APPENDIX I

MASS BALANCE CALCULATIONS

APPENDIX I

MASS BALANCE CALCULATIONS

I.1 CALCULATION ASSUMPTIONS

The mass balance presented in this Appendix has been prepared to provide a basis for the sizing and design of the equipment, pumps, and pipelines that will be utilized in the various sediment management activities that are described in this Intermediate Design Report. Mass balance diagrams have been developed for dredging Phases 1 and 2. As presented in this Appendix, two scenarios have been evaluated for each dredging Phase, the maximum flow produced by the dredge, and the average flow. The maximum flow represents the mass balance of flows while dredging operations are ongoing. The average flow incorporates the dredging "up-time" (assumed to be 70%) to produce calculated average flows over the course of a one-day period.

As described in this design report, selection of a dredging contractor has not been finalized at the time of the preparation of this report. As such, assumptions must be made regarding the flowrate and slurry percent solids that are produced by the equipment utilized to execute the dredging portion of the remedy. As described in Section 2.1.2, a dredge flowrate of 5,000 gpm, and a 10% solids by weight slurry, are assumed to be maintained by the dredging operation. Following selection of the dredging contractor, these assumptions will be reevaluated. If necessary, the mass balance will be updated as part of the Final Design to reflect any changes in these assumptions.

Due to the nature of dredging operations, the achieved percent solids produced will vary significantly over short periods of time, which will result in significant short-term variation in the proportion of water versus solids entering the system at a given time. The impact of these changes on pre-processing equipment is expected to be minimal. Due to the time required for geotextile tube filtrate to flow through the gravel and/or drainage channels, water within the SCA will effectively have some residence time before reaching the sumps. This residence time will attenuate fluctuating solids content, limiting any potential impacts to the SCA WTP.

Slurry Transport Mass Balance Calculation

1.0 Introduction

This package provides the mass balance calculation of the slurry transport, pre-processing, and geotextile tube dewatering. The hydraulically dredged Onondaga Lake sediment will be transported as a slurry to the SCA located on Wastebed 13 via a pipeline. Upon reaching the SCA, the slurry will go through several steps of pre-processing and then the final geotextile tube dewatering. The geotextile tube filtrate, along with water from screened material stockpiles and surface contact water with the active SCA, will be treated in the water treatment plant located on Wastebeds 12 and 13. The clarifier underflow and backwash water generated from the WTP will be sent back to the SCA and dewatered by geotextile tubes.

Following this introduction, Section 2 presents the definition of terms used in this calculation. Section 3 provides the assumptions. Section 4 contains a step-by-step mass balance calculation of the maximum flow scenario (5000 gpm). Section 5 assembles the results in a table format. The calculation of the average flow scenario (70% of the maximum flow or 3500 gpm) uses the same set of equations and steps. The spreadsheets contained in this appendix present calculations for both the maximum and average flow scenarios. Mass balance calculation associated with the water treatment process is provided in a separate submittal.

2.0 Definitions

Primary screening: The process of removing over-sized particles (> 2-inch) by passing the slurry through 2-inch screens.

Secondary screening: The process of removing gravel-sized particles by passing the slurry through 1/4-inch screens.

Hydrocyclone sand-sized particle removal: The process of removing sand-sized particles by passing the slurry through a hydrocyclone system.

Geotextile tube initial dewatering: The first 24 hours after the geotextile tube is filled.

Geotextile tube consolidation dewatering: The duration of 60 days after the initial dewatering. It is assumed that the primary consolidation within the geotextile tubes will complete during this period of time. Longer term consolidation or dewatering (secondary consolidation) is not considered in this calculation.

Filtrate: Including water and total suspended solids.

Geotextile tube filtrate: The summation of filtrate from the geotextile tube initial and consolidation dewatering.

Stockpile filtrate: The filtrate generated by change in water content of screened material stockpile (over-sized, gravel, and sand).

Total filtrate: The summation of geotextile tube filtrate and stockpile filtrate. The total filtrate will be sent to the SCA water treatment plant for treatment.

Phase I: For slurry from Remediation Areas C and D, the dewatering process includes primary screening for over-sized particle removal, polymer injection, and geotextile tube dewatering.

Phase II: For slurry from Remediation Areas A, B, E, and F, the dewatering process includes primary screening for over-sized particle removal, secondary screening for gravel-sized particle removal, hydrocyclone for sand-sized particle removal, polymer and coagulant injection, and geotextile tube dewatering.

3.0 Assumptions

- Geotextile tube consolidation dewatering is assumed to complete in 60 days after the initial dewatering. This calculation considers consolidation dewatering peak flow scenario , which starts from 61 days after the first tube is filled and ends at one day after the last tube is filled for the season.

- Polymer and coagulant particles injected to the slurry will be captured in the geotextile tube during the initial dewatering.

- Water density: $\rho_w := 1 \frac{gm}{cm^3}$ $\rho_w = 62.4279606 \frac{lb}{ft^3}$
- Maximum slurry flow rate: $q := 5000 gpm$, where gpm is gallons per minute.
- Average slurry flow rate: $q_a := q \cdot 70\%$ $q_a = 3500\, gpm$
- Slurry solids content by weight: $P_s := 10\%$
- Specific gravity of lake sediment **(Table 1)**:

  Phase I: $Gs_I := 2.56$

  Phase II: $Gs_{II} := 2.64$

- The specific gravity of total suspended solids is assumed to be the same as lake sediment of each phase.
- Initial water content of screened material stockpile: $WC_{istock} := 25\%$, based on vendor's estimate.
- Final water content of screened material stockpile: $WC_{fstock} := 15\%$, assumed value.
- Total suspended solids (TSS) in geotextile tube filtrate, based on O'Brien & Gere's estimate:

  $$TSS_{tube\_filtrate} := 195.2 \frac{mg}{L}$$

- Assumed TSS in stockpile filtrate (filtrate generated by change in stockpile water content) :

  $$TSS_{stock\_filtrate} := 195.2 \frac{mg}{L}$$

- Maximum booster pump seal water (each): $q_{booster} := 50 gpm$, based on vendor's estimate.
- Average booster pump seal water (each): $q_{booster\_a} := q_{booster} \cdot 70\%$ $q_{booster\_a} = 35\, gpm$
- Number of booster pumps: $N_{booster} := 5$
- Maximum hydrocyclone feed pump seal water (each): $q_{cyclone\_pump} := 15 gpm$
- Average hydrocyclone feed pump seal water (each): $q_{cyclone\_pump\_a} := q_{cyclone\_pump} \cdot 70\%$ $q_{cyclone\_pump\_a} = 10.5\, gpm$
- Number of hydrocyclone feed pumps: $N_{cyclone\_pump} := 2.$
- Maximum geotextile tube feed pump seal water (each): $q_{tube\_pump} := 15 gpm$
- Average geotextile tube feed pump seal water (each): $q_{tube\_pump\_a} := q_{tube\_pump} \cdot 70\%$ $q_{tube\_pump\_a} = 10.5\, gpm$
- Number of active geotextile tube feed pumps: $N_{tube\_pump} := 1$

- Maximum primary screen wash water: $q_{primary} := 102gpm$, based on vendor's estimate.
- Average primary screen wash water: $q_{primary\_a} := q_{primary} \cdot 70\%$ $q_{primary\_a} = 71.4\,gpm$
- Maximum secondary screen and hydrocyclone screen wash water:

  $q_{second\_cyclone} := 510gpm$, based on vendor's estimate.
- Average secondary screen and hydrocyclone screen wash water:

  $q_{second\_cyclone\_a} := q_{second\_cyclone} \cdot 70\%$ $q_{second\_cyclone\_a} = 357\,gpm$
- Clarifier underflow from the SCA water treatment plant , based on O'Brien & Gere's estimate.:

  $q_{clarifier} := 735gpm$ $TSS_{clarifier} := 3017.9\frac{mg}{L}$, where TSS is total suspended solids.
- Spent MMF backwash from the SCA water treatment plant, based on O'Brien & Gere's estimate:

  $q_{MMF} := 166.3gpm$ $TSS_{MMF} := 483.3\frac{mg}{L}$
- Spent GAC backwash from the SCA water treatment plant, based on O'Brien & Gere's estimate:

  $q_{GAC} := 164.6gpm$ $TSS_{GAC} := 95.8\frac{mg}{L}$
- Average percentage of over-sized particle (removed by primary screen), assuming 10% of the gravel-sized particle is over-sized **(Table 1)**:

  Phase I: $P_{oversized\_I} := 0.2\%$

  Phase II: $P_{oversized\_II} := 1.6\%$
- Average percentage of gravel-sized particle (removed by secondary screen) of Remediation Areas A, B, E, and F **(Table 1)**:

  $P_{gravel} := 14.4\%$

  Note: Table 1 shows approximately 16% is gravel. Based on the assumption that 10% of the gravel is over-sized and removed by the primary screen, the gravel removed by the secondary screen is 14.4% (i.e., 90% of 16%).
- Average percentage of sand-sized particle (removed by hydrocyclone) of Remediation Areas A, B, E, and F **(Table 1)**:

  $P_{sand} := 41\%$
- Average percentage of fines (silt and clay-sized particles) **(Table 1)**:

  Phase I: $P_{fine\_I} := 82\%$

  Phase II: $P_{fine\_II} := 43\%$

  Note: The polymer and coagulant dosage is based on dry weight of fines, rather than the total dry solids weight.
- Solids content by weight after initial dewatering in geotextile tubes (i.e., after the first 24 hrs):

  $P_{s2} := 38\%$,based on **P-GDT results**.

- Consolidation dewatering in the geotextile tube will take 60 days to complete, with equal daily filtrate volume. Total days of consolidation dewatering:

  $$t_c := 60\,\text{day}$$

- Solids content by weight after consolidation dewatering in geotextile tubes (i.e., 60 days after the first 24 hrs):

  $$P_{s3} := 50\%$$

- Maximum discharge to Metro WTP from SCA WTP:

  $$MAX_{discharge} := 6.5 \cdot 10^{6} \frac{gal}{day} \qquad MAX_{discharge} = 4513.9\,gpm$$

  $$TSS_{discharge} := 4.5 \frac{mg}{L}$$

4.0 Calculations

4.1 Incoming Slurry

Slurry water content: $WC := \dfrac{1 - P_s}{P_s}$ $\qquad WC = 900\,\%$

Water in slurry:

Phase I:

Volume $\quad q_{w\_I} := \dfrac{q \cdot (1 - P_s) \cdot Gs_I}{P_s + (1 - P_s) \cdot Gs_I} \qquad q_{w\_I} = 6900499 \dfrac{gal}{day}$

Weight $\quad W_{w\_I} := q_{w\_I} \cdot \rho_w \qquad W_{w\_I} = 57587459.3 \dfrac{lb}{day}$

Phase II:

Volume $\quad q_{w\_II} := \dfrac{q \cdot (1 - P_s) \cdot Gs_{II}}{P_s + (1 - P_s) \cdot Gs_{II}} \qquad q_{w\_II} = 6909208 \dfrac{gal}{day}$

Weight $\quad W_{w\_II} := q_{w\_II} \cdot \rho_w \qquad W_{w\_II} = 57660141.3 \dfrac{lb}{day}$

Solids in slurry:

Phase I:

Volume (zero void ratio) $\quad q_{s\_I} := \dfrac{q \cdot P_s}{P_s + (1 - P_s) \cdot Gs_I} \qquad q_{s\_I} = 299500.8 \dfrac{gal}{day}$

Weight $\quad W_{s\_I} := q_{s\_I} \cdot Gs_I \cdot \rho_w \qquad W_{s\_I} = 6398607 \dfrac{lb}{day}$

Phase II:

Volume (zero void ratio) $\quad q_{s\_II} := \dfrac{q \cdot P_s}{P_s + (1 - P_s) \cdot Gs_{II}} \qquad q_{s\_II} = 290792 \dfrac{gal}{day}$

Weight $\quad W_{s\_II} := q_{s\_II} \cdot Gs_{II} \cdot \rho_w \qquad W_{s\_II} = 6406682 \dfrac{lb}{day}$

4.2 Primary Screening for Over-Sized Particle Removal

Weight of removed over-sized particles:

Phase I:

$W_{oversized\_I} := W_{s\_I} \cdot P_{oversized\_I}$ $\qquad W_{oversized\_I} = 12797.2 \frac{lb}{day}$

Phase II:

$W_{oversized\_II} := W_{s\_II} \cdot P_{oversized\_II}$ $\qquad W_{oversized\_II} = 102506.9 \frac{lb}{day}$

Volume of removed over-sized particles (zero void ratio):

Phase I:

$q_{oversized\_I} := q_{s\_I} \cdot P_{oversized\_I}$ $\qquad q_{oversized\_I} = 599 \frac{gal}{day}$

Phase II:

$q_{oversized\_II} := q_{s\_II} \cdot P_{oversized\_II}$ $\qquad q_{oversized\_II} = 4652.7 \frac{gal}{day}$

Weight of water removed with over-sized particles:

Phase I:

$W_{w\_oversized\_I} := W_{oversized\_I} \cdot WC_{istock}$ $\qquad W_{w\_oversized\_I} = 3199.3 \frac{lb}{day}$

Phase II:

$W_{w\_oversized\_II} := W_{oversized\_II} \cdot WC_{istock}$ $\qquad W_{w\_oversized\_II} = 25626.7 \frac{lb}{day}$

Volume of water removed with over-sized particles:

Phase I:

$q_{w\_oversized\_I} := \frac{W_{w\_oversized\_I}}{\rho_w}$ $\qquad q_{w\_oversized\_I} = 383.4 \frac{gal}{day}$

Phase II:

$q_{w\_oversized\_II} := \frac{W_{w\_oversized\_II}}{\rho_w}$ $\qquad q_{w\_oversized\_II} = 3070.8 \frac{gal}{day}$

Remaining dry solids weight in the slurry:

Phase I:

$W_{sr1\_I} := W_{s\_I} - W_{oversized\_I}$ $\qquad W_{sr1\_I} = 6385809.4 \frac{lb}{day}$

Phase II:

$W_{sr1\_II} := W_{s\_II} - W_{oversized\_II}$ $\qquad W_{sr1\_II} = 6304175.5 \frac{lb}{day}$

Remaining solids volume in the slurry (zero void ratio):

Phase I:

$q_{sr1\_I} := q_{s\_I} - q_{oversized\_I}$ $\quad q_{sr1\_I} = 298901.8 \frac{gal}{day}$

Phase II:

$q_{sr1\_II} := q_{s\_II} - q_{oversized\_II}$ $\quad q_{sr1\_II} = 286138.9 \frac{gal}{day}$

Remaining water weight in the slurry:

Phase I:

$W_{wr1\_I} := W_{w\_I} - W_{w\_oversized\_I}$ $\quad W_{wr1\_I} = 57584260 \frac{lb}{day}$

Phase II:

$W_{wr1\_II} := W_{w\_II} - W_{w\_oversized\_II}$ $\quad W_{wr1\_II} = 57634514.6 \frac{lb}{day}$

Remaining water volume in the slurry:

Phase I:

$q_{wr1\_I} := q_{w\_I} - q_{w\_oversized\_I}$ $\quad q_{wr1\_I} = 6900115.8 \frac{gal}{day}$

Phase II:

$q_{wr1\_II} := q_{w\_II} - q_{w\_oversized\_II}$ $\quad q_{wr1\_II} = 6906137.6 \frac{gal}{day}$

4.3 Secondary Screening for Gravel-Sized Particle Removal (Remediation Areas A, B, E, and F only)

Weight of removed gravel-sized particles:

$W_{gravel\_II} := W_{s\_II} \cdot P_{gravel}$ $\quad W_{gravel\_II} = 922562.3 \frac{lb}{day}$

Volume of removed gravel-sized particles (zero void ratio):

$q_{gravel\_II} := q_{s\_II} \cdot P_{gravel}$ $\quad q_{gravel\_II} = 41874 \frac{gal}{day}$

Weight of water removed with gravel-sized particles:

$W_{w\_gravel\_II} := W_{gravel\_II} \cdot WC_{istock}$ $\quad W_{w\_gravel\_II} = 230640.6 \frac{lb}{day}$

Volume of water removed with gravel-sized particles:

$q_{w\_gravel\_II} := \frac{W_{w\_gravel\_II}}{\rho_w}$ $\quad q_{w\_gravel\_II} = 27636.8 \frac{gal}{day}$

Remaining dry solids weight in the slurry:

$W_{sr2\_II} := W_{sr1\_II} - W_{gravel\_II}$ $\quad W_{sr2\_II} = 5381613.2 \frac{lb}{day}$

Remaining solids volume in the slurry (zero void ratio):

$q_{sr2\_II} := q_{sr1\_II} - q_{gravel\_II}$ $\quad q_{sr2\_II} = 244264.9 \frac{gal}{day}$

Remaining water weight in the slurry:

$W_{wr2\_II} := W_{wr1\_II} - W_{w\_gravel\_II}$ $\quad W_{wr2\_II} = 57403874.1 \frac{lb}{day}$

Remaining water volume in the slurry:

$q_{wr2\_II} := q_{wr1\_II} - q_{w\_gravel\_II}$ $\quad q_{wr2\_II} = 6878500.8 \frac{gal}{day}$

4.4 Hydrocyclone for Sand-Sized Particle Removal (Remediation Areas A, B, E, and F only)

Weight of removed sand-sized particles:

$W_{sand\_II} := W_{s\_II} \cdot P_{sand}$ $\quad W_{sand\_II} = 2626739.8 \frac{lb}{day}$

Volume of removed sand-sized particles (zero void ratio):

$q_{sand\_II} := q_{s\_II} \cdot P_{sand}$ $\quad q_{sand\_II} = 119224.6 \frac{gal}{day}$

Weight of water removed with sand-sized particles:

$W_{w\_sand\_II} := W_{sand\_II} \cdot WC_{istock}$ $\quad W_{w\_sand\_II} = 656684.9 \frac{lb}{day}$

Volume of water removed with sand-sized particles:

$q_{w\_sand\_II} := \frac{W_{w\_sand\_II}}{\rho_w}$ $\quad q_{w\_sand\_II} = 78688.2 \frac{gal}{day}$

Remaining dry solids weight in the slurry:

$W_{sr3\_II} := W_{sr2\_II} - W_{sand\_II}$ $\quad W_{sr3\_II} = 2754873.4 \frac{lb}{day}$

Remaining solids volume in the slurry (zero void ratio):

$q_{sr3\_II} := q_{sr2\_II} - q_{sand\_II}$ $\quad q_{sr3\_II} = 125040.4 \frac{gal}{day}$

Remaining water weight in the slurry:

$W_{wr3\_II} := W_{wr2\_II} - W_{w\_sand\_II}$ $\quad W_{wr3\_II} = 56747189.1 \frac{lb}{day}$

Remaining water volume in the slurry:

$q_{wr3\_II} := q_{wr2\_II} - q_{w\_sand\_II}$ $\qquad q_{wr3\_II} = 6799812.6\,\frac{gal}{day}$

4.5 Total Flow from SCA WTP (Clarifier Underflow and MMF and GAC Backwash Water)

Total flow from WTP:

$q_{WTP} := q_{clarifier} + q_{MMF} + q_{GAC}$ $\qquad q_{WTP} = 1065.9\,gpm$ $\qquad q_{WTP} = 1534896\,\frac{gal}{day}$

Weight of total suspended solids (TSS) from SCA WTP:

All Remediation Areas:

$W_{WTP\_TSS} := q_{clarifier} \cdot TSS_{clarifier} + q_{MMF} \cdot TSS_{MMF} + q_{GAC} \cdot TSS_{GAC}$

$W_{WTP\_TSS} = 19.3\,\frac{lb}{min}$ $\qquad W_{WTP\_TSS} = 27811.8050701\,\frac{lb}{day}$

Volume of total suspended solids (TSS) from SCA WTP (zero void ratio):

Phase I:

$q_{WTP\_TSS\_I} := \frac{W_{WTP\_TSS}}{Gs_I \cdot \rho_w}$ $\qquad q_{WTP\_TSS\_I} = 0.904\,gpm$

$q_{WTP\_TSS\_I} = 1301.8\,\frac{gal}{day}$

Phase II:

$q_{WTP\_TSS\_II} := \frac{W_{WTP\_TSS}}{Gs_{II} \cdot \rho_w}$ $\qquad q_{WTP\_TSS\_II} = 0.877\,gpm$

$q_{WTP\_TSS\_II} = 1262.3\,\frac{gal}{day}$

Volume of water from SCA WTP:

Phase I:

$$q_{W\_WTP\_I} := q_{clarifier} \cdot \left(1 - \frac{TSS_{clarifier}}{Gs_I \cdot \rho_w}\right) + q_{MMF} \cdot \left(1 - \frac{TSS_{MMF}}{Gs_I \cdot \rho_w}\right) + q_{GAC} \cdot \left(1 - \frac{TSS_{GAC}}{Gs_I \cdot \rho_w}\right)$$

$q_{W\_WTP\_I} = 1065.0\,gpm$

Phase II:

$$q_{W\_WTP\_II} := q_{clarifier} \cdot \left(1 - \frac{TSS_{clarifier}}{Gs_{II} \cdot \rho_w}\right) + q_{MMF} \cdot \left(1 - \frac{TSS_{MMF}}{Gs_{II} \cdot \rho_w}\right) + q_{GAC} \cdot \left(1 - \frac{TSS_{GAC}}{Gs_{II} \cdot \rho_w}\right)$$

$q_{W\_WTP\_II} = 1065.0\,gpm$

Weight of water from SCA WTP:

Phase I:

$$W_{W\_WTP\_I} := q_{W\_WTP\_I} \cdot \rho_w$$

$$W_{W\_WTP\_I} = 8887.8 \frac{lb}{min} \qquad W_{W\_WTP\_I} = 12798464.5 \frac{lb}{day}$$

Phase II:

$$W_{W\_WTP\_II} := q_{W\_WTP\_II} \cdot \rho_w$$

$$W_{W\_WTP\_II} = 8888.1 \frac{lb}{min} \qquad W_{W\_WTP\_II} = 12798793.8 \frac{lb}{day}$$

4.6 Screened Material Stockpile Filtrate

Weight of water in filtrate from screened material stockpile:

Phase I:

$$W_{w\_stock\_filtrate\_I} := \left(WC_{istock} - WC_{fstock}\right) \cdot W_{oversized\_I}$$

$$W_{w\_stock\_filtrate\_I} = 1279.7 \frac{lb}{day}$$

Phase II:

$$W_{w\_stock\_filtrate\_II} := \left(WC_{istock} - WC_{fstock}\right) \cdot \left(W_{oversized\_II} + W_{gravel\_II} + W_{sand\_II}\right)$$

$$W_{w\_stock\_filtrate\_II} = 365180.9 \frac{lb}{day}$$

Volume of water in filtrate from screened material stockpile:

Phase I:

$$q_{w\_stock\_filtrate\_I} := \frac{W_{w\_stock\_filtrate\_I}}{\rho_w} \qquad q_{w\_stock\_filtrate\_I} = 153.3 \frac{gal}{day}$$

Phase II:

$$q_{w\_stock\_filtrate\_II} := \frac{W_{w\_stock\_filtrate\_II}}{\rho_w} \qquad q_{w\_stock\_filtrate\_II} = 43758.3 \frac{gal}{day}$$

Weight of total suspended solids in stockpile filtrate:

Phase I:

$$W_{TSS\_stock\_filtrate\_I} := \frac{q_{w\_stock\_filtrate\_I} \cdot TSS_{stock\_filtrate} \cdot Gs_I \cdot \rho_w}{Gs_I \cdot \rho_w - TSS_{stock\_filtrate}}$$

$$W_{TSS\_stock\_filtrate\_I} = 0.25 \frac{lb}{day} \qquad W_{TSS\_stock\_filtrate\_I} = 0.000079 \frac{kg}{min}$$

Phase II:

$$W_{TSS\_stock\_filtrate\_II} := \frac{q_{w\_stock\_filtrate\_II} \cdot TSS_{stock\_filtrate} \cdot Gs_{II} \cdot \rho_w}{Gs_{II} \cdot \rho_w - TSS_{stock\_filtrate}}$$

$$W_{TSS\_stock\_filtrate\_II} = 71.29 \frac{lb}{day} \qquad W_{TSS\_stock\_filtrate\_II} = 0.0225 \frac{kg}{min}$$

Volume of total suspended solids in stockpile filtrate (zero void ratio):

Phase I:

$$q_{TSS\_stock\_filtrate\_I} := \frac{W_{TSS\_stock\_filtrate\_I}}{Gs_I \cdot \rho_w}$$

$q_{TSS\_stock\_filtrate\_I} = 0.012\,\frac{gal}{day}$ $\quad$ $q_{TSS\_stock\_filtrate\_I} = 8.12042 \times 10^{-6}\,gpm$

Phase II:

$$q_{TSS\_stock\_filtrate\_II} := \frac{W_{TSS\_stock\_filtrate\_II}}{Gs_{II} \cdot \rho_w}$$

$q_{TSS\_stock\_filtrate\_II} = 3.236\,\frac{gal}{day}$ $\quad$ $q_{TSS\_stock\_filtrate\_II} = 2.247 \times 10^{-3}\,gpm$

Weight of stockpile filtrate:

Phase I:

$W_{stock\_filtrate\_I} := W_{w\_stock\_filtrate\_I} + W_{TSS\_stock\_filtrate\_I}$ $\quad$ $W_{stock\_filtrate\_I} = 1280\,\frac{lb}{day}$

Phase II:

$W_{stock\_filtrate\_II} := W_{w\_stock\_filtrate\_II} + W_{TSS\_stock\_filtrate\_II}$ $\quad$ $W_{stock\_filtrate\_II} = 365252.2\,\frac{lb}{day}$

Volume of stockpile filtrate:

Phase I:

$q_{stock\_filtrate\_I} := q_{w\_stock\_filtrate\_I} + q_{TSS\_stock\_filtrate\_I}$ $\quad$ $q_{stock\_filtrate\_I} = 153.4\,\frac{gal}{day}$

Phase II:

$q_{stock\_filtrate\_II} := q_{w\_stock\_filtrate\_II} + q_{TSS\_stock\_filtrate\_II}$ $\quad$ $q_{stock\_filtrate\_II} = 43761.6\,\frac{gal}{day}$

Weight of final dry solids in stockpile (total minus TSS):

Phase I:

$W_{s\_stock\_I} := W_{oversized\_I} - W_{TSS\_stock\_filtrate\_I}$ $\quad$ $W_{s\_stock\_I} = 12797\,\frac{lb}{day}$

Phase II:

$W_{s\_stock\_II} := W_{oversized\_II} + W_{gravel\_II} + W_{sand\_II} - W_{TSS\_stock\_filtrate\_II}$ $\quad$ $W_{s\_stock\_II} = 3651737.7\,\frac{lb}{day}$

Volume of final solids in stockpile (zero void ratio, total minus TSS):

Phase I:

$q_{s\_stock\_I} := \frac{W_{s\_stock\_I}}{Gs_I \cdot \rho_w}$ $\quad$ $q_{s\_stock\_I} = 599\,\frac{gal}{day}$

Phase II:

$q_{s\_stock\_II} := \frac{W_{s\_stock\_II}}{Gs_{II} \cdot \rho_w}$ $\quad$ $q_{s\_stock\_II} = 165748\,\frac{gal}{day}$

4.7 Polymer Injection

Dry polymer density:

$DEN_{polymer} := 0.7 \frac{gm}{cm^3}$, based on **Ashland 2520 MSDS.**

Dry polymer dosage rate:

$DOS_{polymer} := 1.59 \frac{lb}{ton}$, based on **P-GDT report.**

Weight and volume of dry polymer:

Phase I:

$$W_{drypolymer\_I} := DOS_{polymer}\left(W_{s\_I} \cdot P_{fine\_I} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_I}\right)$$

$W_{drypolymer\_I} = 2.912 \frac{lb}{min}$ $W_{drypolymer\_I} = 4193.36 \frac{lb}{day}$

$q_{drypolymer\_I} := \frac{W_{drypolymer\_I}}{DEN_{polymer}}$ $q_{drypolymer\_I} = 0.4985\, gpm$ $q_{drypolymer\_I} = 717.8 \frac{gal}{day}$

Phase II:

$$W_{drypolymer\_II} := DOS_{polymer}\left(W_{s\_II} \cdot P_{fine\_II} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_II}\right)$$

$W_{drypolymer\_II} = 1.5 \frac{lb}{min}$ $W_{drypolymer\_II} = 2212.3 \frac{lb}{day}$

$q_{drypolymer\_II} := \frac{W_{drypolymer\_II}}{DEN_{polymer}}$ $q_{drypolymer\_II} = 0.3\, gpm$ $q_{drypolymer\_II} = 379 \frac{gal}{day}$

Weight and volume of polymer makeup water:

Phase I:

$q_{polymerwater\_I} := \frac{W_{drypolymer\_I} \cdot 200mL}{0.4gm}$ $q_{polymerwater\_I} = 174.5\, gpm$

$W_{polymerwater\_I} := q_{polymerwater\_I} \cdot \rho_w$ $W_{polymerwater\_I} = 2096681.1 \frac{lb}{day}$

Phase II:

$q_{polymerwater\_II} := \frac{W_{drypolymer\_II} \cdot 200mL}{0.4gm}$ $q_{polymerwater\_II} = 92\, gpm$

$W_{polymerwater\_II} := q_{polymerwater\_II} \cdot \rho_w$ $W_{polymerwater\_II} = 1106145.7 \frac{lb}{day}$

Note: Assume polymer dissolves in makeup water. Makeup water volume is the polymer emulsion volume.

4.8 Coagulant Injection (emulsion, Remediation Areas A, B, E, and F only)

Coagulant emulsion dosage rate:

$DOS_{coag} := 5.71 \frac{lb}{ton}$, based on **P-GDT report.**

Coagulant emulsion density:

$DEN_{coag} := 1.03 \frac{gm}{cm^3}$, based o**n Ashland 492 MSDS.**

Coagulant emulsion weight:

$$W_{coag} := DOS_{coag} \cdot \left(W_{s\_II} \cdot P_{fine\_II} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_II}\right)$$

$W_{coag} = 7944.8 \frac{lb}{day}$ $W_{coag} = 5.5 \frac{lb}{min}$

Coagulant emulsion volume:

$$q_{coag} := \frac{DOS_{coag} \cdot \left(W_{s\_II} \cdot P_{fine\_II} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_II}\right)}{DEN_{coag}}$$

$q_{coag} = 924.265 \frac{gal}{day}$ $q_{coag} = 0.64\, gpm$

Coagulant emulsion makeup water (make down to 1% dilution):

$q_{coagwater} := \frac{W_{coag} \cdot 100mL}{1gm}$ $q_{coagwater} = 66.1\, gpm$ $q_{coagwater} = 95199.3 \frac{gal}{day}$

$W_{coagwater} := q_{coagwater} \cdot \rho_w$ $W_{coagwater} = 794477 \frac{lb}{day}$ $W_{coagwater} = 551.7201 \frac{lb}{min}$

4.9 Geotextile Tube Dewatering

4.9.1 Initial dewatering (the first 24 hrs)

Assume all dry polymer and/or coagulant are retained in the geotextile tubes during the initial dewatering.

Weight of dry solids retained in tubes after initial dewatering:

Phase I:

$W_{s\_ret2\_I} := W_{sr1\_I} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_I} + W_{drypolymer\_I}$ $W_{s\_ret2\_I} = 6417814.79 \frac{lb}{day}$

Phase II:

$W_{s\_ret2\_II} := W_{sr3\_II} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_II} + W_{drypolymer\_II} + W_{coag}$ $W_{s\_ret2\_II} = 2792914 \frac{lb}{day}$

Weight of water retained in tubes after initial dewatering:

Phase I:

$$W_{w\_ret2\_I} := \frac{\left(1 - P_{s2}\right) \cdot \left(W_{sr1\_I} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_I} + W_{drypolymer\_I}\right)}{P_{s2}}$$

$W_{w\_ret2\_I} = 10471171 \frac{lb}{day}$

Phase II:

$$W_{w\_ret2\_II} := \frac{(1 - P_{s2})\cdot(W_{sr3\_II} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_II} + W_{drypolymer\_II} + W_{coag})}{P_{s2}} \qquad W_{w\_ret2\_II} = 4556859\,\frac{lb}{day}$$

Volume of water retained in tubes after initial dewatering:

Phase I:

$$q_{w\_ret2\_I} := \frac{W_{w\_ret2\_I}}{\rho_w} \qquad q_{w\_ret2\_I} = 1254723\,\frac{gal}{day}$$

Phase II:

$$q_{w\_ret2\_II} := \frac{W_{w\_ret2\_II}}{\rho_w} \qquad q_{w\_ret2\_II} = 546032\,\frac{gal}{day}$$

Weight of Water in initial filtrate:

Phase I:

$$W_{w\_if\_I} := W_{wr1\_I} + W_{W\_WTP\_I} + W_{w\_stock\_filtrate\_I} + W_{polymerwater\_I} \cdots + (q_{booster}\cdot N_{booster} + q_{tube\_pump}\cdot N_{tube\_pump})\cdot\rho_w - W_{w\_ret2\_I}$$

$$W_{w\_if\_I} = 65194120\,\frac{lb}{day}$$

Phase II:

$$W_{w\_if\_II} := W_{wr3\_II} + W_{W\_WTP\_II} + W_{w\_stock\_filtrate\_II} + W_{polymerwater\_II} + W_{coagwater} \cdots + (q_{booster}\cdot N_{booster} + q_{cyclone\_pump}\cdot N_{cyclone\_pump} + q_{tube\_pump}\cdot N_{tube\_pump})\cdot\rho_w - W_{w\_ret2\_II}$$

$$W_{w\_if\_II} = 70800055\,\frac{lb}{day}$$

Volume of water in initial filtrate:

Phase I:

$$q_{w\_if\_I} := q_{wr1\_I} + q_{W\_WTP\_I} + q_{w\_stock\_filtrate\_I} + q_{polymerwater\_I} + q_{booster}\cdot N_{booster} + q_{tube\_pump}\cdot N_{tube\_pump} - q_{w\_ret2\_I}$$

$$q_{w\_if\_I} = 7811978\,\frac{gal}{day}$$

Phase II:

$$q_{w\_if\_II} := q_{wr3\_II} + q_{W\_WTP\_II} + q_{w\_stock\_filtrate\_II} + q_{polymerwater\_II} + q_{coagwater} \cdots + q_{booster}\cdot N_{booster} + q_{cyclone\_pump}\cdot N_{cyclone\_pump} + q_{tube\_pump}\cdot N_{tube\_pump} - q_{w\_ret2\_II}$$

$$q_{w\_if\_II} = 8483717\,\frac{gal}{day}$$

4.9.2 Consolidation dewatering (during 60 days after initial dewatering)

Weight of water retained in tubes after consolidation dewatering:

Phase I:

$$W_{w\_ret3\_I} := \frac{(1 - P_{s3}) \cdot (W_{sr1\_I} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_I} + W_{drypolymer\_I})}{P_{s3}}$$

$$W_{w\_ret3\_I} = 6417815 \frac{lb}{day}$$

Phase II:

$$W_{w\_ret3\_II} := \frac{(1 - P_{s3}) \cdot (W_{sr3\_II} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_II} + W_{drypolymer\_II} + W_{coag})}{P_{s3}}$$

$$W_{w\_ret3\_II} = 2792914 \frac{lb}{day}$$

Volume of water retained in tubes after consolidation dewatering:

Phase I:

$$q_{w\_ret3\_I} := \frac{W_{w\_ret3\_I}}{\rho_w} \qquad q_{w\_ret3\_I} = 769024 \frac{gal}{day}$$

Phase II:

$$q_{w\_ret3\_II} := \frac{W_{w\_ret3\_II}}{\rho_w} \qquad q_{w\_ret3\_II} = 334665 \frac{gal}{day}$$

Peak weight of water in consolidation dewatering filtrate:

Phase I:

$$W_{w\_cf\_I} := W_{w\_ret2\_I} - W_{w\_ret3\_I} \qquad W_{w\_cf\_I} = 4053357 \frac{lb}{day}$$

Phase II:

$$W_{w\_cf\_II} := W_{w\_ret2\_II} - W_{w\_ret3\_II} \qquad W_{w\_cf\_II} = 1763945 \frac{lb}{day}$$

Peak volume of water in consolidation dewatering filtrate:

Phase I:

$$q_{w\_cf\_I} := \frac{W_{w\_cf\_I}}{\rho_w} \qquad q_{w\_cf\_I} = 485699 \frac{gal}{day}$$

Phase II:

$$q_{w\_cf\_II} := \frac{W_{w\_cf\_II}}{\rho_w} \qquad q_{w\_cf\_II} = 211367 \frac{gal}{day}$$

Note: Peak consolidation dewatering is assumed to start from 61 days after the first tube in filled and ends at 1 day after the last tube is filled for the season.

4.9.3 Geotextile tube filtrate

Volume of water in geotextile tube filtrate:

Phase I:

$$q_{w\_tube\_filtrate\_I} := q_{w\_if\_I} + q_{w\_cf\_I}$$

$$q_{w\_tube\_filtrate\_I} = 8297677\,\frac{gal}{day}$$

Phase II:

$$q_{w\_tube\_filtrate\_II} := q_{w\_if\_II} + q_{w\_cf\_II}$$

$$q_{w\_tube\_filtrate\_II} = 8695085\,\frac{gal}{day}$$

Weight of total suspended solids in geotextile tube filtrate:

Phase I:

$$W_{TSS\_tube\_filtrate\_I} := \frac{\left(q_{w\_if\_I} + q_{w\_cf\_I}\right)\cdot TSS_{tube\_filtrate}\cdot Gs_I\cdot \rho_w}{Gs_I\cdot \rho_w - TSS_{tube\_filtrate}}$$

$$W_{TSS\_tube\_filtrate\_I} = 13518.1\,\frac{lb}{day} \qquad W_{TSS\_tube\_filtrate\_I} = 4.26\,\frac{kg}{min}$$

Phase II:

$$W_{TSS\_tube\_filtrate\_II} := \frac{\left(q_{w\_if\_II} + q_{w\_cf\_II}\right)\cdot TSS_{tube\_filtrate}\cdot Gs_{II}\cdot \rho_w}{Gs_{II}\cdot \rho_w - TSS_{tube\_filtrate}}$$

$$W_{TSS\_tube\_filtrate\_II} = 14166\,\frac{lb}{day} \qquad W_{TSS\_tube\_filtrate\_II} = 4.46\,\frac{kg}{min}$$

Volume of total suspended solids in geotextile tube filtrate (zero void ratio):

Phase I:

$$q_{TSS\_tube\_filtrate\_I} := \frac{W_{TSS\_tube\_filtrate\_I}}{Gs_I\cdot \rho_w} \qquad q_{TSS\_tube\_filtrate\_I} = 0.439\,gpm \qquad q_{TSS\_tube\_filtrate\_I} = 633\,\frac{gal}{day}$$

Phase II:

$$q_{TSS\_tube\_filtrate\_II} := \frac{W_{TSS\_tube\_filtrate\_II}}{Gs_{II}\cdot \rho_w} \qquad q_{TSS\_tube\_filtrate\_II} = 0.446\,gpm \qquad q_{TSS\_tube\_filtrate\_II} = 643\,\frac{gal}{day}$$

Weight of geotextile tube filtrate (water and TSS):

Phase I:

$$W_{tube\_filtrate\_I} := W_{w\_if\_I} + W_{w\_cf\_I} + W_{TSS\_tube\_filtrate\_I} \qquad W_{tube\_filtrate\_I} = 69260995.2\,\frac{lb}{day}$$

Phase II:

$$W_{tube\_filtrate\_II} := W_{w\_if\_II} + W_{w\_cf\_II} + W_{TSS\_tube\_filtrate\_II} \qquad W_{tube\_filtrate\_II} = 72578166.4\,\frac{lb}{day}$$

Volume of geotextile tube filtrate (water and TSS):

Phase I :

$q_{tube\_filtrate\_I} := q_{w\_if\_I} + q_{w\_cf\_I} + q_{TSS\_tube\_filtrate\_I}$ $\qquad q_{tube\_filtrate\_I} = 8298310 \frac{gal}{day}$

Phase II:

$q_{tube\_filtrate\_II} := q_{w\_if\_II} + q_{w\_cf\_II} + q_{TSS\_tube\_filtrate\_II}$ $\qquad q_{tube\_filtrate\_II} = 8695728 \frac{gal}{day}$

Weight of final dry solids retained in geotextile tubes (total minus TSS):

Phase I:

$W_{s\_ret\_I} := W_{sr1\_I} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_I} + W_{drypolymer\_I} - W_{TSS\_tube\_filtrate\_I}$

$W_{s\_ret\_I} = 6404296.7 \frac{lb}{day}$

Phase II:

$W_{s\_ret\_II} := W_{sr3\_II} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_II} + W_{drypolymer\_II} + W_{coag} - W_{TSS\_tube\_filtrate\_II}$

$W_{s\_ret\_II} = 2778748 \frac{lb}{day}$

Volume of final solids retained in geotextile tubes (zero void ratio, total minus TSS):

Phase I:

$$q_{s\_ret\_I} := \left(\frac{W_{sr1\_I} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_I} - W_{TSS\_tube\_filtrate\_I}}{Gs_I \cdot \rho_w}\right) + q_{drypolymer\_I}$$

$q_{s\_ret\_I} = 300288.7 \frac{gal}{day}$ $\qquad q_{s\_ret\_I} = 208.53\, gpm$

Phase II:

$$q_{s\_ret\_II} := \left(\frac{W_{sr3\_II} + W_{WTP\_TSS} + W_{TSS\_stock\_filtrate\_II} - W_{TSS\_tube\_filtrate\_II}}{Gs_{II} \cdot \rho_w}\right) + q_{drypolymer\_II} + q_{coag}$$

$q_{s\_ret\_II} = 126966 \frac{gal}{day}$ $\qquad q_{s\_ret\_II} = 88.2\, gpm$

4.10 Precipitation

Daily average precipitation, based on on-site meteorological tower data:

$PRE_{daily} := 0.15 \frac{in}{day}$

SCA open area: $A_{SCA} := 50 acre$

Precipitation flow: $q_{PRE} := PRE_{daily} \cdot A_{SCA}$ $\qquad q_{PRE} = 141.4\, gpm$ $\qquad q_{PRE} = 203657.1 \frac{gal}{day}$

4.11 Discharge from SCA WTP to Metro

Weight of TSS in discharge:

$W_{TSS\_dis} := MAX_{discharge} \cdot TSS_{discharge}$ $\qquad W_{TSS\_dis} = 244.1 \frac{lb}{day}$

Volume of TSS in discharge:

Phase I:

$q_{TSS\_dis\_I} := \frac{W_{TSS\_dis}}{Gs_I \cdot \rho_w}$ $\qquad q_{TSS\_dis\_I} = 0.00793\, gpm$

Phase II:

$q_{TSS\_dis\_II} := \frac{W_{TSS\_dis}}{Gs_{II} \cdot \rho_w}$ $\qquad q_{TSS\_dis\_II} = 0.008\, gpm$

Weight of water in discharge:

Phase I:

$W_{w\_dis\_I} := \left(MAX_{discharge} - q_{TSS\_dis\_I}\right) \cdot \rho_w$ $\qquad W_{w\_dis\_I} = 54245036.2 \frac{lb}{day}$

Phase II:

$W_{w\_dis\_II} := \left(MAX_{discharge} - q_{TSS\_dis\_II}\right) \cdot \rho_w$ $\qquad W_{w\_dis\_II} = 54245039.1 \frac{lb}{day}$

Volume of water in discharge:

Phase I:

$q_{w\_dis\_I} := MAX_{discharge} - q_{TSS\_dis\_I}$ $\qquad q_{w\_dis\_I} = 4513.9\, gpm$

Phase II:

$q_{w\_dis\_II} := MAX_{discharge} - q_{TSS\_dis\_II}$ $\qquad q_{w\_dis\_II} = 4513.9\, gpm$

5.0 Mass Balance Tables

This section provides the mass balance calculations of the maximum flow rate (5000 gpm) shown on **Drawings D-002 and 004**. The stream numbers are defined on **Drawings D-001 and 003**, respectively. Some of the stream numbers represent individual components, including the pre-processing steps, geotextile tube dewatering, and precipitation. The flow associated with these stream numbers is shown as positive if the component add flow to the slurry (e.g., polymer injection); whereas, the flow is shown as negative if the component subtracts flow from the slurry (e.g., over-sized particle removal). The other stream numbers represents the subtotal flow at a given location along the flow streamline.

The flow at each Stream Number is shown as an array in the following format:
(total flow rate, water flow rate, solids flow rate).

Phase I:

Stream Number 1:Incoming slurry

$S1_I := \left(q \;\; q_{w\_I} \;\; q_{s\_I}\right)$ $\qquad S1_I = \left(5000 \;\; 4792 \;\; 208\right) gpm$

Stream number 1A: Supplemental lake water intake (normally zero)

$S1A_I := \left(0 \;\; 0 \;\; 0\right) gpm$

Stream Number 2: booster pump seal water

$S2_I := \left(N_{booster} \cdot q_{booster} \;\; N_{booster} \cdot q_{booster} \;\; 0gpm\right)$ $\qquad S2_I = \left(250 \;\; 250 \;\; 0\right) gpm$

Stream Number 3: Subtotal

$S3_I := S1_I + S1A_I + S2_I$ $\qquad S3_I = \left(5250 \;\; 5042 \;\; 208\right) gpm$

Stream Number 4: Primary Screen Wash Water

$S4_I := \left(q_{primary} \;\; q_{primary} \;\; 0gpm\right)$ $\qquad S4_I = \left(102 \;\; 102 \;\; 0\right) gpm$

Stream Number 5: Over-sized Particle Removal

$S5_I := \left[-\left(q_{w\_oversized\_I} + q_{oversized\_I}\right) \;\; -q_{w\_oversized\_I} \;\; -q_{oversized\_I}\right]$

$S5_I = \left(-0.7 \;\; -0.3 \;\; -0.4\right) gpm$

Stream Number 6: Subtotal

$S6_I := S3_I + S4_I + S5_I$ $\qquad S6_I = \left(5351.3 \;\; 5143.7 \;\; 207.6\right) gpm$

Stream Number 7: Geotextile tube feed pump seal water

$S7_I := \left(N_{tube\_pump} \cdot q_{tube\_pump} \;\; N_{tube\_pump} \cdot q_{tube\_pump} \;\; 0gpm\right)$

$S7_I = \left(15 \;\; 15 \;\; 0\right) gpm$

Stream Number 8: Subtotal

$S8_I := S6_I + S7_I$ $\qquad S8_I = \left(5366.3 \;\; 5158.7 \;\; 207.6\right) gpm$

Stream Number 9: SCA WTP clarifier underflow and filter backwash

$S9_I := \left(q_{WTP} \;\; q_{W\_WTP\_I} \;\; q_{WTP\_TSS\_I}\right)$

$S9_I = \left(1065.9 \;\; 1064.996 \;\; 0.904\right) gpm$

Stream Number 10: Stockpile filtrate

$S10_I := (q_{stock\_filtrate\_I} \;\; q_{w\_stock\_filtrate\_I} \;\; q_{TSS\_stock\_filtrate\_I})$

$S10_I = (0.1065 \;\; 0.10649 \;\; 0.00001)\,gpm$

Stream Number 11: Polymer and makeup water

$S11_I := (q_{polymerwater\_I} + q_{drypolymer\_I} \;\; q_{polymerwater\_I} \;\; q_{drypolymer\_I})$

$S11_I = (174.9692 \;\; 174.4707 \;\; 0.4985)\,gpm$

Stream Number 12: Subtotal

$S12_I := S8_I + S9_I + S10_I + S11_I$ $\qquad S12_I = (6607.3 \;\; 6398.3 \;\; 209)\,gpm$

Stream Number 13: Geotextile tube retention

$S13_I := \left[-(q_{w\_ret3\_I} + q_{s\_ret\_I}) \;\; -q_{w\_ret3\_I} \;\; -q_{s\_ret\_I}\right]$

$S13_I = (-742.578119 \;\; -534.044292 \;\; -208.533827)\,gpm$

Stream Number 14: Average precipitation

$S14_I := (q_{PRE} \;\; q_{PRE} \;\; 0gpm)$ $\qquad S14_I = (141.4 \;\; 141.4 \;\; 0)\,gpm$

Stream Number 15: Subtotal

$S15_I := S12_I + S13_I + S14_I$

$S15_I = (6006.144 \;\; 6005.705 \;\; 0.439)\,gpm$

Stream Number 16: Primary screen wash water

$S16_I := (-q_{primary} \;\; -q_{primary} \;\; 0gpm)$ $\qquad S16_I = (-102 \;\; -102 \;\; 0)\,gpm$

Stream Number 17: Net flow to stormwater basins

$S17_{water} := -\left[{S15_I}_{0,1} - q_{primary} - (q_{w\_dis\_I} + q_{polymerwater\_I} + q_{W\_WTP\_I})\right]$

$S17_{TSS} := \dfrac{S17_{water} \cdot {S15_I}_{0,2}}{{S15_I}_{0,1}}$

$S17_{total} := S17_{water} + S17_{TSS}$

$S17_I := (S17_{total} \;\; S17_{water} \;\; S17_{TSS})$ $\qquad S17_I = (-150.368 \;\; -150.357 \;\; -0.011)\,gpm$

Note: If the volume at Stream Number 17 is positive, it indicates no net flow to stormwater basins. Input zero for volume at Stream Number 17
in this case.

Stream Number 18: Effluent to SCA WTP

$S18_I := S15_I + S16_I + S17_I$ $\qquad S18_I = (5753.8 \;\; 5753.3 \;\; 0.4)\,gpm$

$$Title_I := \begin{pmatrix} \text{"Description"} \\ \text{"1. Incoming Slurry"} \\ \text{"2. Booster Pump Seal Water"} \\ \text{"3. Subtotal"} \\ \text{"4. Primary Screen Wash Water"} \\ \text{"5. Oversized Particle Removal"} \\ \text{"6. Subtotal"} \\ \text{"7. Geotextile tube Feed Pump Seal Water"} \\ \text{"8. Subtotal"} \\ \text{"9. SCA WTP Underflow and Backwash"} \\ \text{"10. Stockpile Filtrate"} \\ \text{"11. Polymer and Makeup Water"} \\ \text{"12. Subtotal"} \\ \text{"13. Geotextile tube Retention"} \\ \text{"14. Average Precipitation"} \\ \text{"15. Subtotal"} \\ \text{"16. Primary Screen Wash Water"} \\ \text{"17. Net Flow to Stormwater Basins"} \\ \text{"18. Effluent to SCA WTP"} \end{pmatrix}$$

Flow rate

$$S0 := \begin{pmatrix} \text{"Total (gpm)"} & \text{"Water (gpm)"} & \text{"Solids (gpm)"} \end{pmatrix}$$

$$FR_{volume\_I} := \text{stack}\left(S0, S1_I, S2_I, S3_I, S4_I, S5_I, S6_I, S7_I, S8_I, S9_I, S10_I, S11_I, S12_I, S13_I, S14_I, S15_I, S16_I, S17_I, S18_I\right)$$

Solids mass flow rate

$$FR_{solids\_I} := \begin{bmatrix} \text{"Solids (lbs/min)"} \\ S1_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S2_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S3_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S4_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S5_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S6_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S7_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S8_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S9_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S10_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S11_{I_{0,2}} \cdot DEN_{polymer} \\ \left(S8_{I_{0,2}} + S9_{I_{0,2}} + S10_{I_{0,2}}\right) \cdot Gs_I \cdot \rho_w + S11_{I_{0,2}} \cdot DEN_{polymer} \\ -\left[\left(S8_{I_{0,2}} + S9_{I_{0,2}} + S10_{I_{0,2}}\right) \cdot Gs_I \cdot \rho_w + S11_{I_{0,2}} \cdot DEN_{polymer} - W_{TSS\_tube\_filtrate\_I}\right] \\ S14_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ W_{TSS\_tube\_filtrate\_I} + S14_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S16_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S17_{I_{0,2}} \cdot Gs_I \cdot \rho_w \\ S18_{I_{0,2}} \cdot Gs_I \cdot \rho_w \end{bmatrix}$$

Concentration

$$CON_I := \text{stack}\left(\text{"Concentration"}, \overrightarrow{\left(\frac{\text{submatrix}\left(FR_{solids\_I}, 1, 18, 0, 0\right)}{\text{submatrix}\left(FR_{volume\_I}, 1, 18, 0, 0\right)}\right)}\right)$$

Mass balance tables

$Title_I$ =

	0
0	"Description"
1	"1. Incoming Slurry"
2	"2. Booster Pump Seal Water"
3	"3. Subtotal"
4	"4. Primary Screen Wash Water"
5	"5. Oversized Particle Removal"
6	"6. Subtotal"
7	"7. Geotextile tube Feed Pump Seal Water"
8	"8. Subtotal"
9	"9. SCA WTP Underflow and Backwash"
10	"10. Stockpile Filtrate"
11	"11. Polymer and Makeup Water"
12	"12. Subtotal"
13	"13. Geotextile tube Retention"
14	"14. Average Precipitation"
15	"15. Subtotal"
16	"16. Primary Screen Wash Water"
17	"17. Net Flow to Stormwater Basins"
18	"18. Effluent to SCA WTP"

FR_{volume_I} = (gpm)

	0	1	2
0	"Total (gpm)"	"Water (gpm)"	"Solids (gpm)"
1	5000	4792	208
2	250	250	0
3	5250	5042	208
4	102	102	0
5	-0.7	-0.3	-0.4
6	5351.3	5143.7	207.6
7	15	15	0
8	5366.3	5158.7	207.6
9	1065.9	1065	0.9
10	0.1	0.1	0
11	175	174.5	0.5
12	6607.3	6398.3	209
13	-742.6	-534	-208.5
14	141.4	141.4	0
15	6006.1	6005.7	0.4
16	-102	-102	0
17	-150.4	-150.4	-0
18	5753.8	5753.3	0.4

FR_{solids_I} = ($\frac{lb}{min}$)

	0
0	"Solids (lbs/min)"
1	4443.5
2	0
3	4443.5
4	0
5	-8.9
6	4434.6
7	0
8	4434.6
9	19.3
10	0
11	2.9
12	4456.8
13	-4447.4
14	0
15	9.4
16	0
17	-0.2
18	9.2

CON_I = ($\frac{mg}{L}$)

	0
0	"Concentration"
1	106489.2
2	0
3	101418.3
4	0
5	1560975.6
6	99299.1
7	0
8	99021.5
9	2171.2
10	195.2
11	1994.3
12	80826.5
13	717661.1
14	0
15	187.3
16	0
17	187.3
18	190.6

Note: Stream Number 1A: Supplemental Lake Water Intake is not shown on these tables.

Phase II:

Stream Number 1:Incoming slurry

$S1_{II} := (q \;\; q_{w\_II} \;\; q_{s\_II})$ $\qquad S1_{II} = (5000 \;\; 4798.1 \;\; 201.9)\,gpm$

Stream number 1A: Supplemental lake water intake (normally zero)

$S1A_{II} := (0 \;\; 0 \;\; 0)gpm$

Stream Number 2: booster pump seal water

$S2_{II} := (N_{booster} \cdot q_{booster} \;\; N_{booster} \cdot q_{booster} \;\; 0gpm)$ $\qquad S2_{II} = (250 \;\; 250 \;\; 0)\,gpm$

Stream Number 3: Subtotal

$S3_{II} := S1_{II} + S1A_{II} + S2_{II}$ $\qquad S3_{II} = (5250 \;\; 5048.1 \;\; 201.9)\,gpm$

Stream Number 4: Primary Screen Wash Water

$S4_{II} := (q_{primary} \;\; q_{primary} \;\; 0gpm)$ $\qquad S4_{II} = (102 \;\; 102 \;\; 0)\,gpm$

Stream Number 5: Over-sized Particle Removal

$S5_{II} := \left[-(q_{w\_oversized\_II} + q_{oversized\_II}) \;\; -q_{w\_oversized\_II} \;\; -q_{oversized\_II}\right]$

$S5_{II} = (-5.4 \;\; -2.1 \;\; -3.2)\,gpm$

Stream Number 6: Subtotal

$S6_{II} := S3_{II} + S4_{II} + S5_{II}$ $\qquad S6_{II} = (5346.6 \;\; 5147.9 \;\; 198.7)\,gpm$

Stream Number 7: Hydrocyclone feed pump seal water

$S7_{II} := (N_{cyclone\_pump} \cdot q_{cyclone\_pump} \;\; N_{cyclone\_pump} \cdot q_{cyclone\_pump} \;\; 0gpm)$

$S7_{II} = (30 \;\; 30 \;\; 0)\,gpm$

Stream Number 8: Subtotal

$S8_{II} := S6_{II} + S7_{II}$ $\qquad S8_{II} = (5376.6 \;\; 5177.9 \;\; 198.7)\,gpm$

Stream Number 9: Secondary screen and hydrocyclone screen wash water

$S9_{II} := (q_{second\_cyclone} \;\; q_{second\_cyclone} \;\; 0gpm)$ $\qquad S9_{II} = (510 \;\; 510 \;\; 0)\,gpm$

Stream Number 10: Gravel removal by secondary screens

$S10_{II} := \left[-(q_{w\_gravel\_II} + q_{gravel\_II}) \;\; -q_{w\_gravel\_II} \;\; -q_{gravel\_II}\right]$

$S10_{II} = (-48.3 \;\; -19.2 \;\; -29.1)\,gpm$

Stream Number 11: Sand removal by hydrocyclones

$S11_{II} := \left[-(q_{w\_sand\_II} + q_{sand\_II}) \;\; -q_{w\_sand\_II} \;\; -q_{sand\_II}\right]$

$S11_{II} = (-137.4 \;\; -54.6 \;\; -82.8)\,gpm$

Stream number 12: Subtotal

$S12_{II} := S8_{II} + S9_{II} + S10_{II} + S11_{II}$ $\qquad S12_{II} = (5700.9 \;\; 5614.1 \;\; 86.8)\,gpm$

Stream Number 13: Geotextile tube feed pump seal water

$S13_{II} := \left(N_{tube\_pump} \cdot q_{tube\_pump} \quad N_{tube\_pump} \cdot q_{tube\_pump} \quad 0gpm\right)$ $S13_{II} = \left(15 \quad 15 \quad 0\right) gpm$

Stream Number 14: Subtotal

$S14_{II} := S12_{II} + S13_{II}$ $S14_{II} = \left(5715.9 \quad 5629.1 \quad 86.8\right) gpm$

Stream Number 15: SCA WTP clarifier underflow and filter backwash

$S15_{II} := \left(q_{WTP} \quad q_{W\_WTP\_II} \quad q_{WTP\_TSS\_II}\right)$ $S15_{II} = \left(1065.9 \quad 1065 \quad 0.9\right) gpm$

Stream Number 16: Stockpile filtrate

$S16_{II} := \left(q_{stock\_filtrate\_II} \quad q_{w\_stock\_filtrate\_II} \quad q_{TSS\_stock\_filtrate\_II}\right)$ $S16_{II} = \left(30.38997 \quad 30.38772 \quad 0.00225\right) gpm$

Stream Number 17: Coagulant and makeup water

$S17_{II} := \left(q_{coagwater} + q_{coag} \quad q_{coagwater} \quad q_{coag}\right)$ $S17_{II} = \left(66.752 \quad 66.111 \quad 0.642\right) gpm$

Stream Number 18: Polymer and makeup water

$S18_{II} := \left(q_{polymerwater\_II} + q_{drypolymer\_II} \quad q_{polymerwater\_II} \quad q_{drypolymer\_II}\right)$ $S18_{II} = \left(92.3085 \quad 92.0455 \quad 0.263\right) gpm$

Stream Number 19: Subtotal

$S19_{II} := S14_{II} + S15_{II} + S16_{II} + S17_{II} + S18_{II}$ $S19_{II} = \left(6971.3 \quad 6882.7 \quad 88.6\right) gpm$

Stream Number 20: Geotextile tube retention

$S20_{II} := \left[-\left(q_{w\_ret3\_II} + q_{s\_ret\_II}\right) \quad -q_{w\_ret3\_II} \quad -q_{s\_ret\_II}\right]$ $S20_{II} = \left(-320.576956 \quad -232.406138 \quad -88.170818\right) gpm$

Stream Number 21: Average precipitation

$S21_{II} := \left(q_{PRE} \quad q_{PRE} \quad 0gpm\right)$ $S21_{II} = \left(141.4 \quad 141.4 \quad 0\right) gpm$

Stream Number 22: Subtotal

$S22_{II} := S19_{II} + S20_{II} + S21_{II}$ $S22_{II} = \left(6792.128 \quad 6791.682 \quad 0.446\right) gpm$

Stream Number 23: Primary, secondary and hydrocyclone screen wash water

$S23_{II} := -\left(q_{primary} + q_{second\_cyclone} \quad q_{primary} + q_{second\_cyclone} \quad 0gpm\right)$ $S23_{II} = \left(-612 \quad -612 \quad 0\right) gpm$

Stream Number 24: Net flow to Stormwater basin

$$S24_{water} := -\left[S22_{II_{0,1}} - q_{primary} - q_{second\_cyclone} - \left(q_{w\_dis\_II} + q_{coagwater} + q_{polymerwater\_II} + q_{W\_WTP\_II}\right)\right]$$

$$S24_{TSS} := \frac{S24_{water} \cdot S22_{II_{0,2}}}{S22_{II_{0,1}}} \qquad S24_{total} := S24_{water} + S24_{TSS}$$

$S24_{II} := \left(S24_{total} \quad S24_{water} \quad S24_{TSS}\right)$ $S24_{II} = \left(-442.65 \quad -442.621 \quad -0.029\right) gpm$

Note: If the volume at Stream Number 24 is positive, it indicates no net flow to stormwater basins. Input zero for volume at Stream Number 24 in this case.

Stream Number 25: Effluent to SCA WTP

$S25_{II} := S22_{II} + S23_{II} + S24_{II}$ $S25_{II} = \left(5737.478 \quad 5737.061 \quad 0.417\right) gpm$

$$\text{Title}_{II} := \begin{pmatrix} \text{"Description"} \\ \text{"1. Incoming Slurry"} \\ \text{"2. Booster Pump Seal Water"} \\ \text{"3. Subtotal"} \\ \text{"4. Primary Screen Wash Water"} \\ \text{"5. Oversized Particle Removal"} \\ \text{"6. Subtotal"} \\ \text{"7. Hydrocyclone Feed Pump Seal Water"} \\ \text{"8. Subtotal"} \\ \text{"9. Secondary Screen and Hydrocyclone Screen Wash Water"} \\ \text{"10. Gravel Removal by Secondary Screens"} \\ \text{"11. Sand Removal by Hydrocyclones"} \\ \text{"12. Subtotal"} \\ \text{"13. Geotextile tube Feed Pump Seal Water"} \\ \text{"14. Subtotal"} \\ \text{"15. SCA WTP Underflow and Backwash"} \\ \text{"16. Stockpile Filtrate"} \\ \text{"17. Coagulant and Makeup Water"} \\ \text{"18. Polymer and Makeup Water"} \\ \text{"19. Subtotal"} \\ \text{"20. Geotextile tube Retention"} \\ \text{"21. Average Precipitation"} \\ \text{"22. Subtotal"} \\ \text{"23. Primary, Secondary and Hydrocyclone Screen Wash Water"} \\ \text{"24. Net Flow to Stormwater Basin"} \\ \text{"25. Effluent to SCA WTP"} \end{pmatrix}$$

Flow rate

$$FR_{volume\_IIa} := \text{stack}(S0, S1_{II}, S2_{II}, S3_{II}, S4_{II}, S5_{II}, S6_{II}, S7_{II}, S8_{II}, S9_{II}, S10_{II}, S11_{II}, S12_{II}) *$$

$$FR_{volume\_IIb} := \text{stack}(S13_{II}, S14_{II}, S15_{II}, S16_{II}, S17_{II}, S18_{II}, S19_{II}, S20_{II}, S21_{II}, S22_{II}, S23_{II}, S24_{II}, S25_{II}) *$$

$$FR_{volume\_II} := \text{stack}(FR_{volume\_IIa}, FR_{volume\_IIb})$$

Solids mass flow rate

$$FR_{solids\_II} := \begin{bmatrix} \text{"Solids (lbs/min)"} \\ S1II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S2II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S3II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S4II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S5II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S6II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S7II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S8II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S9II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S10II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S11II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S12II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S13II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S14II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S15II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S16II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S17II_{0,2} \cdot DEN_{coag} \\ S18II_{0,2} \cdot DEN_{polymer} \\ \left(S14II_{0,2} + S15II_{0,2} + S16II_{0,2}\right) \cdot Gs_{II} \cdot \rho_w + S17II_{0,2} \cdot DEN_{coag} + S18II_{0,2} \cdot DEN_{polymer} \\ -\left[\left(S14II_{0,2} + S15II_{0,2} + S16II_{0,2}\right) \cdot Gs_{II} \cdot \rho_w + S17II_{0,2} \cdot DEN_{coag} + S18II_{0,2} \cdot DEN_{polymer} - W_{TSS\_tube\_filtrate\_II}\right] \\ S21II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ W_{TSS\_tube\_filtrate\_II} + S21II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S23II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S24II_{0,2} \cdot Gs_{II} \cdot \rho_w \\ S25II_{0,2} \cdot Gs_{II} \cdot \rho_w \end{bmatrix}$$

Concentration

$$CON_{II} := \text{stack}\left(\text{"Concentration"}, \overrightarrow{\left(\frac{\text{submatrix}\left(FR_{solids\_II}, 1, 25, 0, 0\right)}{\text{submatrix}\left(FR_{volume\_II}, 1, 25, 0, 0\right)}\right)}\right)$$

Mass balance table

$Title_{II} =$

	0
0	"Description"
1	"1. Incoming Slurry"
2	"2. Booster Pump Seal Water"
3	"3. Subtotal"
4	"4. Primary Screen Wash Water"
5	"5. Oversized Particle Removal"
6	"6. Subtotal"
7	"7. Hydrocyclone Feed Pump Seal Water"
8	"8. Subtotal"
9	"9. Secondary Screen and Hydrocyclone Screen Wash Water"
10	"10. Gravel Removal by Secondary Screens"
11	"11. Sand Removal by Hydrocyclones"
12	"12. Subtotal"
13	"13. Geotextile tube Feed Pump Seal Water"
14	"14. Subtotal"
15	"15. SCA WTP Underflow and Backwash"
16	"16. Stockpile Filtrate"
17	"17. Coagulant and Makeup Water"
18	"18. Polymer and Makeup Water"
19	"19. Subtotal"
20	"20. Geotextile tube Retention"
21	"21. Average Precipitation"
22	"22. Subtotal"
23	"23. Primary, Secondary and Hydrocyclone Screen Wash Water"
24	"24. Net Flow to Stormwater Basin"
25	"25. Effluent to SCA WTP"

FR_{volume_II} =

	0	1	2
0	"Total (gpm)"	"Water (gpm)"	"Solids (gpm)"
1	5000	4798.1	201.9
2	250	250	0
3	5250	5048.1	201.9
4	102	102	0
5	-5.4	-2.1	-3.2
6	5346.6	5147.9	198.7
7	30	30	0
8	5376.6	5177.9	198.7
9	510	510	0
10	-48.3	-19.2	-29.1
11	-137.4	-54.6	-82.8
12	5700.9	5614.1	86.8
13	15	15	0
14	5715.9	5629.1	86.8
15	1065.9	1065	0.9
16	30.4	30.4	0
17	66.8	66.1	0.6
18	92.3	92	0.3
19	6971.3	6882.7	88.6
20	-320.6	-232.4	-88.2
21	141.4	141.4	0
22	6792.1	6791.7	0.4
23	-612	-612	0
24	-442.7	-442.6	-0
25	5737.5	5737.1	0.4

gpm

FR_{solids_II} =

	0
0	"Solids (lbs/min)"
1	4449.1
2	0
3	4449.1
4	0
5	-71.2
6	4377.9
7	0
8	4377.9
9	0
10	-640.7
11	-1824.1
12	1913.1
13	0
14	1913.1
15	19.3
16	0
17	5.5
18	1.5
19	1939.5
20	-1929.7
21	0
22	9.8
23	0
24	-0.6
25	9.2

CON_{II} =

	0
0	"Concentration"
1	106623.6
2	0
3	101546.3
4	0
5	1590361.4
6	98115.5
7	0
8	97568.1
9	0
10	1590361.4
11	1590361.4
12	40211.1
13	0
14	40105.6
15	2171.2
16	195.2
17	9903.8
18	1994.3
19	33337.7
20	721285.1
21	0
22	173.5
23	0
24	173.5
25	192.1

$\frac{mg}{L}$

Note: Stream Number 1A: Supplemental Lake Water Intake is not shown on these tables.

Table 1 Geotechnical Properties

2.2M cy Dredging Volume (Base+Contingency)

Remediation Area	Total Dry Weight	Over-Sized Grain	Gravel-Sized Grain (including Over-Sized)	Sand-Sized Grain	Fines	Percent Over-Sized	Percent Gravel (including Over-sized)	Percent Sand	Percent Fines	Weighted Average Specific Gravity
	(tons)	(tons)	(tons)	(tons)	(tons)	(%)	(%)	(%)	(%)	
A	122,063	415	4,150	43,821	74,214	0.34%	3.4%	35.9%	60.8%	
B	20,228	218	2,185	7,545	10,498	1.08%	10.8%	37.3%	51.9%	
C	39,646	428	4,282	14,788	20,576	1.08%	10.8%	37.3%	51.9%	
D	539,814	756	7,557	77,733	454,523	0.14%	1.4%	14.4%	84.2%	
E	613,208	11,528	115,283	257,547	240,377	1.88%	18.8%	42.0%	39.2%	
C/D	579,460	1,184	11,839	92,521	475,100	0.20%	2.0%	16.0%	82.0%	2.56
A/B/E	755,498	12,162	121,618	308,913	325,090	1.61%	16.1%	40.9%	43.0%	2.64

SPREADSHEET CALCULATIONS

PARSONS

Project Number: 444853	Calc.No. from index: 3	Preparer: XDH	Date: 2/17/2010	Rev. No.: 2	Preparer:	Date:
Project Name: Sediment Management Design	Calculation Title: Mass Balance	Reviewer: MTO	Date: 2/18/2010		Review:	Date:

RA-C/D **Maximum Flow Scenario** **5,000 GPM**

Primary Screens Only

Stream Number	1	1A	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Description	Dredge Slurry	Supplemental Lake Water Intake	Booster Pumps Seal Water		Primary Screen Wash Water from SCA Sumps	Over-Sized Removed from Primary Screen		Geotextile Tube Feed Pump Seal Water		Clarifier Underflow and Filter Backwash from SCA WTP	Filtrate from Screened Material Stockpile	Polymer and Makeup Water from SCA WTP		Geotextile Tube Retention	Average Precipitation		Primary Screen Wash Water	Net Flow to Stormwater Basins	Dewatering Effluent to SCA WTP Influent
Total (gpm)	5,000	0	250	5,250	102	(0.7)	5,351	15	5,366	1,065.9	0.1	175.0	6,607	(742.6)	141	6,006	(102)	(150)	5,754
Water (gpm)	4,792	0	250	5,042	102	(0.3)	5,144	15	5,159	1,065.0	0.1	174.5	6,398	(534.0)	141	6,006	(102)	(150)	5,753
Solids (gpm) (Note 2)	208.0	0.0	0.0	208.0	0.0	(0.4)	207.6	0.0	207.6	0.9	0.00001	0.5	209.0	(208.5)	0.0	0.4	0.0	(0.01)	0.4
Solids (lbs/min) (Note 2)	4,443.5	0.0	0.0	4,443.5	0.0	(8.9)	4,434.6	0.0	4,434.6	19.3	0.0002	2.9	4,456.8	(4,447.4)	0.0	9.4	0.0	(0.2)	9.2
Concentration (mg/L)	106,489.2	NA	0.0	101,418.3	0.0	1,560,975.6	99,299.1	0.0	99,021.5	2,171.2	195.2	1,994.3	80,826.5	717,661.1	0.0	187.3	0.0	187.3	190.6

RA-C/D **Average Flow Scenario** **3,500 GPM**

Primary Screens Only

Stream Number	1	1A	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Description	Dredge Slurry	Supplemental Lake Water Intake	Booster Pumps Seal Water		Primary Screen Wash Water from SCA Sumps	Over-Sized Removed from Primary Screen		Geotextile Tube Feed Pump Seal Water		Clarifier Underflow and Filter Backwash from SCA WTP	Filtrate from Screened Material Stockpile	Polymer and Makeup Water from SCA WTP		Geotextile Tube Retention	Average Precipitation		Primary Screen Wash Water	Net Flow to Stormwater Basins	Dewatering Effluent to SCA WTP Influent
Total (gpm)	3,500	0	175	3,675	71	(0.5)	3,746	11	3,756	1,065.9	0.1	122.8	4,945	(520.7)	141	4,566	(71)	0	4,494
Water (gpm)	3,354	0	175	3,529	71	(0.2)	3,601	11	3,611	1,065.0	0.1	122.4	4,799	(374.5)	141	4,566	(71)	0	4,494
Solids (gpm) (Note 2)	145.6	0.0	0.0	145.6	0.0	(0.3)	145.3	0.0	145.3	0.9	0.00001	0.3	146.6	(146.2)	0.0	0.3	0.0	0.0	0.3
Solids (lbs/min) (Note 2)	3,110.4	0.0	0.0	3,110.4	0.0	(6.2)	3,104.2	0.0	3,104.2	19.3	0.0001	2.0	3,125.6	(3,118.5)	0.0	7.1	0.0	0.0	7.1
Concentration (mg/L)	106,489.2	NA	0.0	101,418.3	0.0	1,560,975.6	99,299.1	0.0	99,021.5	2,171.2	195.2	1,994.3	75,736.0	717,576.9	0.0	186.1	0.0	NA	189.1

RA-A/B/E/F **Maximum Flow Scenario** **5,000 GPM**

Primary Screens, Secondary Screens, Hydrocyclones

Stream Number	1	1A	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Description	Dredge Slurry	Supplemental Lake Water Intake	Booster Pumps Seal Water		Primary Screen Wash Water from SCA Sump	Over-Sized Removed from Primary Screen		Sand Separation Feed Pumps Seal Water		Secondary Screen and Hydrocyclone Screen Wash Water from SCA Sump	Gravel Removed from Secondary Screen	Sand Removed from Hydrocyclone		Geotextile Tube Feed Pump Seal Water		Clarifier Underflow and Filter Backwash from SCA WTP	Filtrate from Screened Material Stockpile	Coagulant Emulsion and Makeup Water from SCA WTP	Polymer and Makeup Water from SCA WTP		Geotextile Tube Retention	Average Precipitation		Primary, Secondary and Hydrocyclone Screen Wash Water	Net Flow to Stormwater Basins	Dewatering Effluent to SCA WTP Influent
Total (gpm)	5000	0	250	5,250	102	(5.4)	5,347	30	5,377	510	(48.3)	(137.4)	5,701	15	5,716	1,065.9	30.4	66.8	92.3	6,971	(320.6)	141	6,792	(612)	(442.7)	5,737
Water (gpm)	4798	0	250	5,048	102	(2.1)	5,148	30	5,178	510	(19.2)	(54.6)	5,614	15	5,629	1,065.0	30.4	66.1	92.0	6,883	(232.4)	141	6,792	(612)	(442.6)	5,737
Solids (gpm) (Note 2)	201.9	0.0	0.0	201.9	0.0	(3.2)	198.7	0.0	198.7	0.0	(29.1)	(82.8)	86.8	0.0	86.8	0.9	0.002	0.6	0.3	88.6	(88.2)	0.0	0.4	0.0	(0.03)	0.4
Solids (lbs/min) (Note 2)	4,449.1	0.0	0.0	4,449.1	0.0	(71.2)	4,377.9	0.0	4,377.9	0.0	(640.7)	(1,824.1)	1,913.1	0.0	1,913.1	19.3	0.05	5.5	1.5	1,939.5	(1,929.7)	0.0	9.8	0.0	(0.6)	9.2
Concentration (mg/L)	106,623.6	NA	0.0	101,546.3	0.0	1,590,361.5	98,115.5	0.0	97,568.1	0.0	1,590,361.5	1,590,361.5	40,211.1	0.0	40,105.6	2,171.2	195.2	9,903.8	1,994.3	33,337.7	721,285.1	0.0	173.5	0.0	173.5	192.1

RA-A/B/E/F **Average Flow Scenario** **3,500 GPM**

Primary Screens, Secondary Screens, Hydrocyclones

Stream Number	1	1A	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Description	Dredge Slurry	Supplemental Lake Water Intake	Booster Pumps Seal Water		Primary Screen Wash Water from SCA Sump	Over-Sized Removed from Primary Screen		Sand Separation Feed Pumps Seal Water		Secondary Screen and Hydrocyclone Screen Wash Water from SCA Sump	Gravel Removed from Secondary Screen	Sand Removed from Hydrocyclone		Geotextile Tube Feed Pump Seal Water		Clarifier Underflow and Filter Backwash from SCA WTP	Filtrate from Screened Material Stockpile	Coagulant Emulsion and Makeup Water from SCA WTP	Polymer and Makeup Water from SCA WTP		Geotextile Tube Retention	Average Precipitation		Primary, Secondary and Hydrocyclone Screen Wash Water	Net Flow to Stormwater Basins	Dewatering Effluent to SCA WTP Influent
Total (gpm)	3500	0	175	3,675	71	(3.8)	3,743	21	3,764	357	(33.8)	(96.2)	3,991	11	4,001	1,065.9	21.3	46.9	64.9	5,200	(225.3)	141	5,116	(428)	0	4,688
Water (gpm)	3359	0	175	3,534	71	(1.5)	3,604	21	3,625	357	(13.4)	(38.3)	3,930	11	3,940	1,065.0	21.3	46.5	64.7	5,138	(163.4)	141	5,116	(428)	0	4,687
Solids (gpm) (Note 2)	141.4	0.0	0.0	141.4	0.0	(2.3)	139.1	0.0	139.1	0.0	(20.4)	(58.0)	60.8	0.0	60.8	0.9	0.002	0.5	0.2	62.3	(62.0)	0.0	0.3	0.0	0.0	0.3
Solids (lbs/min) (Note 2)	3,114.4	0.0	0.0	3,114.4	0.0	(49.8)	3,064.5	0.0	3,064.5	0.0	(448.5)	(1,276.9)	1,339.2	0.0	1,339.2	19.3	0.03	3.9	1.1	1,363.5	(1,356.1)	0.0	7.4	0.0	0.0	7.4
Concentration (mg/L)	106,623.6	NA	0.0	101,546.3	0.0	1,590,361.5	98,115.5	0.0	97,568.1	0.0	1,590,361.5	1,590,361.5	40,211.1	0.0	40,105.6	2,171.2	195.2	9,903.8	1,994.3	31,418.6	721,095.5	0.0	173.5	0.0	NA	189.3

Notes:

(1). Stream number without description indicates the total flow at that point.
(2). Theoretical dry weight basis.
(3). Numbers within parenthesis represent diverted flows.
(4). NA indicates not applicable.

Row	A	B	D	F	Notes
1	PARSONS	Project Number: 444853 Calc.No. from index: 3 Preparer: XDH Date:2/17/2010 Rev. No.:2 Preparer: Date:			
3		Project Name:Sediment Management Design Calculation Title: Mass Balance Reviewer:MTO Date:2/18/2010 Review: Date:			
6	**Incoming Slurry**				**Notes**
7	Slurry Flow Rate, q	5,000 gpm			Maximum flow
8	Working Hours, t	24 hr/day			
9	Daily Slurry Volume, q_T	7,200,000 gallons/day	962,500 ft^3/day		
10	Solids Content by Weight of Incoming Slurry, P_s	10%			
11	Specific Gravity of Solids, G_s	2.56			Tab "Weight&Volume"
12	Unit Weight of Water, γ_w	62.4279606 pcf			
13	Slurry Water Content, WC	900%			
14	Water Flow Rate, q_w	4792 gpm			
15	Dry Solids Flow Rate, q_s	208 gpm			
16	Daily Water Volume, q_w	6,900,499 gallons/day	922,463 ft^3/day		
17	Daily Water Weight, W_w	57,587,459 lbs/day			
18	Daily Dry Solids Volume, q_s	299,501 gallons/day	40,037 ft^3/day		
19	Daily Dry Solids Weight, W_s	6,398,607 lbs/day			
20	Slurry Concentration, C_{s1}	0.89 lbs/gallon	6.6 lb/ft^3		
21	% Water in Slurry (by Volume)	96%			
24	**Booster Pump Seal Water**				
25	Booster Pump Seal Water (each), $q_{booster}$	50 gpm			
26	Number of Booster Pumps, $N_{booster}$	5			
27	Daily Volume of Booster Pump Seal Water	360,000 gallons/day	48,125 ft^3/day		
28	Daily Weight of Booster Seal Water	3,004,346 lbs/day			
30	**Primary Screens (Over-Sized Particle Removal, >2-inch)**				
31	Average Percentage of Over-Sized Particles, $P_{over-sized}$	0.2%			Tab "Weight&Volume"
32	Daily Dry Weight of Removed Over-Sized Particle, $W_{over-sized}$	12,797 lbs/day			
33	Daily Volume of Removed Over-Sized Particle, $q_{over-sized}$	599 gallons/day	80 ft^3/day		
34	Initial Water Content of Removed Over-Sized Particles in Stockpile, WC_{istock}	25%			
35	Daily Weight f Water Removed with Over-Sized Particles, $W_{w-over-sized}$	3,199 lbs/day			
36	Daily Volume of Water Removed with Over-Sized Particles, $q_{w-over-sized}$	383 gallons/day	51 ft^3/day		
37	Remaining Daily Dry Solids Weight in Slurry, W_{sr1}	6,385,809 lbs/day			
38	Remaining Daily Water Weight Slurry, W_{wr1}	57,584,260 lbs/day			
39	Remaining Daily Solids Volume Slurry, q_{sr1}	298,902 gallons/day	39,957 ft^3/day		
40	Remaining Daily Water Volume Slurry, q_{wr1}	6,900,116 gallons/day	922,411 ft^3/day		
42	**Geotextile Tube Feed Pump Seal Water**				
43	Geotextile Tube Feed Pump Seal Water (each), $q_{tube-pump}$	15 gpm			
44	Number of Geotextile Tube Feed Pumps, $N_{tube-pump}$	1			
45	Daily Volume of Tube Feed Pump Seal Water	21,600 gallons/day	2,888 ft^3/day		
46	Daily Weight of Tube Feed Pump Seal Water	180,261 lbs/day			
48	**Secondary Screens (Gravel Removal for RA-A/B/E/F)**				
49	Average Percentage of Gravel in RA-A/B/E/F, P_{gravel}	No Applicable			
50	Daily Dry Weight of Removed Gravel, W_{gravel}				
51	Daily Volume of Removed Gravel, q_{gravel}				
52	Initial Water Content of Removed Gravel in Stockpile, WC_{gravel}				
53	Daily Weight of Water Removed with Gravel, $W_{w-gravel}$				
54	Daily Volume of Water Removed with Gravel, $q_{w-gravel}$				
55	Remaining Daily Dry Solids Weight in Slurry, W_{sr2}				
56	Remaining Daily Water Weight in Slurry, W_{wr2}				
57	Remaining Daily Dry Solids Volume in Slurry, q_{sr2}				
58	Remaining Daily Water Volume in Slurry, q_{wr2}				
60	**Hydrocyclone (Sand Removal for RA-A/B/E/F)**				
61	Average Percentage of Sand in RA-A/B/E/F, P_{sand}	No Applicable			
62	Daily Dry Weight of Removed Sand, W_{sand}				
63	Daily Volume of Removed Sand, q_{sand}				
64	Initial Water Content of Removed Sand in Stockpile, WC_{sand}				
65	Daily Weight of Water Removed with Sand, W_{w-sand}				
66	Daily Water Removed with Sand Volume, q_{w-sand}				
67	Remaining Daily Dry Solids Weight in Slurry, W_{sr3}				
68	Remaining Daily Water Weight in Slurry, W_{wr3}				
69	Remaining Daily Dry Solids Volume in Slurry, q_{sr3}				
70	Remaining Daily Water Volume in Slurry, q_{wr3}				
73	**SCA WTP**				**Notes**
74	I.P Clarifier Sludge (OBG line number 16)				OBG's estimate.
75	Total Suspended Solids, $TSS_{clarifier}$	3017.9 mg/L	11424.0 mg/gallon	0.001 gallon/gallon	
76	Clarifier Sludge Flow Rate, $q_{clarifier}$	735 gpm			
77	Flow Rate of Solids in Clarifier Sludge, $q_{TSS-clarifier}$	0.87 gpm			
78	Flow Rate of Water in Clarifier Sludge, $q_{w-clarifier}$	734.1 gpm			
79	Weight of Dry Solids in Clarifier Sludge, $W_{TSS-clarifier}$	8.40 kg/min	1110.7 lbs/hr	26,656 lbs/day	
80	Spent MMF Backwash (OBG line number 21)				
81	Total Suspended Solids, TSS_{MMF}	483.3 mg/L	1829.5 mg/gallon	0.0002 gallon/gallon	
82	MMF Backwash Flow Rate, q_{MMF}	166.3 gpm			
83	Flow Rate of Solids in MMF Backwash, $q_{TSS-MMF}$	0.03 gpm			
84	Flow Rate of Water in MMF Backwash, q_{w-MMF}	166.3 gpm			
85	Weight of Dry Solids in MMF Backwash, $W_{TSS-MMF}$	0.30 kg/min	40.2 lbs/hr	966 lbs/day	
86	Spent GAC Backwash (OBG line number 22)				
87	Total Suspended Solids, TSS_{GAC}	95.8 mg/L	362.6 mg/gallon	0.00004 gallon/gallon	
88	GAC Backwash Flow Rate, q_{GAC}	164.6 gpm			
89	Flow Rate of Solids in GAC Backwash, $q_{TSS-GAC}$	0.006 gpm			
90	Flow Rate of Water in GAC Backwash, q_{w-GAC}	164.6 gpm			
91	Weight of Dry Solids in GAC Backwash, $W_{TSS-GAC}$	0.06 kg/min	7.9 lbs/hr	189 lbs/day	
92	**SCA WTP Total**				
93	Total Flow Rate, q_{WTP}	1065.9 gpm	1,534,896 gallons/day	205,186 ft^3/day	
94	Solid Flow Rate, $q_{WTP-TSS}$	0.9 gpm	1,302 gallons/day	174 ft^3/day	
95	Water Flow Rate, q_{w-WTP}	1065.0 gpm	1,533,594 gallons/day	205,012 ft^3/day	
96	Water Weight, W_{w-WTP}	12,798,465 lbs/day			
97	Solids Weight, $W_{WTP-TSS}$	27,812 lbs/day			
99	**Water from Removed Material (Over-sized) Stockpile**				
100	Typical Solids Content of Sand from Hydrocyclone Shaker (TotalClean) (75-85%)	80%			DelTank TCW-3000
101	Sand Water Content	25%			
102	Assumed Initial Water Content of Screened Material Stockpile, WC_{istock}	25%			
103	Assumed Final Water Content of Screened Material Stockpile, WC_{fstock}	15%			
105	Weight of Water Removed from Stockpile (Water Content from 25% to 15%), $W_{w-stock}$	1,280 lbs/day			
106	Volume of Water Removed from Stockpile (Water Content from 25% to 15%), $q_{w-stock}$	153 gallons/day	20 ft^3/day		
107	Weight of Water Remained in Stockpile, $W_{wr-stock}$	1,920 lbs/day			
108	Volume of Water Remained in Stockpile, $q_{wr-stock}$	230 gallons/day	31 ft^3/day		
110	**Total Suspended Solids in Stockpile Filtrate**				
111	Total Suspended Solids, $TSS_{stock-filtrate}$	195.2 mg/L	738.9 mg/gallon	0.0001 gallon/gallon	
112	Total Stockpile Filtrate Flow Rate, $q_{stock-filtrate}$	0.1 gpm	153 gallons/day		
113	Flow Rate of Solids in Stockpile Filtrate, $q_{s-stock-filtrate}$	8.12042E-06 gpm	0.01 gallons/day		
114	Flow Rate of Water in Stockpile Filtrate, $q_{w-stock-filtrate}$	0.11 gpm	153.34 gallons/day		
115	Weight of Dry Solids in Stockpile Filtrate, $W_{TSS-stock-filtrate}$	7.86889E-05 kg/min	0.25 lbs/day		
116	Weight of Water in Stockpile Filtrate, $W_{w-stock-filtrate}$	1,280 lbs/day			
118	**Polymer and Makeup Water**				
119	Percent Fines in Slurry Solids, P_{fine}	82%			
120	Fine Solids Weight (Fines in Slurry, SCA WTP TSS, Stockpile Filtrate TSS)	5274669.47 lbs/day			
121	Polymer Dosage Rate (lbs of dry polymer per dry ton of solids), $DOS_{polymer}$	1.59 lbs/ton			Based on P-GDT draft report.
122	Dry Polymer Density, $DEN_{polymer}$	0.70 g/cm^3			Ashland 2520 MSDS
123	Daily Dry Polymer Needed, $W_{drypolymer}$	4193.36 lbs/day	2.912 lbs/min		
124	Dry Polymer Volume, $q_{drypolymer}$	0.4985 gpm	718 gallons/day	96 ft^3/day	
125	Polymer Makeup Water Volume, $q_{makeupwater}$	174.47 gpm	251,238 gallons/day	33,586 ft^3/day	Based on P-GDT draft report 0.2% dilution
126	Polymer Makeup water Weight, $W_{makeupwater}$	2,096,681 lbs/day			
129	**Coagulant (Emulsion) for RA-A/B/E/F**				
130	Coagulant Dosage Rate lbs of emulsion per dry ton of solids, DOS_{coag}	Not Applicable			
131	Coagulant Density, DEN_{coag}				
132	Coagulant Flow Rate, q_{coag}				
133	Coagulant Weight, W_{coag}				
136	**RA-C/D Primary Screens and Polymer Injection**				**Notes**
137	**Initial Dewatering in Geotextile Tubes (i.e., the first 24 hrs in the tubes)**				
138	Solids Content by Weight after Initial Dewatering in Tubes, P_{s2}	38%			Based on P-GDT draft report.
139	Daily Weight of Dry Solids Retained in Tubes, W_{s-ret2}	6,417,815 lbs/day			
140	Daily Volume of Solids Retained in Tubes, q_{s-ret2}	300,921 gallons/day	40,227 ft^3/day		
141	Daily Weight of Water Retained in Tubes after Initial Dewatering, W_{wr2}	10,471,172 lbs/day			
142	Daily Volume of Water Retained in Tubes after Initial Dewatering, q_{wr2}	1,254,723 gallons/day	167732.0775 ft^3/day		
143	Daily Weight of Water in Initial Filtrate Weight, W_{if}	65,194,121 lbs/day			
144	Daily Volume of Water in Initial Filtrate, q_{if}	7,811,978 gallons/day	1044309.632 ft^3/day		
145	**Consolidation Dewatering in Geotextile Tubes**				
146	Solids Content by Weight after Consolidation Dewatering, P_{s3}	50%			Assumed value
147	Peak Daily Weight of Retained Water in Tubes after Consolidation Dewatering, W_{wr3}	6,417,815 lbs/day			
148	Peak Daily Volume of Retained Water in Tubes after Consolidation Dewatering, q_{wr3}	769,024 gallons/day	102,804 ft^3/day		
149	Peak Daily Weight of Water in Consolidation Dewatering Filtrate, W_{cf}	4,053,357 lbs/day			
150	Peak Daily Volume of Water in Consolidation Dewatering Filtrate, q_{cf}	485,699 gallons/day	64,929 ft^3/day		
151	Consolidation Dewatering Duration, t_c	60 days			
152	Average Water Volume from Consolidation Dewatering of One Day Filling, q_{acf}	8,095 gallons/day	1,082 ft^3/day		
154	Peak Volume of Water in Geotextile Tube Filtrate, $q_{tube-filtrate}$	8,297,677 gallons/day	1,109,238 ft^3/day		
155	Daily Water Retained in Geotextile Tube, $q_{w-retained}$	769,024 gallons/day	102,804 ft^3/day		
159	**Total Suspended Solids in Geotextile Tube Filtrate**				**Notes**
160	Total Suspended Solids, $TSS_{tube-filtrate}$	195.2 mg/L	738.9 mg/gallon	0.0001 gallon/gallon	OBG's estimate.
161	Total Geotextile Tube Filtrate Flow Rate, $q_{tube-filtrate}$	5762.7 gpm	8,298,310 gallons/day		
162	Flow Rate of Solids in Geotextile Tube Filtrate, $q_{s-tube-filtrate}$	0.44 gpm	633 gallons/day		
163	Flow Rate of Water in Geotextile Tube Filtrate, $q_{w-tube-filtrate}$	5762.3 gpm	8,297,677 gallons/day		
164	Weight of Dry Solids in Geotextile Tube Filtrate, $W_{TSS-tube-filtrate}$	4.26 kg/min	13,518 lbs/day		
166	**Precipitation**				
170	**Effluent Tank Discharge (OBG line number 23)**				
171	Total Suspended Solids, $TSS_{discharge}$	4.5 mg/L	17.03 mg/gallon	1.75781E-06 gallon/gallon	OBG's estimate.
172	Total Flow Rate , $MAX_{discharge}$	4,514 gpm	6,500,000 gallons/day		
173	Flow Rate of Solids in Discharge, q_{TSS-ds}	0.008 gpm	11 gallons/day		
174	Flow Rate of Water in Discharge, q_{w-ds}	4513.88 gpm	6,499,989 gallons/day		
175	Weight of Dry Solids in Discharge, W_{TSS-ds}	0.08 kg/min	10.2 lbs/hr	244.1 lbs/day	

Precipitation (rows 167–168):

Row	Daily Precipitation, PRE_{daily} (inch)	Open Area, A_{SCA} (acres)	Flow Rate, q_{prep} (gpd)	Flow Rate, q_{prep} (gpm)	Notes
168	0.15	50	203,657	141.4	On-site met data.

Mass Balance Tables
RA-C/D
Primary Screens and Polymer Injection

Row		Incremental Total (gpm)	Incremental Water (gpm)	Incremental Solids (gpm)	Incremental Solids (lbs/min)	Stream Number	Accumulative Total (gpm)	Accumulative Water (gpm)	Accumulative Solids (gpm)	Accumulative Solids (lbs/min)	Stream Number	Notes
182	Dredge Slurry	5000	4792	208	4443.5	1	5,000	4,792	208	4443.5		
183	Booster Pumps Seal Water	250	250	0	0.0	2	5,250	5,042	208	4443.5	3	
184	Primary Screen Wash Water from SCA Sumps	102	102	0	0.0	4	5,352	5,144	208	4443.5		Vendor's estimate.
185	Over-Sized Removed from Primary Screen	(0.7)	(0.3)	(0.4)	(8.9)	5	5,351	5,144	208	4434.6	6	
186	Geotextile Tube Feed Pump Seal Water	15	15	0	0.0	7	5,366	5,159	208	4434.6	8	
187	Secondary Screen and Hydrocyclone Screen Wash Water from SCA Sump	0	0	0	0.0							
188	Gravel Removed from Secondary Screen	0.0	0.0	0.0	0.0		5,366	5,159	208	4434.6		
189	Sand Removed from Hydrocyclone	0.0	0.0	0.0	0.0		5,366	5,159	208	4434.6		
190	Geotextile Tube Feed Pump Seal Water	0	0	0	0.0		5,366	5,159	208	4434.6		
191	Clarifier Underflow and Filter Backwash from SCA WTP	1066	1065	0.9	19.3	9	6,432	6,224	208	4453.9		
192	Filtrate from Screened Material Stockpile	0.1	0.1	0.00001	0.0	10						
193	Coagulant Emulsion and Makeup Water from SCA WTP	0	0	0.000	0.0							
194	Polymer and Makeup Water from SCA WTP	175	174	0.5	2.9	11	6,607	6,398	209	4456.8	12	
195	Geotextile Tube Retention	(742.6)	(534.0)	(208.5)	(4447.4)	13	5864.7	5864.3	0.4	9.4		
196	Average Precipitation	141	141	0	0.0	14	6006.1	6005.7	0.4	9.4	15	
197	Primary Screen Wash Water	(102)	(102)	0	0.0	16	5904.1	5903.7	0.4	9.4		
198	Net Flow to Stormwater Basins	(150.4)	(150.4)	(0.01)	(0.2)	17	5753.8	5753.3	0.4	9.2	18	Maximum Flow from EQ Basin to WTP
199	Clarifier Underflow and Filter Backwash	(1066)	(1065)	(0.9)	(19.3)		5,754.26	5,753.35	0.912			
200	Polymer Makeup Water	(174)	(174)	0			4,688.36	4,688.35	0.008			Flow from WTP
201	Net Flow to Holding Basin (Downstream Storage)	0	0	0								
202	Maximum Discharge to Metro						4,513.89	4,513.88	0.008			Maximum Discharge to Metro (6.5 MGD)

PARSONS

Project Number: 444853 Calc.No. from index: 3 Preparer: XDH Date:2/17/2010 Rev. No.:2 Preparer: Date:

Project Name:Sediment Management Design Calculation Title: Mass Balance Reviewer:MTO Date:2/18/2010 Review: Date:

Row	A	B	D	Notes
6	**Incoming Slurry**			**Notes**
7	Slurry Flow Rate, q	3,500 gpm		Maximum flow
8	Working Hours, t	24 hr/day		
9	Daily Slurry Volume, q_T	5,040,000 gallons/day	673,750 ft^3/day	
10	Solids Content by Weight of Incoming Slurry, P_s	10%		
11	Specific Gravity of Solids, G_s	2.56		Tab "Weight&Volume"
12	Unit Weight of Water, γ_w	62.4279606 pcf		
13	Slurry Water Content, WC	900%		
14	Water Flow Rate, q_w	3354 gpm		
15	Dry Solids Flow Rate, q_s	146 gpm		
16	Daily Water Volume, q_w	4,830,349 gallons/day	645,724 ft^3/day	
17	Daily Water Weight, W_w	40,311,222 lbs/day		
18	Daily Dry Solids Volume, q_s	209,651 gallons/day	28,026 ft^3/day	
19	Daily Dry Solids Weight, W_s	4,479,025 lbs/day		
20	Slurry Concentration, C_{s1}	0.89 lbs/gallon	6.6 lb/ft^3	
21	% Water in Slurry (by Volume)	96%		
24	**Booster Pump Seal Water**			
25	Booster Pump Seal Water (each), $q_{booster}$	35 gpm		
26	Number of Booster Pumps, $N_{booster}$	5		
27	Daily Volume of Booster Pump Seal Water	252,000 gallons/day	33,688 ft^3/day	
28	Daily Weight of Booster Seal Water	2,103,042 lbs/day		
30	**Primary Screens (Over-Sized Particle Removal, >2-inch)**			
31	Average Percentage of Over-Sized Particles, $P_{over-sized}$	0.2%		Tab "Weight&Volume"
32	Daily Dry Weight of Removed Over-Sized Particle, $W_{over-sized}$	8,958 lbs/day		
33	Daily Volume of Removed Over-Sized Particle, $q_{over-sized}$	419 gallons/day	56 ft^3/day	
34	Initial Water Content of Removed Over-Sized Particles in Stockpile, WC_{istock}	25%		
35	Daily Weight f Water Removed with Over-Sized Particles, $W_{w-over-sized}$	2,240 lbs/day		
36	Daily Volume of Water Removed with Over-Sized Particles, $q_{w-over-sized}$	268 gallons/day	36 ft^3/day	
37	Remaining Daily Dry Solids Weight in Slurry, W_{sr1}	4,470,067 lbs/day		
38	Remaining Daily Water Weight Slurry, W_{wr1}	40,308,982 lbs/day		
39	Remaining Daily Solids Volume Slurry, q_{sr1}	209,231 gallons/day	27,970 ft^3/day	
40	Remaining Daily Water Volume Slurry, q_{wr1}	4,830,081 gallons/day	645,688 ft^3/day	
42	**Geotextile Tube Feed Pump Seal Water**			
43	Geotextile Tube Feed Pump Seal Water (each), $q_{tube-pump}$	10.5 gpm		
44	Number of Geotextile Tube Feed Pumps, $N_{tube-pump}$	1		
45	Daily Volume of Tube Feed Pump Seal Water	15,120 gallons/day	2,021 ft^3/day	
46	Daily Weight of Tube Feed Pump Seal Water	126,183 lbs/day		
48	**Secondary Screens (Gravel Removal for RA-A/B/E/F)**			
49	Average Percentage of Gravel in RA-A/B/E/F, P_{gravel}	No Applicable		
50	Daily Dry Weight of Removed Gravel, W_{gravel}			
51	Daily Volume of Removed Gravel, q_{gravel}			
52	Initial Water Content of Removed Gravel in Stockpile, WC_{gravel}			
53	Daily Weight of Water Removed with Gravel, $W_{w-gravel}$			
54	Daily Volume of Water Removed with Gravel, $q_{w-gravel}$			
55	Remaining Daily Dry Solids Weight in Slurry, W_{sr2}			
56	Remaining Daily Water Weight in Slurry, W_{wr2}			
57	Remaining Daily Dry Solids Volume in Slurry, q_{sr2}			
58	Remaining Daily Water Volume in Slurry, q_{wr2}			
60	**Hydrocyclone (Sand Removal for RA-A/B/E/F)**			
61	Average Percentage of Sand in RA-A/B/E/F, P_{sand}	No Applicable		
62	Daily Dry Weight of Removed Sand, W_{sand}			
63	Daily Volume of Removed Sand, q_{sand}			
64	Initial Water Content of Removed Sand in Stockpile, WC_{sand}			
65	Daily Weight of Water Removed with Sand, W_{w-sand}			
66	Daily Water Removed with Sand Volume, q_{w-sand}			
67	Remaining Daily Dry Solids Weight in Slurry, W_{sr3}			
68	Remaining Daily Water Weight in Slurry, W_{wr3}			
69	Remaining Daily Dry Solids Volume in Slurry, q_{sr3}			
70	Remaining Daily Water Volume in Slurry, q_{wr3}			

Row	A	B	D	F	Notes
73	**SCA WTP**				**Notes**
74	I.P Clarifier Sludge (OBG line number 16)				OBG's estimate.
75	Total Suspended Solids, $TSS_{clarifier}$	3017.9 mg/L	11424.0 mg/gallon	0.001 gallon/gallon	
76	Clarifier Sludge Flow Rate, $q_{clarifier}$	735 gpm			
77	Flow Rate of Solids in Clarifier Sludge, $q_{TSS-clarifier}$	0.87 gpm			
78	Flow Rate of Water in Clarifier Sludge, $q_{w-clarifier}$	734.1 gpm			
79	Weight of Dry Solids in Clarifier Sludge, $W_{TSS-clarifier}$	8.40 kg/min	1110.7 lbs/hr	26,656 lbs/day	
80	Spent MMF Backwash (OBG line number 21)				
81	Total Suspended Solids, TSS_{MMF}	483.3 mg/L	1829.5 mg/gallon	0.0002 gallon/gallon	
82	MMF Backwash Flow Rate, q_{MMF}	166.3 gpm			
83	Flow Rate of Solids in MMF Backwash, $q_{TSS-MMF}$	0.03 gpm			
84	Flow Rate of Water in MMF Backwash, q_{w-MMF}	166.3 gpm			
85	Weight of Dry Solids in MMF Backwash, $W_{TSS-MMF}$	0.30 kg/min	40.2 lbs/hr	966 lbs/day	
86	Spent GAC Backwash (OBG line number 22)				
87	Total Suspended Solids, TSS_{GAC}	95.8 mg/L	362.6 mg/gallon	0.00004 gallon/gallon	
88	GAC Backwash Flow Rate, q_{GAC}	164.6 gpm			
89	Flow Rate of Solids in GAC Backwash, $q_{TSS-GAC}$	0.006 gpm			
90	Flow Rate of Water in GAC Backwash, q_{w-GAC}	164.6 gpm			
91	Weight of Dry Solids in GAC Backwash, $W_{TSS-GAC}$	0.06 kg/min	7.9 lbs/hr	189 lbs/day	
92	**SCA WTP Total**				
93	Total Flow Rate, q_{WTP}	1065.9 gpm	1,534,896 gallons/day	205,186 ft^3/day	
94	Solid Flow Rate, $q_{WTP-TSS}$	0.9 gpm	1,302 gallons/day	174 ft^3/day	
95	Water Flow Rate, q_{w-WTP}	1065.0 gpm	1,533,594 gallons/day	205,012 ft^3/day	
96	Water Weight, W_{w-WTP}	12,798,465 lbs/day			
97	Solids Weight, $W_{WTP-TSS}$	27,812 lbs/day			

Row	A	B	D	Notes
99	**Water from Removed Material (Over-sized) Stockpile**			
100	Typical Solids Content of Sand from Hydrocyclone Shaker (TotalClean) (75-85%)	80%		DelTank TCW-3000
101	Sand Water Content	25%		
102	Assumed Initial Water Content of Screened Material Stockpile, WC_{istock}	25%		
103	Assumed Final Water Content of Screened Material Stockpile, WC_{fstock}	15%		
105	Weight of Water Removed from Stockpile (Water Content from 25% to 15%), $W_{w-stock}$	896 lbs/day		
106	Volume of Water Removed from Stockpile (Water Content from 25% to 15%), $q_{w-stock}$	107 gallons/day	14 ft^3/day	
107	Weight of Water Remained in Stockpile, $W_{wr-stock}$	1,344 lbs/day		
108	Volume of Water Remained in Stockpile, $q_{wr-stock}$	161 gallons/day	22 ft^3/day	

Row	A	B	D	F	Notes
110	**Total Suspended Solids in Stockpile Filtrate**				
111	Total Suspended Solids, $TSS_{stock-filtrate}$	195.2 mg/L	738.9 mg/gallon	0.0001 gallon/gallon	
112	Total Stockpile Filtrate Flow Rate, $q_{stock-filtrate}$	0.1 gpm	107 gallons/day		
113	Flow Rate of Solids in Stockpile Filtrate, $q_{s-stock-filtrate}$	5.68429E-06 gpm	0.01 gallons/day		
114	Flow Rate of Water in Stockpile Filtrate, $q_{w-stock-filtrate}$	0.07 gpm	107.34 gallons/day		
115	Weight of Dry Solids in Stockpile Filtrate, $W_{TSS-stock-filtrate}$	5.50822E-05 kg/min	0.17 lbs/day		
116	Weight of Water in Stockpile Filtrate, $W_{w-stock-filtrate}$	896 lbs/day			
118	**Polymer and Makeup Water**				
119	Percent Fines in Slurry Solids, P_{fine}	82%			
120	Fine Solids Weight (Fines in Slurry, SCA WTP TSS, Stockpile Filtrate TSS)	3700612.17 lbs/day			
121	Polymer Dosage Rate (lbs of dry polymer per dry ton of solids), $DOS_{polymer}$	1.59 lbs/ton			Based on P-GDT draft report.
122	Dry Polymer Density, $DEN_{polymer}$	0.70 g/cm^3			Ashland 2520 MSDS
123	Daily Dry Polymer Needed, $W_{drypolymer}$	2941.99 lbs/day	2.043 lbs/min		
124	Dry Polymer Volume, $q_{drypolymer}$	0.3497 gpm	504 gallons/day	67 ft^3/day	
125	Polymer Makeup Water Volume, $q_{makeupwater}$	122.41 gpm	176,264 gallons/day	23,563 ft^3/day	Based on P-GDT draft report 0.2% dilution
126	Polymer Makeup water Weight, $W_{makeupwater}$	1,470,993 lbs/day			
129	**Coagulant (Emulsion) for RA-A/B/E/F**				
130	Coagulant Dosage Rate lbs of emulsion per dry ton of solids, DOS_{coag}	Not Applicable			
131	Coagulant Density, DEN_{coag}				
132	Coagulant Flow Rate, q_{coag}				
133	Coagulant Weight, W_{coag}				

Row	A	B	D	Notes
136	**RA-C/D Primary Screens and Polymer Injection**			**Notes**
137	**Initial Dewatering in Geotextile Tubes (i.e., the first 24 hrs in the tubes)**			
138	Solids Content by Weight after Initial Dewatering in Tubes, P_{s2}	38%		Based on P-GDT draft report.
139	Daily Weight of Dry Solids Retained in Tubes, W_{s-ret2}	4,500,821 lbs/day		
140	Daily Volume of Solids Retained in Tubes, q_{s-ret2}	211,037 gallons/day	28,212 ft^3/day	
141	Daily Weight of Water Retained in Tubes after Initial Dewatering, W_{ret2}	7,343,444 lbs/day		
142	Daily Volume of Water Retained in Tubes after Initial Dewatering, q_{ret2}	879,939 gallons/day	117630.6893 ft^3/day	
143	Daily Weight of Water in Initial Filtrate Weight, W_{if}	49,465,116 lbs/day		
144	Daily Volume of Water in Initial Filtrate, q_{if}	5,927,228 gallons/day	792355.1544 ft^3/day	
145	**Consolidation Dewatering in Geotextile Tubes**			
146	Solids Content by Weight after Consolidation Dewatering, P_{s3}	50%		Assumed value
147	Peak Daily Weight of Retained Water in Tubes after Consolidation Dewatering, W_{ret3}	4,500,821 lbs/day		
148	Peak Daily Volume of Retained Water in Tubes after Consolidation Dewatering, q_{ret3}	539,317 gallons/day	72,096 ft^3/day	
149	Peak Daily Weight of Water in Consolidation Dewatering Filtrate, W_{cf}	2,842,623 lbs/day		
150	Peak Daily Volume of Water in Consolidation Dewatering Filtrate, q_{cf}	340,621 gallons/day	45,534 ft^3/day	
151	Consolidation Dewatering Duration, t_c	60 days		
152	Average Water Volume from Consolidation Dewatering of One Day Filling, q_{dcf}	5,677 gallons/day	759 ft^3/day	
154	Peak Volume of Water in Geotextile Tube Filtrate, $q_{tube-filtrate}$	6,267,849 gallons/day	837,890 ft^3/day	
155	Daily Water Retained in Geotextile Tube, $q_{w-retained}$	539,317 gallons/day	72,096 ft^3/day	

Row	A	B	D	F	Notes
159	**Total Suspended Solids in Geotextile Tube Filtrate**				**Notes**
160	Total Suspended Solids, $TSS_{tube-filtrate}$	195.2 mg/L	738.9 mg/gallon	0.0001 gallon/gallon	OBG's estimate.
161	Total Geotextile Tube Filtrate Flow Rate, $q_{tube-filtrate}$	4353.0 gpm	6,268,327 gallons/day		
162	Flow Rate of Solids in Geotextile Tube Filtrate, $q_{s-tube-filtrate}$	0.33 gpm	478 gallons/day		
163	Flow Rate of Water in Geotextile Tube Filtrate, $q_{w-tube-filtrate}$	4352.7 gpm	6,267,849 gallons/day		
164	Weight of Dry Solids in Geotextile Tube Filtrate, $W_{TSS-tube-filtrate}$	3.22 kg/min	10,211 lbs/day		

Row	**Precipitation**	Open Area, A_{SCA} (acres)	Flow Rate, q_{PRE} (gpd)	Flow Rate, q_{PRE} (gpm)	Notes
167	Daily Precipitation, PRE_{daily} (inch)				
168	0.15	50	203,657	141.4	On-site met data.

Row	A	B	D	F	Notes
170	**Effluent Tank Discharge (OBG line number 23)**				
171	Total Suspended Solids, $TSS_{discharge}$	4.5 mg/L	17.03 mg/gallon	1.75781E-06 gallon/gallon	OBG's estimate.
172	Total Flow Rate , $MAX_{discharge}$	3,306 gpm	4,760,824 gallons/day		
173	Flow Rate of Solids in Discharge, $q_{TSS-dis}$	0.006 gpm	8 gallons/day		
174	Flow Rate of Water in Discharge, q_{w-dis}	3306.12 gpm	4,760,816 gallons/day		
175	Weight of Dry Solids in Discharge, $W_{TSS-dis}$	0.06 kg/min	7.4 lbs/hr	178.8 lbs/day	

Mass Balance Tables

RA-C/D

Primary Screens and Polymer Injection

Row		Incremental					Accumulative					Notes
181		Total (gpm)	Water (gpm)	Solids (gpm)	Solids (lbs/min)	Stream Number	Total (gpm)	Water (gpm)	Solids (gpm)	Solids (lbs/min)	Stream Number	
182	Dredge Slurry	3500	3354	146	3110.4	1	3,500	3,354	146	3110.4		
183	Booster Pumps Seal Water	175	175	0	0.0	2	3,675	3,529	146	3110.4	3	
184	Primary Screen Wash Water from SCA Sumps	71	71	0	0.0	4	3,746	3,601	146	3110.4		Vendor's estimate.
185	Over-Sized Removed from Primary Screen	(0.5)	(0.2)	(0.3)	(6.2)	5	3,746	3,601	145	3104.2	6	
186	Geotextile Tube Feed Pump Seal Water	11	11	0	0.0	7	3,756	3,611	145	3104.2	8	
187	Secondary Screen and Hydrocyclone Screen Wash Water from SCA Sump	0	0	0	0.0							
188	Gravel Removed from Secondary Screen	0.0	0.0	0.0	0.0		3,756	3,611	145	3104.2		
189	Sand Removed from Hydrocyclone	0.0	0.0	0.0	0.0		3,756	3,611	145	3104.2		
190	Geotextile Tube Feed Pump Seal Water	0	0	0	0.0		3,756	3,611	145	3104.2		
191	Clarifier Underflow and Filter Backwash from SCA WTP	1066	1065	0.9	19.3	9	4,822	4,676	146	3123.5		
192	Filtrate from Screened Material Stockpile	0.1	0.1	0.00001	0.0	10						
193	Coagulant Emulsion and Makeup Water from SCA WTP	0	0	0.000	0.0							
194	Polymer and Makeup Water from SCA WTP	123	122	0.3	2.0	11	4,945	4,799	147	3125.6	12	
195	Geotextile Tube Retention	(520.7)	(374.5)	(146.2)	(3118.5)	13	4424.4	4424.1	0.3	7.1		
196	Average Precipitation	141	141	0	0.0	14	4565.8	4565.5	0.3	7.1	15	
197	Primary Screen Wash Water	(71)	(71)	0	0.0	16	4494.4	4494.1	0.3	7.1		
198	Net Flow to Stormwater Basins	0.0	0.0	0.00	0.0	17	4494.4	4494.1	0.3	7.1	18	Maximum Flow from EQ Basin to WTP
199	Clarifier Underflow and Filter Backwash	(1066)	(1065)	(0.9)	(19.3)							
200	Polymer Makeup Water	(122)	(122)	0								Flow from WTP
201	Net Flow to Holding Basin (Downstream Storage)	0	0	0								
202	Maximum Discharge to Metro						3,306	3,306	0.006			Maximum Discharge to Metro (6.5 MGD)

	A	B / C	D / E	F	G / Notes
1	PARSONS	Project Number: 444853 Calc.No. from index: 3	Preparer: XDH Date:2/17/2010 Rev. No.:2	Preparer:	Date:
3		Project Name:Sediment Management Design Calculation Title: Mass Balance	Reviewer:MTO Date:2/18/2010		Review: Date:
6	**Incoming Slurry**				**Notes**
7	Slurry Flow Rate, q	5,000 gpm			Maximum flow
8	Working Hours, t	24 hr/day			
9	Daily Slurry Volume, q_T	7,200,000 gallons/day	962,500 ft^3/day		
10	Solids Content by Weight of Incoming Slurry, P_s	10%			
11	Specific Gravity of Solids, G_s	2.64			Tab "Weight&Volume"
12	Unit Weight of Water, γ_w	62.4279606 pcf			
13	Slurry Water Content, WC	900%			
14	Water Flow Rate, q_w	4798 gpm			
15	Dry Solids Flow Rate, q_s	202 gpm			
16	Daily Water Volume, q_w	6,909,208 gallons/day	923,627 ft^3/day		
17	Daily Water Weight, W_w	57,660,142 lbs/day			
18	Daily Dry Solids Volume, q_s	290,792 gallons/day	38,873 ft^3/day		
19	Daily Dry Solids Weight, W_s	6,406,682 lbs/day			
20	Slurry Concentration, C_{s1}	0.89 lbs/gallon	6.7 lb/ft^3		
21	% Water in Slurry (by Volume)	96%			
24	**Booster Pump Seal Water**				
25	Booster Pump Seal Water (each), $q_{booster}$	50 gpm			
26	Number of Booster Pumps, $N_{booster}$	5			
27	Daily Volume of Booster Pump Seal Water	360,000 gallons/day	48,125 ft^3/day		
28	Daily Weight of Booster Seal Water	3,004,346 lbs/day			
30	**Primary Screens (Over-Sized Grain Removal, >2-inch)**				
31	Average Percentage of Over-Sized Particles, $P_{over-sized}$	1.6%			Tab "Weight&Volume"
32	Daily Dry Weight of Removed Over-Sized Particle, $W_{over-sized}$	102,507 lbs/day			
33	Daily Volume of Removed Over-Sized Particle, $q_{over-sized}$	4,653 gallons/day	622 ft^3/day		
34	Initial Water Content of Removed Over-Sized Particles in Stockpile, WC_{istock}	25%			
35	Daily Weight f Water Removed with Over-Sized Particles, $W_{w-over-sized}$	25,627 lbs/day			
36	Daily Volume of Water Removed with Over-Sized Particles, $q_{w-over-sized}$	3,071 gallons/day	411 ft^3/day		
37	Remaining Daily Dry Solids Weight in Slurry, W_{sr1}	6,304,175 lbs/day			
38	Remaining Daily Water Weight Slurry, W_{wr1}	57,634,515 lbs/day			
39	Remaining Daily Solids Volume Slurry, q_{sr1}	286,139 gallons/day	38,251 ft^3/day		
40	Remaining Daily Water Volume Slurry, q_{wr1}	6,906,138 gallons/day	923,216 ft^3/day		
42	**Hydrocyclone Feed Pump Seal Water**				
43	Hydrocyclone Feed Pump Seal Water (each), $q_{cyclone-pump}$	15 gpm			
44	Number of Hydrocyclone Feed Pumps, $N_{cyclone-pump}$	2			
45	Daily Volume of Booster Pump Seal Water	43,200 gallons/day	5,775 ft^3/day		
46	Daily Weight of Booster Seal Water	360,521 lbs/day			
48	**Secondary Screens (Gravel Removal for RA-A/B/E/F)**				Tab "Weight&Volume"
49	Average Percentage of Gravel in RA-A/B/E/F, P_{gravel}	14.4%			
50	Daily Dry Weight of Removed Gravel, W_{gravel}	922,562 lbs/day			
51	Daily Volume of Removed Gravel, q_{gravel}	41,874 gallons/day	5,598 ft^3/day		
52	Initial Water Content of Removed Gravel in Stockpile, WC_{gravel}	25%			
53	Daily Weight of Water Removed with Gravel, $W_{w-gravel}$	230,641 lbs/day			
54	Daily Volume of Water Removed with Gravel, $q_{w-gravel}$	27,637 gallons/day	3,695 ft^3/day		
55	Remaining Daily Dry Solids Weight in Slurry, W_{sr2}	5,381,613 lbs/day			
56	Remaining Daily Water Weight in Slurry, W_{wr2}	57,403,874 lbs/day			
57	Remaining Daily Dry Solids Volume in Slurry, q_{sr2}	244,265 gallons/day	32,653 ft^3/day		
58	Remaining Daily Water Volume in Slurry, q_{wr2}	6,878,501 gallons/day	919,522 ft^3/day		
60	**Hydrocyclone (Sand Removal for RA-A/B/E/F)**				Tab "Weight&Volume"
61	Average Percentage of Sand in RA-A/B/E/F, P_{sand}	41%			
62	Daily Dry Weight of Removed Sand, W_{sand}	2,626,740 lbs/day			
63	Daily Volume of Removed Sand, q_{sand}	119,225 gallons/day	15,938 ft^3/day		
64	Initial Water Content of Removed Sand in Stockpile, WC_{sand}	25%			
65	Daily Weight of Water Removed with Sand, W_{w-sand}	656,685 lbs/day			
66	Daily Water Removed with Sand Volume, q_{w-sand}	78,688 gallons/day	10,519 ft^3/day		
67	Remaining Daily Dry Solids Weight in Slurry, W_{sr3}	2,754,873 lbs/day			
68	Remaining Daily Water Weight in Slurry, W_{wr3}	56,747,189 lbs/day			
69	Remaining Daily Dry Solids Volume in Slurry, q_{sr3}	125,040 gallons/day	16,715 ft^3/day		
70	Remaining Daily Water Volume in Slurry, q_{wr3}	6,799,813 gallons/day	909,003 ft^3/day		
72	**Geotextile Tube Feed Pump Seal Water**				
73	Geotextile Tube Feed Pump Seal Water (each), $q_{tube-pump}$	15 gpm			
74	Number of Geotextile Tube Feed Pumps, $N_{tube-pump}$	1			
75	Daily Volume of Tube Feed Pump Seal Water	21,600 gallons/day	2,888 ft^3/day		
76	Daily Weight of Tube Feed Pump Seal Water	180,261 lbs/day			
78	**SCA WTP**				**Notes**
79	I.P Clarifier Sludge (OBG line number 16)				OBG's estimate.
80	Total Suspended Solids, $TSS_{clarifier}$	3017.9 mg/L	11424.0 mg/gallon	0.001 gallon/gallon	
81	Clarifier Sludge Flow Rate, $q_{clarifier}$	735 gpm			
82	Flow Rate of Solids in Clarifier Sludge, $q_{TSS-clarifier}$	0.84 gpm			
83	Flow Rate of Water in Clarifier Sludge, $q_{w-clarifier}$	734.2 gpm	734.2 gpm		
84	Weight of Dry Solids in Clarifier Sludge, $W_{TSS-clarifier}$	8.40 kg/min	1110.7 lbs/hr	26,656 lbs/day	
85	Spent MMF Backwash (OBG line number 21)				
86	Total Suspended Solids, TSS_{MMF}	483.3 mg/L	1829.5 mg/gallon	0.0002 gallon/gallon	
87	MMF Backwash Flow Rate, q_{MMF}	166.3 gpm			
88	Flow Rate of Solids in MMF Backwash, $q_{TSS-MMF}$	0.03 gpm			
89	Flow Rate of Water in MMF Backwash, q_{w-MMF}	166.3 gpm	166.3 gpm		
90	Weight of Dry Solids in MMF Backwash, $W_{TSS-MMF}$	0.30 kg/min	40.2 lbs/hr	966 lbs/day	
91	Spent GAC Backwash (OBG line number 22)				
92	Total Suspended Solids, TSS_{GAC}	95.8 mg/L	362.6 mg/gallon	0.00004 gallon/gallon	
93	GAC Backwash Flow Rate, q_{GAC}	164.6 gpm			
94	Flow Rate of Solids in GAC Backwash, $q_{TSS-GAC}$	0.006 gpm			
95	Flow Rate of Water in GAC Backwash, q_{w-GAC}	164.6 gpm	164.6 gpm		
96	Weight of Dry Solids in GAC Backwash, $W_{TSS-GAC}$	0.06 kg/min	7.9 lbs/hr	189 lbs/day	
97	**SCA WTP Total**				
98	Total Flow Rate, q_{WTP}	1065.9 gpm	1,534,896 gallons/day	205,186 ft^3/day	
99	Solid Flow Rate, $q_{WTP-TSS}$	0.88 gpm	1,262 gallons/day	169 ft^3/day	
100	Water Flow Rate, q_{w-WTP}	1065.0 gpm	1,533,634 gallons/day	205,017 ft^3/day	
101	Water Weight, W_{w-WTP}	12,798,794 lbs/day			
102	Solids Weight, $W_{WTP-TSS}$	27812 lbs/day			
104	**Water from Removed Material (Over-sized, Gravel, and Sand) Stockpile**				
105	Typical Solids Content of Sand from Hydrocyclone Shaker (TotalClean) (75-85%)	80%			DelTank TCW-3000
106	Sand Water Content	25%			
107	Assumed Initial Water Content of Screened Material Stockpile, WC_{istock}	25%			
108	Assumed Final Water Content of Screened Material Stockpile, WC_{fstock}	15%			
110	Weight of Water Removed from Stockpile (Water Content from 25% to 15%), $W_{w-stock}$	365,181 lbs/day			
111	Volume of Water Removed from Stockpile (Water Content from 25% to 15%), $q_{w-stock}$	43,758 gallons/day	5,850 ft^3		
112	Weight of Water Remained in Stockpile, $W_{wr-stock}$	15,376 lbs/day			
113	Volume of Water Remained in Stockpile, $q_{wr-stock}$	1,842 gallons/day	246 ft^3		
115	**Total Suspended Solids in Stockpile Filtrate**				
116	Total Suspended Solids, $TSS_{stock-filtrate}$	195.2 mg/L	738.9 mg/gallon	0.0001 gallon/gallon	
117	Total Stockpile Filtrate Flow Rate, $q_{stock-filtrate}$	30.4 gpm	43,762 gallons/day		
118	Flow Rate of Solids in Stockpile Filtrate, $q_{s-stock-filtrate}$	0.002 gpm	3 gallons/day	0 ft^3/day	
119	Flow Rate of Water in Stockpile Filtrate, $q_{w-stock-filtrate}$	30.4 gpm	43,758 gallons/day	5,850 ft^3/day	
120	Weight of Dry Solids in Stockpile Filtrate, $W_{TSS-stock-filtrate}$	0.02 kg/min	71 lbs/day		
121	Weight of Water in Stockpile Filtrate, $W_{w-stock-filtrate}$	365,181 lbs/day			
123	**Polymer and Makeup Water**				
124	Percent Fines in Slurry Solids, P_{fine}	43%			
125	Fine Solids Weight (Fines in Slurry, SCA WTP TSS, Stockpile Filtrate TSS)	2782756.52 lbs/day			
126	Polymer Dosage Rate (lbs of dry polymer per dry ton of solids), $DOS_{polymer}$	1.59 lbs/ton			Based on P-GDT draft report.
127	Dry Polymer Density, $DEN_{polymer}$	0.70 g/cm^3			Ashland 2520 MSDS
128	Daily Dry Polymer Needed, $W_{drypolymer}$	1.536 lbs/min	2212.29 lbs/day		
129	Dry Polymer Volume, $q_{drypolymer}$	0.2630 gpm	379 gallons/day	51 ft^3/day	
130	Polymer Makeup Water Volume, $q_{makeupwater}$	92.05 gpm	132,545 gallons/day	17,719 ft^3/day	Based on P-GDT draft report 0.2% dilution
131	Polymer Makeup water Weight, $W_{makeupwater}$	1,106,146 lbs/day			
133	**Coagulant (Emulsion) for RA-A/B/E/F**				
134	Coagulant Dosage Rate (lbs of emulsion per dry ton of solids), DOS_{coag}	5.71 lbs/ton			Based on P-GDT draft report.
135	Coagulant Emulsion Density, DEN_{coag}	1.03 g/cm^3	64.300799 pcf		Based on Ashland 492 MSDS
136	Coagulant Emulsion Flow Rate, q_{coag}	0.64 gpm	924 gallons/day	124 ft^3/day	
137	Coagulant Emulsion Weight, W_{coag}	5.5 lbs/min	7,945 lbs/day		
138	Weight of Coagulant Makeup Water, $W_{coagwater}$	551.7 lbs/min	794,477 lbs/day		
139	Volume of Coagulant Makeup Water, $q_{coagwater}$	66.1 gpm	95199 gallons/day		
142	**RA-A/B/E/F Primary Screens, Secondary Screens, Hydrocyclones, Polymer Injection, and Coagulant Injection**				**Notes**
143	**Initial Dewatering in Geotextile Tubes (i.e., the first 24 hrs in the tubes)**				
144	Solids Content by Weight after Initial Dewatering in Tubes, P_{s2}	38%			Based on P-GDT draft report.
145	Daily Weight of Dry Solids Retained in Tubes, W_{s-ret2}	2,792,914 lbs/day			
146	Daily Volume of Solids Retained in Tubes, q_{s-ret2}	127,609 gallons/day	17,059 ft^3/day		
147	Daily Weight of Water Retained in Tubes after Initial Dewatering, W_{ret2}	4,556,859 lbs/day			
148	Daily Volume of Water Retained in Tubes after Initial Dewatering, q_{ret2}	546,032 gallons/day	72993.87901 ft^3/day		
149	Daily Weight of Water in Initial Filtrate Weight, W_{if}	70,800,056 lbs/day			
150	Daily Volume of Water in Initial Filtrate, q_{if}	8,483,717 gallons/day	1134108.098 ft^3/day		
151	**Consolidation Dewatering**				
152	Solids Content by Weight after Consolidation Dewatering, P_{s3}	50%			Assumed value
153	Peak Daily Weight of Retained Water in Tubes after Consolidation Dewatering, W_{ret3}	2,792,914 lbs/day			
154	Peak Daily Volume of Retained Water in Tubes after Consolidation Dewatering, q_{ret3}	334,665 gallons/day	44,738 ft^3/day		
155	Peak Daily Weight of Water in Consolidation Dewatering Filtrate, W_{cf}	1,763,945 lbs/day			
156	Peak Daily Volume of Water in Consolidation Dewatering Filtrate, q_{cf}	211,367 gallons/day	28,256 ft^3/day		
157	Consolidation Dewatering Duration, t_c	60 days			
158	Average Water Volume from Consolidation Dewatering of One Day Filling, q_{dcf}	3,523 gallons/day	471 ft^3/day		
160	Peak Volume of Water in Geotextile Tube Filtrate, $q_{tube-filtrate}$	8,695,085 gallons/day	1,162,364 ft^3/day		
161	Daily Water Retained in Geotube, $q_{w-retained}$	334,665 gallons/day	44,738 ft^3/day		
165	**Total Suspended Solids in Geotextile Tube Filtrate**				**Notes**
166	Total Suspended Solids, $TSS_{tube-filtrate}$	195.2 mg/L	738.9 mg/gallon	0.0001 gallon/gallon	OBG's estimate.
167	Total Geotextile Tube Filtrate Flow Rate, $q_{tube-filtrate}$	6038.7 gpm	8,695,728 gallons/day		
168	Flow Rate of Solids in Geotextile Tube Filtrate, $q_{s-tube-filtrate}$	0.446 gpm	643 gallons/day		
169	Flow Rate of Water in Geotextile Tube Filtrate, $q_{w-tube-filtrate}$	6038.3 gpm	8,695,085 gallons/day		
170	Weight of Dry Solids in Geotextile Tube Filtrate, $W_{TSS-tube-filtrate}$	4.46 kg/min	14,166 lbs/day		
172	**Precipitation**				
173	Daily Precipitation, PRE_{daily} (inch)	Open Area, A_{SCA} (acres) / Flow Rate, q_{PRE} (gpd)	Flow Rate, q_{PRE} (gpm)		
174	0.15	50 / 203,657	141.4		On-site met data.
176	**Effluent Tank Discharge (OBG line number 23)**				
177	Total Suspended Solids, $TSS_{discharge}$	4.5 mg/L	17.03 mg/gallon	1.7045E-06 gallon/gallon	OBG's estimate.
178	Total Flow Rate , $MAX_{discharge}$	4,514 gpm	6,500,000 gallons/day		
179	Flow Rate of Solids in Discharge, $q_{TSS-dis}$	0.008 gpm	11 gallons/day		
180	Flow Rate of Water in Discharge, q_{w-dis}	4513.9 gpm	6,499,989 gallons/day		
181	Weight of Dry Solids in Discharge, $W_{TSS-dis}$	0.08 kg/min	10.2 lbs/hr	244.1 lbs/day	

Mass Balance Tables

RA-A/B/E/F

Primary Screens, Secondary Screens, Hydrocyclones, Polymer Injection, and Coagulant Injection

Row		Incremental					Accumulative					Notes
187		Total (gpm)	Water (gpm)	Solids (gpm)	Solids (lbs/min)	Stream Number	Total (gpm)	Water (gpm)	Solids (gpm)	Solids (lbs/min)	Stream Number	
188	Dredge Slurry	5000	4798	201.9	4449.1	1	5,000	4,798	202	4449.1		
189	Booster Pumps Seal Water	250	250	0	0.0	2	5,250	5,048	202	4449.1	3	
190	Primary Screen Wash Water from SCA Sump	102	102	0	0.0	4	5,352	5,150	202	4449.1		Vendor's estimate.
191	Over-Sized Removed from Primary Screen	(5.4)	(2.1)	(3.2)	(71.2)	5	5,347	5,148	199	4377.9	6	
192	Sand Separation Feed Pumps Seal Water	30	30	0	0.0	7	5,377	5,178	199	4377.9	8	
193	Secondary Screen and Hydrocyclone Screen Wash Water from SCA Sump	510	510	0	0.0	9						
194	Gravel Removed from Secondary Screen	(48)	(19)	(29)	(640.7)	10	5,838	5,669	170	3737.2		
195	Sand Removed from Hydrocyclone	(137)	(55)	(83)	(1824.1)	11	5,701	5,614	87	1913.1	12	
196	Geotextile Tube Feed Pump Seal Water	15	15	0	0.0	13	5,716	5,629	87	1913.1	14	
197	Clarifier Underflow and Filter Backwash from SCA WTP	1066	1065	0.9	19.3	15	6,782	6,694	88	1932.4		
198	Filtrate from Screened Material Stockpile	30.4	30.4	0.002	0.0	16						
199	Coagulant Emulsion and Makeup Water from SCA WTP	66.75	66.11	0.64	5.5	17						
200	Polymer and Makeup Water from SCA WTP	92.3	92.0	0.3	1.5	18	6,971	6,883	89	1939.5	19	
201	Geotextile Tube Retention	(320.6)	(232.4)	(88.2)	(1929.7)	20						
202	Average Precipitation	141	141	0.00	0.0	21	6,792	6,792	0.4	9.8	22	
203	Primary, Secondary and Hydrocyclone Screen Wash Water	(612)	(612)	0	0.0	23	6180.1	6179.7	0.4	9.8		
204	Net Flow to Stormwater Basins	(442.7)	(442.6)	(0.03)	(0.641)	24	5737.5	5737.1	0.4	9.2	25	Maximum Flow from EQ Basin to WTP
205	Clarifier Underflow and Filter Backwash	(1066)	(1065)	(0.9)	(19.3)		5,738	5,737	0.9			
206	Coagulant and Polymer Makeup Water	(158)	(158)	0			4,672	4,672	0.008			Flow from WTP
207	Net Flow to Holding Basin (Downstream Storage)	0	0	0								
208	Maximum Discharge to Metro						4,514	4,514	0.008			Maximum Discharge to Metro (6.5 MGD)

PARSONS

Project Number: 444853 Calc.No. from index: 3 Preparer: XDH Date:2/17/2010 Rev. No.:2 Preparer: Date:

Project Name:Sediment Management Design Calculation Title: Mass Balance Reviewer:MTO Date:2/18/2010 Review: Date:

Row	Item	Value	Value 2	Value 3	Notes
6	**Incoming Slurry**				**Notes**
7	Slurry Flow Rate, q	3,500 gpm			Maximum flow
8	Working Hours, t	24 hr/day			
9	Daily Slurry Volume, q_T	5,040,000 gallons/day	673,750 ft^3/day		
10	Solids Content by Weight of Incoming Slurry, P_s	10%			
11	Specific Gravity of Solids, G_s	2.64			Tab "Weight&Volume"
12	Unit Weight of Water, γ_w	62.4279606 pcf			
13	Slurry Water Content, WC	900%			
14	Water Flow Rate, q_w	3359 gpm			
15	Dry Solids Flow Rate, q_s	141 gpm			
16	Daily Water Volume, q_w	4,836,446 gallons/day	646,539 ft^3/day		
17	Daily Water Weight, W_w	40,362,099 lbs/day			
18	Daily Dry Solids Volume, q_s	203,554 gallons/day	27,211 ft^3/day		
19	Daily Dry Solids Weight, W_s	4,484,678 lbs/day			
20	Slurry Concentration, C_{s1}	0.89 lbs/gallon	6.7 lb/ft^3		
21	% Water in Slurry (by Volume)	96%			
22					
23					
24	**Booster Pump Seal Water**				
25	Booster Pump Seal Water (each), $q_{booster}$	35 gpm			
26	Number of Booster Pumps, $N_{booster}$	5			
27	Daily Volume of Booster Pump Seal Water	252,000 gallons/day	33,688 ft^3/day		
28	Daily Weight of Booster Seal Water	2,103,042 lbs/day			
29					
30	**Primary Screens (Over-Sized Grain Removal, >2-inch)**				
31	Average Percentage of Over-Sized Particles, $P_{over-sized}$	1.6%			Tab "Weight&Volume"
32	Daily Dry Weight of Removed Over-Sized Particle, $W_{over-sized}$	71,755 lbs/day			
33	Daily Volume of Removed Over-Sized Particle, $q_{over-sized}$	3,257 gallons/day	435 ft^3/day		
34	Initial Water Content of Removed Over-Sized Particles in Stockpile, WC_{istock}	25%			
35	Daily Weight f Water Removed with Over-Sized Particles, $W_{w-over-sized}$	17,939 lbs/day			
36	Daily Volume of Water Removed with Over-Sized Particles, $q_{w-over-sized}$	2,150 gallons/day	287 ft^3/day		
37	Remaining Daily Dry Solids Weight in Slurry, W_{sr1}	4,412,923 lbs/day			
38	Remaining Daily Water Weight Slurry, W_{wr1}	40,344,160 lbs/day			
39	Remaining Daily Solids Volume Slurry, q_{sr1}	200,297 gallons/day	26,776 ft^3/day		
40	Remaining Daily Water Volume Slurry, q_{wr1}	4,834,296 gallons/day	646,251 ft^3/day		
41					
42	**Hydrocyclone Feed Pump Seal Water**				
43	Hydrocyclone Feed Pump Seal Water (each), $q_{cyclone-pump}$	10.5 gpm			
44	Number of Hydrocyclone Feed Pumps, $N_{cyclone-pump}$	2			
45	Daily Volume of Booster Pump Seal Water	30,240 gallons/day	4,043 ft^3/day		
46	Daily Weight of Booster Seal Water	252,365 lbs/day			
47					
48	**Secondary Screens (Gravel Removal for RA-A/B/E/F)**				Tab "Weight&Volume"
49	Average Percentage of Gravel in RA-A/B/E/F, P_{gravel}	14.4%			
50	Daily Dry Weight of Removed Gravel, W_{gravel}	645,794 lbs/day			
51	Daily Volume of Removed Gravel, q_{gravel}	29,312 gallons/day	3,918 ft^3/day		
52	Initial Water Content of Removed Gravel in Stockpile, WC_{gravel}	25%			
53	Daily Weight of Water Removed with Gravel, $W_{w-gravel}$	161,448 lbs/day			
54	Daily Volume of Water Removed with Gravel, $q_{w-gravel}$	19,346 gallons/day	2,586 ft^3/day		
55	Remaining Daily Dry Solids Weight in Slurry, W_{sr2}	3,767,129 lbs/day			
56	Remaining Daily Water Weight in Slurry, W_{wr2}	40,182,712 lbs/day			
57	Remaining Daily Dry Solids Volume in Slurry, q_{sr2}	170,985 gallons/day	22,857 ft^3/day		
58	Remaining Daily Water Volume in Slurry, q_{wr2}	4,814,951 gallons/day	643,665 ft^3/day		
59					
60	**Hydrocyclone (Sand Removal for RA-A/B/E/F)**				Tab "Weight&Volume"
61	Average Percentage of Sand in RA-A/B/E/F, P_{sand}	41%			
62	Daily Dry Weight of Removed Sand, W_{sand}	1,838,718 lbs/day			
63	Daily Volume of Removed Sand, q_{sand}	83,457 gallons/day	11,157 ft^3/day		
64	Initial Water Content of Removed Sand in Stockpile, WC_{sand}	25%			
65	Daily Weight of Water Removed with Sand, W_{w-sand}	459,679 lbs/day			
66	Daily Water Removed with Sand Volume, q_{w-sand}	55,082 gallons/day	7,363 ft^3/day		
67	Remaining Daily Dry Solids Weight in Slurry, W_{sr3}	1,928,411 lbs/day			
68	Remaining Daily Water Weight in Slurry, W_{wr3}	39,723,032 lbs/day			
69	Remaining Daily Dry Solids Volume in Slurry, q_{sr3}	87,528 gallons/day	11,701 ft^3/day		
70	Remaining Daily Water Volume in Slurry, q_{wr3}	4,759,869 gallons/day	636,302 ft^3/day		
71					
72	**Geotextile Tube Feed Pump Seal Water**				
73	Geotextile Tube Feed Pump Seal Water (each), $q_{tube-pump}$	10.5 gpm			
74	Number of Geotextile Tube Feed Pumps, $N_{tube-pump}$	1			
75	Daily Volume of Tube Feed Pump Seal Water	15,120 gallons/day	2,021 ft^3/day		
76	Daily Weight of Tube Feed Pump Seal Water	126,183 lbs/day			
77					
78	**SCA WTP**				**Notes**
79	I.P Clarifier Sludge (OBG line number 16)				OBG's estimate.
80	Total Suspended Solids, $TSS_{clarifier}$	3017.9 mg/L	11424.0 mg/gallon	0.001 gallon/gallon	
81	Clarifier Sludge Flow Rate, $q_{clarifier}$	735 gpm			
82	Flow Rate of Solids in Clarifier Sludge, $q_{TSS-clarifier}$	0.84 gpm			
83	Flow Rate of Water in Clarifier Sludge, $q_{w-clarifier}$	734.2 gpm	734.2 gpm		
84	Weight of Dry Solids in Clarifier Sludge, $W_{TSS-clarifier}$	8.40 kg/min	1110.7 lbs/hr	26,656 lbs/day	
85	Spent MMF Backwash (OBG line number 21)				
86	Total Suspended Solids, TSS_{MMF}	483.3 mg/L	1829.5 mg/gallon	0.0002 gallon/gallon	
87	MMF Backwash Flow Rate, q_{MMF}	166.3 gpm			
88	Flow Rate of Solids in MMF Backwash, $q_{TSS-MMF}$	0.03 gpm			
89	Flow Rate of Water in MMF Backwash, q_{w-MMF}	166.3 gpm	166.3 gpm		
90	Weight of Dry Solids in MMF Backwash, $W_{TSS-MMF}$	0.30 kg/min	40.2 lbs/hr	966 lbs/day	
91	Spent GAC Backwash (OBG line number 22)				
92	Total Suspended Solids, TSS_{GAC}	95.8 mg/L	362.6 mg/gallon	0.00004 gallon/gallon	
93	GAC Backwash Flow Rate, q_{GAC}	164.6 gpm			
94	Flow Rate of Solids in GAC Backwash, $q_{TSS-GAC}$	0.006 gpm			
95	Flow Rate of Water in GAC Backwash, q_{w-GAC}	164.6 gpm	164.6 gpm		
96	Weight of Dry Solids in GAC Backwash, $W_{TSS-GAC}$	0.06 kg/min	7.9 lbs/hr	189 lbs/day	
97	**SCA WTP Total**				
98	Total Flow Rate, q_{WTP}	1065.9 gpm	1,534,896 gallons/day	205,186 ft^3/day	
99	Solid Flow Rate, $q_{WTP-TSS}$	0.88 gpm	1,262 gallons/day	169 ft^3/day	
100	Water Flow Rate, q_{w-WTP}	1065.0 gpm	1,533,634 gallons/day	205,017 ft^3/day	
101	Water Weight, W_{w-WTP}	12,798,794 lbs/day			
102	Solids Weight, $W_{WTP-TSS}$	27812 lbs/day			
103					
104	**Water from Removed Material (Over-sized, Gravel, and Sand) Stockpile**				
105	Typical Solids Content of Sand from Hydrocyclone Shaker (TotalClean) (75-85%)	80%			DelTank TCW-3000
106	Sand Water Content	25%			
107	Assumed Initial Water Content of Screened Material Stockpile, WC_{istock}	25%			
108	Assumed Final Water Content of Screened Material Stockpile, WC_{fstock}	15%			
109					
110	Weight of Water Removed from Stockpile (Water Content from 25% to 15%), $W_{w-stock}$	255,627 lbs/day			
111	Volume of Water Removed from Stockpile (Water Content from 25% to 15%), $q_{w-stock}$	30,631 gallons/day	4,095 ft^3		
112	Weight of Water Remained in Stockpile, $W_{wr-stock}$	10,763 lbs/day			
113	Volume of Water Remained in Stockpile, $q_{wr-stock}$	1,290 gallons/day	172 ft^3		
114					
115	**Total Suspended Solids in Stockpile Filtrate**				
116	Total Suspended Solids, $TSS_{stock-filtrate}$	195.2 mg/L	738.9 mg/gallon	0.0001 gallon/gallon	
117	Total Stockpile Filtrate Flow Rate, $q_{stock-filtrate}$	21.3 gpm	30,633 gallons/day		
118	Flow Rate of Solids in Stockpile Filtrate, $q_{s-stock-filtrate}$	0.002 gpm	2 gallons/day	0 ft^3/day	
119	Flow Rate of Water in Stockpile Filtrate, $q_{w-stock-filtrate}$	21.3 gpm	30,631 gallons/day	4,095 ft^3/day	
120	Weight of Dry Solids in Stockpile Filtrate, $W_{TSS-stock-filtrate}$	0.02 kg/min	50 lbs/day		
121	Weight of Water in Stockpile Filtrate, $W_{w-stock-filtrate}$	255,627 lbs/day			
122					
123	**Polymer and Makeup Water**				
124	Percent Fines in Slurry Solids, P_{fine}	43%			
125	Fine Solids Weight (Fines in Slurry, SCA WTP TSS, Stockpile Filtrate TSS)	1956273.11 lbs/day			
126	Polymer Dosage Rate (lbs of dry polymer per dry ton of solids), $DOS_{polymer}$	1.59 lbs/ton			Based on P-GDT draft report.
127	Dry Polymer Density, $DEN_{polymer}$	0.70 g/cm^3			Ashland 2520 MSDS
128	Daily Dry Polymer Needed, $W_{drypolymer}$	1.080 lbs/min	1555.24 lbs/day		
129	Dry Polymer Volume, $q_{drypolymer}$	0.1849 gpm	266 gallons/day	36 ft^3/day	
130	Polymer Makeup Water Volume, $q_{makeupwater}$	64.71 gpm	93,179 gallons/day	12,456 ft^3/day	Based on P-GDT draft report 0.2% dilution
131	Polymer Makeup water Weight, $W_{makeupwater}$	777,619 lbs/day			
132					
133	**Coagulant (Emulsion) for RA-A/B/E/F**				
134	Coagulant Dosage Rate (lbs of emulsion per dry ton of solids), DOS_{coag}	5.71 lbs/ton			Based on P-GDT draft report.
135	Coagulant Emulsion Density, DEN_{coag}	1.03 g/cm^3	64.300799 pcf		Based on Ashland 492 MSDS
136	Coagulant Emulsion Flow Rate, q_{coag}	0.45 gpm	650 gallons/day	87 ft^3/day	
137	Coagulant Emulsion Weight, W_{coag}	3.9 lbs/min	5,585 lbs/day		
138	Weight of Coagulant Makeup Water, $W_{coagwater}$	387.9 lbs/min	558,516 lbs/day		
139	Volume of Coagulant Makeup Water, $q_{coagwater}$	46.5 gpm	66925 gallons/day		
140					
141					
142	**RA-A/B/E/F Primary Screens, Secondary Screens, Hydrocyclones, Polymer Injection, and Coagulant Injection**				**Notes**
143	**Initial Dewatering in Geotextile Tubes (i.e., the first 24 hrs in the tubes)**				
144	Solids Content by Weight after Initial Dewatering in Tubes, P_{s2}	38%			Based on P-GDT draft report.
145	Daily Weight of Dry Solids Retained in Tubes, W_{s-ret2}	1,963,414 lbs/day			
146	Daily Volume of Solids Retained in Tubes, q_{s-ret2}	89,709 gallons/day	11,992 ft^3/day		
147	Daily Weight of Water Retained in Tubes after Initial Dewatering, W_{ret2}	3,203,464 lbs/day			
148	Daily Volume of Water Retained in Tubes after Initial Dewatering, q_{ret2}	383,860 gallons/day	51314.57292 ft^3/day		
149	Daily Weight of Water in Initial Filtrate Weight, W_{if}	53,391,713 lbs/day			
150	Daily Volume of Water in Initial Filtrate, q_{if}	6,397,738 gallons/day	855253.1977 ft^3/day		
151	**Consolidation Dewatering**				
152	Solids Content by Weight after Consolidation Dewatering, P_{s3}	50%			Assumed value
153	Peak Daily Weight of Retained Water in Tubes after Consolidation Dewatering, W_{ret3}	1,963,414 lbs/day			
154	Peak Daily Volume of Retained Water in Tubes after Consolidation Dewatering, q_{ret3}	235,269 gallons/day	31,451 ft^3/day		
155	Peak Daily Weight of Water in Consolidation Dewatering Filtrate, W_{cf}	1,240,051 lbs/day			
156	Peak Daily Volume of Water in Consolidation Dewatering Filtrate, q_{cf}	148,591 gallons/day	19,864 ft^3/day		
157	Consolidation Dewatering Duration, t_c	60 days			
158	Average Water Volume from Consolidation Dewatering of One Day Filling, q_{dcf}	2,477 gallons/day	331 ft^3/day		
159					
160	Peak Volume of Water in Geotextile Tube Filtrate, $q_{tube-filtrate}$	6,546,329 gallons/day	875,117 ft^3/day		
161	Daily Water Retained in Geotube, $q_{w-retained}$	235,269 gallons/day	31,451 ft^3/day		
162					
163					
164					
165	**Total Suspended Solids in Geotextile Tube Filtrate**				**Notes**
166	Total Suspended Solids, $TSS_{tube-filtrate}$	195.2 mg/L	738.9 mg/gallon	0.0001 gallon/gallon	OBG's estimate.
167	Total Geotextile Tube Filtrate Flow Rate, $q_{tube-filtrate}$	4546.4 gpm	6,546,813 gallons/day		
168	Flow Rate of Solids in Geotextile Tube Filtrate, $q_{s-tube-filtrate}$	0.336 gpm	484 gallons/day		
169	Flow Rate of Water in Geotextile Tube Filtrate, $q_{w-tube-filtrate}$	4546.1 gpm	6,546,329 gallons/day		
170	Weight of Dry Solids in Geotextile Tube Filtrate, $W_{TSS-tube-filtrate}$	3.36 kg/min	10,665 lbs/day		
171					
172	**Precipitation**				
173	Daily Precipitation, PRE_{daily} (inch)	Open Area, A_{SCA} (acres)	Flow Rate, q_{PRE} (gpd)	Flow Rate, q_{PRE} (gpm)	
174	0.15	50	203,657	141.4	On-site met data.
175					
176	**Effluent Tank Discharge (OBG line number 23)**				
177	Total Suspended Solids, $TSS_{discharge}$	4.5 mg/L	17.03 mg/gallon	1.7045E-06 gallon/gallon	OBG's estimate.
178	Total Flow Rate , $MAX_{discharge}$	3,511 gpm	5,055,470 gallons/day		
179	Flow Rate of Solids in Discharge, $q_{TSS-dis}$	0.006 gpm	9 gallons/day		
180	Flow Rate of Water in Discharge, q_{w-dis}	3510.7 gpm	5,055,461 gallons/day		
181	Weight of Dry Solids in Discharge, $W_{TSS-dis}$	0.06 kg/min	7.9 lbs/hr	189.9 lbs/day	
182					

Mass Balance Tables

RA-A/B/E/F

Primary Screens, Secondary Screens, Hydrocyclones, Polymer Injection, and Coagulant Injection

Row		Incremental					Accumulative					Notes
187		Total (gpm)	Water (gpm)	Solids (gpm)	Solids (lbs/min)	Stream Number	Total (gpm)	Water (gpm)	Solids (gpm)	Solids (lbs/min)	Stream Number	
188	Dredge Slurry	3500	3359	141.4	3114.4	1	3,500	3,359	141	3114.4		
189	Booster Pumps Seal Water	175	175	0	0.0	2	3,675	3,534	141	3114.4	3	
190	Primary Screen Wash Water from SCA Sump	71	71	0	0.0	4	3,746	3,605	141	3114.4		Vendor's estimate.
191	Over-Sized Removed from Primary Screen	(3.8)	(1.5)	(2.3)	(49.8)	5	3,743	3,604	139	3064.5	6	
192	Sand Separation Feed Pumps Seal Water	21	21	0	0.0	7	3,764	3,625	139	3064.5	8	
193	Secondary Screen and Hydrocyclone Screen Wash Water from SCA Sump	357	357	0	0.0	9						
194	Gravel Removed from Secondary Screen	(34)	(13)	(20)	(448.5)	10	4,087	3,968	119	2616.1		
195	Sand Removed from Hydrocyclone	(96)	(38)	(58)	(1276.9)	11	3,991	3,930	61	1339.2	12	
196	Geotextile Tube Feed Pump Seal Water	11	11	0	0.0	13	4,001	3,940	61	1339.2	14	
197	Clarifier Underflow and Filter Backwash from SCA WTP	1066	1065	0.9	19.3	15	5,067	5,005	62	1358.5		
198	Filtrate from Screened Material Stockpile	21.3	21.3	0.002	0.0	16						
199	Coagulant Emulsion and Makeup Water from SCA WTP	46.93	46.48	0.45	3.9	17						
200	Polymer and Makeup Water from SCA WTP	64.9	64.7	0.2	1.1	18	5,200	5,138	62	1363.5	19	
201	Geotextile Tube Retention	(225.3)	(163.4)	(62.0)	(1356.1)	20						
202	Average Precipitation	141	141	0.00	0.0	21	5,116	5,116	0	7.4	22	
203	Primary, Secondary and Hydrocyclone Screen Wash Water	(428)	(428)	0	0.0	23	4687.8	4687.5	0.3	7.4		
204	Net Flow to Stormwater Basins	0.0	0.0	0.00	0.000	24	4687.8	4687.5	0.3	7.4	25	Maximum Flow from EQ Basin to WTP
205	Clarifier Underflow and Filter Backwash	(1066)	(1065)	(0.9)	(19.3)							
206	Coagulant and Polymer Makeup Water	(111)	(111)	0								Flow from WTP
207	Net Flow to Holding Basin (Downstream Storage)	0	0	0								
208	Maximum Discharge to Metro						3,511	3,511	0.006			Maximum Discharge to Metro (6.5 MGD)

PARSONS

Project Number: 444853	Calc.No. from index: 3	Preparer: XDH Date:2/17/2010 Rev. No.:2	Preparer:	Date:
Project Name:Sediment Management Design	Calculation Title: Mass Balance	Reviewer:MTO Date:2/18/2010	Review:	Date:

								Calculated properties							
	Average sediment properties in dredge zone									2.2M cy Dredging Volume (Base+Contingency)			2M cy Dredging Volume (Base)		
Remediation Area	Average Water Content	Average Specific Gravity	Pore Water Density	Average Percent Gravel-Sized	Average Percent Sand-Sized	Average Percent Silt-Sized	Average Percent Clay-Sized	Solids by Weight	Dry Density	Dredge Volume	Total Dredge Dry Weight	Dry Solids Volume	Dredge Volume	Total Dredge Dry Weight	Dry Solids Volume
	(%)		(pcf)	(%)	(%)	(%)	(%)	(%)	(pcf)	(cy)	(tons)	(cy)	(cy)	(tons)	(cy)
A	80.7	2.68	62.4	3.4%	35.9%	51.5%	9.3%	55.3%	52.9	171,000	122,063	54,067	133,000	94,938	42,052
B	68.4	2.80	62.4	10.8%	37.3%	42.3%	9.6%	59.4%	59.9	25,000	20,228	8,576	20,000	16,182	6,861
C	68.4	2.80	62.4	10.8%	37.3%	42.3%	9.6%	59.4%	59.9	49,000	39,646	16,808	38,000	30,746	13,035
D	148.5	2.54	62.4	1.4%	14.4%	64.1%	20.1%	40.2%	33.2	1,204,000	539,814	252,389	1,147,000	514,258	240,440
E	61.3	2.63	62.4	18.8%	42.0%	30.8%	8.4%	62.0%	62.8	723,000	613,208	276,779	588,000	498,708	225,098
TOTAL										2,172,000	1,334,958	608,619	1,926,000	1,154,832	527,486

2.2M cy Dredging Volume (Base+Contingency)

Remediation Area	Total Dry Weight	Over-Sized Grain	Gravel-Sized Grain (including Over-Sized)	Sand-Sized Grain	Fines	Percent Over-Sized	Percent Gravel (including Over-sized)	Percent Sand	Percent Fines	Weighted Average Specific Gravity
	(tons)	(tons)	(tons)	(tons)	(tons)	(%)	(%)	(%)	(%)	
A	122,063	415	4,150	43,821	74,214	0.34%	3.4%	35.9%	60.8%	
B	20,228	218	2,185	7,545	10,498	1.08%	10.8%	37.3%	51.9%	
C	39,646	428	4,282	14,788	20,576	1.08%	10.8%	37.3%	51.9%	
D	539,814	756	7,557	77,733	454,523	0.14%	1.4%	14.4%	84.2%	
E	613,208	11,528	115,283	257,547	240,377	1.88%	18.8%	42.0%	39.2%	
C/D	579,460	1,184	11,839	92,521	475,100	0.20%	2.0%	16.0%	82.0%	2.56
A/B/E	755,498	12,162	121,618	308,913	325,090	1.61%	16.1%	40.9%	43.0%	2.64

2M cy Dredging Volume (Base)

Remediation Area	Total Dry Weight	Over-Sized Grain	Gravel-Sized Grain (including Over-Sized)	Sand-Sized Grain	Fines	Percent Over-Sized	Percent Gravel (including Over-sized)	Percent Sand	Percent Fines	Weighted Average Specific Gravity
	(tons)	(tons)	(tons)	(tons)	(tons)	(%)	(%)	(%)	(%)	
A	94,938	323	3,228	34,083	57,722	0.34%	3.4%	35.9%	60.8%	
B	16,182	175	1,748	6,036	8,399	1.08%	10.8%	37.3%	51.9%	
C	30,746	332	3,321	11,468	15,957	1.08%	10.8%	37.3%	51.9%	
D	514,258	720	7,200	74,053	433,005	0.14%	1.4%	14.4%	84.2%	
E	498,708	9,376	93,757	209,458	195,494	1.88%	18.8%	42.0%	39.2%	
C/D	545,004	1,052	10,520	85,521	448,962	0.19%	1.9%	15.7%	82.4%	2.55
A/B/E	609,828	9,873	98,733	249,576	261,614	1.62%	16.2%	40.9%	42.9%	2.64