



Qualitative Water Shortage in the North of Lower Saxony: Solutions for the Antifreeze Irrigation

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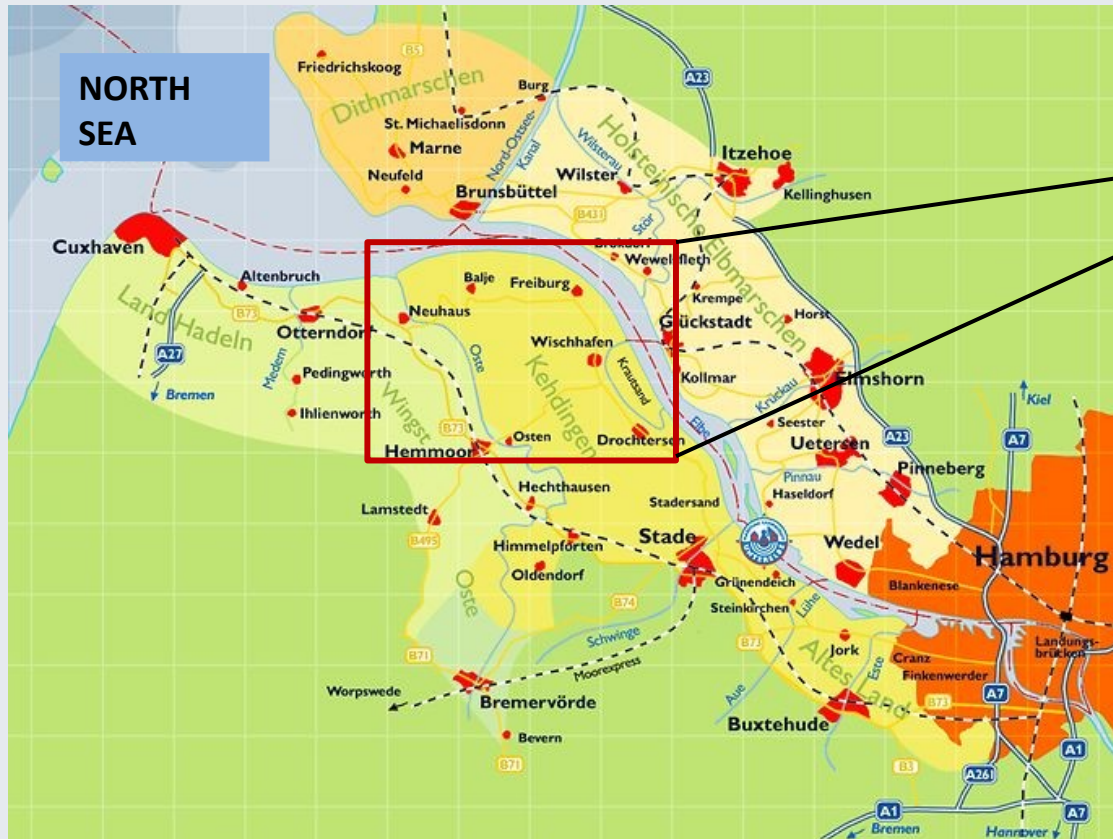
- in 2015 in Lower Saxony (Germany) approx. 18,000 ha of vegetables were cultivated
- antifreeze irrigation serves the protection of plants from freeze to death during the flowering period
- common practice in the north of Lower Saxony to avoid future crop failures
- investigation area is called Altes Land, where up to 1,000m³ water per night and ha are needed for the antifreeze irrigation
- usable fresh water must have a quality of no more than 0.2 to 0.3 ‰ salt content

Antifreeze Irrigation

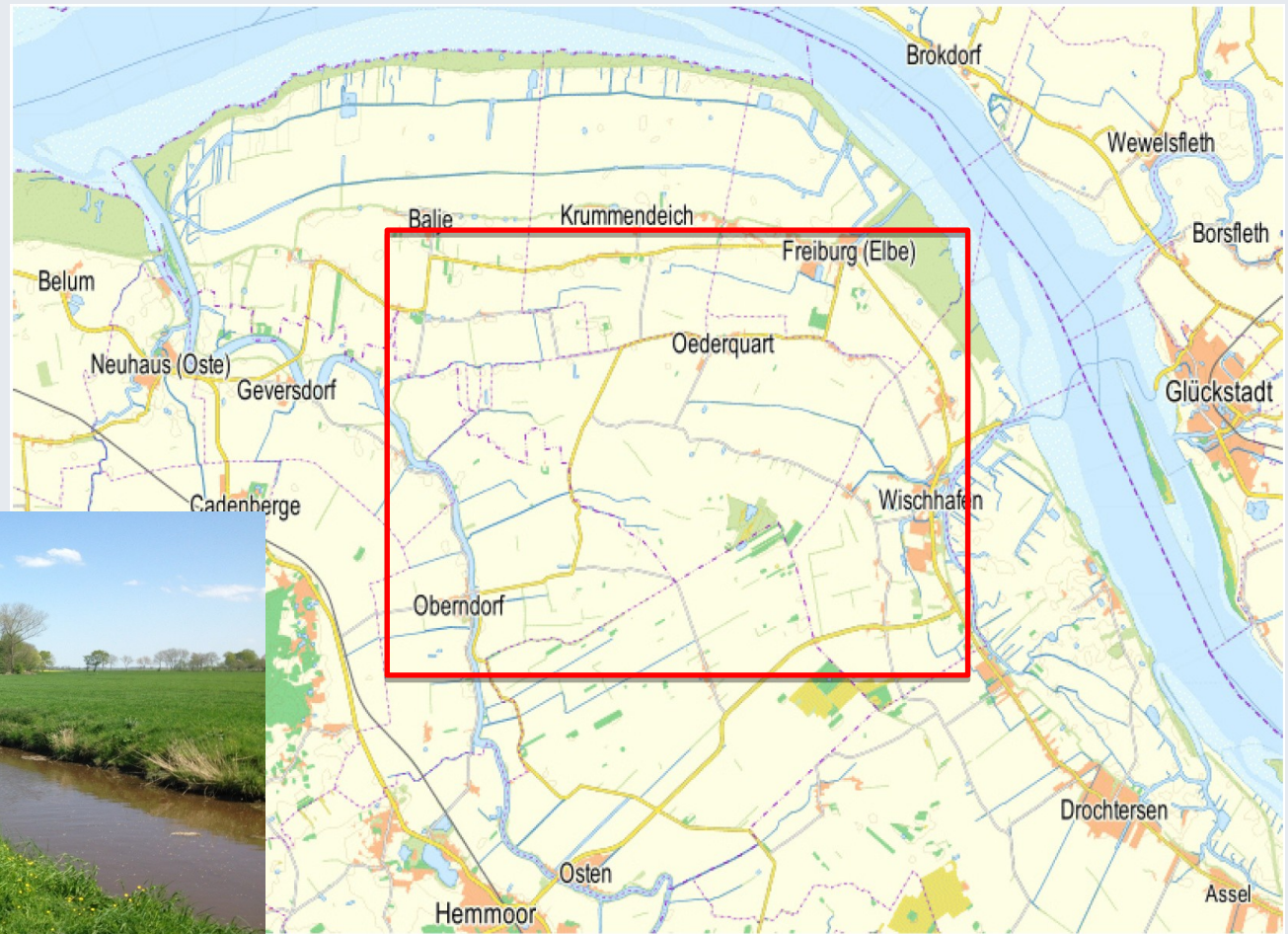


- water for the antifreeze irrigation is currently fed into the various marshes in the area via the dikes of the Elbe River
- due to the increasing Elbe depression, several rivers in the Elbe catchment of Altes Land do not contain anymore proper fresh water, and reached already a salt content of $>1 \text{ ‰}$
- brackish water zone of the Elbe River is shifting downstream causing a qualitative water scarcity
- need for an alternative fresh water supply
- need for irrigation water has steadily increased also due to recent climatic changes

Setting and Location



Setting and Location

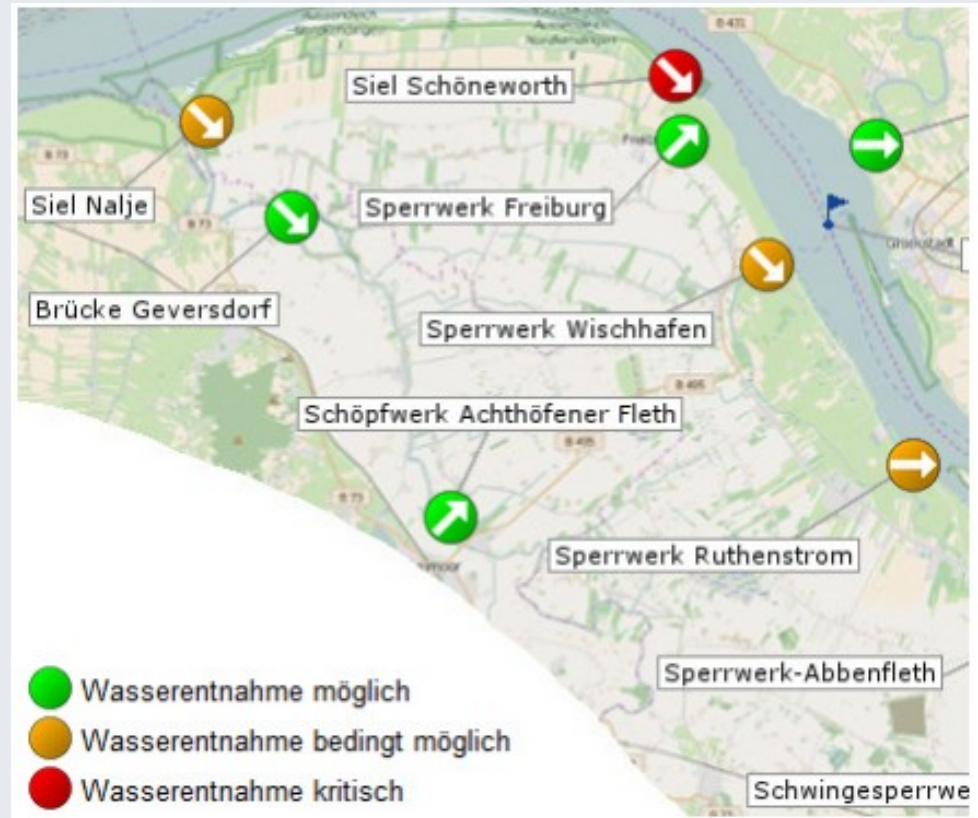


Setting and Situation



Salinity

- Antifreeze irrigation before flowering: ≤ 1.0 g NaCl/L
(≈ 3600 mS / cm)
- Moisturizing irrigation: ≤ 0.5 g NaCl/L
(≈ 1900 mS / cm)



(www.portal-tideelbe.de)

- to determine alternative fresh water supply options outside the Elbe River, especially for the Freiburg-Schleusenfleth water system
- a connection to the Oste River was examined as a preferred variant
- the water demand was determined, and inventoried in terms of the current water availability
- further was conducted a deficit analysis of the current water supply and an option analysis

Overall scope: reduction of risk for qualitative water stress

- water provision through gravity flow or by pumping from tributaries and / or adjacent areas
- increasing the storage volume by creating new irrigation ponds or reservoirs and / or river widening
- injection from the existing drinking water network or wells.

Gravity Flow Options

Variants	General location
1	Oste – Wischhafener Schleusenfleth - Hollerdeicher Wetteren - Allwördener Fleth
2	Oste – Neuenseer Schleusenfleth – Krummendeich – Freiburger Schleusenfleth
2.1	Oste - Neuenseer Schleusenfleth – Krummendeich – Freiburger Schleusenfleth (alternative location)
3	Oste – Neuenseer Schleusenfleth – Wischhafen – Freiburger Schleusenfleth
4	Oste – Herrenfleth – Wischhafen – Freiburger Schleusenfleth

Vizualisation of the Options



Option 1

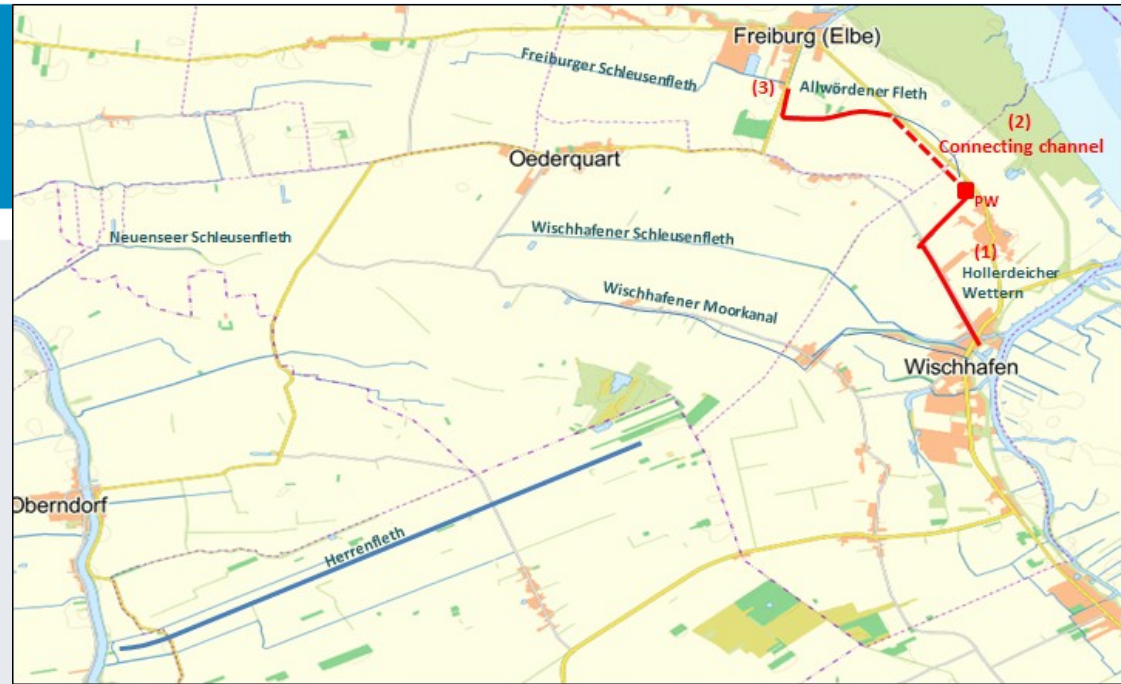
Length: approx. 6 km

Course of the route:

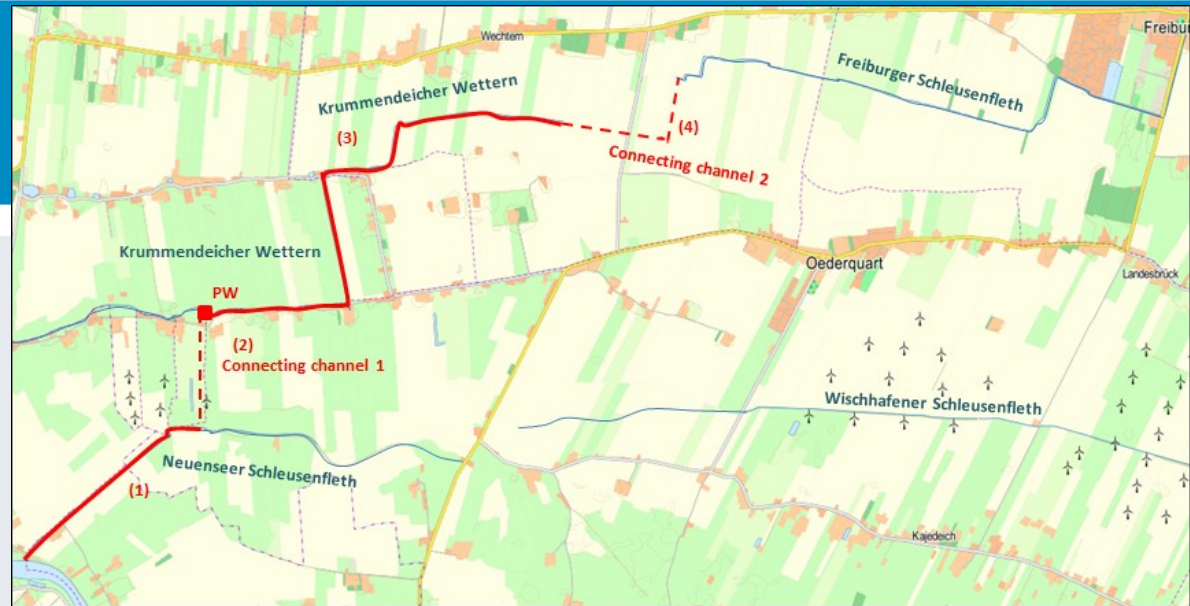
- 1) Wischhafener Schleusenfleth (expansion)
- 2) Hollerdeicher Wetterern (expansion)
- 3) Connecting channel (new building)
- 4) Allwördener Fleth (expansion)

Construction costs (estimated): approx. € 1.37 million (trench)

Construction costs (estimated): approx. € 2.87 million (tube)



Option 2



Length: approx. 9.5 km

Course of the route:

- 1) Neusenseer Schleusenfleth (expansion)
- 2) Connecting channel 1 (new building)
- 3) Krummendeicher Wetteren (removal)
- 4) Connecting channel 2 (new building)

Construction costs (estimated): approx. € 2.4 million (trench)

Construction costs (estimated): approx. € 4.5 million (tube)

Option 2.1



Length of the supply route: 20.6 km

Course of the route:

- 1) Neusenseer Schleusenfleth (expansion)
- 2) Connecting channel 1 (new building)
- 3) Krummendeicher Wetteren (removal)
- 4) Connecting channel 2 (new building)
- 5) Connecting channel 3 (new building)

Construction costs (estimated): approx. € 3.2 million (trench)

Construction costs (estimated): approx. € 5.26 million (tube)

Option 3

Length: approx. 20,6 km

Course of the route:

- 1) Neusenseer Schleusenfleth (expansion)
- 2) Connecting channel 1 (new building)
- 3) Wischhafener Schleusenfleth (expansion)
- 4) Hollerdeicher Wetterern (expansion)
- 5) Connecting channel 2 (new building)
- 6) Allwördener Fleth (expansion)

Construction costs (estimated): approx. € 3.55 million (trench)

Construction costs (estimated): approx. € 6.15 million (tube)



Option 4

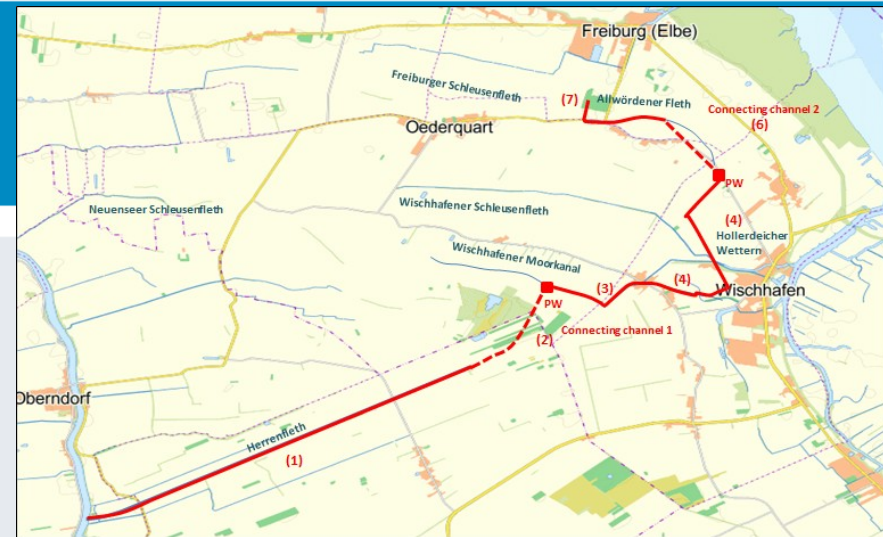
Length: approx. 20.4 km

Course of the route:

- 1) Herrenfleth (expansion)
- 2) Connecting channel 1 (new building)
- 3) Wischhafener Moorkanal (expansion)
- 4) Wischhafener Schleusenfleth (expansion)
- 5) Hollerdeicher Wetterern (expansion)
- 6) Connecting channel 2 (new building)
- 7) Allwördener Fleth (expansion)

Construction costs (estimated): approx. € 4.48 million (trench)

Construction costs (estimated): approx. € 8.86 million (tube)



- Concept 1 is considered a feasible variant:
 - if the depression of the Elbe does not cause a significant change to the expected salt content in the Elbe river at Wischhafen.
- Concept 2 is considered the most cost-effective variant:
 - an optimal solution with regard to the resolution of saltwater intrusion problems in the Lower Elbe at Freiburg and Wischhafen, and ***therefore preferable***.

- Concept 3 is not considered a preferred option:
 - not economically feasible compared to the preferred variant, therefore an implementation is not recommended.
- Concept 4 is also not considered a preferred option :
 - not economically feasible compared to the preferred variant, therefore an implementation is not recommended. The option might become relevant for an upstream shifting of the brackish water zone in the Oste river.

Conclusions



- all variants are technically feasible, the difference is made up by the cost
- beside the Elbe waterway deepening, the salt water problem will be significantly worsened in the future by climatic changes
- design might be feasible also as “flying tube” with additional cost



- need for a regularly monitoring of the saltwater problem on the Elbe river
- further investigation needs to concern the impact of the planned navigation channel adaptation on the brackish water zone of the Lower Elbe



Thank you for listening !

