

RUHR-UNIVERSITÄT BOCHUM

WaterMiner

Räumlich-zeitlich abgestimmte
Kreislaufführung und Wiedernutzung
von Bergbauabwässern

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Prof. Dr. H. Stolpe

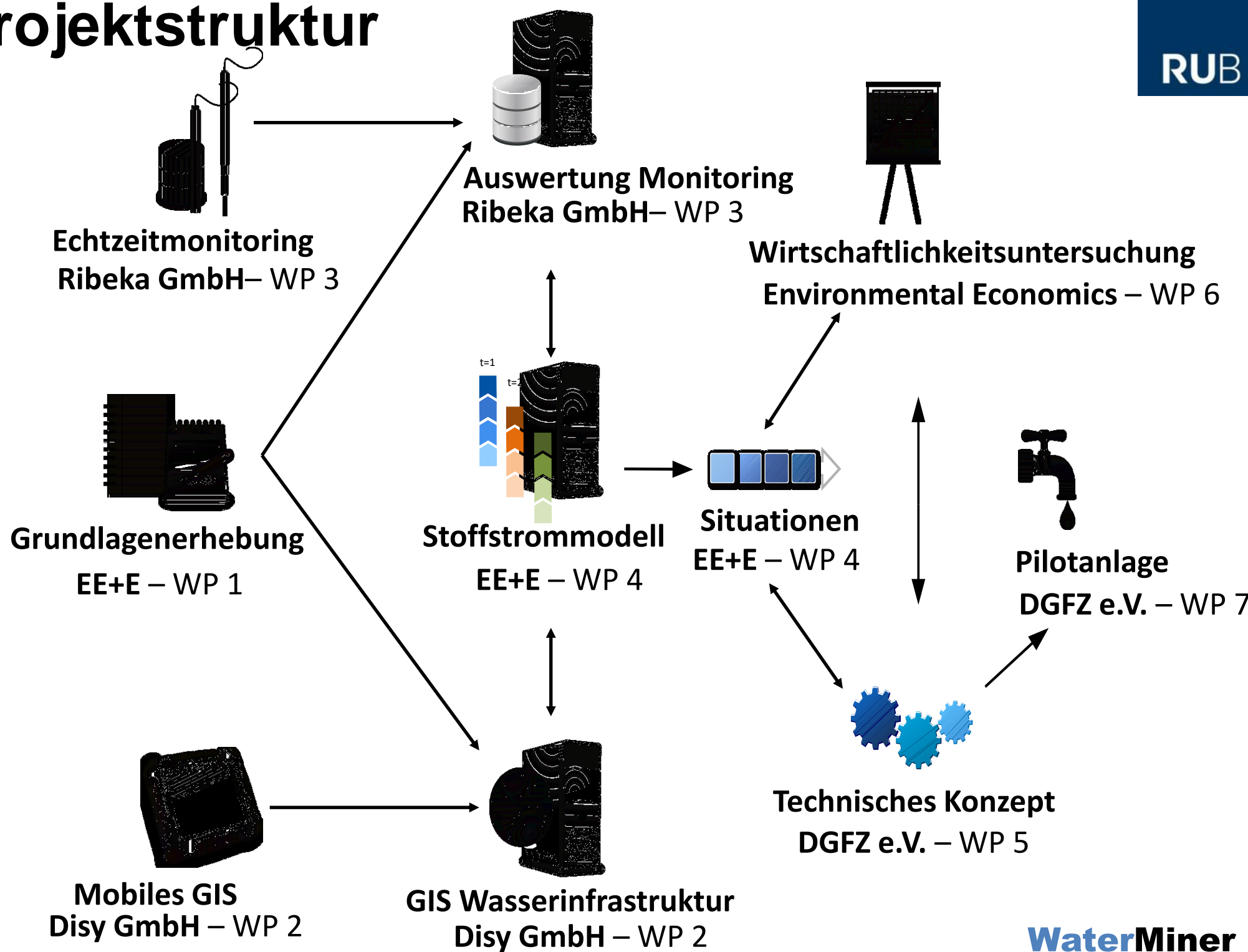
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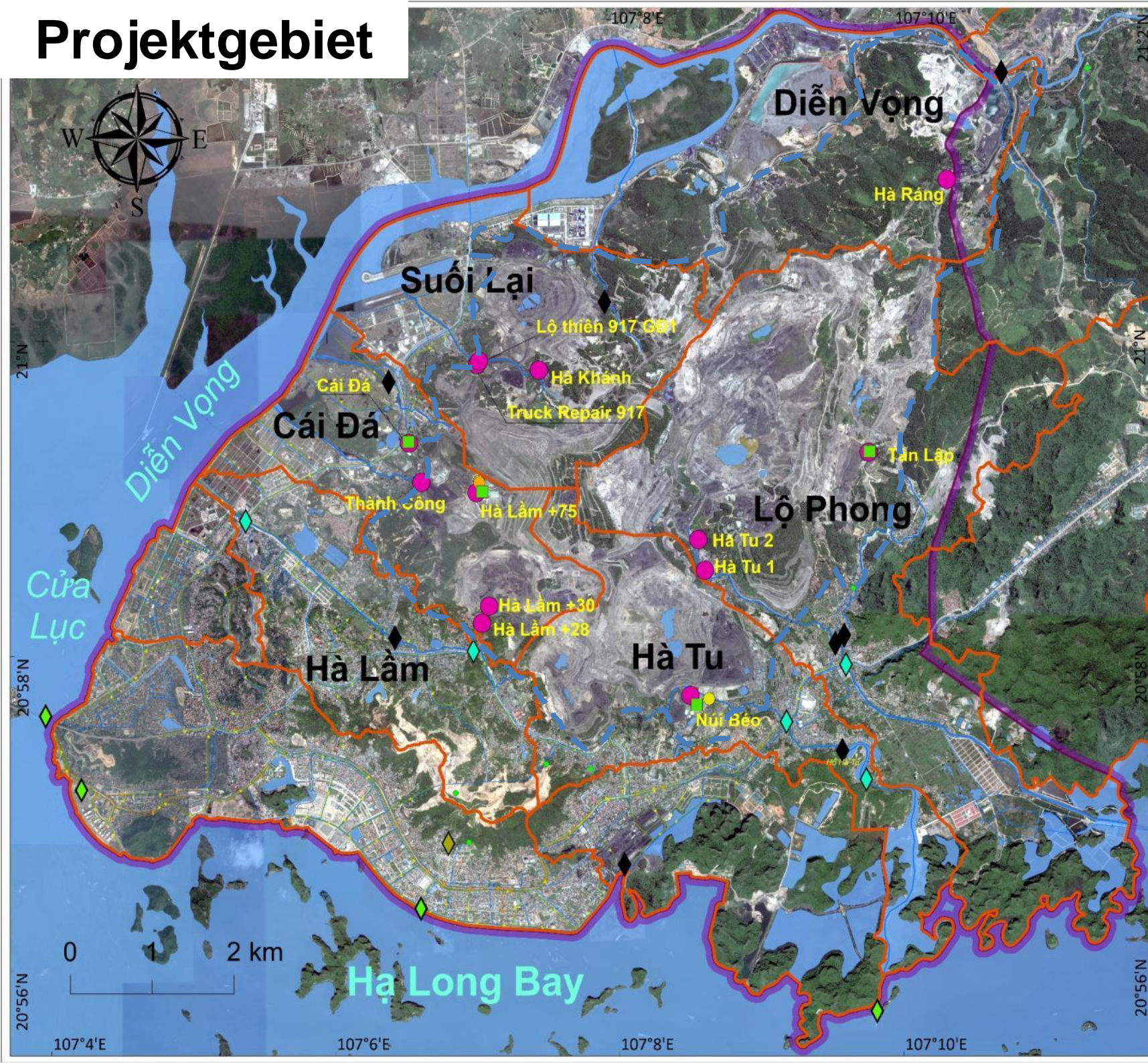
Inhalt

- Einleitung
- Exemplarische Drainage Units
 - Stoffstrommodellierung
 - NA/ Sedimenttransport
 - Ökonomie
 - Entwicklung, Optimierung zukünftiger Situationsmen
- Nächste Schritte

Projektstruktur



Projektgebiet



Legend

- Drainage unit
- Project area
- Mine water treatment**
 - Mine water treatment
 - Domestic water treatment
 - Desalination
 - Recycling water supply
- Mining area
- Monitoring**
 - Mine wastewater
 - Coastal water
 - Ground water
 - Surface water
- Water facility**
 - Domestic water supply
 - Domestic wastewater system
 - Rainwater collecting network
 - Water supply network



WaterMiner Recirculation and reutilization of mining impacted waters

Elements of the system
- State in 2017 -

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 Editor: Trinh Quoc Viet
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 Map frame: A0 (841 x 1189 mm)
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Tagebau Ha Tu

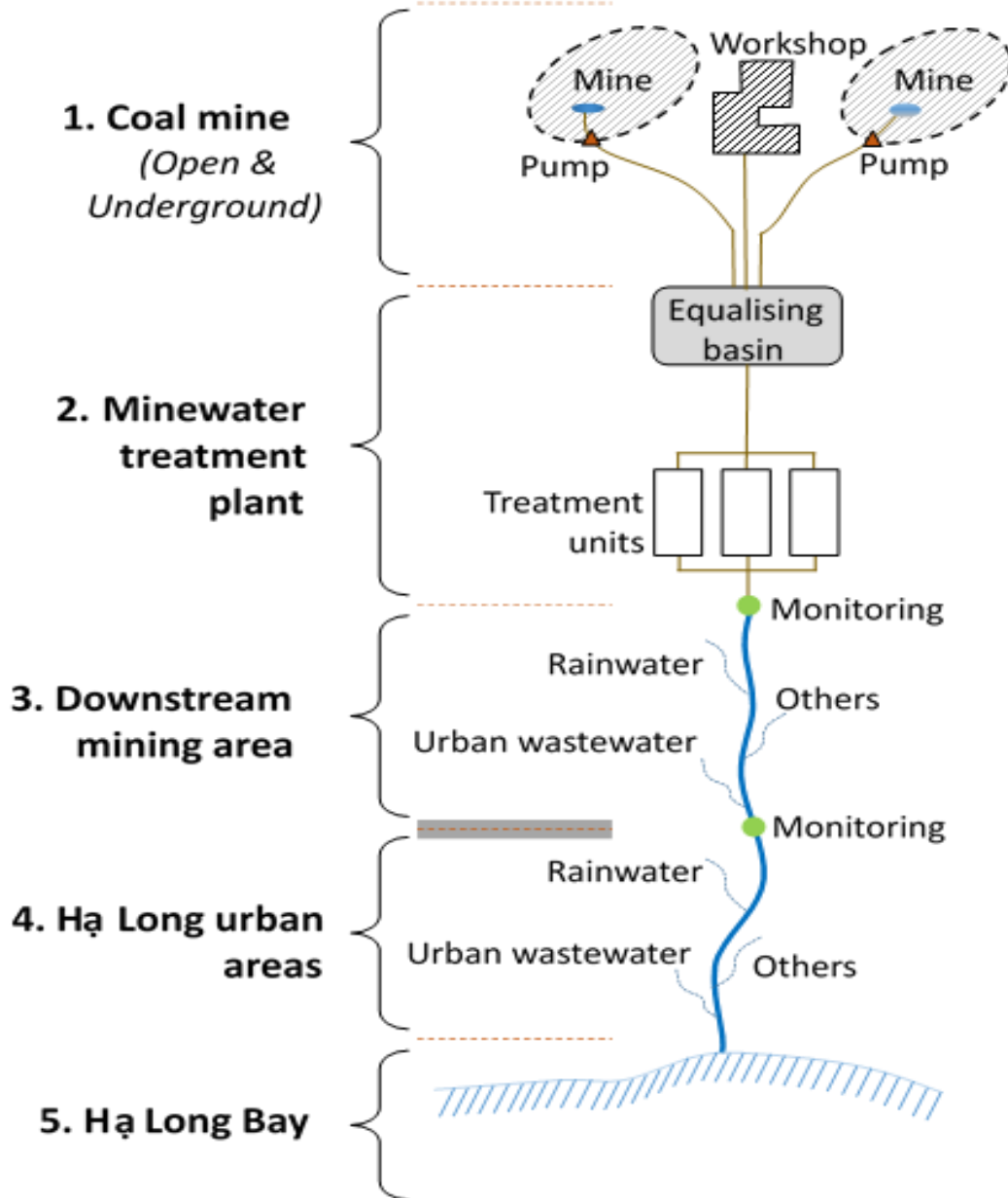


Tagebau 2

Tagebau 1

Grundlagenerhebung

Flowchart of minewater treatment



Basic data

- Basic information of mine
 - Number of pumps
 - Capacity of pumps
 - Water storage volume in the mine
 - Monitoring points
 - Electric power
-
- Basic information of treatment plant
 - Number, size of equalizing basins
 - Number, capacity of treatment lines
 - Technical specification of MWTP
 - Monitoring amount and quality of inflow, outflow
 - Monitoring electric consumption
 - Monitoring chemicals used
-
- Basic information of rivers
 - Volume of rainwater discharges
 - Volume of urban wastewater discharges
 - Monitoring water quality

####

####

Grundlagenerhebung

Flowchart of minewater treatment

Basic data

1. Coal mine
(Open & Underground)



- Basic information of mine
- Number of pumps
- Capacity of pumps
- Water storage volume in the mine

2. Minewater treatment plant

- Bergbauaktivitäten
- Bergbauliche Abwässer
- Abwasserbehandlung
- Monitoring
- Bestehende/ potenzielle Wassernutzung

treatment plant
 alizing basins
 treatment lines
 on of MWTP
 and quality of inflow, outflow
 consumption
 ls used

3. Downstream mining area

Ur

rivers
 r discharges
 stewater discharges
 quality

4. Hả Long urban areas

Urban wastewater Others

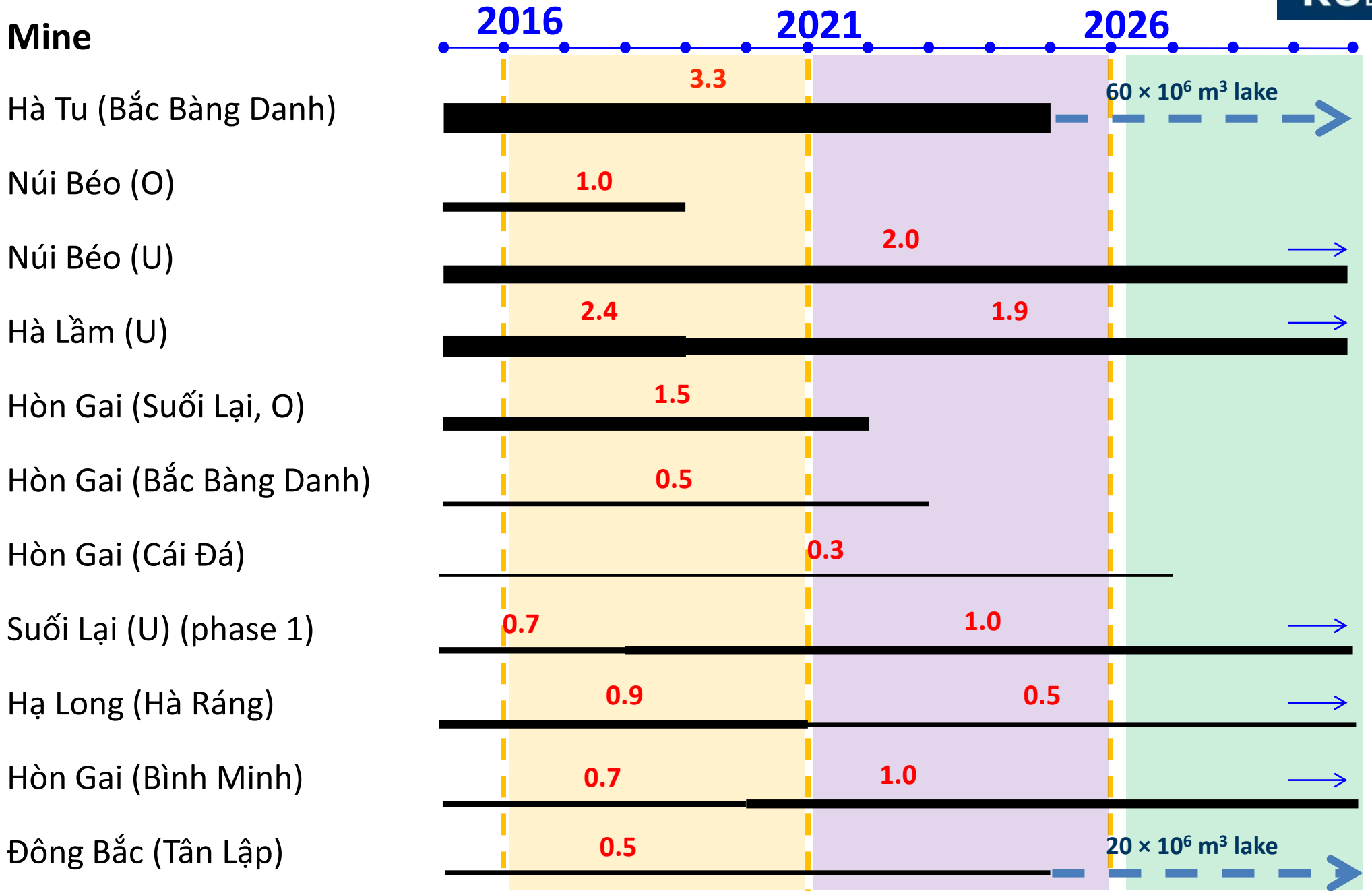
5. Hả Long Bay



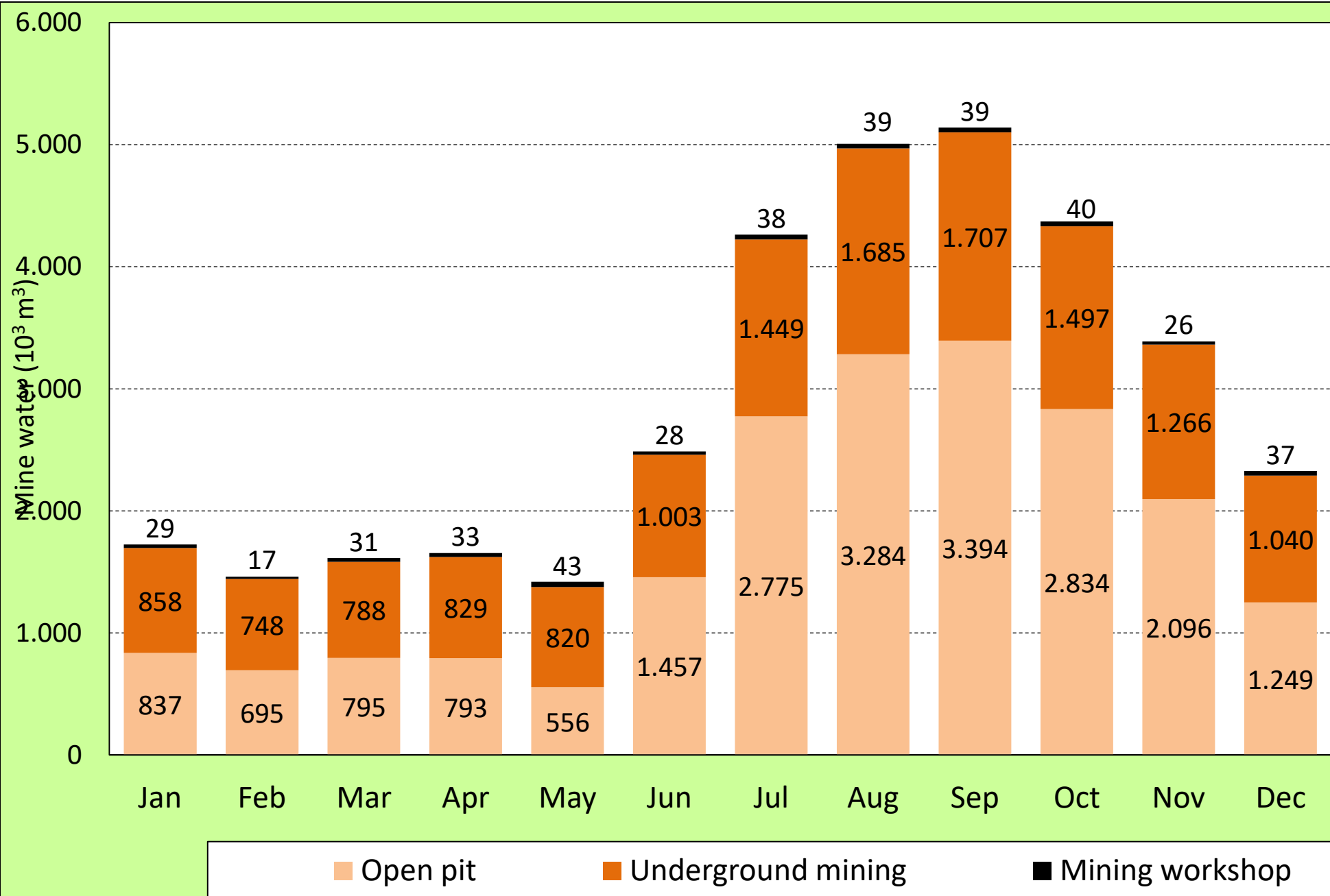
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3 räumlich-zeitliche Situationen

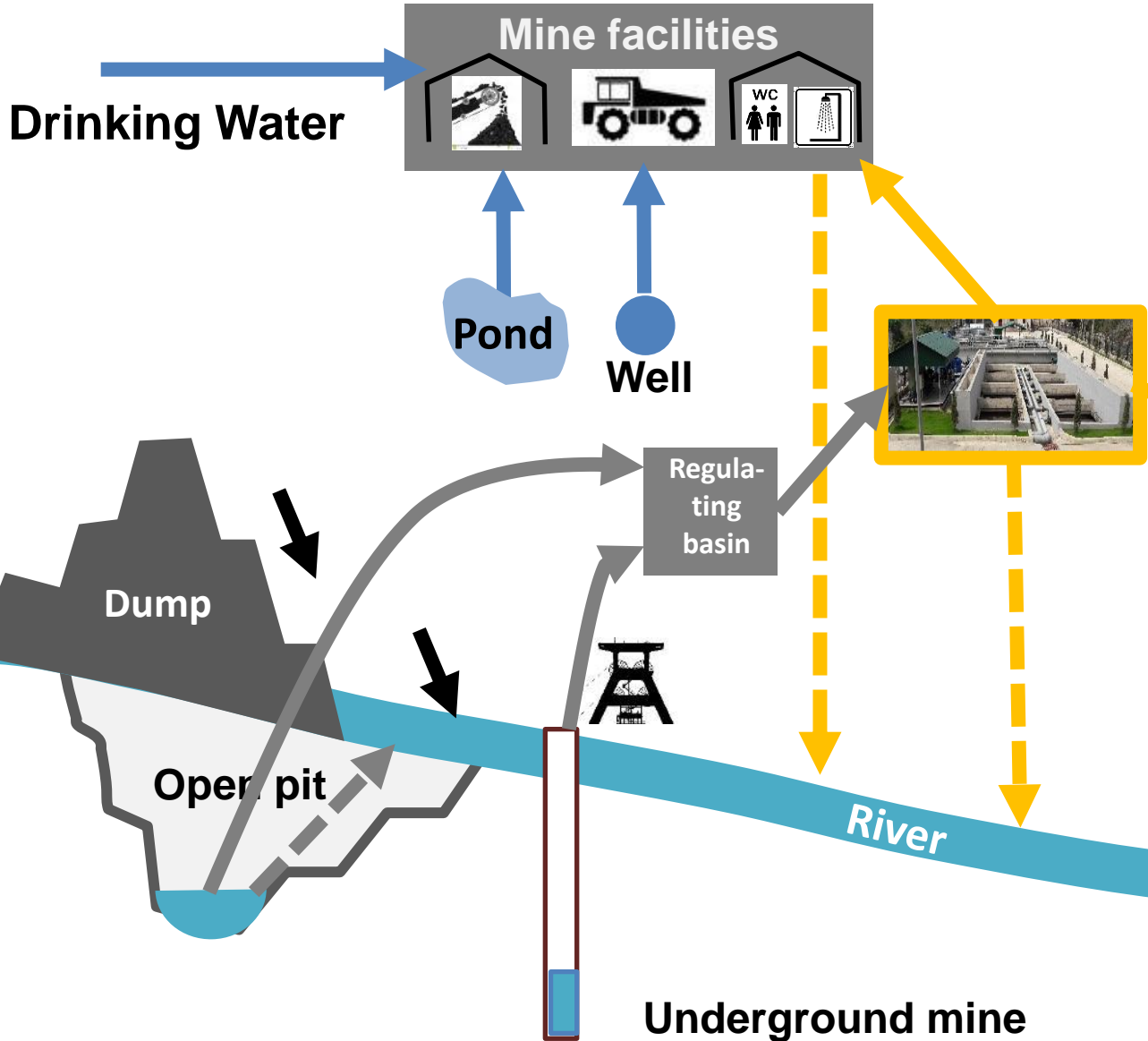
Mine



Bergbauwässer im Ist-Zustand



(Potential) Internal water user



Urban area



Sea

Potential external water user

- Grey arrow: Waste water (untreated)
- Yellow arrow: Waste water (treated)
- Black arrow: Surface water runoff
- Yellow arrow: Water for use (external source)
- Yellow arrow: Water for use (internal source)

Wasserherkunft, Level der Behandlung, Nutzung

Mine Water Treatment	
	Drinking Water Treatment Level
	Improved Treatment Level B
Existing Treatment level B	
No Treatment	



Water Uses	
I	Drinking Water (QCVN 02)
A	Domestic use except drinking water (QCVN 40)
B	Dust control, truck washing etc. (QCVN 40)
B- B- - B- - -	Coal selecting



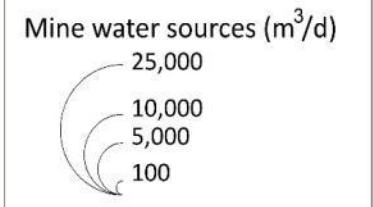
B- - - Very low quality	B- - Low Quality	B- - Closely B QCVN 40
Coal selecting, truck washing etc.	Active pit lakes, domestic waste water	Inactive pit lakes, underground mine water
Mine Water Sources		

Mine water sources



Legend

- Drainage unit
- Project area
- Piloted units



Mine water sources	
Category	Sources
B ⁺⁺ very low quality	Coal selection, coal store, truck washing, surface runoff
B ⁻ Low quality	Active mine pit lakes, domestic wastewater
B ⁻ Closely column B, QCVN 40:2011	Inactive mine pit lakes, underground mine water



WaterMiner Recirculation and reutilization of mining impacted waters

Mine water sources

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Mine water uses



Legend

- Drainage unit
- Project area
- Piloted units

Daily water uses (m³/d)

- 4000
- 2000
- 500
- 100

Mine water USES	
Category	Sources
A*	Drinking
A	Domestic use (except drinking), mechanical processing, laundries
B	Dust control, irrigation, truck washing
< B	Coal selecting



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Mine water uses

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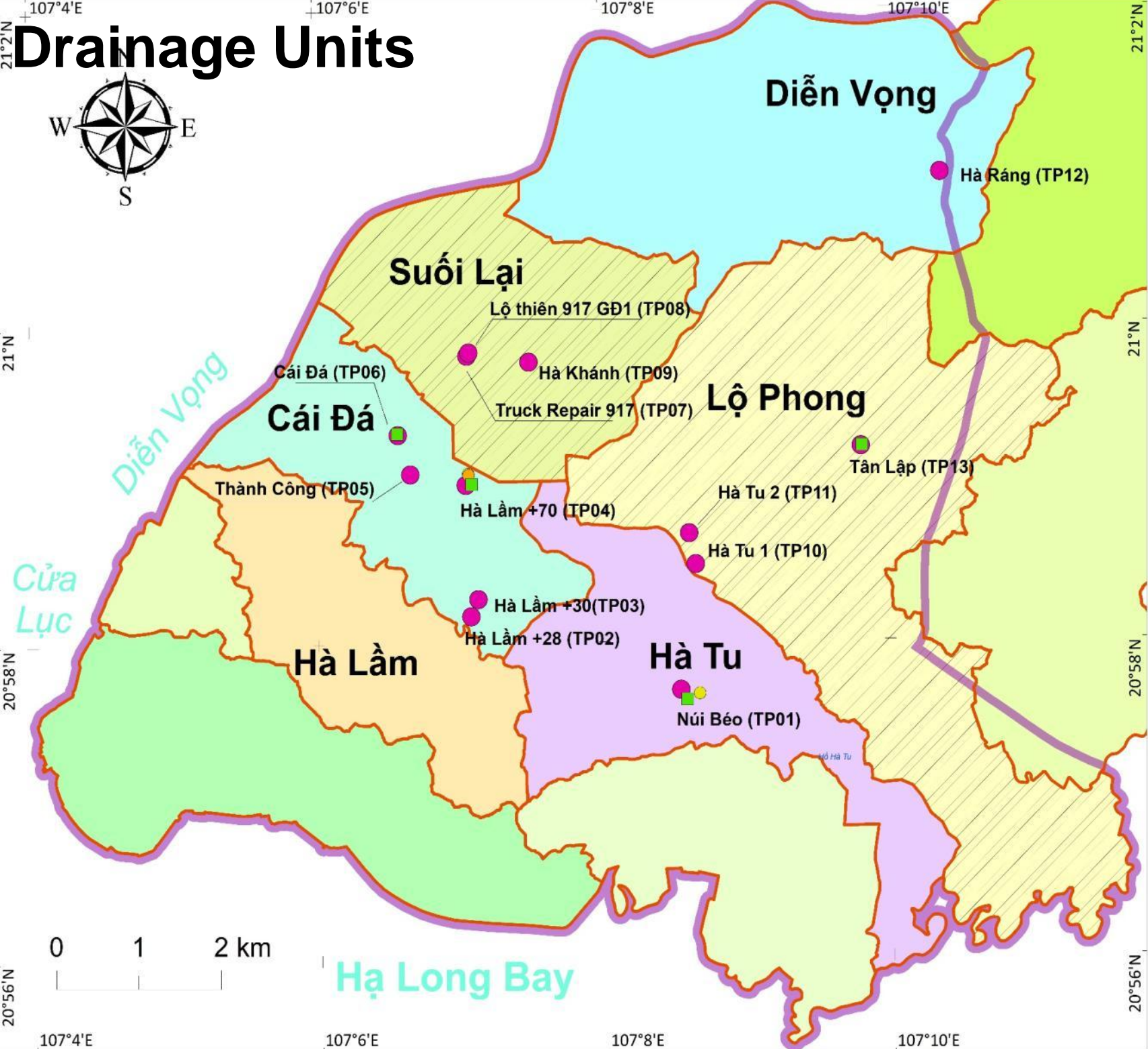
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Exemplarische Drainage Units

- **Lộ Phong Drainage Unit:**
zwei Tagebaubetriebe Hà Tu und Tân Lập
- **Suối Lạ Drainage Unit:**
Tagebau Suối Lạ und Tiefbau Suoi Lai

Drainage Units



Legend

Mine water treatment

- Mine water treatment (pink dot)
- Domestic water treatment (yellow dot)
- Desalination (orange dot)
- Recycling water supply (green dot)

Border

- Drainage unit (orange outline)
- Project area (purple outline)
- Piloted units (hatched pattern)

Drainage Unit

Lộ Phong	Cái Đá
Hà Tu	Suối Lại
Cầu Trắng	Diễn Vọng
Hà Lâm	Hà Ráng
Hòn Gai	Cầm Phả
Cao Xanh	



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Drainage unit

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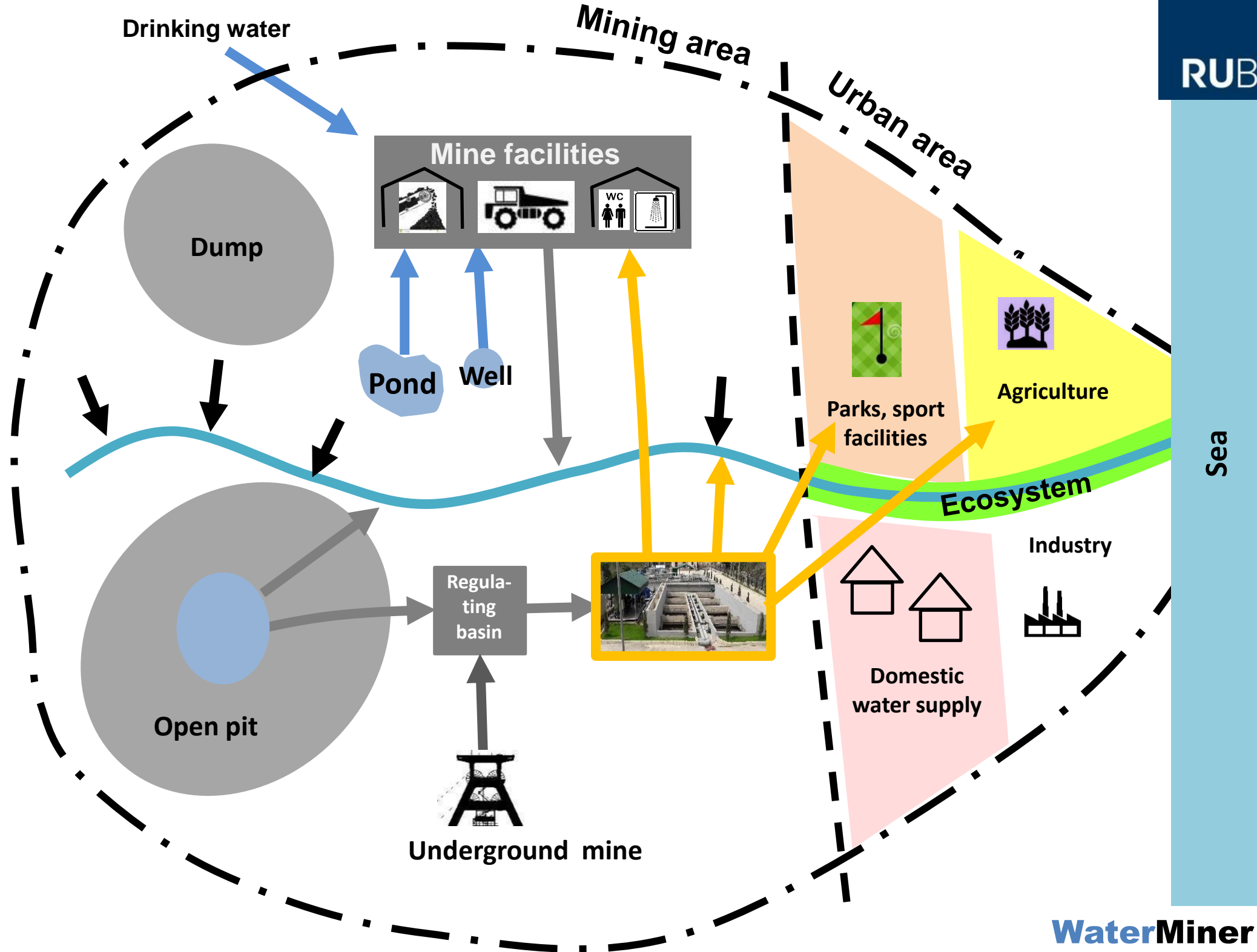
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0 1 2 km

Hạ Long Bay



3 Modelle

Modelle zur Entwicklung, Beschreibung und Bewertung vorgeschlagener Massnahmen

Stoffstrom:

U+Ö Umwelttechnik+Ökologie im Bauwesen Ruhr-Universität Bochum

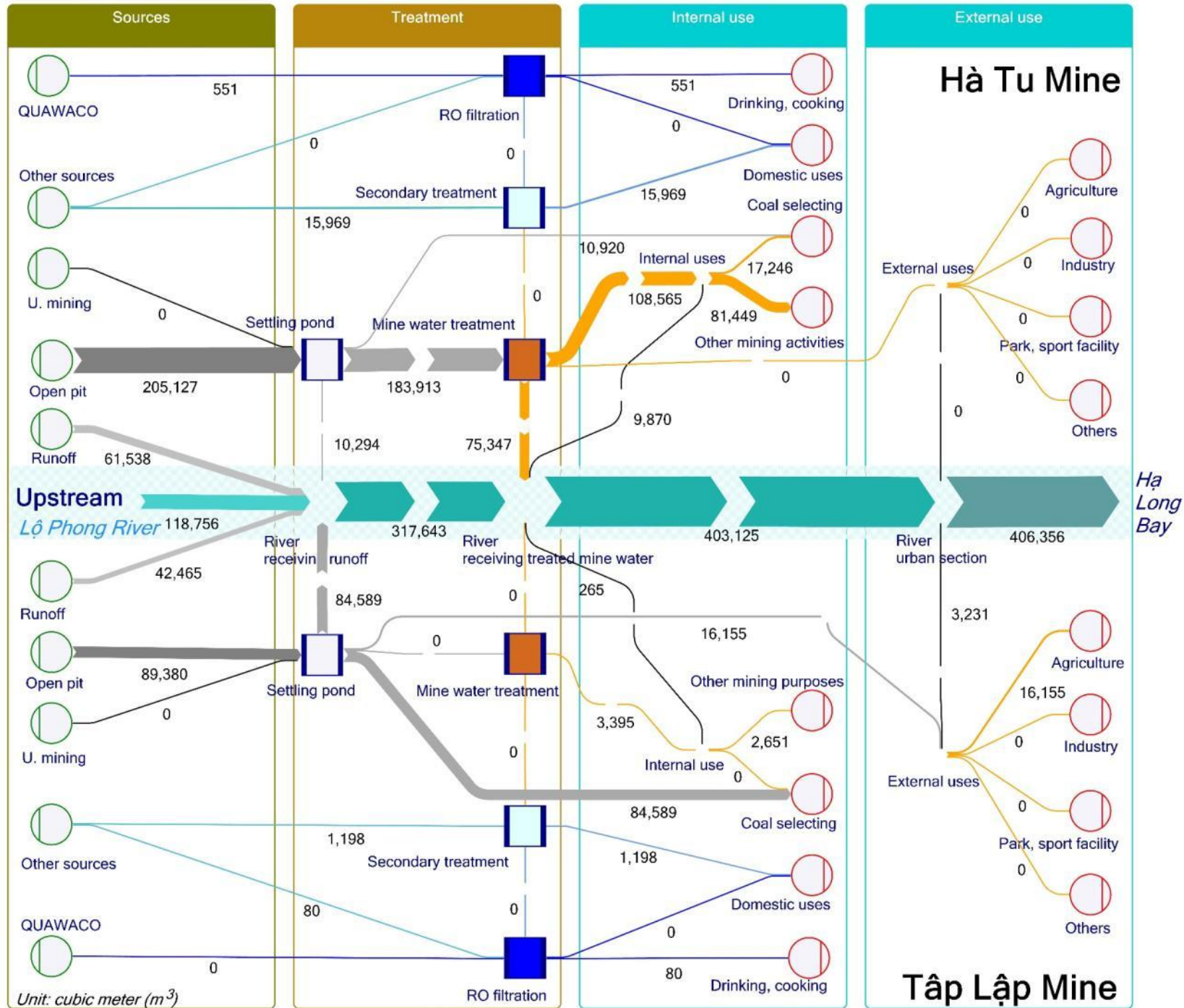
NA- und Sedimenttransport:

Dresdner Grundwasserforschungszentrum

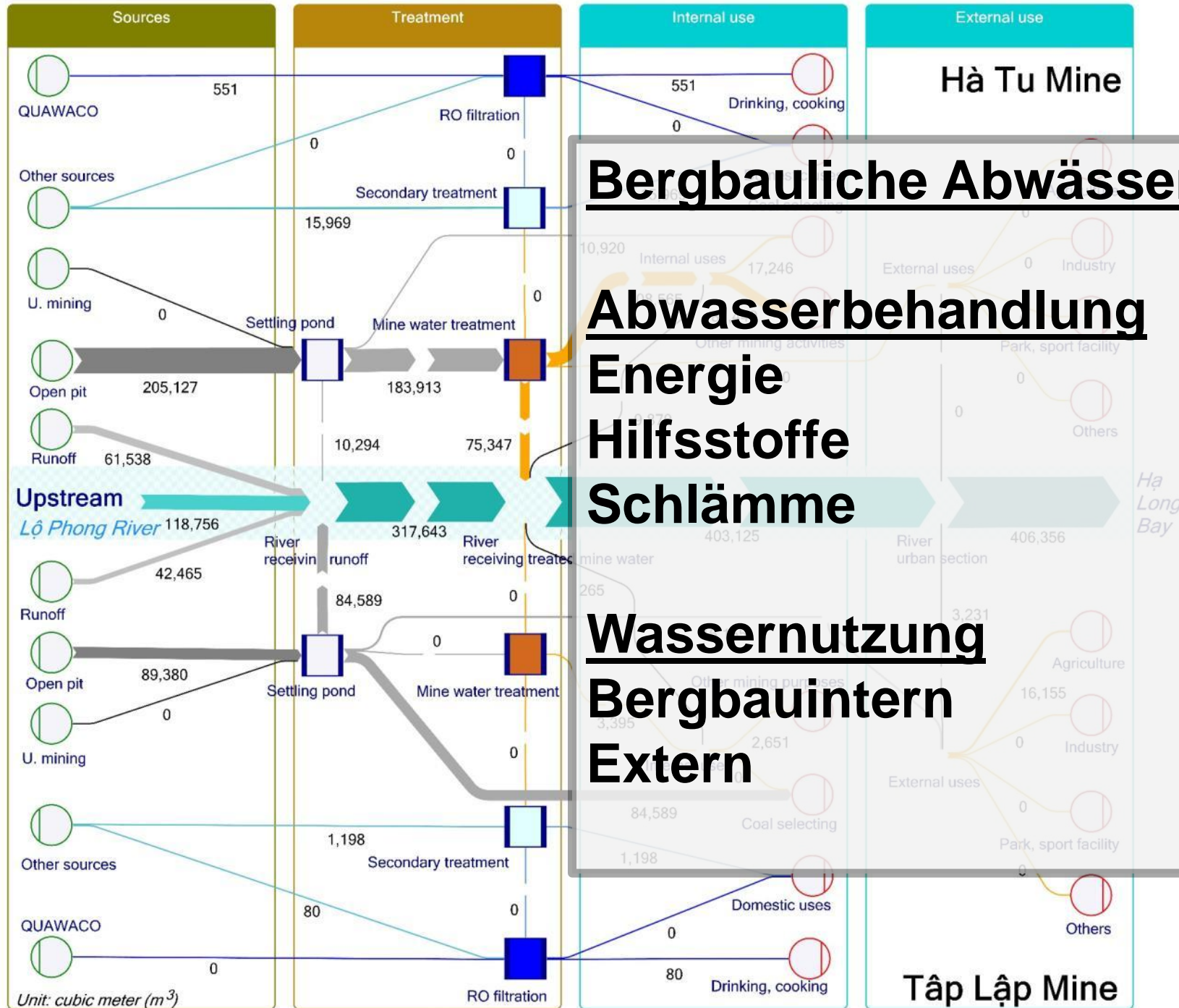
Ökonomie:

Environmental Economics
Universität Koblenz Landau

Stoffstrommodell



Stoffstrommodell



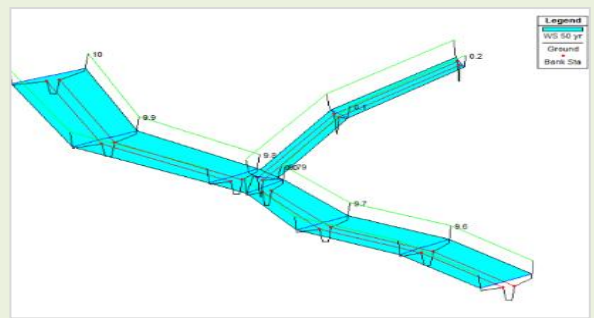
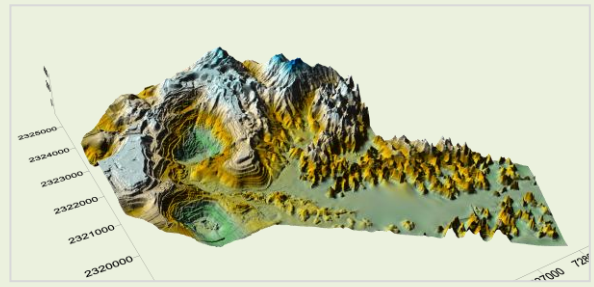
NA- und Sedimenttransportmodell

Zielstellung

- Modellierung Wasser- und Sedimenttransport
- Planung Maßnahmen zum Sedimentrückhalt
- Planung Wasserspeicher zum Ausgleich des Wasserdefizits in der Trockenzeit

Input

- Geländeoberfläche
- Niederschlag
- Flussgeometrie, Wasser- Bauwerke
- Wasserzu- und abflüsse
- Bodenparameter



Kalibrierdaten

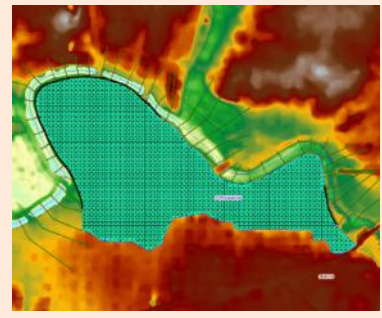
- Wasserstand
- Durchfluss
- Sedimentzusammensetzung

Monitoringdaten



Modell

HEC-RAS



Output

- Wasserstand
- Durchfluss
- Sedimentverlagerung und -anreicherung
- Sedimentzusammensetzung

Beispiel Monitoring-Equipment (DGfZ / ribeka)



Bergbauinterne Wiederverwendung:

- Investitionsanalyse
- Berechnung der Amortisationszeit
- Szenario Analyse

Externe Wiederverwendung:

- Produktivitätsanalyse (Landwirtschaft)
- Marktpreisanalyse (Wasserversorgung)
- Ökosystemdienstbewertung (Haushalte)

Wasserwirtschaftliche Situationen, Optimierung

Situation 2016-2017 (Ist-Zustand)

Situation ca. 2025

Situation nach 2030

Situationen

Lo Phong Drainage Unit (m³ / Monat)

Situation	Quellen	Behandlung	Speicherung	Interne Bedarfsdeckung	Externe Bedarfsdeckung	Anmerkungen
Ist-Zustand	Wasseraufkommen, Aufbereitung, Nutzung bergbauintern und bergbauextern					
Situation 2025	Bergbau beendet. Geringes Wasseraufkommen aus alten Tagebaubereichen von Lo Phong. Nutzung für bergbauinterne Bewässerung zur Renaturierung					
Situation 2025 optimiert	Tagebaurestloch als Wasserspeicher. Nutzung für bergbauinterne Bewässerung zur Renaturierung und für die Versorgung bergbauexterner Nutzer					
Situation nach 2030	---					
Situation nach 2030 optimiert	Tagebaurestloch als Wasserspeicher. Nutzung für bergbauinterne Bewässerung zur Renaturierung und für die Versorgung bergbauexterner Nutzer					

Nächste Schritte

- Entwicklung und Beschreibung der zukünftigen Situationen: Wasserdargebot, Aufbereitung, Wassernutzung
- Optimierung der zukünftigen Situationen: Stoffstrom, NA/Sedimenttransport, Ökonomie
- Pilotanlage verbesserte Abwasserreinigung und Kohlenstoffrückgewinnung
- Verallgemeinerung der entwickelten Vorgehensweise

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