Faro Mine Remediation Project – Electronic Data Capture and Field-accessible Project Data

Alan Campbell, CH2M HILL

Photo taken by: Howard Thomas/VBC
Presentation Outline

• Overview of project and field activities
• Hardware
• Moving-map GPS navigation
• Directories of project files
• Electronic Data Capture
• Pending Improvements
• Summary of Benefits
Overview of Project and Field Activities
**Faro Mine Site:**
- Operated from 1969-1998
- Footprint of 25 km²
- 376 million tons of waste rock
- 84 million tons of tailings
- 3 open pits and one backfilled pit

**Scope of current project:**
- Contracted by Yukon Government to advance final closure plan developed by previous consultant
  - Replace WTP
  - Upgrade existing dams and surface water diversion structures
  - Install groundwater interception systems
- Ongoing engineering support for client
Field Work:
• Drilling / Test Pitting / Well Installation
• Groundwater Sampling
• Soil Gas Sampling
• Surface Water / Seep Sampling
• Geological Mapping
• Streambed Surveys
• Aquifer Testing
• Dye Testing
• Water level and Flow Monitoring
• Meteorological Monitoring
• Vegetation and Soil Surveys
• Instrumented Cover Trials on Tailings and Waste Rock Dumps
• CPT
• Wildlife Surveys
• Pit Lake Profiling
Hardware

- Samsung Galaxy Tab 2 10.1” with Android 4.1.1 OS
- Wi-Fi and Bluetooth connectivity
- Built-in GPS and support for external GPS via Bluetooth
- Rear-facing camera
- Water resistant rubber case and screen protector
Moving-Map GPS Navigation

- Application **Oruxmaps**
- Plots GPS position to roughly +/- 3m accuracy
- Displays various online and offline map imagery files
- Displays point vector files and attributes
- Limited support for display of linear vector features
Select among various offline map imagery files
• Low altitude 2012 aerial Ortho-imagery
• Pre-mining topographic map
• Surficial geology and soil geochemistry
• Bedrock Geology
• Overlay waypoints / vector point files
• List of waypoint files on device
• Searching / Filtering list of waypoints
• Select point(s) to display on map
• Selected monitoring well displayed on map
• Selected monitoring well displayed on map
• Tapping on monitoring well displayed on map
• Overlay linear vector features
Directories of Project Files

1.0 Purpose and Scope

The purpose of this standard operating procedure (SOP) is to establish guidelines for low-flow groundwater purging and sampling at monitoring wells at the Faro Mine Complex. This SOP outlines the process of groundwater purging and sampling, and is designed to confirm that low-flow groundwater sampling is performed and documented in a consistent and accurate manner. The procedure does not address purging and sampling using "normal or higher flow" techniques (see SOP MSR021). Refer to the project work plan (WP) and field sampling plan (FSP) and quality assurance project plan (QAPP) for detailed project requirements for groundwater sampling and analysis. This SOP follows the US Environmental Protection Agency (USEPA) standard procedure for low-flow groundwater sampling procedures.

Construct New Vangorda Creek Diversion

Task Description

The alignment of the existing Vangorda Creek Diversion (VCD) follows a near-surface route adjacent to an undeveloped access road along the western rim of Vangorda Pit varying in grade from 1.5 percent in the upper reach to a relative steep grade of 11 percent in the lower reach before entering the plunge pool and the existing dropbox system.

The SRK closure plan (2014) describes various problems with the current Vangorda Creek Diversion. These include: (1) a realignment from a near vertical slope, causing damage to one section of the flume that required replacement of about 39 metres (m) of the flume, and (2) damage to the flume, as it is being subjected to continuous pressure from ice build-up annually. Damage to the flume includes buckling of cross-bracing and damage to the seals between each of the flume sections, resulting in leakage out of the flume and associated uplift pressure. The flume consists of a half corrugated metal pipe.

SRK proposed a new CSD performed a geotechnical test pits and considered additional alignment, but their diversion channel of recommended as the best solution.

Data Gaps

The primary data gap is the lack of soil boring data for the area.

Sheet 1 of 2

PROJECT NUMBER: 78-18

SOIL BORING LOG

SOIL DESCRIPTION

Gravel Fill

50 cm: Frozen, black organic Silt, pieces of wood and ice crystals to 12 mm diameter.

55 cm: Frozen, brown to grey layered fine to medium SAND, some fine gravel layers.
Electronic Data Capture

- Flexible custom form generation
- Various data input fields:
  - Text
  - Boolean
  - Integer
  - Real Number
  - Multi select
  - String Select
  - Calculation
  - Date/Time
  - Photo capture
  - GPS coordinate capture
- Data entry validation and input field precedence
- Frequent data backup to external drive
- Output to CSV file – send via email or USB cable
• Completing a form entry
• Demonstration of eDC during seep sampling.
• View of completed sample logs and collected photographs
• Exporting data as csv file via email
<table>
<thead>
<tr>
<th>Project Number</th>
<th>Field Team</th>
<th>Date and Time</th>
<th>Location</th>
<th>GPS Coordinates</th>
<th>Weather</th>
<th>New Location or Improved coordinates?</th>
<th>Seep Condition</th>
<th>Seep Flow Measurement</th>
<th>Seep Description - Precipitate Presence</th>
<th>Seep Description - Algae Growth</th>
<th>Upstream source and other sampling locations</th>
<th>YSI ID Number</th>
<th>YSI Calibration Date</th>
<th>Parameters - Conductivity</th>
<th>Parameters - Temperature</th>
<th>Parameters - Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>12/09/14 15:34</td>
<td>CH-109</td>
<td>42.26346881662</td>
<td>Dry</td>
<td>FALSE</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>1114000025</td>
<td>12/09/14</td>
<td>1.856</td>
<td>7.74</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>12/09/14 15:35</td>
<td>CH-109</td>
<td>42.26346881662</td>
<td>Dry</td>
<td>FALSE</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>1114000025</td>
<td>12/09/14</td>
<td>2.035</td>
<td>6.06</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>12/09/14 15:36</td>
<td>CH-109</td>
<td>42.26346881662</td>
<td>Dry</td>
<td>FALSE</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>1114000025</td>
<td>12/09/14</td>
<td>1.473</td>
<td>4.02</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>12/09/14 15:37</td>
<td>CH-109</td>
<td>42.26346881662</td>
<td>Dry</td>
<td>FALSE</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>1114000025</td>
<td>12/09/14</td>
<td>5.334</td>
<td>7.96</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>12/09/14 15:38</td>
<td>CH-109</td>
<td>42.26346881662</td>
<td>Dry</td>
<td>FALSE</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>1114000025</td>
<td>12/09/14</td>
<td>4.556</td>
<td>6.88</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>10</td>
<td>12/09/14 15:39</td>
<td>CH-109</td>
<td>42.26346881662</td>
<td>Dry</td>
<td>FALSE</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>1114000025</td>
<td>12/09/14</td>
<td>3.384</td>
<td>7.82</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>10</td>
<td>12/09/14 15:40</td>
<td>CH-109</td>
<td>42.26346881662</td>
<td>Dry</td>
<td>FALSE</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>1114000025</td>
<td>12/09/14</td>
<td>5.879</td>
<td>3.36</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>10</td>
<td>12/09/14 15:41</td>
<td>CH-109</td>
<td>42.26346881662</td>
<td>Dry</td>
<td>FALSE</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>1114000025</td>
<td>12/09/14</td>
<td>6.26</td>
<td>4.96</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>12/09/14 15:42</td>
<td>CH-109</td>
<td>42.26346881662</td>
<td>Dry</td>
<td>FALSE</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>1114000025</td>
<td>12/09/14</td>
<td>1.981</td>
<td>1.56</td>
<td></td>
</tr>
</tbody>
</table>

- CSV Output File from Memento
- Photographs on project Sharepoint
• Groundwater Purge Log
**Data Quality and Project integration**

- Develop automated workflow process for QA/QC of collected data and upload to project database
- Improve data validation in field forms to provide immediate identification of significant changes, regulatory exceedance or adaptive management plan triggers
- Develop automated system for deploying updated FSPs, SOPs, waypoints to devices
Improvements

Devices:

- Plog for borehole and Test pit logging – GINT-ready output, ability to preview graphical log output while logging in field
- Application for groundwater sampling purge log
  - Pre-load well completion information and calculate well volumes using database of existing wells
  - Wireless communication with sonde to log field parameters.
  - Continuously chart changes and calculate stability.
- Reduce Screen Glare – shroud, anti-glare film, alternative hardware
Summary of Benefits

• Rapid data QA/QC and distribution
• Eliminate costs and potential error associated with digitization of hardcopy logs
• Consistency / standardization of field observations
• Provide specific and relevant project information to field staff when and where they need it
• Supports conceptual site model visualization
Questions?