
Exhibit 3
Water Sampling Locations
Pond 3
Pond 4
Culvert N
Culvert S
Alma
Alma
8
10
9
19
665
Buckskin St
N Oak St
W 1st St
Singleton Rd
Chisholm Way
S Main St
© 2021 Google
1221 ft
Google Earth

Exhibit 3

Ponds 3 and 4 with views of the embankment and proximity to river. Note sediment variability, cobbles and vegetation density.

Exhibit 3

Pond 4 with views of the embankment materials and reworked ground. Murky water where disturbed from sampling.

Note sediment variability with density of cobbles and gravels, with silt/clay fines.

1:19-cv-01246-WJM-STV
TRIAL EXHIBIT A3
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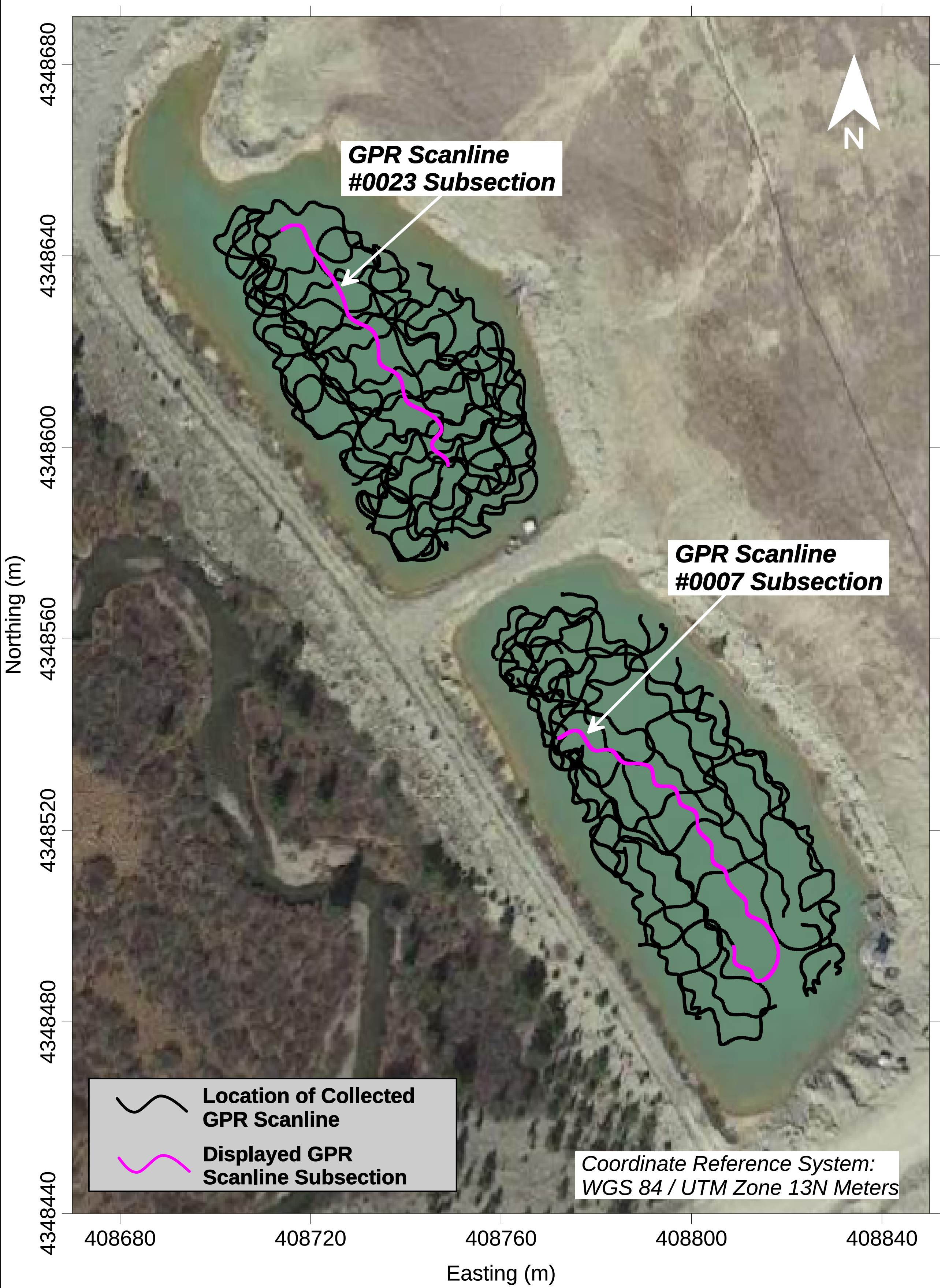
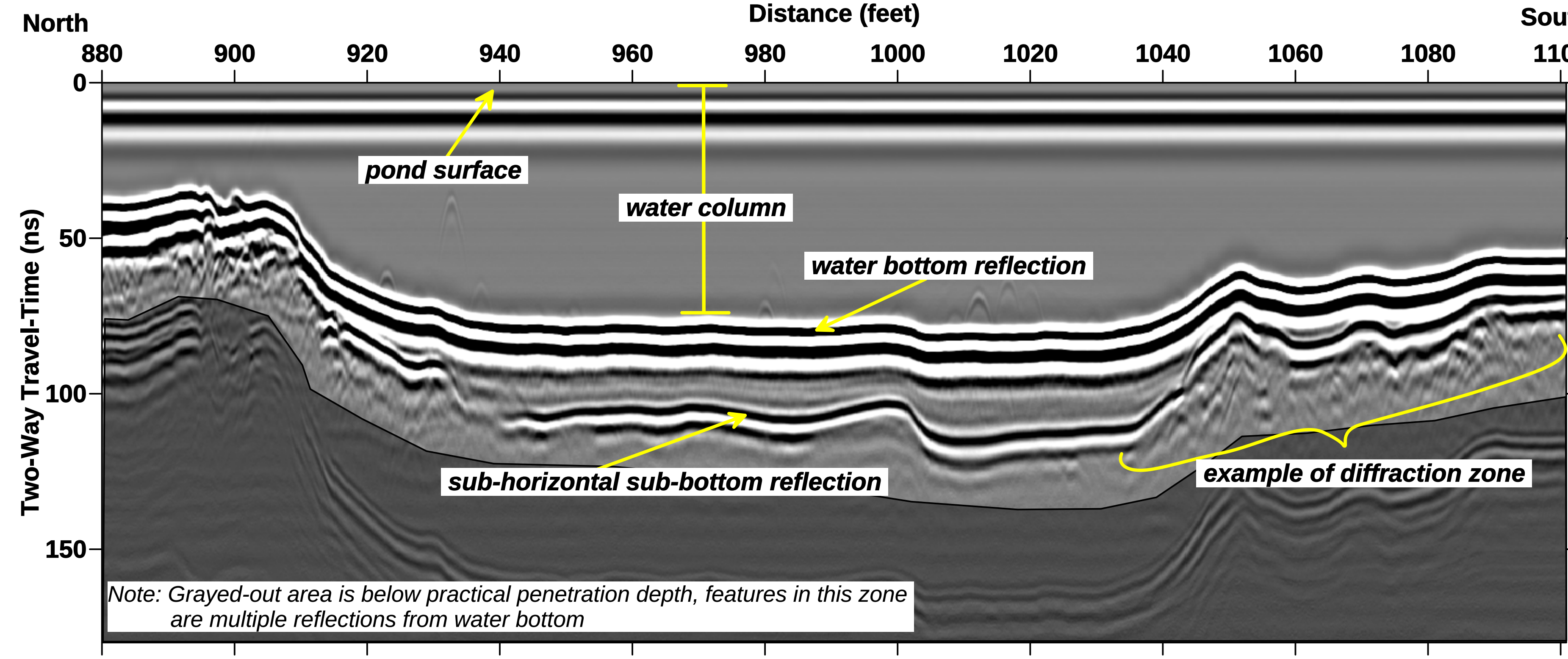
Exhibit 4

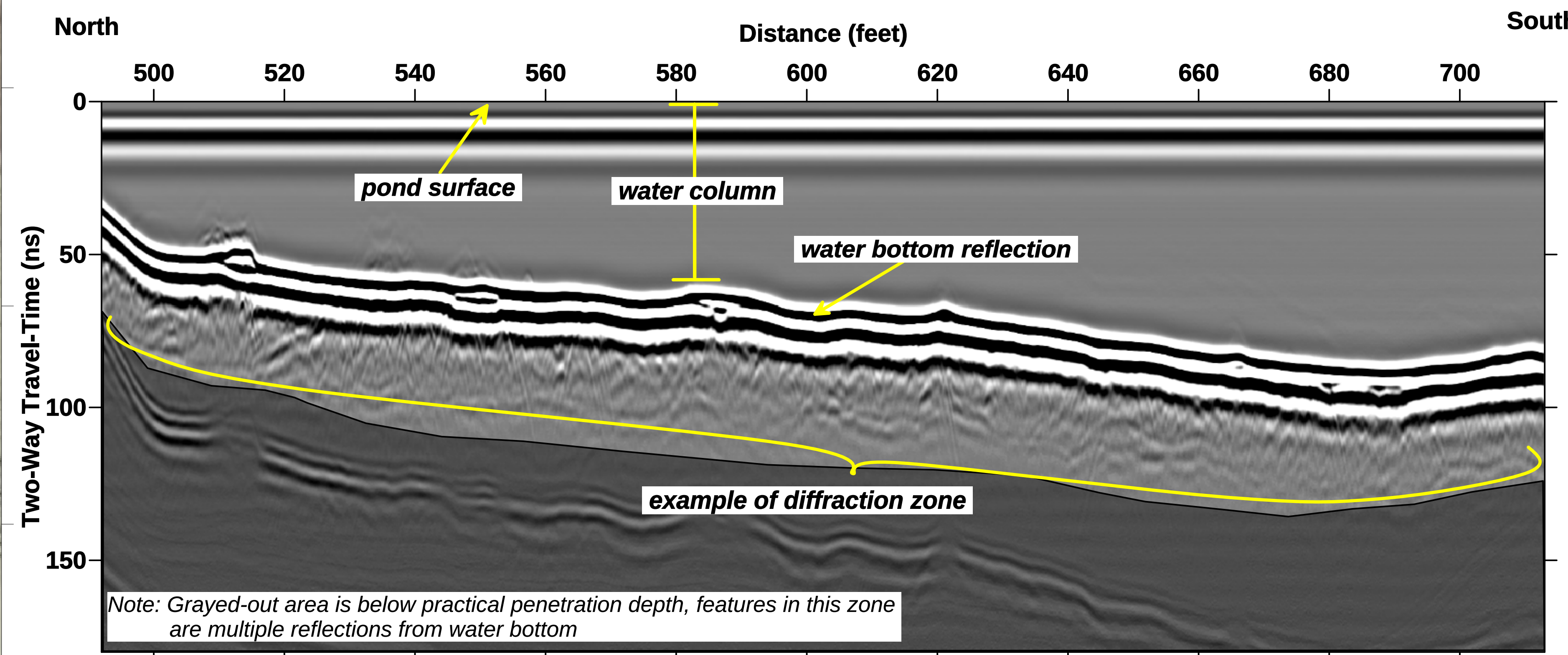
GPR Scanline Locations



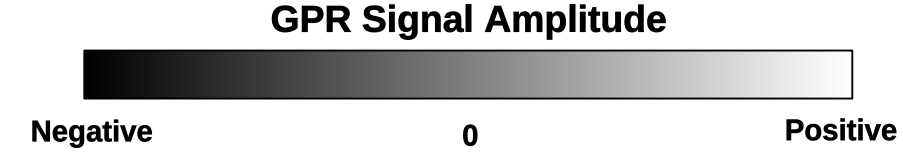
GPR Scanline #0023 Subsection



GPR Scanline #0007 Subsection



GPR Signal Amplitude



GPR Results
Alma Placer mine
Alma, CO

COLLIER GEOPHYSICS

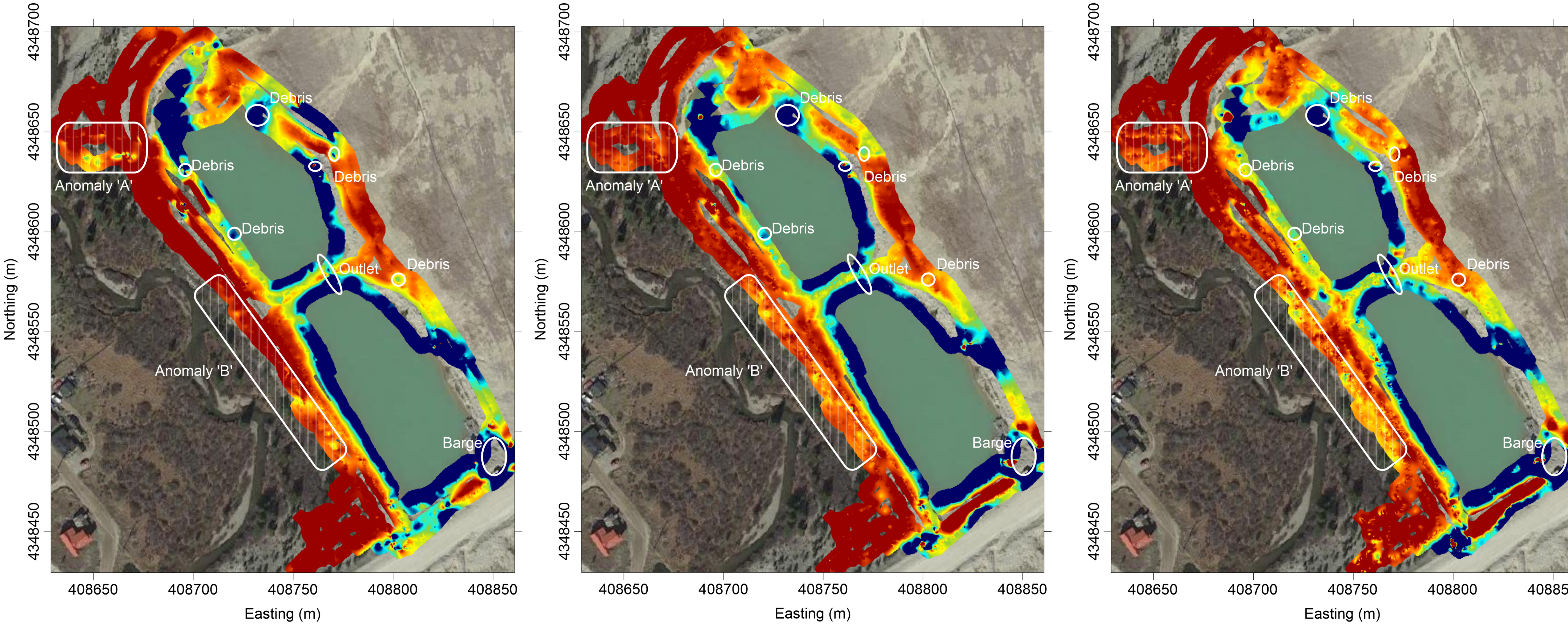
Law Offices of Randall Weiner

Project #: 21-223 | FIGURE A-2

Drafted by: R. Bowling | Checked by: P. Sirles | July 2021


HMMC003176

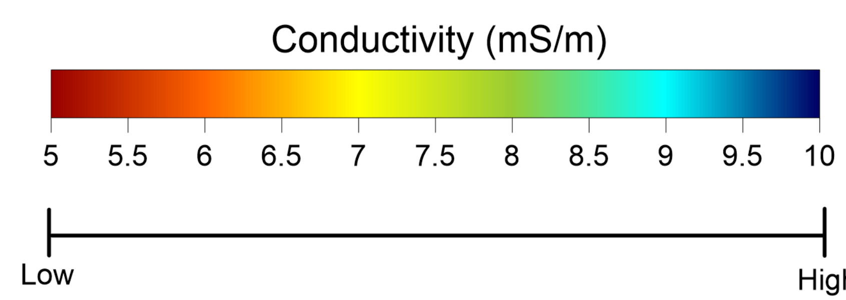
Exhibit 4



Coil 1 - Least Depth
1.48 m (4.86 ft) separation

Coil 2 - Intermediate Depth
2.82 m (9.25 ft) separation

Coil 3 - Greatest Depth
4.49 m (14.73 ft) separation



Coordinate Reference System:
WGS 84 / UTM Zone 13N Meters

FDEM Conductivity Results
Alma Placer mine
Alma, CO

COLLIER GEOPHYSICS

Law Offices of Randall Weiner

Project #: 21-223

FIGURE A-1

Drafted by: T. Ensele

Checked by: P. Sirles

July 2021

navigable waters, even if the pollutants then flow to those waters. It also seems to exclude a pipe that hangs out over the water and adds pollutants to the air, through which the pollutants fall to navigable waters. The absurdity of such an interpretation is obvious enough.

We therefore reject this reading as well: Like Maui's and the Government's, it is inconsistent with the statutory text and simultaneously creates a massive loophole in the permitting scheme that Congress established.

E

For the reasons set forth in Part III and in this Part, we conclude that, in light of the statute's language, structure, and purposes, the interpretations offered by the parties, the Government, and the dissents are too extreme.

V

Over the years, courts and EPA have tried to find general language that will reflect a middle ground between these extremes. The statute's words reflect Congress' basic aim to provide federal regulation of identifiable sources of pollutants entering navigable waters without undermining the States' longstanding regulatory authority over land and groundwater. We hold that the statute requires a permit when there is a direct discharge from a point source into navigable waters or when there is the *functional equivalent of a direct discharge*. We think this phrase best captures, in broad terms, those circumstances in which Congress intended to require a federal permit. That is, an addition falls within the statutory requirement that it be "from any point source" when a point source directly deposits pollutants into navigable waters, or when the discharge reaches the same result through roughly similar means.

Time and distance are obviously important. Where a pipe ends a few feet from navigable waters and the pipe emits pollutants that travel those few feet through groundwater (or over the beach), the permitting requirement clearly applies. If the pipe ends 50 miles from navigable waters and the pipe emits pollutants that travel with groundwater, mix with much other material, and end up in navigable waters only many years later, the permitting requirements likely do not apply.

The object in a given scenario will be to advance, in a manner consistent with the statute's language, the statutory purposes that Congress sought to achieve. As we have said (repeatedly), the word "from" seeks a "point source" origin, and context imposes natural limits as to when a point source can properly be considered the origin of pollution that travels through groundwater. That context includes the need, reflected in the statute, to preserve state regulation of groundwater and other nonpoint sources of pollution. Whether pollutants that arrive at navigable waters after traveling through groundwater are "from" a point source depends upon how similar to (or different from) the particular discharge is to a direct discharge.

The difficulty with this approach, we recognize, is that it does not, on its own, clearly explain how to deal with middle instances. But there are too many potentially relevant factors applicable to factually different cases for this Court now to use more specific language. Consider, for example, just some of the factors that may prove relevant (depending upon the circumstances of a particular case): (1) transit time, (2) distance traveled, (3) the nature of the material through which the pollutant travels, (4) the extent to which the pollutant is diluted or chemically changed as it travels, (5) the amount of pollutant entering the navigable waters relative to the amount of the pollutant that leaves the point source, (6) the manner by or area in which the pollutant enters the navigable waters, (7) the degree to which the pollution (at that point) has maintained its specific identity. Time and distance will be the most important factors in most cases, but not necessarily every case.

2003) (pollutants include "suspended solids, calcium, magnesium, sodium, potassium, bicarbonate, carbonate, sulfate, chloride, and fluoride"); *El Paso Gold Mines*, 421 F.3d at 1136 (zinc and manganese are pollutants when discharged into water from a gold mine).

3. Discharge and Hydrological Connection

a. *Legal standards*

150. District courts in Colorado have long recognized that the CWA precludes discharges to groundwater that reach navigable waters. *Sierra Club v. Colo. Ref. Co.,* 838 F. Supp. 1428, 1433–34 (D. Colo. 1993). Recently, the Supreme Court directly addressed the question of whether the CWA "requires a permit when pollutants originate from a point source but are conveyed to navigable waters by a nonpoint source, here, groundwater." *Cnty. of Maui, Hawaii v. Hawaii Wildlife Fund*, 140 S. Ct. 1462, 1468 (2020) (quotations omitted).

151. The Supreme Court held that "the statutory provisions at issue require a permit if the addition of the pollutants through groundwater is the functional equivalent of a direct discharge from the point source into navigable waters." *Id*.

152. The *Maui* decision listed seven factors to consider in determining whether a discharge to groundwater is the functional equivalent of a direct discharge: (1) transit time; (2) distance traveled; (3) the nature of the material through which the pollutant travels; (4) the extent to which the pollutant is diluted or chemically changed as it travels; (5) the amount of pollutant entering the navigable waters relative to the amount of the pollutant that leaves the point source; (6) the manner by or area in which the pollutant enters the navigable waters; and (7) the degree to which the pollution (at that point) has maintained its specific identity. *Id.* at 1476–77.

153. The Supreme Court noted that "[t]ime and distance will be the most important factors in most cases." *Id.* at 1477.

b. *Analysis*

154. As an initial matter, the Court notes that Ponds 3 and 4 are upgradient from the Middle Fork and less than 100 feet away, ¶¶ 43–44, and it makes physical and logical sense that a discharge to groundwater so close to the river is the functional equivalent of a direct discharge into the river. This commonsense notion is supported by the Supreme Court's reasoning in *Maui*:

> Consider a pipe that spews pollution directly into coastal waters. There is an "addition of" a "pollutant to navigable waters from [a] point source." Hence, a permit is required. But Maui and the Government read the permitting requirement *not* to apply if there is *any* amount of groundwater between the end of the pipe and the edge of the navigable water. If that is the correct interpretation of the statute, then why could not the pipe's owner, seeking to avoid the permit requirement, simply move the pipe back, perhaps only a few yards, so that the pollution must travel through at least some groundwater before reaching the sea? We do not see how Congress could have intended to create such a large and obvious loophole in one of the key regulatory innovations of the Clean Water Act.

Maui, 140 S. Ct. at 1473 (emphasis in original).

155. In addition, all experts who testified on this issue—except Murray, whose testimony was not credible—agreed that if the Settling Ponds discharged to groundwater, that discharged water would reach the Middle Fork. ¶¶ 89, 93.

156. Next, the Court turns to the *Maui* factors.

(i) Distance Traveled and Transit Time

157. In *Maui*, the Court stated that distance is an "obviously important" factor. To guide district court's application of this factor, the Court defined two ends of a

spectrum for addressing distance:

> Where a pipe ends a few feet from navigable waters and the pipe emits pollutants that travel those few feet through groundwater (or over the beach), the permitting requirement clearly applies. If the pipe ends 50 miles from navigable waters and the pipe emits pollutants that travel with groundwater . . . the permitting requirements likely do not apply.

Maui, 140 S. Ct. at 1476.

158. Ponds 3 and 4 are less than 100 feet away from the Middle Fork. ¶¶ 43–44. And Ponds 1 and 2 are only slightly further away. *See* Ex. 40 at 1.

159. The geological surveys conducted by Sirles show that the discharged water from Ponds 3 and 4 travel through discernable paths, identified as Anomalies A and B, to the Middle Fork. ¶¶ 81–85.

160. The Court concludes that the distance traveled factor weighs heavily in favor of the Plaintiffs. One hundred feet is orders of magnitude shorter than 50 miles, the distance at which the CWA would likely not apply. *Maui*, 140 S. Ct. at 1476.

161. The Court's conclusion is further buttressed by its consistency with the permitting practice of the WQCD, which applies a rebuttable presumption that discharges to groundwater within 300 feet of a mountain stream are the functional equivalent of surface water discharges. ¶ 102; *see Maui*, 140 S.Ct. at 1476 ("Decisions should not create serious risks either of undermining state regulation of groundwater or of creating loopholes that undermine the statute's basic federal regulatory objectives.").

162. Along with distance traveled, transit time is one of the most important factors. In *Maui*, the Court states that a transit time of "many years" would weigh against applying the CWA. *Id.* at 1476 (emphasis added). Here, the only expert to opine on transit time calculated it to be approximately two days. ¶ 95. Even if this

estimate were off by a factor of ten, in other words, if the transit time were actually 20 days, which the Court finds unlikely given Johnson's method, transit time would still be less than three weeks. And needless to say, three weeks is but a tiny fraction of "many years."

163. Thus, the transit time at issue in this case is on a vastly different scale than the "many years" referenced in *Maui*. Given, in addition, that this testimony was unrebutted, the Court gives this factor considerable weight and finds that it favors the Plaintiffs.[4]

(ii) Nature of the Material Through Which the Pollutants Travel

164. Sirles's geophysical investigation showed that "[a] combination of fine and coarse-grained sediments exists from the embankment east, south, and north of the ponds." Ex. 47 at 2. Murray agreed with that statement. Tr. 870:5–13. Johnson testified that the soils around the ponds are comprised of boulders, cobbles, gravels, silts, and clays. Tr. 72:9–10 (Johnson); *see also* Tr. 626:22–627:2 (Lewicki testimony that "the material on the surface at the Alma Placer that's been disturbed for years has an extremely high percolation rate").

[4] On remand, the District of Hawaii applied this "functional equivalent" test and found that Maui County's wastewater constituted the functional equivalent of a direct discharge of pollution into the Pacific Ocean, mandating an NPDES permit. *Hawai'i Wildlife Fund v. Cnty. of Maui*, 550 F.Supp.3d 871, 873 (D. Haw. 2021). The court underscored the factors of time and distance—that is, the time it took the wastewater to reach the ocean and the distance the wastewater had to travel to get there. *See id.* at 885, 889. The court cited a study in which dye placed in two wells reached the ocean in "as little as 84 days, with peak concentration of the dye occurring 9 to 10 months after placement" and an average transit time of 14 to 16 months. *Id.* at 886. The court noted that these wells were located "one-half mile or less from the Pacific Ocean" and that "even with diffuse flow, the wastewater likely travel[ed] a relatively short distance through groundwater." *Id.* at 888. The court found that these factors weighed in favor of requiring a permit. *Id.* Here the factors of distance and time weigh even more heavily in favor of requiring a permit since both the time and distance are significantly shorter than in *Maui*.

165. Defendants introduced no evidence that the nature of the materials through which the pollutants traveled should weigh in their favor.

166. The Court finds that this factor also weighs in favor of Plaintiffs because the evidence presented at trial indicated that the pollutants traveled through porous materials. However, because of the limited evidence presented about the composition of the soil below the Settling Ponds, the Court gives this factor little weight.

(iii) Remaining Factors

167. Neither party presented evidence regarding the extent to which the pollutants were diluted or chemically changed as they traveled to the Middle Fork. Nor was there evidence presented about the degree to which the pollution maintained its specific identity as it traveled to the Middle Fork.

168. Again, Defendants presented no evidence to persuade the Court that these factors should weigh in their favor.[5]

169. Based on the lack of evidence relevant to these two factors, the Court gives them no weight.

170. Similarly, there was limited evidence regarding the amount of pollutant entering the navigable waters relative to the amount of the pollutant that leaves. As such, the Court also gives this factor no weight.

B. Liability: South Pond

171. Plaintiffs' claim fails with regard to the South Pond because they have not proven by a preponderance of the evidence that the South Pond discharged pollutants.

[5] Had Defendants introduced evidence that the materials below the pond were effective at filtering pollutants, this factor would have weighed in their favor.

High Mountain was fined $5,000.

205. The Court finds that the October 2014 spill is a violation of a completely different nature than the violations at issue in this case. Therefore, the Court does not consider the October 2014 spill in its evaluation of High Mountain's history of violations. 33 U.S.C. § 1319(d) (courts are to consider whether defendant has a "history of *such* violations," not a history of *any* CWA violation).

206. As to the next factor, good faith, High Mountain made no apparent efforts to comply with the permitting requirements at issue here. Under the WQCD's implementation of the NPDES permit system, High Mountain had an affirmative duty to ensure it is not discharging pollutants to surface waters under the CWA. Tr. 305:18-306:3. And yet, even during the period when High Mountain acknowledged that the Settling Ponds were discharging into groundwater, it made no attempt to obtain an NPDES permit. High Mountain's lack of action weighs against a finding that it acted in good faith.

207. In considering the economic impact of the penalty, the Court considers that Alma Placer Mine has relatively limited cashflow: some years it has a positive cashflow of approximately 2 million, some years it has a negative cashflow of 2 million. ¶ 188. A penalty anywhere near the statutory maximum $165 million would bankrupt the company. *Id.* On the other hand, given the scale of High Mountain's business, a penalty that is too low would insufficiently incentivize compliance with the CWA.

208. In conclusion, the Court finds that a penalty should be imposed on High Mountain in the amount of $500,000.

209. $500,000 represents the Court's best estimate of the economic benefit High Mountain enjoyed by avoiding compliance with the CWA. The Court has not increased the penalty based on the statutory factors because of the lack of evidence that the violations caused serious environmental damage, and because too high of a penalty would likely bankrupt the company.

210. A $500,000 penalty represents a penalty of $171.11 for each day that High Mountain violated the CWA from April 29, 2014 to April 29, 2021.

2. <u>Injunctive Relief</u>

211. District courts are statutorily authorized to enter injunctions in citizen suit proceedings under the CWA. *See* 33 U.S.C. § 1365(a). To obtain a permanent injunction Plaintiffs must demonstrate: (1) actual success on the merits; (2) irreparable harm unless the injunction is issued; (3) the threat of injury outweighs the harm the injunction may cause to the opposing party; and (4) if issued, the injunction will not adversely affect the public. *Fisher v. Oklahoma Health Care Auth.,* 335 F.3d 1175, 1180 (10th Cir. 2003). "The grant of jurisdiction to ensure compliance with a statute hardly suggests an absolute duty to do so under any and all circumstances, and a federal judge sitting as chancellor is not mechanically obligated to grant an injunction for every violation of law." *Amoco Prod. Co. v. Vill. of Gambell*, 480 U.S. 531, 542 (1987) (quoting *Weinberger v. Romero–Barcelo*, 456 U.S. 305, 313 (1982)). Instead, the CWA "permits the district court to order that relief it considers necessary to secure prompt compliance with the Act." *Weinberger*, 465 U.S. at 320.

212. Plaintiffs fail to offer any meaningful arguments to support their request for injunctive relief, and as a result, the Court finds that Plaintiffs have waived this issue. *See generally* ECF No. 174.

HMMC000238

At the same time, courts can provide guidance through decisions in individual cases. The Circuits have tried to do so, often using general language somewhat similar to the language we have used. And the traditional common-law method, making decisions that provide examples that in turn lead to ever more refined principles, is sometimes useful, even in an era of statutes.

The underlying statutory objectives also provide guidance. Decisions should not create serious risks either of undermining state regulation of groundwater or of creating loopholes that undermine the statute's basic federal regulatory objectives.

EPA, too, can provide administrative guidance (within statutory boundaries) in numerous ways, including through, for example, grants of individual permits, promulgation of general permits, or the development of general rules. Indeed, over the years, EPA and the States have often considered the Act's application to discharges through groundwater.

Both Maui and the Government object that to subject discharges to navigable waters through groundwater to the statute's permitting requirements, as our interpretation will sometimes do, would vastly expand the scope of the statute, perhaps requiring permits for each of the 650,000 wells like petitioner's or for each of the over 20 million septic systems used in many Americans' homes. Brief for Petitioner 44–48; Brief for United States as *Amicus Curiae* 24–25. Cf. *Utility Air Regulatory Group* v. *EPA*, 573 U. S. 302, 324 (2014).

But EPA has applied the permitting provision to some (but not to all) discharges through groundwater for over 30 years. See *supra*, at 8–9. In that time we have seen no evidence of unmanageable expansion. EPA and the States also have tools to mitigate those harms, should they arise, by (for example) developing general permits for recurring situations or by issuing permits based on best practices

Statement of Qualifications for

Geophysical Services

COLLIER
GEOPHYSICS

Surface • Borehole • Marine

Service-Disabled Veteran Owned Business

Service Disabled Veteran Owned Small Business
SDVOSB
cVE

TABLE OF CONTENTS

OUR COMPANY

Collier Geophysics (CGp) is a Texas based firm, with offices in Colorado, Ohio, and Wisconsin, that provides competent, efficient and innovative geophysical services to the groundwater, engineering, energy, and mining markets. CGp is a Service-Disabled Veteran Owned. We work in all 50 states and on select international projects. Our roots are in groundwater, subsequently we are well versed in hydrogeology and how geophysics can be efficiently applied to aid groundwater studies. We have a special focus on geophysical applications for engineering investigations, groundwater studies, and high resolution seismic for petroleum exploration.

CGp has an exceptional team of senior level geophysicists and supporting staff. We have five senior geophysicists, each with over 30 years of experience in their area of expertise. We are organized into five geophysical market sectors; **Groundwater**, **Engineering**, **Energy**, **Mining**, and **Drone-Enabled**. We have subject experts in each of these fields, but share resources and knowledge across the sectors to provide the expertise and manpower needed for even the most difficult projects.

Our seismic capabilities are among the best available in the shallow petroleum groundwater fields and considered to be pushing the envelope for high resolution imaging. We maintain a close relationship with two seismic processing shops where we are developing proprietary processing packages to better resolve complex structure and improve the detection and imaging of fine faults and fractures. We are leaders in the use of geophysics to map karst and voids and one of the first companies to bring full wave form inversion to the groundwater and engineering geophysical field.

CGp is affiliated with Collier Consulting, Inc. (CCINC), a woman-owned geoscience and engineering consulting firm specializing in all facets of groundwater development. CCINC is a federal HUBzone-Certified Small Business. CCINC was incorporated in 1998 and has enjoyed sustained growth throughout its history. CGp was incorporated in 2018 to better manage CCINC's rapidly growing geophysical group. CCINC has a staff of approximately 40 employees includes hydrogeologists, engineers, geologists, geophysicists, computer scientists, GIS professionals, and environmental scientists. Company headquarters is in Stephenville, Texas with satellite offices in Lakewood, CO, Ohio, Wisconsin, Austin, Houston, and Waco.

CGp maintains a comprehensive supply of surface and borehole geophysical equipment, hydrogeological and petrophysical software, hydrogeological equipment, and GIS software. Our combination of in-house and cloud-based computing capabilities, in conjunction with our technical expertise, allows us to provide our clients world-class solutions while maintaining a high level of information security.

Our founder, Dr. Hughbert Collier is the author of Texas Water Development Board (TWDB) Report 343, Borehole Geophysical Techniques for Determining the Water Quality and Reservoir Parameters of Fresh and Saline Water Aquifers in Texas. Collier Consulting staff and associates have taught short courses and lectured internationally and throughout the U.S. on hydrogeology, geophysics, and log interpretation.

OUR PRESIDENT

Major Nathan Collier, P.E. is the President of Collier Geophysics, a SDVOSB in Stephenville, TX founded in 2018.

Major Collier attended the United States Military Academy at West Point, Class of 2007. His class has the distinction of being the first to fully begin the Academy's admission process after September 11, 2001.

Major Collier played as an offensive lineman and lettered for Army Football. Upon graduation with a BS in Engineering Management, he was commissioned as a 2nd Lieutenant in the Field Artillery.

Major Collier served on active duty for eight years including assignments to Grafenwöhr and Schweinfurt, Germany, Schofield Barracks and Fort Shafter, Hawaii, and Fort Sill, Oklahoma. He served in a multitude of roles including Battery Commander, Fire Support Officer, Executive Officer, Platoon Leader, and Future Operations Planner.

Major Collier has deployed in support of Operation Iraqi Freedom '08-'09, Operation Enduring Freedom '11 and Operation Foal Eagle '14 in South Korea.

Major Collier's military decorations include the Bronze Star Medal, Army Meritorious Service Medal, Parachutist Badge, Air Assault Badge, and Pathfinder Badge.

Major Collier continues to serve as an Engineer Officer in the Texas National Guard.

GEOPHYSICAL EXPERIENCE

We provide geophysical services applied to:

- *Groundwater investigations and aquifer characterization*
- *Aquifer Storage and Recovery feasibility studies*
- *Contaminant delineation and water quality assessment*
- *Karst feature location and delineation*
- *Fault and fracture studies*
- *Top-of-rock profiling*
- *Geotechnical characterization*
- *Dam and levee integrity studies*
- *Geohazard surveys*
- *Natural resources exploration*
- *Petroleum exploration*
- *Injection well siting*
- *Metallic and aggregate mining*

Geophysical investigations have become an integral part of site assessment and characterization studies, feasibility studies, and engineering design. CGp's geophysical investigations are planned and performed by professional geophysicists with portable equipment that allows access to almost any area. Our experience, field techniques, computer processing, modeling, and display procedures ensure that the results of geophysical investigations provide the information needed for successful, cost-effective site assessments and realistic solutions integrated into your project requirements.

Our geophysicists are also experienced hydrogeologists and geologists, allowing us to provide full-service expertise in the application of geophysics to the assessment of hydrogeology and aquifer characterization.

GEOPHYSICAL MARKET SECTORS

CGp is organized along five market sectors to focus our expertise and more effectively serve our clients.

- **Groundwater Geophysics**
- **Engineering Geophysics**
- **Energy Geophysics**
- **Mining Geophysics**
- **Drone-Enabled Geophysics**

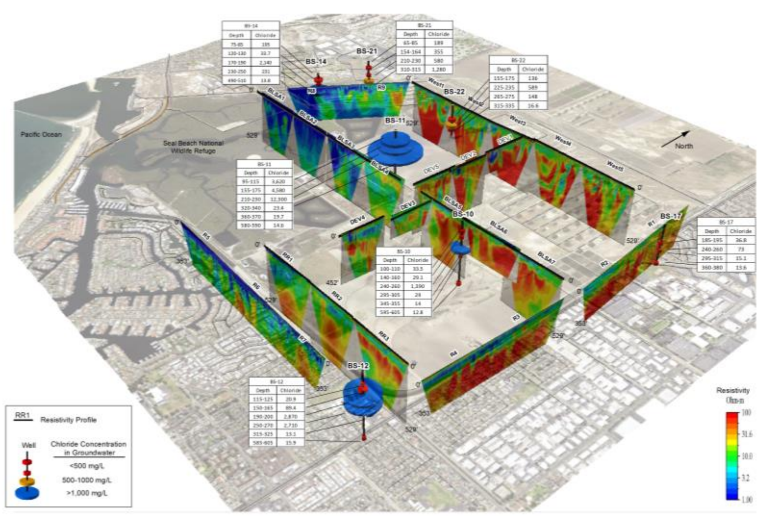
Each sector is led by well-respected experts with over 30 years of experience in the field. Designed to help us focus on our client's needs, the sectors are not rigid; CGp shares resources and staff between sectors to handle large and difficult jobs.

Groundwater Geophysics

CGp offers geophysical surveys to support groundwater studies. We understand that most groundwater studies are hampered by the limited availability of borehole data. We provide focused geophysical surveys to provide the additional subsurface information needed to understand the hydrogeology of your site and improve the success of your project. Our sector leaders, **John Jansen** P.G., P.Gp., Ph.D. and **Doug Laymon**, P.G., are geophysicists with extensive experience in hydrogeology. We understand what data you need and can help you plan a survey that will significantly increase your understanding of your site and produce a better result for your client.

CGp offers surface and borehole geophysical studies to:

- **Map aquifers and site high capacity wells**
- **Find fractures and faults**
- **Regional basin studies**
- **Map saltwater intrusion plumes**
- **Map the top of bedrock or confining units**
- **Map karst features**
- **Measure interval head and transmissivity in open boreholes**
- **Differential flow studies to identify zones of poor water quality in production wells**



ERT Survey to Map Saltwater Intrusion in a Coastal Aquifer

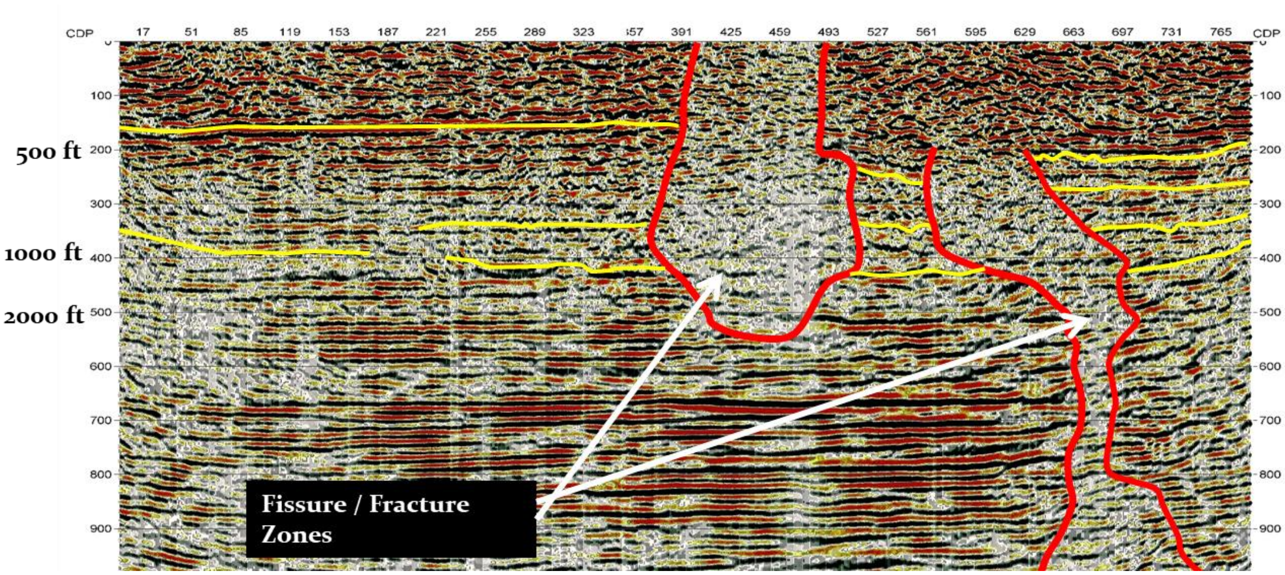
Engineering Geophysics

CGp provides geophysical surveys to support civil engineering and environmental studies. We can focus on small scale targets that impact structures to large scale features that affect regional planning. We offer passive and active seismic, electrical, electromagnetic, and potential field methods to provide the subsurface information engineers need to design robust structures and diagnose problems in existing structures. We are leaders in applying drones to geophysical data acquisition and mapping karst.

Our sector leaders, **Phil Sirles,** P.G. and **Doug Laymon**, P.G., are geophysicists with extensive experience in engineering geophysics. Our staff has both OSHA HAZWOPER and MSHA health and safety training, with annual refresher courses. Our geophysicists have specialty training in soils and rock mechanics, geology and groundwater to better understand the needs of our clients.

CGp offers geophysical surveys for:

- **Depth-to-bedrock**
- **Competency of bedrock – (rippability, Poisson's Ratio, Shear Modulus)**
- **Injection well siting**
- **Mapping faults, karst or caliche**
- **Depth to water table**
- **Dam stability**
- **Dam seepage**
- **Levee assessment**
- **Obstacles to construction**
- **Landslide and slope monitoring**
- **Permafrost thickness and stiffness**
- **Soil and bedrock characterization below active rivers**
- **Mapping abandoned mine workings**

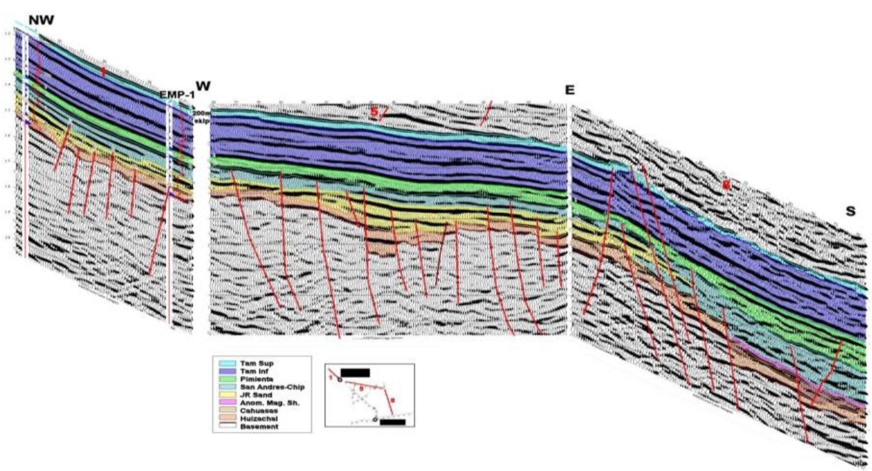


Mapping Karst and Fracture Zones to Depths of Over 2,000 ft to Map Regional Subsidence Problems

Energy Geophysics

CGp provides shallow geophysical services designed to serve most facets of the energy market including petroleum exploration, frack water sources, geothermal exploration, water for solar renewable energy projects, and siting injection wells. CGp is a leader in the application of shallow high-resolution 2D and 3D reflection surveys for small and medium sized petroleum exploration projects. We have specialized expertise in planning, logistical management, and field operations in environmentally sensitive and challenging terrain and sensitive regions. We design, plan, and perform geophysical data acquisition on a contract basis or as a turnkey service including data processing and interpretation to map; stratigraphy, oil and gas deposits, coal bed methane (CBM) formations, coal seams, gas storage vessels, geothermal reservoirs, abandoned wells and pipelines, and other targets of interest. We are leaders in the use of full wave form acquisition and processing of reflection and refraction tomography data to map deep karst features and fracture detection. We are experts at finding water sources for energy, finding abandoned wells and pipelines, and characterizing sites for gas storage or Compressed Air Energy (CAES) projects.

Our sector leaders, **Finn Michelson**, P.G. and **Ron Bell** are respected leaders in their fields. Finn and Ron each have more than 30 years of experience in their fields and offer specialized expertise in high resolution seismic and drone-based magnetics and EM surveys.



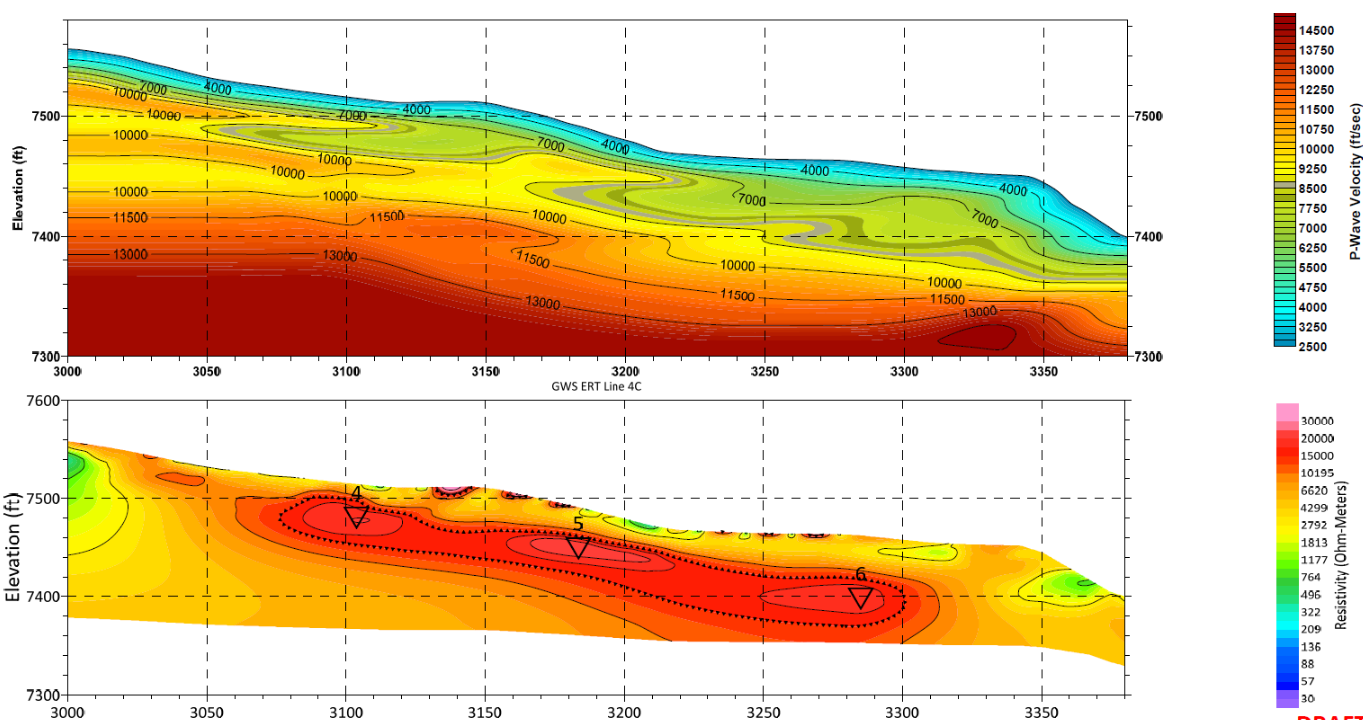
Seismic Reflection Line

Mining Geophysics – Mine Site Engineering

Mine operators are often faced with groundwater or geotechnical challenges that can adversely impact mine operations or present significant safety hazards. In many cases, information about groundwater flow or subsurface conditions can be obtained by non-invasive geophysical methods and can be applied to improve mine operations and the mineral extraction process. The geophysicists at Collier Geophysics (CGp) bring decades of experience in applying geophysical subsurface imaging tools to a broad array of mine site challenges including but not limited to:

- Assessing the integrity of tailings dams
- Identifying sources of acid rock drainage
- Delineating preferential flow paths for groundwater
- Monitoring groundwater flow
- Locating leaks in pond liners
- Determining rippability of rock
- Detecting underground mine workings
- Mapping overburden thickness

Our mining site sector leaders, **Ron Bell** and **Phil Sirles**, P.G., have more than 30 years of experience each in the mining industry. We support surface and underground mining clients in the coal, uranium, base and precious metals, and aggregate industries. CGp has unique expertise in finding karst features and application of geophysics for mine site water management.



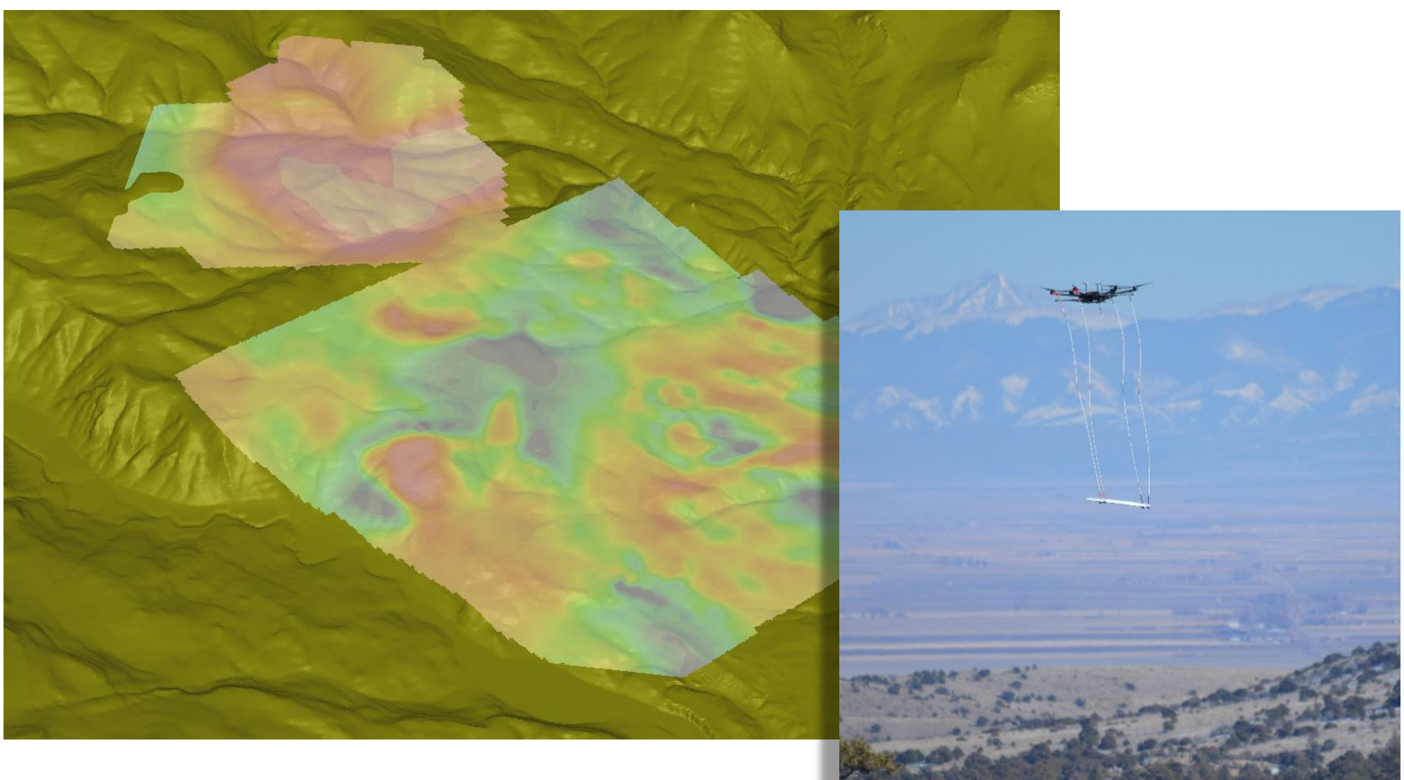
Seismic Refraction Tomography (Top) and Electrical Resistivity Tomography (Bottom) Survey Mapping Potential Karst Features in Aggregate Mining Area

Mining Geophysics – Mineral Exploration

Geophysical and remote sensing technologies have become essential to the discovery and assessment of gold and silver, base metal, coal and uranium, and strategic mineral deposits. Airborne geophysical methods are employed to map large areas and increase the efficiency and success of the exploration program. Ground and borehole geophysical methods are deployed to map the subsurface geology and structure in in much more detail with respect to the size of the prospect and commodity type. The Collier Geophysics team collectively bring multiple decades of experience in the acquisition and interpretation of data with the following geophysical methods for resource exploration.

Gravity
DC Resistivity & Induced Polarization
Time Domain Electromagnetic (TDEM)
Seismic Refraction Tomography
Drone Enabled Magnetometry
Magnetics
Very Low Frequency Electromagnetic (VLF-EM)
Frequency Domain Electromagnetic (FDEM)
2D & 3D Seismic Reflection Imaging
Airborne EM and Magnetics

Collier Geophysics is leading the way in the application of Unmanned Aerial Vehicle (UAV) Based geophysics. We are currently applying UAV enabled magnetometry to detailed exploration of mineral prospects. Our mine exploration sector leader, **Mr. Ron Bell**, is a globally recognized leader in the development and application of drone magnetometry to mineral exploration.



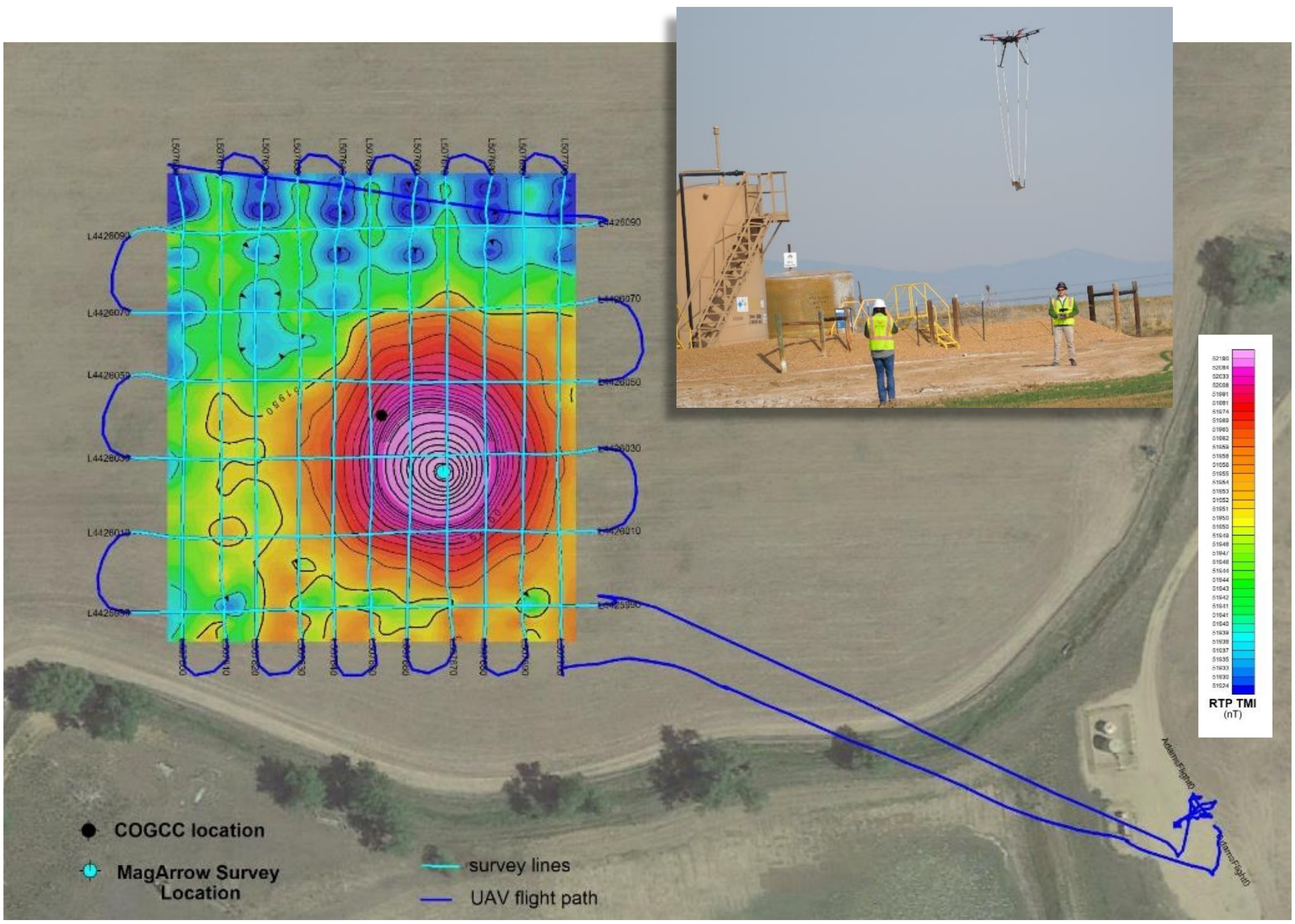
Contour Map of Total Magnetic Intensity (TMI) Superimposed on Digital Elevation Model Acquired with the Drone Enabled MagArrow$_{TM}$ (Left), Mineral Exploration Survey in Southern Colorado (Right).

Drone Enabled Geophysics

Collier Geophysics offers low altitude aeromagnetic surveys for locating abandoned oil and gas wells and delineating buried pipelines. These techniques may also be used for mapping geology for groundwater and mineral resource exploration and development.

We deploy the latest innovation in magnetometers, the **MagArrow**$_{TM}$ by Geometrics, Inc., using a small unmanned aerial vehicle (UAV) to obtain magnetic data over areas that are difficult to access or are simply too large to cost -effectively survey on the ground. Color photogrammetry, thermal infrared and LiDAR drone surveys are also offered. In addition, Collier Geophysics offers data processing, visualization, and interpretation of drone magnetic and other data.

Our drone services manager and business development lead is **Mr. Ron Bell**, an exploration and environmental geophysicist with over 30 years of experience in the acquisition, processing and interpretation of ground and airborne geophysical data and a recognized industry leader in the application of small unmanned aircraft systems (UAS) to geophysical exploration and geoscientific mapping.



Drone Magnetic Survey to Locate an Abandoned Oil and Gas Well in Colorado.

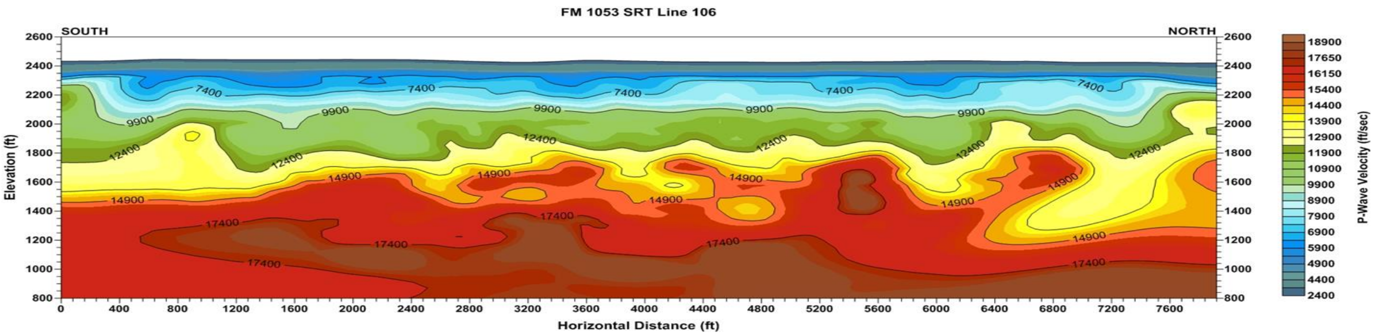
GEOPHYSICAL METHODS

CGp provides expertise in most contemporary geophysical methods as summarized on the following table. A brief description of the most commonly used methods follows the table.

Table 1: List of Common Geophysical Methods and Applications			
Method	What it Measures:	Mode of application	Typical Uses
ELECTRICAL METHODS			
Electrical Resistivity	Electrical Conductvity	Surface and Marine	Stratigraphy, Saltwater Intrusion, Fracture Zones
Induced Polarization (IP)	Electrical Chargeability	Surface	Sulfide Mineralization, Clay Content
Spontaneous Potential (SP)	Electrokinetic Potential	Surface	Fluid Flow
Mise a la Masse	Electrical Conductvity	Surface	Conductive Bodies
SEISMIC METHODS			
Seismic Refraction	Seismic Velocity	Surface	Depth to Bedrock or Confing Units
Seismic Reflection	Acoustic Impedance	Surface and Marine	Stratigraphy, Structure,Faulting
Multi-Channel Analysis of Surface Waves (MASW)	Shear Wave Velocity	Surface	Depth to Bedrock, Voids, Incometent Zones
Full Wave-Form Tomography	Seismic Wave Propagation	Surface	Stratigraphy, Structure, Karst
Horizontal to Vertical Spectral Ratio (HVSR) Method	Shear Wave Velocity	Surface	Depth to Bedrock
ELECTROMAGNETIC METHODS (EM)			
Frequency Domain Electromagnetic Induction (FDEM)	Electrical Conductvity	Surface, Marine & Airborne	Stratigraphy, Saltwater Intrusion, Fracture Zones
Time Domain Electromagnetic Induction (TEM)	Electrical Conductvity	Surface, Marine & Airborne	Stratigraphy, Saltwater Intrusion, Fracture Zones
Ground Penetrating Radar (GPR)	Dielectric Constant	Surface & Marine	Stratigraphy, Buried Targets
Controlled Source Audio Frequency Magnetotellurics (CSAMT)	Electrical Conductvity	Surface	Stratigraphy, Saltwater Intrusion, Fracture Zones
Very Low Frequency Induction (VLF)	Electrical Conductvity	Surface	Bedrock Fractures, Depth to Bedrock
Metal Detectors	Electrical Conductvity	Surface & Marine	Buried Metal, Utilities
POTENTIAL FIELD METHODS			
Magnetometry	Magnetic Suceptibility	Surface, Marine and Airborne	Ferrous Bodies
Gravity Surveys	Density	Surface, Marine and Airborne	Depth to Bedrock, Voids, Structure
Geothermal Methods	Thermal Conductvity	Surface	Fluid Flow
BOREHOLE METHODS			
ELECTRICAL LOGS			
Spontaneous Potential Log	Electrokinetic Potential	Fluid Filled Borehole	Sand vs Shale, Water Quality
Resistivity Logs	Electrical Conductvity	Fluid Filled Borehole	Stratigraphy, Water Quality
Resistance Logs	Electrical Resistance	Fluid Filled Borehole	Formation Contacts
Induction Logs	Electrical Conductvity	Fluid or Airfilled Borehole	Stratigraphy, Water Quality
Gamma Logs	Gamma Ray Emmission	Fluid or Airfilled Borehole	Clay Content
POROSITY LOGS			
Nuclear Magnetic Resonance Log (NMR)	Hydrogen Ion Content	Fluid or Airfilled Borehole	Porosity and Permeability
BOREHOLD IMAGING LOGS			
Down Hole Televising Log	Borehole Image	clear fluid or air filled	borehole condition, stratigrpahy
Acoustic Televiewer	High Frequency Sonic Scan	fluid filled borehole	borehole condition, fractures
Optical Televiewer	Optical Light Scan	clear fluid or air filled	borehole condition, stratigraphy, fractures
Caliper Log	Borehole Diameter	any borehole	borehole diameter, fractures
Alignment Logs	Borehole Deviation	any borehole	hole allignment
FLOW METERS			
Temperature Logs	Fluid Temperature	Water Filled Borehole	Flow in Open Borehole
Borehole Fluid Conductivity Logs	Electrical Conductvity	Water Filled Borehole	Flow in Open Borehole
Spinner Logs	Fluid Flow	Water Filled Borehole	Flow in Open Borehole
Heat Pulse Flow Meters	Fluid Flow	Water Filled Borehole	Flow in Open Borehole
Electromagnetic Flow Meters	Fluid Flow	Water Filled Borehole	Flow in Open Borehole
Fluid Displacement Logs	Fluid Flow	Dionized Water Filled	Flow in Open Borehole
WATER QUALITY LOGS			
Geochemical Logs	Ionic concentration	Water Filled Borehole	Concentration of Specific Ions like Chloride or Nitrate
Downhole Samplers	Water Quality	Water Filled Borehole	Collecting Water Smaples from Specific Depths in a Water Filled

Seismic Methods

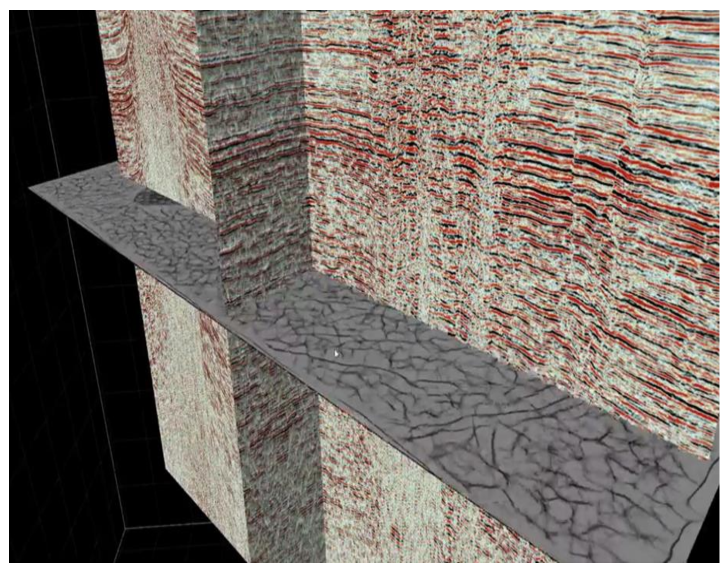
Seismic methods measure the elastic properties of soil and rock that are a function of the physical properties such as seismic velocity, density, and shear modulus. CGp applies various types of seismic methods to various problems including: reflection, refraction, tomography, active and passive MASW, downhole and cross-hole seismic, and marine applications. We are a leader in applying full wave form inversion to shallow seismic applications to map fractures, voids and karst.



**Seismic Refraction Tomography Profile Mapping
Karst Features at Approximately 1,600 Feet**

Typical Applications of the Seismic Method

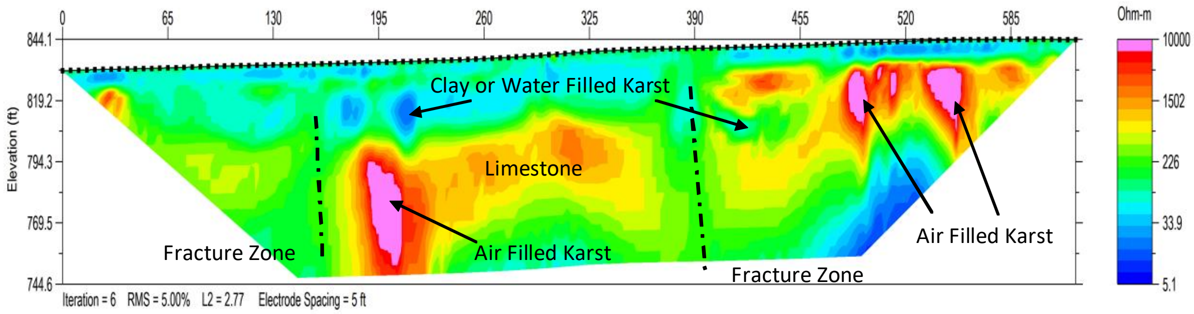
- Overburden thickness
- Bedrock topography
- Water table depth
- Rippability of bedrock
- Lithology
- Fractures, faults, and karst
- P and S wave velocity for dynamic modulus calculations
- Characterization for geotechnical and civil engineering projects
- Dam and levee assessment
- Petroleum exploration
- Marine applications



3D Seismic Reflection Data Cube Showing Fracture Attribute on Horizontal Plane

Electrical Methods

Electrical methods measure subsurface electrical resistivity (inverse of conductivity). This is a function of soil and rock physical and mineralogical properties and chemistry of pore fluids. Electrical resistivity measurements are made by injecting electrical current into the ground and measuring the resulting potential field through an array of electrodes. CGp uses electrical resistivity tomography (ERT) which uses arrays of multiple electrodes to produce 2D and 3D tomographic images of the subsurface. Additionally, CGp utilizes other electrical methods such as inverse polarization (IP) and spontaneous potential (SP) to characterize subsurface conditions.

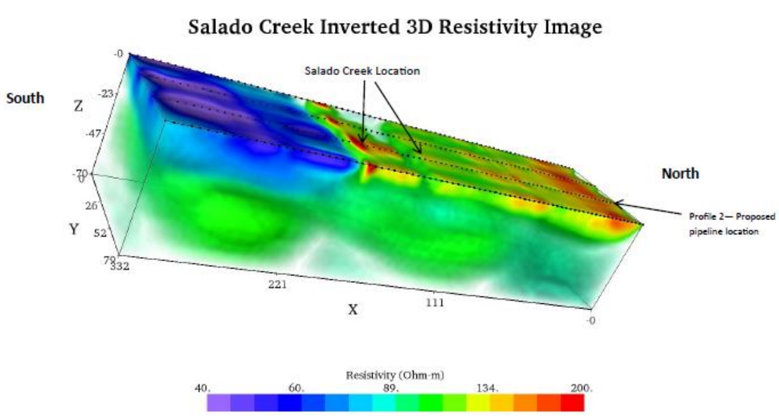


Electrical Resistivity Tomographic Profile

Typical Applications of Electrical Methods

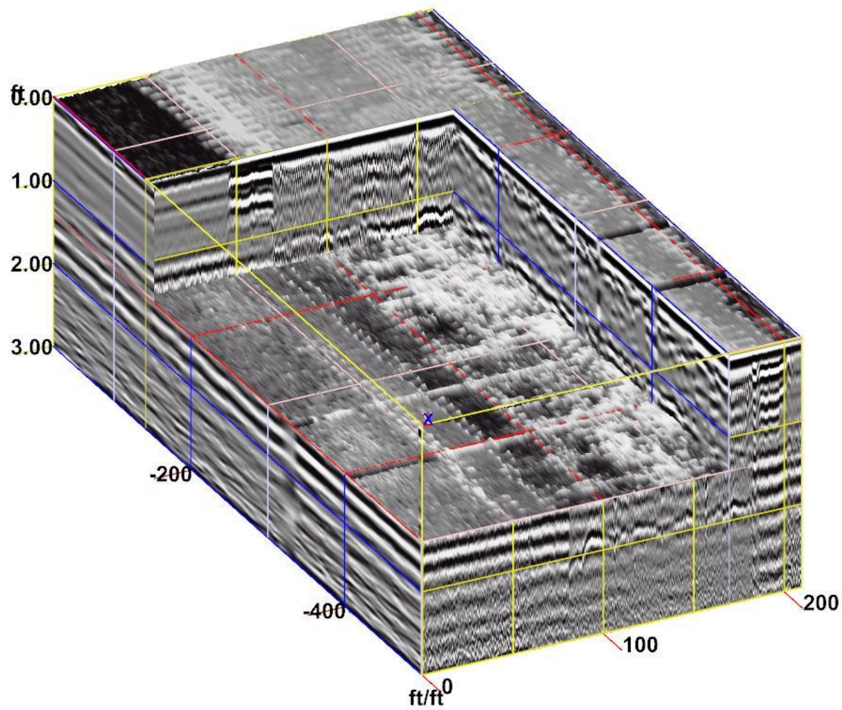
- Soil and bedrock lithology
- Contaminant plumes
- Lateral and vertical variations
- Aquifer characterization
- Water table depth
- Bedrock topography
- Fractures, fault, and karst mapping
- Natural resources exploration
- Dam and levee assessment
- Corrosion assessment
- Grounding surveys
- Marine applications

Resistivity Survey of a Proposed Pipeline River Crossing



Ground Penetrating Radar (GPR) Methods

GPR methods measure the changes in the propagation of electromagnetic energy in the ground to produce an image of subsurface conditions. Data are collected digitally and processed to produce 2D and 3D images of the subsurface. CGp utilizes GPR for a variety of engineering and environmental applications.



3D Radar Section

Typical Applications of GPR Methods

- Buried objects (drums, USTs)
- Utility mapping and detection
- Clearing of boring locations
- Concrete and rebar assessment
- Voids
- Subsurface structures
- Waste pits and trenches
- Fractures, faults, and karst
- Archeology
- Forensics

Electromagnetic (EM) Methods

EM methods measure the electrical conductivity of the subsurface using electromagnetic induction. Soil conductivity is a function of the electrical properties of subsurface materials and chemistry of pore fluids, and is the inverse of electrical resistivity. EM methods are very useful in mapping changes in lithology and water quality, salt water intrusion, and fracture zones. EM methods can also be used to detect buried ferrous and non-ferrous metal. CGp utilizes both Frequency Domain and Time Domain EM instruments for various applications.

EM Conductivity Data for a Levee Characterization

Typical Applications of Electromagnetic Methods

- Lithology mapping
- Contaminant plumes
- Boundaries of landfills and pits
- Metal detection
- Utility mapping and detection
- Ordnance UXO
- Lateral and vertical variations in soil
- Aquifer characterization
- Fractures, faults, and karst
- Dam and levee assessment

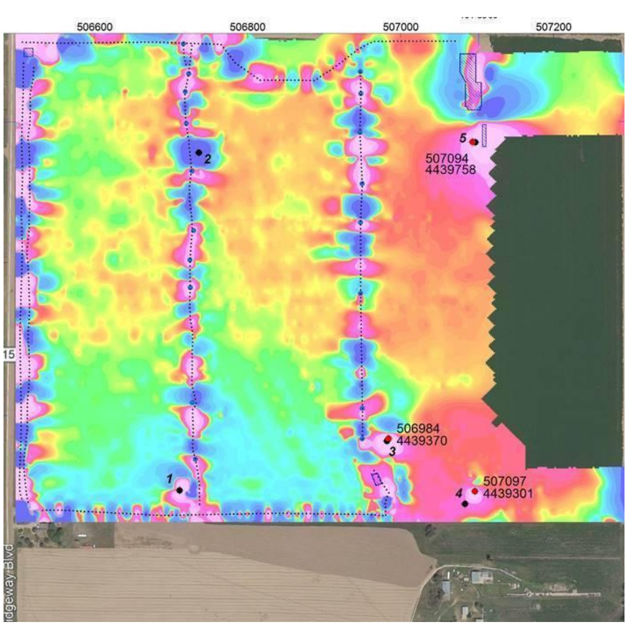
Magnetic Methods

Magnetic methods measure the earth's magnetic field and anomalies caused by naturally occurring and manmade ferrous materials. Theoretical models can be used to approximate size, depth, shape, and composition of various targets. CGp utilizes magnetic methods on a variety of engineering and environmental applications including drone-based magnetometer systems.

Typical Applications of Magnetic Methods

- Buried metal objects
- Ordnance UXO
- Utility mapping and detection
- Clearing of borehole locations
- Abandoned wells
- Geologic structure and faults
- Natural resources exploration
- Archeology

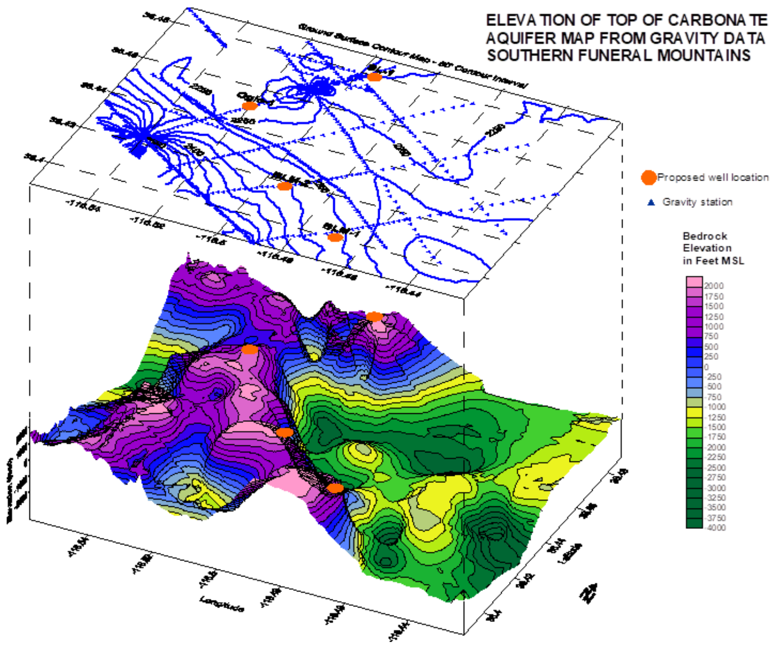
Ground Based Magnetometer Survey in Death Valley



Drone Based Magnetometer System Mapping Abandoned Oil Wells and Flow Lines in Colorado

Gravity Methods

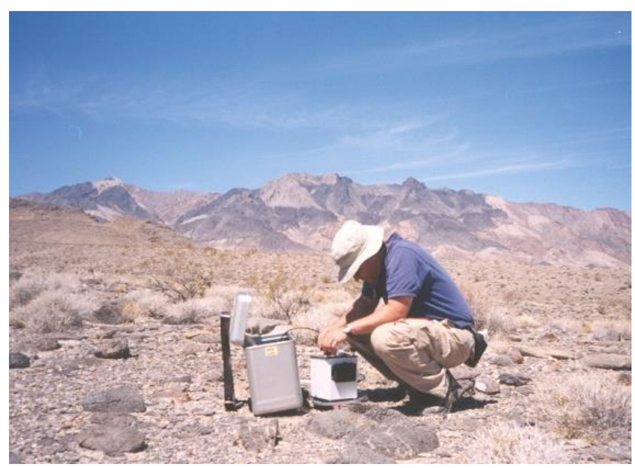
Gravity methods measure the change in the earth's gravitational field caused by variations in the density of the subsurface. Gravity surveys can be used to detect and map buried structures such as faults, voids, bedrock topography, and basin geometry. The data can be processed to determine the size, depth, shape, and composition of various targets.



Buried Bedrock Surface from Gravity Survey Beneath the Amargosa Valley, CA

Typical Applications of Gravity Methods

- Karst features
- Voids and tunnels
- Bedrock valleys and paleo channels
- Faults and other geologic structure
- Basin geometry
- Petroleum exploration
- Natural resources exploration

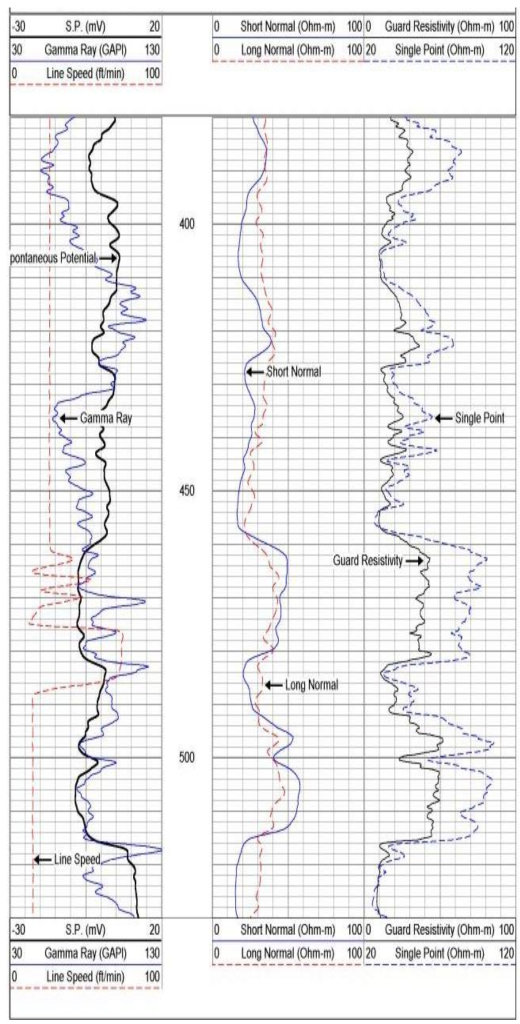


Borehole Geophysical Logging Methods

Borehole logging methods are used to measure a variety of subsurface physical properties in the borehole. Borehole logging methods are used to make high resolution measurements of the variation in fluid and physical properties in and around the well bore that are not easily measured in drill cuttings. CGp has years of experience acquiring and interpreting borehole logging data for various applications.

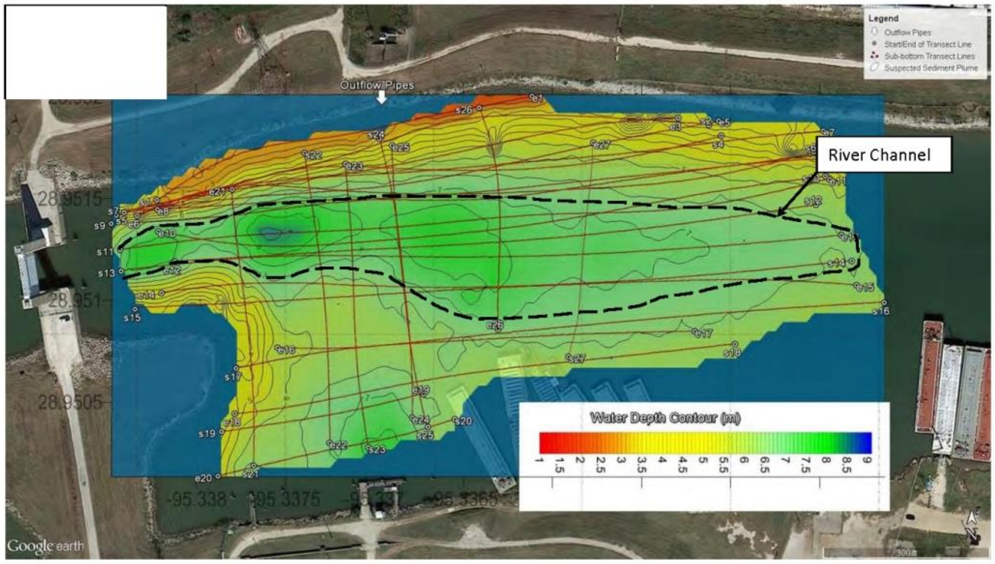
Borehole Tools Used by CGp

- Video Camera Surveys
- Gamma Ray
- Spontaneous Potential (SP)
- Short and Long Normal Resistivity
- Induction
- Single Point
- Caliper
- Sonic
- Borehole Deviation
- Fluid Conductivity
- Temperature
- Flow Meter
- Fluid Sampler
- Cement Bond Log
- Borehole Televiewer



Marine Geophysical Methods

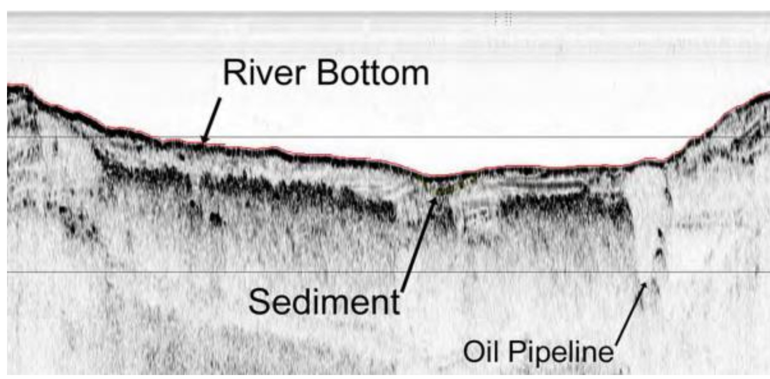
Marine geophysical methods utilize many of the traditional geophysical methodologies but applied to marine environments. Marine geophysical methods can be utilized in the ocean, near shore, lakes, streams, and rivers to solve a variety of problems for various engineering applications. CGp utilizes a variety of geophysical methods for marine applications.



Sub-bottom Profiling and Bathymetry Survey

Marine Methods Used by CGp

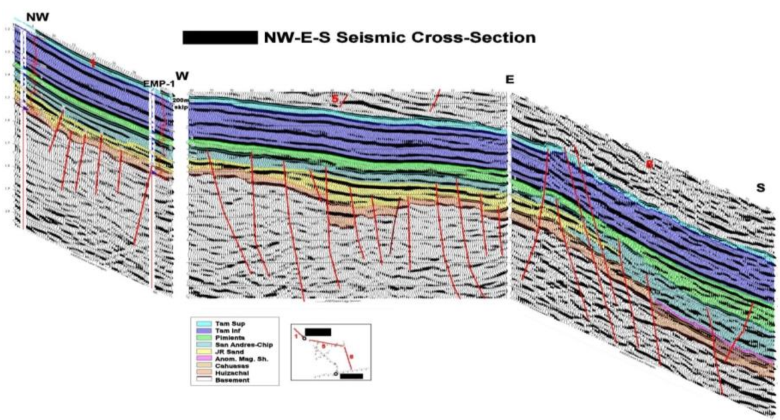
- Side Scan Sonar
- Sub-bottom Profiling
- Multibeam Bathymetry
- Seismic
- Electrical Resistivity
- Marine Magnetics



PETROLEUM SEISMIC SURVEY SERVICES

CGp is a leader in the application of shallow high-resolution 2D and 3D reflection surveys for small and medium sized petroleum exploration projects. We have specialized expertise in planning, logistical management, and field operations in environmentally sensitive regions and challenging terrain. We design, plan, and perform seismic data acquisition on a contract basis or as a turnkey service including data processing and interpretation to map; stratigraphy, oil and gas deposits, coal bed methane (CBM) formations, coal seams, and other economic minerals. We are leaders in the use of full wave form acquisition and processing of reflection and refraction tomography data to map deep karst features and fracture detection.

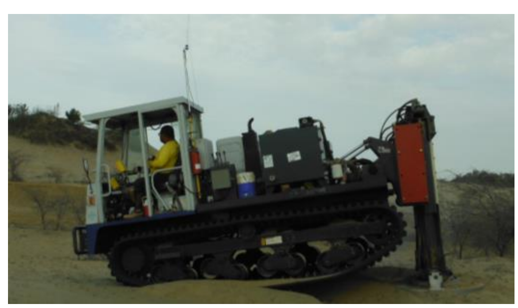
We are leaders in bringing attribute processing to the shallow reflection market and have proprietary processing strings to map fine scale faulting, karst, and fractures. We work in urban environments, mountainous terrain, desert environments, wetland, jungle regions, and other difficult environments. Our seismic surveys are designed to minimize impact on the environment by using portable instruments, wireless acquisition systems, small seismic crews, and seismic sources with a small environmental footprint.



CGp uses only the most modern seismic survey equipment and can customize and integrate equipment to enhance data quality and meet special field operations and environmental conditions. Prior to conducting the planned survey, all seismic equipment is tested to confirm performance according to manufacturer specifications. Initial QA/QC data may be acquired periodically to make sure the survey parameters will produce the desired results. In-field pre-processing analysis is often performed (e.g. refraction picks, generation of time-distance curves, velocity analysis, and/or brute stacks) to provide initial interpretation and field QA/QC analysis.

Accelerated Impact Seismic Energy Source Operations

Where applicable, CGp uses the Nitrogen Gas-Charged Accelerated Impact Seismic Energy Source system to acquire seismic data where other conventional energy source systems cannot be used. These energy source systems are high powered, environmentally friendly, impact seismic sources that can be used with almost any type of modern seismograph system and can be used for a variety of 2D and 3D seismic programs. These seismic sources can work in many areas where explosive and vibratory seismic sources cannot, either because of regulations, or because of the risk of damage to underground pipes, utility lines, surface structures, and wildlife habitats. Survey applications using the accelerated impact source include shallow and deep refraction surveys, 2D and 3D seismic reflection surveys, Vertical Seismic Profiling (VSP), and downhole seismic or low velocity layer (LVL) surveys. High precision GPS/DGPS



mobile receivers are routinely utilized for quality control, as well as (x,y,z) source location and monitoring.

CGp also employs the use of explosives for 2D and 3D seismic surveys in areas where permitted. Seismic surveys using explosives are performed and managed in accordance with the International Association of Geophysical Contractors (IAGC) Guidelines and Safety Programs. CGP routinely develops guidelines and site specific plans of execution to minimize drilling and seismic operation impact on the environment.

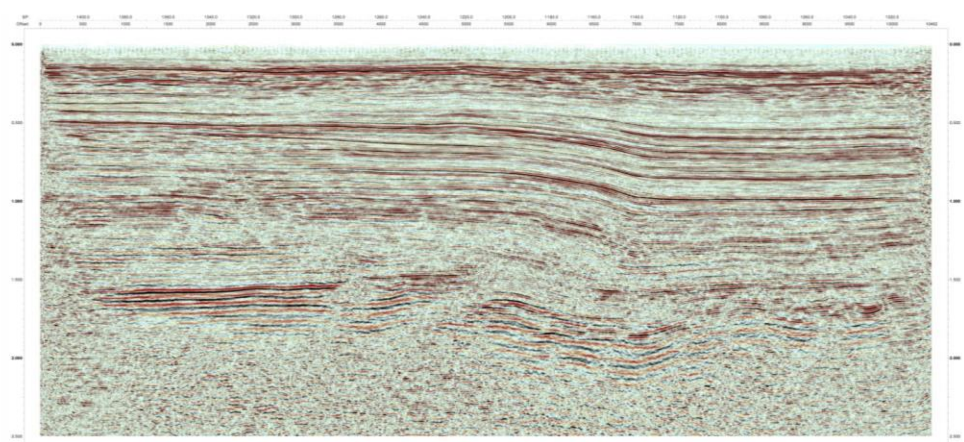
Geospace GSX Cable-Free Seismic System

Seismic Survey Special Operations

Seismic surveys located in difficult terrain and regions that are environmentally sensitive require specialized seismic instruments, drilling and operations support equipment, and field logistics management. As each survey site is unique in terms of these requirements, CGp emphasizes detailed advance project planning consulting services to develop operations plans that will minimize impact on the environment and maximize seismic coverage and overall data quality.

2D and 3D Seismic Processing and Interpretation

Seismic data processing capabilities include in-field 2D processing for QA/QC purposes, and final full 2D and 3D data processing. Programs used for in-field QA/QC seismic processing are ProMax or RadExPro. The Vista™ 2D and 3D seismic processing programs are used for full final in-house data processing. For seismic surveys conducted in areas that exhibit complex near surface refraction and reflection velocity-statics problems, GSS uses the joint travel-time and full waveform inversion 2D and 3D TomoPlus™ tomography processing program. Application of TomoPlus tomography processing correctly defines complex near surface statics and velocity fields to provide improved deep seismic imaging.



Sechura Basin Peru Seismic Section. Bandwidth is 12 Hz to 104 Hz. 2,000 Meter Depth

REPRESENTATIVE CLIENTS

AECOM
Atmos Energy
Apex Companies
Aqua America
Arias, Inc.
Balcones Geotechnical
Baroid Drilling Fluids
CB&I
Chesapeake Energy
Chevron
City of Austin
City of Alamogordo
City of Fort Worth
City of Salado
Coca Cola
Corsair
Devon Energy
EOG Resources
EP Energy
Facebook
Freese & Nichols
Fugro Consultants
Geosyntec
INEOS
Intera
Isleta Pueblo
Jacobs Engineering
Kasberg, Patrick, & Associates
Kiewit
Kinder Morgan
Kleinfelder
Lone Wolf Groundwater Conservation District
Marathon
Pioneer Natural Resources
Philips May
Schnabel
Sequitur Energy
South Florida Water Management District
Southwest Water Company
Terracon
Texas Department of Criminal Justice
Texas Department of Transportation
Texas Water Development Board
Tierra Group International
University Lands
Upper Trinity Groundwater Conservation District
WSP

REPRESENTATIVE PROJECTS

Residential Water Well Siting – Steamboat Springs, Colorado CGp completed a resistivity survey to assist in the siting of a water well. The resistivity data were used to identify fracture zones in limestone where well yield could be maximized.

GPR and Electromagnetic (EM) Survey of a Taxiway – DFW International Airport, **Texas** CGp completed a GPR and EM survey to identify pavement thickness, potential voids below concrete, and saturated areas of subgrade/subbase material below paving.

Magnetometer Survey for Characterizing a Proposed Frac Water Tank Site – Big Lake, Texas CGp completed a magnetometer survey over 1,500 x 1,500 foot area to assist in locating the presence of potential abandoned oil and gas wells at the site.

Geophysical Characterization of a Proposed Gas Pipeline Location for Karst – Austin, TX CGp completed a geophysical survey using the electrical resistivity tomography (ERT) and ground penetrating radar (GPR) methods to assess the subsurface characteristics of the Edwards Limestone for the presence and location of potential karst features such as caves or voids at the site.

Pre-Construction Investigation of a Future Dam Location – New Braunfels, TX CGp completed a high-resolution resistivity and seismic refraction survey over the Edwards Limestone formation for a future dry dam construction location. The work was completed to characterize the depth to bedrock and map the locations of fault or fracture zones and karst features, if present, that may influence design or construction of the dam.

SAWS Terminus Water Plant Pre-Construction Assessment – San Antonio, TX CGp completed a phased geophysical investigation (ERT &SRT) for a proposed SAWS water plant site located on the north side of San Antonio, Texas. The survey was completed over the proposed construction areas located over the Edwards Limestone formation. The objective of this geophysical investigation was to assess the subsurface characteristics of the bedrock for the potential presence and location of air-filled karst features at the Site. This work was a supplement to the overall geotechnical assessment of the Site.

Pre-Tunnel Construction Assessment for SAWS – San Antonio, TX CGp completed a phased geophysical investigation (ERT &SRT) for a proposed SAWS water pipeline and tunnel site located on the north side of San Antonio, Texas. The survey was completed along 10,000 feet of the proposed tunnel alignment. The objective of this geophysical investigation was to assess the subsurface characteristics of the bedrock for the potential presence and location of air-filled karst features at the Site. This work was also completed to supplement the overall geotechnical assessment of the Site.

Geophysical Characterization for TxDOT of a Sag Feature near FM 1053 – Imperial, TX. CGp completed a geophysical characterization of a sag feature along FM 1053 near Imperial, Texas. ERT and Seismic reflection surveys were completed in a survey area that includes 14 parallel lines each over a mile long and totaling over 20 miles. The data were used to characterize the subsurface and potential source of the sag.

Pre-Construction Investigation of a Tailings Dam and Future Plant Location – Los Gatos Silver Mine, Mexico. CGp completed a seismic refraction survey and MASW survey of portions of the Los Gatos Mine. The seismic work was completed to obtained depth to bedrock, potential rippability, and seismic velocities for the calculation of dynamic moduli to aid in engineering design.

Potential Fracture and Seepage Mapping at Dam 21 – Brushy Creek Flood Control District – Pflugerville, TX. CGp completed a seismic refraction tomographic survey and spontaneous potential (SP) to map depth bedrock, potential fracture zones, and potential seepage zones along the tow of the dam. The data were compared with geotechnical borings and assisted in the overall characterization of the site.

Potential Fracture and Seepage Mapping at Dam 8 – Brushy Creek Flood Control District – Austin, TX. CGp completed a seismic refraction tomographic survey and spontaneous potential (SP) to map depth bedrock, potential fracture zones, and potential seepage zones along the tow of the dam. The data was compared with geotechnical borings and assisted in the overall characterization of the Site.

Salado Creek Investigation of Potential Karst Area – Salado, Texas. Completed a high-resolution resistivity survey to investigate a potential subsurface Karst. The work was used to characterize the site prior to the installation of utility line under Salado Creek to minimize potential impacts to the creek and the Salado Salamander habitat.

Investigation of Potential Karst Area – Belton, Texas. Completed a high-resolution resistivity (ERT) survey to investigate a potential construction location for subsurface karst. The work was used for pre-construction evaluation of a water tank location.

Geophysical Investigation to Characterize a LPST – Morton Texas. CGp completed a GPR and TDEM survey to assist in the characterization and location of LPST at a TCEQ project site.

Geophysical Survey to Characterize Septic Field – Stephenville, TX. A GPR survey was completed over the location of a known septic field to further identify the extent and location of the drain field.

Characterization of a Former Storage Yard Using EM Methods – Wichita, Kansas. An FDEM survey was completed over a former Raytheon storage yard to assess for buried waste and debris. The survey area consisted of approximately 20 acres. A Geonics EM-31 was towed across the site using an ATV and non-ferrous sled. Conductivity and in-phase data were collected, and positioning was accomplished by utilizing a real time GPS connected to the EM unit.

Clearing of Crane Pads at ABIA – Austin, Texas. CGp completed a GPR survey at two construction crane pads to identify potential geohazards in the near surface. The work was completed prior to placing construction cranes on each location.

Preliminary Groundwater Evaluation of the Pecan Bayou Farm Property in Brown County, Texas. CGp completed a desk-top study to gather pertinent information on the surface geology of the acreage and any available data on wells in the immediate vicinity of the property. A geophysical investigation consisting of an ERT survey was then completed to assist in imaging the subsurface and characteristics of potential water bearing sands in the alluvial deposits near the Pecan Bayou River. A soil boring investigation utilizing the interpretation from the ERT data to locate potential water bearing sand zones was completed. It was determined that alluvial sands were not suitable water bearing units.

GPR Survey to Locate Subsurface Drain Pipe – Odessa, TX. CGp completed a GPR survey at commercial oil and gas facility in Odessa, Texas to identify subsurface drain pipes and other subsurface features that could be of concern due to water leaking from the pipes, if present, in the GPR data.

GPR Survey to Locate Drains at a Former Dairy Plant – El Campo, TX. CGp completed a GPR survey at TCEQ project site. The overall objective of this survey was to identify subsurface drains and other utilities, if found present in the GPR data. Both 2D and 3D data sets were collected and interpreted for potential anomalies in the subsurface at this site.

Geophysical Survey to Characterize a Former Refinery Property for the Presence of Buried Features – Ingleside, Texas. CGp completed an FDEM survey of 117 acre property which was former fuel refinery for World War II. The FDEM survey was completed to assist in mapping the subsurface and characteristics of potential buried man-made features. A Geonics EM-31 was towed across the site using an ATV and non-ferrous sled. Conductivity and in-phase data were collected, and positioning was accomplished by utilizing a real time GPS connected to the EM unit. Anomaly locations identified by the FDEM survey were used to locate boring and test locations.

Geophysical Investigation for a Proposed Drainage Improvement Ditch – Austin, TX. CGp consulting completed a GPR survey over the proposed location of a drainage improvement ditch prior to its construction. This was done to identify subsurface voids or sinkholes along the proposed corridor which was over 3,000 feet long.

KEY GEOPHYSICAL STAFF

Hughbert Collier, Ph.D., P.G.

Senior Vice-President, Collier Consulting, Inc.
hughbert@collierconsulting.com
(254) 968-8741 office (254) 396-0446 cell

Education
Ph.D. Geosciences
University at Texas at Dallas

Registrations
P.G. License
Texas, Arkansas, & Florida

Location
Stephenville, Texas

Dr. Collier's professional experience includes over thirty years of consulting, research, technical support for litigation, and teaching throughout the United States. Dr. Collier has conducted petrophysical and hydrogeological investigations on a number of aquifers throughout the United States. He has also provided technical support including field investigations, hydrogeological reports, petrophysical analyses of fresh and saline water aquifers, and reviews of technical reports, for a number of clients.

Dr. Collier has been the principal investigator for several research projects in which he was the geologist, hydrogeologist, and/or petrophysicist. One of his specialties is the hydrogeological characterization of aquifers by integrating various types of data (e.g. borehole geophysics, water analyses, pumping tests, cuttings, cores, and surface geophysics). This expertise has been applied to numerous groundwater studies, environmental litigation cases, and brackish water studies.

Dr. Collier has authored a dozen papers, including a textbook, **Borehole Geophysical Techniques for Determining the Water Quality and Reservoir Parameters of Fresh and Saline Water Aquifers in Texas**. He has taught short courses for the National Ground Water Association and Environmental Education Enterprises. He has taught undergraduate and graduate geology and hydrogeology courses at Tarleton State University, Stephenville, Texas. Dr. Collier manages the technical team at Collier Consulting, Inc. Dr. Collier is a Licensed Professional Geologist in Texas, Arkansas, and Florida.

Douglas E. Laymon, M.S., P.G.

Senior Geophysicist / Hydrogeologist, Collier Consulting, Inc.

doug@collierconsulting.com

(512) 995-6995

Education
M.S. Geology - Geophysics, Northern Illinois University

Registrations
PG License
Texas

Location
Austin, Texas

Mr. Laymon is the manager of geophysical services (CGp) and a Senior Geophysicist / Hydrogeologist with Collier Consulting, Inc. He is based in Austin, Texas. Mr. Laymon has over 30 years' experience in project management, hydrogeology, groundwater availability, mining, environmental sciences, and engineering geophysics. Mr. Laymon has conducted and overseen a variety of site hydrogeologic investigations in various locations and hydrogeologic environments. He has designed and managed numerous surface and downhole geophysical investigations and utilized geophysical techniques for site geotechnical and hydrogeological characterizations. He has a MS in geology, specializing in geophysics, and is a registered professional geologist in the State of Texas.

Mr. Laymon is a Past President of the Environmental and Engineering Geophysics Society's (EEGS) Board of Directors. He currently serves on the EEGS Foundation Board and is a committee member for Geoscientists Without Borders (GWB). He has also served as Chair of the North Central Section; Association of Engineering Geologist 2003-2005 Chair (National Board Member), North Central Section.

Finn B. Michelsen, P.G.

Senior Geophysicist
finn@collierconsulting.com
(832) 366-4168

Education
B.S./MSc. Geology and Geophysics
University of Hawaii

Registrations
PG License
Texas

Location
Houston, Texas

Mr. Michelsen is an accomplished geoscientist with multi-disciplinary, integrated expertise in applied geophysics, geology, instruments engineering and design capabilities. His career is supported by academic advanced studies in geology and geophysics. He has 30 years of professional land and marine work experience in applied geophysical and geologic survey services, project management, and business development, oil and gas, applied engineering geophysics, and environmental industries worldwide.

During his career, Mr. Michelsen has been involved in a wide range of projects worldwide, supporting petroleum and minerals exploration projects, land and marine geohazards and geo-engineering projects, hydro-geologic projects, geotechnical and civil engineering projects, environmental and archaeological site investigations, and unexploded ordnance (UXO) investigations, using a variety of advanced geophysical survey and data processing methods. Applied geophysical and geologic research and development activities is represented by 10 years of experience associated with seismic instruments manufacturer and applications technology development companies, where projects emphasized applied surface and borehole 2D/3D seismic, seismic and acoustic sensor and energy source systems design and applications development for oil and gas exploration, 2D/3D electrical resistivity imaging (ERI), near surface seismic tomography imaging, and other integrated applied geophysical survey and data processing methods.

Worldwide geophysics and geologic project experience includes domestic USA and Canada, and international projects in more than 20 countries worldwide. International experience includes Europe (Norway, Denmark, United Kingdom, France, Italy, Greece), African Continent (Egypt, Qatar, Saudi Arabia, Nigeria, Equatorial Guinea, Yemen, Morocco, Angola), South and Central America (Peru, Mexico, Venezuela, Ecuador, Brazil, Trinidad), the Far East, Australia, Japan, India, Antarctica.

John Jansen, Ph.D., P.G., P.Gp.

Senior Geophysicist / Hydrogeologist, Collier Consulting, Inc.
john@collierconsulting.com
(239) 896-0576

Education
Ph.D. in Geological Sciences,
University of Wisconsin - Milwaukee

Registrations
P.G. License
Arizona, Illinois, Indiana, Minnesota, Wisconsin, & Wyoming

P.GP. License
California

Location
Milwaukee, Wisconsin

Dr. Jansen has over 30 years of experience in groundwater resource investigations and is a Senior Geophysicist/Hydrogeologist at Collier Consulting, Inc. He specializes in groundwater management, high capacity well siting and design, surface and borehole geophysics, groundwater modeling, managed aquifer recharge, agricultural impacts, mine hydrogeology, water permitting for energy projects, and expert witness testimony.

Dr. Jansen previously worked nationally as an independent groundwater consultant, the chief geoscientist for an international well construction contractor, and as an office manager and principal for a large international natural resource management consultant. He is the author of numerous publications and presentations on groundwater-related topics including the borehole geophysics chapter in the third edition of Groundwater and Wells.

John holds three patents on well rehabilitation, horizontal drilling, and in-situ radium treatment. He was the 2013 NGWA McEllhiney Distinguished Lecturer in Water Well Technology and the 2012 recipient of the NGWA Keith A. Anderson Award for service to the groundwater industry. John has served on several national panels to review federal water research priorities and has been an expert witness in several water resource cases.

Phil Sirles, M.S.

Senior Geophysicist / Colorado Operations Manager
phil@collierconsulting.com
(720) 934-2901

Education
M.S. Geophysics-Mackay School of Mines-University of Nevada-Reno

Location
Denver, Colorado

Mr. Sirles has a broad range of experience in engineering and environmental geophysics. His MS thesis involved Crosshole seismic velocity and attenuation measurement to assess liquefiable soils near Reno. Since his thesis, he has focused on applications of geophysics for geotechnical engineers. He has extensive consulting experience with seismic, electrical, electromagnetic and ground penetrating radar methods. He has used multiple geophysical methods for subsurface characterization on transportation investigations to determine anomalous conditions with 1D, 2D and 3D analyses; the results have been used for design, construction and failure mitigation. Recent projects have involved assessing karst and (salt/evaporate) dis-solution voids, light-rail foundation investigations in Hawaii and Colorado, re-alignment surveys in seven National Parks, MSE wall studies, and active landslides impacting state and county roadways. Multiple projects have been published demonstrating innovative approaches using new seismic technologies in unique settings. He is responsible for all aspects of consulting projects, including initial client contact, proposal preparation, field testing, data analysis, report preparation, and final report review; as well as management of the geophysical crews.

Over a 10-year span Mr. Sirles was the Program Manager and the key person responsible for development of: the FHWA 774-page manual "***Geophysics for Transportation Projects***" (2003), the associated searchable website of the manual - www.cflhd.gov/resources/agm (2004); the NCHRP Synthesis No. 357 "Application of Geophysics for Transportation" (2006); and the recent completion of a studio-produced 8-hour DVD (3-DVD set) providing a training course for Federal and state DOT agencies entitled "***Engineering Geophysics for Transportation***" (May, 2013). Along with the development of these publications, Mr. Sirles has conducted training classes/short courses for FHWA, EEGS, AEG, ASCE and ACSM; he is an accredited instructor which allows participants to receive Continuing Education Units / Professional Development Hours.

Mr. Sirles has performed geophysical investigations at over 300 dams for federal, state and county 'safety-of-dams' investigations, and at numerous transportation project sites throughout the country and overseas. Experience with critical structures for subsurface characterization is his specialty: dams, levees, highways, bridges, power-plants and hospitals. He also has experience using seismic (reflection) for exploration of mineral, oil-and-gas and geothermal programs. Mr. Sirles was employed as a project geophysicist at the U.S. Bureau of Reclamation from 1986-1996 where he trained civil and geotechnical engineers on the use of geophysics for safety of dams studies, while conducting surveys.

Ted L. Powell, P.G.

Senior Geophysicist / Hydrogeologist
ted@collierconsulting.com
(414) 881-6957

Education
M.S. Earth Science
Western Michigan University

Registrations
PG License
Illinois & Wisconsin

Location
Milwaukee, Wisconsin

Mr. Powell is a Senior Hydrogeologist/Geophysicist for Collier Consulting, Inc. located in Eagle, WI. He has a BS in geology from Lake Superior State University and a MS in earth science, with an emphasis in hydrogeology, from Western Michigan University. He has 25 plus years of professional experience as a geoscientist involved in water resource and water supply investigations, as a hydrogeologist conducting remedial investigations, feasibility studies and remedial design aquifer pilot testing, and as a field geologist in the petroleum industry.

For the past 19 years Ted has focused his practice primarily in water resource and supply investigations where he has managed wellhead protection and water supply projects that range from comprehensive well siting investigations to aquifer vulnerability studies. He has extensive experience with the design, performance and analysis of aquifer pumping tests and has conducted numerous surface and borehole geophysical investigations to map aquifers, identify favorable drilling targets, characterize flow zones within formations, delineate potential recharge and storage formations, and map groundwater basin and aquifer boundary structures.

Ron Bell

Senior Geophysicist
ron@collierconsulting.com
(414) 881-6957

Education
B.S. Applied Physics
Michigan Technological University

Location
Denver, Colorado

Mr. Bell has been actively engaged in the application of geophysical data, with an emphasis on the use of magnetic, gravity, electromagnetic, direct current electrical, and induced polarization methods to the exploration for base and precious metal, groundwater, oil and gas, and geothermal resources as well as the subsurface characterization of environmental contamination and engineering sites.

He has broad, practical experience in the acquisition, processing, visualization, and interpretation of magnetic, gravity, DC electrical resistivity/induced polarization (IP), controlled source frequency and time domain (FDEM\TDEM) electromagnetic, controlled source and natural field magnetotelluric (CS\NFMT), self-potential (SP), EM conductivity, gamma ray spectrometry, seismic refraction, and seismic reflection methods. In addition, he has been engaged in the development, application, and marketing of geophysical interpretation software and innovative geophysical technologies for fluid flow monitoring.

Since 1991, Mr. Bell has processed and interpreted numerous aeromagnetic data sets for hydrocarbon and mineral exploration. For many of the hydrocarbon exploration projects, ground gravity data were an important component of the data package to be processed and interpreted.