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GEODIVINING GROUNDWATER SURVEYS
Principles and Substantiation:

20 years in unconventional exploration - January 2014

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by Doug Bates – Consulting Exploration Geologist; Founder of Geodivining International

Introduction:

As a conventionally trained and experienced exploration geologist I 'cut my teeth' on a wide variety of exploration and mining projects in Southern Africa before moving to Scotland in 1991.

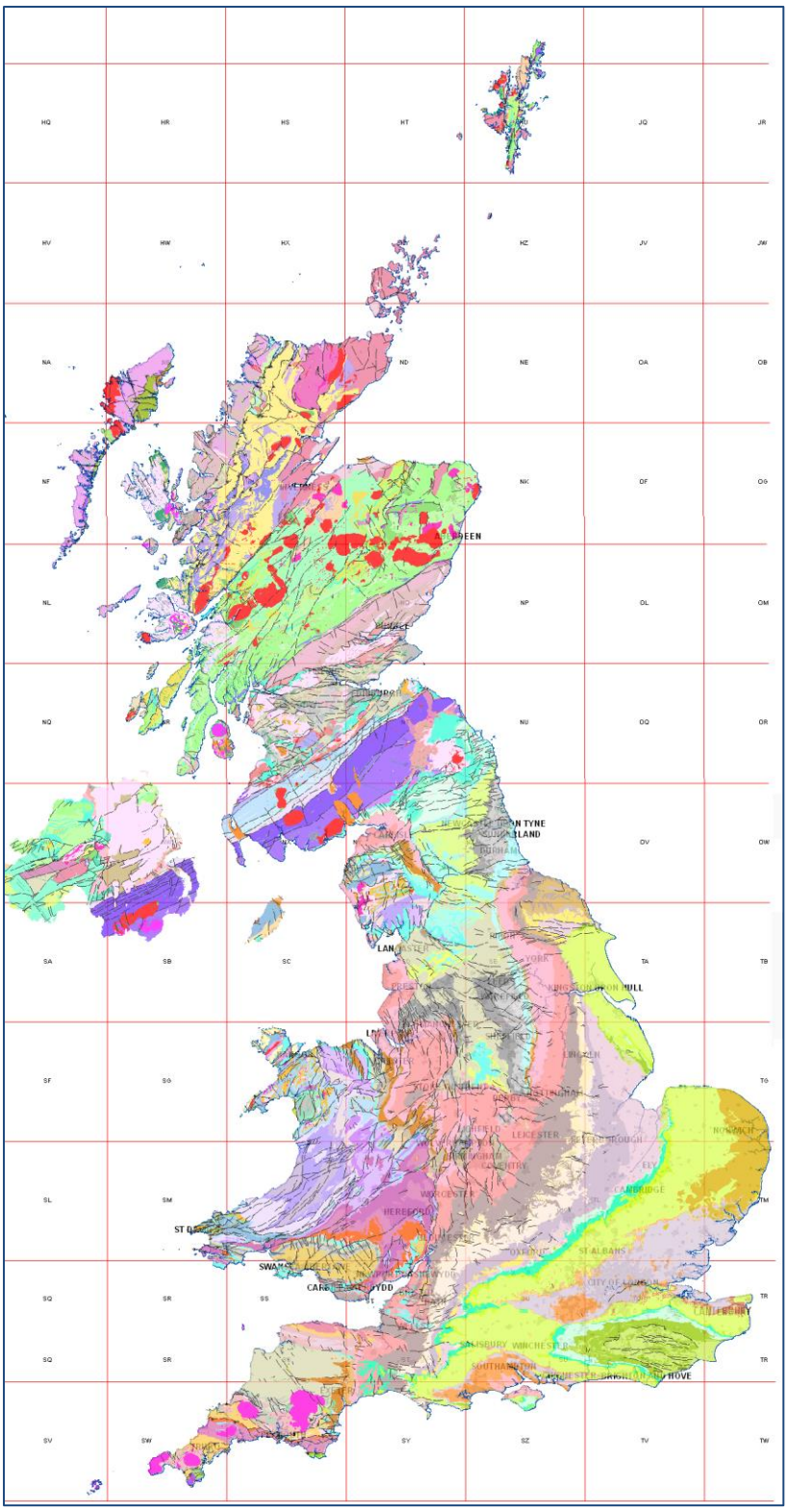
In 1993, while employed in estate management and enhancement, I had the serendipitous opportunity to study literature on unconventional remote-sensory exploration methods and began to practice and experiment in this arena, developing new techniques for remote-sensory groundwater surveying as well as in mineral and oil exploration. These techniques may be most simply described as a pragmatic blend of conventional geoscientific methodology with the ancient and modern sensory art of dowsing or divining, which I termed 'Geodivining'…

Then, 20 years ago, at the age of 32, I took a leap of faith into this extraordinary realm of pioneering unconventional exploration work by launching the unconventional water, mineral and oil exploration consultancy Geodivining International.
From that moment to this I have enjoyed a meteoric career that has been fascinating and illuminating, challenging and rewarding. I have learned to work confidently at and beyond the frontiers of conventional geoscience, to expect the unexpected, and to achieve the seemingly impossible through the use of often-controversial goal-oriented extra-sensory techniques that defy conventional scientific explanation but that have been proven time and time again to be highly effective in practice…

My work in this field has always been highly goal oriented, setting high standards for predictive assessment of resources, and for achieving exceptionally high success rates proven through results.
In exploration for high-yield groundwater sources, and for economically viable mineral resources and oil and gas reserves, I have enjoyed extraordinary success beyond the wildest imaginings of my relatively unremarkable early career in conventional geology and geophysics.
Geodivining has been quite controversial at times, arousing philosophical challenges to many of the present conventions of the scientific establishment, and it has transformed a cautious conventional functionary approach to scientific thinking and evaluation, into a much more pragmatic and intuitive scientific enlightenment, that has extended a long esoteric heritage and opened up new frontiers in bio-sensory science.

The scope of Geodivining principles and techniques is broad, but this article is confined to describing the Groundwater Survey Methods and providing substantiation of the real efficacy of the techniques through a track record of results.
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Geological Diversity -
A challenging background to the development of Geodivining Groundwater Surveys.



The British Isles are situated in a continental marginal zone in which many cycles of volcanic activity have occurred, associated both with tectonic compression, ocean basin closure, fold-belt accretion, uplift, and mountain building; and with tectonic extension, intermontane rifting and subsidence, and marine basin development.

The Geological Mapping of Britain recognises over 100 major rock groups with well over 1,000 named formations or rock units, in all classes of igneous, metamorphic and sedimentary rocks representing all geological periods spanning 3,800 million years of the Earth's history from the Archaean, Proterozoic, Palaeozoic, Mesozoic, and Cenozoic eras.

The structural complexity in the north and west is quite mind-boggling, especially in Scotland, where the degree of compression and folding, transverse wrench-faulting, normal and reverse faulting, over-thrusting, uplift and subsidence is extreme... There are thousands of igneous intrusions and all kinds of extrusive igneous rocks including more than 300 extinct volcanoes…

All this geological diversity shapes the wonderfully varied landscapes of Scotland, Northern England and Wales, and to a large extent dictates climate and land use in each region.

Groundwater occurrence, flow and quality is just as varied as the geology, and borehole yields range through 5 orders of magnitude from dust-dry holes and small trickles to intermediate yields typical of particular rock types or formations and to high yields up to and exceeding 100,000 litres per hour in some locations…

In all rock formations, including the major aquifers, the highest yields are confined to deep networks of interconnected faults and fractures, dyke margins and other structural features that act as conduits for rapid groundwater infiltration, flow, and discharge.

The Limitations of Hydrogeological theory and hydro-geophysics

Hydrogeology is a relatively young science that studies the dynamics of groundwater infiltration, flow and discharge in a variety of deposits and rock formations. The modern science depends largely on a set of formulae and equations derived from the study of flow through a homogeneous porous medium such as sand or sandstone under the influence of gravity, called Darcian flow.

A number of computer software programs have been developed, using these and a range of more complex formulae that attempt to simulate real flow conditions in the ground. These are widely used to model large aquifers in which there are enough springs and boreholes to provide sufficient input data for a working model, however, they are also often used at a local scale to try to predict aquifer properties and sustainable well yields, or to model contaminant transport in polluted sites…

All such formulae used to build mathematical models are entirely data-dependent and where data is lacking (as in most locations) they have to assume degrees of homogeneity within the rock strata and thus attribute hydraulic properties or characteristics to rock formations that may only be a poor approximation of their true heterogeneous nature. Key measured values such as 'transmissivity' and 'specific capacity' in boreholes typically vary through 3 or 4 orders of magnitude in most aquifer systems, and thus the predictive capabilities of such assumptive numerical models are limited by a lack of specific structural detail, even at the earliest stages of developing conceptual models…

The great diversity of Britain's geology ensures extreme structural and hydraulic heterogeneity in the older rock formations and most aquifers, the only exceptions being a few of the youngest sandstones and unconsolidated superficial sand and gravel aquifers. In most aquifers considerable physical heterogeneity in grain size and mineralogy creates lateral and vertical variability in theoretically calculated hydraulic properties, such that all models must assume variable inputs and variable outputs, without much location-specific predictive accuracy, until after boreholes have already been drilled, logged and flow tested.

Most numerical models suffer from a lack of real survey and test data and, more often than not, simulated flow nets and sustainable yield forecasts fail to achieve any more than can be deduced from simple conceptual models.
Even the most advanced fracture flow models can only work on the basis of assumed fracture size, extent, and distribution patterns within an aquifer to arrive at approximate theoretical values for aquifer properties that offer a 'best fit' solution to measured data from boreholes and springs.
Conventional hydrogeological models fail to impress in highly heterogeneous fractured aquifers and in non-porous fractured crystalline terrain* they are of little real use…

(* Such terrain includes all igneous and metamorphic rocks, which constitute more than 90% of Earth's crust by volume and about 30% of Earth's land areas, and most Palaeozoic and Mesozoic sedimentary formations and aquifers, which constitute up to 50% of Earth's land areas).

In most geological settings, the key to accurate hydrogeological models is to obtain accurate and detailed mapping of the faults and fracture networks in the bedrock. In some open locations where ground conditions are favourable and there is not too much interference from artificial features in the landscape, ground resistivity, seismo-electric, magneto-telluric, or ground penetrating radar surveys can reveal quite detailed structural patterns and areas of enhanced permeability, especially within the shallow sub-surface zone down to about 30m depth. At greater depths resolution of detail becomes difficult with these geophysical methods and it is rare to be able to discern anything beyond about 50-60m depth… In any case, extensive geophysics coverage is time consuming and prohibitively expensive for most real water development projects.

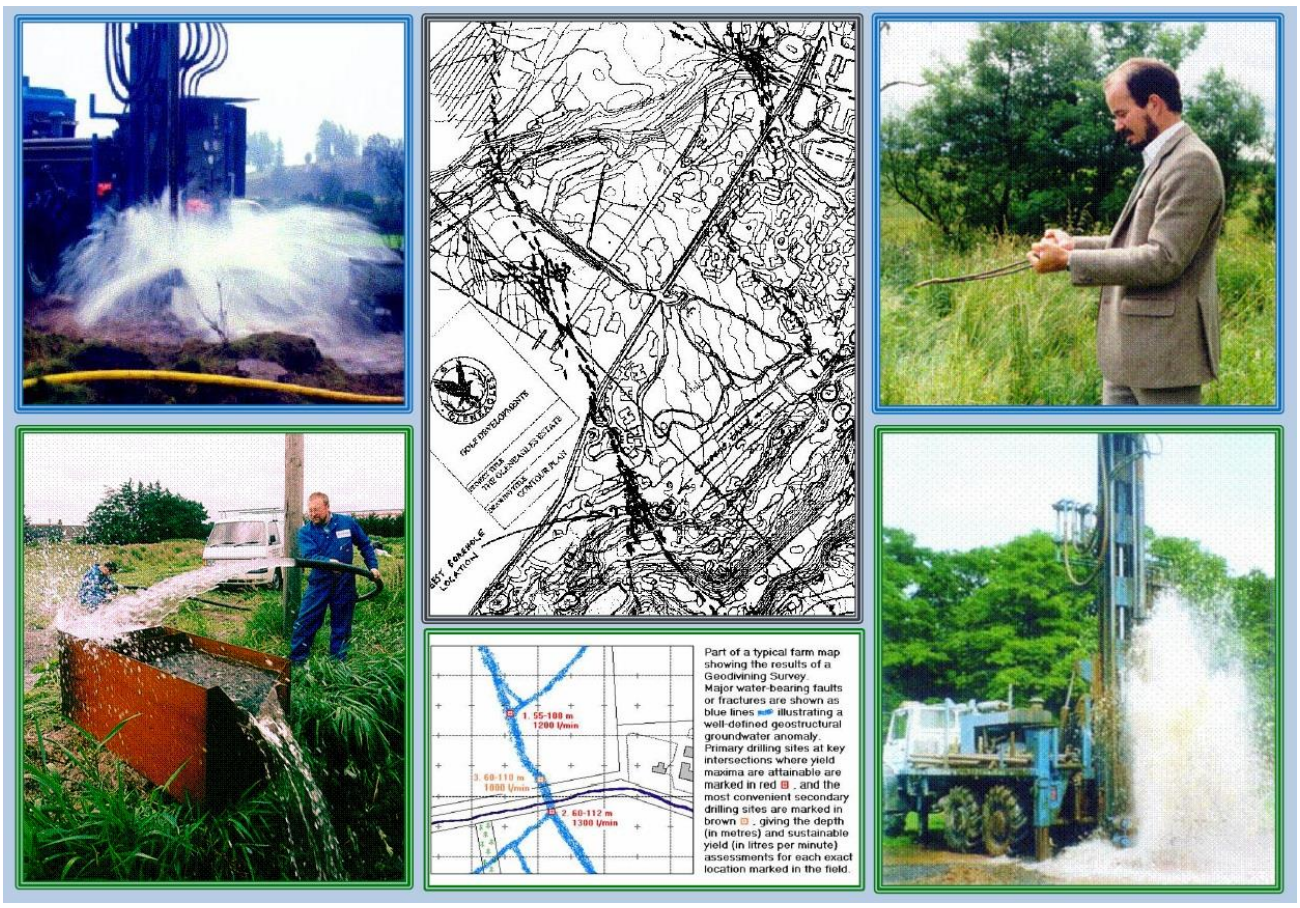
Raising the performance bar for Groundwater Surveying and fractured aquifer assessment

Geodivining Survey techniques were developed for accurate geostructural mapping in all rock formations at any depth, and for goal-oriented target-yield matching groundwater flow detection, element-specific target-grade matching mineral resource detection, and also hydrocarbon detection. These highly target-specific Exploration Techniques, though not universally accepted, have been well proven to outperform conventional exploration methods and have been the basis for reliable Troubleshooting by Geodivining International over the past 20 years.

Geodivining International specialises in accurate mapping of deep water-bearing faults and fractures, which form the primary conduits for groundwater flow in older fractured aquifers and otherwise relatively impermeable hard rock terrain, where borehole yields are highly variable, cannot conventionally be predicted with any certainty, and where dry and low-yielding drilling outcomes are quite common.
We have an enviable track record of successfully developing relatively high and seasonally sustainable yields in such areas, often achieving exceptional yields (typically at least 2 to 5 times, often 5 to 20 times, and sometimes up to 100 times the local average yield), usually for considerably less drilling than other high yielding boreholes in the same rock formations.

Exact location selection and accurate vertical drilling are important as we have proved on a significant number of sites where near misses were recorded, or where we achieved high yields within a few metres of other relatively low-yielding boreholes.

Using these methods, with over 2,500 boreholes completed over the past 20 years, Geodivining has achieved an enviable record of success with regional, national and global first-strike drilling success rates consistently above 85%. Among the small proportion of first attempt failures, second and third attempt drilling successes raise the overall project success rate to 96%..... Most of these boreholes are in the older Palaeozoic and Proterozoic fractured rock formations of Scotland, but we have also done many in other parts of the UK, Europe, Asia, Africa, America, and Australia.



How Geodivining Groundwater Surveys are done:

Geodivining works well beyond the scope of any conventional hydrogeological assessment…
The primary purpose of a Geodivining Groundwater Survey is to accurately delineate and assess target-matching water-bearing structures in the survey area and to mark and measure the best exact drilling locations to intersect these structures for optimum yield potential… The principles and details of this survey work, done partly prior to visit and partly in the field, are set out in this article.

The target in every case is to develop the full resource potential to match our clients' water supply requirements. Usually this is calculated to a pre-defined daily water supply requirement of X m^3/day and a minimum hourly water supply requirement of Ym^3/hr based on no more than 10 hours pumping per day. For some industrial and municipal clients Y/X has to be more than 10/24 and may run to 24/24 continuous pumping, in which case it is very important to try to gauge long term sustainable yield potential in advance.
We aim to achieve the full yield requirement from a single borehole or (in a few cases for some large supplies) a realistic number of boreholes allowed for in a pre-planned drilling budget.
Using our proprietary survey methods, with over 2,500 boreholes completed over the past 20 years, Geodivining has achieved an enviable record of success with regional, national and global first-strike drilling success rates consistently above 85%. Among the small proportion of first attempt failures, second and third attempt drilling successes raise the overall project success rate to 97%.....

A Geodivining Survey provides a complete conventional geological assessment and site survey service, which examines the observable geology in as much detail as possible, and combines this with the valuable additional benefit of our unique professional water divining techniques to discern concealed water sources in deep faults and fracture zones in the bedrock. It is this unique combined scientific and intuitive approach to exploration that makes our service so exceptionally successful…

Utilising unique goal-oriented remote-sensory techniques we look carefully and in detail at concealed underlying structures in the bedrock formations, to see where enhanced infiltration and deep groundwater flow is occurring, and this is followed by further detailed water divining work on site to confirm and assess key targets precisely, and ultimately to enable direct intersection of the most promising structures by drilling at exact locations chosen for optimum yield and sustainability.

A typical Geodivining Groundwater Survey covers five steps:

(1) The geological 'desk study' research and conventional hydrogeological prognosis,
(2) The broad-scale and detailed remote-sensory structural mapping,
(3) The complete site geological survey and assessment of any new geological observations,
(4) The detailed water divining survey with at least two, sometimes three or more, exact drilling locations marked and assessed with productive depth-range measurements and sustainable yield forecasts for each location, and
(5) The comprehensive Geodivining Survey Report with technical drilling specifications, water quality expectations, hazard assessment, and environmental compliance advice. These are the primary elements in every report.

A high proportion of our surveys are troubleshooting jobs, which I personally undertake, where previous drilling attempts by other consultants and contractors resulted in dry or low-yielding boreholes and failed to find enough water for the client's needs. Attached to this article is a table of 100 successful troubleshooting jobs comparing our results with previous results and showing that we maintain our exceptionally high success rates despite the inclusion in our statistics of all these troubleshooting surveys, many of which achieved success after multiple previous failures by other consultants, thus making our success all the more remarkable.

Troubleshooting Surveys; the Ultimate Test of Efficacy – 100 examples.

Many of our troubleshooting jobs provide an opportunity to clearly demonstrate the exceptional results and substantial savings achievable through working with Geodivining Groundwater Solutions Ltd & Geodivining International.
The best proof of survey method efficacy is to examine the drilling results of specific jobs and of all boreholes completed over an extended period of time…

A very good recent example from 2009 was at **Inverlair, Glen Spean**, in the central Highlands Region, where hard metamorphic and igneous bedrock geology is concealed beneath extensive glacial moraine, till, and glacio-fluvial deposits.
The water supply requirement was quite small in this case, only about 900 litres per hour (0.25 l/s); and assuming this could be easily found, a drilling contractor had already drilled 3 boreholes, each more than 115m deep, but all of them were dust-dry…
A Geodivining Survey was commissioned and this delineated one clearly defined fracture zone in the bedrock beneath the site, assessed by Geodivining to have flowing water at 20-30m depth with a sustainable yield in excess of 1,500 l/hr. Two potential drilling locations were marked on this structure, about 100m apart, and one was subsequently drilled to 30m with a successful outcome, producing water from fractured bedrock at 18-27m with a sustainable yield of 2,250 l/hr (0.625 l/s)...
This successful result was achieved for less than one tenth of the drilling work sunk into the three failed boreholes, and money was also saved thanks to a relatively short and easy borehole lining and pump installation… Had the Geodivining Survey been commissioned first, the client would have saved the cost of 350m of fruitless drilling work, which at 'cost-only rates' was about £15,000.

Even saving the cost of one dry or low-yield borehole is more than enough to justify Geodivining Survey and Project Management fees… For example, a soft fruit grower at Westfield near Aberdeen had spent £10,000 on a 100m borehole with lining and pump installation that was filling a reservoir at a hopelessly inadequate rate of only 135 l/hr. Obviously they needed a lot more water.
In 2003 we located a clearly defined major fault in the migmatitic psammite and granite bedrock, which when intersected by a single 75m borehole yielded over 4,500 litres/hr . Accuracy is vital….
These two boreholes were less than 10m apart with a 33-fold difference in yield!

There are numerous examples throughout Scotland, where we have successfully developed much larger water supplies (up to 100,000 l/hr) from single boreholes, often in places where previous multiple drilling attempts had failed, demonstrating highly satisfactory first-strike success and real substantial savings thanks to Geodivining methods, relative to repeated failure and high costs running into tens of thousands of pounds incurred without the benefit of Geodivining…

A prime early example at the top end of the scale is **Brownrigg Farm near North Berwick**, East Lothian, where 12 previous drilling attempts (1,500m of fruitless drilling) by 4 different drilling outfits, over a number of years, had failed to find any substantial water supplies in the thick volcanic rocks of the Garleton Hills Volcanic Formation. In this case the water requirement was for irrigation (ideally in excess of 45,000 l/hr) and though not all the boreholes had been dry the best had produced only 5,000 l/hr… not nearly enough…
The 1995 Geodivining Survey revealed a few minor local structures and one major vertical fault line running right through the farm, which presented a 3m-wide linear target on the ground and was assessed by Geodivining to offer a sustainable yield in excess of 45,000 l/hr from about 300ft (90m). Subsequent drilling work on the exact location developed a yield of 54,000 l/hr from 270-350ft (105m) with a strong artesian flow up to 15,000 l/hr in the winter months.
In this case the cost of all previous failed drilling works was more than £80,000 of wasted money and years of lost time growing crops without the benefit of irrigation, adding a considerable further cost in lost earnings. Since the successful drilling in 1995 the borehole has provided all the water needed on the farm added substantially to the value of the farm and the crops grown on it…

MYRESIDE & PRIESTFIELD FARMS, INVERKEILOR, and BURNSIDE OF BOYSACK FARM, COLLISTON, NEAR ARBROATH, ANGUS. (A Case Study)

Willie McEwan, a potato farmer in the Angus region had got wind of the fact that there were several high yielding boreholes in his area (found mostly by divining), and assumed that large quantities of water must be available everywhere in the Devonian sandstones of that district.
In reality, however, some 90% of the region's groundwater flow is confined to faults and fissures in the rock formations. It is not easy to find high yields just by drilling anywhere...
Randomly drilled boreholes are often dry and seldom produce more than 10,000 litres/hour.

This client has several farms in Angus, and had just drilled 4 unsuccessful boreholes on one farm before making a lucky strike that yielded 45,000 l/hr. The drillers then moved on to Myreside and Priestfield Farms and drilled 5 more deep boreholes, all to no avail. (only a 10% success rate).
We had just started advertising in all the Scottish and Northern English yellow pages that year, having persuaded them to open a new category for Water Diviners, and the Drilling Contractor concerned had entered their ad in the category as well. … As a last resort, they called on us to do a Geodivining survey and see what we could come up with.

I used remote-sensory map-dowsing on a 1:10,000 scale farm map faxed to us in Aberdeen, to delineate all the major faults and fissures in the area, and from this I identified 8 key intersection points that would be highly productive for yields exceeding 45,000 l/hr.
I drove down to Inverkeilor the next day, and half a day's fieldwork with the driller and client in attendance, enabled me to confirm, mark, and assess all 8 of these sites as sources capable of yielding over 50,000 l/hr…. One of them in particular, was clearly better than the rest, offering a potential yield of 67,000 l/hr from a 120m borehole, and this one was selected for drilling.

Willie was still very sceptical, as this site was less than 30 yards away from a 105m borehole that yielded only 4,000 l/hr. All scepticism was erased, however, when drilling to 105m on my mark yielded 80,000 l/hr…… 20 times more than the nearby failed borehole…



I went on to survey Burnside of Boysack, another of the McEwans' farms, and identified more major water sources, and after one drilling failure due to unexpectedly deep running sand overlying the sandstone bedrock, I relocated the rig to another fault-bound source where, after spot-divining the whole area, I found the overburden to be at its thinnest, with bedrock at about 15m depth, and an anticipated yield of at least 65,000 l/hr from a well-defined vertical fault zone only 2m in width.

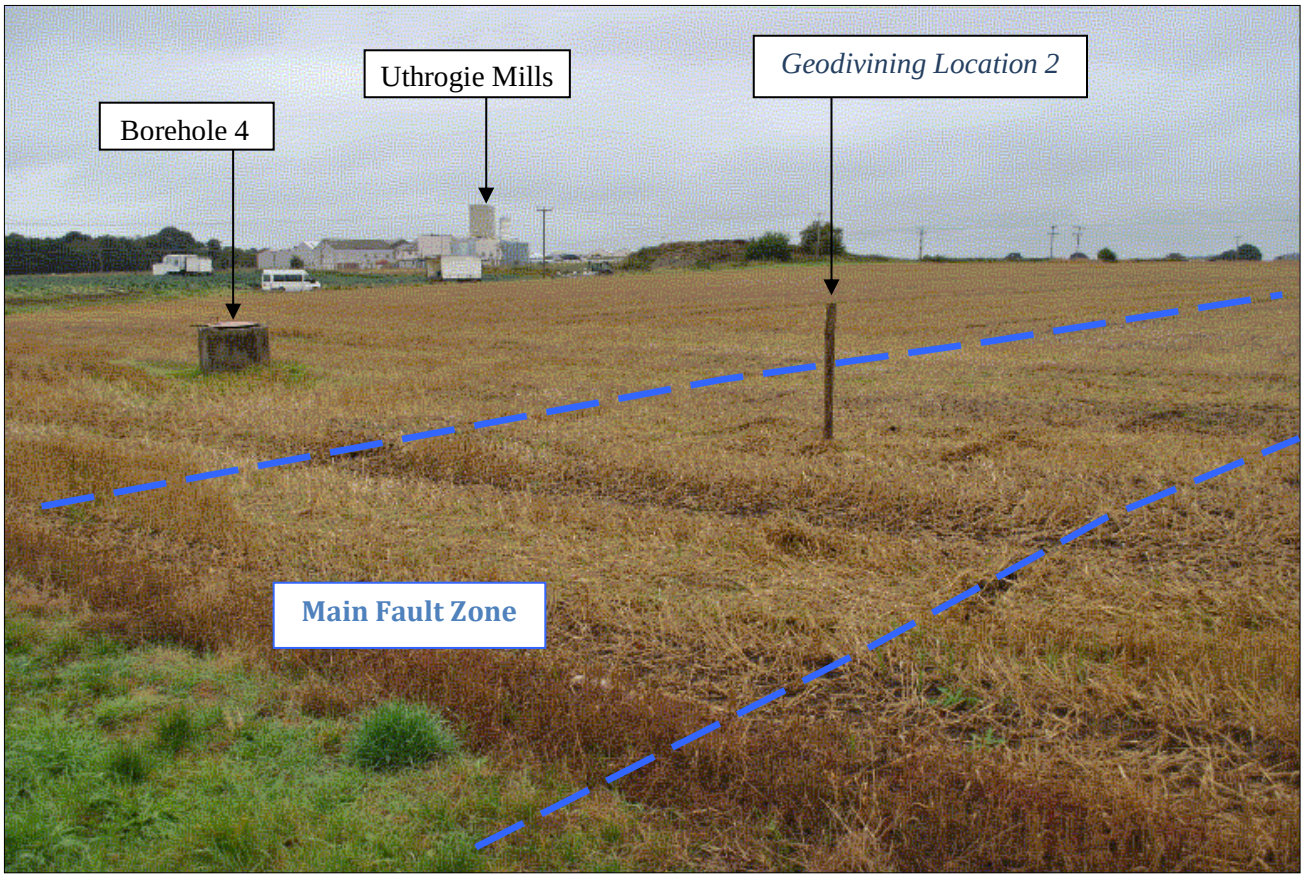
The successful 100m borehole struck a high pressure artesian supply in excess of 72,000 l/hr; and tested for over 100,000 l/hr by pumping. I then went on to survey Willie's home farm at West Mains of Colliston and got another 90,000 l/hr yield there…
After that, those Drilling Contractors (One of Scotland's largest and best equipped firms) started referring all their water well clients to Geodivining International before they start drilling, and to date we have a 96% success rate with them!

A good more recent example is the Geodivining Survey of **Hilton of Carslogie near Cupar, Fife**.
The prognosis for high yield prospects was quite poor, what with close proximity to underlying volcanic rocks, a number of abandoned test boreholes, and five known low-yielding boreholes on the farm…. Four of these boreholes pumped simultaneously into a buffer tank provided barely enough water to run one irrigator…
The Geodivining Survey revealed a previously unknown major fault zone running right through the farm and passing within 10m of one of the low yield boreholes (see photo below). The existing borehole no.4 had a known depth of 77m and an estimated yield of 14,800 l/hr.

This location near borehole no.4 was the second of the two targets assessed from the remote-sensory survey as likely to produce a sustainable yield well in excess of 45,000 l/hr, and the detailed assessment on site indicated a possible yield as high as 67,000 l/hr) if it was drilled to a sufficient depth to fully intersect the source structure.
Once the location was marked a sequence of on-the-spot Geodivining measurements were made to establish a depth and yield profile for the borehole through a productive depth range of 150-500 ft (45-150m), mainly from 200-400 ft (60-120m), giving yield estimates / forecasts of 22,000 l/hr at 60m, 40,000 l/hr by 90m depth, and 45,000 to 54,000 l/hr at 120m depth. It was estimated that deepening to 150m into weathered volcanic rocks of the Ochil Hills Volcanic Formation would increase the yield still further up to 60,000 to 70,000 l/hr.

Drilling to 135m subsequently proved this was another high yielding successful borehole with measured flow off the drill well in excess of 60,000 l/hr (13,300 gall/hr).

View of the Geodivining Location 2 at Hilton of Carslogie, marking the centre of the fault zone, the edges of which are shown by the scuff marks on the ground, with existing Borehole 4 a few metres away to the left.



INDUSTRIAL AND COMMERCIAL INTERESTS.

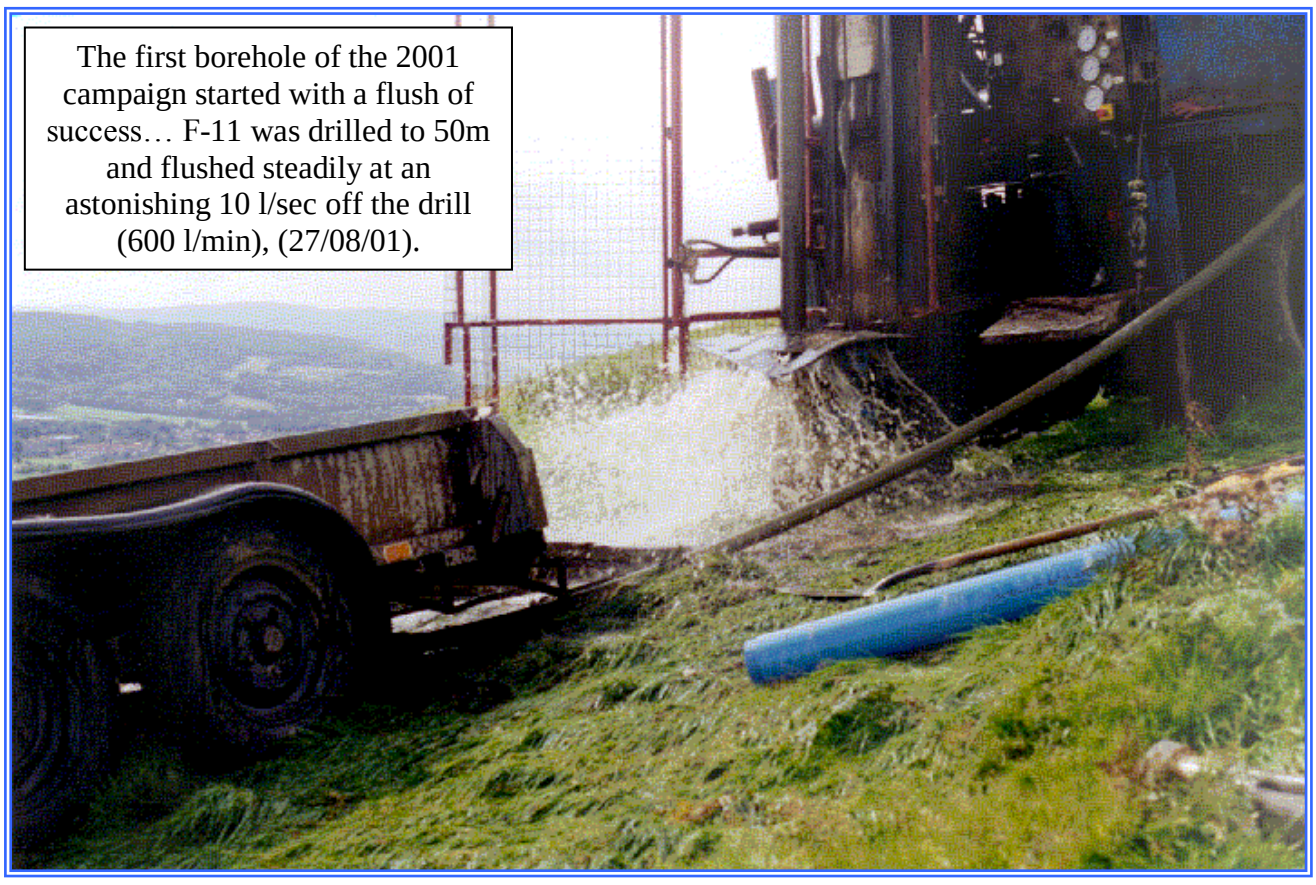
Our record in other challenging environments outside the agricultural sector has been equally successful with large water supplies developed for some of Scotland's biggest corporate clients, Scottish Power's Longannet and Cockenzie power stations, prestigious hotels and leisure facilities, and a wide range of food processing businesses, brewers and distillers, soft drinks and bottled water producers, and similar businesses abroad.

BOTTLED WATER BUSINESS:

Perhaps the most statistically significant body of Geodivining work from a single area comes from our successful development of multiple groundwater resources for Hazlewood Foods group's **Campsie Spring Ltd,** the UK's largest own-label Natural Mineral Water producer, in three phases from 1998 to 2001.

A comprehensive geological report had been prepared by a learned professor of geology, which was very interesting in many respects, but which failed to indicate with any certainty where the best drilling locations might be…
Over 100 boreholes had been drilled prior to my involvement. Most were dry or very low yielding, and the few that did produce well had seasonally variable yields in a highly heterogeneous high-relief environment with cyclical sedimentary strata containing multiple small aquifer units faulted against the high volcanic escarpment of the Campsie Fells…

The introduction of Geodivining dramatically improved their drilling success rate from a miserable <20% up to 95%.
The Geodivining Survey effectively mapped all water-bearing structures, obstacles and hazards and supervised drilling brought in 19 successful new wells, more than doubling the average borehole yield for producing wells, and quadrupling the sustainable water supply from 120Ml/a to 480Ml/a….
This resource was worth over £7,500,000 per annum in increased profit potential.



The first borehole of the 2001 campaign started with a flush of success… F-11 was drilled to 50m and flushed steadily at an astonishing 10 l/sec off the drill (600 l/min), (27/08/01).

Ayrshire Springs Natural Mineral Water prospect development:

In 2007 the directors of Campsie Spring referred me to a new prospect in the hills of East Ayrshire that they were interested in investing in at the time, where the owners had some promising springs and were trying to get commercial interest in their water.
Situated in an upland conservation area the prospect had good potential and my geological investigation revealed that the springs flow from an isolated well-protected semi-confined sandstone aquifer extending to about 1,000 hectares, in which there were no boreholes at the time…
BGS reports indicated that yields up to about 18,000 l/hr might be achievable but the findings from the Geodivining Survey showed that higher yields over 30,000 l/hr were possible.

Seven high-yield locations were marked at selected fault and fracture intersections on Craigdullyeart Hill and two of these were selected for drilling, one at 220m elevation and one at 282m elevation. Both were drilled to 75m depth to produce truly exceptional yields in excess of 108,000 l/hr.
Ayrshire Springs is currently the most prolific Natural Mineral Water resource available for commercial development in Scotland…



The 'High Linn Spring' borehole, one of two gushers drilled near New Cumnock for Ayrshire Springs Ltd in June 2007. At 282m above sea level, this is by far the most productive high level borehole in Scotland. Yield off the drill at 74m depth was 35 l/s, 126,000 l/hr or 28,000 gall / hr. Test pumping at 17 l/s (1,468 m^3 / day) induced a drawdown of only 9.25m after 96 hours, giving Specific Capacity of 158.8 m^2/d (m^3/day/m), and Transmissivity values of 49 to 63 m^2/d.
I project managed the whole development. Water quality is outstandingly good and both boreholes and the whole aquifer have been officially recognised in the EU as Natural Mineral Water sources.

Some of the most difficult challenges have produced the most satisfyingly accurate results….

Early in my water divining career I successfully located and developed groundwater resources for Sangs (Banff) Ltd, an established family-run soft drinks manufacturer located on the top of the Macduff headland 210ft above sea level, where 8 previous drilling attempts had failed to find any water in the hard unforgiving vertical slates and greywackes of the Macduff Formation.

The Managing Director told me he needed a supply of 10,000 litres per hour (2,200 gall/hr) and showed me the locations of the dry holes peppered across the half-hectare site. He was understandably sceptical of my methods, but he was desperate for a positive outcome and agreed to show me around his site…

I did the water divining on site immediately, working confidently as he watched, and within a few minutes I had found one good point that was clearly the best place to drill. It was located less than 10m from two of the failed boreholes and lay completely concealed beneath concrete and tarmac paving and 30ft of boulder-clay subsoil. There was no possible clue on the surface as to its existence, and given the 8 previous drilling failures no conventional hydrogeologist would have been able to offer a positive prognosis… but I could.
Marking the site carefully and assessing it as a steeply inclined near-vertical fracture intersection on a quite major NE-striking fault structure, I made detailed depth and yield measurements on my exact location, which indicated that 2,600 gall/hr (11,700 l/hr) was available from 150-180ft depth.

The MD was still sceptical, until I followed up with two days' work providing detailed geological mapping of rock exposures around the cliffs and slate quarries in the area, from which I discovered that there was indeed a previously unknown major vertical fault zone in the slate corresponding to the line I had located.

Drilling work was subsequently arranged and successfully completed with 100% precision, much to everyone's astonishment and delight…



My successful 60m Sangs no.1 borehole replaced an expensive and restricted metered water supply. It accurately intersected the concealed near-vertical water-bearing fault structure in the bedrock through the exact depth range and produced the exact sustainable yield I had forecast.

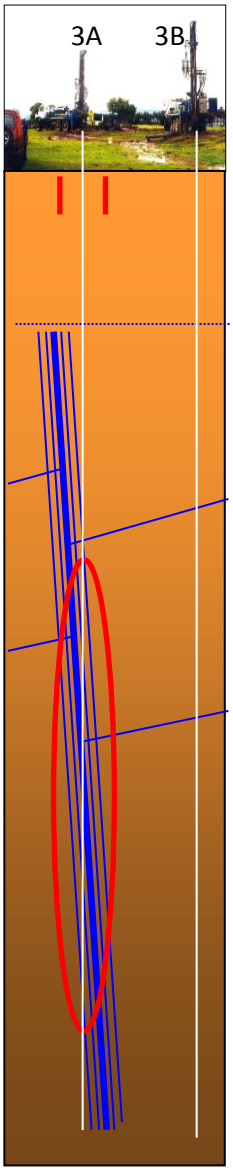
For over a decade it provided over 300,000 litres per day, which enabled the company's successful three-fold expansion and development of new soft drinks and water products.

In subsequent years additional land was acquired to protect the source and develop additional supplies. At least a dozen more boreholes were drilled and three were developed for water supply, but none attained even half the yield of my original well, proving that it was in the best spot. The business was sold in 2007 for about £10,000,000.

Geodivining Test on TV…

Another trouble-shooting job turned into one of my most lauded successes for the world famous **Gleneagles Hotel and Championship Golf Courses**, where in 1998 I successfully located and developed 4 of 4 planned boreholes for 3,500,000 litres per day, again where previous drilling had failed. This greatly enhanced the water features and landscape quality of the estate and saved many tens of thousands of pounds in water rates each year.

The picturesque Gleneagles Estate provided the ideal setting for an interesting test of the 'claim' that Geodivining accurately locates deep vertical water-bearing faults in the bedrock, when I was approached by a BBC documentary producer …



<u>One of the Gleneagles boreholes was drilled in conjunction with a joint Discovery Channel / BBC Science Documentary, for which we operated two drilling rigs to simultaneously drill two identical boreholes, one, 3A, carefully positioned on my target structure and the other, 3B, positioned just 12m away from it as a deliberate near miss</u>…

The bedrock aquifer consisted of a thick sequence of lower Devonian-aged siltstones and sandstones broken by occasional deep faults and fractures and dolerite dykes, concealed beneath 12-15m of boulder-clay overburden, as illustrated (left)…..
My deep target source structure (marked in blue) presented an anomaly only 4m in width (marked red) for which I forecast 27,000 litres per hour from 60-120m beneath location 3A, and the equivalent forecast for location 3B was less than 1,500 litres per hour... This test was designed to typify the conditions from some of the more extreme troubleshooting scenarios where I have often found high yields within a few metres of very poor yielding or dry wells….

<u>At 100m depth borehole 3A produced 25 times as much water as borehole 3B</u> effectively demonstrating:

(1) that in heterogeneous ground conditions (applicable in most sedimentary aquifers and all fractured crystalline rocks) the high yield groundwater flows are mostly confined to networks of major faults and fractures, especially vertical or high angle faults into which all other minor fractures drain and which are open to extensive lateral flow as well as deep infiltration or up-welling flow, and

(2) that these structures can indeed be accurately located and assessed by the Biophysical Remote Sensing methods developed by Geodivining International.

This test also demonstrates another important point about the way in which Geodivining surveying is done both remotely and on site, plotting the exact positions of features lying vertically beneath the surface.
There will always be sceptics who can't or won't believe it is possible to locate such deep features with such geophysical accuracy, using only these unconventional bio-sensory abilities; but we have the data and statistics that provide ample evidence that it is not only possible but can be relied upon to be correct in the great majority of applications.
Scepticism multiplies a thousand-fold when you move into the realms of mineral and oil exploration, but I and a few other professional diviners have done so successfully and there is a growing body of evidence of remarkable feats of accuracy and detail in this arena too.

100 Examples…

The few classic examples described above add to many other examples listed in the attached table of '100 Examples of Successful Troubleshooting Jobs by Geodivining', in which it may be seen that we typically achieve our objectives with a single borehole or a specified small number of boreholes, and that our results are spectacularly better than those achieved by other methods:

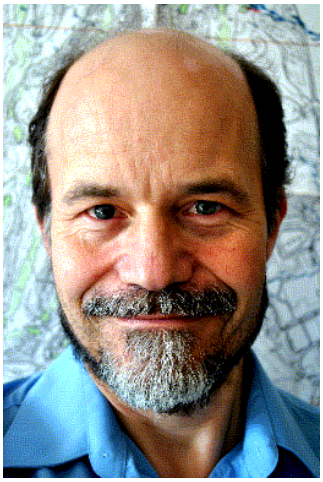
In the final column of the table the comments include calculated Improvement Factors (based on 'specific yield' or yield per metre drilled) typically in the 5-times better to 20-times better range, and sometimes much higher.
On this statistically substantiated basis, and notwithstanding the fact that in many cases the existing boreholes were positioned by other hydrogeologists or other water diviners; In most locations, by using Geodivining methods, I fully expect to be able to discover hitherto unknown deep water sources capable of sustainable yields at least 2 or 3 times better, or sometimes up to 10 times better than other boreholes in the same area, except in a few rare instances where the following caveat always applies…

Not always plain sailing…

Inevitably, we do have failures sometimes, but the Geodivining Survey Method is designed to minimise the risks of failure, and even failure provides useful information by which you have a better chance of success at a second attempt. More than 85% of our first attempt boreholes and 75% of our second attempt boreholes are successfully completed, leading to an overall project success rate in the high nineties.
Of course human errors do creep in from time to time and ultimately, there are some places where water just can't be found no matter how hard you try…
As high as our first-strike success rate and overall success rates are, no system is perfect and it is not possible to attain 100%... Unlike some less scrupulous consultants, I have never quoted success rates above those actually achieved and statistically substantiated from real drilling results. Although our success rates and borehole yields are exceptionally high, even with Geodivining there remains a small risk that results could prove disappointing. The potential yields indicated from Geodivining Surveys cannot be absolutely guaranteed and must ultimately be proved by drilling and testing.

Doug Bates, BSc.(Geol), FGSA, MGA, MIAH. (Geologist & Professional Water Diviner)
Founding Chairman, Geodivining International
Director, Geodivining Groundwater Solutions Ltd.

About the Author: Doug Bates is a qualified geologist who specialised in Structural Geology and Mineral Exploration in Southern Africa in the 1980's. In the early 90's he moved to Scotland and researched, learned, and practised the ancient art of Water Divining developing a unique set of bio-geophysical remote-sensory techniques for water prospecting & mineral exploration.
In 1994 Doug founded Geodivining International, which has become a world-leading consultancy in this field with over 2,500 successful water supply developments for private and corporate clients in UK, Europe, America, Africa and Australia.
For further information visit www.geodivining.com



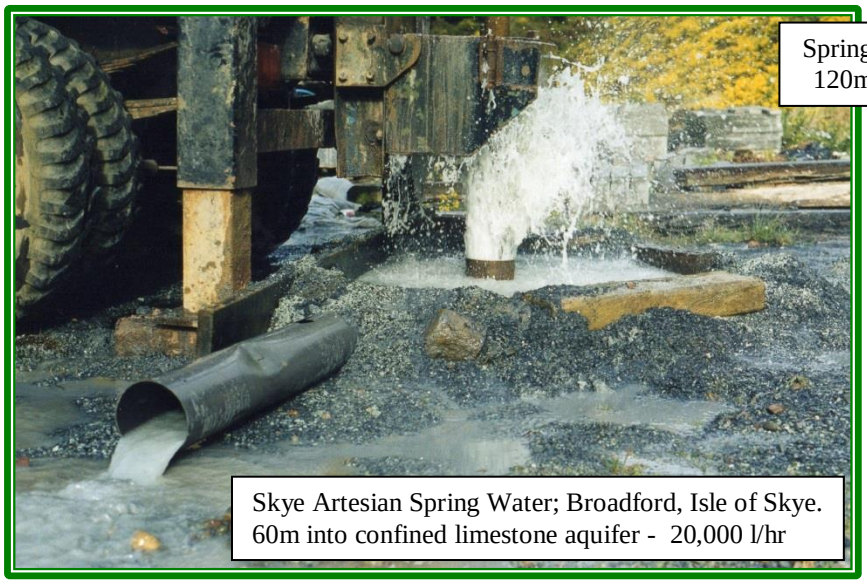
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100 EXAMPLES OF SUCCESSFUL TROUBLESHOOTING JOBS BY GEODIVINING (DOUG BATES) 1								
Location	Year	Previous Drilling Works			Geodivining Results			Comments
		bores	drilled	Max Yield	bores	drilled	Max Yield	Improvement factor Yx
1. Sangs (Banff) Ltd, Macduff, Aberdeenshire	1995	8	600m	1,300 l/hr	1	60m	11,700 l/hr	Major Fault in Slate, within 6m of failed bore. 90x
2. Brownrigg Farm, Drem, East Lothian	1995	12	1500m	Best 4,800 l/hr	1	105m	54,000 l/hr	Major Fault in Basalt 157x
3. Abacus Frozen Foods, Mintlaw, Aberdeenshire	1995	2	180m	500 l/hr	1	50m	36,000 l/hr	Dyke margin in Gneiss 259x
4. Grampian Country Pork, Burgie by Forres, Moray	1996	1	90m	dry	1	60m	9,000 l/hr	Major Fault in Quartzite >150x
5. Seedcrushers Scotland Ltd Arbroath, Angus	1996	1	120m	900 l/hr	1	81m	18,000 l/hr	Local fault in sandstone 30x
6. S Bayne, Gospetry Farm, Milnathort Fife	1996	2	250m	Best 12,000 l/hr	2	100m 75m	59,000 l/hr 36,000 l/hr	Local faults in sandstones and siltstones 4-7x
Oil Exploration in the North Sea & Atlantic	**1996**	**9 out of 9 (100%) successful projects confirmed by subsequent development over the following decade 1997-2007**						
7. Moray Leisure Centre, Elgin, Moray	1997	1	60m	failed	1	90m	13,500 l/hr	Local fault in sandstone >10x
8. Murrayshall Golf Club, Scone, Perthshire	1997	2	190m	900 l/hr	1	75m	8,500 l/hr	Local Fault in Basalt 23x
9. Lumgair Farms, 3 farms Forfar, Angus	1997	3	400m	2 failed 36,000 l/hr	3	100m 110m 120m	Total 170,000 l/hr	Local faults in interbedded sandstones & basalts 5-6x
10. Langside Farm, Kennoway, Fife	1997	2	180m	15,000 l/hr	1	90m	75,000 l/hr	Major Fault in sandstones, mudstones, limestones. 10x
11&12. W M McEwan Farms, Arbroath, Angus.	1998	1 of 10	Total > 1000m	Best 1 45,000 l/hr avg 5500 l/hr	2 of 2	105m 100m	103,000 l/hr 81,000 l/hr	Major Faults in Sandstones Within 30m of a failed well; 14-18x above average
13&14. Gleneagles Golf Club, Auchterarder, Perths	1998	1	90m	failed	2	108m 105m	52,000 l/hr 27,000 l/hr	Major Faults in Sandstone > 25-50x
15&16. Gleneagles Hotel & Est. Aucterarder, Perthshire	1998-2001	1	100m	800 l/hr	2	100m 108m	18,000 l/hr 50,000 l/hr	Major Faults in Sandstone > 20-60x
17-40. Greencore Campsie Spring, Glorat Estate, Lennoxtown, Dumbartonshire	1998-2001	30 of 154 (20%)	Total 13800 m	Total 72,000 l/hr	23 of 26 (88%)	Total 1,750m	Total 249,000 l/hr	Complete wellfield development in complex aquifers. Natural Mineral Water – 27x
41. Caledonian Cheese Co, Stranraer, Galloway	1999	3	190m	Best 7,500 l/hr	2	100m 100m	Best 33,300 l/hr	Major Fault Zone in Breccio-conglomerate 4-5x
42. Balgonie South Parks, Glenrothes, Fife	1999	2	210m	Total 32,000 l/hr	1	120m	80,000 l/hr	Local Fault in the Passage Group Sandstone 4-5x
43&44. Big Berry, Hoddles Creek, Victoria, Australia	1999	2	240m	Total 7,000 l/hr	2	120m 120m	Total 28,000 l/hr	Deep Faults in schists 4x
45-47. Established Trees, HC Victoria, Australia	1999	4	500m	Total 15,000 l/hr	3	120m 120m 120m	Total 67,000 l/hr	Deep Faults in schists 6x
48. Chapmans, Silvan Victoria, Australia	1999	3	430m	Total 9,000 l/hr	1	120m	12,000 l/hr	Deep Fault in schist 4-5x
49. Mark Chapman, Euroa Victoria, Australia	1999	1	120m	dry	1	90m	2,000 l/hr	Deep Fault in Granite >10x
50. Mount Barker Orchards, South Australia	1999	2	250m	Best 5,000 l/hr	1	120m	35,000 l/hr	Deep fault in schists 14-15x

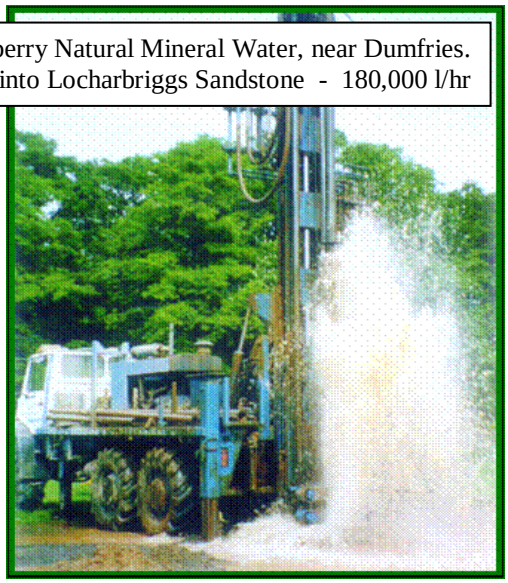
100 EXAMPLES OF SUCCESSFUL TROUBLESHOOTING JOBS BY GEODIVINING (DOUG BATES) 2								
Location	Year	Previous Drilling Works			Geodivining Results			Comments
		bores	drilled	Max Yield	bores	drilled	Max Yield	Improvement factor Yx
51. Airdrie Farm Anstruther, Fife	2000	1	120m	14,000 l/hr	1	100m	85,000 l/hr	Major Fault in sandstones 7x
52. Carnegie Centre, Dunfermline, Fife	2000	1	90m	< 100 l/hr	1	75m	11,200 l/hr	Local fault in Limestone >13x
53. Galleon Centre, Kilmarnock, Ayrshire	2001	1	90m	1,300 l/hr	1	90m	13,500 l/hr	Local Fault in Limestone 10x
54. Firle Estate, Firle Lewes, Sussex	2001	1	68m	16,400 l/hr contaminated	1	50m	45,000 l/hr	Fracture Zone in Chalk 3.7x
55. Milton Farm, Leuchars, Fife	2001	2	230m	Best 18,000 l/hr	1	120m	67,000 l/hr	Local Fault in sandstones 7x
56. W Lothian Golf Club Linlithgow, West Lothian	2001	1	75m	900 l/hr	1	66m	11,300 l/hr	Local Fault in basalt 14x
Uganda; Gold Exploration Uganda; Oil Exploration	2002-2004	Highly successful gold deposit mapping and development. 5% conversion to mines. 2 out of 2 (100%) successful projects confirmed by subsequent development results.						
57. Loch Tay Highland Lodges, Perthshire	2003	1	150m	Dust dry	1	60m	5,000 l/hr	Local fault in Precambrian Tay Limestone > 250x
58. Springfield Properties, Glassgreen, Elgin	2003	1	100m	2,000 l/hr	1	100m	27,000 l/hr	Local fault in sandstones 13.5x
59. Kilnhillock, Westfield, Aberdeenshire	2003	1	90m	135 l/hr	1	75m	4,500 l/hr	Local fault in Granite within 10m of the failed bore… 40x
60. J Grant, Tulloch, Nethy Bridge, Speyside	2003	1	90m	180 l/hr	1	70m	22,000 l/hr	Local fault in Granite 157x
61. Auchenlarie Holiday Park, Carsluith, Galloway	2003	3	220m	Total 3,100 l/hr	1	60m	7,200 l/hr	Fault in greywackes 8.5x
62. Ettrickshaws & Hyndhope Estates, Selkirk, Borders.	2003 2009	1	75m	150 l/hr	2	50m 60m	900 l/hr 2,100 l/hr	Local fractures in sheared greywackes & shales 13.6x
63. W M McEwan Farms, Colliston, Arbroath, Angus.	2003	1	120m	18,000 l/hr	1	120m	108,000 l/hr	Deep Fault in Sandstone 6x
64-67 Balbirnie Estates, – Pittillock, Muirhead, Kirkforthar, Pyeston, Broomfield, Treaton and Newtonhall – Central Fife.	2004	6	Approx. 600m	4 failed Total of 2 22,500 l/hr	4	360m	Total of 4 238,000 l/hr	Deep Faults in sedimentary Carboniferous strata and the Great sill Dolerite. 17.6x
68-70 Aquascot Fish Farm, Ardtaraig, Argyll & Bute	2004	3	80m	All failed	3	60m	72,000 l/hr	Alluvial fan gravel deposits > 100x
71&72. Diageo, Banbeath Leven, Fife	2004	4	600m	Best 18,000 l/hr	2	150m 150m	Best 90,000 l/hr	Deep faults in coal measures and sandstones 10x
73. Auchmull, Gannochy Estate Glenesk, Angus	2004	2	120m	Best 550 l/hr	1	60m	22,000 l/hr	Local faults in psammite (Dalradian schists) 80x
74. Findlays Spring, Pitcox Dunbar, East Lothian	2004	1	Spring	9,000 l/hr	1	90m	45,000 l/hr	Major Fault in sandstones Natural Mineral Water – 5x
75&76. Inverhouse Distillers, Moffat Distillery, Airdrie	2004	2	300m	Both failed	2	165m 180m	60,000 l/hr 58,000 l/hr	Local faults in coal measures dolerite and PG sandstone > 100x
77&78. West Herdhill & Reedie Farms, Kirriemuir	2004	3	360m	Total 17,000 l/hr	2	120m 135m	66,000 l/hr 60,000 l/hr	Local faults in Old Red Sandstone … 10.4x
79. Crieff Hydro Hotel & Spa, and Leisure Complex	2004 2006	3	250m	Best 2,700 l/hr	2	240m	Best 3,800 l/hr	Dyke Margin Fracture 1.5x

100 EXAMPLES OF SUCCESSFUL TROUBLESHOOTING JOBS BY GEODIVINING (DOUG BATES) 3								
Location	Year	Previous Drilling Works			Geodivining Results			Comments
		bores	drilled	Max Yield	bores	drilled	Max Yield	Improvement factor Yx
80. Nairn Golf Club, Moray	2005	1	75m	7,600 l/hr	1	75m	18,000 l/hr	Local Faults in fine-grained Devonian sandstones 2.3x
81 Inverpolly Estate, NW Highlands, Ullapool	2005	1	90m	225 l/hr	1	75m	3,400 l/hr	Local fault in Gneiss 18x
82-85. Glenapp Estate, Ballantrae, South Ayrshire	2006	3	Approx. 180m	Best 750 l/hr	4	225m	Total 11,700 l/hr	Local faults in greywackes 12.5x
86. Curin, Strathconon, Inverness-shire	2006	1	90m	< 50 l/hr	1	75m	4,400 l/hr	Locally fractured psammite > 100x
87. Kirkbymoorside Golf Club, North Yorkshire	2007	1	100m	900 l/hr	1	90m	8,200 l/hr	Local fault, Corallian oolitic limestone and sandstone, within 15m of failed bore. 10x
88. Marfit Head Farm, Pickering North Yorkshire	2007	1	89m	2,000 l/hr	1	120m	11,000 l/hr	Local fault, Corallian oolitic limestone & sandstone. 4x
89. Balnacoil Estate, Strath Brora, Highland Region	2007	1	100m	< 200 l/hr	1	75m	1,850 l/hr	Local fault or fracture zone in Highland schists. > 12x
90&91. Ayrshire Springs, New Cumnock, Ayrshire	2007	1	springs	Variable 10,000 l/hr	2	75m 74m	110,000 l/hr 126,000 l/hr	Local faults in previously untested sandstone aquifer > 10x
92&93 NTS Glencoe Visitor Centre and Camping Ground	2008	2	200m	failed	2	90m 90m	800 l/hr 2,000 l/hr	Local faults in Ballachulish slates and limestones > 100x
94-96. Wilson, Stiltons, Court House & Waterloo; Helmsley	2008	4	440m	Total 3,800 l/hr	3	100m 100m 120m	Total 31,000 l/hr	Local faults in Corallian oolitic limestones and sandstones. 11x
97&98. Blaen Twyni Ltd, Brecon Beacons, Wales	2008	6	Approx. 540m	4 failed 4,700 l/hr 8,200 l/hr	2	120m 150m	22,000 l/hr 27,000 l/hr	Local faults in Devonian siltstones and sandstones; Natural Mineral Water – 8x
99. Inverlair, Glen Spean, Highland Region	2009	3	350m	All dust dry	1	30m	2,250 l/hr	Local fault or fracture zone in Highland schists > 1000x
100. Hilton of Carslogie & Uthrogie, Cupar, Fife	2010	6	413m	2 failed, Best 15 kl/h Total 36,000 l/hr	1	135m	60,000 l/hr	Deep fault in sandstones within 10m of one of the original boreholes… 5x
… and many more…								

Typical Improvement Factors in the 5x to 20x bracket, and higher; based on Specific Capacity (Yield per meter drilled)



Skye Artesian Spring Water; Broadford, Isle of Skye.
60m into confined limestone aquifer - 20,000 l/hr



Springberry Natural Mineral Water, near Dumfries.
120m into Locharbriggs Sandstone - 180,000 l/hr