Mid-conference tour

Tuesday August 28, 2012

GUIDEBOOK

7th IASSC

26 August - 1 September 2012

Vaasa, Finland

7th International Acid Sulfate Soil Conference

Vaasa, Finland 2012

Towards Harmony between Land Use and the Environment

7th IASSC
26 August - 1 September 2012
Vaasa, Finland

Mid-conference tour

Tuesday August 28, 2012

by

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Cover photos: Rainer Rosendahl

Mid-conference tour Tuesday, August 28

8:00 Buses leave from Vaasa towards the Söderfjärden plain which is 10 km south of Vaasa and located in a 520 Ma old impact crater. We will pass the Vaasa Bay, which is polluted by acid sulfate (AS) soils, and drive along the edge of the crater to the Söderfjärden pump station (1 on the map) that drains 2300 hectares of farmland. At the pump station a presentation will be given about how this fertile land area was once reclaimed from the sea.

9:10 We will arrive to the Meteoria exhibition house and bird-watching tower (2) in the middle of the crater where a video and a display of the history and geology of the area, including the formation of the crater, will be given. Here we will also be in the middle of a resting place for cranes as up to 8000 cranes stay here for a while every year.

10:10 We arrive to the CATERMASS test site (3) in the SW-part of Söderfjärden. The participants will be divided in to four groups and presentations will be given about:

1. Soil pedology and properties in a ca. 2 m deep soil pit.

2. Sampling and mapping acid sulfate soils (demonstration)

3. Presentation of the CATERMASS test site (18.5 hectares), where controlled drainage, subsurface irrigation and by-pass flow prevention is trialed. Subsurface irrigation and installation of groundwater pipes will be demonstrated.

4. Demonstration of methods used for monitoring of the test site.

Additionally there will be an exhibition of materials used for drainage and controlled drainage in Finland.

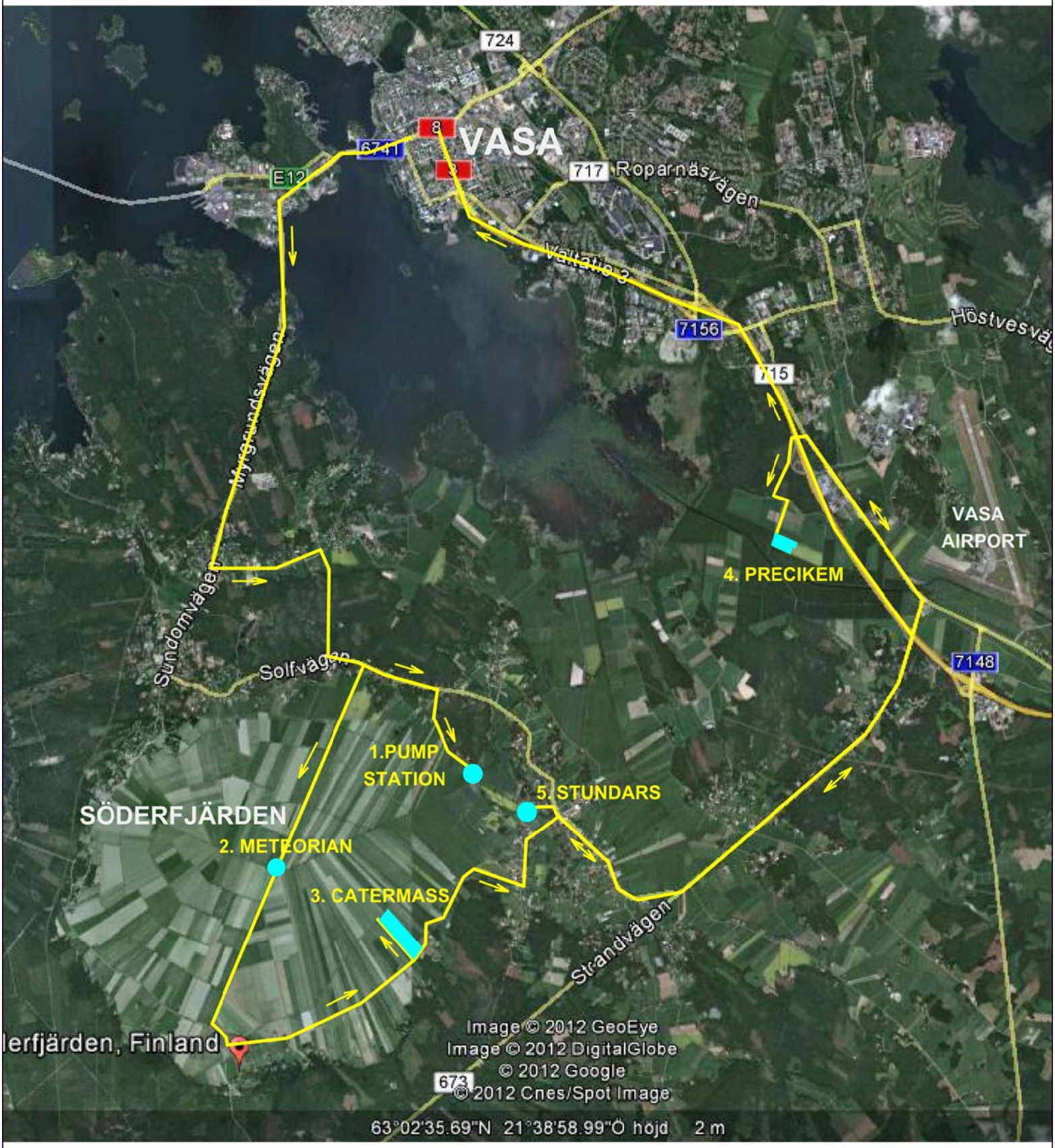
11:30 The buses will take us to the Hemmergården restaurant at Stundars (5) for lunch

12:30 Back at the CATERMASS test site we will see a demonstration on how to install a vertical plastic sheet in order to prevent by-pass flow of stored groundwater in well-structured soils to adjacent open drains.

13:50 After a coffee break we will take the bus to the Risöfladan plain near Vaasa airport, and visit the PRECIKEM test field (4). The field is divided in to 9 similar subfields, each 1.0 hectare with its own drainage system. Here suspensions of chemicals, including $CaCO_3$ and $Ca(OH)_2$ are pumped in to the soil through subsurface drains with the aim to neutralize acidity and hamper microbial sulfide oxidation in critical soil layers above parent sediments. Demonstrations of the methods used will be given.

15:40 Leaving to to Stundars open-air and arts-and-crafts museum (5) in Solf. We will see a village environment that represents genuine Finnish peasant culture 100 years ago. Barbeque and drinks will be served.

About 18:00 Buses to hotels in Vaasa


724
VASA
8
6741
E12
717
Roparnäsvägen
7156
715
Höstvesvä
Myrgrundsvägen
Sundomvägen
Solfvägen
VASA
AIRPORT
4. PRECIKEM
7148
1.PUMP
STATION
5. STUNDARS
SÖDERFJÄRDEN
2. METEORIAN
3. CATERMASS
Strandvägen
673
Image © 2012 GeoEye
Image © 2012 DigitalGlobe
© 2012 Google
© 2012 Cnes/Spot Image
63°02'35.69"N 21°38'58.99"Ö höjd 2 m

The soil profile at Söderfjärden

Markku Yli-Halla, University of Helsinki

A soil profile about 500 m from the present CATERMASS experimental field at Söderfjärden was described and sampled to the depth of 220 cm in October, 2008. The soil pit was about 20 metres from the major ditch bordering the experimental field. The field had no subsurface pipe drainage but rather shallow (0.5 m) open ditches. Barley had been grown in the previous summer.

The horizons down to 1.5 m were oxidized, indicated by the thick continuous iron hydroxide coatings on aggregate faces. Jarosite coatings were observed immediately below the plough layer. The structure of the B horizon was very strong, consisting of very coarse prismatic aggregates in the lower part. The Cg horizons below 1.5 meters were reduced, indicated by high pH and the lack of iron hydroxide mottles. The Cg horizons had a total sulfur content of about 0.8%, which is typical of the area. The negligible water conductivity of the reduced subsoil was demonstrated in the soil pit. Some groundwater was observed at the bottom of the pit only after six hours in spite of the fact that the water level in the major ditch 20 meters away was about 1 meter higher than the bottom of the pit.

Table 1. Characteristics of the soil profile of Söderfjärden.

Depth (cm)	Horizon	Texture	pH(H2O) fresh	C_{tot} (%)[1)]	N_{tot} (%)[1)]	S_{tot} (%)[1)]	SO_4-S (mg/kg)[2)]	Clay (%)	Silt (%)	Sand (%)
0-28	Ap	sil	6.7	2.3	0.23	0.23	17.2	26	68	6
28-50	Bgj1	sicl	4.7	1.2	0.16	0.35	15.3	32	65	2
50-86	Bgj2	sicl	4.0	1.5	0.22	0.39	39.7	38	60	3
86-152	Bg	sicl	3.8	1.9	0.28	0.18	592	36	64	0
152-182	Cg1	sicl	7.9	2.2	0.32	0.83	409	38	61	1
182-220	Cg2	sicl	8.6	2.1	0.29	0.79	759	40	60	1

1) Dry combustion with LECO apparatus
2) 0.01 M $CaCl_2$ extraction of air dry samples

Pedological features

- The plough layer (Ap horizon) is a 28-cm deep **ochric epipedon**. The dry color is too light for an umbric epipedon.
- In large parts of the profile, the aggregates are covered with thick coatings of iron hydroxide, and the aggregate interiors are homogeneously gray. The **gleyic color pattern** starts right below the Ap horizon and extends to the depth of the investigated soil profile.
- At least the soil at 28-86 cm meets the requirements of a **cambic horizon**.

- **Colors of jarosite** are visible at 28-86 cm.
- The Bg horizon at 86-152 cm meets the requirements of a **Thionic horizon** (WRB: pH<4, sulfate concentration >500 ppm, thickness >15 cm).
- **Sulfidic materials** occur below 152 cm.
- The low pH is associated with **low base saturation** and most likely to **high concentration of exchangeable Al** in the subsoil.
- The concentration of **organic carbon is >1%** throughout the investigated depth in each horizon.

According to **Soil Taxonomy**, the soil belongs to ***Sulfic Cryaquepts.*** This classification arises from the 1) cambic horizon, 2) aquic soil moisture regime, 3) cryic soil temperature regime and 4) a horizon between 86-152 cm meeting the requirements of a sulfuric horizon, except the pH which is between 3.5 and 4.0.

Strictly following the criteria of the **WRB system**, this soil falls out of the Gleysols because the Ap horizon is too thick (28 cm) to allow the gleyic color pattern to start *within 25 cm of soil surface*. This outcome is attributable to deep ploughing. It is evident that with a more shallow ploughing the criteria of a Gleysols would be met. If the criterion of the starting depth of the gleyic color pattern is waived, the soil is, according to the WRB system (2007 edition), as follows:

Haplic Gleysol (Thionic, Humic, Alumic?, Dystric, Siltic)

If the criteria of the Gleysols are strictly followed, the soil is:

Thionic Endogleyic Cambisol (Ferric, Alumic?, Humic, Dystric, Siltic).

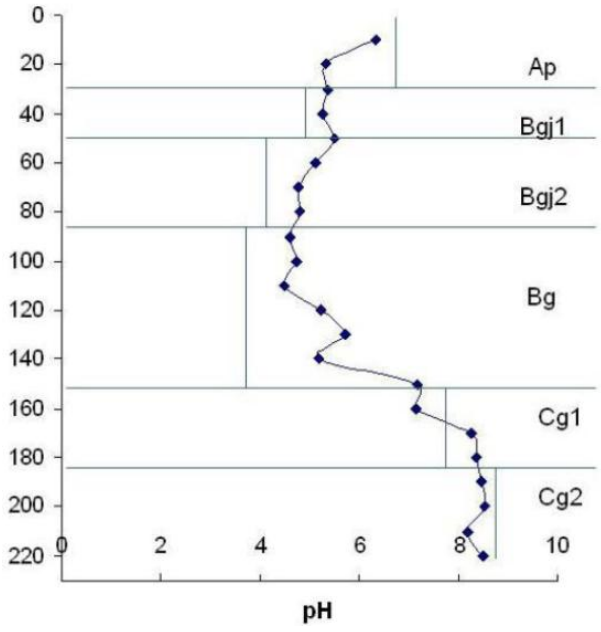
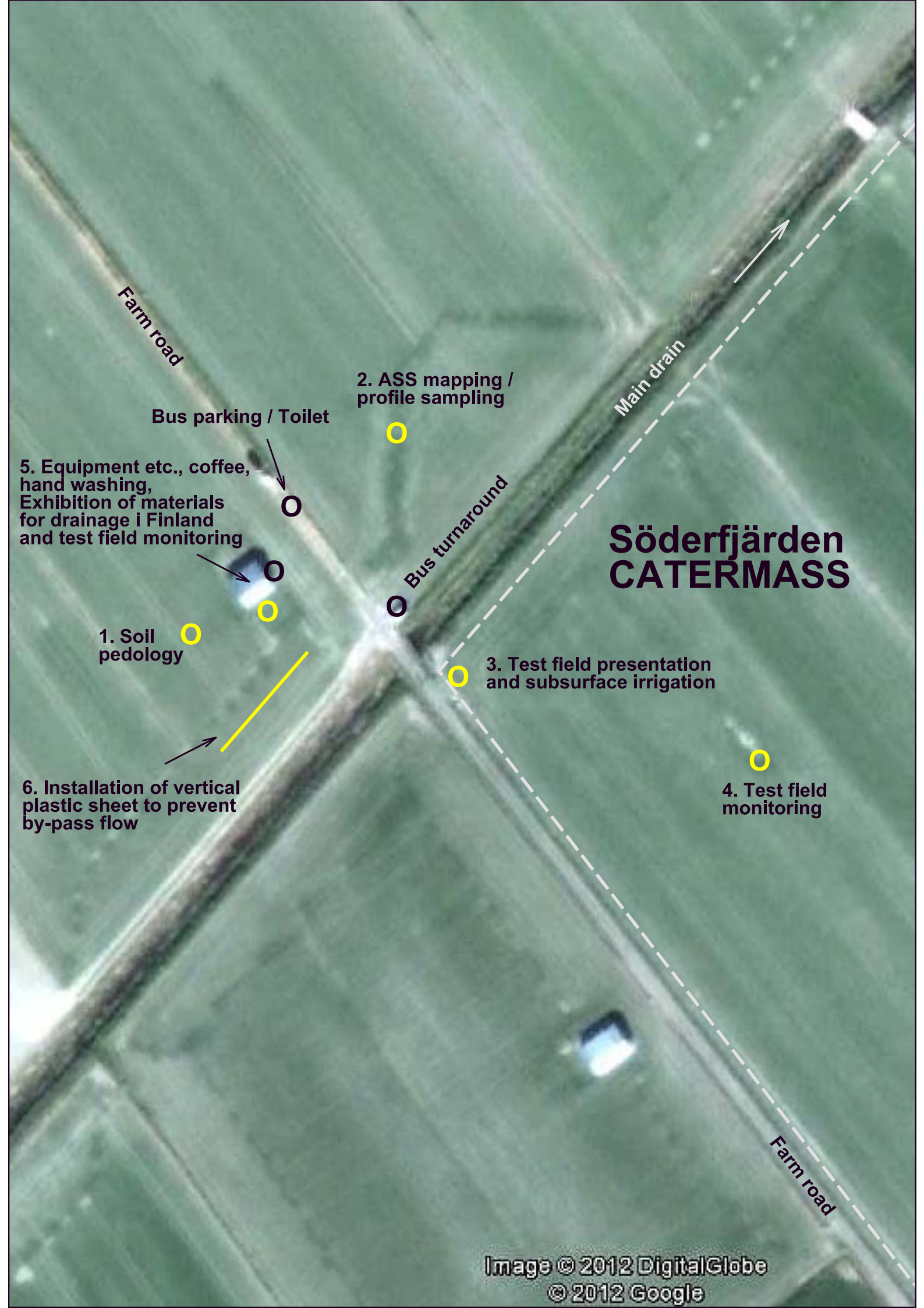


Fig. 1. Soil pH measured in the field at the intervals of 10 cm (-■-). Vertical lines indicate the pH measured in the laboratory from a composite sample of the respective horizon.

Fig. 2. The Söderfjärden soil on 6 October, 2008 (Photo: Johanna Laakso).


Farm road
2. ASS mapping / profile sampling
Bus parking / Toilet
Main drain
5. Equipment etc., coffee, hand washing, Exhibition of materials for drainage i Finland and test field monitoring
Bus turnaround
Söderfjärden CATERMASS
1. Soil pedology
3. Test field presentation and subsurface irrigation
6. Installation of vertical plastic sheet to prevent by-pass flow
4. Test field monitoring
Farm road
Image © 2012 DigitalGlobe
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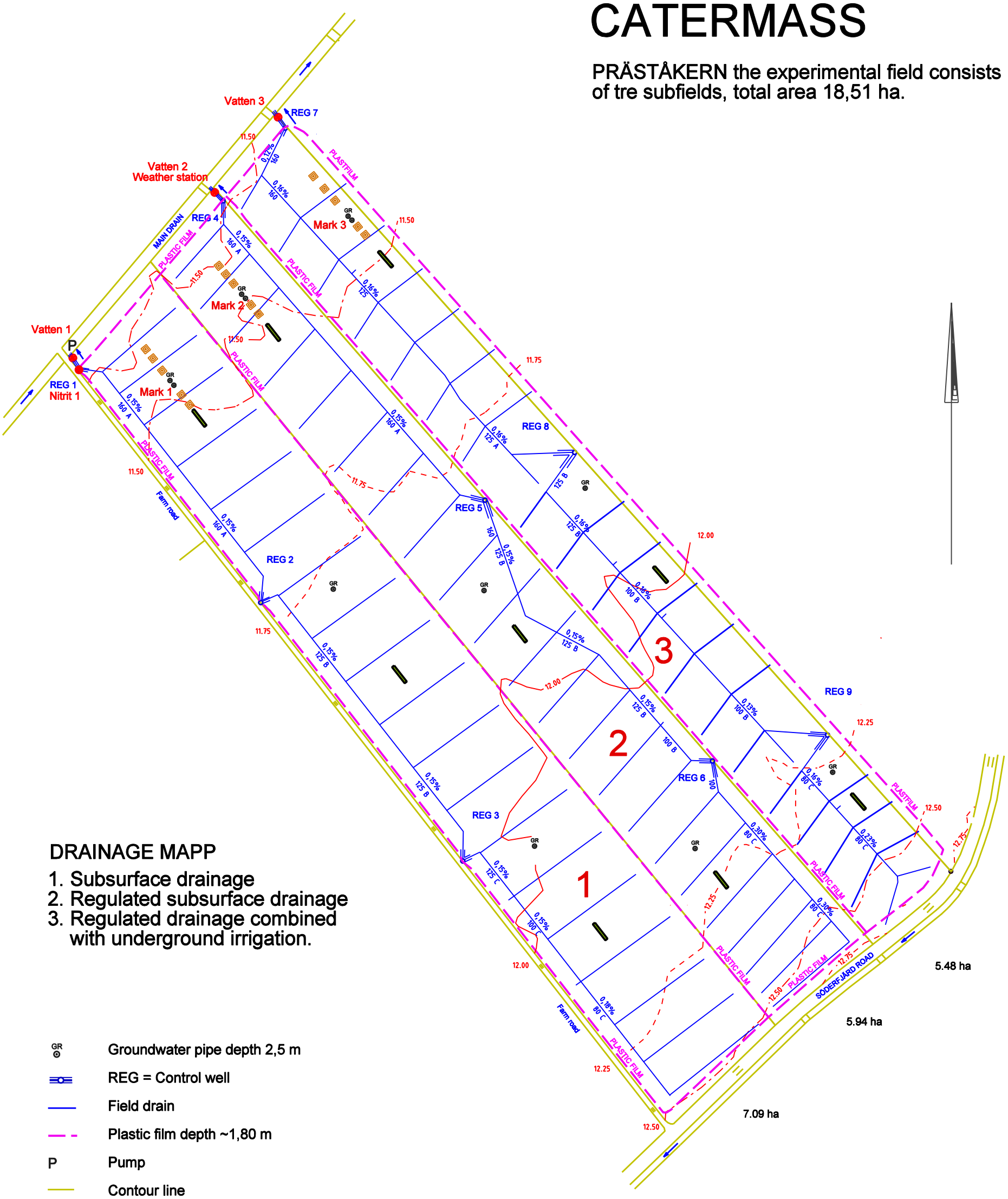
CATERMASS

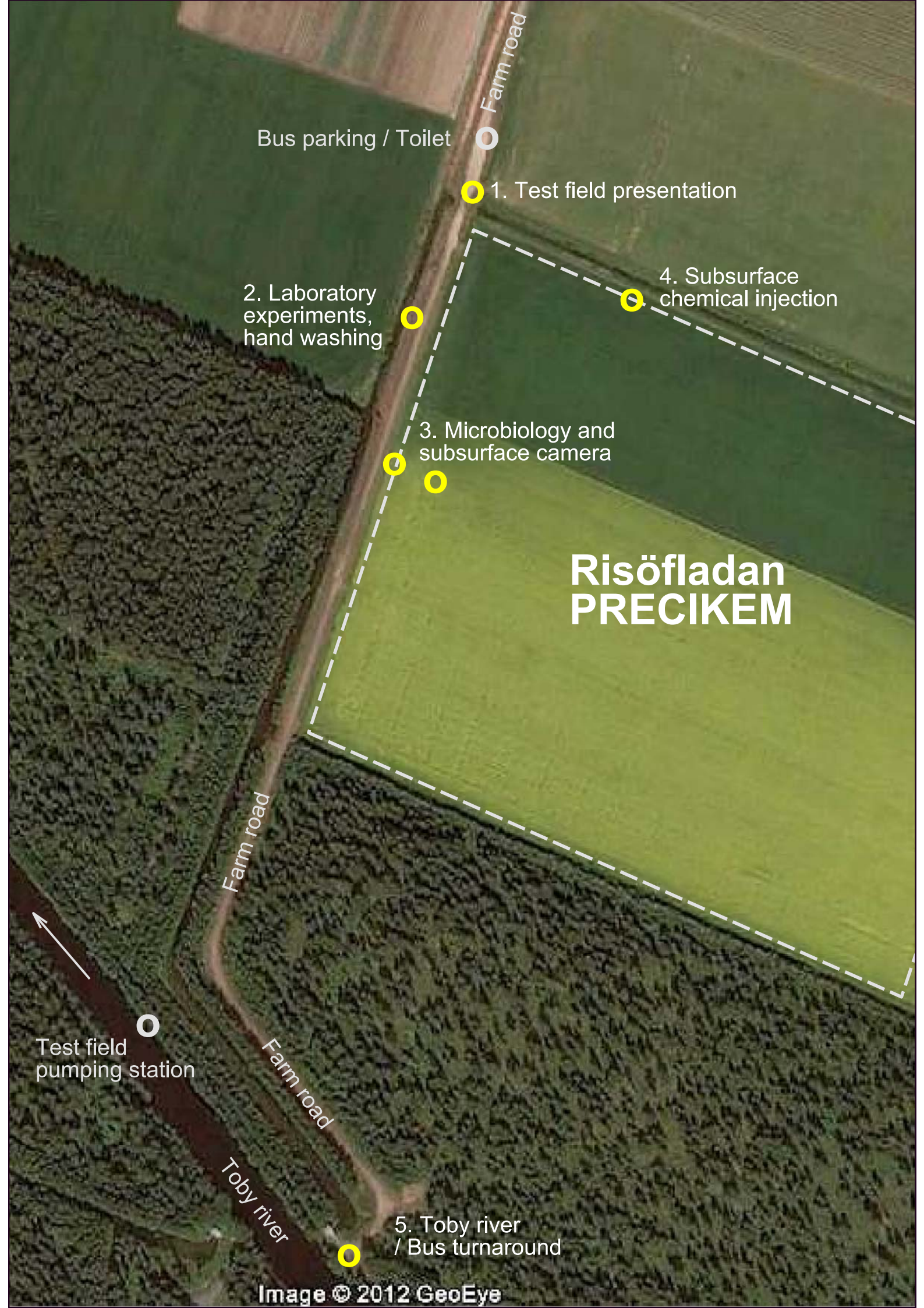
PRÄSTÅKERN the experimental field consists of tre subfields, total area 18,51 ha.

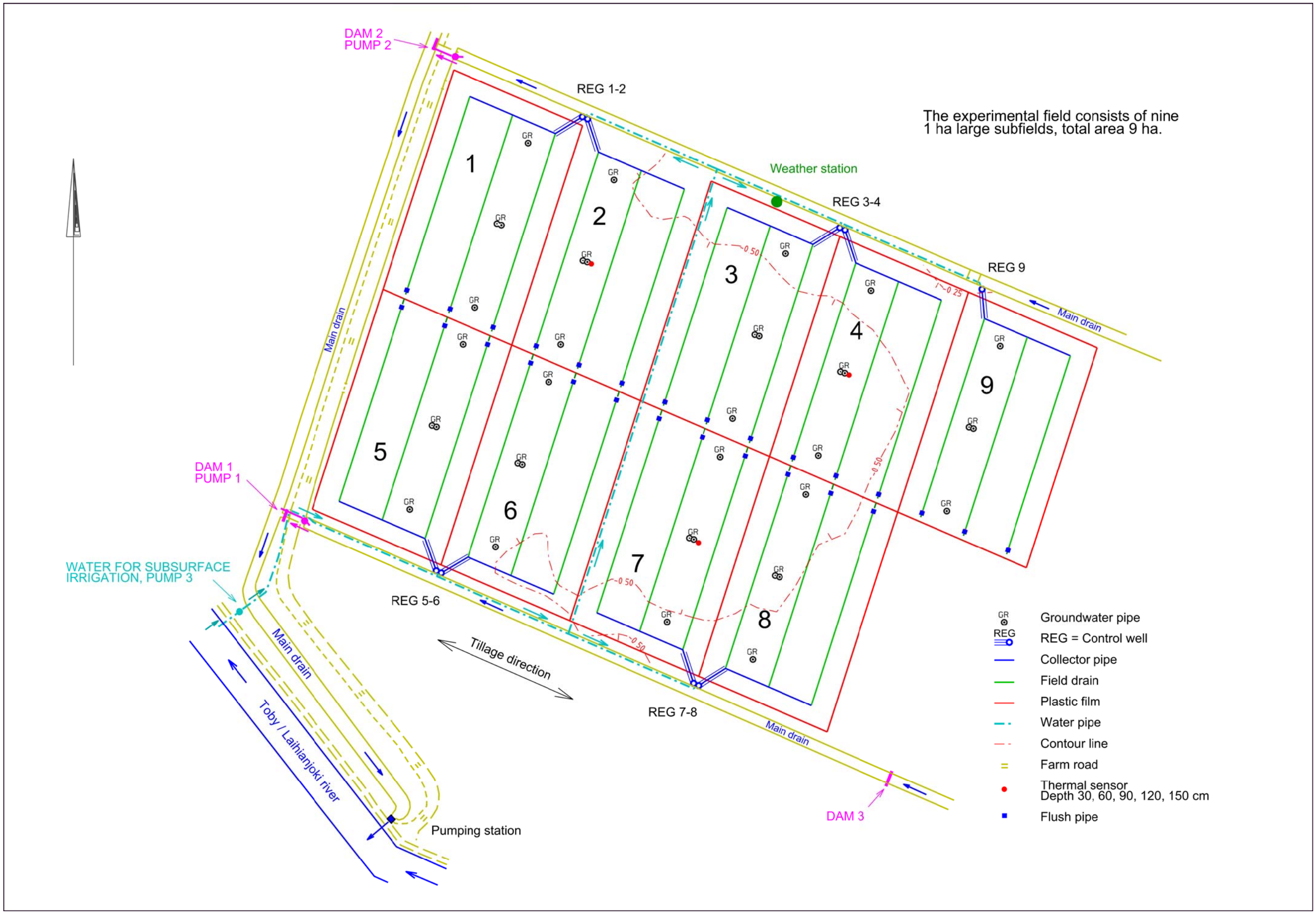


DRAINAGE MAPP

1. Subsurface drainage
2. Regulated subsurface drainage
3. Regulated drainage combined with underground irrigation.

GR	Groundwater pipe depth 2,5 m
	REG = Control well
	Field drain
	Plastic film depth ~1,80 m
P	Pump
	Contour line
	Farm road
	Measuring station for greenhose gas emissions and nutrient loses, depth 30, 50 and 70 cm
	Automatic measuring stations for out flow, pH and conductivity Vatten 1-3 Thermal and moistur sensor, depth 40 and 70 cm and ground water level Mark 1-3 Nitrit sensor, Nitrit 1
	Test area for crop


Farm road
Bus parking / Toilet
1. Test field presentation
2. Laboratory experiments, hand washing
4. Subsurface chemical injection
3. Microbiology and subsurface camera
Risöfladan
PRECIKEM
Farm road
Test field pumping station
Farm road
Toby river
5. Toby river / Bus turnaround
Image © 2012 GeoEye


DAM 2
PUMP 2
REG 1-2
The experimental field consists of nine
1 ha large subfields, total area 9 ha.
Weather station
REG 3-4
REG 9
Main drain
Main drain
1
2
3
4
5
6
7
8
9
GR
0 50
0 25
DAM 1
PUMP 1
WATER FOR SUBSURFACE
IRRIGATION, PUMP 3
REG 5-6
Tillage direction
REG 7-8
Main drain
Toby / Laihianjoki river
Pumping station
DAM 3
GR
Groundwater pipe
REG
REG = Control well
Collector pipe
Field drain
Plastic film
Water pipe
Contour line
Farm road
Thermal sensor
Depth 30, 60, 90, 120, 150 cm
Flush pipe

The Söderfjärden impact crater

Peter Edén, Geological Survey of Finland

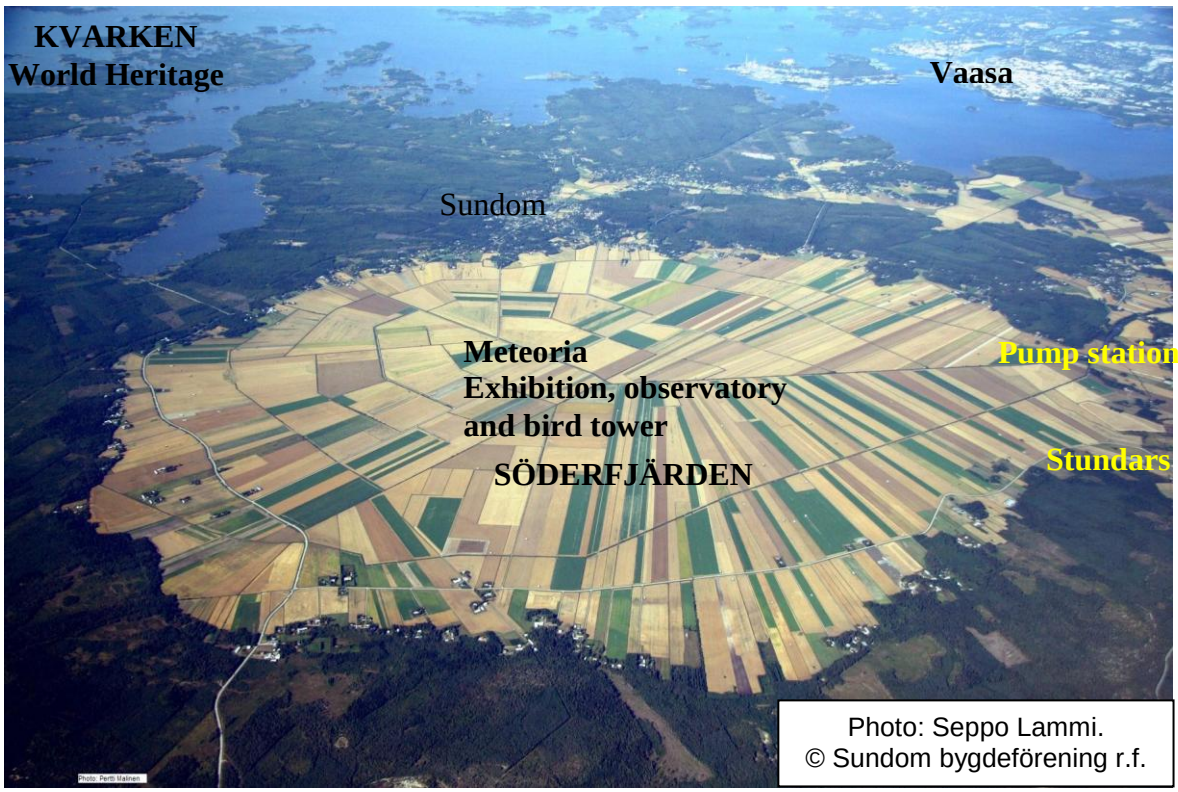
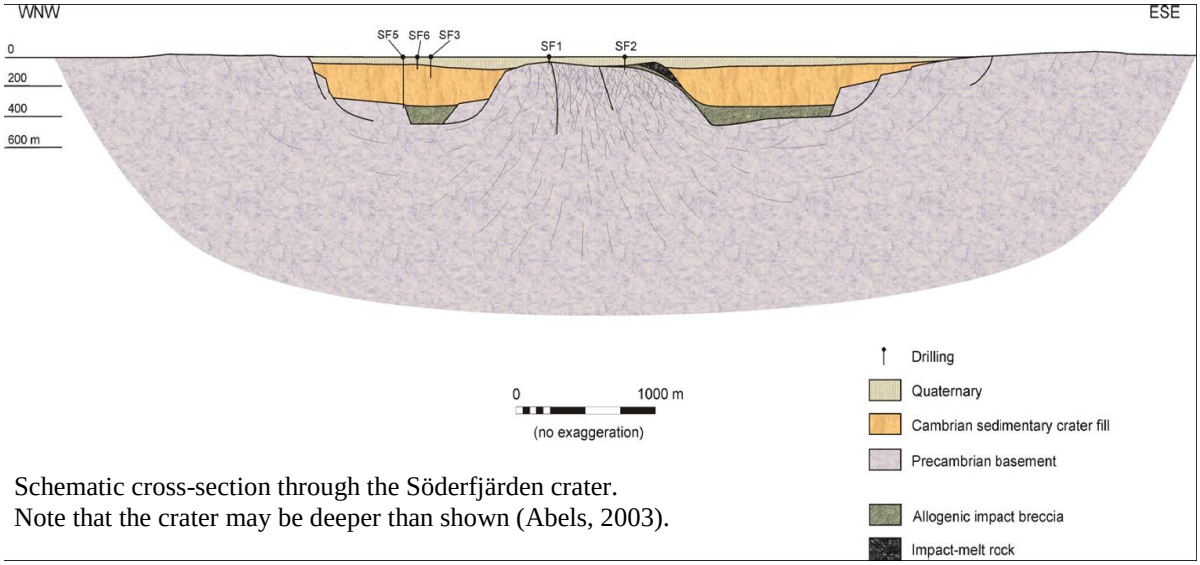


Photo: Seppo Lammi.
© Sundom bygdeförening r.f.

Söderfjärden is situated on the border between the city of Vaasa and the municipality of Korsholm. It is one of the best-preserved meteorite impact craters in the world and it is unique in many ways.

Söderfjärden – a unique place

More than 520 million years ago a great ball of fire from space hit the Earth south of the equator. Because of the enormous speed, 61,000 km/h, the collision was so violent, that the 300 m big meteorite made a crater 6 km wide and more than 300 m deep. Due to continental drift the crater has moved to its current position at 63°N.



Schematic cross-section through the Söderfjärden crater.
Note that the crater may be deeper than shown (Abels, 2003).

The crater was filled with sand and clay, which during millions of years compacted to sandstone and claystone, which also contain fossils. Above these layers there is 40-70 m of loose soil deposited during several Ice Ages. The uppermost layers consist of clay deposited during 10,000 years after the latest glaciation, when Söderfjärden was under water.

Ice Ages and land uplift, the first people

The continental ice had for tenths of thousands of years pressed down the crust of the Earth. When the ice melted about 10,000 years ago, the pressure lacked and the ground started to rise. Fast at first, but the speed has gradually decreased and is now ca 8 mm/year. Öjberget (50 m above sea level) rose from the sea 4600 years ago. During the Stone Age 4000 years ago fishermen had their camp on the slopes of Öjberget, and 2000 years ago men lived in cabins on a small island west of Sundom.

From fishing water to arable land, reclamation

Söderfjärden was fishing water until the 18th century, when the land uplift made fishing for a living impossible. At that time the outer parts of the plain was already used for farming. Digging of the Knight's Ditch (Riddardiket), which today drains most of Söderfjärden, started as early as 1821, but not until the 1920's was this, the largest reclamation project in Northern Europe, finished. Twenty-five km of channels and ditches were dug by hand. The pump station started 1926 and 1400 hectares of new land was soon dried, and after that Söderfjärden consists of 2300 hectares of fertile arable land. A new pump station was built in 1964 and it is still in use, because one tenth of Söderfjärden is below sea level.

The new (red, 1964) and old (white, 1926) pumpstation on Söderfjärden. Photo: Peter Edén.

Cranes – Natura 2000 – National landscape

Söderfjärden is the most important resting place in Finland for cranes. Thousands of cranes stop here every fall, at most more than 7000 at the same time. Thanks to the cranes and other birds Söderfjärden is a Natura 2000 –area. Also in the spring lots of geese, swans and cranes visit the crater. Söderfjärden and adjacent parts of the villages (Sundom, Solf and Munsmo) is a landscape area of national interest.

Thousands of cranes coming in to Söderfjärden at dawn every morning.
Photo: Seppo Lammi. © Sundom bygdeförening r.f.

Worth seeing

- A nature trail and a watchtower on **Öjberget**
- In the **pump station** there is a reclamation museum and art telling the story of Söderfjärden.
- **Stundars** is a living open-air museum and cultural centre close to the crater. A cultural trail via Söderfjärden starts from Stundars.
- **The Meteoria.** An old barn has been moved to Söderfjärden and contains today an **exhibition about Söderfjärden, an astronomical observatory and a bird tower**.