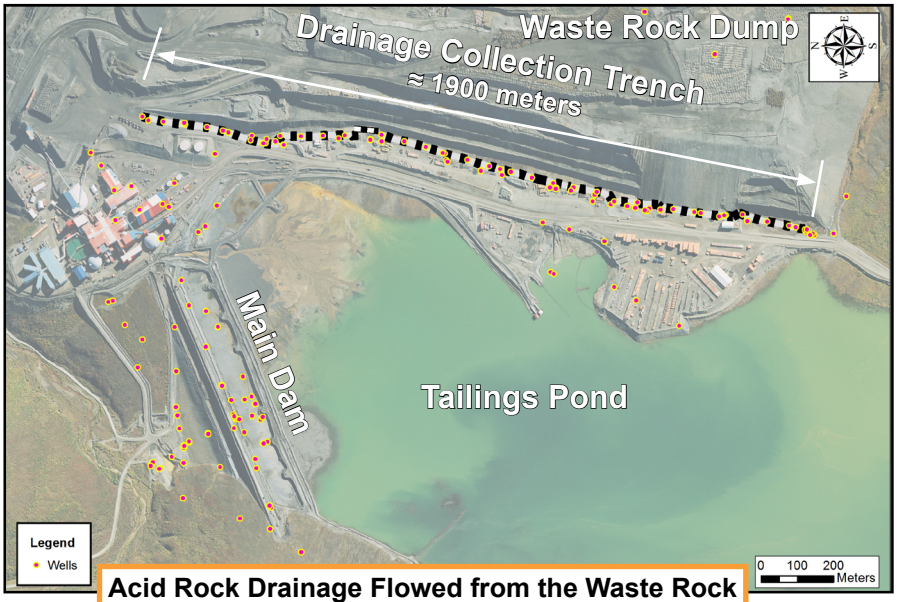
USING TECHNOLOGY TO IDENTIFY PREFERENTIAL FLOW OF ACID ROCK DRAINAGE AT A ZINC MINE



Acid Rock Drainage Flowed from the Waste Rock Dump into the Tailings Pond

SUMMARY

LOCATION
Alaska, USA

CHALLENGE

The client needed to understand where acid rock drainage was bypassing the drainage collection trench

SOLUTION

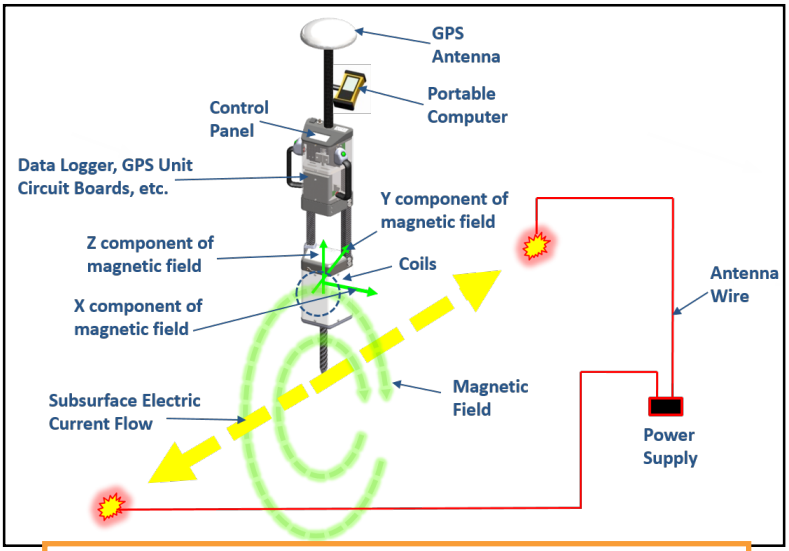
A Willowstick groundwater investigation was performed and identified several preferential flow paths

BENEFIT

Targeted remediation, saving time and money

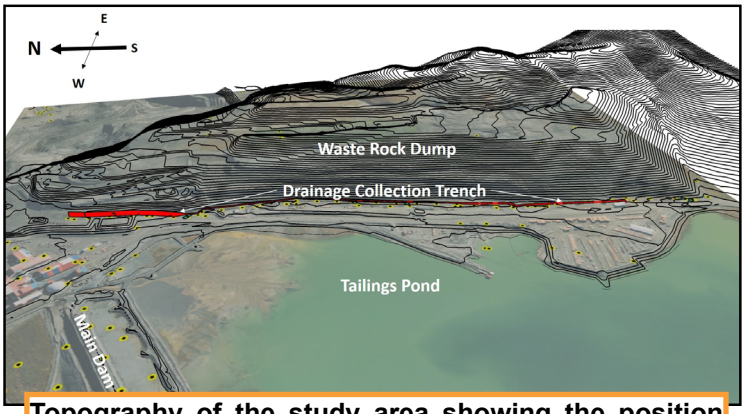
INTRODUCTION

Seepage flow paths exiting and/or entering tailings impoundments are a major headache for mine owners, operators and regulators. These preferential seepage flow paths are notoriously difficult and expensive to find. Traditional methods are often inexact, expensive and time-consuming. A better alternative is the Magnetometric Resistivity (MMR) method, which can be used to identify the exact location of preferential groundwater flow paths. The method uses electrodes that are placed strategically upstream and downstream of the investigation area, and the water between them is energized with a low-voltage, low-amperage, alternating electrical current with a 380 Hz frequency. The current creates a signature magnetic field that reveals the exact location and depth of the groundwater flow between the electrodes. This magnetic field can be measured from the surface using a Willowstick instrument. The collected magnetic field data is used to create two- and three-dimensional (2D and 3D) maps and Electric Current Distribution (ECD) models of seepage paths. Using



The Willowstick Instrument simultaneously collects magnetic field and GPS data

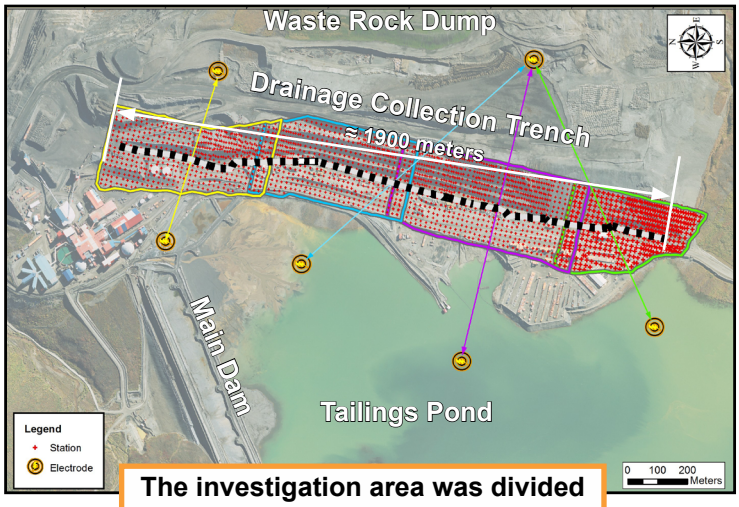
this technique, investigative teams have accurately identified seepage and groundwater flow paths for over 300 projects in locations around the world.



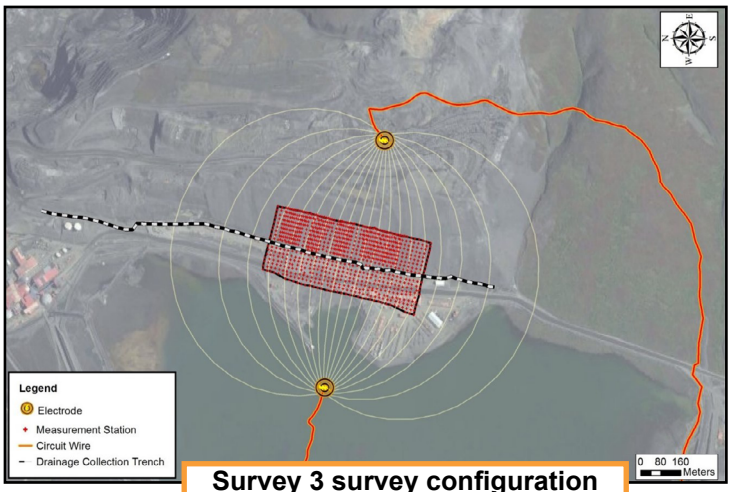
Topography of the study area showing the position of the drainage collection trench at the bottom of the waste rock dump

ZINC MINE IN ALASKA

A mine located in Alaska had a waste rock dump and down-gradient of it was a tailings pond. The tailings pond provided storage for tailings, waste water and drainage for the mine. The waste rock dump had Acid Rock Drainage (ARD) flowing into the tailings water. The client built a drainage collection trench to divert and later treat the contaminated water. Unfortunately, water was bypassing the trench. Over fifty wells were drilled to understand the problem, however, the wells alone couldn't provide an explanation of where water bypassed the trench. The purpose of the investigation was to identify preferential drainage flow paths bypassing the collection trench to the tailings pond.

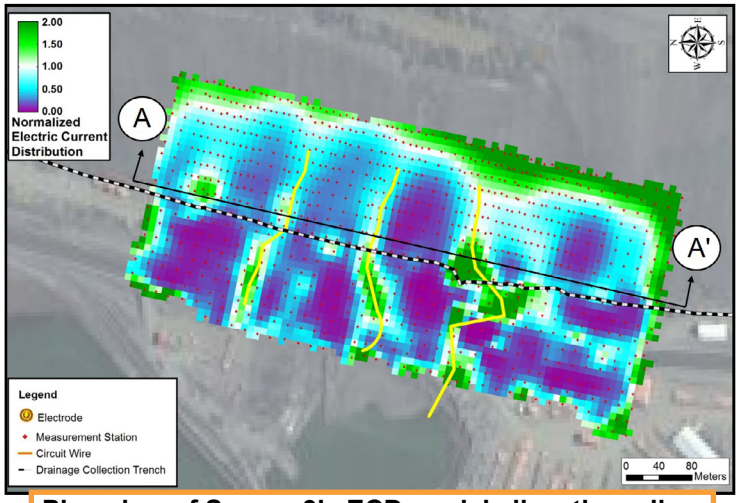


The investigation area was divided into 4 sub-surveys S1 to S4



Survey 3 survey configuration with 908 measurement stations

Given the length of the drainage collection trench (approximately 1900m long), four separate survey configurations were employed to energize the different segments of the trench. For every survey an electric current was placed in the ground and the resulting magnetic field was measured using the Willowstick instruments.



Plan view of Survey 3's ECD model slice, the yellow lines represent preferential groundwater flow paths

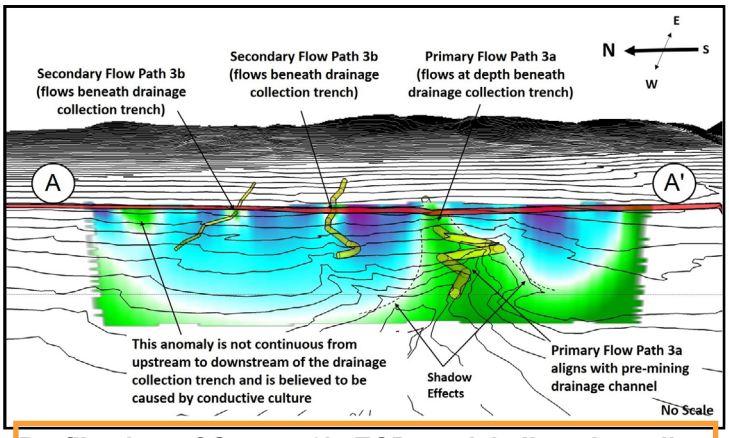
The field work took about two weeks to complete, and once it was completed, the magnetic field was used to create a 3D ECD model. The preferential groundwater flow paths were identified within the ECD model.

Thirteen preferential flow paths of electric current were identified which were caused by groundwater passing beneath the drainage collection trench. After comparing the locations of the flow paths to pre-mining contours, it was determined the contaminated water was following paleochannels. With this information,

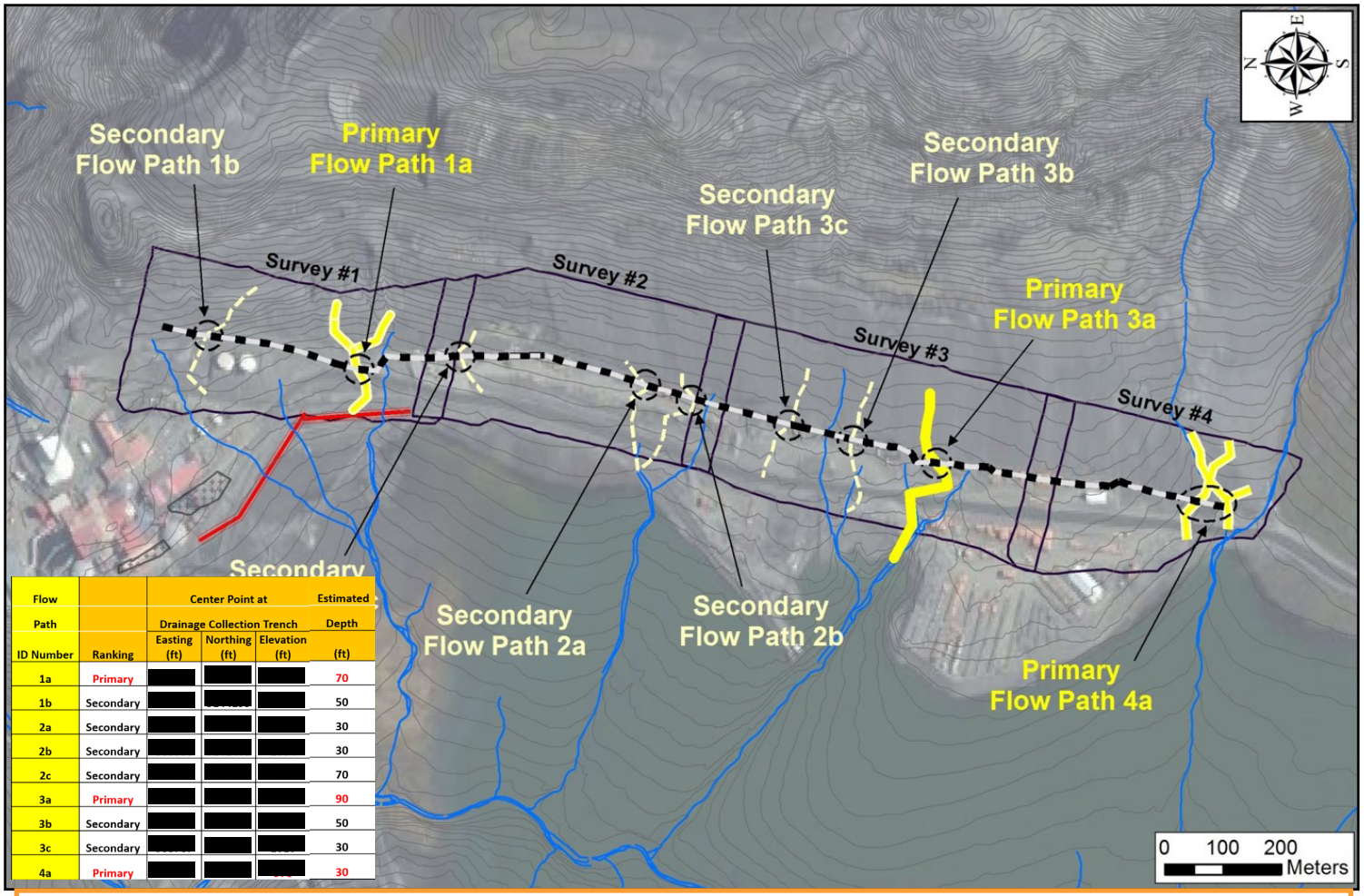
the mine showed regulators they understood the problem and they began targeted remediation.

CONCLUSION

A mine in Alaska had ARD flowing into their tailings pond from the waste rock dump. They built a drainage collection trench to divert and clean the water. Unfortunately, the water bypassed the trench. There were over 50 wells drilled to understand the problem, but they couldn't explain the groundwater flow. Using the MMR method Willowstick identified 13 preferential flow paths of electric current caused by groundwater passing beneath the collection trench. The results gave the mine operators the exact location and depth of the problem areas. This allowed them to show the regulators they understood the situation and they began targeted remediation, saving the mine a significant amount of time and money.



Profile view of Survey 3's ECD model slice, the yellow tubes represent preferential groundwater flow paths



Flow Path ID Number	Ranking	Center Point at Drainage Collection Trench Easting (ft)	Northing (ft)	Elevation (ft)	Estimated Depth (ft)
1a	Primary	[redacted]	[redacted]	[redacted]	70
1b	Secondary	[redacted]	[redacted]	[redacted]	50
2a	Secondary	[redacted]	[redacted]	[redacted]	30
2b	Secondary	[redacted]	[redacted]	[redacted]	30
2c	Secondary	[redacted]	[redacted]	[redacted]	70
3a	Primary	[redacted]	[redacted]	[redacted]	90
3b	Secondary	[redacted]	[redacted]	[redacted]	50
3c	Secondary	[redacted]	[redacted]	[redacted]	30
4a	Primary	[redacted]	[redacted]	[redacted]	30

Summary of the investigation, the contours shown are pre-mining elevation contours, the blue lines represent paleochannels, the yellow lines represent the preferential flow paths identified by the MMR investigation. A table of the flow paths' coordinates and depth is shown.