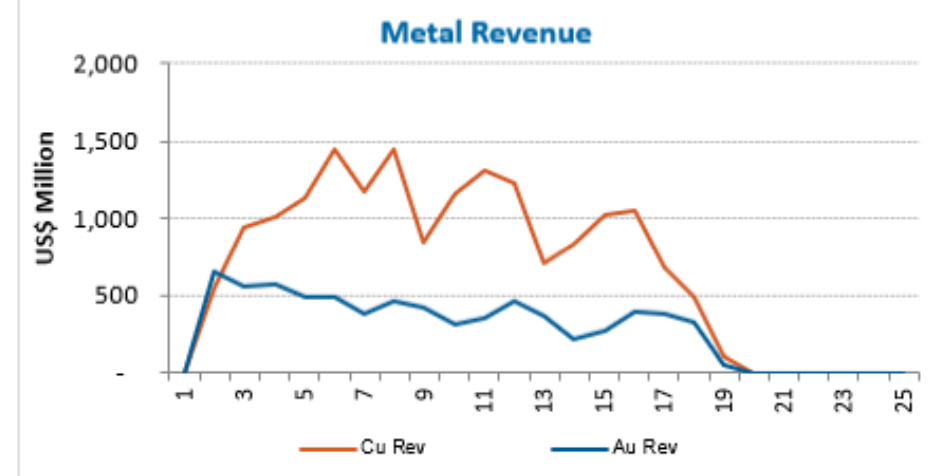
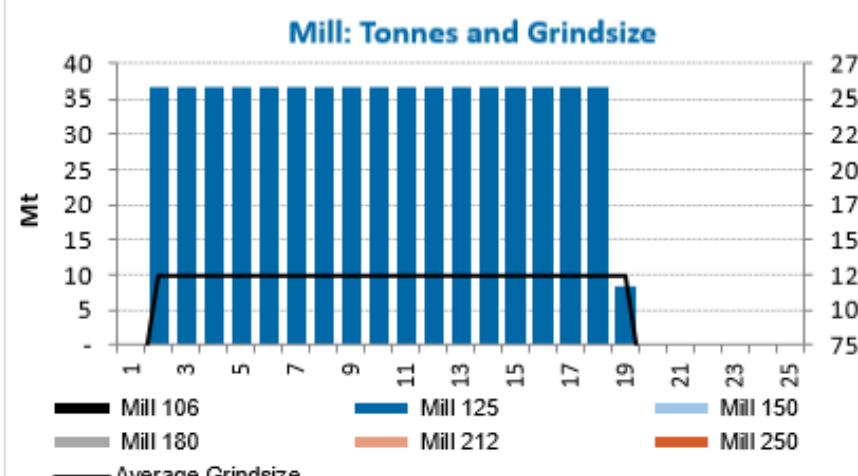
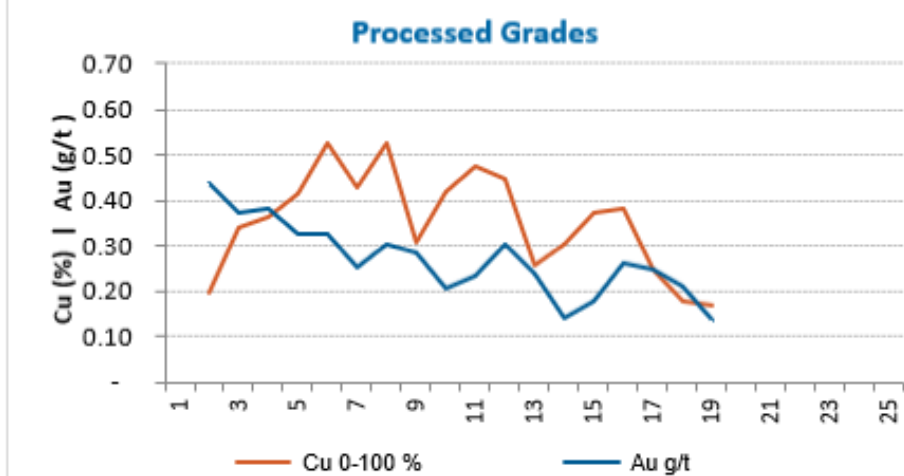
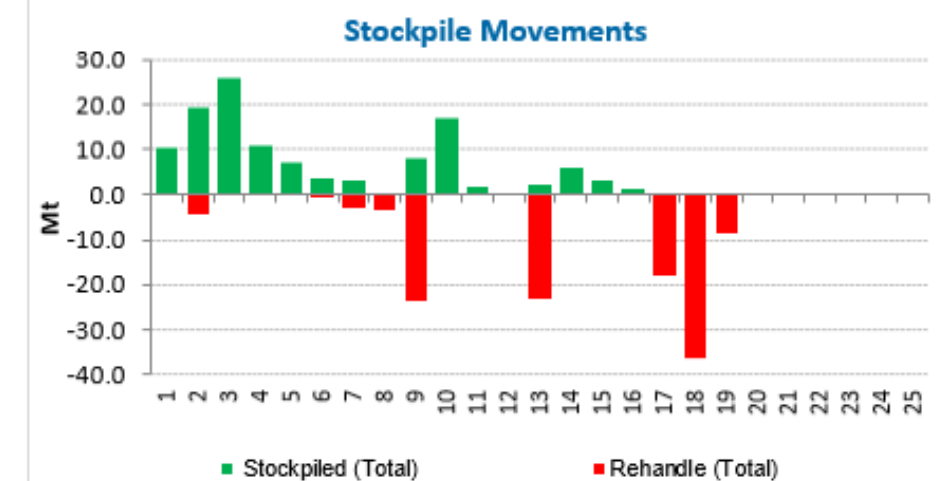
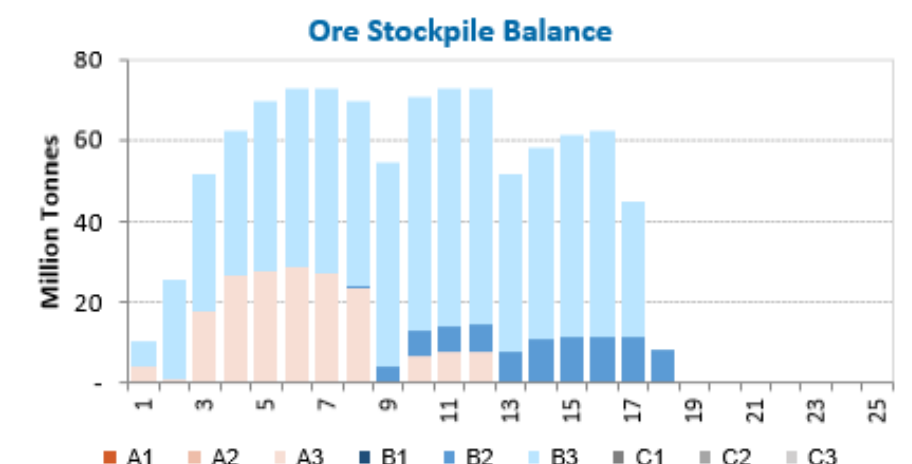
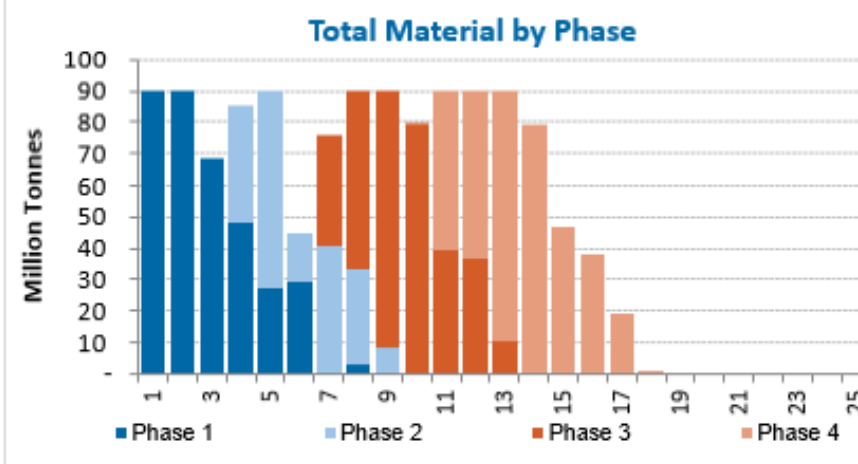
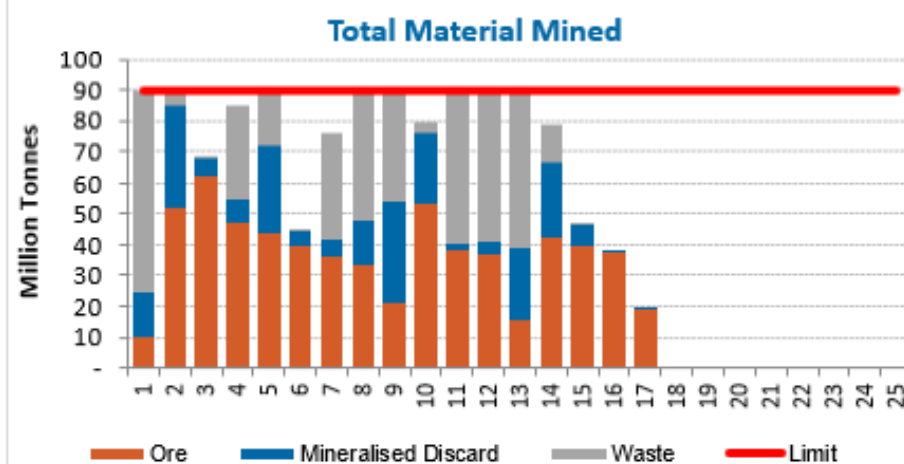
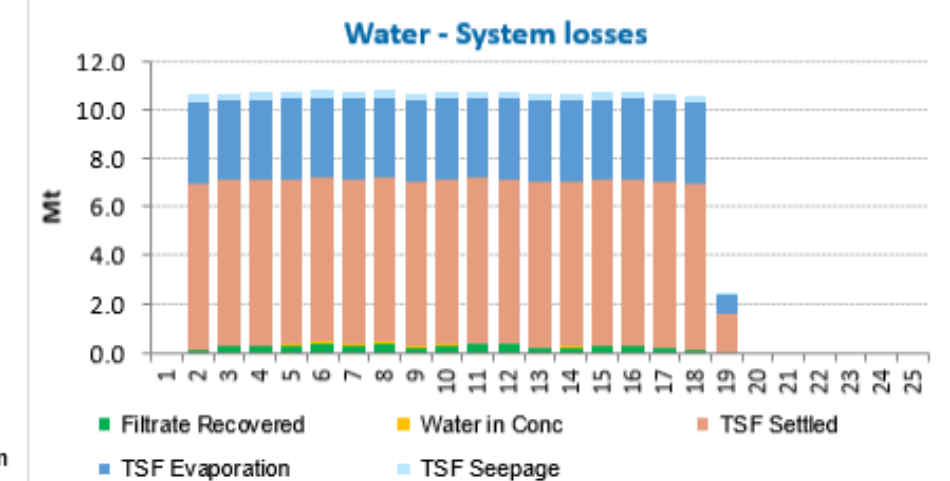
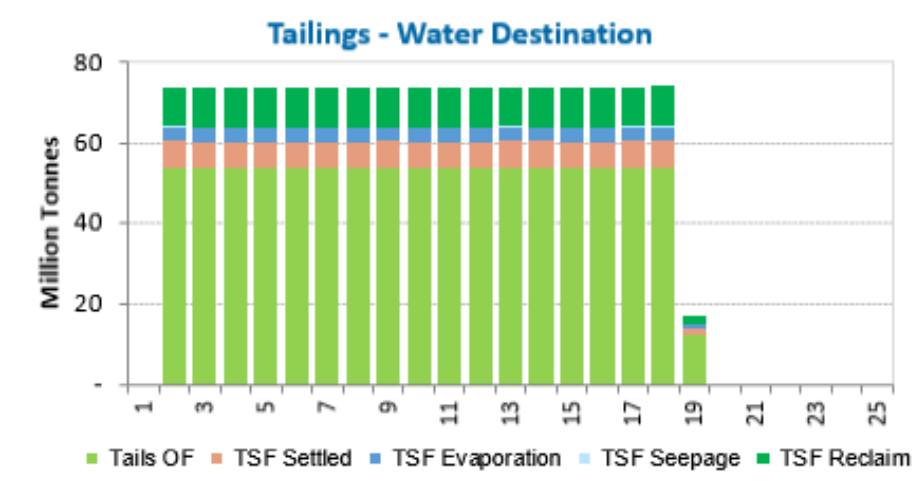
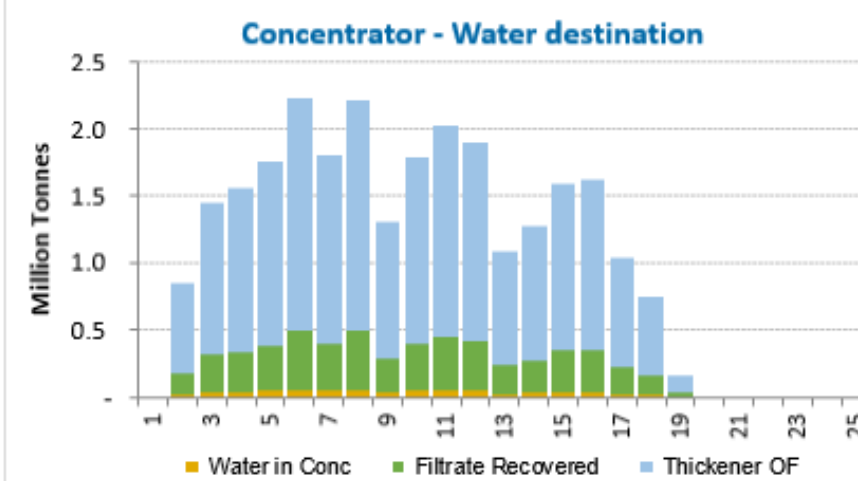
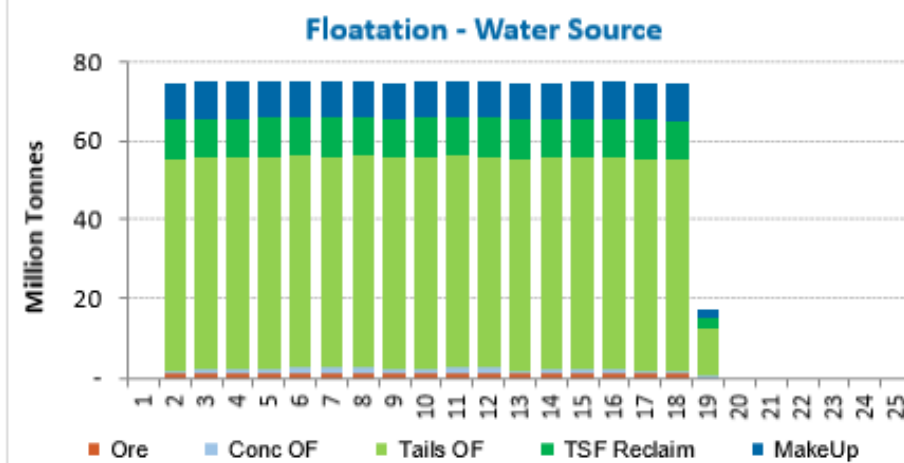
Mined Material: **1,256.8** Mt  
 Ore Processed: **628.9** Mt  
 Discarded Mineralised: **228.9** Mt  
 Peak Stockpiled: **73.0** Mt  
 Cu Produced: **2,020.6** Kt  
 Au Produced: **4.11** M TrOz  
 As Produced: **34.3** Kt

MakeUp Water: **10.27** Mtpa  
 Tailings Volume: **346.34** M m<sup>3</sup>  
 Slurry Density: **2.13** t/m<sup>3</sup>  
 SG of Dry Tailings: **1.79** t/m<sup>3</sup>  
 Water Intensity: **0.25** m<sup>3</sup>/Ore t  
 ..for Cu produced: **78.99** m<sup>3</sup>/Cu t

Water supply OPEX: **334.3** MUSD  
 Water treat OPEX: **1.9** MUSD  
 Tail Dewater OPEX: **138.9** MUSD  
 Water supply CAPEX: **495.0** MUSD  
 Water treat CAPEX: **26.3** MUSD  
 TSF dewater CAPEX: **163.1** MUSD

Raw Seawater - Paste thickened - 4400masl 165km  
 Static grindsize and Concentrate grade

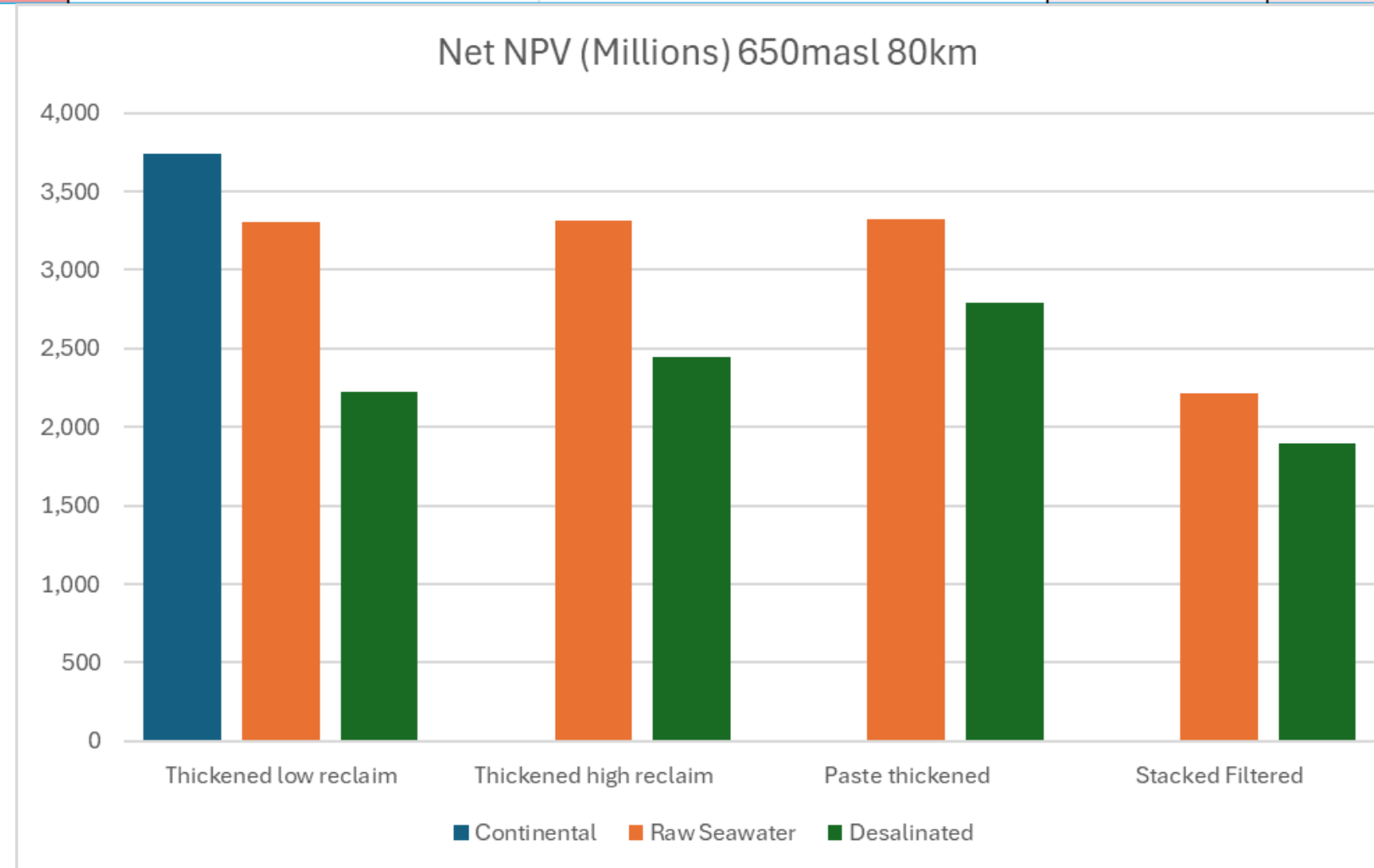
## RUN o21\_S\_T3\_L4 DASHBOARD





# Outputs – 650masl 80km

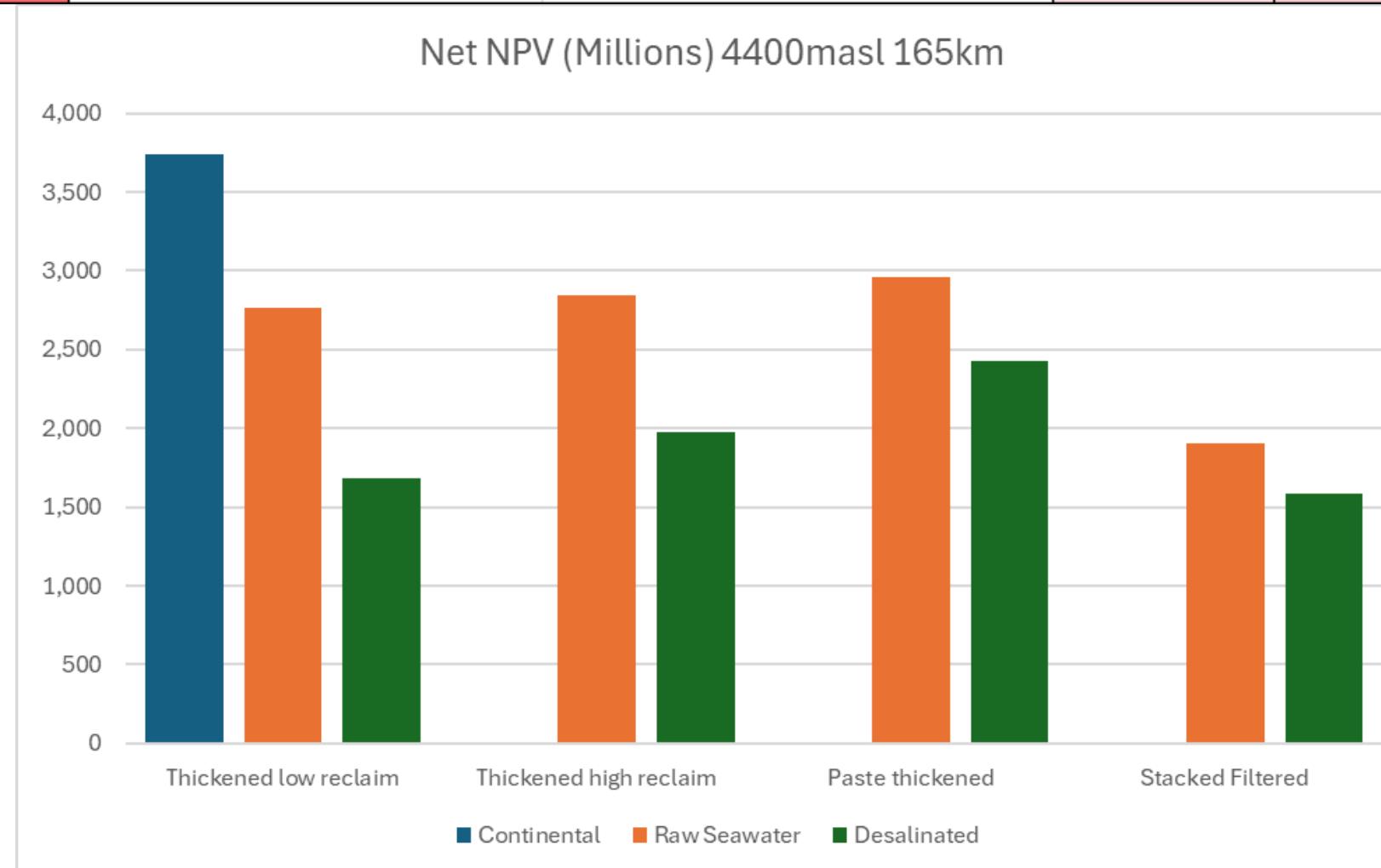
Net NPV	CAPEX	NPV/CAPEX	Water Type:	Tailing Paradigm:	Water OPEX	Water CAPEX	Water Total	Water intensity Ore	Water intensity Cu
<i>MUSD</i>	<i>MUSD</i>	<i>0-100%</i>			<i>MUSD Undiscounted</i>			<i>m<sup>3</sup> / ore t</i>	<i>m<sup>3</sup> / cu t</i>
3,736.6	2,153.6	174%	Fresh groundwater	Thickened low reclaim	237	136	373	0.67	206.6
3,303.7	2,432.4	136%	Raw Seawater	Thickened low reclaim	309	415	723	0.67	208.9
3,314.6	2,441.3	136%	Raw Seawater	Thickened high reclaim	263	423	687	0.50	155.3
3,321.7	2,447.0	136%	Raw Seawater	Paste thickened	232	429	662	0.25	79.6
2,214.4	3,088.4	72%	Raw Seawater	Stacked Filtered	1345	1071	2416	0.13	40.3
2,221.4	3,574.7	62%	Desalinated seawater	Thickened low reclaim	463	1557	2019	0.67	206.2
2,441.4	3,390.9	72%	Desalinated seawater	Thickened high reclaim	379	1373	1752	0.50	153.5
2,792.3	3,075.6	91%	Desalinated seawater	Paste thickened	291	1058	1349	0.25	78.6
1,898.3	3,515.4	54%	Desalinated seawater	Stacked Filtered	1376	1498	2874	0.13	39.9





# Outputs – 4400masl 165km

Net NPV	CAPEX	NPV/CAPEX	Water Type:	Tailing Paradigm:	Water OPEX	Water CAPEX	Water Total	Water intensity Ore	Water intensity Cu
<i>MUSD</i>	<i>MUSD</i>	<i>0-100%</i>			<i>MUSD Undiscounted</i>			<i>m<sup>3</sup> / ore t</i>	<i>m<sup>3</sup> / cu t</i>
3,736.6	2,153.6	174%	Fresh groundwater	Thickened low reclaim	237	136	373	0.67	206.6
2,761.8	2,687.1	103%	Raw Seawater	Thickened low reclaim	998	669	1668	0.67	208.5
2,843.4	2,698.4	105%	Raw Seawater	Thickened high reclaim	775	681	1456	0.50	154.8
2,954.9	2,702.1	109%	Raw Seawater	Paste thickened	499	684	1184	0.25	79.7
1,901.6	3,343.4	57%	Raw Seawater	Stacked Filtered	1479	1326	2804	0.13	40.3
1,681.9	3,826.4	44%	Desalinated seawater	Thickened low reclaim	1150	1809	2959	0.67	205.8
1,977.5	3,640.8	54%	Desalinated seawater	Thickened high reclaim	888	1623	2511	0.50	152.9
2,427.9	3,330.6	73%	Desalinated seawater	Paste thickened	555	1313	1868	0.25	78.6
1,586.9	3,770.1	42%	Desalinated seawater	Stacked Filtered	1508	1752	3260	0.13	39.9





# Outputs

NPV/CAPEX	Thickened low reclaim	Thickened high reclaim	Paste thickened	Stacked Filtered
<b>650masl 80km</b>				
Fresh groundwater	174%			
Desalinated seawater	62%	72%	91%	54%
Raw Seawater	136%	136%	136%	72%
<b>4400masl 165km</b>				
Fresh groundwater	174%			
Desalinated seawater	44%	54%	73%	42%
Raw Seawater	103%	105%	109%	57%



# Conclusions

Mine optimisation is complicated and dynamic (ideally).

You have to do the work, for that specific orebody.

All these outcomes are guided by the choice of metrics that are important to the company's board.

In the economic evaluation of water supply, it is not sufficient to stop at the first-order items; second-order has sufficient effects to influence decisions.

This work is a step towards a fuller integration of water into the mine planning processes; there is more....



# Scope Extension Ideas – what to tackle next

Current Model

A

Processing (GTR)  
PAG vs NAG  
New Climatic Loc.  
Moly. Sensitivity  
Cu & Au Price

Pre-concentration  
Flowsheet or  
Technology Options

e.g. Coarse Particle Flotation  
and/or Hydraulic Dewatered  
Stacking

C

Link to Hydrology Models

Catchment Footprint;  
River Diversion;  
Pit Boundaries;  
Lake Interactions;  
Pit-dewatering etc

Existing Operation

B

Depleted Orebody  
Looming Restrictions

- Close (or C&M)?
- Scale Back?
- Change Supply?
- Change Tails de-water?

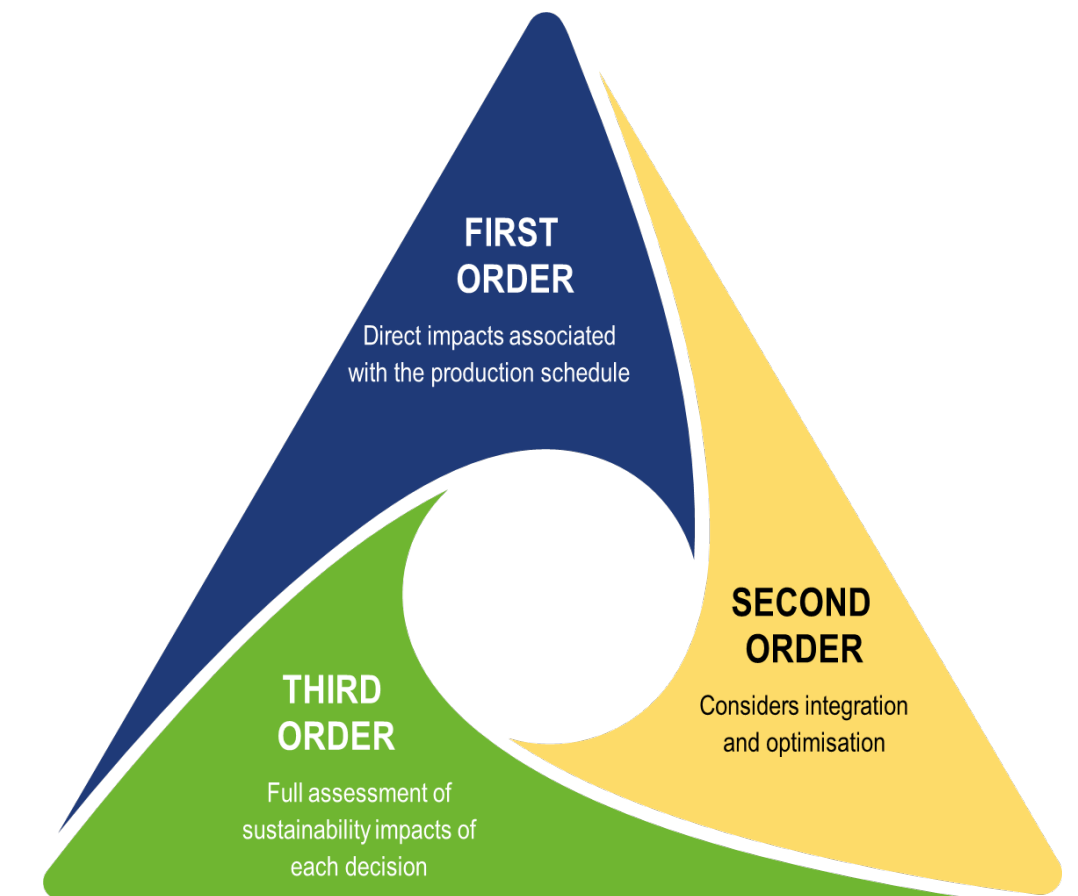
D

New Versions of Marvin

What Ore Type?



# Discussion & Questions



*GWl water wheel framework*



Thanks

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