Mt Todd Goldsim Water Balance Model – An Introduction

The Mt. Todd site wide water balance model was developed using the GoldSim software (Version 10.50) to simulate 13 years of mine production at the Vista Gold Mt Todd site. The site wide water balance was created in December of 2012 for the PFS update with a primary goal of providing sizing for the water treatment plant (WTP). The design considers a 50,000 tonnes/day mine plan at the Mt. Todd mine site. A general description of the model inputs, structure and results are presented herein.

Inputs

The model is allowed to run for 13 years on a daily time step. Multiple "realizations", or equally likely simulations, are run so that the stochastic, or uncertainty aspect, is fully captured. A minimum of 100 realizations are run so that typical, best and worst case outcomes may be understood.

Weather Data

Rainfall is modeled stochastically by use of a Markov structure operating upon real site data. Site data were augmented by including correlated gage data from the Katherine area, thus extending the period of record from 10 years to over 100. Data from the site include the recent and extreme Boxing Day event from 2011. The Markov structure places the model into either a "wet" or a "dry" state depending upon the season and then calculates rainfall, if the season is wet. No rainfall is calculated during the dry season.

Rainfall is then linked to runoff within the Edith River by using the Australian Water Balance Method (AWBM). Calibration of the AWBM was achieved using real site precipitation, evaporation and Edith flow data. Catchment parameters Kb, BFI, Ks and storage capacities are consistent with studies performed in the Northern Territory, site observations of the Edith and the local geology.

Runoff within individual retention pond (RP) catchments was modeled using the Soil Conservation Service (SCS) method, given the paucity of real data available for calibration (none of the RP catchments are gauged) and considering the curve number development performed for the calibration model. Catchment areas may adjust over time, wherein runoff surfaces are occupied by expanding rock dumps or consumed by pit expansion.

Seepage

Seepage for the various rock piles on site (Heap Leach Pad, Low Grade Ore Stockpile and Waste Rock Dump) has been modeled using finite element seepage and unsaturated flow models. The seepage is modeled as a loss through the rock pile footprint that reports to the RPs (with an associated delay). The footprints are allowed to adjust through time as more material is either added to or removed from the pile. Piles that diminish are the Heap Leach Pad and the Low Grade Ore Stockpile, which will be run through process. The Waste Rock Dump will grow throughout the life of mine.

Stage storage

Stage storage relationships were developed for the RPs and used to determine the free water surface upon which precipitation inputs and evaporative losses occur. The relationships are also used to assess storage capability, determine overtopping events and initiate removal of water by pumping.

Model Structure

Water moves around the site first by entering the system as precipitation onto the site's RPs directly or by runoff processes from the catchment basins. This water, in addition to seepage (where applicable), reports to the RPs and is eventually pumped to the Equalization Pond (EQP) to be treated at the Water Treatment Plant (WTP). The effluent of the WTP is either reused in the process plant or applied as dust suppression. Water leaves the system through evaporation and overtopping. Below are detailed descriptions of the individual entities of the model.

Retention Ponds (RPs)

Retention ponds comprise the majority of the site wide water balance model. Initial conditions for each RP are based on results from the pre-production water balance model, which relied on site observed water surfaces within the RPs from October 2012 and was allowed to run for a 2-year period. Water elevations at the conclusion of the pre-production model were assumed to be identical to initial conditions for production.

Inputs to RPs include:

- direct precipitation
- catchment runoff
- seepage (where applicable)

Outputs from the RPs include:

- evaporative loss
- pumping to the EQP
- overtopping events (uncontrolled releases)

Descriptions of the RP catchments are explained below:

RP1 – WRD runoff and seepage

RP2 – Low grade ore stockpile runoff and seepage

RP3 – Pit wall runoff

RP5 – Process and mill site pad runoff

HLP – Heap Leach Pad moat

Equalization Pond and Water Treatment Plant (EQP and WTP)

The equalization pond serves as the intake reservoir for the WTP. It is sized to 5 days of storage at the WTP rate of 500m^3/hr, or 60,000m^3. Pumping logic within the model never allows for the EQP to overtop. If the EQP's water level approaches the freeboard limitation, pumps from RPs are not allowed to send until more water is treated and water levels within the EQP subside.

The inputs to the EQP include pumping from:

- RP1
- RP2
- RP3
- RP5
- HLP

The model allows no discharge from the WTP to the Edith River during the dry season under permit 178-2.

Processing Plant (PP)

The PP receives water from the RWD, the thickener overflow, the WTP effluent and the TSF decant return to satisfy process demands. Water loss in the tailings slurry and minor water input from incoming ore water are currently not included in the water balance model.

Raw Water Dam (RWD)

The RWD provides water for many of the processes on the Mt. Todd site and has a storage capacity of 8,362,000m^3.

Inputs to the RWD include:

- Direct precipitation
- Runoff from the catchment basin

Outputs from the RWD include:

- Evaporation
- Pump to process plant (including reagent water demand and gland water demand)
- Pump to dust suppression
- Potable water demand
- Reverse osmosis water for the site power plant

Dust Suppression

A monthly dust suppression schedule was provided by Tom Dyer. The dust application rates vary from 220m3/day during the wet season to 1153m3/day during the dry season. Dust suppression water needs are fulfilled by effluent from the WTP and the RWD. The remainder of the WTP effluent not consumed by the process plant is sent to the dust suppression tank and the RWD satisfies the remaining demand. The dust suppression tank is sized to contain 2 days of the highest application rate (1153 m3/d).

Tailings Storage Facilities (TSF)

The TSFs are not currently modeled, with the exception of the decant return, which is split 90% to process and 10% as a bleed stream to the WTP. The magnitude of the decant is based on preliminary designs by the process design team, Proteus. Model improvements include implementation of the TSFs as a water balance entity.

Results

The site wide water balance was used to determine WTP capacity and to evaluate the potential for overflow from the various RPs due to extreme storm events. Future iterations of the model will include enhancing the capacity of RP1 by deepening and RP2 by relocation and resizing.