Horse Creek Stewardship Program
Summary of Methods and Results
Overview

Created to ensure that Mosaic’s mining activities do not adversely affect Horse Creek, Peace River, or Charlotte Harbor

The three components of the plan are:

• Monitoring and reporting on stream quality
• Investigating adverse conditions or significant trends
• Implementing corrective action for adverse changes to Horse Creek caused by Mosaic’s mining activities, as necessary
Methods
Water Quantity

Stream Level
• Monthly staff gauge readings at four Horse Creek stations

Discharge
• USGS daily streamflow at HCSW-1 and HCSW-4
• Continuous Mosaic NPDES discharge

Rainfall
• NOAA daily rainfall at Myakka River State Park and Arcadia
• SWFWMD Flatford Swamp daily rainfall
• Mosaic daily rainfall at three upper Horse Creek Basin gauges
• Horse Creek North
• Horse Creek South
• Manson Jenkins
Water Quality

Continuous (15-min intervals) sampling at HCSW-1
• pH, dissolved oxygen, specific conductivity, temperature, and turbidity

Monthly sampling at four stations
• Qualitative Stream Conditions
• Field Measurements: Water temperature, pH, dissolved oxygen, specific conductivity, and turbidity
• Samples split between Mosaic and independent third-party consultant
• Lab Analysis of 16 parameters including nutrients, minerals, and mining reagents

Additional sampling coincident with biological sampling
• Field parameters of temperature, pH, dissolved oxygen, specific conductivity, and turbidity
## Trigger Levels

<table>
<thead>
<tr>
<th>Pollutant Category</th>
<th>Analytical Parameters</th>
<th>Reporting Units</th>
<th>Trigger Level</th>
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<tbody>
<tr>
<td><strong>General Physio-chemical Indicators</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>pH</td>
<td>Std. Units</td>
<td>&lt;6.0-&gt;8.5</td>
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<tr>
<td>Dissolved Oxygen Saturation</td>
<td>%</td>
<td>&lt;38% daily average</td>
<td></td>
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<tr>
<td>Turbidity</td>
<td>NTU</td>
<td>&gt;29</td>
<td></td>
</tr>
<tr>
<td>Color</td>
<td>PCU</td>
<td>&lt;25</td>
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<tr>
<td><strong>Nutrients</strong></td>
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<td></td>
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</tr>
<tr>
<td>Total Nitrogen</td>
<td>mg/L</td>
<td>&gt;3.0</td>
<td></td>
</tr>
<tr>
<td>Total Ammonia</td>
<td>mg/L</td>
<td>&gt;0.3</td>
<td></td>
</tr>
<tr>
<td>Ortho Phosphate</td>
<td>mg/L</td>
<td>&gt;2.5</td>
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<tr>
<td>Chlorophyll-α</td>
<td>mg/L</td>
<td>&gt;15</td>
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<tr>
<td>Specific Conductance</td>
<td>µS</td>
<td>&gt;1.275</td>
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<tr>
<td>Total Alkalinity</td>
<td>mg/L</td>
<td>&gt;100</td>
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</tr>
<tr>
<td>Calcium</td>
<td>mg/L</td>
<td>&gt;100</td>
<td></td>
</tr>
<tr>
<td>Iron</td>
<td>mg/L</td>
<td>&gt;0.3; &gt;1.0</td>
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</tr>
<tr>
<td>Chloride</td>
<td>mg/L</td>
<td>&gt;250</td>
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<tr>
<td>Fluoride</td>
<td>mg/L</td>
<td>&gt;1.5; &gt;4</td>
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</tr>
<tr>
<td>Combined Radium (²²⁶Ra + ²²⁸Ra)</td>
<td>pCi/L</td>
<td>&gt;5</td>
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<tr>
<td>Sulfate</td>
<td>mg/L</td>
<td>&gt;250</td>
<td></td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>mg/L</td>
<td>&gt;500</td>
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<tr>
<td><strong>Dissolved Minerals</strong></td>
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<tr>
<td>Petroleum Range Organics</td>
<td>mg/L</td>
<td></td>
<td>Discontinued</td>
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<tr>
<td>Total Fatty Acids, Incl. Oleic, Linoleic, and Linolenic Acid</td>
<td>mg/L</td>
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<td>Fatty Amido-Amines</td>
<td>mg/L</td>
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Biology

**Benthic Macroinvertebrates:**
- Stream Habitat Assessment
- Florida Stream Condition Index (SCI)
- FDEP methodology (SCI-1000)
- Shannon-Wiener Diversity Index

**Fish:**
- Sampled with 4’ x 8’ seine and electrofishing
- Species richness
- Shannon-Wiener Diversity Index
- Morisita’s Community Similarity Index
- Species Accumulation Curve
Reporting

• Immediate notification is provided to the PRMRWSA if continuous recorders detect high turbidity.
• Monthly reports of water quality data are submitted to the PRMRWSA and the TAG for review.
  – The TAG includes staff from Manatee, Sarasota, Charlotte, and Desoto counties, as well as an independent third-party consultant
  – Third-party review take place prior to data acceptance
  – Anomalous results are addressed immediately
• Annual reports are submitted to the PRMRWSA and the TAG for review.
  - Mosaic presents the results for water quantity, water quality, and biological data collected by the Program
  - The PRMRWSA and the TAG compile questions and comments that are incorporated into the final report draft
  - If any adverse long-term trends are identified in the report, Mosaic conducts an impact assessment
• Annual reports have been produced from 2003 to present, and a historical analysis was also prepared.
• Robust oversight and quality assurance is built in at every step
  – Field observations and split samples
  – Monthly water quality review
  – Annual report review
• The 2018 report is complete, and the 2019 report is prepared and currently in review process.
Summary of Results
Water Quantity Results
Rainfall and Streamflow, 2018 Daily Average

Figure 5-7
Streamflow, 2018

Figure 5-5

Average Daily Stream Flow, cfs

Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec

HCSW-1  HCSW-4
Rainfall and Streamflow – 2018 NPDES Discharge

Figure 5-10

Average Daily Discharge, cfs

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Average daily rainfall Mosaic gauges

WIN-004 Flow
Streamflow and NPDES Discharge, 2018

Figure 5-11

Average Daily Flow, cfs

WIN-004 Flow MGD
HCSW-1
## Combined NPDES Discharge to Horse Creek, POR

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<thead>
<tr>
<th>Year</th>
<th>Total annual flow, MG</th>
<th>Rank</th>
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<td>2003</td>
<td>9253</td>
<td>1</td>
</tr>
<tr>
<td>2009</td>
<td>8767</td>
<td>2</td>
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<tr>
<td>2016</td>
<td>7047</td>
<td>3</td>
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<td>2010</td>
<td>6712</td>
<td>4</td>
</tr>
<tr>
<td>2008</td>
<td>4613</td>
<td>5</td>
</tr>
<tr>
<td>2013</td>
<td>4597</td>
<td>6</td>
</tr>
<tr>
<td>2005</td>
<td>3411</td>
<td>7</td>
</tr>
<tr>
<td>2015</td>
<td>3224</td>
<td>8</td>
</tr>
<tr>
<td><strong>2018</strong></td>
<td><strong>3201</strong></td>
<td>9</td>
</tr>
<tr>
<td>2004</td>
<td>2222</td>
<td>10</td>
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<tr>
<td>2012</td>
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<td>2007</td>
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<td>2006</td>
<td>4</td>
<td>17</td>
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<tr>
<td>2017</td>
<td>0</td>
<td>18</td>
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Water Quality Results
Horse Creek Conductivity

- Station 1 in Blue Closest to Mining
- Station 4 in Red Farthest from Mining
- Station 4 Always Higher Conductivity
- Impacts from Irrigation
24 water quality notifications in 2018 – all were deemed to be unrelated to mining discharges

HCSW-1 (closest to outfalls) had only one notification - 495 days after the last discharge.

HCSW-2 had notifications relating to Dissolved Oxygen and Ammonia
  – HCSW-2 is unlike other sites due to upstream impoundment and prairie.
  – Notifications were found to be related to longer residence time, periods of reduced or no water velocity and thick anaerobic organic benthic layer.
  – Ammonia notifications were G-qualified, Field blank > trigger value, and HCSW-1< trigger value

HCSW-3 had notifications relating to Dissolved Oxygen, Sulfate, TDS, and Ammonia
  – Notifications related to Dissolved Oxygen, Sulfate, and TDS occurred only at sites in lower basin
  – Ammonia notifications were G-qualified, Field blank > trigger value, and HCSW-1< trigger value

HCSW-4 had notifications relating to Iron, Sulfate, TDS, Ammonia, and Calcium
  – Iron levels were similar to HCSW-1, 2, and 3, but HCSW-4 has a lower trigger level for this analyte
  – Impact Assessments were conducted for Sulfate, TDS, and Calcium.
  – Ammonia notifications were G-qualified, Field blank > trigger value, and HCSW-1< trigger value
  – Notifications were found to be related to low flow conditions coupled with non mining land use activities
Biology Results
Macroinvertebrate Taxa Richness

Figure 7-3
SCI Scores

![Graph showing SCI scores for HCSW-1, HCSW-2, HCSW-3, and HCSW-4 over time. Each site has data points indicating SCI scores, with categories labeled as 'Exceptional', 'Healthy', and 'Impaired'. The graph spans from 2004 to 2018.]
Macroinvertebrate Results POR

- **Biological Diversity**
  - Spring 2018 taxa richness was the highest recorded so far at HCSW-1, HCSW-3, & HCSW-4
  - Spring 2018 Shannon-Wiener diversity was the highest on record so far at HCSW-1 & HCSW-3

- **Stream Condition Index**
  - HCSW-1 is the only station with a detected trend in SCI scores for the period 2007-2018 (+2.33/year, Annual Kendall tau = 0.55, p<0.05)
Fish Species Richness

Figure 7-1
Species Accumulation Curve

Figure 7-13
2018 Fish Results & Conclusions

- Number of species caught: 21 (historical annual range 18-32)
- Cumulative total 2003-2018: 44
- Most commonly collected groups: livebearers, shiners, sunfishes, and silversides
- No increasing or decreasing trends when all stations were combined and analyzed annually or seasonally adjusted
- No increasing or decreasing trends for individual stations by annual median diversity; spring, summer, or winter diversity
Final Thoughts

• Sixteen years of data related to water quantity, water quality, and biology
• Robust quality assurance plan with input from many different stakeholders
• Baseline data for water quality and biological comparison as mining and reclamation progresses in the Horse Creek watershed
• No mining related impacts observed
Questions & Comments