

# Addendum

## Evaluation of Faro Water Treatment Plant Sizing and Water Quality in Rose Creek at Monitoring Station X14

PREPARED FOR: Government of Yukon  
PREPARED BY: CH2M HILL Canada Limited  
DATE: June 17, 2013  
PROJECT NUMBER: 472645.13.WT.AD.01.DM

### 1.0 Introduction

This technical memorandum (TM) provides the results of additional modelling simulations conducted to evaluate capacity requirements for design of the new Faro Mine Water Treatment Plant (WTP). These additional simulations were completed in response to a request from the Design Review Committee at the Faro Mine Remediation Project (FMRP) water treatment plant conceptual design review meeting held on June 11 and 12, 2013.

This TM provides an addendum to the TM *Evaluation of Faro Water Treatment Plant Sizing and Water Quality in Rose Creek at Monitoring Station X14* (Evaluation Report) (CH2M HILL, 2013). That TM presented analysis pertaining to capacity of the new WTP and the predicted concentrations of zinc at the Rose Creek Monitoring Station X14 (X14), located in Rose Creek, downstream of the Cross Valley Dam (CVD).

This TM presents the results of additional GoldSim modelling runs with the following modifications to the GoldSim water quality model parameters:

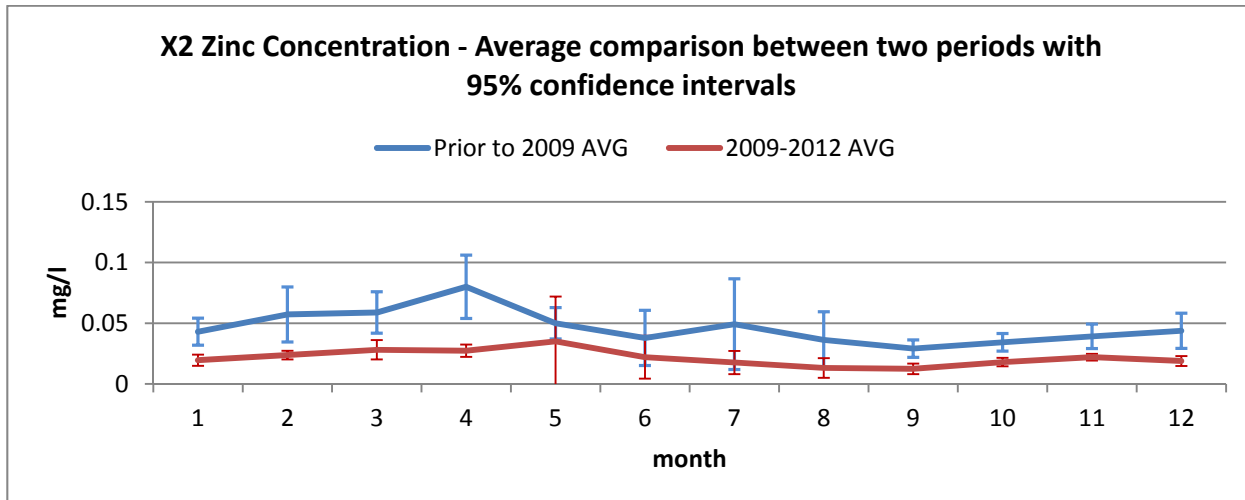
- Zinc concentrations modeled at water quality monitoring Station X2, were reduced to more closely represent analytical test results obtained for samples tested between 2009 and 2012.
- Annual zinc concentration range modeled at Station X-5, located at the Cross Valley Dam discharge location, was adjusted in the model to better represent current pond conditions (post 2011).

### 2.0 Station X-2 Concentrations

The zinc load observed at water quality monitoring Station X2, located on the North Fork of Rose Creek upstream from the Rose Creek Diversion, makes up a significant portion of the zinc load observed downstream at monitoring Station X14. The modelling simulations presented in the Evaluation Report estimated existing zinc concentrations at X2 based on averaging all historical data which included test data obtained from 1997 to 2012.

However, the zinc concentrations at X2, and the associated zinc loads, have been reduced since operation of the S-Wells Seepage Interception System (SIS) capture wells began in 2009. Figure 1 shows the change in the average monthly zinc concentration at X2 prior to and after 2009. The revised modelling runs presented in this TM used the 2009-2012 data set to calculate X2 zinc concentrations.

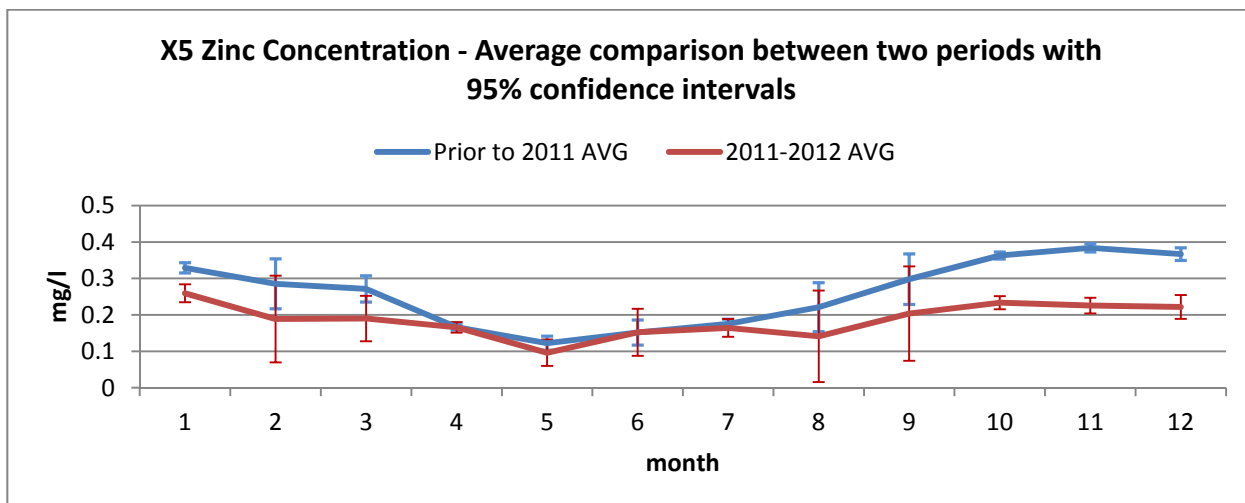
*The document contained herein should be considered Final as approved by the Government of Yukon on August 27, 2014 with no changes made since the draft submission.*



**Figure 1**  
**Station X-2 Zinc Concentration**

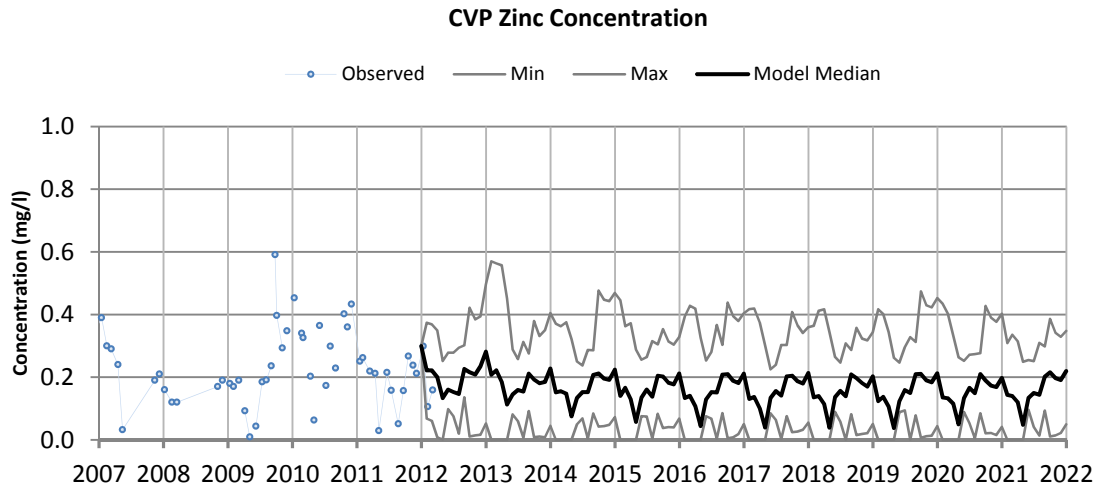
### 3.0 Cross Valley Pond Zinc Variability

The model simulations presented in the Evaluation Report used zinc concentrations, ranging from 0.1 to 0.3 mg/l, to represent discharge from the CVD at Monitoring Station X5. The Evaluation Report also described variability for zinc concentrations at the pond based on historical data (2004 to current date). The stochastic range for zinc at X5 presented in the Evaluation Report was believed by the Design Review Committee to be excessively high to represent the current pond conditions. Additional alkalinity (lime slurry) has been added to the water treatment plant effluent starting in 2011 and has significantly decreased the range of zinc concentrations at the pond. The revised analyses simulated annual variability in zinc concentration at Station X5 by stochastically varying the mean concentrations based on the variability of the zinc concentration data observed between 2011 and 2012. Figure 2 presents the data confirming the observed reduction in zinc concentrations due to lime addition to the polishing pond.



**Figure 2**  
**Station X-5 Zinc Concentration**

Figure 3 presents the current adjusted variability range of zinc concentration at the CVP X5 used in the updated GoldSim model runs. The figure shows the variability for a WTP discharging at 0.2 mg/l concentration; the modeled variability changes as a function of WTP effluent discharges.



**Figure 3**  
**Station X-5 Zinc Concentration**

## 4.0 Results

As requested by the Design Review Committee, additional model simulations were conducted incorporating the changes pertaining to X2 and X5 zinc concentrations, as described above, for both 6,000 gpm and 8,100 gpm capacity water treatment plants. A listing of the scenarios is provided in Attachment C-1. The attachments in this TM are designated as Attachment C to differentiate the results from the simulations presented in the Evaluation Report. The results of the simulations are provided in Attachment C-2. As expected, the results of the additional simulations demonstrate a reduction in the predicted zinc concentrations at Station X14 from that predicted in the Evaluation Report.

## 5.0 Works Cited

CH2M HILL Canada Limited (CH2M HILL). 2013. *Evaluation of Faro Water Treatment Plant Sizing and Water Quality in Rose Creek at Monitoring Station X14*. Prepared for the Government of Yukon. Technical Memorandum. June 7.

**Attachment C-1**  
**Model Scenarios**

---

**Attachment C-1**  
**Goldsim Modelling Simulations**  
**June 17, 2013**

Figure	Scenario	WTP Capacity (gpm)	Treatment Season	WTP Discharge Zinc Concentration (mg/l)	Faro Pit Operation	CVP Operation	SIS/VG/GR
C-1	C-1a	8,100	May-Sept	0.1	Release (treat) as much as possible earlier in the season (MAY-JUN)	discharge via CVP when there is opportunity to eliminate load. Discharge limited to the min of WTP capacity or 10,000 gpm	w/o CVD SIS and G/V
C-2	C-1b	8,100	May-Sept	0.2	Release (treat) as much as possible earlier in the season (MAY-JUN)	discharge via CVP when there is opportunity to eliminate load. Discharge limited to the min of WTP capacity or 10,000 gpm	w/o CVD SIS and G/V
C-3	C-1c	8,100	May-Sept	0.3	Release (treat) as much as possible earlier in the season (MAY-JUN)	discharge via CVP when there is opportunity to eliminate load. Discharge limited to the min of WTP capacity or 10,000 gpm	w/o CVD SIS and G/V
C-4	C-1e	8,100	May-Sept	0.1	Release (treat) as much as possible earlier in the season (MAY-JUN)	discharge via CVP when there is opportunity to eliminate load. Discharge limited to the min of WTP capacity or 10,000 gpm	w/ CVD SIS and G/V
C-5	C-1f	8,100	May-Sept	0.2	Release (treat) as much as possible earlier in the season (MAY-JUN)	discharge via CVP when there is opportunity to eliminate load. Discharge limited to the min of WTP capacity or 10,000 gpm	w/ CVD SIS and G/V
C-6	C-1g	8,100	May-Sept	0.3	Release (treat) as much as possible earlier in the season (MAY-JUN)	discharge via CVP when there is opportunity to eliminate load. Discharge limited to the min of WTP capacity or 10,000 gpm	w/ CVD SIS and G/V
C-7	C-6a	6,000	May-Sept and expanded as needed	0.1	Release (treat) as much as possible earlier in the season (MAY-JUN)	discharge via CVP when there is opportunity to eliminate load. Discharge limited to the min of WTP capacity or 10,000 gpm	w/o CVD SIS and G/V
C-8	C-6b	6,000	May-Sept and expanded as needed	0.2	Release (treat) as much as possible earlier in the season (MAY-JUN)	discharge via CVP when there is opportunity to eliminate load. Discharge limited to the min of WTP capacity or 10,000 gpm	w/o CVD SIS and G/V

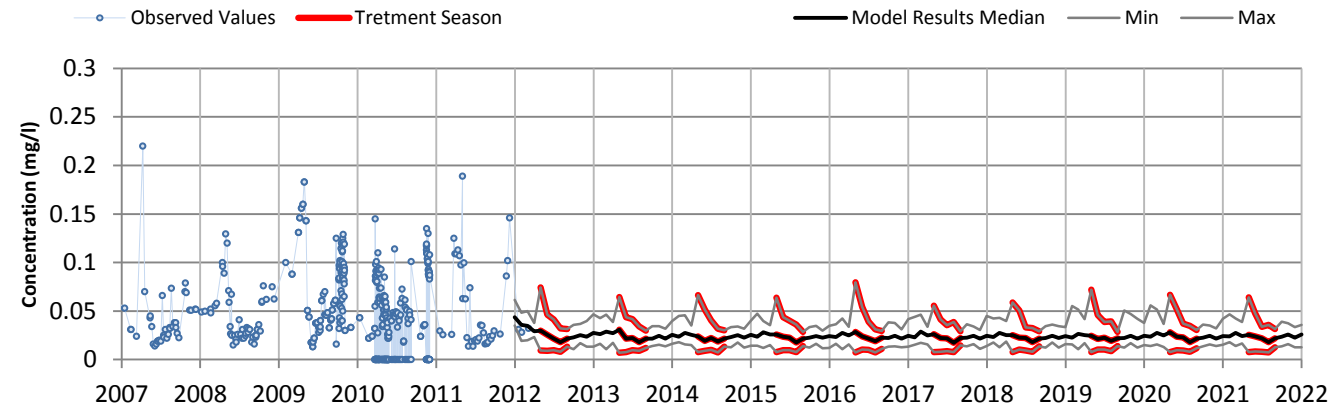
**Attachment C-1**  
**Goldsim Modelling Simulations**  
**June 17, 2013**

Figure	Scenario	WTP Capacity (gpm)	Treatment Season	WTP Discharge Zinc Concentration (mg/l)	Faro Pit Operation	CVP Operation	SIS/VG/GR
C-9	C-6c	6,000	May-Sept and expanded as needed	0.3	Release (treat) as much as possible earlier in the season (MAY-JUN)	discharge via CVP when there is opportunity to eliminate load. Discharge limited to the min of WTP capacity or 10,000 gpm	w/o CVD SIS and G/V
C-10	C-6e	6,000	May-Sept and expanded as needed	0.1	Release (treat) as much as possible earlier in the season (MAY-JUN)	discharge via CVP when there is opportunity to eliminate load. Discharge limited to the min of WTP capacity or 10,000 gpm	w/ CVD SIS and G/V
C-11	C-6f	6,000	May-Sept and expanded as needed	0.2	Release (treat) as much as possible earlier in the season (MAY-JUN)	discharge via CVP when there is opportunity to eliminate load. Discharge limited to the min of WTP capacity or 10,000 gpm	w/ CVD SIS and G/V
C-12	C-6g	6,000	May-Sept and expanded as needed	0.3	Release (treat) as much as possible earlier in the season (MAY-JUN)	discharge via CVP when there is opportunity to eliminate load. Discharge limited to the min of WTP capacity or 10,000 gpm	w/ CVD SIS and G/V

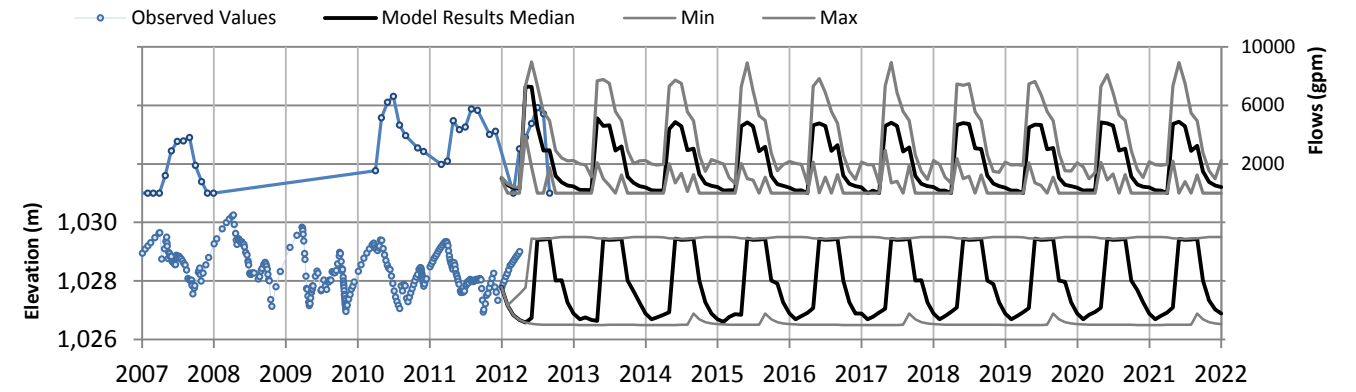
**Attachment C-2**  
**GoldSim Analysis Plotted Results**

---

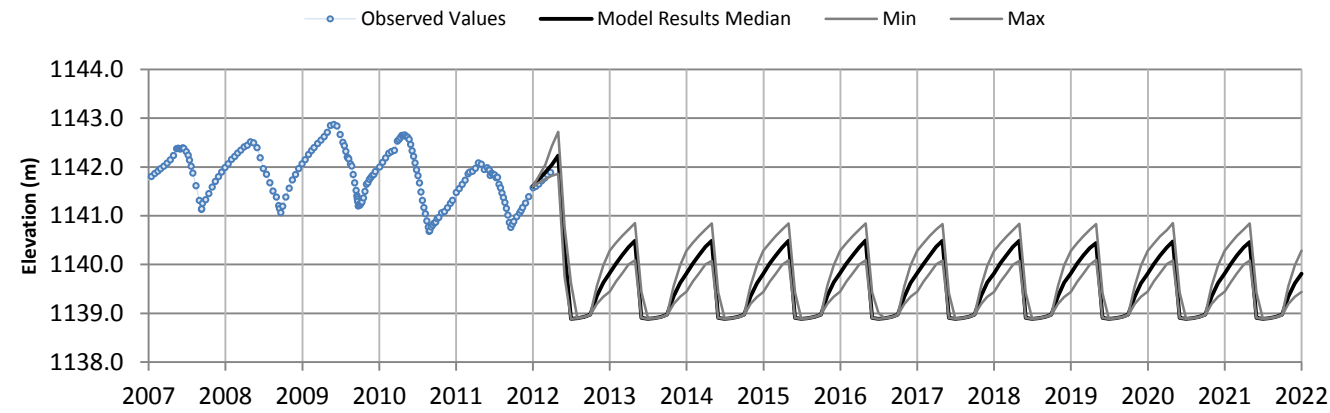
**Plot A - Zinc Concentrations at X14 - Scenario C-1a**



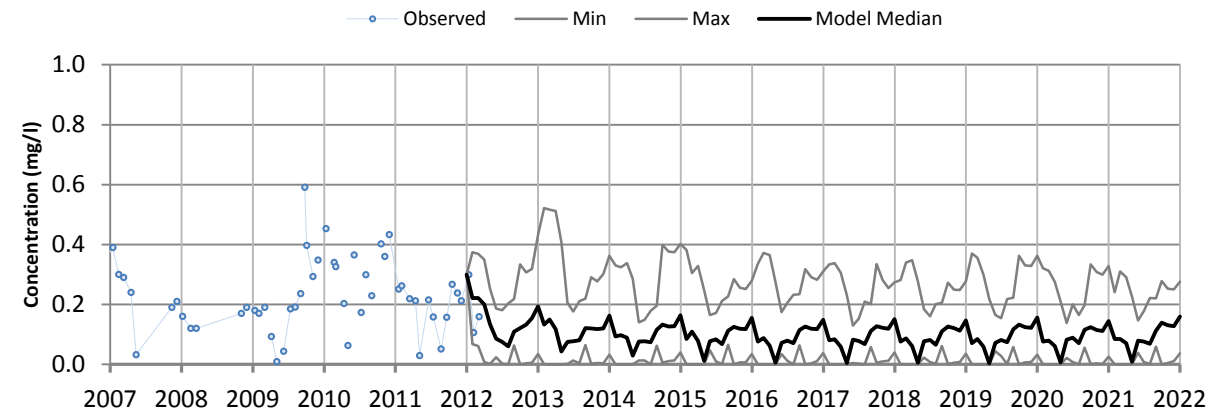
**Plot B - CVP Operation - Scenario C-1a**



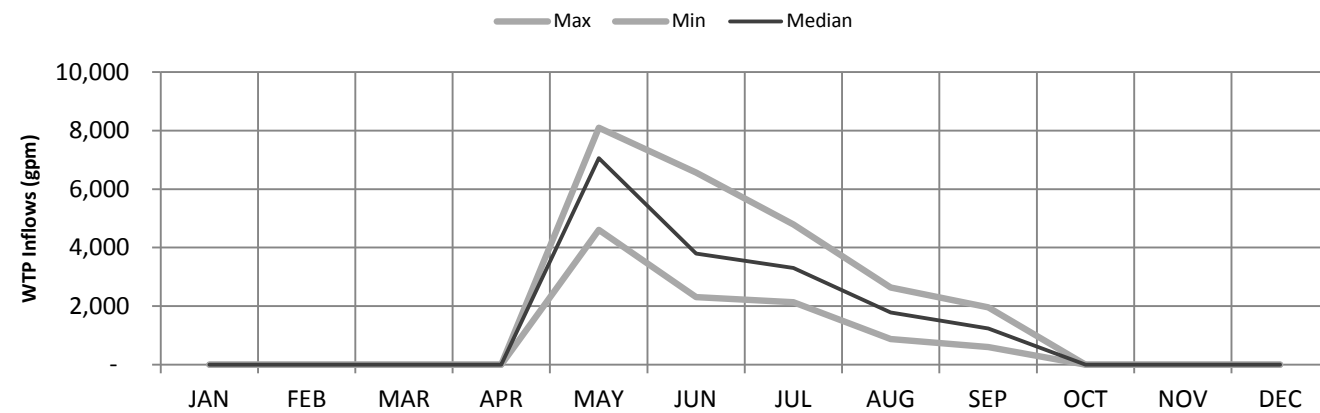
**Plot C - Faro Pit Elevation - Scenario C-1a**



**Plot D - CVP Zinc Concentration - Scenario C-1a**



**Plot E - Range of Monthly WTP flows - Scenario C-1a**



**Plot F - Range of Monthly CVP Discharge flows - Scenario C-1a**

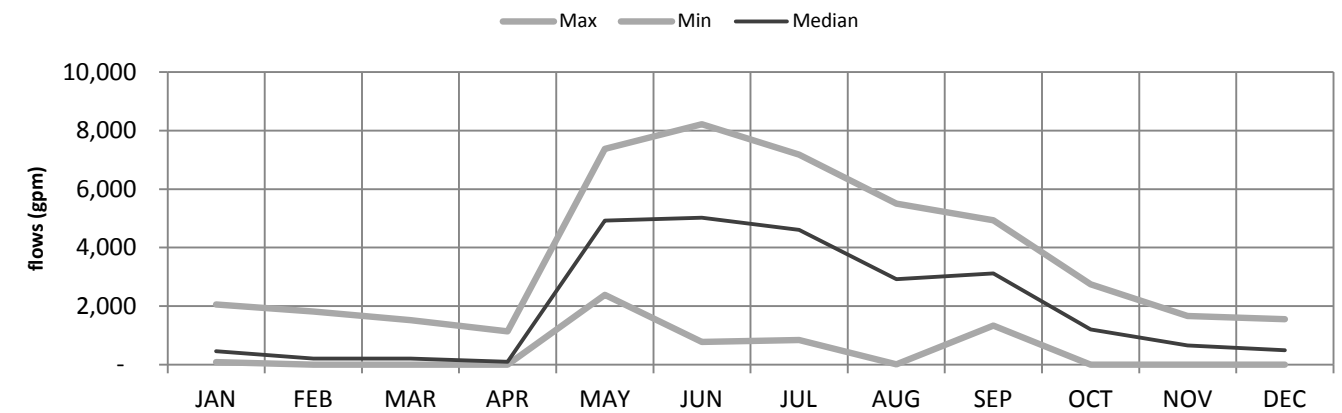
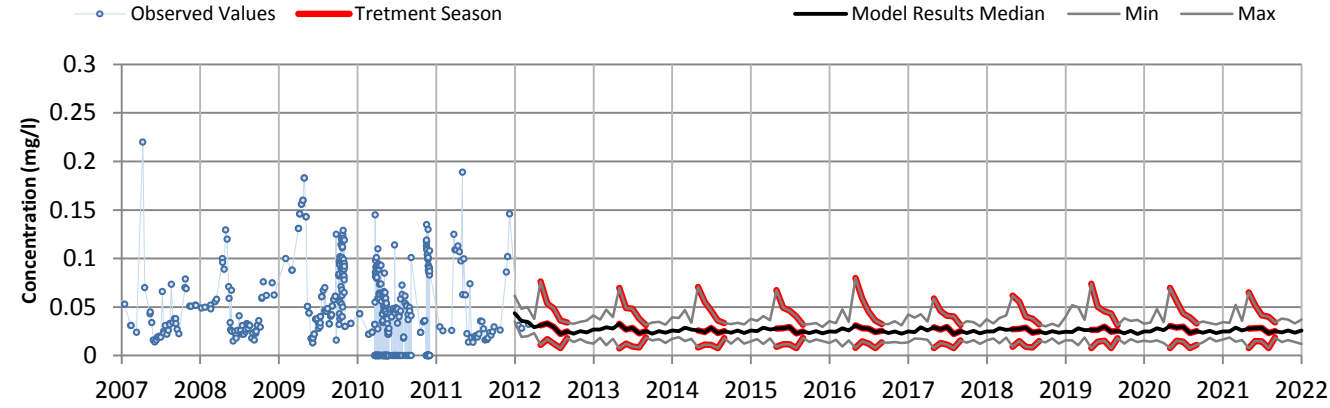


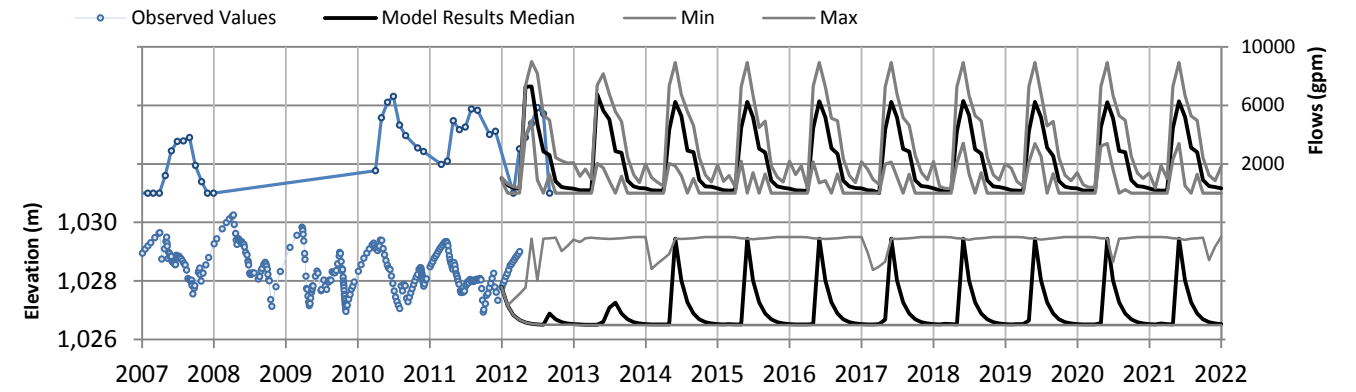
Figure C-1  
**Scenario C-1a Results**  
 Faro Mine Remediation Project



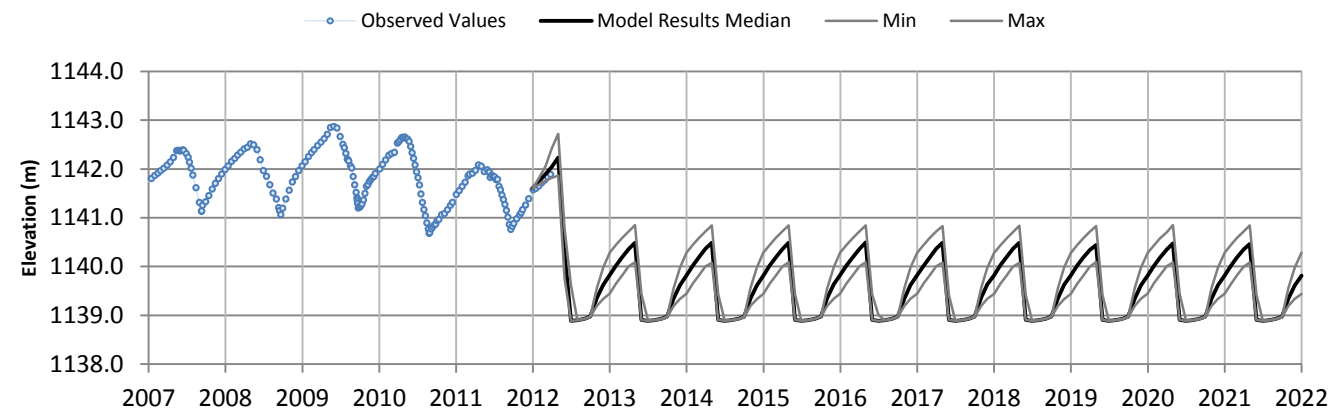
**Plot A - Zinc Concentrations at X14 - Scenario C-1b**



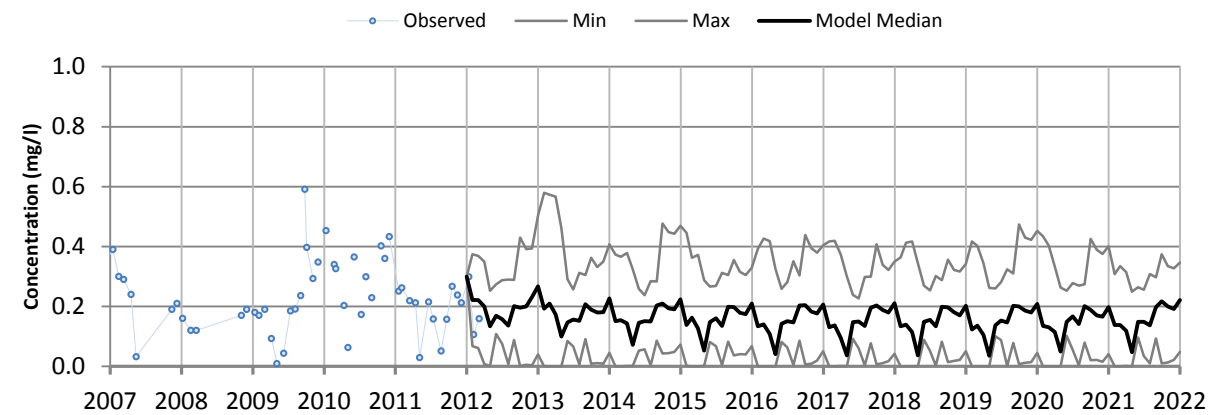
**Plot B - CVP Operation - Scenario C-1b**



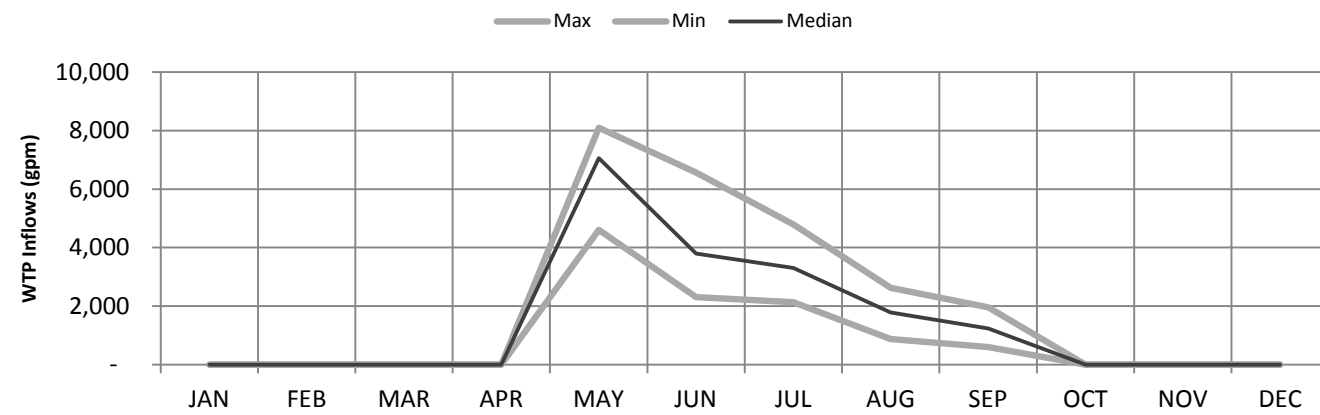
**Plot C - Faro Pit Elevation - Scenario C-1b**



**Plot D - CVP Zinc Concentration - Scenario C-1b**



**Plot E - Range of Monthly WTP flows - Scenario C-1b**



**Plot F - Range of Monthly CVP Discharge flows - Scenario C-1b**

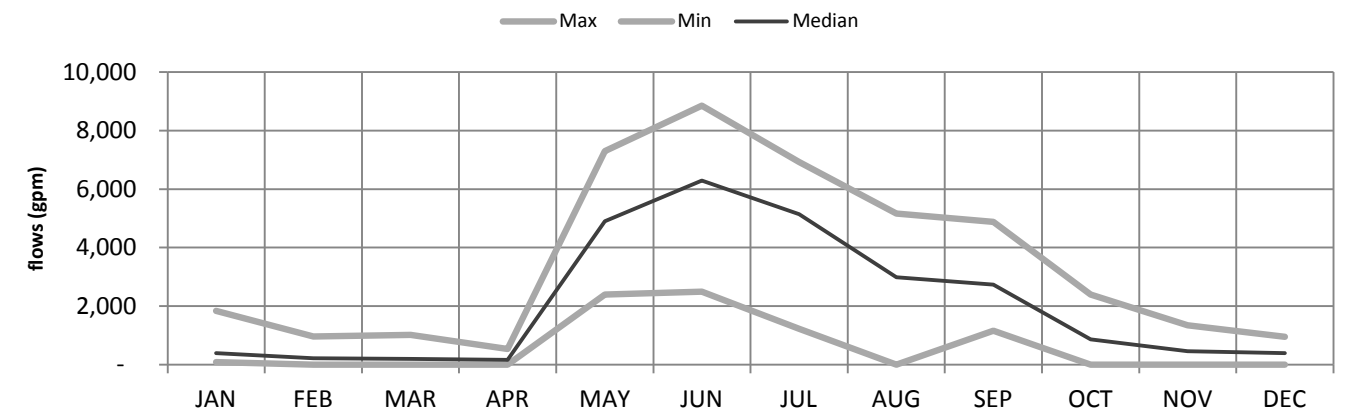
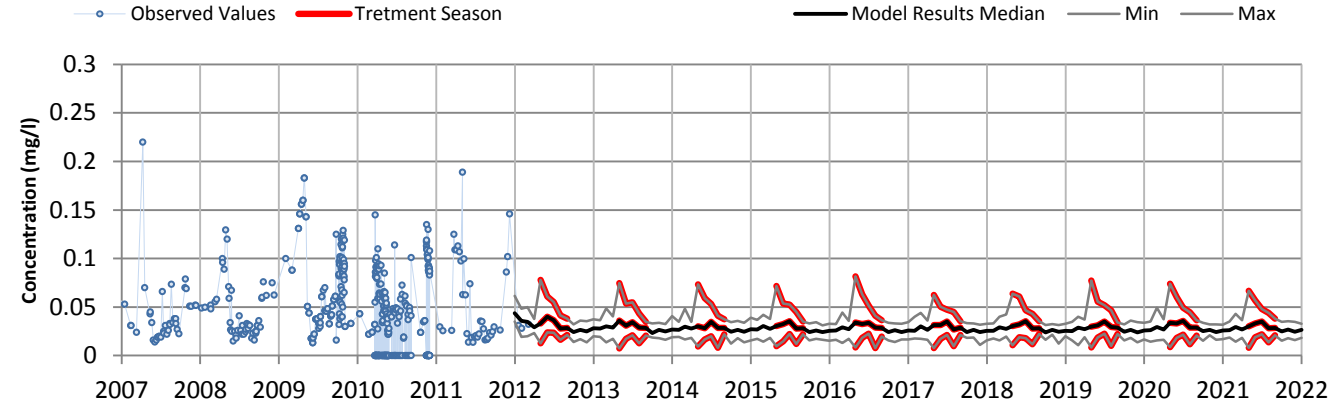
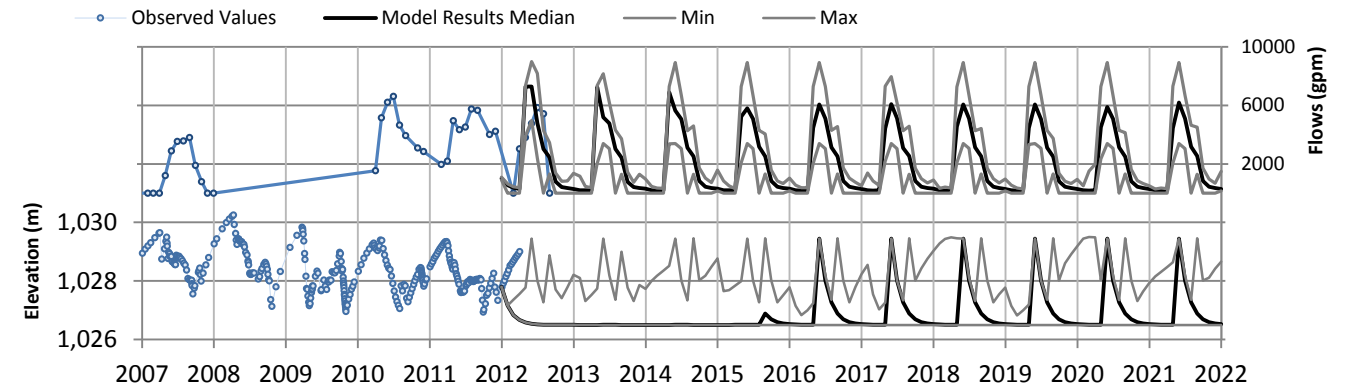


Figure C-2  
**Scenario C-1b Results**  
 Faro Mine Remediation Project

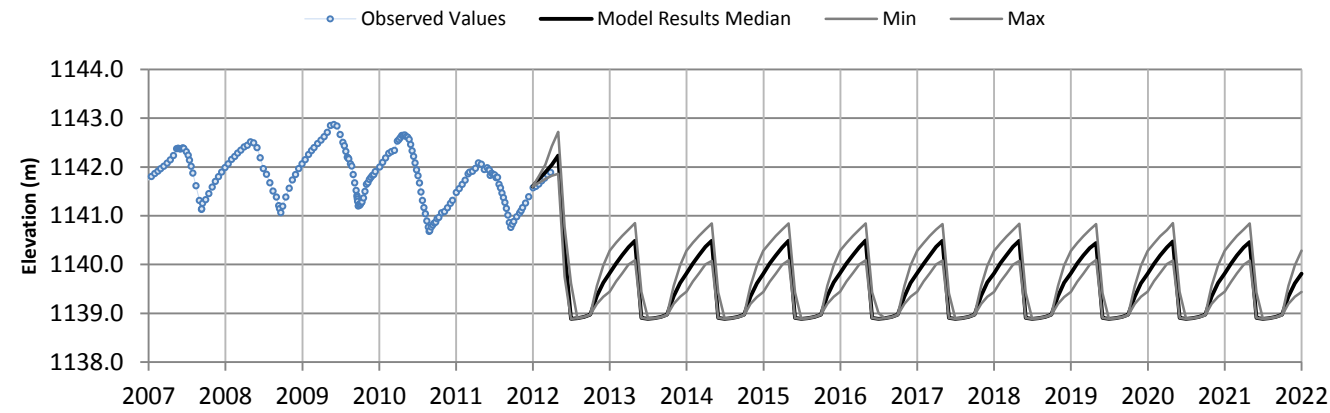
**Plot A - Zinc Concentrations at X14 - Scenario C-1c**



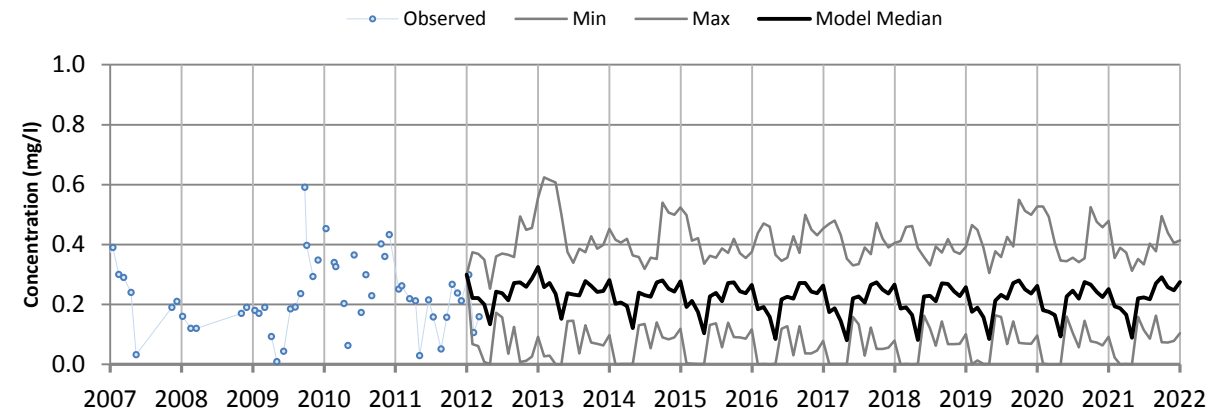
**Plot B - CVP Operation - Scenario C-1c**



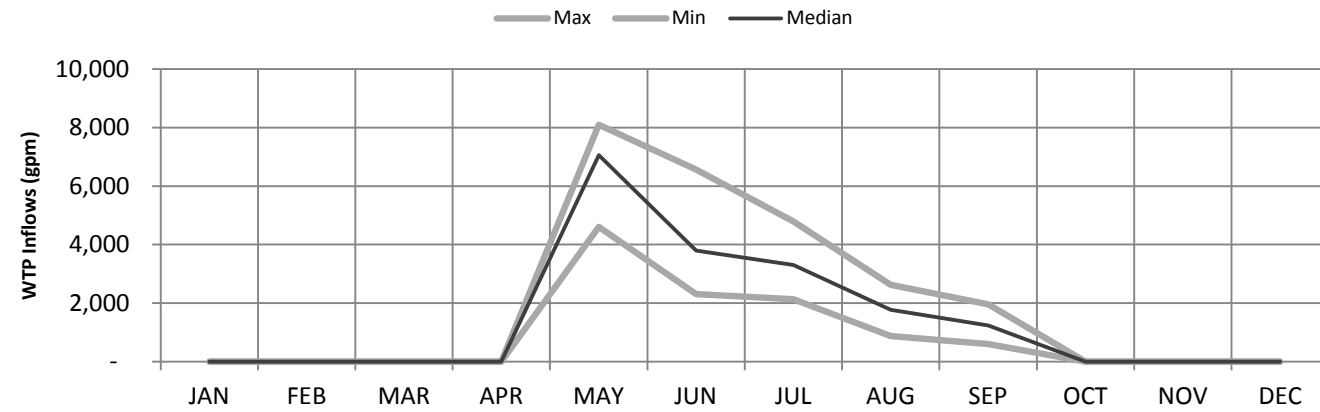
**Plot C - Faro Pit Elevation - Scenario C-1c**



**Plot D - CVP Zinc Concentration - Scenario C-1c**



**Plot E - Range of Monthly WTP flows - Scenario C-1c**



**Plot F - Range of Monthly CVP Discharge flows - Scenario C-1c**

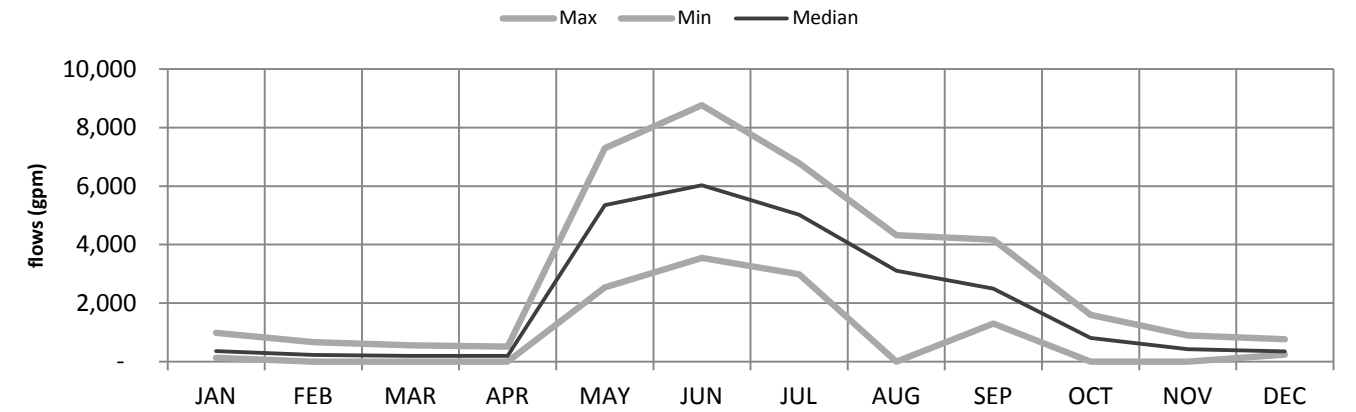
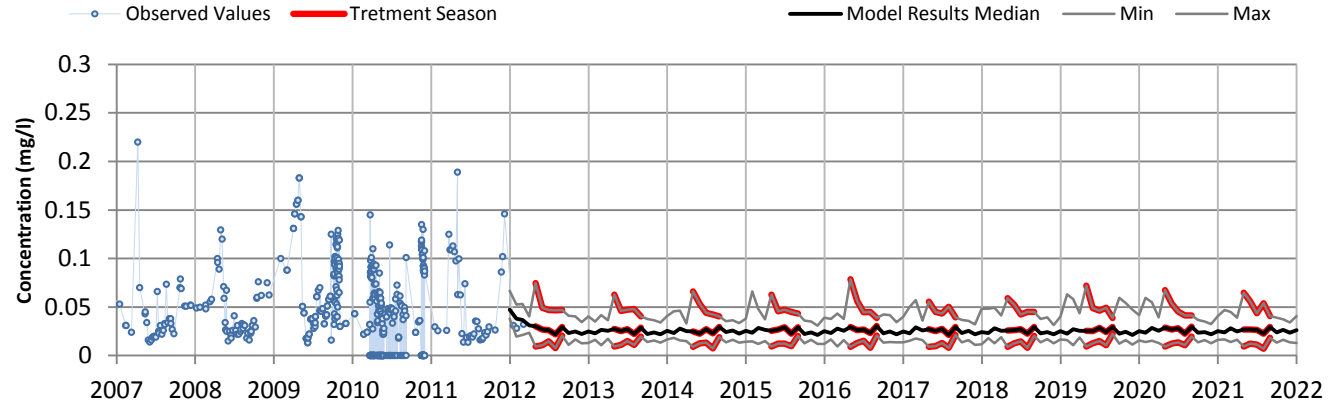
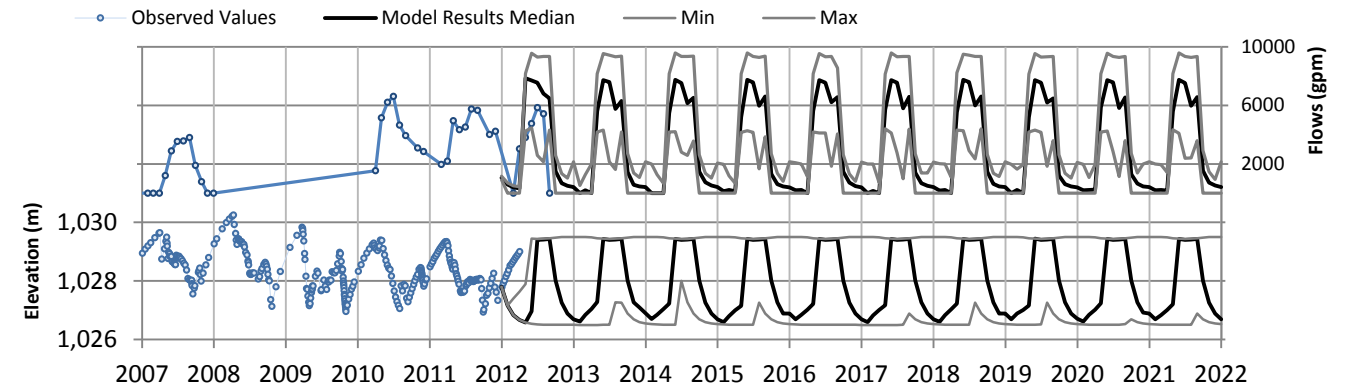


Figure C-3  
**Scenario C-1c Results**  
 Faro Mine Remediation Project

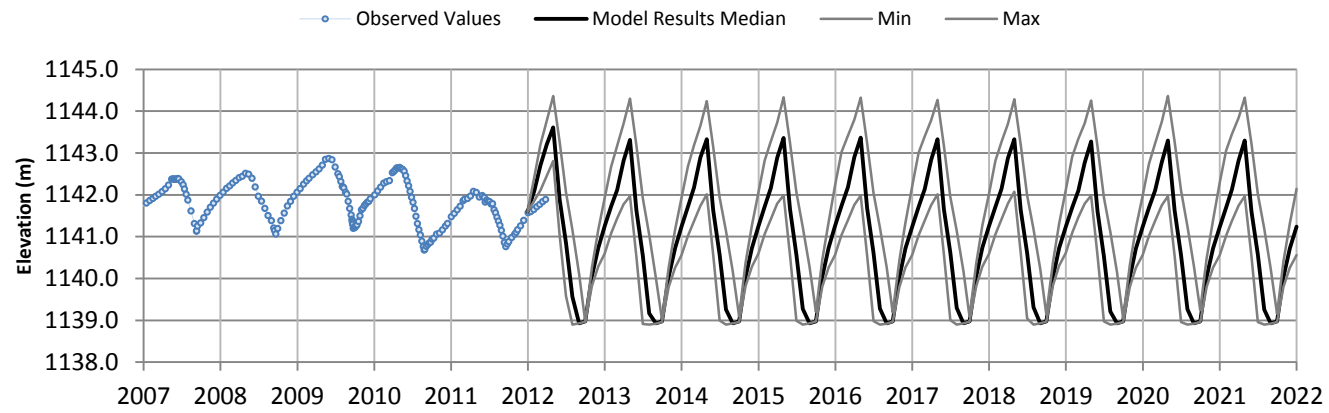
**Plot A - Zinc Concentrations at X14 - Scenario C-1e**



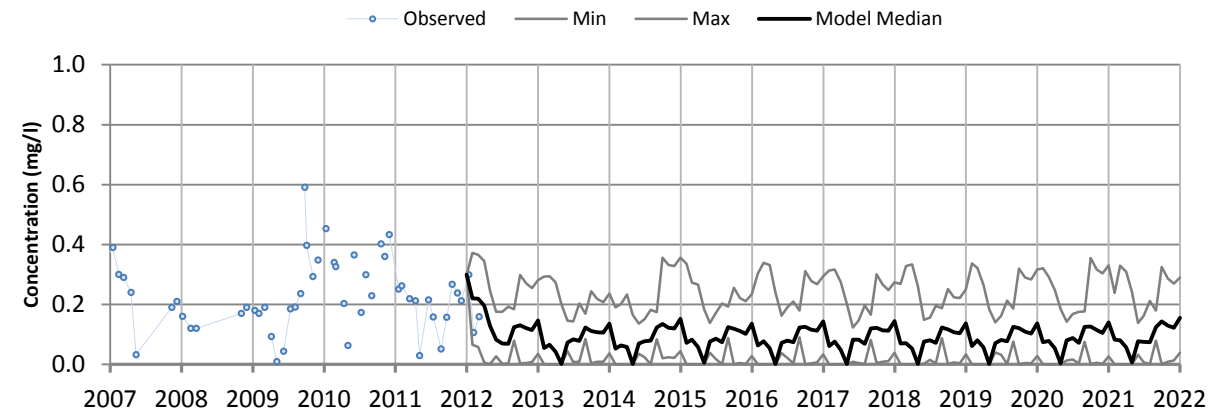
**Plot B - CVP Operation - Scenario C-1e**



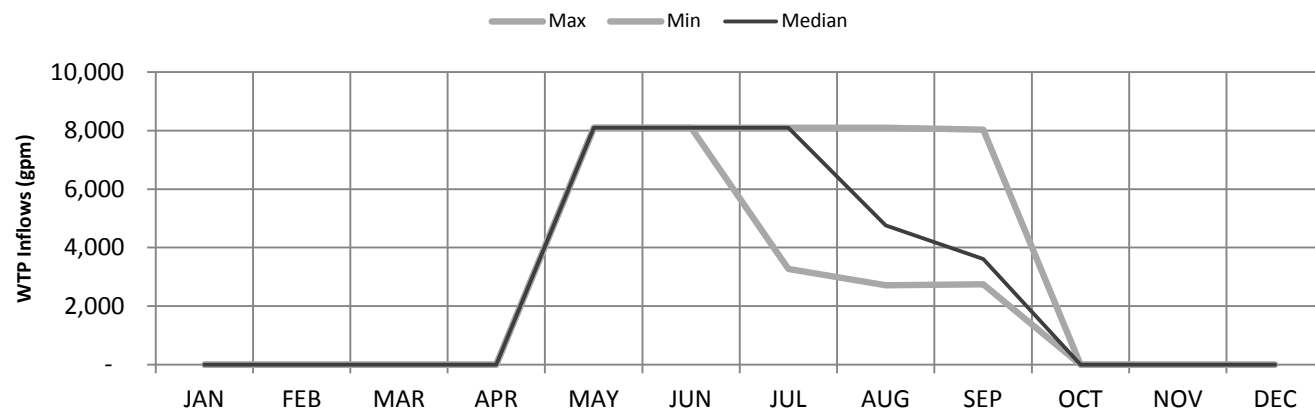
**Plot C - Faro Pit Elevation - Scenario C-1e**



**Plot D - CVP Zinc Concentration - Scenario C-1e**



**Plot E - Range of Monthly WTP flows - Scenario C-1e**



**Plot F - Range of Monthly CVP Discharge flows - Scenario C-1e**

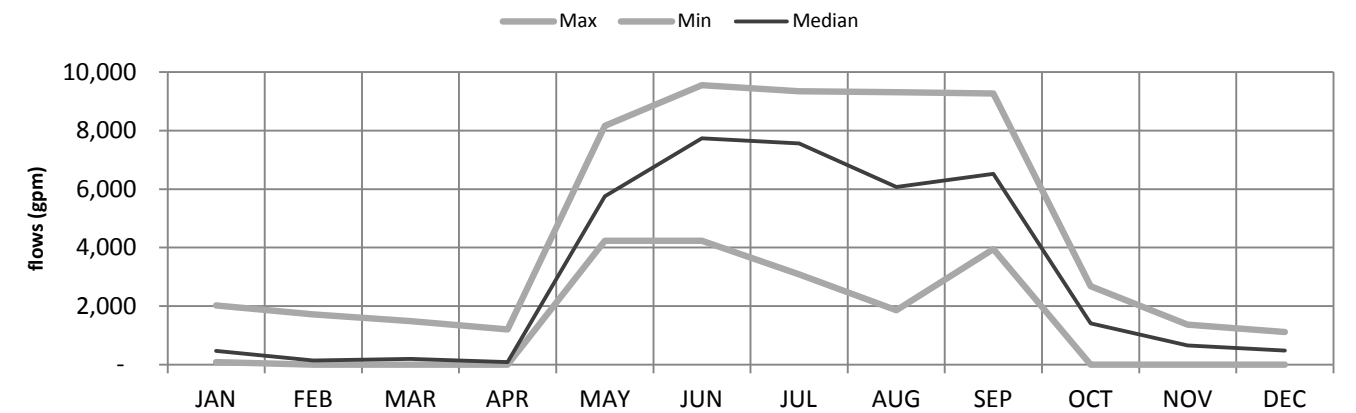
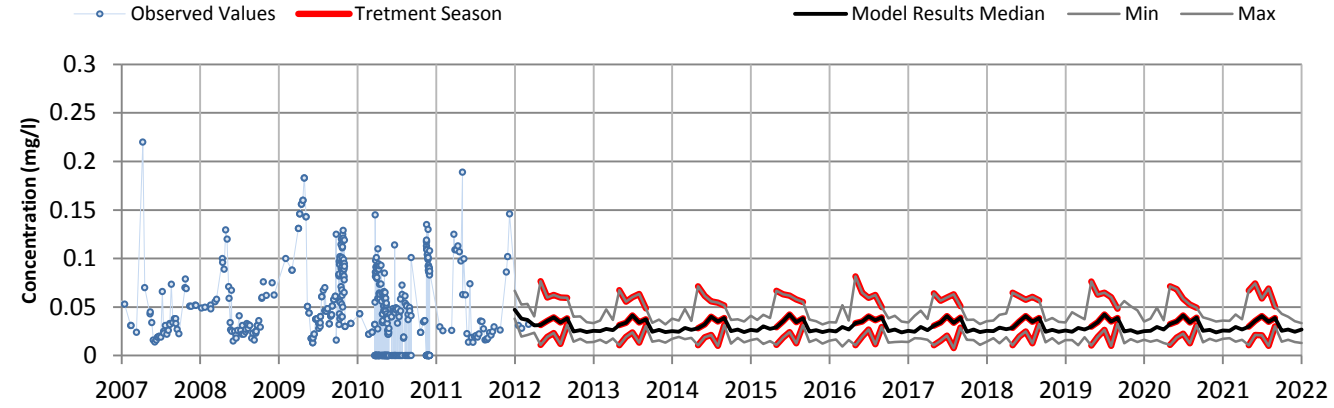
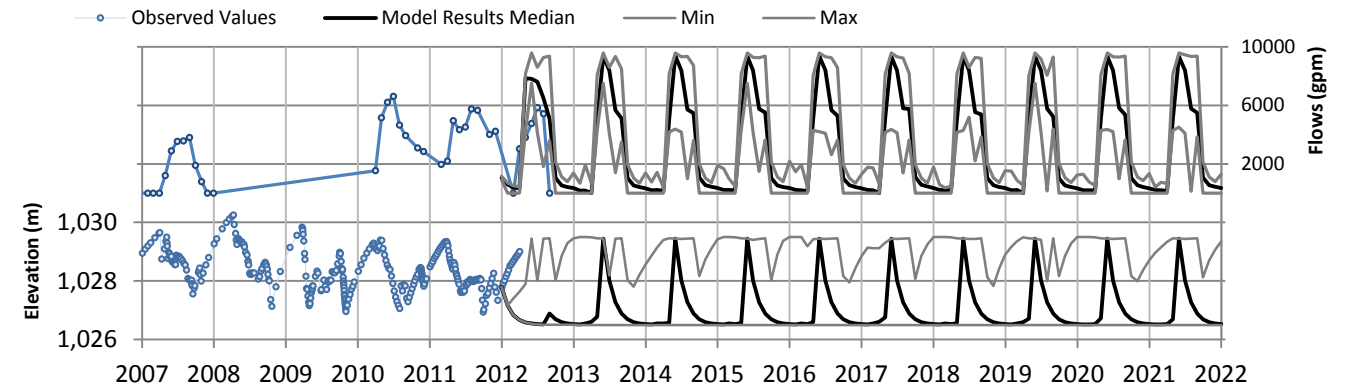


Figure C-4  
**Scenario C-1e Results**  
 Faro Mine Remediation Project

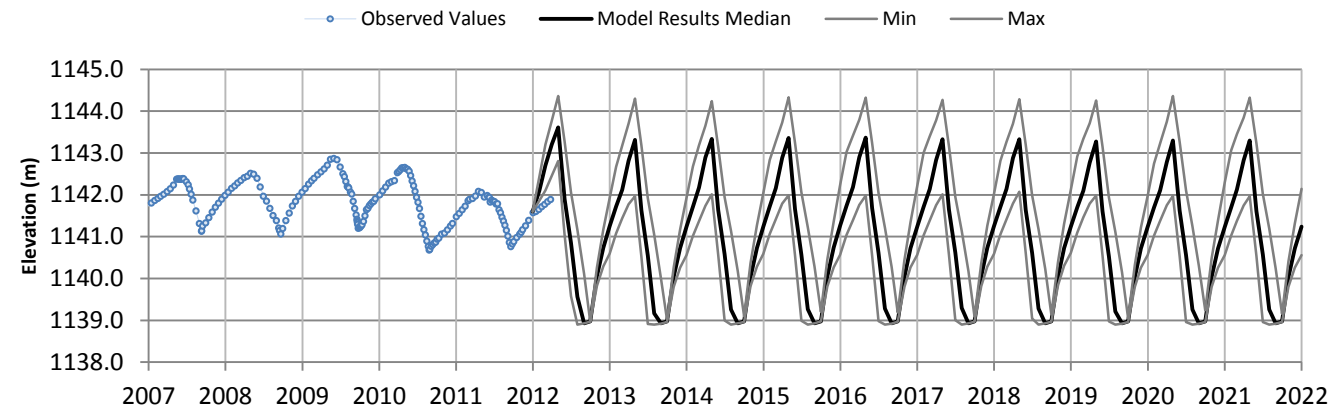
**Plot A - Zinc Concentrations at X14 - Scenario C-1f**



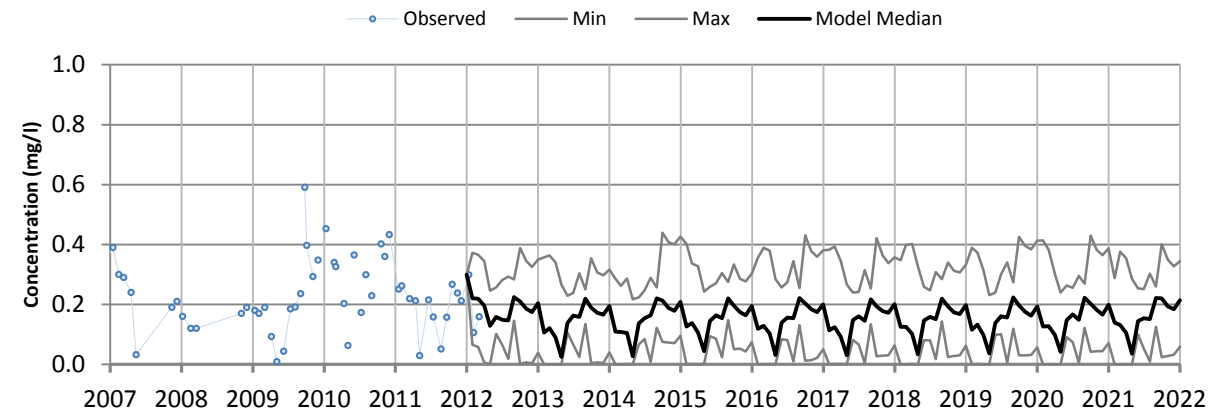
**Plot B - CVP Operation - Scenario C-1f**



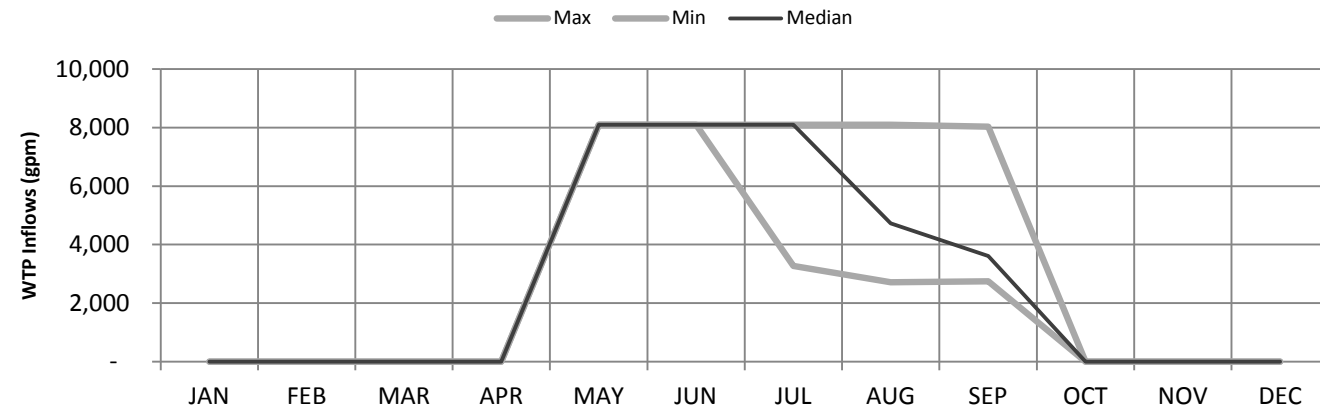
**Plot C - Faro Pit Elevation - Scenario C-1f**



**Plot D - CVP Zinc Concentration - Scenario C-1f**



**Plot E - Range of Monthly WTP flows - Scenario C-1f**



**Plot F - Range of Monthly CVP Discharge flows - Scenario C-1f**

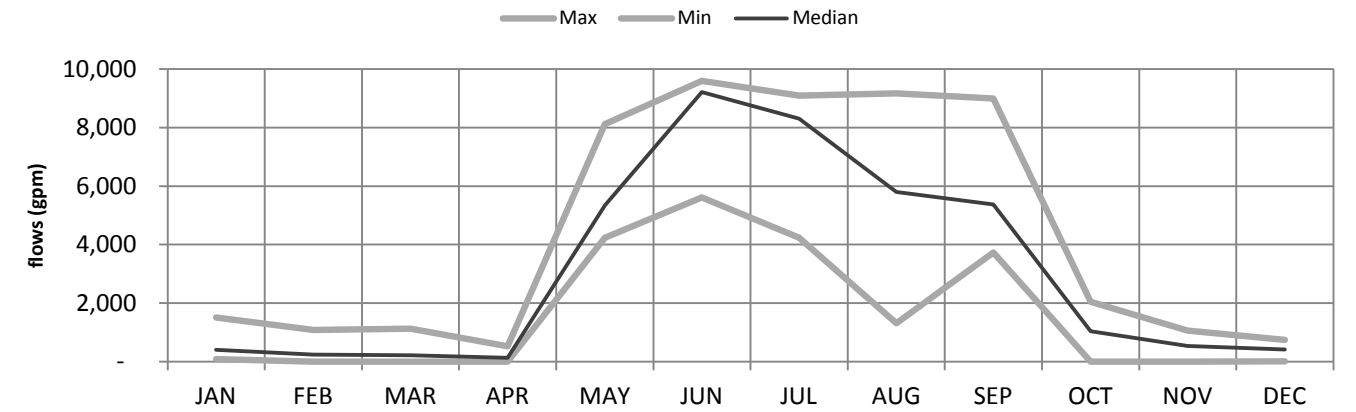
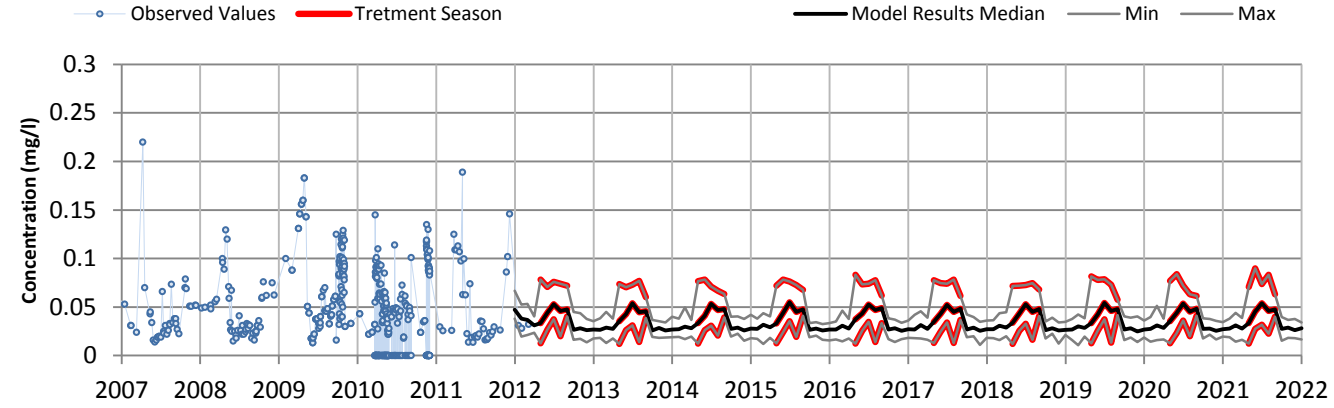
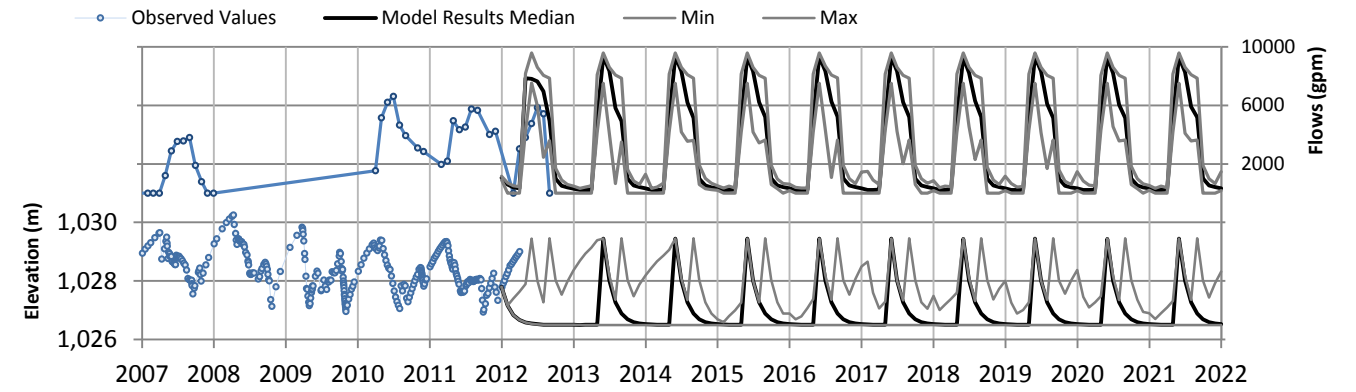


Figure C-5  
**Scenario C-1f Results**  
 Faro Mine Remediation Project

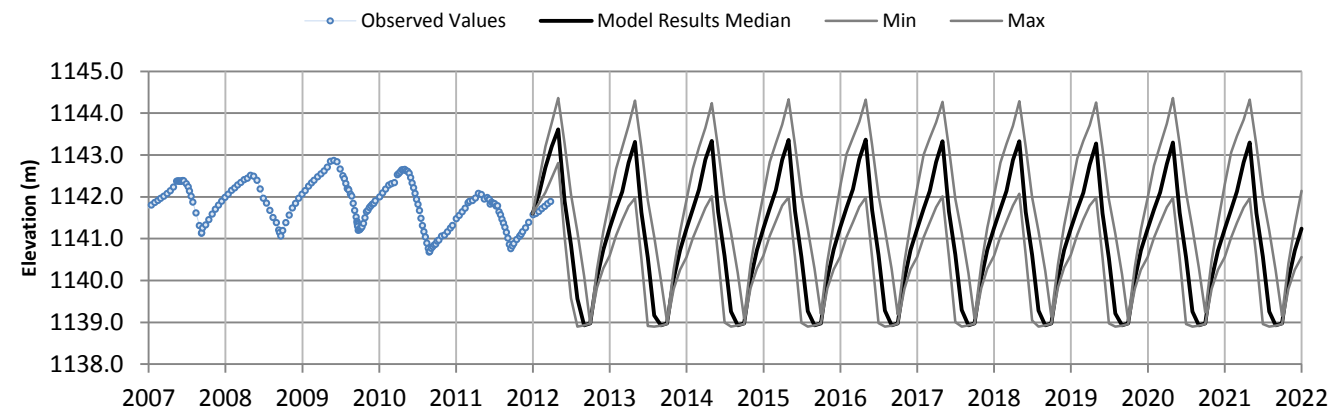
**Plot A - Zinc Concentrations at X14 - Scenario C-1g**



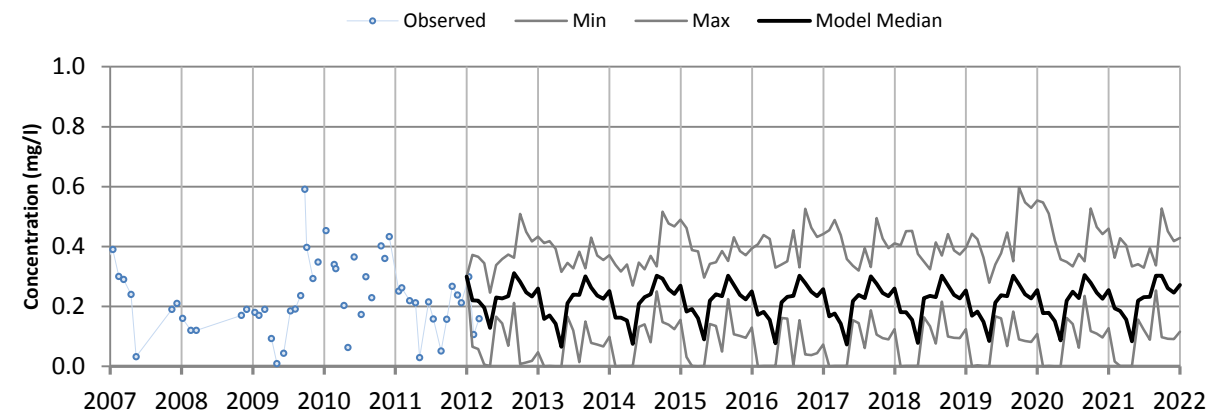
**Plot B - CVP Operation - Scenario C-1g**



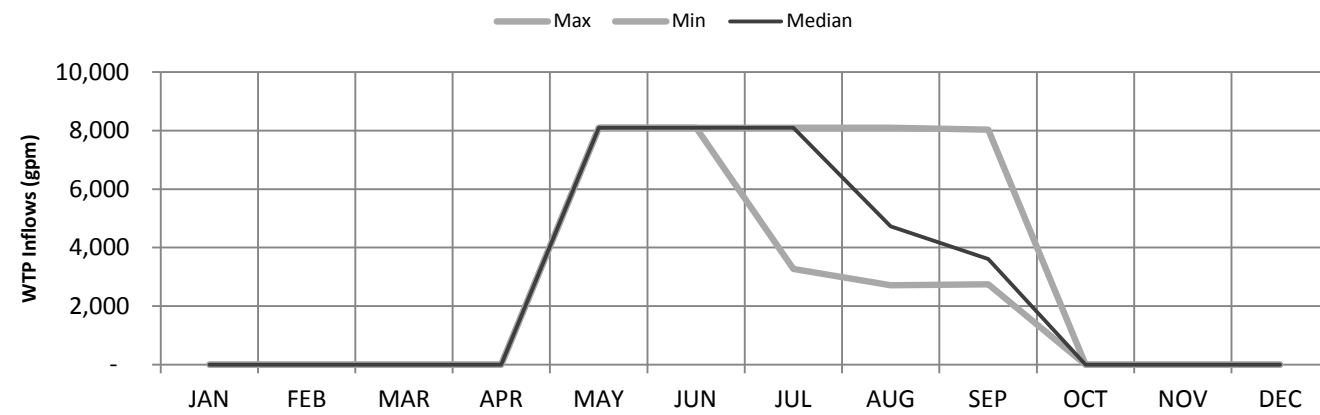
**Plot C - Faro Pit Elevation - Scenario C-1g**



**Plot D - CVP Zinc Concentration - Scenario C-1g**



**Plot E - Range of Monthly WTP flows - Scenario C-1g**



**Plot F - Range of Monthly CVP Discharge flows - Scenario C-1g**

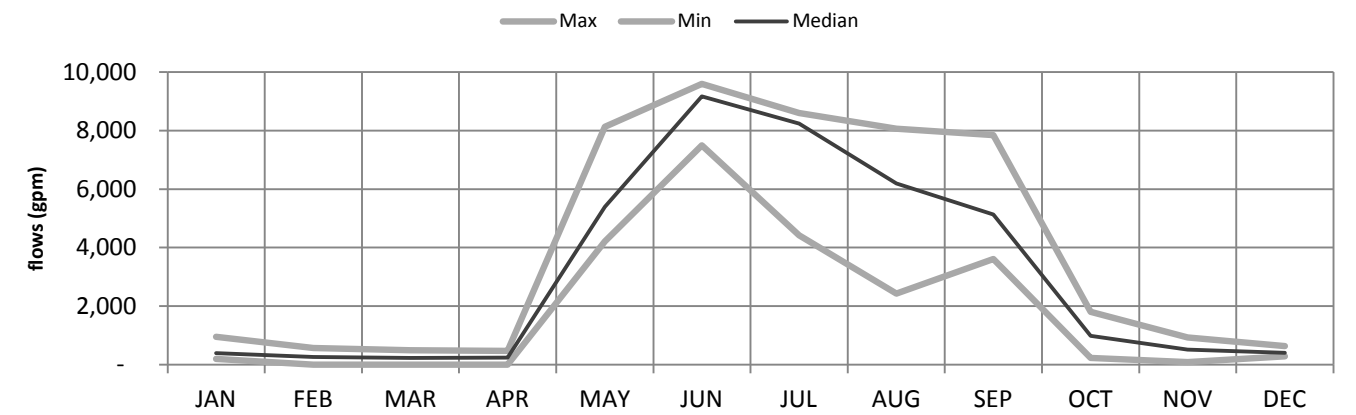
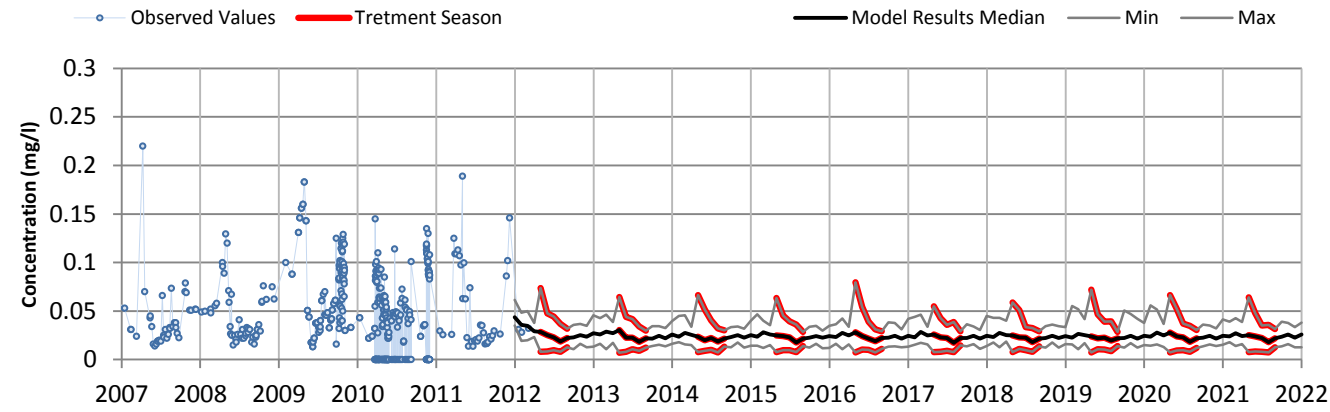
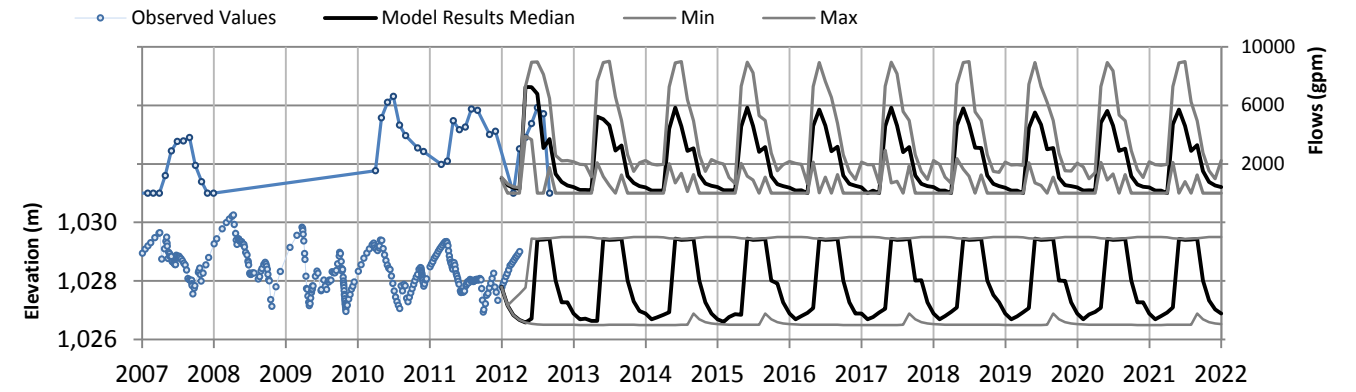


Figure C-6  
**Scenario C-1g Results**  
 Faro Mine Remediation Project

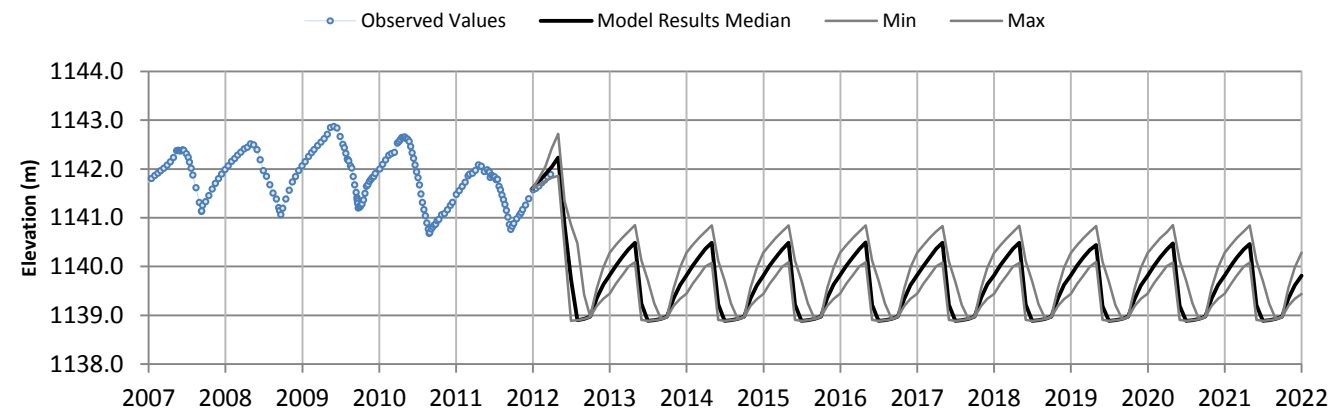
**Plot A - Zinc Concentrations at X14 - Scenario C-6a**



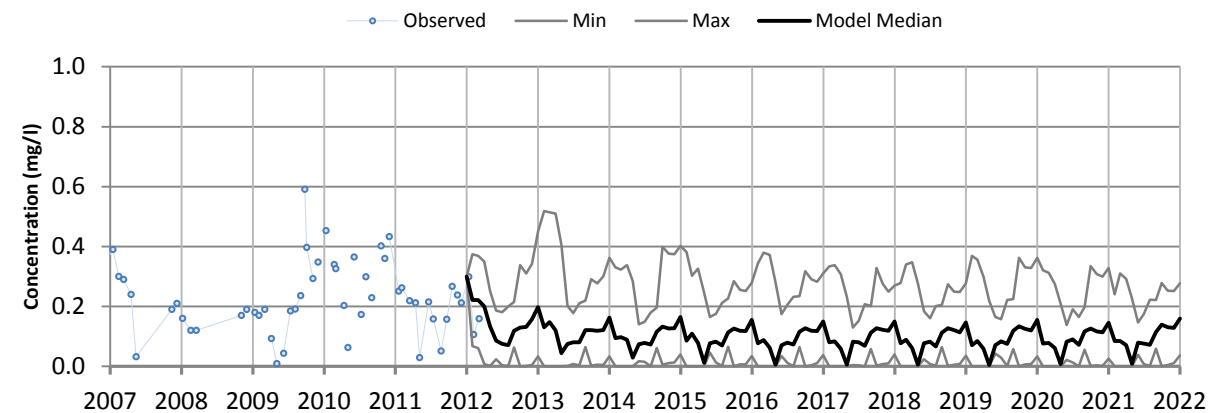
**Plot B - CVP Operation - Scenario C-6a**



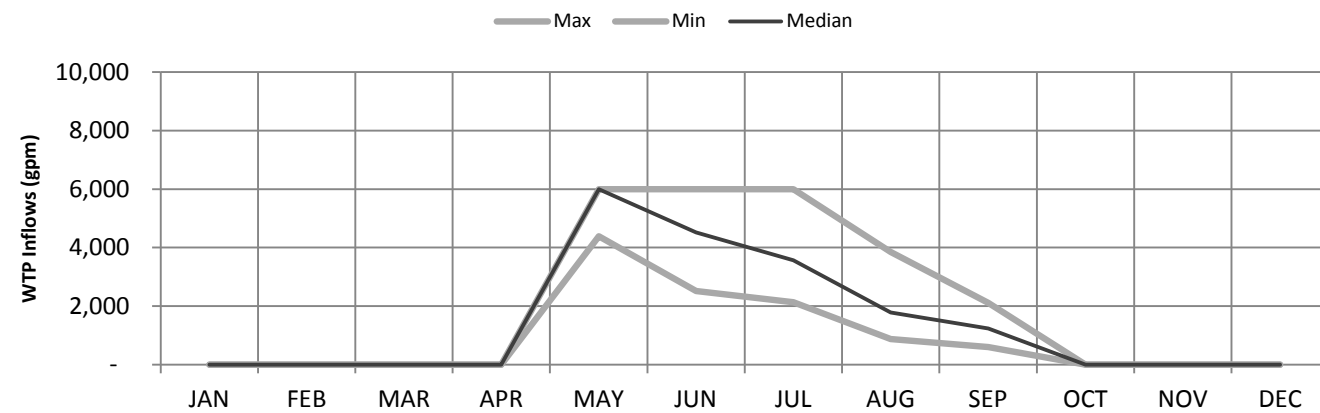
**Plot C - Faro Pit Elevation - Scenario C-6a**



**Plot D - CVP Zinc Concentration - Scenario C-6a**



**Plot E - Range of Monthly WTP flows - Scenario C-6a**



**Plot F - Range of Monthly CVP Discharge flows - Scenario C-6a**

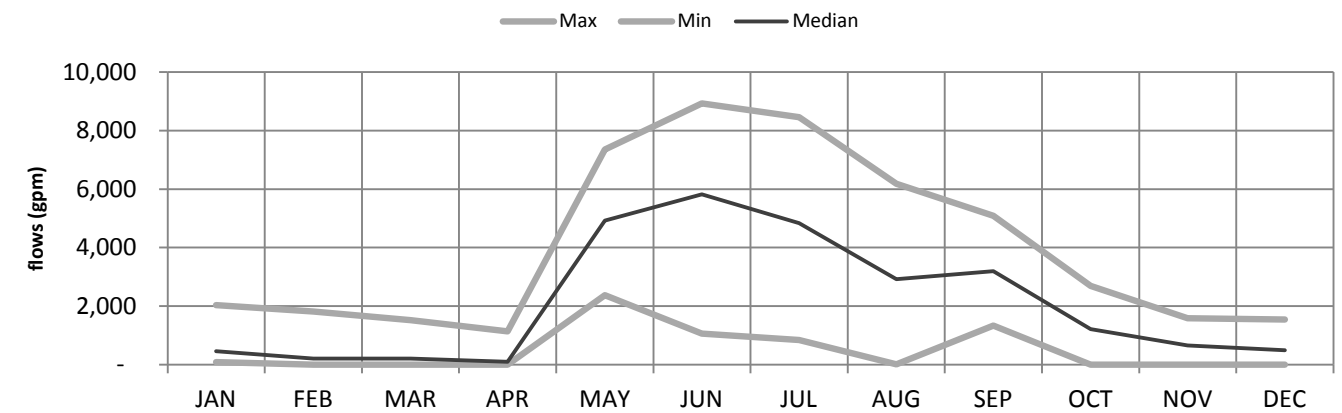
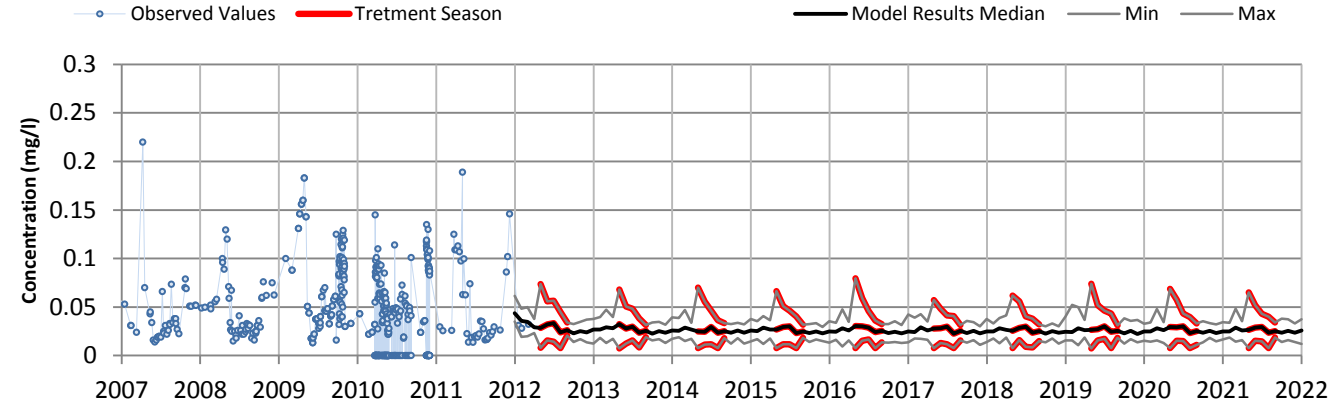
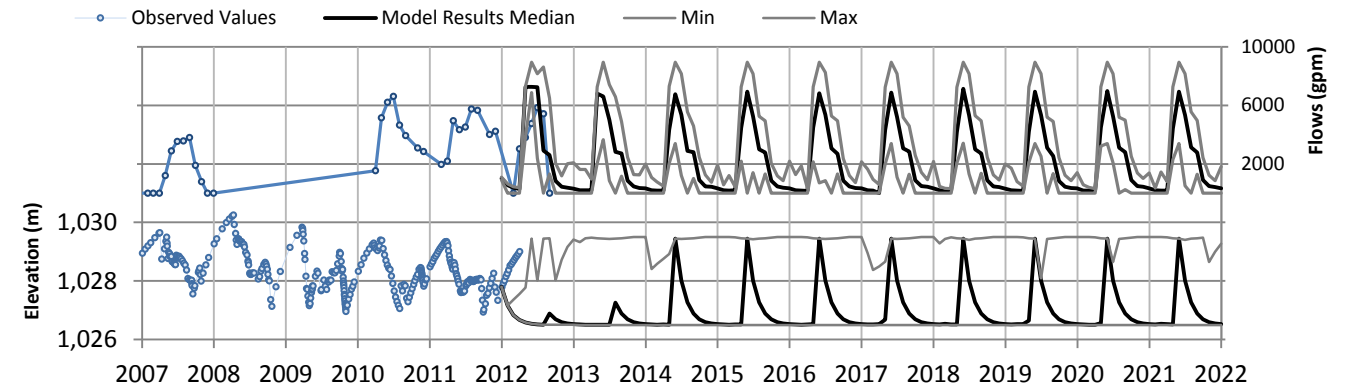


Figure C-7  
**Scenario C-6a Results**  
 Faro Mine Remediation Project

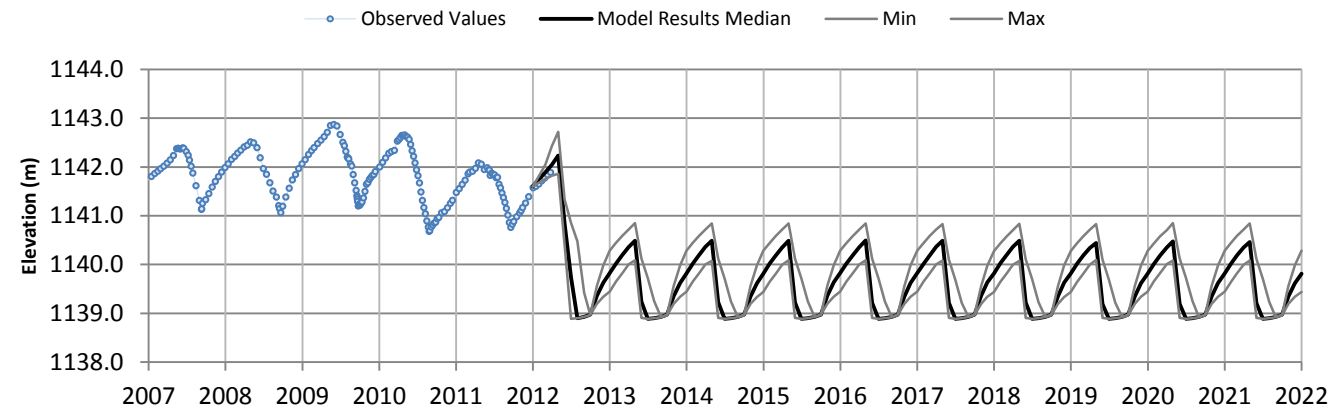
**Plot A - Zinc Concentrations at X14 - Scenario C-6b**



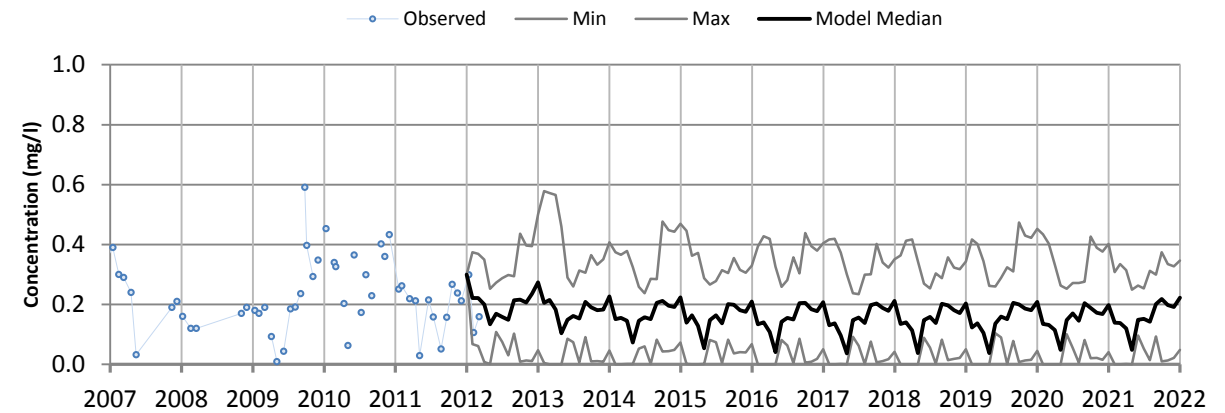
**Plot B - CVP Operation - Scenario C-6b**



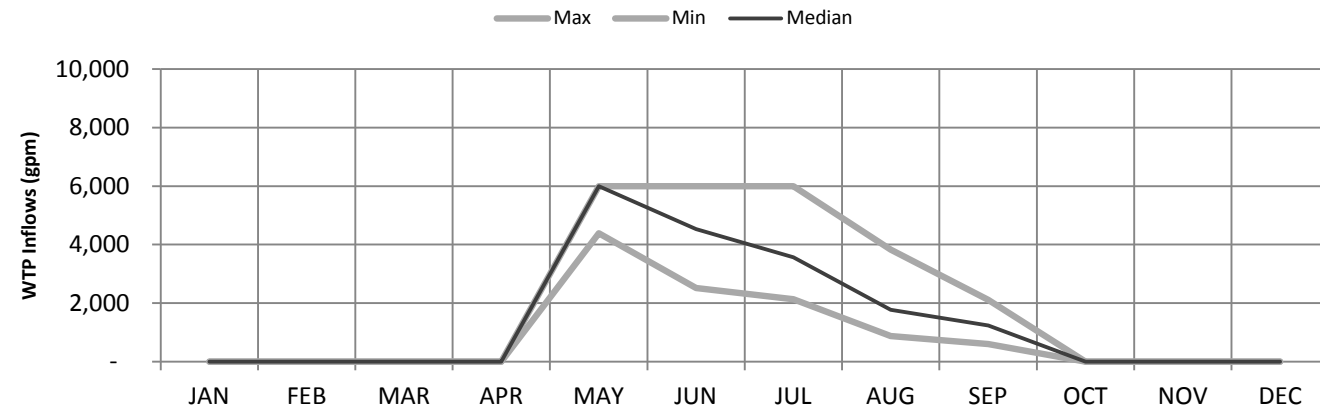
**Plot C - Faro Pit Elevation - Scenario C-6b**



**Plot D - CVP Zinc Concentration - Scenario C-6b**



**Plot E - Range of Monthly WTP flows - Scenario C-6b**



**Plot F - Range of Monthly CVP Discharge flows - Scenario C-6b**

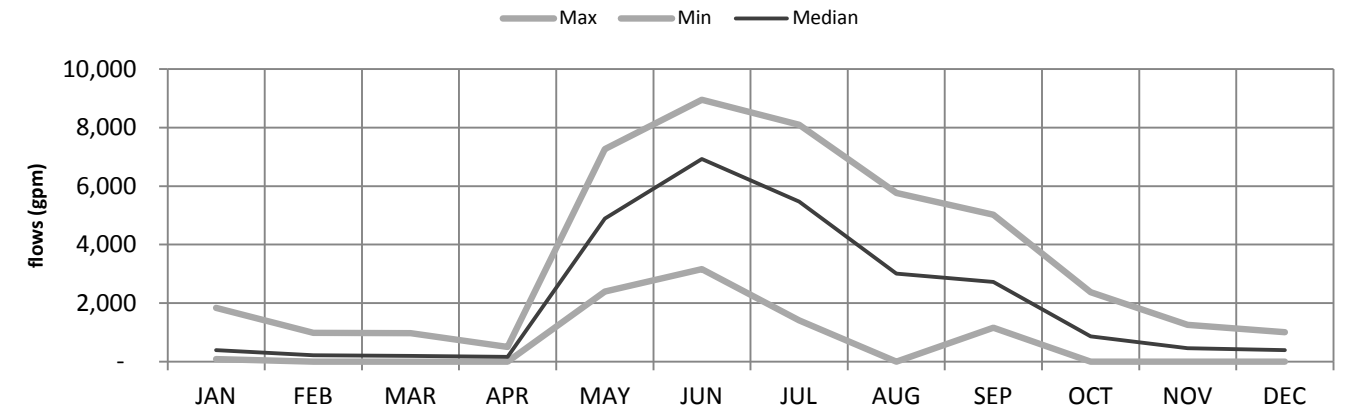
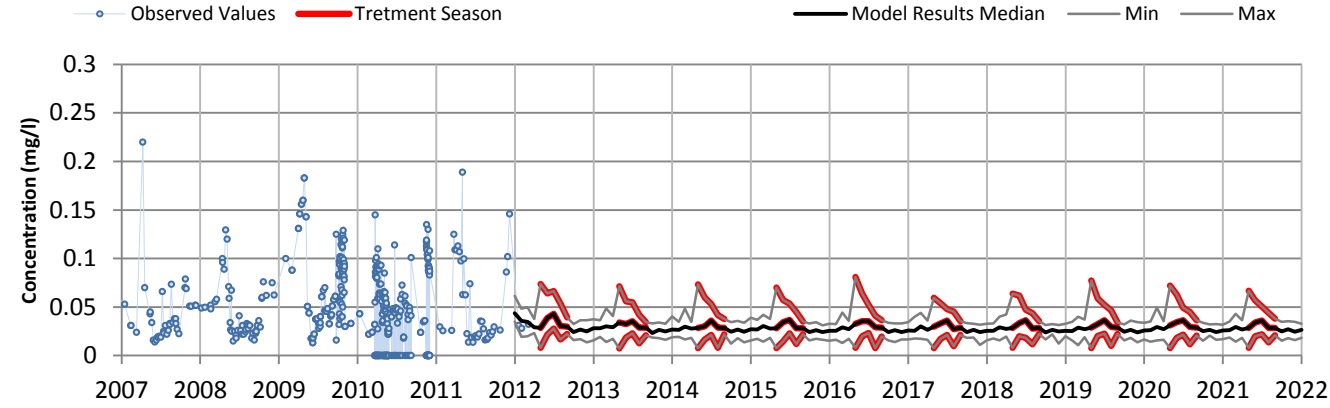
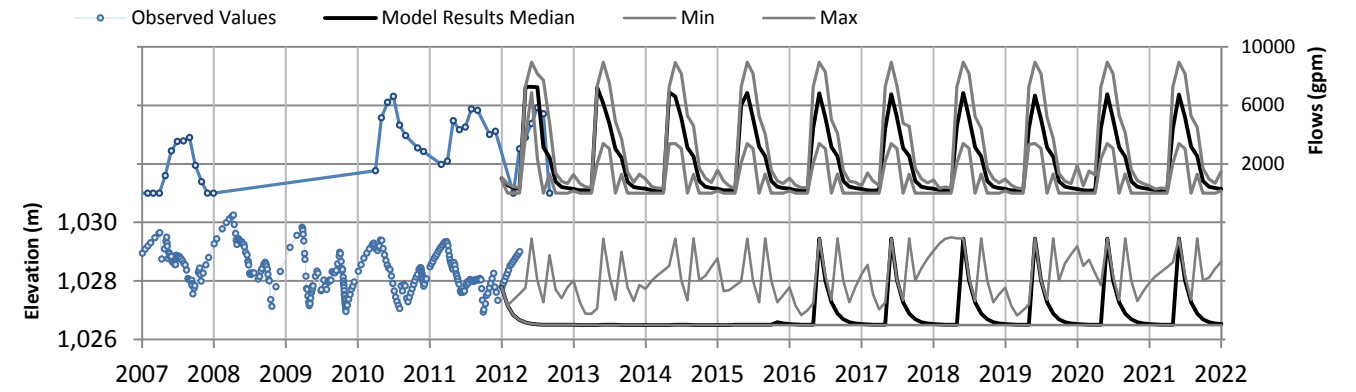


Figure C-8  
**Scenario C-6b Results**  
 Faro Mine Remediation Project

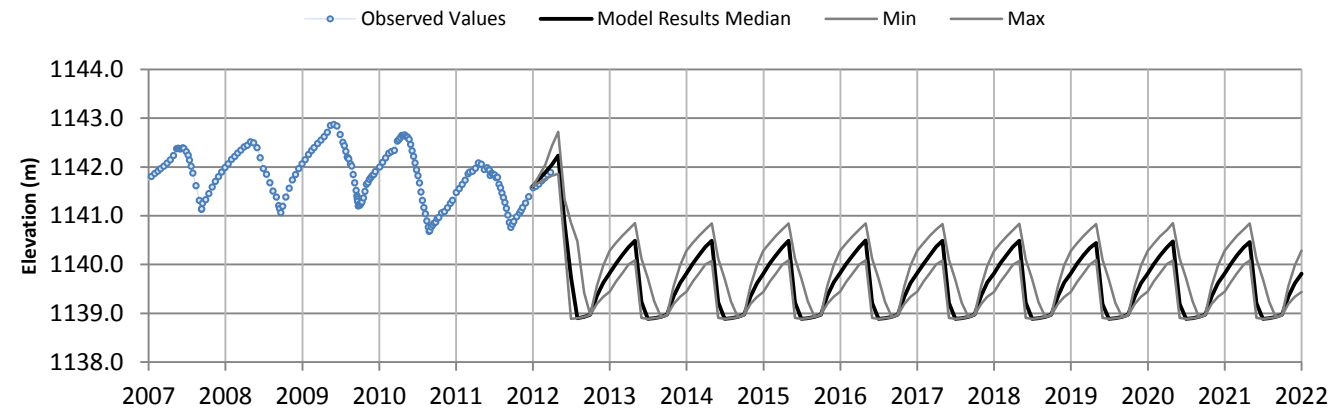
**Plot A - Zinc Concentrations at X14 - Scenario C-6c**



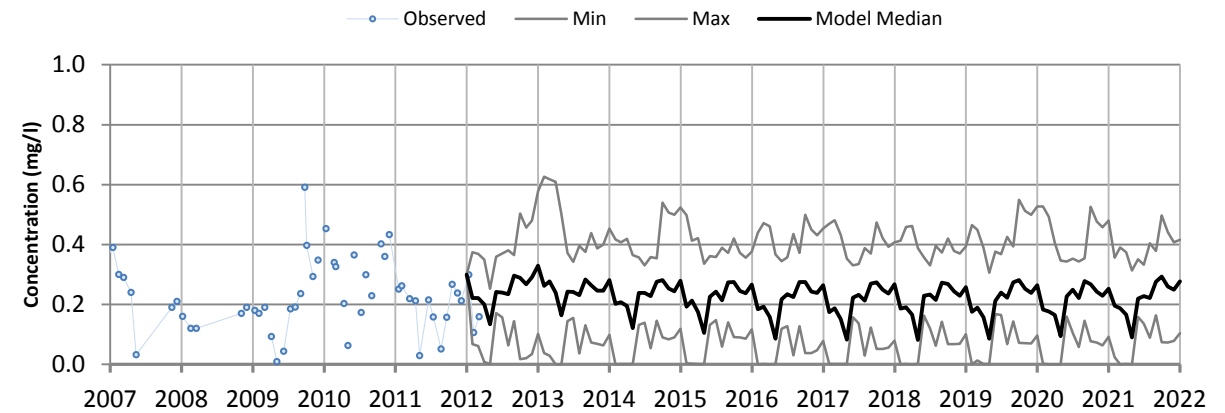
**Plot B - CVP Operation - Scenario C-6c**



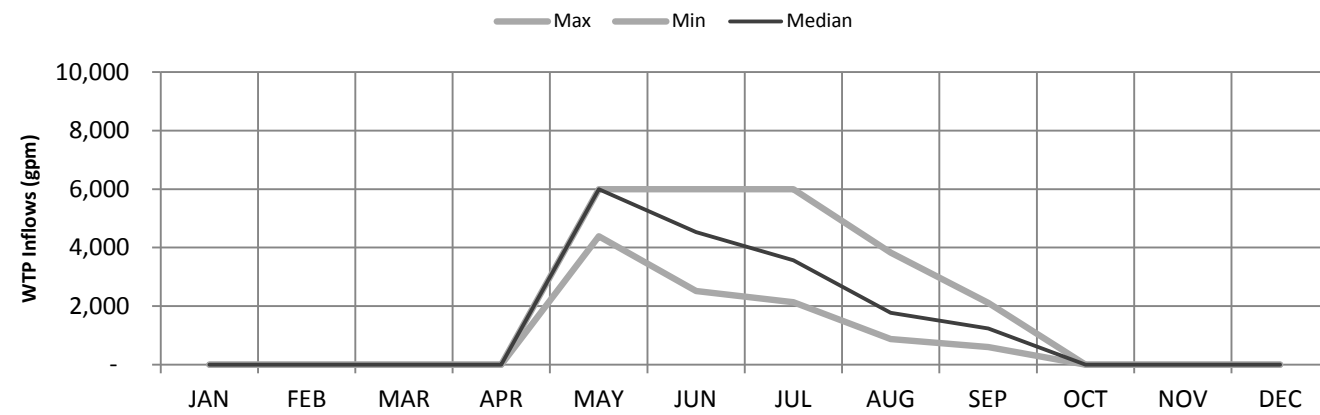
**Plot C - Faro Pit Elevation - Scenario C-6c**



**Plot D - CVP Zinc Concentration - Scenario C-6c**



**Plot E - Range of Monthly WTP flows - Scenario C-6c**



**Plot F - Range of Monthly CVP Discharge flows - Scenario C-6c**

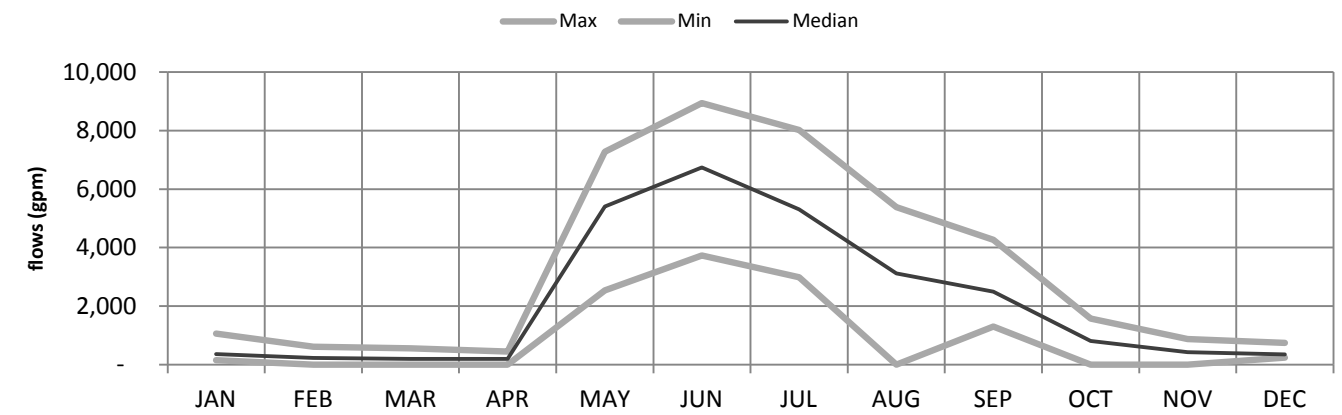
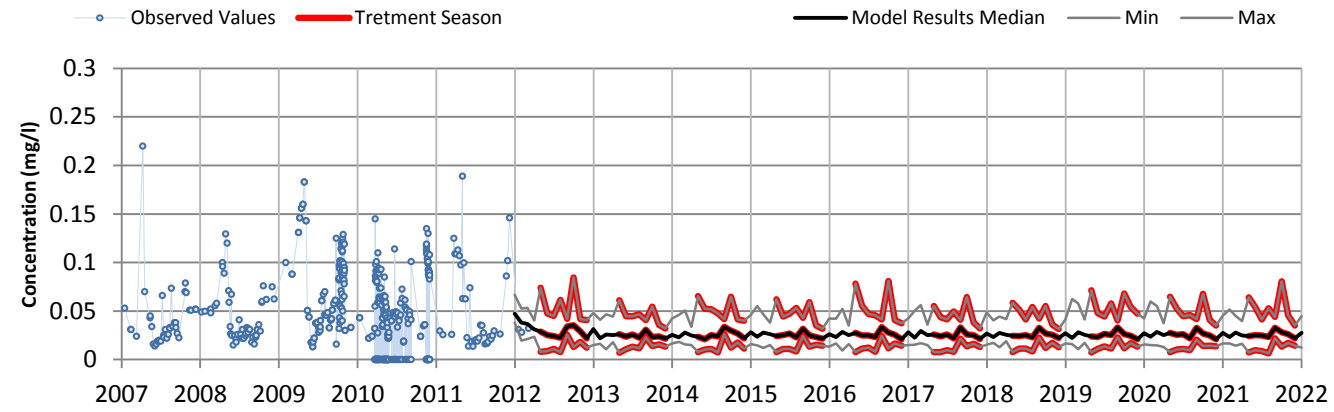


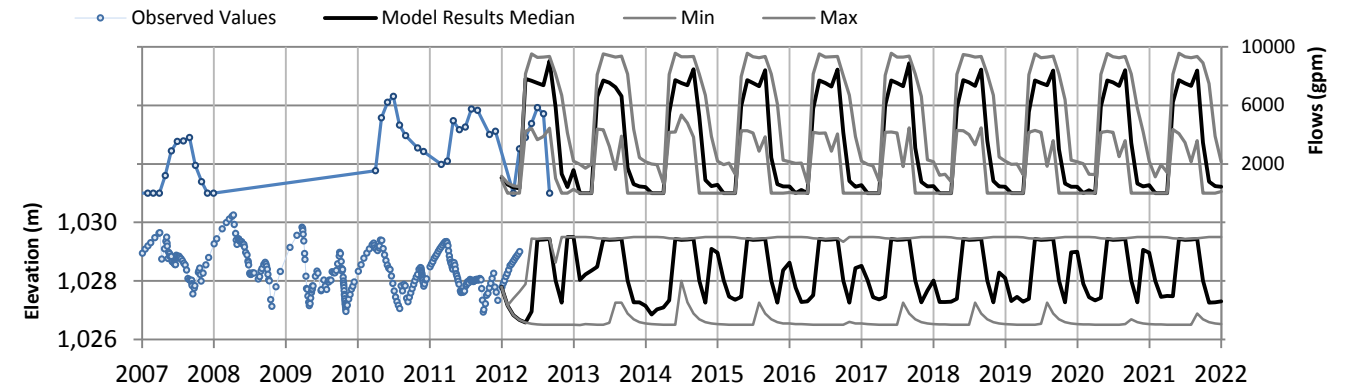
Figure C-9  
**Scenario C-6c Results**  
 Faro Mine Remediation Project



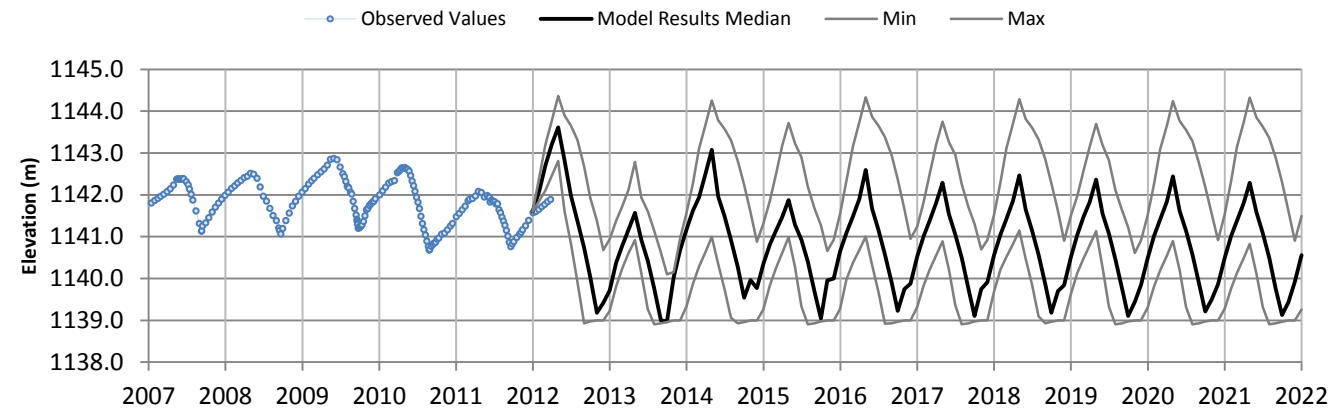
**Plot A - Zinc Concentrations at X14 - Scenario C-6e**



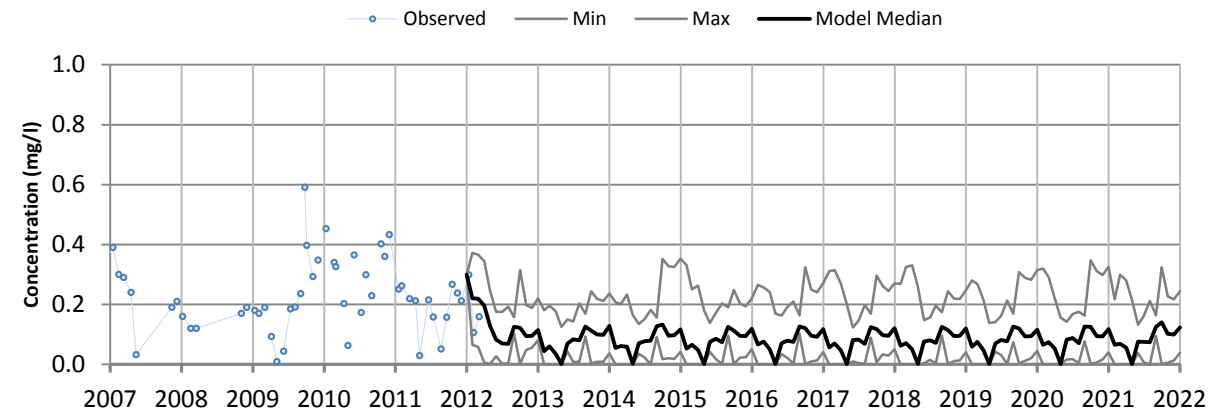
**Plot B - CVP Operation - Scenario C-6e**



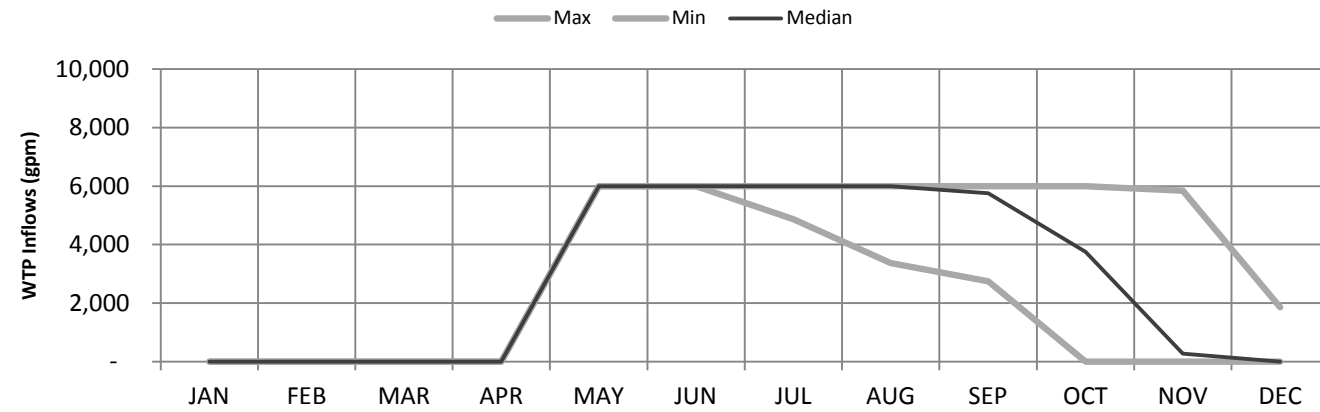
**Plot C - Faro Pit Elevation - Scenario C-6e**



**Plot D - CVP Zinc Concentration - Scenario C-6e**



**Plot E - Range of Monthly WTP flows - Scenario C-6e**



**Plot F - Range of Monthly CVP Discharge flows - Scenario C-6e**

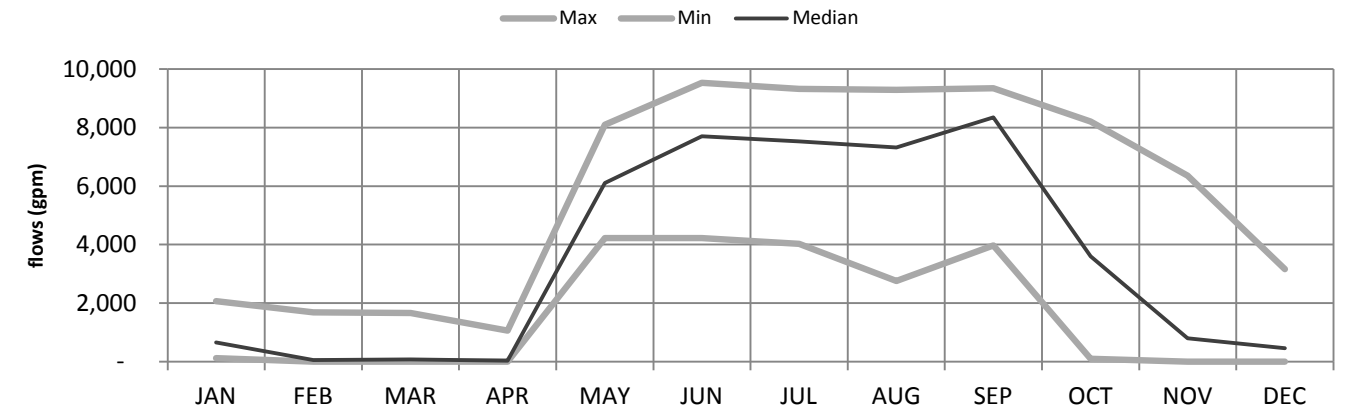
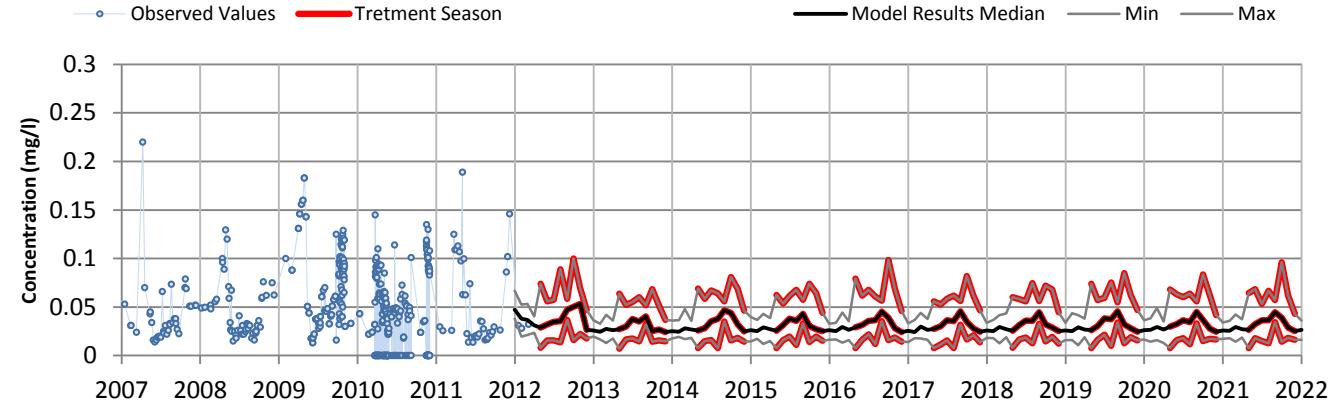
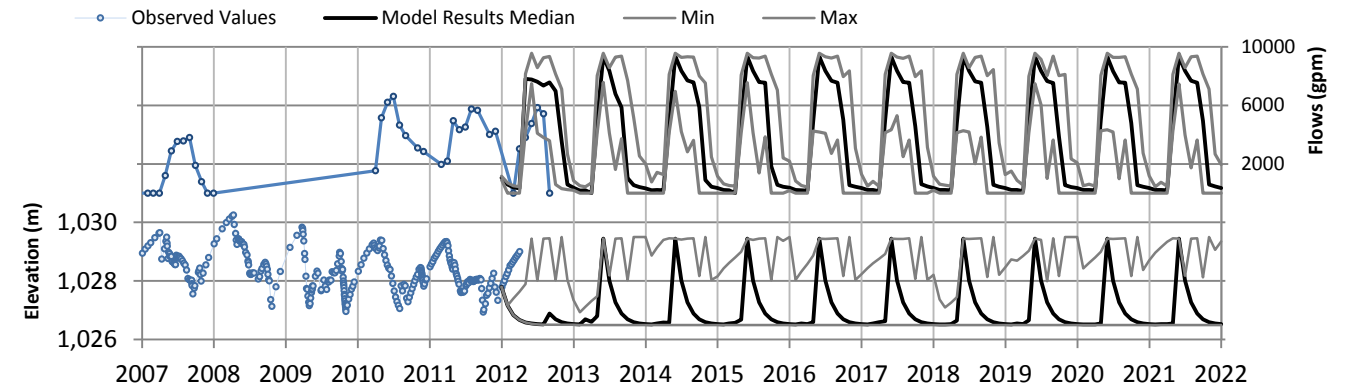


Figure C-10  
**Scenario C-6e Results**  
 Faro Mine Remediation Project

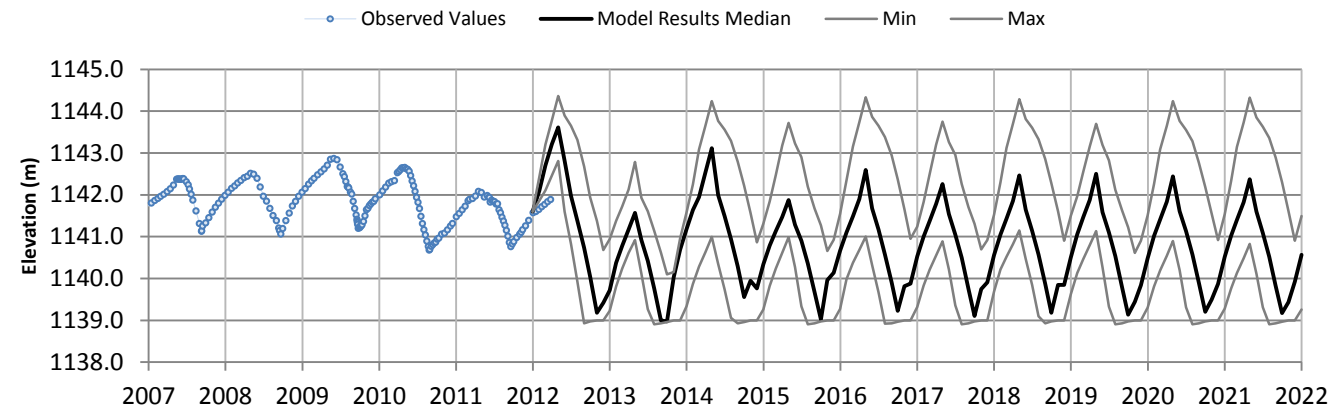
**Plot A - Zinc Concentrations at X14 - Scenario C-6f**



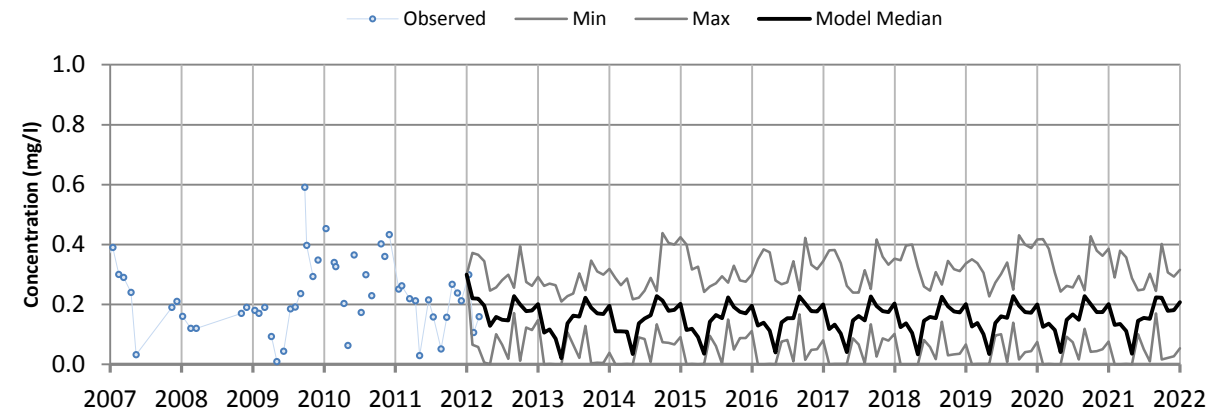
**Plot B - CVP Operation - Scenario C-6f**



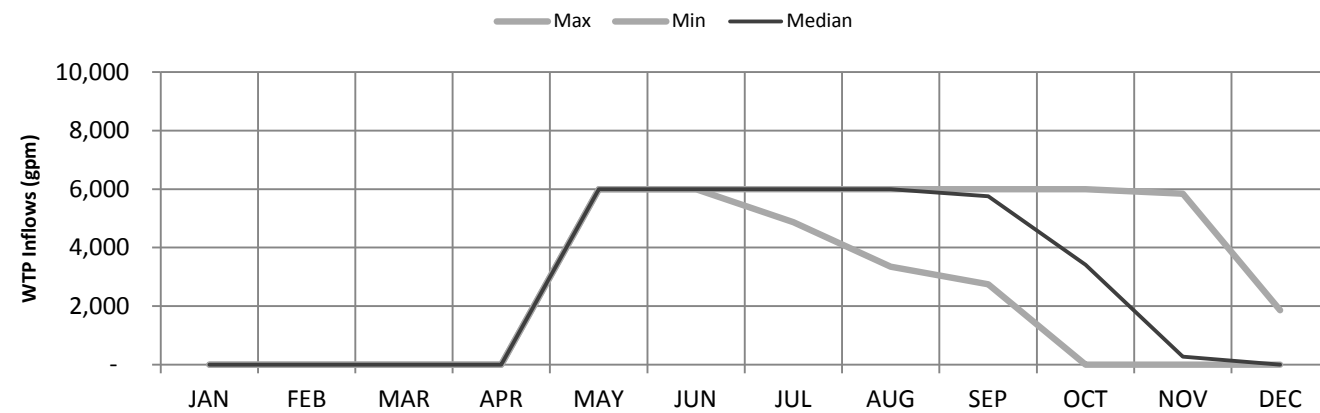
**Plot C - Faro Pit Elevation - Scenario C-6f**



**Plot D - CVP Zinc Concentration - Scenario C-6f**



**Plot E - Range of Monthly WTP flows - Scenario C-6f**



**Plot F - Range of Monthly CVP Discharge flows - Scenario C-6f**

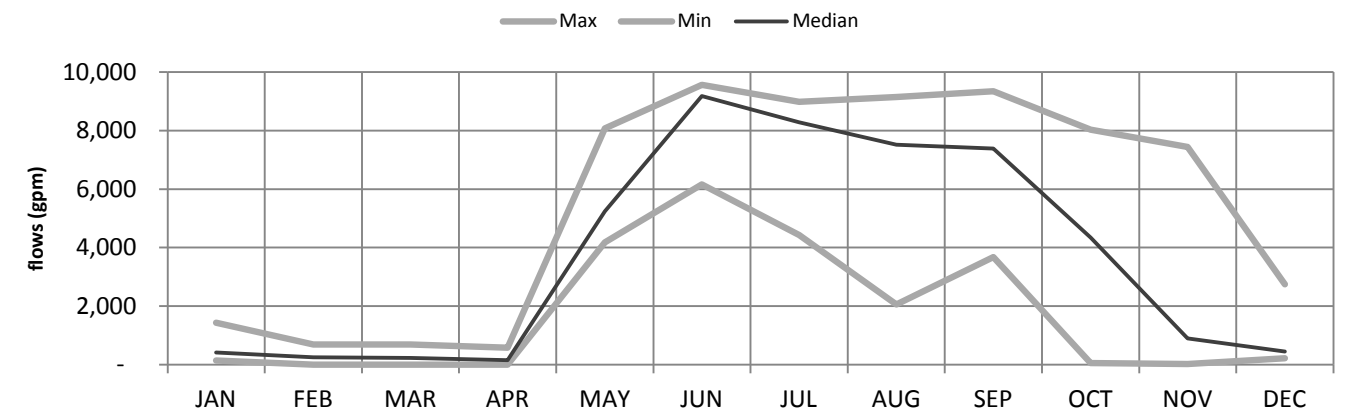
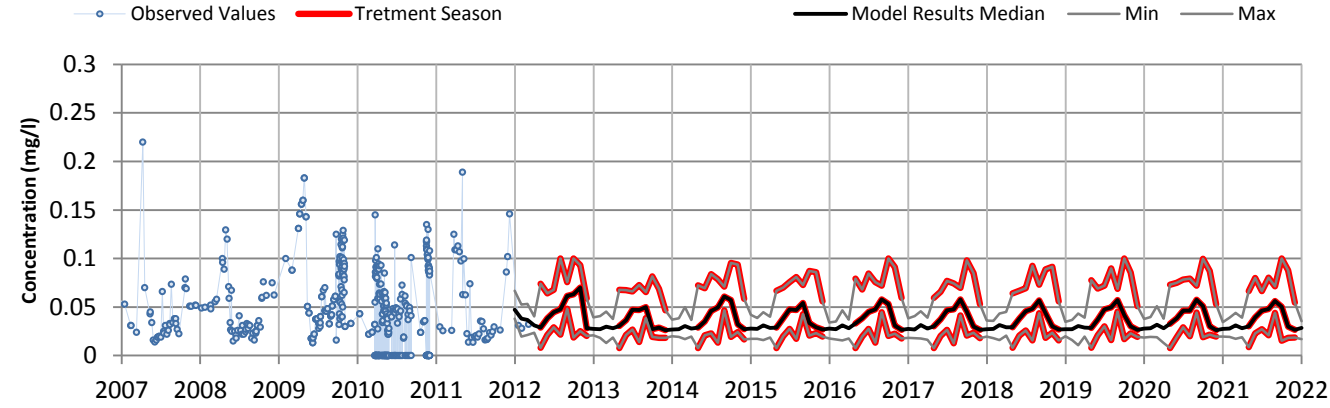
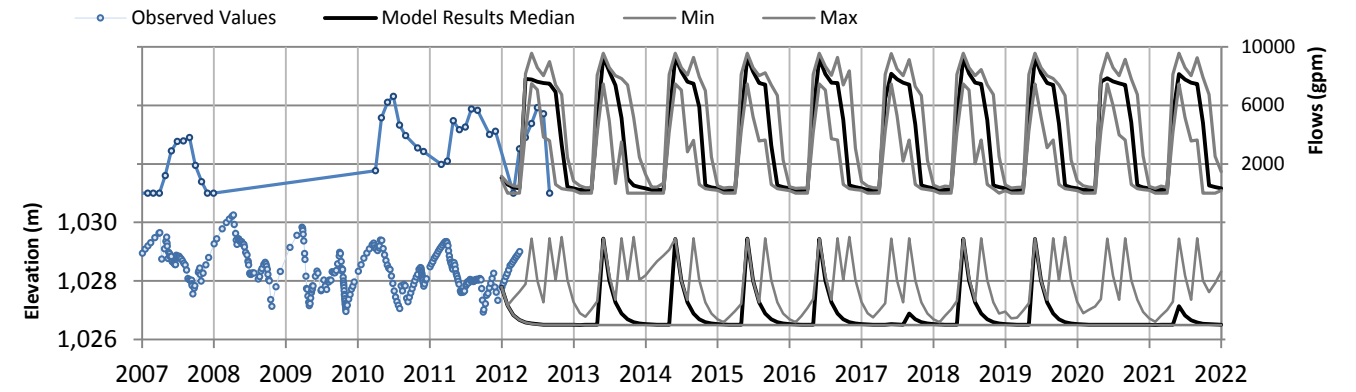


Figure 11  
**Scenario C-6f Results**  
 Faro Mine Remediation Project

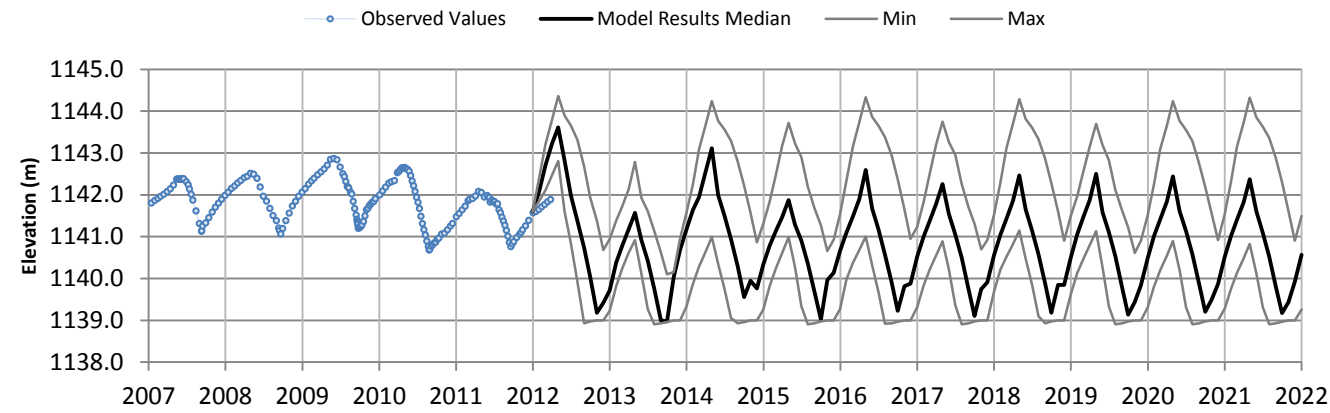
**Plot A - Zinc Concentrations at X14 - Scenario C-6g**



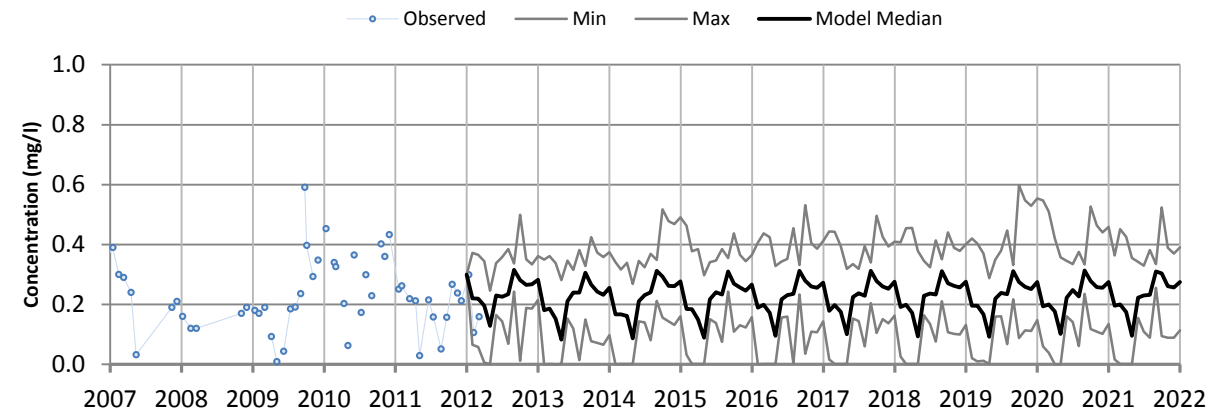
**Plot B - CVP Operation - Scenario C-6g**



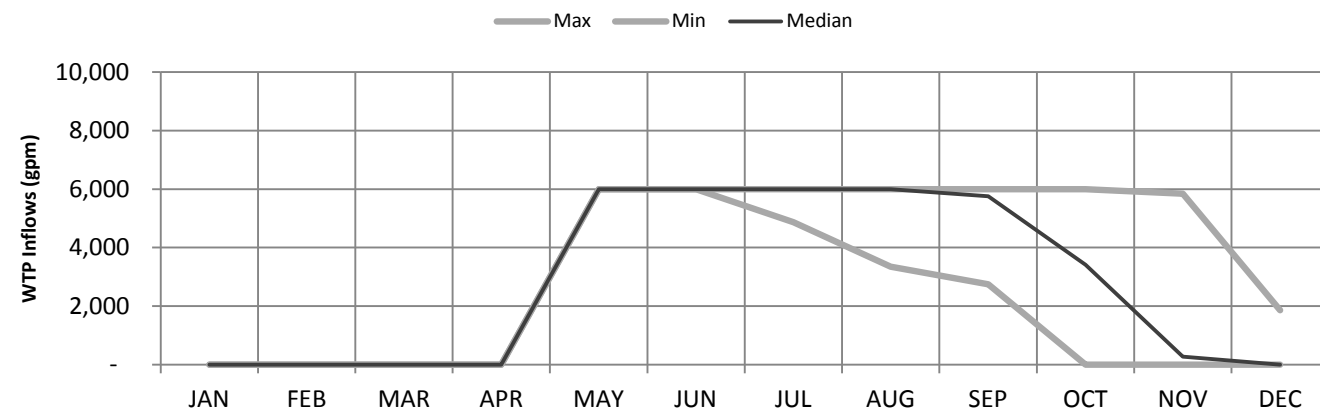
**Plot C - Faro Pit Elevation - Scenario C-6g**



**Plot D - CVP Zinc Concentration - Scenario C-6g**



**Plot E - Range of Monthly WTP flows - Scenario C-6g**



**Plot F - Range of Monthly CVP Discharge flows - Scenario C-6g**

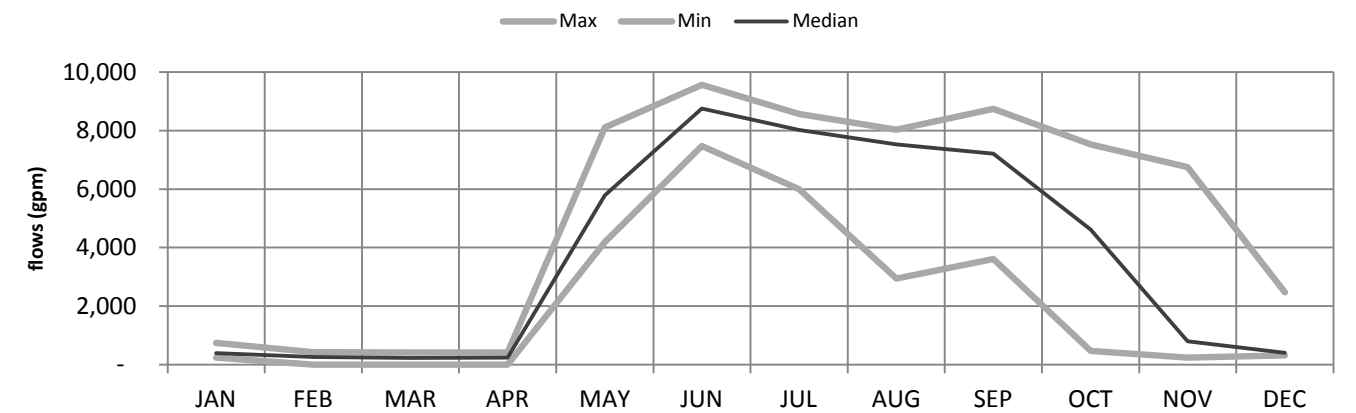


Figure 12  
**Scenario C-6g Results**  
 Faro Mine Remediation Project