Mine Dewatering and Water Management at Barrick Goldstrike Mine in the Carlin Trend, Nevada

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Distance:
1 meter = 3.3 feet

Flow rate:
1 liters/second = 16 gallons/minute (gpm)

Weight (Gold):
1 tonne = 32,000 troy ounces
1. Introduction – Barrick

North America:
- Donlin Creek
- Goldstrike
- Turquoise Ridge
- Marigold
- Bald Mountain
- Cortez
- Ruby Hill
- Round Mountain
- Golden Sunlight
- Hemlo

South America:
- Lagunas Norte
- Pierina
- Zaldívar
- Cerro Casale
- Pascua-Lama
- Veladero

African Barrick:
- North Mara
- Kabanga
- Tulawaka
- Bulyanhulu
- Buzwagi
- Lumwana

Australia Pacific:
- Reko Diq
- Plutonic
- Darlot
- Granny Smith
- Kanowna
- Kalgoorlie
- Cowal

Mine  Project
1. Introduction – Goldstrike Mine

[Map of Goldstrike Mine and surrounding area]
Open Pit

3,700 m

2,000 m

400 m
Pre-mining water table 1600 m amsl

Current water table 1100 m amsl with a drawdown of 500 m
2. Goldstrike Dewatering System
Dewatering System - Active

Pumping well -
Depth: 1000 m
Diameter: 50 cm
Rate: 200 l/s (3,000 gpm)
Power: 2,000 HP
Cost: US$3 Million/Each
Dewatering System - Active

- Piezometer
- Regional Well
- Local Well
Dewatering System - Passive
Dewatering System - Passive

- Numbers: 1800
- Length: 10 – 450 m
- Total Length: 380 km
Water Management System

560,000 m²/Each
Cumulative Water Balance

- Mine Use: 52%
- Irrigation: 27%
- Infiltration/Injection: 6%
- Discharge to Humboldt River: 10%
- Flood Irrigation and Evap: 5%

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3. Goldstrike Monitoring System – 15,000 km

Manual/Automatic Groundwater Monitoring

Manual/Automatic Surface Water Monitoring
Water Level Change To-Date

Drawdown

Mounding
New Tools – Ground Deformation

A New Assessment Tool - Interferometric Synthetic Aperture Radar (InSAR)
Identified Subsidence/Uplift Associated with Mine Dewatering
100km x 100km coverage at 5m pixel resolution

From Massonnet, 1997
Ground Deformation – InSAR Results

Subsidence and Uplift
June 1, 1992 – Nov 26, 2000

From Katzenstein, 2008
Monitoring System – InSAR Results

Deformation Rate vs. Time

From Katzenstein, 2008

From Maurer et al., 1996

Pre-Mining Water Level (1990-1991)

MODFLOW Model Grids
Flow Model – Steady State (Pre-mining)

Statistics of observed-simulated water levels:
- Number of wells: 167
- Mean observed head: 5,289 ft
- Root mean square error (ft): 24.9
- Standard deviation of residual error (ft): 25.0
- Bias (mean error in ft): -0.79
- Calibration ratio: 0.0119
- R-squared: 0.9981
Flow Model – Transient (Pit Area)

- Measured Pit Composite
- Betze simulated, layer 1
- Betze simulated, layer 2
- Betze simulated, layer 3

Water level (ft amsl)
Flow Model – Transient (Mountain Block)
Flow Model – Transient (Infiltration Basin)
Flow Model – Transient (Surface Water)
Flow Model – Projection

Post-Mining Pit Lake Recovery

Simulated Pit Stage

- Groundwater level
- Pit water stage

Recovery Time in Year

Simulated Maximum Drawdown (10 feet)
5. Conclusions

- Groundwater pumping at Goldstrike has resulted in 520 m of drawdown around the mine site.

- Most of the water pumped at the mine has been returned to the same hydrologic basin.

- Extensive monitoring program, assisted by modern satellite technology and by robust modeling, has identified aquifer responses.

- Improvement of the water-management system, the monitoring network, the modeling and analysis continue at Goldstrike.
Thank You for Your Attention!