



Agriculture



Golf Courses



Sports Stadiums

**Your professional partner for
permanent below-ground
wireless environmental
monitoring**



SOIL SCOUT



**“Through data, we will safeguard
our soils and make them flourish
for future generations”**

#GainADeeperView



@Soil_Scout



@SoilScout

The Soil Scout story....

‘The first prototype is still buried and beeping 13 years later...’

In the year 2000, agrotechnology student and 19th generation farmer Johannes Tiusanen wrote an essay on future farming at the University of Helsinki, in which he stated that farmers in 2025 “will get online reports on underground soil conditions - just like a local weather report.”

He realised the sensors that captured this data would need to be permanently buried, but no one knew why mobile signals attenuated when underground. He answered this question while completing his doctorate, which led to the creation of a new kind of antenna.

With the help of his good friend, Jussi Sirkiä, who had an abundance of experience in power electronics, the pair were able to build a new product that could transmit enormous amounts of radio power while maintaining a lower power state the rest of the time and last for 20 years buried underground. The first prototype is still buried and beeping 13 years later.

Having initially built the product to solve his own problems, Johannes realised the potential of the technology as a commercial solution and founded Soil Scout in 2013. The team solved the final piece of the puzzle - they refined the solution to the point where a person can take their phone out of their pocket and understand what is happening underground in real-time.

Our mission is to give soil experts the insights and data they need to manage their lands in the most efficient and effective ways. Through data, we will safeguard our soils and make them flourish for future generations.



Johannes Tiusanen

Chief Science Officer, Soil Scout

#thesoilscoutstory

“We wanted to help soil professionals get the insights they need from the soils they manage”

The Soil Scout timeline....



2000

Johannes wrote an essay on future farming at University



2004

Development of a unique underground antenna

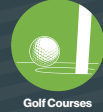


2005

Johannes and Jussi produced their first wireless soil sensor



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Welcome to Soil Scout

Soil Scout enables land use related water and energy optimization in an unprecedented detail and ease by providing a future-proof below-ground monitoring system.

Soil Scout provides the only wireless sensors capable of transmitting moisture, temperature and salinity data in near real-time out-of-sight performance from up to 2 metres / 6 feet below the surface, for up to 20 years, maintenance free.

Understanding what's happening below the soil surface is critical for many industries. Soil Scout takes monitoring to the next level by providing a detailed view into in-field variation, enabling our customers to expand the Precision Agriculture approach to all land use challenges, be that smart farming, irrigation control or turf quality optimization.

Previous solutions for measuring environmental conditions are based on wires and cables or a single observation pole, which are impractical, inefficient, labour-intensive or unable to assess spatial variability. Soil Scout provides critical insight into data from deep below the surface wirelessly, enabling 365x24 insight and profiling which allows our customers to perform better, understand their operations deeper and reduce water and energy use by up to 50%.



2013

Soil Scout is founded and welcomes first Angel investor



2015

Release of the latest HYDRA100 sensor



2019

Husqvarna becomes the latest to invest in Soil Scout

Read more

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- 5 **New user case study**
Kevin Hauschel of The Meadow Club, Fairfax, California
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Benefits from using wireless sensor technology under sports turf
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Why choose **Soil Scout**?

The managed sports turf industry uses in excess of 16.2 billion litres of water daily, studies suggest that up to 40% of this water is wasted from over watering from irrigation systems and practices.

The effects of over watering lead on and create a devastating trail of after effects.

By using Soil Scouts wireless underground sensors, these issues won't be cured, but you can go a long way to putting it right and gaining significant savings, and dramatically increasing your efficiencies along the way.

As a sports turf professional, your priority is to provide a safe, durable, and high performing surface, for the participants of whichever sector of the industry you are within.

Sustainability is the word on everyone's minds right now, and with the ever increasing costs of all inputs, all involved in decision making within this sector, need to use water (admittedly our most valuable resource) as efficiently as possible.



The **Soil Scout** story....

“You can see all the data from your phone instead of going to the field. A golf superintendent is always stressed about the course conditions - now he can stay at home and check the conditions from his app”

Tommi Tienhaara

Sales, Soil Scout

#thesoilscoutstory





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Case Study

The Meadow Club

Fairfax, California

Having in ground sensors from Soil Scout helps us become more efficient and tells us when and where we need the water most at critical times.

The biggest reason for choosing Soil Scout is the not having to fiddle round, taking sensors in and out like our previous sensors. The ability to just put it in the ground and know that it is going to work and then gain credible, accurate data so we can make real time decisions.

Upon opening the packaging and viewing the hardware, I loved it, such exceptional build quality. The customizability is amazing, if I want to move them I can, plus the bespoke nature of being able to add sensors, year on year, as budget allows is great. To have a product with radio signal rather than cellular was a big drawer for us, as we don't need to rely on good cellular coverage right across the property, so we can install them where we want rather than where coverage allows.

The ability to build patterns year on year and monitor trends, gives us that chance to learn more about timings of our inputs like fertilisers, and then pesticides, for disease, grubs, etc on our property. We also use the Greensight drone solution, so we can now compare the above ground imagery, with the below ground evidence and really fine tune our actions when we see change happening.

Overall as of yet we have only recently installed the product, but initial feelings are great. The whole process from sales to order then delivery and installation has been simple and straight forward, so it hasn't cost me valuable time at this time of year.



Kevin Hauschel

Golf Course Superintendent at the Meadow Club 1927, Dr. Alister Mackenzie's first golf course design in the US



@KevinHauschel

“Having in ground sensors from Soil Scout helps us become more efficient and tells us when and where we need the water most at critical times”

What does **Soil Scout** do?

Benefits from using wireless sensor technology under sports turf



The soil moisture, temperature and salinity are three critical components to monitor, if you are looking to achieve optimum conditions for plant health, and ideal growth.

Historically superintendents / Course managers / Head greenkeepers / Stadium turf managers etc have known there own wants, when it has come to what's needed to achieve a top class surface. But now, with our underground soil temperature, moisture and salinity sensor, we can make that job more efficient, and streamlined, from many levels. Increasing ecological sustainability, auditable actions, and simpler, connected management practices.

After learning the interpretation of the data you receive, and how it benefits you and your property personally, it is an added asset to the arsenal to add more playing days, and help enhance player perception of the turfs you manage.

“We constantly aim to push our industry forward, both in terms of the technology and processes it uses, but also in terms of the potential ways in which it can help the world”

The **Soil Scout** story....

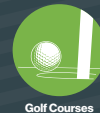
“We helped them manage the entire system in a simple way, and they received real information on the value of their soil for the first time. We helped them leverage smart farming techniques”

Jalmari Talola
CEO, Soil Scout
[#thesoilscoutstory](#)





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Key benefits

- ✓ A significant reduction in water usage / or use of same water, but in areas more needy
- ✓ Savings on power / fuel from pumping
- ✓ The ability to lower or increase desired moisture / temperature / salinity levels, from accurate data, according to local / historical knowledge or plant needs
- ✓ Reduce black layer / thatch
- ✓ Gain a knowledge of ideal conditions, for more effective plans on timing of fertiliser applications
- ✓ Forward plan / pre-warning on disease risk
- ✓ Lower labour costs / gain time to do other tasks, by minimising the use of hand held sensors, also making the hand held more valuable by highlighting specific areas to manually pinpoint problems
- ✓ Automate irrigation / sub-surface air systems
- ✓ Auditable recording of data, to quantify water usage, and other input usages
- ✓ Monitor ever increasing salinity levels

Case Study

A streamlined approach at The Belfry Hotel & Resort

Being able to monitor the various data, can help us become a lot more streamlined with our irrigation usage. Having 56 holes requires a significant amount of water management, so every effort counts. Our water is also recycled city water, so it will be interesting to monitor salinity levels to implement better timings of fertiliser applications.

We are also aiming for GEO accreditation, and having a remote sensor solution like Soil Scout, will help us show evidence that we are cautious with what we do, and also make us more auditable.

Angus Macleod

Director of Golf Courses and Estates at
The Belfry Hotel & Resort



@AngusMacleod9





GAIN A DEEPER VIEW

The Soil Scout photographer joined International Sales Manager Adam Sedgwick on a recent installation on the Brabazon Course at The Belfry Hotel & Resort.



1



2



3



4



Wireless underground **Sports Turf** sensor

Make informed decisions based on accurate and permanent measurements

Soil Scout

- Integrated Moisture, EC (Salinity) and Temperature sensors
- Transmits from up to two metres underground
- Broadcasts through soil, turf, sand, clay, biomass, snow and concrete
- Nothing on field to interfere with machinery, players or turf growth
- Create a multidimensional picture for subsoil environment

Features

- Broadcasts every 20 minutes for up to 20 years (other intervals available)
- Data transmitted to a gateway and onwards to the monitoring service
- Water and energy savings up to 50%
- Unaffected by weather, temperature extremes or seasons
- Enables detailed profile to be established continuously over time
- Ability to integrate with 3rd party systems or machinery (irrigation, aeration, moisture removal)

**OVER 100 SATISFIED
CUSTOMERS - OVER
1000 ACTIVE
SENSORS**



Patented Technology

Regular radio antennas do not work properly if buried in soil because the speed of radio waves varies depending on soil properties. This is why an antenna for a specific wave length would go out of tune when soil moisture changes.

Soil Scout has developed a patented underground antenna that interacts with the surrounding medium in a way that balances the antenna input to the prevailing soil conditions. As a result, the antenna is not very efficient in air, but gains an efficiency exceeding 95% when soil is introduced to the antennas near field.

US9673912B2

The **Soil Scout** story....

“Our data enables agronomists to base their recommendations on real life evidence instead of visual evidence from history. This means they can make real-time management decisions, helping them structure their business to be more proactive than reactive - and more sustainable through timely use of resources”

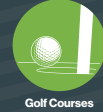
Adam Sedgwick

International Sales Manager, Soil Scout
#thesoilscoutstory





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Expert Opinion

Leading industry experts give their opinions on Soil Scout

Good greenkeeping and turf management is all about observation and correlation of actions that have led to good results, we often call this experience.

Having the ability to collect moisture levels, EC, temperature and salinity data continuously provides important data to aid the decision making process. It will never replace experience but can massively help to make the correct decision.

However, data is only as good as the user's ability to access it, interpret results and relate this to desired outcomes. The Soil Scout system provides the answer to the problem of data collection, recording, filing and long term storage. The cloud based system allows interrogation and correlation of the data. It is easy to use and can generate standard reports easily and quickly.

By automating data collections the system can run in the background collecting information - no need to remember to go sampling - no batteries to be continuously charged, no broken probes and piece of mind that the information is being collected accurately and continuously.

A comment we often hear is; "If only I had time we would of started carrying out moisture reading earlier". This system allows data collection to continue with no intervention, the data can be viewed remotely and remedial measures can be taken. The real skill comes from combining this information with other variables, observation and recording.

Very quickly greenkeepers and turf managers can determine what level of irrigation is required to produce the desired outcome. Following on from this variables can be tweaked to optimise performance and efficiency. Greenkeepers and turf managers can very soon determine the optimum readings required.

The flexibility of the system allows users to start with a limited number of scouts to gauge the benefits they receive from the system. The number of scouts and area covered by the Soil Scout system can very easily be expanded to enhance the volume and quality of the data collected.

The system can be designed in a bespoke method to match the requirements of the organisation or club.

Peter Corbett
Rigby Taylor Limited

Huge potential to improve how we manage sports turf

The use of remote soil probes has huge potential to improve how we manage sports turf. With regulatory pressure increasing on many turf management products improved understanding of optimum timing is critical.

Recording soil temperatures and moisture levels on a regular basis has become standard practice in many venues now and having the ability to automatically record those over a long period of time will help to give stronger indications of disease outbreaks, timings of insect flights and guide timings of many products.

This kind of technology will in time become a key factor to influence the timings of our management programmes.

**Research manager - from the turf industries
premium pesticides manufacturer**

"We reveal varying underground conditions in real-time which builds understanding of how soils behave and enables proactive field management"

Case Study

Football pitch consistency is key at Fulham FC

We are installing 18 sensors at Craven Cottage, my main reason is that by having regular real time updates on moisture level, so that I can accurately keep the pitch at the exact same level game after game.

If we use our hand-held sensor, we can only get a reading for the time of the sample, but levels can change so quickly, especially during the game. We have an irrigation system that we can operate from our phones 24/7, so being able to do the same with our sensors, we can water anytime of day or night.

Repeatability is also key, and being able to monitor different areas continuously is a boost, for instance if the Hammersmith End is dryer than the other end without sensors it is visibly different, now we can get an even match right across the surface.

We have a sustainable plan in place, and anything that can help us become more sustainable is a bonus too. Potentially, as we learn more from the data, we can fertilise more effectively, and maybe as we get better at using the data we can stretch out our fertiliser plan, and maybe save money.

Another big factor is that products like this are the future, and if you stand still you get left behind, being able to build year on year patterns can teach us so much.

At Fulham I have pretty a free reign on pitch condition, the manager just wants short, tight, sleek conditions, so with this new data, I can now present a playing surface to match the managers ambitions.



Niall Hazlehurst

Head of Grounds at
Fulham Football Club



@NiallHazlehurst

“Using Soil Scout will help us to match the managers ambitions and give him the pitch conditions that he wants to play on”



The **Soil Scout** story....

“We’re giving farmers data for better problem assessment. We’re replacing guesswork with actual real-time view of something that been hidden - underground soil data. We help them turn this data into management practices - they get tangible, actionable information”

Johannes Tiusanen

Chief Science Officer, Soil Scout

#thesoilscoutstory

FAQ

Soil Scout answers your frequently asked questions...



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What do we do when we want to do our normal aeration practices?

This is the primary question that we are always asked, as it is another essential part of your turf management strategy. There are numerous ways of overcoming this issue.

- 1 Locate and remove whilst aeration takes place. As you will have learnt, the install is very quick and simple, so removal and replacement is a quick process.
- 2 Install sensors a measurable distance from objects that you normally avoid when aerating.



How many sensors do we need?

To this question, there is no right or wrong answer. There are so many variables and reasons to measure but as a start off rule of thumb we recommend three sensors per green in golf. This allows you to monitor your best area, worst area, and average area, which gives you the ability to average your data out over the three reference points.

In a stadium environment, there are several simple ways to make a decision regarding the amount of sensors, mainly by identifying how many individual sectors the turf field is split into, then either have one or two sensors in each region. If two, the power of data gives a different degree of awareness, as it is very simple to reduce or manage your wetting agent usage by monitoring speed of water through the profile.

How accurate is the data?

The data is extremely accurate, due to the nature of our patented, permanently retuning, underground antenna, which is constantly reconfiguring to the current soil conditions. The accuracy is all viewable on the tech info page, but briefly summarises as:

- EC (salinity) +/- 0.2dS/m
- Moisture +/- 1% dependant on correct installation and correct soil type entered
- Temperature +/- 0.1degree C

Do Soil Scout provide installation services?

We can do by all means, but generally the instructions are simple to follow, enabling the process, to be quick, simple, and comprehensive for a self install.

For all major installs it is recommended to have one of the Soil Scout team on site with you for a smooth, simple installation.



How often do the sensors need replacing?

One of our big selling points, is our very long battery life. The sensor is pretty much bury and forget item, with battery life-scale of up to 20 years, dependant on the model and timed transmissions.

Range Estimation Table

Approximate maximum ranges (yards / metres): USGA Sand

Receiving Antenna type and height

Chart One
Feet and Inches



		Omnidirectional Antenna				Directive Yagi Antenna 90			
	Depth	3 ^{ft}	7 ^{ft}	10 ^{ft}	17 ^{ft}	3 ^{ft}	7 ^{ft}	10 ^{ft}	17 ^{ft}
Dry	4 ⁱⁿ	150	290	340	440	150	400	490	620
	12 ⁱⁿ	140	270	320	410	140	370	450	570
	24 ⁱⁿ	130	240	290	370	130	330	410	520
Wet	4 ⁱⁿ	140	270	320	410	140	370	450	570
	12 ⁱⁿ	120	220	270	330	120	300	370	480
	24 ⁱⁿ	80	160	190	250	80	220	280	360

Receiving Antenna type and height

Chart Two
Metres and Centimetres



		Omnidirectional Antenna				Directive Yagi Antenna 90			
	Depth	1 ^{mt}	2 ^{mt}	3 ^{mt}	5 ^{mt}	1 ^{mt}	2 ^{mt}	3 ^{mt}	5 ^{mt}
Dry	10 ^{cm}	140	270	320	410	140	370	450	570
	30 ^{cm}	130	250	300	380	130	340	420	530
	60 ^{cm}	120	220	270	340	120	310	380	480
Wet	10 ^{cm}	130	250	300	380	130	340	420	530
	30 ^{cm}	110	210	250	310	110	280	340	440
	60 ^{cm}	80	150	180	230	80	210	260	330

Note:

- Estimates are presented for dry soil (20% volumetric moisture) and wet soil (50% vol. moist.)
- Environmental conditions may reduce range temporarily (e.g. wet layer on dry soil or vice versa)
- Tree(s) and/or shrubs between Scout and Base may reduce the range by 50%
- In urban environments, static radio noise may hamper receiver sensitivity and decrease range by 10-20%
- Saline soils (4 dS/m and higher) will attenuate signals and lower achievable depth in wet conditions

Disclaimer:

The information in this table is provided as an indicative planning guide, and is not a guarantee or warranty of performance under the stated conditions. Soil Scout Oy accepts no responsibility for errors or the inaccuracy of the information herein.

Technical Specifications

HYDRA100 Scout				
Radio power	27.0 dBm (500 mW) Transmit only			
Frequency Variants	869.5 MHz (ITU-1) 915 MHz (ITU-2) Custom	Europe and selected other markets Americas, Australia, New Zealand and selected other markets Information upon request		
Battery capacity	3000 mAh, encapsulated primary lithium			
Life expectancy	Up to 20 years @ 1 cycle per 20 minutes			
Encapsulation	Black polyurethane molding			
Dimensions (L x W x H)	129 x 59 x 25mm (5.1" x 2.3" x 1.0")			
Sensors	Temperature Three-prong integrated Capacitive (moisture content) and Resistive (EC / salinity)			
Moisture Accuracy	± 2 % mean error (1% with correct soil type, 1% installation repeatability)			
EC Accuracy	± 0.2 dS/m mean error, Typical resolution 0.1 dS/m, Range 0 to 20 dS/m			
Dielectric Accuracy	± 2 % mean error, Resolution 0.5 to 1.5 ε, Range 1 to 135 ε			
Temperature Accuracy Resolution	Range -40 to +80 °C / -40 to 176 °F		Accuracy: +/- 0.1 °C / 0.18 °F	
	-40 to -11 °C	1.00 °C	-40 to 12 °F	1.80 °F
	-10 to +10 °C	0.25 °C	-12 to +50 °F	0.45 °F
	+10.5 to +80 °C	0.50 °C	+50 to +176 °F	0.90 °F



Base Station	
Receiver RF sensitivity	-100 dBm, BNC connector
Frequency Variants	Same as HYDRA100 Scout
Operating Voltage	8-14 VDC, 300 mA
Dimensions (L x W x H)	180 x 130 x 100 mm (7.1" x 5.1" x 3.9") ²⁾
Data interface	GSM / WCDMA Cellular modem / Custom ¹⁾
Power Supply	100-240VAC with 5m (16'4") lead (included)
A wide selection of Omni-directional / Directional / Sector antennas are compatible	



ECHO Repeater	
Receiver RF sensitivity	-100 dBm, BNC connector
Frequency Variants	Same as HYDRA100 Scout
Radio transmit power	27 dBm (500 mW)
Power Supply	Solar panel charging a 2400 mAh 3.7V Li-ion battery. Mains power supply available as accessory (same as used for Base Station) Optional Repeater variant to enable connection to heavy battery
Range	10km / 6-mile line-of-sight from ECHO to Base Station / another ECHO ³⁾
Dimensions (W x H x D)	190 x 135 x 95 mm (7.5" x 5.3" x 3.7")
Mounting	50 mm (2") pole mount / wall mount



1) Cellular modem is a third-party component. Network specific SIM-card not supplied. Not eSIM compatible.

2) Excluding mounting tabs + external interface ports

3) Any obstacles (vegetation, hills, buildings) between the radios will decrease range. Base Stations & Repeaters dynamically mesh.

Specifications subject to change without notice

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