

## Approval of the Iveland Hydropower Plant, Norway

Decision of 1 February 2018

### The hydropower plant

- Name: *Iveland*
- Owner and contact information: *Agder Energi, Postboks 603 Lundsiden, 4606 Kristiansand (<https://www.ae.no/>)*
- Year of construction: *unit 1: 1949 unit 2: 2016*
- Fall height and tunnel length: *50 m fall height, tunnel length 2600m*
- Annual electricity production (on average): *500 GWh*
- Turbine type: *four Francis turbines*

Iveland is a set of two power plants located in Iveland municipally in Aust-Agder, Southern Norway utilising the fall of 50 meters between Gåseflåfjorden reservoir and the village of Skaiå. Iveland consists of two units (Iveland 1 and 2) that can be operated independently or simultaneously. Iveland 1 has three Francis turbines that were installed in 1949, 1950 and 1955, whereas Iveland 2 has one Francis turbine that was installed in 2016.

Iveland 2 was built as an upgrade and improvement of Iveland 1 to increase the efficiency of the power production from the Gåseflåfjorden reservoir. Iveland 2 utilises the same tunnels and infrastructure as Iveland 1, but also produces electricity from a small turbine that was installed at Gåseflå dam to utilise the height of the dam. Due to the installation of this turbine there is now continuous flow in the river Otra downstream from the dam (upstream from the power plant and the main tunnel outflows), with a minimum continuous flow of 2 m<sup>3</sup>/s in winter and 3 m<sup>3</sup>/s in summer. This improves the ecological conditions in the river Otra downstream from the Gåseflå dam. The average water flow in this area of river Otra is 130 m<sup>3</sup>/s.

### The Otra river

The Otra is 245 kilometres long, making it Norway's eighth longest river. It flows from the mountains in Bykle municipally in the north, down to the municipality of Kristiansand in the south, where it flows into the Skagerrak strait. There are many large lakes/reservoirs along the Otra river system and 12 hydroelectric power plants, providing electricity for much of the Southern Norway.

In addition, the amount of hydropower installations on the river Otra also act as flood defence systems, with the energy producers actively lowering reservoir water levels if heavy rainfall is expected and directing flow through hydropower tunnels to increase the water holding capacity of the whole river system.

### Fish

- Have migratory fish moved upstream before the power plant was built: *No, natural obstacle downstream from the plant*
- Is there a fish pass or other solution to safeguard the migration of fish upstream and downstream: *No fish pass (reservoir-type hydropower plant), but has continuous minimum flow from the dam to safeguard aquatic organisms.*

Even though Otra river is a popular salmon fishing river with angling and fly-fishing enthusiasts, fish from the sea can only migrate upstream as far as Vigeland (Vikeland) where there is a natural migration stop due to a waterfall. In addition to the natural obstacle (and the hydropower plant that is located there) there are three other hydropower stations downstream from Iveland, none of which have any fish passes installed, therefore the fish migration up and down the Otra river is limited by many factors.

The local population of Atlantic salmon was all but extinct between 1950s-1990s due to local industrial pollution and long transported acid rain in the river Otra, with genetic studies on the current Otra salmon stocks indicating that these salmon originated from other populations in the neighbouring rivers. As the biochemical conditions in the river have improved, the salmon numbers in river Otra are on the rise, with the annual catch volume increasing.

Apart from salmon populations far downstream from the Iveland hydropower plant, there are small, but established populations of freshwater fish species (such as perch and brown trout) in the Gåseflåfjorden reservoir upstream and the Nomelandsdammen reservoir just downstream the Iveland plant, as reported in a survey in the 2006 (see below).

### **Mitigating measures**

- Are there measures identified to minimise the impact of this power plant? *A report carried out before the Iveland 2 development indicated one measure, that has been implemented already.*

As a part of the Iveland 2 development, before any building commenced, a fish biodiversity study was conducted by researchers from the University of Bergen in 2006. The aim of this survey was three-fold: to assess the fish population in the Iveland impact area, to assess potential impacts of Iveland 2 development on the fish populations, and to indicate any mitigating measures that should be considered to strengthen the fish stocks. Overall it was concluded that the upgrade and expansion of Iveland power plant would have a minor effect on the fish stocks in the impact area. The main mitigating measure suggested in this study was the request for continuous minimal flow from the dam, which is now established. Other measures for fish recruitment (eg establishment of brown trout spawning areas) were deemed cost-inefficient, as the fish stocks were low.

### **Conclusion**

The demand for EKOenergy certified hydropower in Norway is always increasing so the Secretariat is actively researching power plants suitable for approval. Agder Energi suggested Iveland 1 and 2 as potential EKOenergy power plants based on our current criteria and have been very forthcoming during this research process – answering our questions and forwarding us all the relevant reports and permits (for example the legal concessions for Iveland 1 and 2, and the biodiversity assessment survey from University of Bergen. Copies of these can be presented if needed). This is the type of relationship with the energy producers that EKOenergy likes to encourage.

### **Decision**

EKOenergy allows that the electricity from the Iveland hydropower plant can be sold as EKOenergy (by licensees of EKOenergy). The decision is valid until 30 January 2023.

### **References**

<http://www.xn--miljodirektoratet-oxb.no/no/Nyheter/Nyheter/Nyhetsarkiv/2008/2/Mindre-forurensning-og-mer-laks-i-Otra/> (A study on salmon ecology in river Otra, in Norwegian)

[http://uni.no/media/manual\\_upload/LFI\\_141.pdf](http://uni.no/media/manual_upload/LFI_141.pdf) (the fish biodiversity assessment report from the University of Bergen. In Norwegian)

<https://www.ae.no/virksomhet/vannkraft/kraftstasjoner/iveland-kraftstasjon/>

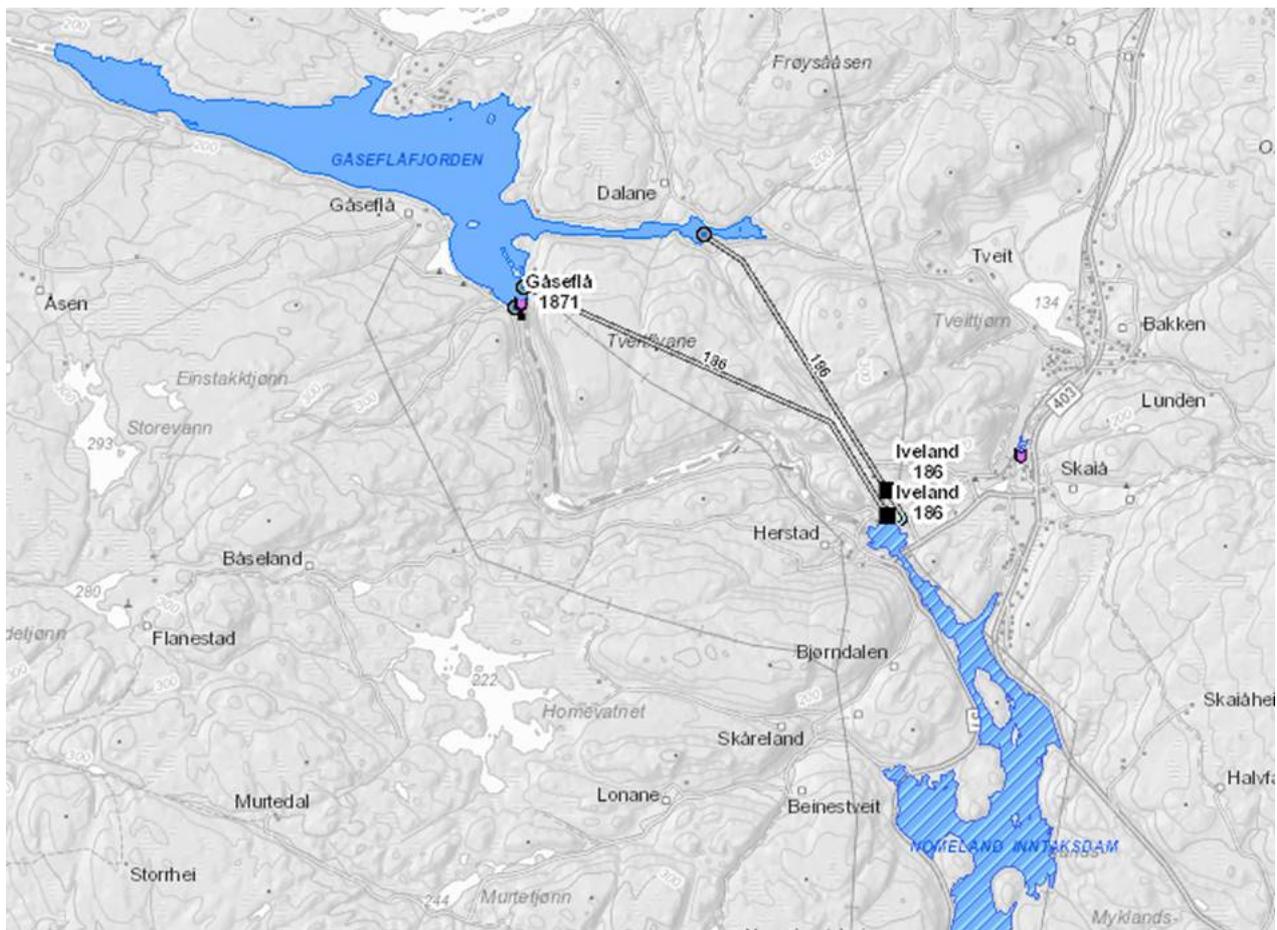
<http://www.sweco.no/en/projects/iveland-2/>

<https://www.energinorge.no/fagomrader/energibruk-og-klima/nyheter/2017/agder-energi-begrenset-flomskadene-pa-sorlandet/> (news item on the flooding in Otra river. In Norwegian)

## ANNEXES



**Figure 1.** River Otra, with annotations for the Gåseflå dam and Iveland power plant. Black arrows indicate the direction of the river flow. Taken from Google Maps, with annotations from the author.



**Figure 2.** Iveland 1 and 2 power plants with the solid lines illustrating the water tunnels. Solid blue colour is the intake reservoir (Gåseflåfjorden), dashed blue colour is the outflow reservoir (Nomelandsdammen), black dashed line is the course of the Oтра river from Gåseflå dam. Figure provided by Agder Energi.