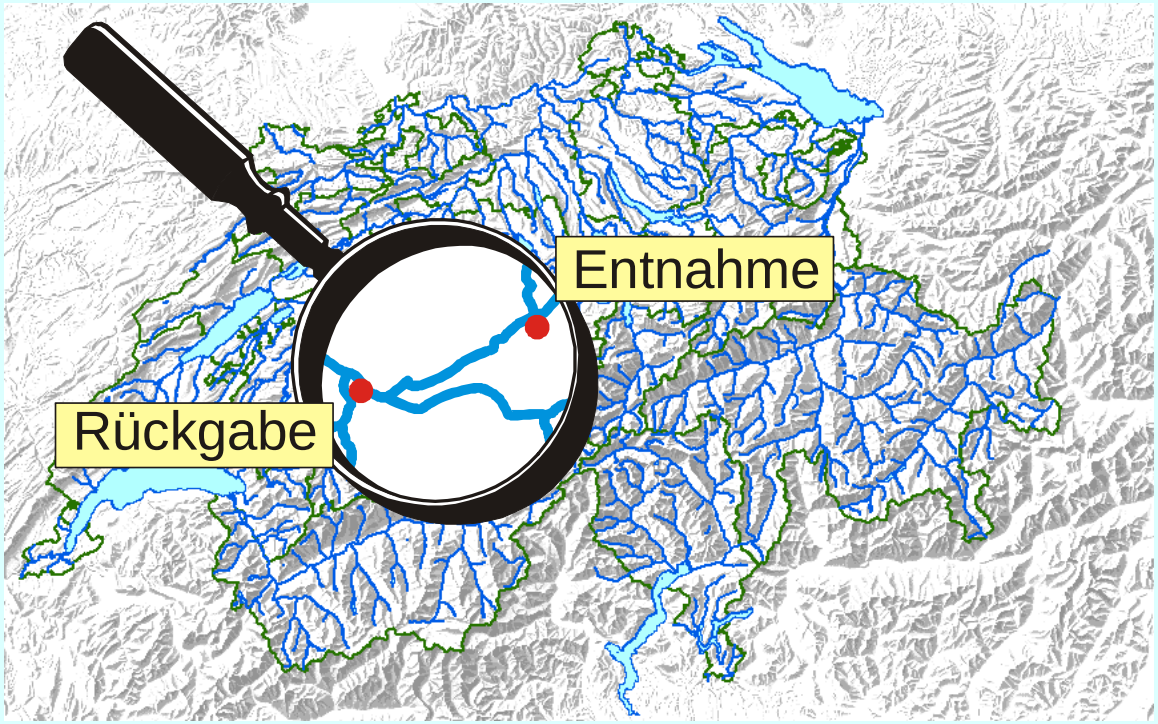
GIS-based Identification of Potential Sites for Small Hydro Power Plants



Yvo Weidmann, Geomatic and Software Engineer

WaterGisWeb AG
Donnerbühlweg 41
CH-3012 Bern

Tel. 031 / 305 18 11
Fax 031 305 18 14

www.watergisweb.ch
office@watergisweb.ch

Objectives, Clients

Depending on the client, the objectives may be different.

investor

- Evaluation of potential sites for small hydro power plants
- Report of possible capacity
- Identification of interesting areas for new power plants

public authorities

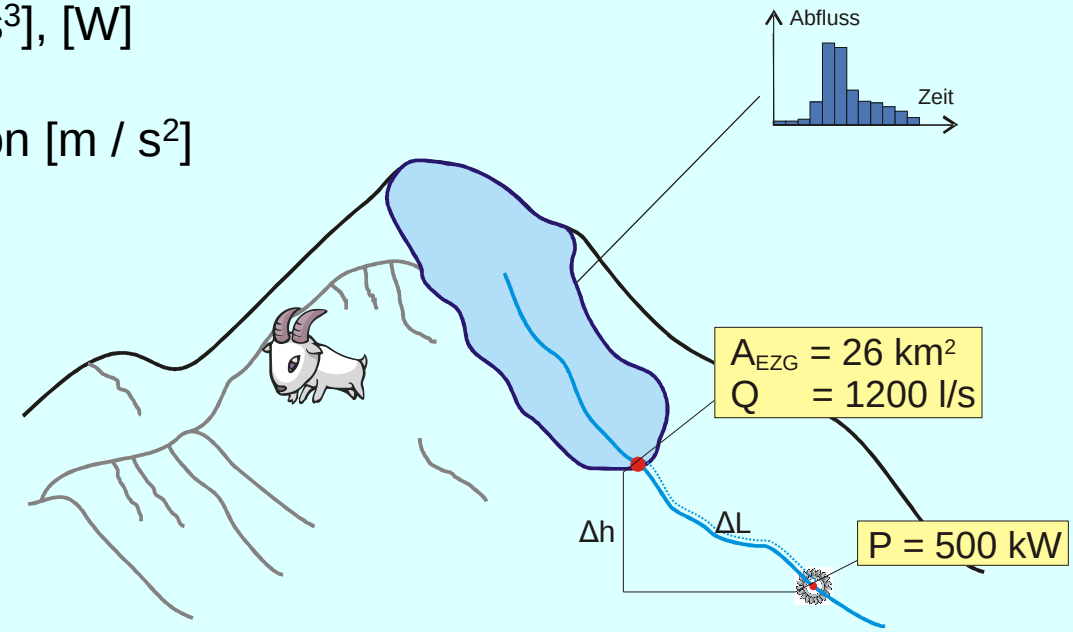
- Base information for political decision makers
- Tool for approval process
- Overview of potential hydro power

Background

The hydroelectrically potential of a stream is defined through the runoff and the head.

$$P = \rho \cdot g \cdot Q \cdot \Delta h \cdot \eta$$

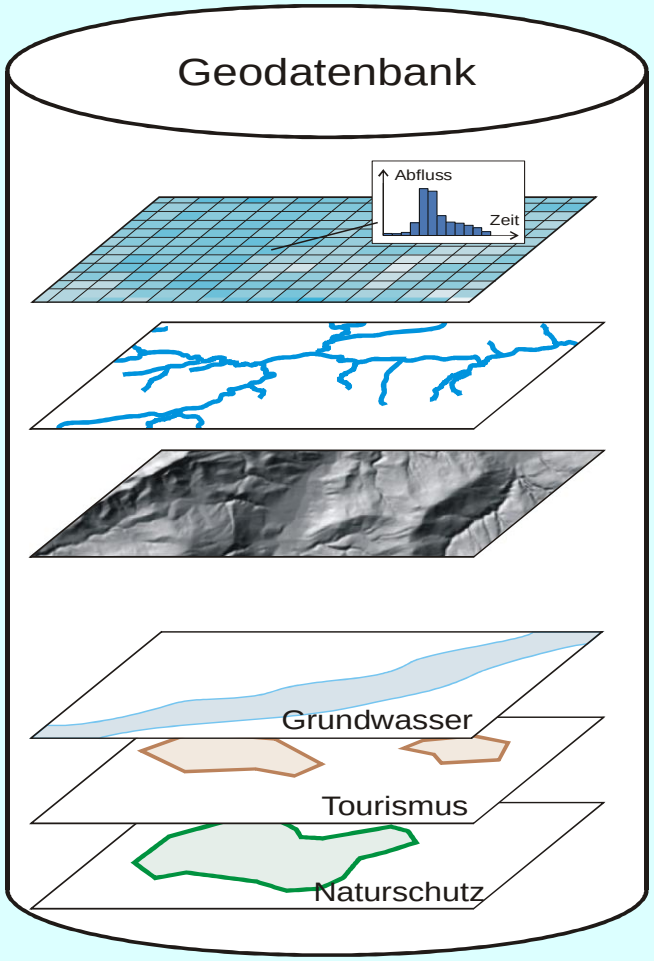
P	Rated power [kg · m^2 / s^3], [W]
ρ	Density [kg / m^3]
g	Gravitational acceleration [m / s^2]
Q	Runoff [m^3 / s]
Δh	Head [m]
η	Efficiency



Geographical data

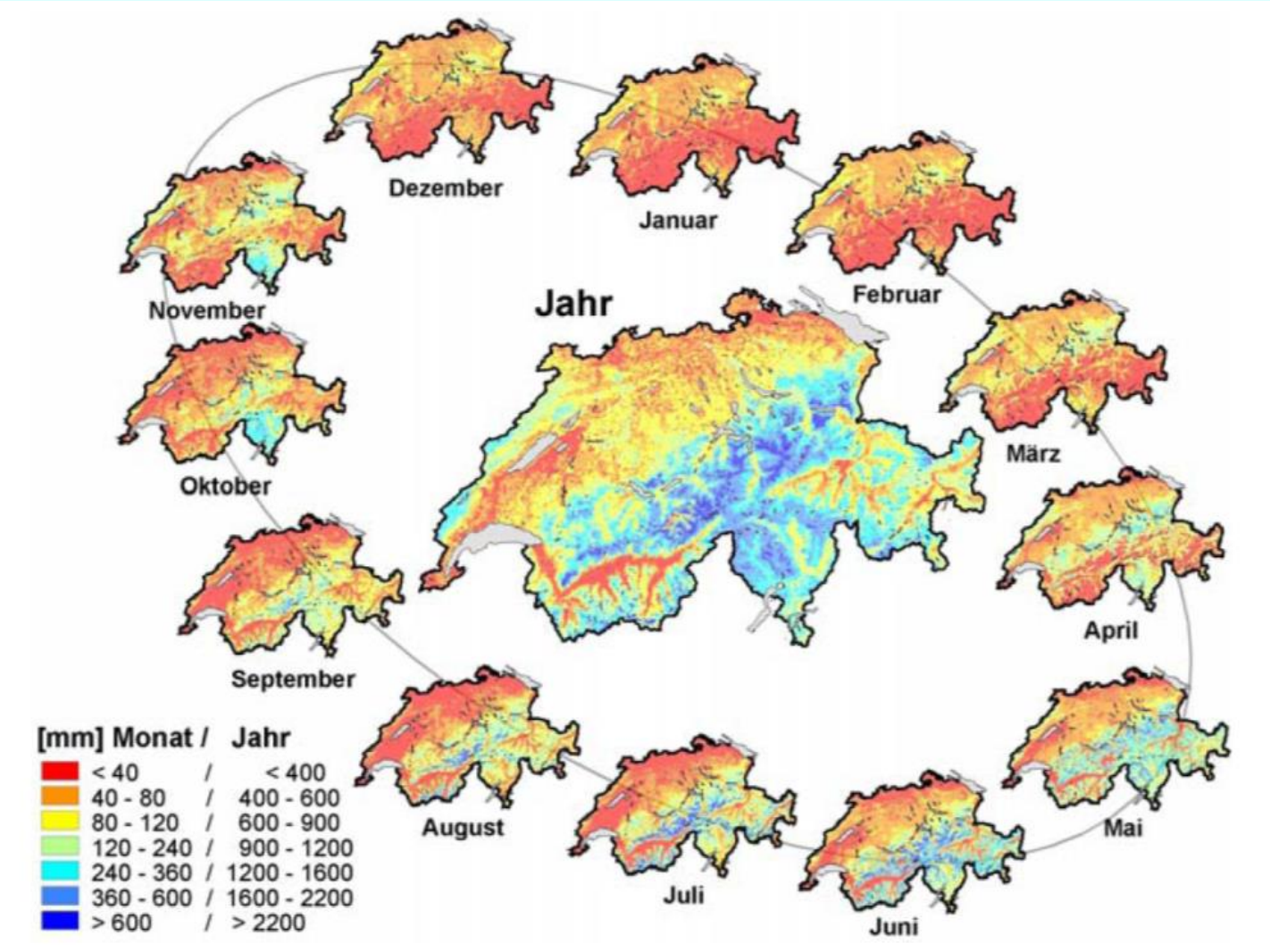
The used geographical data are available and can be retrieved from the government

- Mean monthly runoff
- Digital stream network
- Digital terrain model
- Additional factors
  (national parks, natural resorts, groundwater bodies, avalanches, …)
- Existing hydropower plants



Mean monthly runoff

Nationwide information on mean annual and mean monthly runoff.

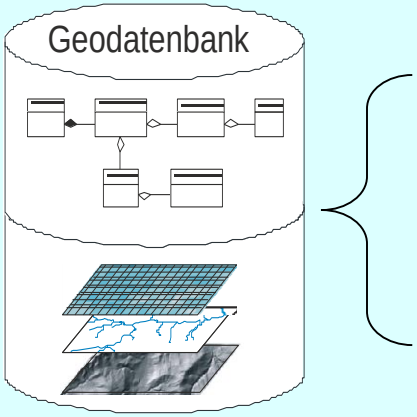


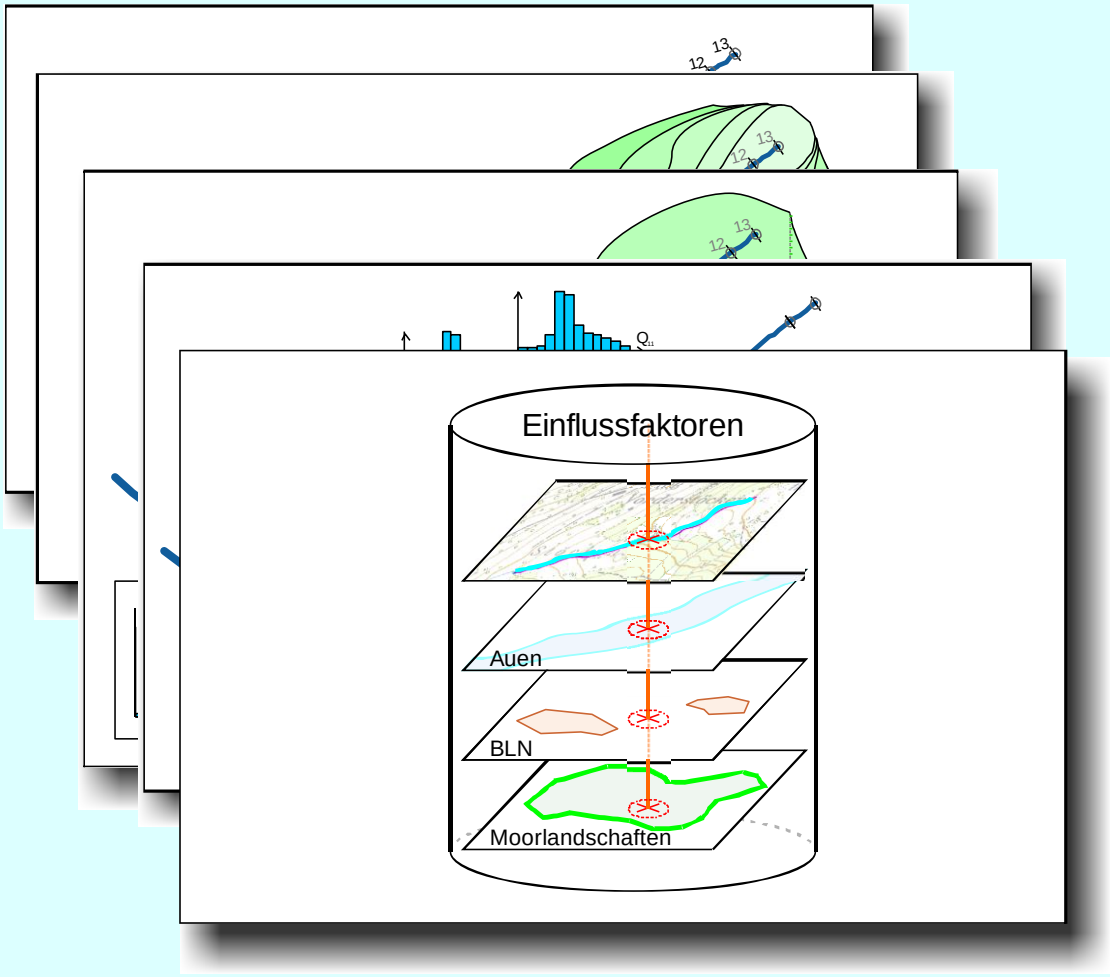
Source: BAFU und WSL, 2006: Rasterdatensatz mittlere Abflüsse der Schweiz für die Periode 1981-2000

Approach

Calculation of geographical and hydrological variables for discrete points along the streams

- Definition of discrete points along all streams (every 50m)
- Calculation of watershed
- Calculation of runoff
- Identify additional properties of the sites
- Storing of the information



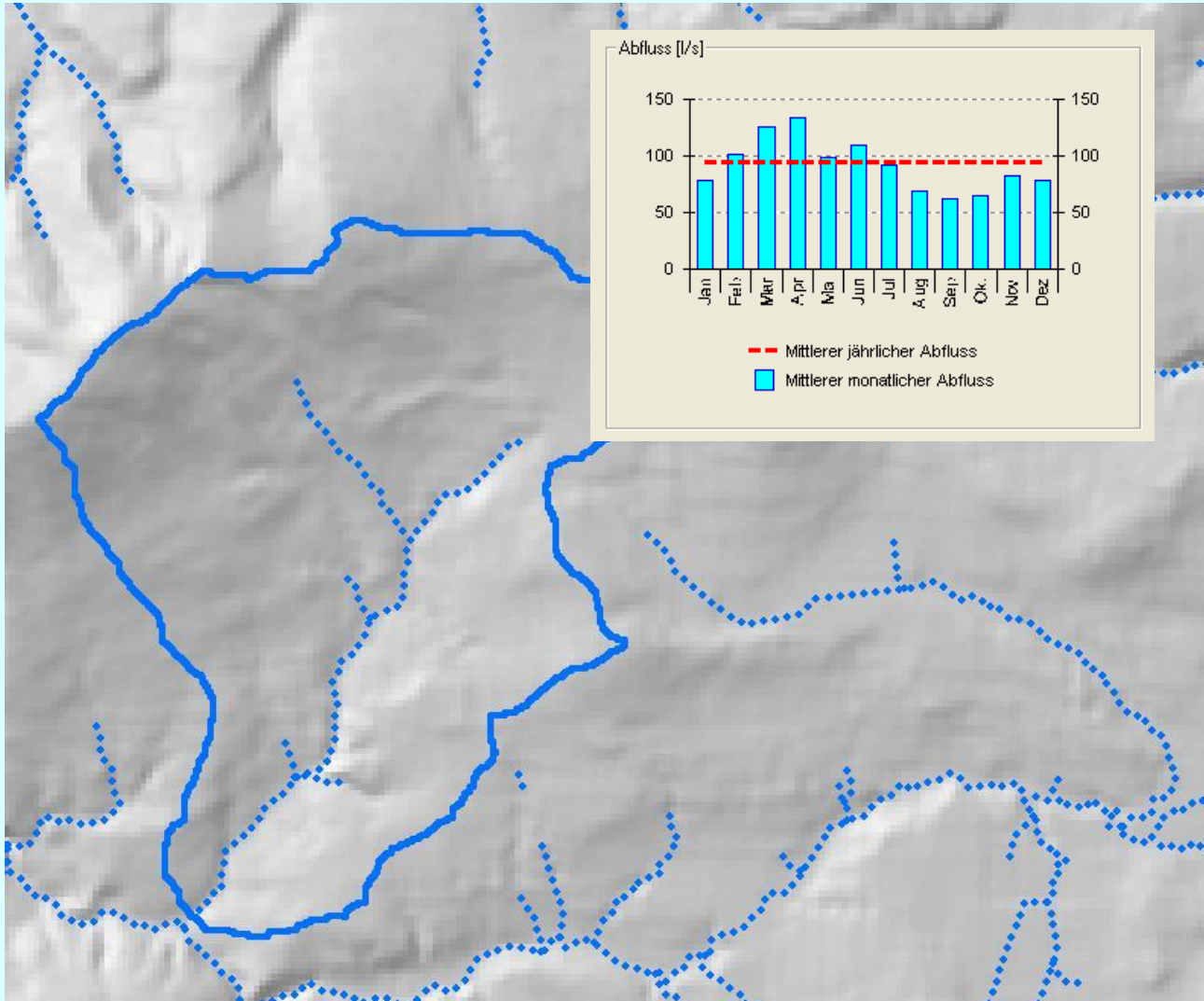


Watershed and runoff

For each single point along the streams the watershed and the monthly and yearly runoff will be calculated.

Calculation of watershed for every single point

Calculation of monthly and yearly runoff

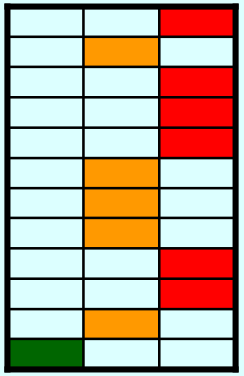


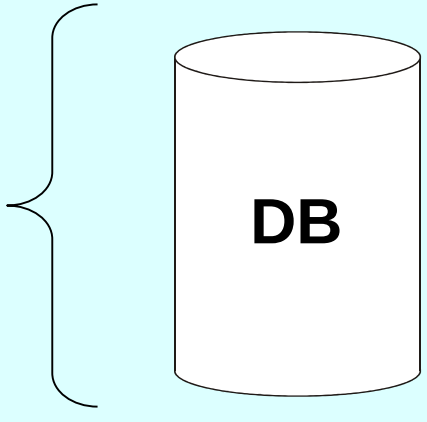
Additional factors

Identifying of additional factors on each single point along the stream trough spatial analysis.

Definition of three classes:

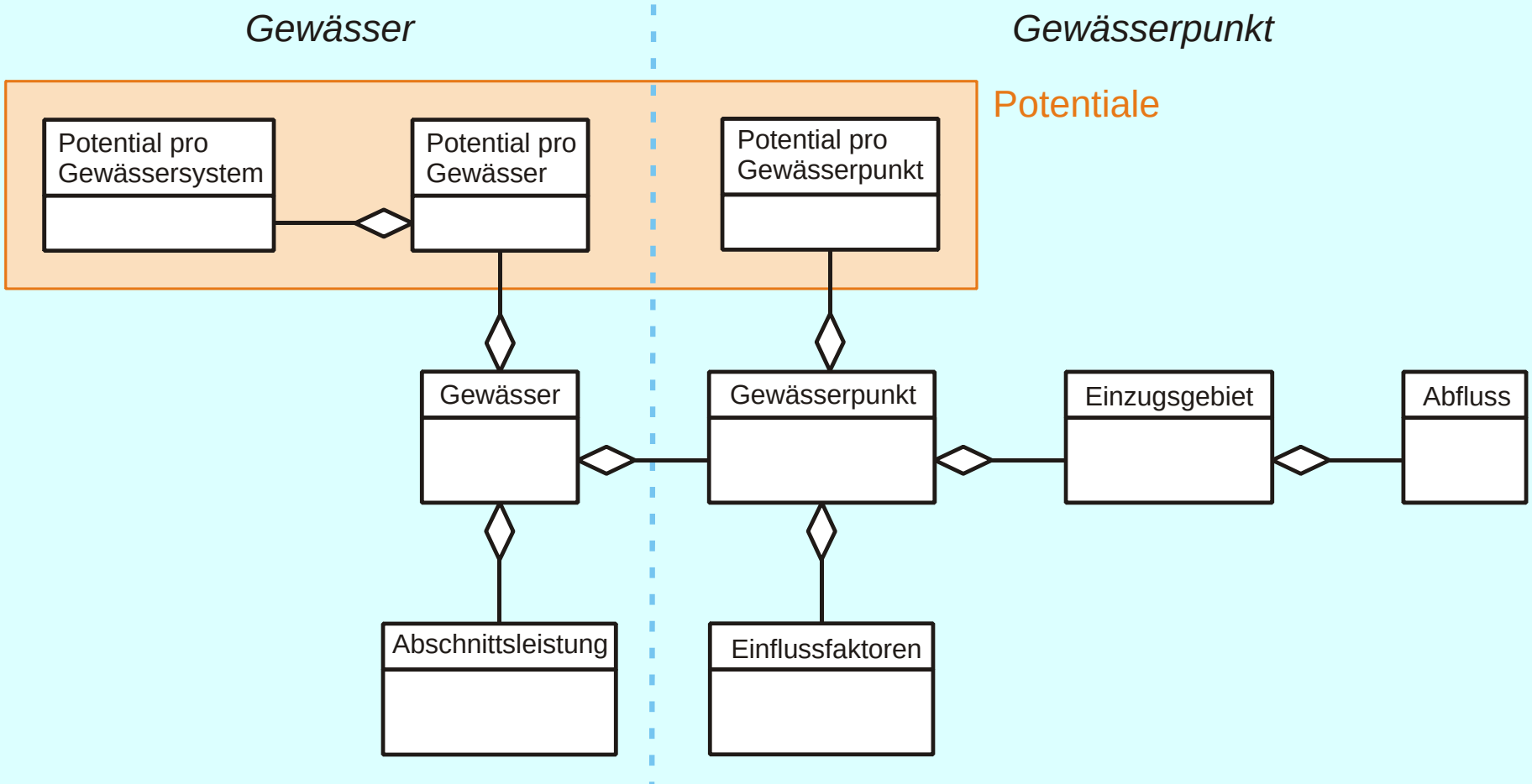
- **Influencing factors**
- **Kill factors**
- **Existing hydropower plants**





Database

All results are stored within a relational database system and are available for further investigations.



Result for public authorities

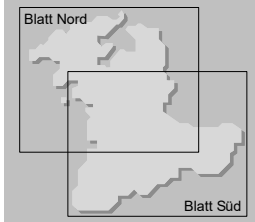
Overview 1:100 000

Blatt Süd

Wasserkraft-
Potenzialstudie
Kanton Bern

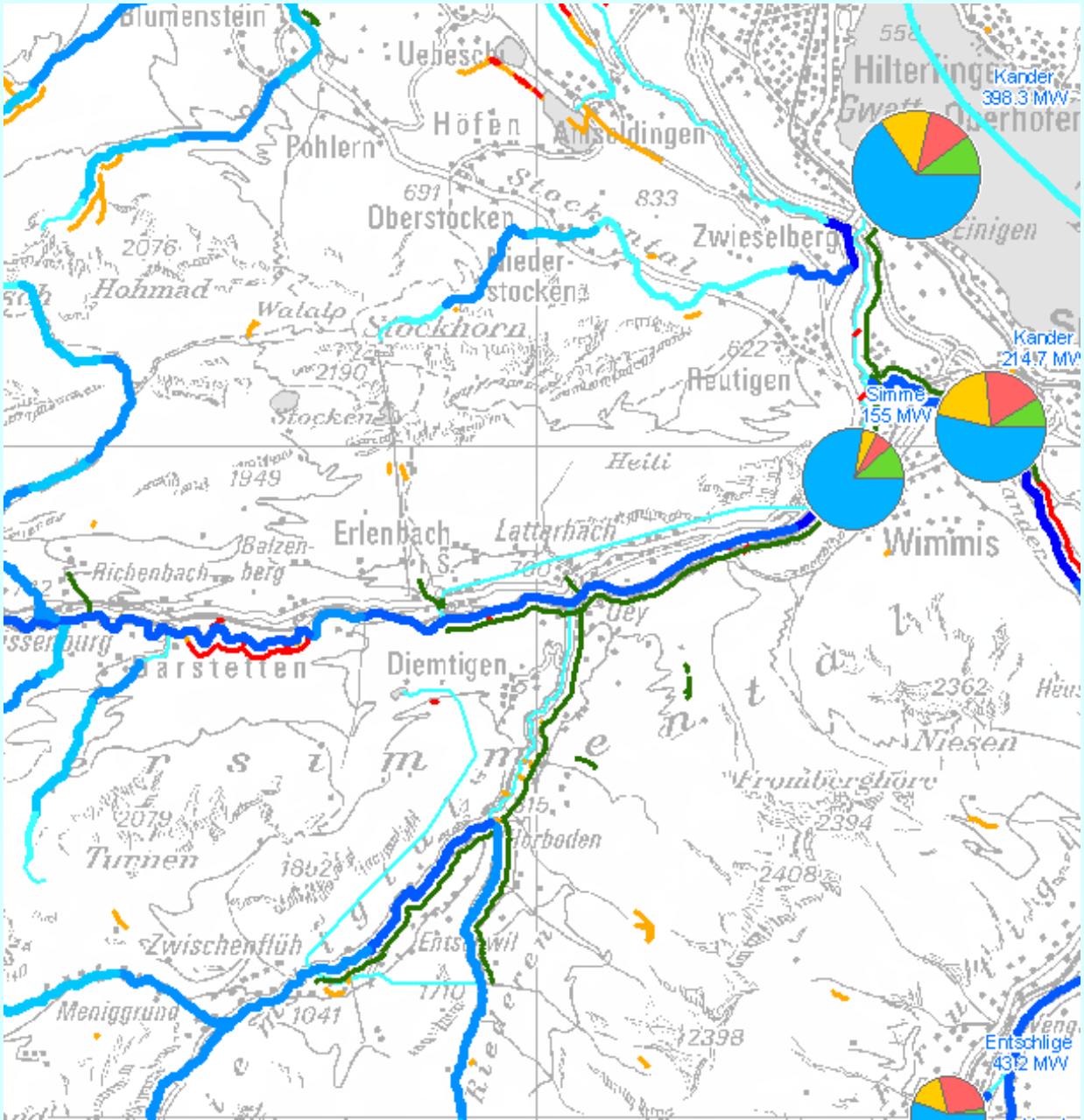
1:100 000

Ausgabe 2009



AWA
Amt für Wasser und Abfall

Bau-, Verkehrs- und
Energiedirektion
des Kantons Bern



Result for investors

Calculation of possible sites for small hydropower plants with arbitrary capacity:

- 0.5 MW, 1.0 MW, 2.0 MW

Consideration of technical, ecological and economical limitations:

- Efficiency ($\eta = 0.7$)
- Volume of water during certain period (Q_{120})
- Maximum length of pipe (depending on capacity)
- Sensitivity on change in runoff ($Q_{120} \pm 20\%$)

Presentation of the results:

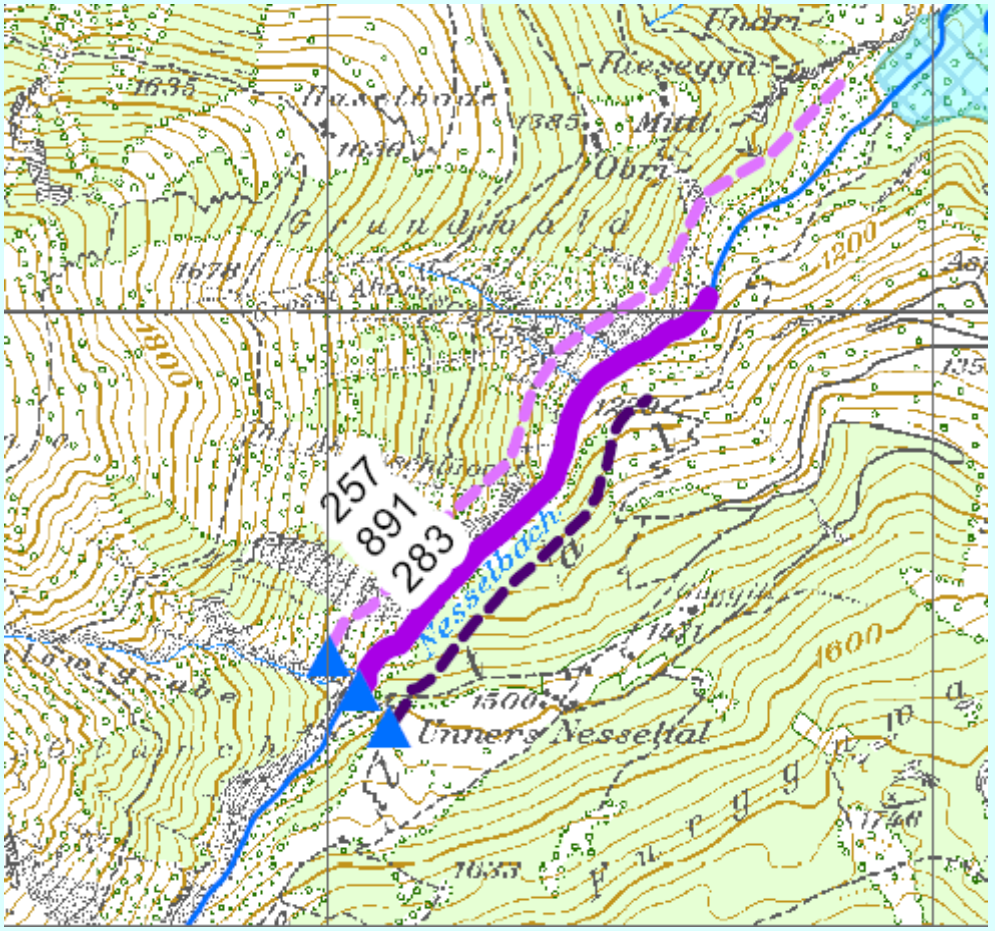
- Maps of possible sites1:25 000
- GoogleEarth

Sensitivity of possible sites

With the consideration of the variability (Q_{120} ± 20%) of the runoff the robustness of a site can be estimated.

Site detected with:

- **Q_{120} + 20%**
- **Q_{120}**
- **Q_{120} - 20%**



Conclusion

- Very detailed information covering of a whole area
- Data for further analysis
- Problem-oriented presentation of the results

- Elaboration of methodology with investors and public authorities
- Widely applied methodology
- Quality inspection of the results in the field

The methodology and the implementation was be awarded with the *Swiss Mountain Water Award 2008*

Thank you very much for your attention

Swiss Mountain Water Award 2008

Ein Wettbewerb zur Umsetzung von innovativen Wasserprojekten im Schweizer Berggebiet

GEWINNERZERTIFIKAT

Der Swiss Mountain Water Award, verliehen vom Netzwerk Wasser im Berggebiet, im Wert von 60'000.- geht an das Projekt

Flächendeckende GIS-gestütze Identifikation potentieller Standorte für Kleinwasserkraftwerke

Das Projekt wurde eingereicht durch **WaterGisWeb AG**

Landquart, 20. August 2008,
Pankraz Freitag,
Ständeratspräsident des Kantons Glarus und Präsident der Jury

...herzliche Gratulation!

sam creating sustainable value

POWER SYSTEMS Hydro | ALSTOM

NWB Netzwerk Wasser im Berggebiet